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SANTA ANA RIVER MAINSTEM SANTIAGO CREEK
ORANGE COUNTY, CALIFORNIA

Draft Supplemental Environmental Assessment / Initial Study and Mitigated Negative Declaration

This draft Supplemental Environmental Assessment (SEA) and Initial Study/Mitigated Negative Declaration (IS/MND) for the Santiago Creek component of the Santa Ana River Mainstem Flood Control Project (SARMP) has been prepared by the U.S. Army Corps of Engineers (USACE) as a supplement to the Final Supplemental Environmental Impact Statement (SEIS) for the Santa Ana River Mainstem including Santiago Creek, dated September 1988 (hereinafter referred to as the 1988 SEIS).

September 2023

DRAFT MITIGATED FINDING OF NO SIGNIFICANT IMPACT

SANTA ANA RIVER MAINSTEM, SANTIAGO CREEK
ORANGE COUNTY, CALIFORNIA

The U.S. Army Corps of Engineers, Chicago District (USACE) has conducted additional environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended, for the Santiago Creek component of the Santa Ana River Mainstem Project (Project). Environmental review of the Project was originally documented in the *Final Supplemental Environmental Impact Statement (Final SEIS) for the Santa Ana River Mainstem including Santiago Creek Project (SARMP)*, dated September 1988. The *Draft Supplemental Environmental Assessment (SEA), Santa Ana River Mainstem, Santiago Creek, Orange County, California*, dated 15 September 2023, addresses design refinements to construction of the Santiago Creek component of SARMP and discusses new information provided detailing the presence of two federally listed bird species in association with the Project's footprint that were not analyzed in the 1988 Final SEIS. The purpose of SARMP is to provide flood risk reductions to areas susceptible to flooding within the counties of San Bernardino, Riverside, and Orange. The purpose of the Santiago Creek component of SARMP is the same as the previously approved Santiago Creek project, which is to provide 100-year flood protection for residents in the Santiago Creek floodplain, Orange County, California.

The Draft SEA, incorporated herein by reference, evaluated two alternatives that would provide 100-year flood protection for residents in the study area. The Proposed Action Alternative updates the engineering design of the authorized 1988 Alternative. The Proposed Action Alternative includes:

- Stabilizing of slopes within Smith Basin.
  - Santiago Road (Line A) for 1,000 feet (ft) compacted buttress fill at 2.5 Horizontal (H):1 Vertical (V.)
  - Santiago Road (Line B) for 500-ft compacted buttress fill at 2H:1V.
  - Villa Park Road (Line I) for 750-ft excavation and compacted fill at 2H:1V.
- Regrading Smith Basin to create a low-flow channel through the middle of the basin for Santiago Creek.
- Rehabilitating a maintenance road along the north side of Smith Basin.
- Stabilizing of slopes within Blue Diamond and Bond basins.
  - Hewes Avenue (Line E) for 300-ft excavation and compacted fill at 2H:1V.
  - Hewes Avenue (Line F) for 1,400 ft excavation and compacted fill with tie back wall and buttress slope at 2H:1V.
  - Prospect Street (Line H) for 400 ft excavation and compacted fill at 2H:1V.
  - Prospect Street (Line K) for 150 ft compacted fill berm along bike tunnel.
- Stabilizing Santiago Creek between I-5 and confluence of the creek with the Santa Ana River Mainstem. To stabilize, buried riprap will be installed along the full downstream channel extent. Riprap will then be buried with native substrates and native vegetation will be restored.
- Constructing floodwalls along portions of the Santiago Creek channel.
  - Construct 900 feet concrete topped steel sheetpile floodwall west of Bristol Avenue and along the north side of the Santiago Creek channel only.
  - Construct a total of 5,200 feet concrete topped steel sheetpile floodwall between Bristol Avenue and Flower Street. Floodwalls will be approximately 2,600 feet along the north and south sides of the channel, for a total of 5,200 feet.
- Implementation of all required environmental compensatory mitigation (see below discussion on the mitigation requirements) and associated monitoring and mitigation area adaptive management plan, when applicable and appropriate. Monitoring and management of the compensatory mitigation will continue as set forth in the environmental commitments found in the Draft SEA, Section 3.4.3.4.

In addition to a “no action” plan (i.e., No Construction Alternative), two alternatives were evaluated. The alternatives included the No Change Alternative which was the 1988 authorized project and the Proposed Action Alternative. Refer to Section 2.2 of the SEA for a description of the alternative considered.

For all alternatives, the potential effects were evaluated, as appropriate. The Proposed Action could have a significant effect on the environment. However, the implementation of the following mitigation measures would reduce all significant impacts to less than significant levels to support a mitigated Finding of No Significant Impact (FONSI), thereby avoiding the need to prepare an Environmental Impact Statement (EIS). Mitigation measures, as described in the Draft SEA, reduce effects to the following resources: biological resources (Section 3.4.3.4), geology and soils (Section 3.4.6.4), land use and planning (Section 3.4.10.4), noise (Section 3.4.11.1), and tribal cultural resources (Section 3.4.14.4). A summary assessment of the potential effects of the Proposed Action Alternative, including mitigation, are listed in Table 1:

Table 1: Summary of Potential Effects of the Proposed Action Alternative

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action
Agricultural and Forestry Resources	☐	☐	☒
Mineral Resources	☐	☐	☒
Population & Housing	☐	☐	☒
Public Services	☐	☐	☒
Aesthetics	☐	☒	☐
Air Quality	☒	☐	☐
Biological Resources	☐	☒	☐
Cultural Resources	☐	☒	☐
Energy	☒	☐	☐
Geology and Soils	☒	☐	☐
Greenhouse Gas Emissions	☒	☐	☐
Hazards and Hazardous Materials	☒	☐	☐
Hydrology and Water Quality	☒	☐	☐
Land Use and Planning	☐	☒	☐
Noise	☐	☒	☐
Recreation	☒	☐	☐
Transportation	☒	☐	☐
Tribal Cultural Resources	☐	☒	☐
Utilities and Service Systems	☒	☐	☐
Wildfire	☒	☐	☐
Environmental Justice	☒	☐	☐

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the proposed action. Best management practices (BMPs) as detailed in Section 3 of the SEA will be implemented, if appropriate, to minimize impacts.

- In 2023, USACE formally consulted with the U.S. Fish and Wildlife Service (FWS) for the federally threatened coastal California gnatcatcher and the federally endangered least Bell’s vireo. USACE anticipates receiving a Biological Opinion from the FWS by September 22, 2023. Reasonable and prudent measures in the FWS’s Biological Opinion will be included in the Final SEA and implemented. In addition, mitigation measures listed in Section 3.4.3.4 of the Draft SEA would be implemented, as applicable, to avoid adverse effects to listed

species, species proposed for listing, or their associated habitat.

- Implementation of the mitigation measure in Section 3.4.6.4 of the Draft SEA would require the Project to be built taking into consideration the area's geologic and subsurface conditions as well as incorporate specific recommendations listed in the Geotechnical Investigation Report to avoid adverse effects due to seismic activity.

- Implementation of the mitigation measures in Section 3.4.10.4 of the Draft SEA would require permanent losses to riparian and upland habitat be mitigated at a 5:1 and 3:1 ratio, respectively, within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam. In addition, mitigation measures in Section 3.4.10.4 of the Draft SEA would require temporary impacts to riparian and upland habitat be mitigated by restoring native riparian and upland vegetation to temporarily disturbed areas within the project footprint as well as restoring native riparian and upland vegetation at a 1:1 ratio within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam. Implementation of these mitigation measures would address adverse effects to mitigation sites required under Regional General Permit 90 within Smith Basin and the Blue Diamond and Bond basins. Prior to implementation of the project RGP 90 will need to be amended to deconflict any HMP mitigation requirements impacted by the project activities. If this does not happen, a revised 404(b)(1) analysis and new ESA Section 7 consultation with FWS must be completed prior to implementation of the project.

- Mitigation measures to reduce potentially significant noise and vibration impacts are discussed in Section 3.4.11.1 of the Draft SEA. Mitigation measures include sound attenuation measures during construction to meet local ordinances; provision of advance notice of project activities, schedule, anticipated traffic, and potential noise issues; scheduling heavy truck deliveries during exempt working hours and avoiding multiple deliveries in a single hour; prohibiting engineer brake (i.e., jake brake) use within city limits; properly maintaining and tuning engines of all equipment and properly maintaining mufflers on all internal combustion engines; implementing a standard 24-hour hotline for noise complaints; and using a silent pile driver instead of an impact or vibratory pile driver where sensitive receptors are located nearby. All mitigation measures would be in place prior to initiation of any construction activities and would be maintained until construction activities have been completed.

- Implementation of the mitigation measure discussed in Section 3.4.13.4 of the Draft SEA would require the construction contractor to develop a construction traffic control plan as well as a plan for notifications and a process for communication with affected residences and transit agencies prior to the start of construction. Implementation of the mitigation measure would avoid potentially significant adverse effects to localized traffic and ensure unrestricted access and passage for emergency vehicles.

- Mitigation measures to reduce potentially significant adverse effects during an inadvertent discovery of previously unidentified intact subsurface historical, tribal cultural, or archaeological resources are discussed in Section 3.4.14.4 of the Draft SEA. Mitigation measures include the preparation and implementation of a monitoring and discovery plan if previously undiscovered resources are identified during an undertaking; and ceasing work immediately if a previously unknown tribal cultural resource is discovered until the requirements of 36 C.F.R. 800.13 are complied with. All mitigation measures would be in place prior to initiation of any construction activities and would be maintained until construction activities have been completed.

The Draft SEA and Draft Mitigated FONSI are being circulated for public review by agencies, organizations, and individuals known to have an interest in the Project. Any comments received would be addressed in Appendix 9 of the Final SEA.

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service (FWS) issued a biological opinion, dated TBD, that determined that the proposed action will not jeopardize the continued existence of the following federally listed species or adversely modify designated critical habitat: least Bell's vireo and coastal California gnatcatcher. The mitigation measures listed in Section 3.4.3.4 of the Draft SEA will be implemented. In addition, all terms and conditions, conservation measures, and reasonable and prudent alternatives and measures resulting from these consultations shall be implemented to minimize take of endangered species and avoid jeopardizing the species.

Pursuant to section 106 of the National Historic Preservation Act of 1966, as amended, the USACE determined that historic properties would not be adversely affected by the recommended plan. The California Historic Preservation Office concurred with the determination on TBD.

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the recommended plan has been found to be compliant with section 404(b)(1) Guidelines (40 CFR 230). There are no federal jurisdictional wetland waters of the U.S. within the project footprint in Smith Basin, the Blue Diamond and Bond basins, or the lower Santiago Creek channel. The Clean Water Act Section 404(b)(1) Guidelines evaluation is found in Appendix 3 of the Draft DEA.

A water quality certification pursuant to section 401 of the Clean Water Act will be obtained from the Santa Ana Water Quality Control Board prior to construction. In a letter dated TBD, the State stated that the recommended plan appears to meet the requirements of the water quality certification, pending confirmation based on information to be developed during the pre-construction engineering and design phase. All conditions of the water quality certification will be implemented to minimize adverse impacts to water quality.

All applicable environmental laws have been considered and coordination with appropriate agencies and officials has been completed. The Proposed Action analyzed in the Draft SEA focuses on the proposed design refinements relevant to the construction, operation, and maintenance of the Santiago Creek component of the SARMP. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives addressed in the Final SEA. Based on this Final SEA, the reviews by other Federal, State, and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the Proposed Action could have a significant effect on the environment; however, implementation of mitigation measures would reduce all significant impacts to less than significant levels to support a mitigated FONSI. Therefore, preparation of an EIS is not required.

_____
Date

_____
Kenneth P. Rockwell
Colonel, Corps of Engineers
District Commander

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DRAFT SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY AND MITIGATED NEGATIVE DECLARATION

SECTION 1 - INTRODUCTION

This draft Supplemental Environmental Assessment (SEA) / Initial Study and Mitigated Negative Declaration (IS/MND) for the Santiago Creek component of the Santa Ana River Mainstem Flood Control Project (SARMP) has been prepared by the U.S. Army Corps of Engineers (USACE) as a supplement to the Final Supplemental Environmental Impact Statement (SEIS) for the Santa Ana River Mainstem including Santiago Creek, dated September 1988 (hereinafter referred to as the 1988 SEIS). The 1988 SEIS addressed several components of SARMP, including Santiago Creek, and assessed impacts to resource categories (i.e., listed in Section 3) related to both implementation and future maintenance. Alternatives were described in Chapter 4 of the 1988 SEIS, which is incorporated here by reference. This current draft SEA includes the preferred alternative described in the 1988 SEIS (the No Change Alternative) and proposed modifications (the Proposed Action Alternative) as identified in Table 1. The No Construction Alternative (i.e., No Action) was evaluated in the 1975 Survey Report but will also be reevaluated in this SEA/IS/MND. This SEA/IS/MND satisfies requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) documentation.

The purpose of the SARMP is to provide flood risk reductions to areas susceptible to flooding within the counties of San Bernardino, Riverside, and Orange. The USACE is the lead agency for compliance with NEPA. The non-federal sponsor (NFS), Orange County Public Works (OCPW) acting on behalf of the Orange County Flood Control District (OCFCD), is the lead agency for compliance with CEQA. The OCPW is responsible for operation, maintenance, repair, replacement, and rehabilitation of many of the SARMP features, including Santiago Creek. Other agencies (i.e., cooperating, responsible, and trustee agencies) that may use this SEA/IS/MND in the decision-making or permit process will consider the information in this combined document along with other information that may be presented during the NEPA/CEQA process. Other responsible and trustee agencies are listed as follows:

- California Department of Fish and Wildlife (CDFW)
- City of Orange
- City of Santa Ana
- City of Villa Park
- Orange County Flood Control District (OCFCD)
- Santa Ana Regional Water Quality Control Board (SARWQCB), and
- United States Fish and Wildlife Service (FWS)

Major flood control improvements have been approved as part of the SARMP. The Santiago Creek component of SARMP is the last authorized project yet to be constructed. This SEA/IS/MND is necessary to document and evaluate the impacts of design refinements on resource categories (listed in Section 3), and to document changed conditions in the project area.

1.1 Project Location

Santiago Creek is the largest tributary of the Santa Ana River downstream from Prado Dam. The headwaters of the creek are in the vicinity of Santiago Peak of the Santa Ana Mountains in the northern part of Orange County. The stream flows in a northwest direction for approximately 15 miles (mi) to Villa Park Road in the City of Orange, then turns southwest for about another 7 mi before joining the Santa Ana River in the City of Santa Ana. The total drainage area of Santiago Creek is 102 square miles (mi^2). The runoff from 80 percent of the drainage area is controlled by the existing Santiago Dam (a water supply reservoir built by the Irvine Company in 1933) and Villa Park Dam (a flood control structure constructed by Orange County in 1963). The drainage area remaining downstream from Villa Park Dam is approximately 19 mi^2.

For the purposes of this document, the “project area” consists of the lower reach of Santiago Creek extending from the Santa Ana Freeway to the creek’s confluence with the Santa Ana River. The “project area” also consists of the reach of Santiago Creek that flows through the Santiago Recharge Basins (i.e., Blue Diamond Basin, Bond Basin, and Smith Basin).

1.2 Project Authority

The SARMP is located along a 75-mi reach of the Santa Ana River in Orange, Riverside, and San Bernardino Counties, California. The SARMP is a comprehensive flood risk management system that was authorized for construction by Section 401(a) of the Water Resources Development Act (WRDA) of 1986.

The recommended plan for the SARMP is contained in the Phase I General Design Memorandum (GDM) (USACE, 1980) and included eight elements, which were subsequently reevaluated in the Phase II GDM (USACE, 1988). The Phase II GDM modified the SARMP by redefining the authorized SARMP features and clarifying that the Standard Project Flood term referred in most cases to the 100-year flood event. Construction of the SARMP commenced in fiscal year 1989.

1.3 Previously Prepared Documents

Below is a list of relevant environmental documents that have been completed for the SARMP. Throughout the analysis of this SEA/IS/MND, the following documents may be referenced:

- Survey Report and EIS, USACE, Los Angeles District, 1975.
- Lower Santiago Creek Specific Plan, Orange County Environmental Management Agency (OCEMA), 1977.
- Santa Ana River Mainstem Including Santiago Creek. Phase I GDM and SEIS, USACE, Los Angeles District, 1980.
- Santa Ana River Mainstem Including Santiago Creek. Phase II GDM and SEIS, USACE, Los Angeles District, 1988.
- Geotechnical Design and Specifications for the Bond Pit, Proposed Santiago Basin Improvements, Orange County Water District (OCWD), 1988.
- Santiago Creek Feature Design: Alternate Channel Station 10+15 to 74+75. Santa Ana River Mainstem Project including Santiago Creek: Design Memorandum No. 14, USACE, Los Angeles District, 1992.
- Bond Pit Slope Stabilization: Santiago Basin Slope Remediation Project, Orange County, California, OCWD, 1996.
- Santiago Creek Feature Design: Santiago Creek Reservoir. Santa Ana River Mainstem Project including Santiago Creek. Design Memorandum No. 18, USACE, Los Angeles District, 1998.
- Report of Geotechnical Investigations, Santiago Pits Intertie Project, OCWD, 2009.
- District Updated Geotechnical Recommendations, Santiago Floating Pump District, OCWD, 2010.
- Economic Reevaluation Report of the Santa Ana River Mainstem including Santiago Creek, USACE, Los Angeles District, 2013.
- Project Survey Report. Santiago Creek Project, Orange County, California, USACE, Los Angeles District, 2018.

1.4 Objectives, Purpose, and Need

In accordance with 40 Code of Federal Regulations (CFR) 1502.13, this section provides an explanation of the “underlying purpose and need to which the [USACE] is responding in proposing the alternatives including the Proposed Action.”

The federal objective of water and related land resources project planning is to contribute to national economic development (NED). Such contributions are considered increases in the net value of the national output of goods and services expressed in monetary units. These contributions are to be consistent with the protection of the nation’s environment, pursuant to applicable executive orders and other federal planning programs, including the consideration of

state and local concerns. The NED objective of the approved SARMP is to provide flood risk management for portions of Orange, Riverside, San Bernardino counties, while maximizing contributions to the NED. The Santiago Creek project is a component of SARMP and was analyzed in the 1988 SEIS. During preparation of the project's Plans and Specifications, the design of the Santiago Creek project (Proposed Action) was further refined.

The main objective of the Proposed Action would be the same as the previously approved Santiago Creek Project, which is to provide 100-year flood protection for residents in the Santiago Creek floodplain.

Statement of Need
As discussed in the 1988 SEIS, the need for the project is due to significant flooding along the Santa Ana River — including Santiago Creek — within Orange, Riverside, and San Bernardino counties in California, which has been documented since at least 1897. According to USACE documentation, the largest recorded flooding event by peak flow occurred in 1938 following a series of large storm events, the flooding caused at least $4,000,000 in damages within Orange County alone (1938 price levels) (USACE, 1980, 1988, and 2017). In February 1969, a series of significant storms resulted in approximately $22,000,000 in damages within Orange County (1969 price levels) and at least twelve deaths. Unprotected banks along Santiago Creek are subject to erosion which could cause damage to residential and commercial developments along the creek (USACE, 1988).

Statement of Purpose
The purpose of the Proposed Action is to contain the 1% annual exceedance probability (AEP) floods, providing flood protection for approximately 74,000 people living in the Santiago Creek project area (2017 population).

1.5 Environmental Determination

Based on the analysis conducted in this Initial Study, the County of Orange, OC Public Works, Development Services/Planning, as the Lead CEQA Agency, has made the following determination.

Environmental Determination	
I find that the proposed project COULD NOT have a significant effect on the environment, and a **NEGATIVE DECLARATION** will be prepared.	☐
I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made or agreed to by the project proponent. A **MITIGATED NEGATIVE DECLARATION** will be prepared.	☒
I find that the proposed project MAY have a significant effect on the environment, and an **ENVIRONMENTAL IMPACT REPORT** is required.	☐
I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An **ENVIRONMENTAL IMPACT REPORT** is required, but it must analyze only the effects that remain to be addressed.	☐
I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier **EIR** or **NEGATIVE DECLARATION** pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier **EIR** or **NEGATIVE DECLARATION**, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.	☐
I find that the proposed project has previously been analyzed as part of an earlier CEQA document (which either mitigated the project or adopted impacts pursuant to findings) adopted/certified pursuant to the State CEQA Guidelines and the County's adopted Local CEQA Guidelines. The proposed project is a component of the whole action analyzed in the previously adopted/certified CEQA document.	☐
I find that the proposed project has previously been analyzed as part of an earlier CEQA document (which either mitigated the project or adopted impacts pursuant to findings) adopted/certified pursuant to State and County CEQA Guidelines. Minor additions and/or clarifications are needed to make the previous documentation adequate to cover the project which are documented in this addendum to the earlier CEQA document (CEQA §15164).	☐
I find that the proposed project Has previously been analyzed as part of an earlier CEQA document (which either mitigated the project or adopted impacts pursuant to findings) adopted/certified pursuant to State and County CEQA Guidelines. However, there is important new information and/or substantial changes have occurred requiring the preparation of an additional CEQA document (ND or EIR) pursuant to CEQA Guidelines Sections 15162 through 15163.	☐

Kevin Shannon

Signature
Kevin Shannon
Consultant – Environmental Planner

August 31, 2023
Date

SECTION 2 – PROPOSED ACTION AND ALTERNATIVES*

2.1 Comparison of No Change Alternative and Proposed Action

A comparison of the No Change Alternative and Proposed Action is shown below in Table 1.

Table 1: Differences between No Change Alternative and Proposed Action

No Change Alternative Project Features	Proposed Action Project Features	Difference Between Project Features
Reservoir Flow Regulation *Outlet Structure* -Construction of gated outlet structure at Prospect Street (southwest corner of Santiago Recharge Basins) to provide outflow regulation. -Outlet structure controlled and regulated so that peak discharge does not exceed 3,500 cubic feet per second (ft^3/s) during the 100-year design flood. *Overflow Structure* -Grouted riprap overflow structure located along the left bank of the existing channel of Santiago Creek upstream of Prospect Street. Overflow structure will provide 2-feet (ft) of freeboard for the design flood. *Outlet Channel* -Rectangular concrete box culvert under Prospect Street. Downstream of box culvert 300-ft-long concrete transition channel. Downstream of the transition, a trapezoidal riprap channel for 4,000 ft (stopping near Walnut Avenue).	**Reservoir Flow Regulation** *Outlet Structure* -The outlet structure will no longer be constructed. *Overflow Structure* -The overflow structure will no longer be constructed. *Outlet Channel* -The outlet channel will no longer be constructed.	**Reservoir Flow Regulation** *Outlet Structure* -The outlet structure, that was part of the No Change Alternative will no longer be constructed under the Proposed Action Alternative. *Overflow Structure* -The overflow structure that was part of the No Change Alternative will no longer be constructed under the Proposed Action Alternative. *Outlet Channel* -The outlet channel that was part of the No Change Alternative will no longer be constructed under the Proposed Action Alternative.
Reservoir Slope Stabilization -Smith Basin – Santiago Road (Line A) for 1,000-ft compacted buttress fill 2 Horizontal (H) :1 Vertical (V). -Smith Basin – Santiago Road (Line B) for 500-ft compacted buttress fill at 2H:1V. -Santiago Creek Interconnecting Channel (Line C) for 500-ft excavated trapezoidal channel. -Saddle Area Interconnecting Channel (Line D) for 500-ft excavated trapezoidal channel. -Blue Diamond Basin – Hewes Avenue (Line E) for 300-ft excavated and compacted buttress fill 2H:1V. -Bond Basin – Hewes Avenue (Line F) for 1,400 ft	**Reservoir Slope Stabilization** -Smith Basin – Santiago Road (Line A) for 1,000-ft compacted buttress fill at 2.5H:1V. -Smith Basin – Santiago Road (Line B) for 500-ft compacted buttress fill at 2H:1V. -Smith Basin – Villa Park Road (Line I) for 750 ft excavation and compacted fill at 2H:1V. -Smith Basin – Rehabilitation of basin to include debris removal, floor regrading, maintenance road rehabilitation, and replanting. -Blue Diamond Basin – Hewes Avenue (Line E) for 300-ft excavation and compacted fill at	**Reservoir Slope Stabilization** -The No Change Alternative included 6,300 linear ft of reservoir slope stabilization. -The Proposed Action includes 4,500 linear ft of reservoir slope stabilization (decrease of 1,800 linear ft).

excavation and compacted fill with tie back wall and buttress slope at 2H:1V. -Bond Basin – Bond Avenue (Line G) for 1,700 ft excavation and compacted buttress fill at 3H:1V along with 10-ft gabion retaining wall and tie back wall. -Bond Basin – Prospect Street (Line H) for 400-ft excavation and compacted buttress fill at 2H:1V.	2H:1V. -Bond Basin – Hewes Avenue (Line F) for 1,400 ft excavation and compacted fill with tie back wall and buttress slope at 2H:1V. -Bond Basin – Prospect Street (Line H) for 400-ft excavation and compacted fill at 2H:1V. -Bond Basin – Prospect Street (Line K) for 150 ft compacted fill berm along bike tunnel.	
Channel Improvements -Construct 6,400 ft long trapezoidal riprapped channel from the Santa Ana Freeway to the confluence of Santiago Creek with the Santa Ana River. -Construct of 24-inch thick, 50-ft-long grouted rock apron placed 10 ft below the design invert of the mainstem at the confluence of Santiago Creek with the Santa Ana River.	**Channel Improvements** -Install buried riprap along 6,400 ft of Santiago Creek from the Santa Ana Freeway to the confluence with the Santa Ana River. Bury riprap with native substrates and restore native vegetation along channel banks.	**Channel Improvements** -The Proposed Action includes same amount of linear feet of channel (6,400), but design has changed to an 'engineering with nature' design. -Proposed Action does not include construction of rock apron at confluence (already constructed).
Recreational Features -Construct bicycle/hiking/jogging trail from Walnut Avenue to Prospect Street along maintenance road. -Construct trail rest area on west side of Hewes Road directly adjacent to an as yet unnamed county Regional Park.	**Recreational Features** -No recreational features constructed.	**Recreational Features** -The Proposed Action does not include bicycle/hiking/jogging trail (already constructed). -The Proposed Action does not include trail rest area (regional park never constructed).
Floodwalls -No floodwalls included under the No Change Alternative.	**Floodwalls** -Construct 900 ft of concrete topped steel sheetpile floodwall along the north side of Santiago Creek, west of Bristol Avenue. -Construct a total of 5,200 ft (2,600 ft on each side) of concrete topped steel sheetpile floodwall along the north and south sides of Santiago Creek between Bristol Avenue and Flower Street.	**Floodwalls** -The Proposed Action includes a total of 6,100 ft of floodwall which was not part of the No Change Alternative.

2.2 Project Alternatives (Alternatives Considered for Environmental Analysis)

Three alternatives have been carried forward for detailed analysis in each of the environmental resources listed in Section 3 of this draft SEA/IS/MND. These alternatives are:

- No Construction Alternative
- No Change Alternative
- Proposed Action Alternative

2.2.1 No Construction Alternative

The No Construction Alternative is required pursuant to NEPA (i.e., No Action Alternative), and a No Project Alternative is required for CEQA. For this document, the No Construction Alternative is the same as the No Action Alternative and the No Project Alternative. Under the No Construction Alternative, USACE and OCPW would not implement the flood control improvement. The No Construction Alternative constitutes the future without project conditions based on all currently available data. It would serve as the environmental baseline: (1) evaluate the environmental impacts of the Proposed Action; and (2) update the 1988 SEIS by determining if any new information or conditions create additional environmental impacts not previously analyzed in the SEIS.

2.2.2 No Change Alternative

The No Change Alternative in this case is the previously approved design from the 1988 Phase II GDM. The No Change Alternative will evaluate the previously approved design against current conditions. It would serve as the project impact baseline to compare the environmental impacts of the Proposed Action against the updated environmental impacts of the previously approved plan.

2.2.3 Proposed Action Alternative

The Proposed Action Alternative (Figure 1, Figure 2, and Figure 3) is synonymous with the Proposed Action. Major elements of this alternative were based off the 1988 design in the Phase II GDM, but were updated based on existing conditions, current design criteria, and current design practices. The following are major elements of the Proposed Action:

1. Reservoir Slope Stabilization

The existing slopes of the Santiago Recharge Basins require repair in order to accommodate the 1% AEP water surface elevation. Several locations have been identified along the basins which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H): 1 Vertical (V), installation of retaining walls, or installation of armoring. As shown in Figure 2, buttress fill will be used to stabilize slopes Line H, Line F, and Line E and to construct the bike trail berm within the Blue Diamond and Bond basins project site. At this stage of design, riprap is not necessary to stabilize the above slopes; however, two concrete tie-back walls measuring approximately three feet in width are required for stabilization of Line F. The tie-back walls would be similar to what has already been constructed to stabilize the slope that runs along Bond Avenue in the Blue Diamond and Bond basins. As shown in Figure 3, buttress fill will be used to stabilize slopes Line B, Line A, and Line I within the Smith Basin project site. At this stage of design, riprap is necessary to stabilize Line A and Line I, but not Line B. For Line A, riprap would extend from the toe of the slope and up the slope for approximately 45 feet. Similarly, for Line I riprap would extend from the toe of the slope and up slope for approximately 40 feet. After the riprap, buttress fill with no riprap would be used to stabilize the slope. In addition, riprap placed to stabilize these two slopes would be buried with approximately two feet of soil allowing for native vegetation to be replanted on top of the riprap. Areas with just buttress fill would also be replanted with native vegetation. The replanting scheme would include mulefat on top of the buried riprap graduating to coastal sage scrub where only buttress fill is located.

In addition to reservoir slope stabilization within Smith Basin, the floor of Smith Basin will also require rehabilitation to protect the repaired slopes from future erosion. Currently, the existing creek channel flows head on into Line A and portions of Line I. Just to repair and stabilize the

slopes, the existing creek channel would need to be filled in. Therefore, the Proposed Action Alternative includes grading a low flow channel more through the center of Smith Basin and redirecting the existing channel to this location. If in the future the channel moves back south towards Line A and Line I there should be no need to redirect the channel a second time as the slopes will have been repaired and stabilized at the toe with buried riprap. The low flow channel through Smith Basin would be an approximately 1-foot depression by approximately 20 feet in width through the middle of Smith Basin. The design of the graded-out depression does not include stream veins or stream training structures. Once the low flow channel is created and the slopes have been stabilized, replanting of native riparian vegetation (i.e., willow and mulefat) within the bottom of Smith Basin would occur.

Lastly, reservoir slope stabilization also includes the rehabilitation of a historic maintenance access road within Smith Basin. The access road is located along the toe of the northern slope of Smith Basin and would be restored and graded to its original condition. This 12 ft wide road would become the main access into and out of the bottom of Smith Basin and would be accessed from Santiago Road located along the northeast edge of Smith Basin.

2. Channel Improvements

Flow velocities within Santiago Creek are erosive during large storm events (approximately 9-13 feet per second during the 1% AEP), potentially compromising adjacent properties along the highly urbanized floodway. To rehabilitate and improve the creek's flood conveyance capability, the Proposed Action will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will then be covered with native substrate to (i) enhance access for ongoing operation and maintenance, (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) maintain existing aesthetics; and (iv) enhance environmental integrity of the stream corridor. The Proposed Action will involve excavating surficial material from the channel bottom and installing the buried riprap. Re-placing that excavated surficial substrate overlying the riprap layer will stabilize the slopes, maintain the channel's natural appearance, and allow for establishment of native, ecologically desirable vegetation. A channel operation and maintenance program will be necessary to prevent invasive vegetation, large woody growth, debris, and other flow inhibiting concerns from re-establishing within the channel.

In total, the proposed stream stabilization measures include 6,400-feet of trapezoidal channel armored with buried riprap. The proposed cross section includes a gravel bedding layer and riprap armor layer. The riprap armor layer would be covered with approximately one (1) foot of native substrate harvested from the channel. The surficial layer will provide suitable substrate for native vegetation growth. The planting palette is comprised of two native vegetation species mixes, a low-growth mix for the channel invert and a coastal sage scrub mix for the channel bank (i.e., mitigation areas). The channel invert width varies from 30-feet to 80-feet, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitations and will be installed to a slope of 1.75H:1V.

The removal of some trees (exact number to be defined during the next phase of design) in the downstream channel right-of-way would be necessary to complete grading and channel construction. The trees in the downstream reaches are primarily exotic and/or invasive species such as eucalyptus, black locust, Shamel ash, and tree of heaven. To improve the vegetation quality in the channel, native vegetation would be established along the top of the bank and side slopes of the lower Santiago Creek channel after earthmoving and channel construction is complete. Coast live oak trees will be protected when possible. Native plantings would consist of container plantings, cuttings, and hydroseed from the local region. Drip irrigation would be installed for approximately 2 to 3 years to allow plant establishment, and monitoring and maintenance of the restored areas would occur for a 5-year period. The goal of the restored habitat is to create a self-sustaining ecosystem that would require minimal long-term

maintenance. Once the 5-year monitoring and maintenance period is over, USACE would provide the non-federal sponsor with an Operations and Maintenance (O&M) manual.

A survey for California coast live oak (*Quercus agrifolia*) trees and other native tree species within the project limits would be completed during detailed design when the channel design is further refined. The tree survey would identify the different species of trees more precisely. The refined channel design may allow for some native trees to remain in the channel where they currently exist. California coast live oak trees will be protected in place, if possible. All trees within the channel areas where floodwalls are required would likely need to be removed permanently for channel conveyance and to meet the design criteria. The native trees and vegetation to be avoided within the project limits will be flagged for trimming or protect in place.

The project limits and proposed haul routes for construction vehicles will be delineated and marked with flagging and stakes.

3. Floodwalls

Floodwalls are required in select locations along Santiago Creek under the Proposed Action. Floodwalls will extend for approximately 2,600 feet between Bristol Avenue and Flower Street on both the north and south sides of the lower Santiago Creek channel, and for 900 feet on the north side of the lower Santiago Creek channel west of Bristol Avenue. The floodwalls will be steel sheetpile varying in total length from 19 to 30 feet with a reinforced concrete cap extending from two feet below the existing grade to the design elevation based on the hydraulic model for the system. Typical total height of the concrete cap is four to five feet. The location of the wall alignment is at the top of the proposed bank in all areas defined above.

2.3 Future Operation, Maintenance, Repair, Replacement, and Rehabilitation

Maintenance, including routine inspections and minor repairs, of the Santiago Creek project and its associated project features, would be required after construction is completed. The following activities may occur:

- Routine and special inspection with pickup trucks and sport utility vehicles, as needed, and up to daily during flood events.
- Repair of maintenance roads and ramps is anticipated every few years.
- Ecological maintenance activities outside the bird nesting season, including weeding, herbicide application, and re-seeding.
- Vegetation management within the lower Santiago Creek channel and only where floodwalls are located. Vegetation management in the areas with floodwalls would be in accordance with Corps [USACE] of Engineers Engineering Pamphlet 1110-2-18; at a minimum 15-feet down slope of the floodwall would need to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except for grasses for the purpose of erosion control.
- Periodic mending of fencing and gates.
- Periodic graffiti removal and vandalization repair.

Rarely, following large and erosive flood flows, larger-scale maintenance and repairs may be required along the channel and the toe of the basin slopes, which could require access and use of heavy equipment within the floodplain adjacent to the structure. Equipment would need to traverse the channel and maintenance roads along the Santiago Recharge Basins. A temporary work area may need to be established around repair sites. The local sponsor would be required to obtain emergency or standard permits from regulatory agencies, including USACE Regulatory, who would coordinate and consult, if needed, with the FWS. These permits would likely require active habitat restoration of temporary construction and access roads. It is likely that a storm event large enough to damage the channel or basin slopes would also have removed vegetation in the immediate area, but specific impacts cannot be evaluated until or unless damage occurs, and repair work is defined.



Figure 1: Project Footprint of the Proposed Action within the Lower Santiago Creek Channel Action Area.



Figure 2: Project Footprint of the Proposed Action within the Blue Diamond and Bond Basins Action Area.



Figure 3: Project Footprint for the Proposed Action within the Smith Basin Action Area.

SECTION 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

This section evaluates the following environmental resources, for which the proposed Santiago Creek project could have new or potentially significant effects:

Agricultural and Forestry Resources	Air Quality	Noise
Land Use and Planning	Biological Resources	Transportation
Mineral Resources	Cultural Resources	Tribal Cultural Resources
Population & Housing	Energy	Utilities and Service Systems
Public Services	Geology and Soils	Wildlife
Recreation	Greenhouse Gas Emissions	Mandatory Findings of Significance
Aesthetics	Hazards and Hazardous Materials	Growth-Inducing Effects

The affected environment and existing conditions within the Santiago Creek project area have changed since those described in the 1988 SEIS. Therefore, this document updates the affected environment and existing conditions.

Below is a list of the relevant environmental documents that have been completed for the SARMP. Throughout the analysis of this SEA/IS/MND, the following documents may be referenced:

- Santa Ana River Mainstem including Santiago Creek. Phase II GDM and SEIS, USACE, Los Angeles District, 1988.

3.1 Thresholds of Significance

Thresholds of significance are identifiable quantitative, qualitative, or a performance level of a particular environmental effect. Non-compliance with a threshold means the effect will normally be determined to be significant and, conversely, compliance with a threshold means the effect will normally be less than significant. The USACE is relying upon the specific questions relating to environmental impact areas listed in Appendix G of the CEQA Guidelines to determine level of significance, since this is a combined NEPA/CEQA document and OCPW is required to comply with CEQA.

3.2 Environmental Baseline

To adequately determine the significance of a potential environmental impact, the environmental baseline must be established. The environmental baseline for the project constitutes the existing physical conditions as they exist at the time that the environmental process commenced. The No Construction Alternative constitutes the future without project conditions based on all currently available data at the time that the environmental process commenced. The No Action Alternative serves as the environmental baseline (as consistent with Section 2.2.1) to: (1) evaluate the environmental impacts of the Proposed Action; and (2) update the 1988 SEIS by determining if any new information or conditions create additional environmental impacts not previously analyzed in the 1988 SEIS.

3.3 Resources with No Impact

Because of the relatively small size and short duration of this project, no additional effects are expected on agricultural and forestry resources, land use and planning, mineral resources, population and housing, public services, and recreation. Additionally, since no impacts to these resource categories are anticipated no environmental commitments would be required.

3.3.1 Agricultural and Forestry Resources

3.3.1.1 Regulatory Setting

Relevant federal and state laws/regulations include:

- Farmland Protection Policy Act

- California Farmland Conservancy Program

3.3.1.2 Existing Conditions

The State of California Farmland Mapping and Monitoring Program indicates that there is no Prime Farmland, Unique Farmland, or Farmland of Statewide importance in the project area (California Department of Conservation [CDC], 2021) (Figure 4 and Figure 5). In addition, the California's Forest Resources, 2001-2005 Technical Report (Christensen et al., 2008) indicates that there are no forests or rangelands within the project area (Figure 6).



Figure 4: California Important Farmland Finder Map Layer for the Lower Santiago Creek Channel. Map indicates that the project area is 'Urban and Built-Up Land'.



Figure 5: California Important Farmland Finder Map Layer for the Santiago Recharge Basins. Map indicates that the project area is a combination of 'Other Land' and 'Urban and Built-Up Land'.



Figure 6: Forest and Non-forest Areas by California County (Source: Christensen et al., 2008).

3.3.1.3 Environmental Impacts

Significance Criteria

The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to Agricultural and Forestry Resources would be considered significant if the project would result in any of the following:

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland mapping and Monitoring Program of the California Resources Agency, to non-agricultural uses;
b) Conflict with existing zoning for agricultural use or a Williamson Act contract;

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g);
d) Result in the loss of forest land or conversion of forest land to non-forest use; or
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not cause the conversion of prime, unique, or farmland of statewide importance to non-agricultural uses; conflict with an existing zoning for agricultural use or a Williamson Act contract; conflict with existing zoning or cause rezoning of forest land; result in the loss of forest land or conversion of forest land to non-forest use; or involve other changes to the existing environment which could result in the conversion of farmland to non-agricultural uses.

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland mapping and Monitoring Program of the California Resources Agency, to non-agricultural uses?

No Change Alternative

No Impact: The California Department of Conservation's California Important Farmland Finder (CDC, 2021a) indicates that there is no Prime Farmland, Unique Farmland, or Farmland of Statewide Importance with the project area. Santiago Creek is listed as "urban and built-up land" (Figure 4) while the Santiago Recharge Basins are a combination of "urban and built-up land" and "other land" (Figure 5). Therefore, no direct/indirect or short-term/long-term impacts associated with farmland would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

b) Conflict with existing zoning for agricultural use or a Williamson Act contract?

No Change Alternative

No Impact: The City of Orange Zoning Map (City of Orange, 2020) shows the project area along the southeastern sides of the Santiago Recharge Basins zoned for "Sand and Gravel" land uses. The City of Villa Park Zoning Map (City of Villa Park, 2015) shows the northwest sides of the Santiago Recharge Basins zoned for "Orange County Flood Control District". The Orange County Zoning Map (OCPW, 2021) shows the Santiago Recharge Basins zoned for "Sand and Gravel Extraction". Lastly, the City of Santa Ana Zoning Map (City of Santa Ana, 2021) shows the lower reach of Santiago Creek zoned as "Open Space". In addition, neither the Santiago Recharge Basins nor the lower Santiago Creek channel are under a Williamson Act contract. Therefore, based on the above information, the project area is not zoned for agricultural uses, nor is it subject to a Williamson Contract. Therefore, no direct/indirect or short-term/long-term impacts associated with a conflict with existing zoning for agricultural use, or a Williamson Contract (California Department of Conservation 2021b) would occur, and no mitigation measures would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g), timberland (as defined by Public Resources Code section 4526), or timberland zoned for Timberland Production (as defined by Government Code section 51104(g)?

No Change Alternative

No Impact: Refer to the discussion under *(b)* above for project site zoning information. Overall, the project area is not zoned for forest land, timberland, or timberland zoned for Timberland Production. Therefore, no direct/indirect or short-term/long-term impacts associated with conflict with zoning for timberland uses would occur and no mitigation measures would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

d) Result in the loss of forest land or conversion of forest land to non-forest use?

No Change Alternative

No Impact: Refer to discussion under *(b)* above for project site zoning information. The No Change Alternative involves the construction of features that would reduce flood risk and erosion potential. Therefore, no direct/indirect or short-term/long-term impacts associated with the conversion of the project area from existing forest land to non-forest land would occur and no mitigation measures would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?

No Change Alternative

No Impact: Currently, there is no existing farmland on any of the project area. Therefore, no direct/indirect or short-term/long-term impacts associated with the loss of any forest land or the conversion of forest lands to non-forest lands would occur, and no mitigation measures would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*e*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.3.1.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be no impacts to agricultural or forestry resources.

3.3.2 Mineral Resources

This section describes the existing conditions for mineral resources in the vicinity of the project area, regulatory setting, significant thresholds, effect analysis, and mitigation measures.

3.3.2.1 Regulatory Setting

No federal regulations related to mineral resources would be applicable to the project.
state laws/regulations include:

- Surface Mining and Reclamation Act of 1975
- Geologic Energy Management Division
- Division of Mines and Geology

3.3.2.2 Existing Conditions

The California Geologic Energy Management Division (CalGEM) Well Finder tool (CalGEM, 2021) was used to query the presence of any wells within the project area. According to the Well Finder tool, there are no wells located within 0.25-mi of the project area. Table 2 lists the wells that are nearest the project area, but outside 0.25-mi of the project area.

Table 2: Information on Wells Located Near the Project Area.

Well Identification Number (API)	Well Status	Well Type	Operator	General Distance and Location from Project Area
0405901240	Plugged	Dry Hole	Chevron U.S.A., Inc.	1.01-mi north of Santiago Creek
0405901266	Plugged	Dry Hole	Trustees Dev. Association	1.02-mi east of Santiago Creek
0405901106	Idle	Oil and Gas	Penn Drilling Co.	1.14-mi west of Santiago Recharge Basins
0405901184	Plugged	Dry Hole	Chevron U.S.A., Inc.	0.91-mi northeast of Santiago Recharge Basins
405901247	Plugged	Dry Hole	Chevron U.S.A., Inc.	0.5-mi north of Santiago Recharge Basins

Regarding aggregate resources, sand and gravel are the principal mineral resources in Orange County. According to the California Department of Conservation, Division of Mines and Geology (Miller, 1994), *Update of Mineral Land Classification of Portland Cement Concrete Aggregate in Ventura, Los Angeles, and Orange Counties, California, Part III, Plate 1 Generalized Mineral Land Classification of Orange County, California Aggregate Resources Only*, the Proposed Action is in Mineral Resources Zone-2 (MRZ) and MRZ-3 zones. The MRZ-2 land classification indicates areas where adequate information indicates significant mineral deposits are present, or where it

is judged that a high likelihood exists for their presence. The MRZ-3 land classification indicates areas containing mineral deposits (aggregate), the significance of which cannot be evaluated from available data (Miller, 1994). The portion of Santiago Creek in the project area is classified as MRZ-3. The Santiago Recharge Basins are classified as MRZ-2.

3.3.2.3 Environmental Impacts

Significance Criteria

The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to mineral resources would be considered significant if the project would result in any of the following:

a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state; or
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not result in the loss of availability of a known mineral resource of value to the region or result in the loss of availability of a locally important mineral resource recovery site.

(a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?

No Change Alternative

No Impact: The Santiago Recharge Basins are currently groundwater management basins that previously operated as aggregate mines (for sand and gravel aggregate) prior to their purchase by the OCWD in 1990. The Santiago Recharge Basins have not functioned as aggregate mines since their purchase by OCWD in 1990. In addition, the City of Orange General Plan – Natural Resources Element (City of Orange, 2010a), identifies that many state-designated MRZs have been declassified, including the Santiago Recharge Basins. Similarly, the City of Villa Park General Plan – Open Space/Conservation Element (City of Villa Park, 2010a) designation for the portions of the Santiago Recharge Basins within Villa Park is Open Space; the area is not designated for mineral resource recovery. The lower Santiago Creek channel is a naturally occurring tributary to the Santa Ana River and no mining has occurred within this portion of the channel in recent memory. The No Change Alternative involves modifications to the Santiago Recharge Basins to allow for greater holding capacity during storm events. The project also includes burying riprap and then covering the riprap with native substrate along the lower Santiago Creek channel to allow for greater capacity and higher flow velocities during storm events. Therefore, no direct/indirect or short-term/long-term impacts associated with loss of availability of a known mineral resource that would be of value to the region and residents of the state would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) Result in the loss of availability of a locally-important mineral resource recovery site

delineated on a local general plan, specific plan or other land use plan?

No Change Alternative

No Impact: The Santiago Recharge Basins are currently groundwater basins that previously operated as aggregate mines (for sand and gravel aggregate) prior to their purchase by OCWD in 1990. The Santiago Recharge Basins have not functioned as aggregate mines since their purchase by OCWD in 1990. The lower reach of Santiago Creek is a naturally occurring tributary to the Santa Ana River and no mining has occurred within this portion of the channel. The City of Orange General Plan – Natural Resources Element (City of Orange, 2010a) identifies that many state-designated MRZs have been declassified, including the Santiago Recharge Basins. The City of Orange General Plan – Land Use Element (City of Orange, 2010b) includes a Resource Area designation that provides for the continued use of areas for mining and agriculture. The City of Orange General Plan – Land Use designation for the Santiago Recharge Basins is Open Space, and it is not designated for mineral resource recovery. Similarly, the City of Villa Park General Plan – Open Space/Conservation Element (City of Villa Park, 2010a) designation for the portions of the Santiago Recharge Basins within Villa Park is Open Space; the area is not designated for mineral resource recovery. Regarding the lower reach of Santiago Creek, the City of Santa Ana General Plan – Land Use Element (City of Santa Ana, 1982a) designation is Open Space; the area is not designated for mineral resource recovery. The lower Santiago Creek channel is a naturally occurring tributary to the Santa Ana River and no mining has occurred within this portion of the channel in recent memory. The No Change Alternative involves modifications to the Santiago Recharge Basins to allow for greater holding capacity during storm events. The project also includes burying riprap with native substrates to stabilize the lower Santiago Creek channel from increased flow velocities. Therefore, no direct/indirect or short-term/long-term impacts associated with loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.3.2.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be no impacts to mineral resources.

3.3.3 Population & Housing

3.3.3.1 Regulatory Setting

Relevant federal and state laws/regulations include:

- EO 12898
- EO 13045

3.3.3.2 Existing Conditions

The U.S. Census Bureau's Explore Census Data tool (U.S. Census Bureau, 2021) was queried for demographic data on the State of California, Orange County, and the following communities: Santa Ana, Villa Park, and Orange. The demographics for these communities are summarized in Table 3.

Table 3: Socioeconomic Information for the Project Area.

	City of Santa Ana	City of Villa Park	City of Orange	Orange County	State of California
Population	332,318	5,861	138,661	3,168,044	39,512,223
Population under 5 years	7.4%	1.9%	6.8%	5.9%	6.0%
Population under 18 years	26.9%	18.4%	22.0%	22.2%	22.5%
White	40.2%	78.8%	74.0%	61.0%	59.4%
Black or African American	1.1%	0.5%	1.3%	1.8%	5.8%
American Indian and Alaska Native	0.5%	0.0%	0.6%	0.5%	0.8%
Asian	11.8%	17.7%	12.1%	20.5%	14.8%
Native Hawaiian and Other Pacific Islander	0.3%	0.0%	1.4%	0.3%	0.4%
Hispanic or Latino	76.8%	12.3%	43.2%	34.1%	39.4%
Two or more races	2.1%	2.0%	4.1%	4.1%	5.0%
High School or Higher	59.6%	93.4%	84.5%	85.5%	84.0%
BA or Higher	15.0%	54.8%	43.5%	40.6%	35.0%
Median Household Income	$66,145	$165,000	$95,827	$90,234	$80,440
Below Poverty Level	15.7%	6.5%	9.2%	10.9%	11.8%

3.3.3.3 Environmental Impacts

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis effects to population and housing would be considered significant if the project would result in any of the following:

a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure); or
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not induce directly or indirectly substantial unplanned population growth in an area or displace substantial numbers of existing people or housing. Under the No Construction Alternative, the current level of risk would remain for flooding of communities within the vicinity of Santiago Creek. Flooding and inundation could require temporary or permanent

relocation of residents and businesses to nearby communities depending on the location, severity, and duration of the flooding.

(a) *Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?*

No Change Alternative

No Impact: The project would not result in any residential development, and the number of required employees to conduct the improvements would be minimal (approximately 40 personnel). The project would not directly induce population growth through addition of homes or businesses. Therefore, no direct/indirect or short-term/long-term impacts associated with direct or indirect population growth would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) *Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?*

No Change Alternative

No Impact: No housing exists on the project area, and no housing in the vicinity of the project area would be displaced. Therefore, no direct/indirect or short-term/long-term impacts associated with the displacement of existing housing would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.3.3.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be no impacts to population and housing.

3.3.4 Public Services

3.3.4.1 Regulatory Setting

There are no federal/state laws or regulations associated with public services.

3.3.4.2 Existing Conditions

The project area is located within Orange County, California and includes the communities of Santa Ana, Villa Park, and Orange. Public services with respect to these communities are discussed below.

Santa Ana

The City of Santa Ana is within the jurisdiction of four school districts: Santa Ana Unified, Garden Grove Unified, Tustin Unified, and Orange Unified (City of Santa Ana, 1982e). The facilities of Santa Ana Unified School District account for over 90 percent of school resources available in the city. These facilities are over-enrolled with respect to current available space. The city library system consists of a central library in Civic Center' Plaza and two branch libraries in the western portion of Santa Ana: the McFadden and Newhope Branches. The library has a combined annual circulation of approximately 900,000 volumes.

The city is served by seven hospitals: four in Santa Ana and three in Orange. These hospitals — Santa Ana-Tustin Community, Doctor's, Mercy General, Riverview, St. Joseph's, Children's Hospital of Orange County, and University of California at Irvine Medical Center — provide a combined total of over 1,500 beds and all provide 24-hour emergency care. Health services are also available through the Orange County Health Department located in the Civic Center. Other community health facilities include the County of Orange East Regional Mental Health Services and Mental Health Association of Orange. The principal cultural facility in Santa Ana is the Bowers Museum. The Bowers Museum describes the history and earlier culture of the Santa Ana / Orange County region.

Santa Ana has created an important multi-jurisdictional government center which serves not only city residents, but those of the county-at-large. The Civic Center includes City Hall, central library, and police facilities, as well as county, state and federal offices (City of Santa Ana, 1982e). The city's central police station is in the Civic Center (City of Santa Ana, 1982f). Built in 1997, the four-level facility meets the administrative space requirements for 566+ employees. The city contracts fire department services with the Orange County Fire Authority (OCFA) which fulfills both fire protection and emergency medical responsibilities. The OCFA operates ten stations throughout Santa Ana and has access to an additional 61 stations in its service area. These stations are well distributed, at an approximate of 1.5-mi service radii through the city (City of Santa Ana, 1982f).

Villa Park

The City of Villa Park is within the jurisdiction of the Orange Unified School District. The Orange Unified School District operates 29 elementary, 5 middle, and 4 high schools, a continuation high school, a K-8 math and science magnet school, and two special schools. Enrollment within the Orange Unified School District stands around 29,473 students. The city library system consists of one library: the Villa Park Library.

The city is served by four hospitals: Anaheim Regional Medical Center, Anaheim General Hospital, Children's Hospital of Orange County, and UCI Medical Center. Additional health services include the Karlton Residential Care Center; a licensed 70-bed care center located in Orange County, designed for elderly persons requiring assisted living due to Alzheimer's Disease or other related disorders. The city is served by the Orange County Sheriff and contracts fire department services with OCFA.

Orange

The City of Orange is within the jurisdiction of the Orange Unified School District. The City of Orange is served by the Orange Public Library and History Center; the main public library facility for the city. The main library is also supported by two branches: the El Modena Branch and Taft Branch.

The city is served by four hospitals: Children's Hospital of Orange County, St. Joseph Hospital of Orange, UC Irvine Medical Center, and Uptown Orange. The city is served by the Orange Police Department which responds to emergency situations and patrols neighborhoods and commercial areas. Orange's Fire Department provides fire, paramedic, and ambulance services. Paramedic teams are located at eight stations, of which three also provide ambulance service with an average response time of 4 minutes, 47 seconds: and average transport unit response times of 5 minutes, 29 seconds.

Unincorporated Orange County

Unincorporated Orange County is serviced by the Orange Unified School District. The Orange Unified School District is an urban district in Orange County, California, that educates approximately 26,000 preschool-12th grade students in the cities of Orange, Villa Park, Anaheim, Garden Grove, Santa Ana, and unincorporated county areas.

The Orange County Sheriff's North Patrol provides police services for the 72,212 residents of unincorporated Orange County. The Orange County Fire Authority is a regional fire service agency that serves 23 cities in Orange County and all unincorporated areas in Orange County.

3.3.4.3 Environmental Impacts

Significance Criteria

The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis effects to public services would be considered significant if the project would result in any of the following:

a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, to maintain acceptable service ratios, response times or other performance objectives for any public services (e.g., fire protection, police protection, schools, parks, other public facilities).

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not result in substantial adverse physical impacts associated with the provision of governmental facilities, altered governmental facilities, or impact response times or other performance objectives for fire protection, police protection, schools, parks, or other public facilities.

(a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratio and response times for fire protection, police protection, schools, parks or other public facilities?

No Change Alternative

No Impact: Regarding fire protection, portions of Smith Basin are designated as a Wildland High Fire or Very High Fire Hazard Area in the City of Orange General Plan – Public Safety Element (City of Orange, 2010c). The northern boundary of the Blue Diamond Basin is designated as a Wildland High Fire Hazard Area in the City of Orange General Plan – Public Safety Element (City of Orange, 2010). The remaining boundaries of the Santiago Recharge Basins are not designated as Wildland High Fire or Very High Fire Hazard Areas in either the City of Orange General Plan – Public Safety Element (City of Orange, 2010) or the City of Villa Park General Plan – Safety Element (City of Villa Park, 2010b). Lastly, the lower Santiago Creek channel is not within a designated Wildland High Fire or Very High Fire Area according to the Orange County General Plan – Safety Element (Orange County, 2012a). Although portions of the project area are located within Wildland High or Very High Fire Hazard Area, the project does not include the construction of any habitable structures. Therefore, no direct/indirect or short-term/long-term impacts associated with the need for new fire protection facilities would occur and no mitigation would be required.

Regarding police protection, the project does not include the construction of any habitable structures that would induce any population growth in the City of Orange Police Department, City

of Villa Park Police Department, or City of Santa Ana Police Department service areas. Similarly, the project does not include the construction of any habitable structures that would induce any population growth in unincorporated Orange County which is provided police protection services by Orange County. Therefore, no direct/indirect or short-term/long-term impacts associated with the need for new police protection facilities would occur and no mitigation would be required.

Regarding schools, the project does not include the construction of any habitable structures that would induce any population growth that would result in new students entering the local school districts. Therefore, no direct/indirect or short-term/long-term impacts associated with the need for school facilities would occur and no mitigation would be required.

Regarding parks, the project does not include the construction of any habitable structures that would induce population growth that would result in demands for parks by new residents. The Santiago Recharge Basins are an active groundwater recharge facility with the surrounding non-water areas designated as Open Space in the General Plans for the City of Orange (City of Orange, 2010b) and the City of Villa Park (City of Villa Park, 2010c). Similarly, the City of Santa Ana General Plan (City of Santa Ana, 1982b) designates the lower Santiago Creek channel as Open Space. The Santiago Creek Bike Trail is located immediately east of the Santiago Recharge Basins, however, public access to the Santiago Creek Bike Trail would be maintained throughout the duration of project construction. Therefore, no direct/indirect or short-term/long-term impacts associated with the need for park facilities would occur and no mitigation would be required.

Regarding public facilities, the project does not include the construction of any habitable structures that would induce any population growth that would result in demands for other public facilities by new residents or businesses. Similarly, the project would not displace, short-term or long-term, any existing public facilities. Therefore, no direct/indirect or short-term/long-term impacts associated with the need for other public facilities would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.3.4.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be no impacts to public services.

3.4 Resources with Impact Other than No Impact

Results of an initial evaluation indicated that the project could affect the following resources. Sections 3.4.1 through 3.4.14 describe the existing conditions, effects, and proposed mitigation for the resources that could be significantly affected by the implementation of the project.

3.4.1 Aesthetics

This section describes the existing conditions for aesthetics, regulatory setting, significance thresholds, effect analysis, and a qualitative analysis of effects.

3.4.1.1 Regulatory Setting

There are no federal laws or regulations associated with aesthetics and visual resources. State laws include the following:

- California Department of Transportation Scenic Highways Program

- City of Orange General Plan, Natural Resources Element
- City of Villa Park General Plan, Open Space and Conservation Element
- City of Santa Ana General Plan, Open Space, Parks and Recreation Element
- Orange County General Plan, Open Space Element

3.4.1.2 Existing Conditions

Santiago Recharge Basin includes the Bond Basin, Blue Diamond Basin, and Smith Basin. The Bond and Blue Diamond basins have the appearance of a large lake. Smith Basin does not maintain the appearance of a large lake, but instead maintains the appearance of a depressed land formation with vegetated portions of slope and floor bottom. Santiago Creek cuts through the floor of Smith Basin. The Santiago Creek Bike Trail extends along the perimeter of the Santiago Recharge Basins and provides public views of the site. Additionally, residential uses within the vicinity of the Santiago Recharge Basin have private views of the project area. The City of Orange General Plan - Natural Resources Element (City of Orange, 2010a) identifies the nearest viewscape corridor as being located on Jamboree Road and Chapman Avenue, approximately 2.7 miles southeast of the Santiago Recharge Basins. The City of Villa Park General Plan – Open Space and Conservation Element (City of Villa Park, 2010) does not identify specific viewscapes but does note that property belonging to Villa Park within the Santiago Recharge Basins has been designated as Open Space. The City of Villa Park General Plan – Open Space/Conservation Element (City of Villa Park, 2010) also notes that the Santiago Recharge Basins provide passive open space benefits to the city and current uses consistent with goals of the Santa Ana River/Santiago Creek Greenbelt Plan adopted by the County of Orange and the cities of Villa Park and Orange.

Santiago Creek is the largest tributary of the Santa Ana River downstream of Prado Dam. Above the Villa Park Dam, the creek flows through a mountainous area with steep slopes generally devoid of urban development. Downstream from Villa Park Dam, the creek continues to flow along a narrow streambed in a hilly area with canyon walls before reaching the alluvial fan at the northeastern part of the City of Orange. Urban development has encroached on the floodplain of Santiago Creek from Collins Avenue downstream to the Santa Ana River. In addition to residential and commercial development within this area, there are three major highway crossings (i.e., Costa Mesa Freeway, Garden Grove Freeway, and Santa Ana Freeway) and eight street bridges (i.e., Chapman Avenue, Tustin Street, Cambridge Street, Glassell Street, Main Street, Broadway, Flower Street, and Bristol Street). Two overpasses for North Bristol and North Flower Streets currently intersect the project site. The project site is currently overgrown with non-native vegetation, particularly along the slopes of the creek's channel. Existing erosion control features along the channel slopes include wire mesh reinforcements; however, existing reinforcements are deteriorated. The substrate along channel slopes and underlying existing structures along the project site is currently scoured and eroded. Within the project area, Santiago Creek has the appearance of an intermittent stream. The City of Santa Ana General Plan – Open Space, Parks and Recreation Element (City of Santa Ana, 1982b) identifies Santiago Creek as a regional scenic corridor. Furthermore, the General Plan notes that Santiago Creek is part of a regional system of open space corridors promoted by the Orange County General Plan – Open Space Element.

Existing conditions at the project site could potentially exacerbate flooding risk in the project vicinity. In the event of a 100-year flood event, the lower portion of the Santiago Creek that feeds into the Santa Ana River mainstem has a potential to overflow and flood portions of the surrounding community. In the event of high flow rates along the project site, existing eroded conditions along the Santiago Creek channel may result in slope failure that could damage adjacent properties and homes. Additionally, existing non-native vegetation encroachment within the creek reduces the channel's flow capacity, and its capacity to detain flood waters.

According to the California Department of Transportation Scenic Highways Program, State Route 91 is the closest designated and/or eligible State Scenic Highway to the project area. This segment of State Route 91 is a little over 2.5 miles from the project area.

3.4.1.3 Environmental Impacts

Significance Criteria

The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, the project would result in a potentially significant impact to aesthetics if it would:

a) Have a substantial adverse effect on a scenic vista;
b) Substantially damage scenic resources, including, but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway;
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings (Public views are those that are experienced from publicly accessible vantage point)? If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality; or
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not have a substantial adverse effect on a scenic vista; substantially damage scenic resources; substantially degrade existing visual character or quality of public views; or create a new source of substantial light or glare.

(a) *Have a substantial adverse effect on a scenic vista?*

No Change Alternative

Less than Significant Impact: As stated under existing conditions, the City of Orange General Plan – Natural Resources Element (City of Orange, 2010a) identifies the nearest viewscape corridor as being located on Jamboree Road and Chapman Avenue, approximately 2.7 miles southeast of the Santiago Recharge Basins. Due to intervening topography and development, the Santiago Recharge Basins are not visible from this viewscape corridor. The Santiago Recharge Basins are not identified specifically as a viewscape but have been designated as Open Space by the City of Villa Park and City of Orange general plans and provide passive open space benefits (City of Villa Park, 2010 and City of Orange, 2010a). Regarding Santiago Creek, the City of Santa Ana General Plan – Open Space, Parks, and Recreation Element (City of Santa Ana, 1982b) and the Orange County General Plan – Open Space Element (Orange County, 2010), designates the creek as part of a regional system of open space corridors. Long-term, the project does not involve the construction of any structures that would obstruct existing views of residences surrounding the Santiago Recharge Basins or Santiago Creek. Short-term, construction of the project would require the operation of heavy construction equipment within the Santiago Recharge Basins and Santiago Creek for the duration of the flood risk management project which would directly obstruct views while construction activities are occurring. Construction of shoreline stabilization features in the Santiago Recharge Basins, construction of the outlet and overflow structures within the Bond Basin, and modification of the Santiago Creek earthen channel to include burying riprap and then covering the riprap with native substrate would modify existing views of the Santiago Recharge Basins and Santiago Creek directly and long-term; however, the views would not be substantially modified. The project site occurring along Santiago Creek, extends from the I-5 freeway to the Santa Ana River mainstem confluence and includes views from the Bristol Street and Flower Street overpasses, which intersect Santiago Creek. Additionally, the Santa Ana General Plan EIR identifies scenic corridors that provide major view and vantage points of significant scenic features in the city. These corridors provide views of Santa Ana and largely influence the public's aesthetic and visual experience of the city. These corridors include watercourse corridors like the Santa Ana River and Santiago Creek, operating at a regional scale and belonging to the county's open space network. Both Bristol Street and Flower Street, which intersect the project site, are not identified as scenic corridors that contain

scenic vistas. Overall, direct/indirect and short-term/long-term impacts are considered less than significant, and no mitigation is required.

Proposed Action Alternative

Less than Significant Impact: The Proposed Action differs from the No Change Alternative in that only shoreline stabilization would occur within the Santiago Recharge Basins. Construction of the outlet structure would not occur under the Proposed Action. The Proposed Action also differs from the No Change Alternative in that floodwalls would be constructed along the lower Santiago Creek channel, primarily between Bristol Street and Flower Street. Regardless the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for the Proposed Action project impacts.

(b) *Substantially damage scenic resources, including, but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway?*

No Change Alternative

No Impact: There are no trees, rock outcroppings, and/or historic buildings located on the project site that have been identified as important scenic resources or would otherwise constitute significant landscape features. The California Department of Transportation (Caltrans) administers the Scenic Highway Program, pursuant to the Streets and Highways Code, Sections 260-263. State highways are classified as either Officially Designated or Eligible. There are no Officially Designated State Scenic Highways in the vicinity of the project site. The nearest Officially Designated State Scenic Highway is located along State Route 91 (SR-91), approximately 5.64 miles northeast of the project site. Additionally, the nearest Eligible State Scenic Highway is also located along SR-91, approximately 9.64 miles northeast of the project site. Due to the distance between the project site and Officially Designated or Eligible State Scenic Highways, the eligibility of nearby State Scenic Highways, scenic resources located within the highway segments or its viewshed would not be impacted by the proposed project. Therefore, no direct/indirect or short-term/long-term impact on scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a State Scenic Highway would occur as a result of the proposed project. No mitigation is required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c) *In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings (Public views are those that are experienced from publicly accessible vantage point)? If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?*

No Change Alternative

Less Than Significant Impact: The Santiago Recharge Basins are active groundwater recharge facilities and have a natural open space visual character. In addition, both the City of Orange (City of Orange, 2010b) and City of Villa Park (City of Villa Park, 2010c) general plans designate the non-water areas surrounding the Santiago Recharge Basins as “Open Space”. Similarly, the

City of Santa Ana General Plan (City of Santa Ana, 1982b) designates the lower Santiago Creek channel as “Open Space”. Shoreline stabilization features within the Santiago Recharge Basins are not expected to substantially alter the existing visual character of the site. During construction, heavy equipment would be operating within the Santiago Recharge Basins. Once construction is complete, the outlet and overflow structures within Bond Basin would be permanently visible structures that would alter the visual character of the site. Other features that are part of the project such as shoreline stabilization features would not substantially alter the existing visual character of the site. To minimize the impact to the visual character from the shoreline stabilization features, replanting native vegetation similar to what was present in temporarily disturbed areas will occur.

Within the lower Santiago Creek channel project site, the proposed project would require the removal of existing non-native vegetation that has encroached on the project area and currently hinders the function of the channel. The proposed project would reinforce the channel floor and slopes with layers of bedding, riprap armoring, native riparian stone and substrate, and would plant native vegetation along the channel’s slopes at a height and density that would not impede water flow during a flood event. The project would also directly result in noticeable tree removal within the Santiago Creek right-of-way westward from Flower Street and eastward from Bristol Street, reducing the visual density of tree cover while enhancing and increasing native foliage on the slopes and centerline of the creek channel. The key sensitive receptors to short-term and long-term changes in visual quality in the project site would be residential locations adjacent to the site that have a view of the channel. The proposed project would directly alter existing visual characteristics of the project site with vegetation removal and shaded habitat reduction. However, the proposed project would replace removed vegetation with native vegetation that would preserve the open space character of the project site long-term while allowing proper flood and erosion control along the Santiago Creek channel.

The project site is zoned Open Space Land (O) and designated Open Space (OS) in the City of Santa Ana General Plan. The purpose of the O designation is to provide permanent open spaces in the City of Santa Ana. The proposed project would not result in changes to the project site that would convert open space uses to other land uses. The proposed project would directly improve flood and erosion control features on the Santiago Creek Channel and would plant native vegetation that would preserve the open space visual character of the project site long-term. As such, the proposed project would not directly or indirectly conflict with the project site’s zoning or with regulations governing scenic quality, or substantially degrade the visual character or quality of public views of the site and its surroundings. As such, a less than significant impact would occur, and no mitigation is required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins. In addition, the Proposed Action includes the construction of floodwalls along the lower Santiago Creek channel primarily between Bristol Avenue and Flower Street. Figure 7 through Figure 12 depict the existing and proposed conditions along the lower Santiago Creek channel where the floodwalls are located.

(d) *Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?*

No Change Alternative

No Impacts: The proposed project would not involve the permanent installation of outdoor lighting or reflective features that could adversely affect day or nighttime views of the area long-term. Construction of the project could directly result in light and glare from construction vehicles or equipment short-term; however, construction activities are anticipated to occur during daylight hours and once construction is completed, light and glare from these activities would cease to occur. After construction of the project is completed, no activities that could introduce light or glare to the project area would occur. Therefore, the project would not create a new source of substantial light or glare long-term, which would adversely affect day or nighttime views in the area. Therefore, no impact related to light and glare would occur.

Proposed Action Alternative

Less than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.



Figure 7: Bristol Street Bridge Existing Conditions Facing East (Picture taken 4/19/23).



Figure 8: Bristol Street Bridge Proposed Conditions Facing East.



Figure 9: Bristol Street Bridge Existing Conditions Facing West (Picture taken 4/19/23).



Figure 10: Bristol Street Bridge Proposed Conditions Facing West.



Figure 11: Santiago Creek Existing Conditions Facing East (Picture taken 4/19/23).



Figure 12: Santiago Creek Proposed Conditions Facing East.

3.4.1.4 Environmental Commitments

Mitigation Measures
No mitigation measures are recommended since there are less than significant impacts to aesthetics.

Best Management Practices
BMPs used to minimize impacts to aesthetics during construction include:

- Work and staging areas will be kept orderly and free of trash and debris; and
- Construction lighting fixtures will be shielded by providing side flaps on lights. Onsite construction lighting will be arranged so that direct rays will not shine in or produce glares to nearby residences.

3.4.2 Air Quality
This section describes the existing conditions for air quality, regulatory background, significance thresholds, effect analysis, and a qualitative analysis of effects.

3.4.2.1 Regulatory Setting
Relevant federal and state laws/regulations include:

- Clean Air Act
- General Conformity Rule
- State Implementation Plan – Final 2016 Air Quality Management Plan
- Non-Road Diesel Fuel Rule
- Emissions Standards for On-Road Trucks
- Environmental Protection Agency Diesel Fuel Rule
- Off-Road Diesel Engine Rule
- California Clean Air Act
- CARB Regulation for In-Use Off-Road Diesel Vehicles
- CARB Resolution 08-43 for On-Road Diesel Truck Fleets
- Assembly Bill (AB) 1807 – Air Toxics Program
- AB 2588 – Air Toxics “Hot Spots” Information and Assessment Act
- Heavy Duty Diesel Truck Idling Regulation
- CARB Drayage Truck Regulations
- California Diesel Fuel Regulations
- Statewide Portable Equipment Registration Program (PERP)
- Heavy-Duty Diesel Truck Idling Regulation
- Assembly Bill 1493
- SCAQMD Rule 401 – Visible Emissions
- SCAQMD Rule 402 – Nuisance
- SCAQMD Rule 403 – Fugitive Dust
- SCAQMD Rule 1113 – Architectural Coatings
- SCAQMD Regulation XI – Source Specific Standards
- SCAQMD Regulations XIII – New Source Review

3.4.2.2 Existing Conditions
The project area is in Orange County and is within the South Coast Air Basin (basin). To the west of the basin is the Pacific Ocean. To the north and east of the basin are the San Gabriel, San Bernardino, and San Jacinto Mountains, while the southern limit of the basin is the San Diego County line. The basin consists of Orange County, all of Los Angeles County except for the Antelope Valley, the non-desert portion of western San Bernardino County, and the western and Coachella Valley portions of Riverside County. The air quality in the basin is impacted by dominant airflows, topography, atmospheric, inversions, location, season, and time of day.

Dominant airflows provide the driving mechanism for transport and dispersion of air pollution. The mountains surrounding the region form natural horizontal barriers to the dispersion of air contaminants. Air pollution created in the coastal areas and around the Los Angeles area is transported inland until it reaches the mountains where the combination of mountains and inversion layers generally prevent further dispersion. This poor ventilation results in a gradual degradation of air quality from coastal areas to inland areas. Air stagnation may occur during the early evening and early morning periods of transition between day and nighttime flows. The region also experiences periods of hot, dry winds from the desert, known as Santa Ana winds. If the Santa Ana winds are strong, they can surpass the sea breeze, which flows from the ocean to the land, and carry the suspended dust and pollutants out to the ocean. If the winds are weak, they are opposed by the sea breeze and cause stagnation, resulting in high pollution events.

The primary wind direction of the project area is to the northeast. The average temperatures in the project area typically range from the 60s °F to 80s °F0 and most of the annual rainfall occurs between December and March. The average annual precipitation in the Proposed Action area is 14.26 inches.

Temperature inversions limit the vertical depth through which pollution can be mixed. Among the most common temperature inversions in the basin are radiation inversions, which form on clear winter nights when cold air off mountains sink to the valley floor while the air aloft over the valley remains warm. These inversions, in conjunction with calm winds, trap pollutants near the source. Other types of temperature inversions that affect the basin include marine, subsidence, and high-pressure inversions. Summers often have periods of hazy visibility and occasionally unhealthful air, while air quality impacts in the winter tend to be localized. Higher temperatures and sunshine can contribute to air pollutant formation, particularly ozone.

Local Air Quality

The local air quality can be evaluated by reviewing relevant air pollution concentrations near the project area. For evaluation purposes, the South Coast Air Quality Management District (SCAQMD) has divided the basin into 36 Source Receptor Areas within the basin operating monitoring stations in most of the areas. These Source Receptor Areas are designated to provide a general representation of the local meteorological, terrain, and air quality conditions within the geographical area. The project area is within Source Receptor Areas 16 and 17. SCAQMD operates an air monitoring station in Anaheim, California.

Table 4 summarizes the local ambient air quality. The data shows that during the past few years, the project area has exceeded ozone, PM_{10}, and $PM_{2.5}$ standards.

Table 4: Local Ambient Air Quality (Source: SCAQMD 2016)

Pollutants	Pollutant Criteria	Air Quality Monitoring Station Central Orange County (Anaheim)	Air Quality Monitoring Station North Coastal (Costa Mesa)
Carbon Monoxide[a]	Max Conc. in ppm 1-hour	2.6	2.1
	Max Conc. in ppm 8-hour	2.1	1.7
Ozone[b]	Max Conc. in ppm 8-hour	0.074	0.069
	No. Days Exceeded Federal 8-hour Standards (>0.084)	0	0
	No. Days Exceeded State 8-hour Standards (>0.070)	4	0
Nitrogen Dioxide[c]	Max Conc. in ppb 1-hour	64.3	59.8
	Average Annual AAM. Conc. ppb	14.8	10.1
Sulfur Dioxide[d]	Max Conc. in ppb 1-hour	-	3.3

Pollutants	Pollutant Criteria	Air Quality Monitoring Station Central Orange County (Anaheim)	Air Quality Monitoring Station North Coastal (Costa Mesa)
Suspended Particulates PM_{10}[e]	Max Conc. in µg/m^3 24-hour	74	-
	No. (%) Samples Exceeding Federal 24-hour Standards (>150 µg/m^3)	0	0
	No. (%) Samples Exceeding State 24-hour Standards (>50 µg/m^3)	3 (1%)	-
	Annual Average Conc.[f] (AAM) µg/m^3	24.4	-
Fine Particulates $PM_{2.5}$[g]	Max Conc. in µg/m^3 24-hour	44.45	-
	No. (%) Samples Exceeding Federal 24-hour Standards (>35 µg/m^3)	1 (0.3%)	-
	Annual Average Conc.[h] (AAM) µg/m^3	9.47	-
Lead[i]	Max. Monthly Average Conc. µg/m^3	-	-
	Max. 3-Months Rolling Averages µg/m^3	-	-
PM_{10} Sulfate[j]	Max. Conc. in 24-hour µg/m^3	-	-

- Pollutant not monitored; ppm – Parts Per Million parts of air, by volume; ppb – Parts Per Billion parts of air, by volume; AAM – Annual Arithmetic Mean; µg/m^3 – Micrograms per cubic meter of air

a) The federal and state 8-hour CO standards (9 ppm and 9.0 ppm) were not exceeded. The federal and state 1-hour CO standards (35 ppm and 20 ppm) were not exceeded, either.

b) The current (2015) O3 federal standard was revised effective December 28, 2015.

c) The NO_2 federal 1-hour standard is 100 ppb and the annual standard is annual arithmetic mean NO_2 > 0.0534 ppm (53.4 ppb). The state 1-hour and annual standards are 0.18 ppm and 0.030 ppm.

d) The federal SO_2 1-hour standard is 75 ppb (0.075 ppm). The state standards are 1-hour average SO_2 > 0.25 ppm (250 ppb) and 24-hour average SO_2 > 0.04 ppm (40 ppb).

e) PM_{10} statistics listed are based on combined Federal Reference Method (FRM) and Federal Equivalent Method (FEM) data.

f) State annual average (AAM) PM_{10} standard is > 20 µg/m^3. Federal annual PM_{10} standard (AAM > 50 µg/m^3) was revoked in 2006.

g) $PM_{2.5}$ statistics listed above are for the FRM data only. FEM $PM_{2.5}$ continuous monitoring instruments were operated at some of the above locations for real-time alerts and forecasting only.

h) Both federal and state standards are annual average (AAM) > 12.0 µg/m^3.

i) Federal lead standard is 3-months rolling average > 0.15 µg/m^3; state standard is monthly average ≥ 1.5 µg/m^3. Lead standards were not exceeded.

j) State sulfate standard is 24-hour ≥ 25 µg/m^3. There is no federal standard for sulfate. Sulfate data is not available at this time.

+ High PM_{10} (≥ 155 µg/m^3) data recorded in Coachella Valley (due to high winds) and the Basin (due to Independence Day fireworks) are excluded in accordance with the U.S. EPA Exceptional Event Rule.

Attainment Status

The U.S. Environmental Protection Agency (USEPA) and the California Air Resources Board (CARB) designate air basins where ambient air quality standards are exceeded as "nonattainment" areas. If standards are met, the area is designated as an "attainment" area. If there is inadequate or inconclusive data to make a definitive attainment designation, they are considered "unclassified." National nonattainment areas are further designated as marginal, moderate, serious, severe, or extreme as a function of deviation from standards. Each standard has a different definition, or "form" of what constitutes attainment, based on specific air quality

statistics. For example, the federal 8-hour carbon monoxide (CO) standards is not to be exceeded more than once per year; therefore, an area is in attainment of the CO standard if no more than one 8-hour ambient air monitoring value exceeds the threshold per year. In contract, the federal annual particulate matter$_{2.5}$ (PM) standard is met if the three-year average of the annual average $PM_{2.5}$ concentration is less than or equal to the standard.

The current attainment designations for Orange County are shown in Table 5. The county is designated as nonattainment for the state ozone, $PM_{10,}$ and $PM_{2.5}$ standards; nonattainment for federal ozone and $PM_{2.5}$ standards; and attainment - maintenance status for the federal PM_{10} standard (see also Appendix 4: Air Quality and General Conformity Analysis).

Table 5: Orange County Attainment Designation Status

Pollutant	State Status	National Status
Ozone	Nonattainment	Extreme Nonattainment
Carbon Monoxide	Attainment	Attainment/Unclassified
Nitrogen Dioxide	Attainment	Attainment/Unclassified
Sulfur Dioxide	Attainment	Attainment
PM_{10}	Nonattainment	Attainment – Maintenance Period
$PM_{2.5}$	Nonattainment	Serious Nonattainment

Notes:
Source of state status: California Air Resources Board, 2020 State Area Designations https://ww2.arb.ca.gov/resources/documents/maps-state-and-federal-area-designations
Source of National status: U.S. Environmental Protection Agency , Greenbook. https://www3.epa.gov/airquality/greenbook/anayo_ca.html

Sensitive Receptors

Some locations are considered more sensitive to adverse effects from air pollution than others. These locations are termed sensitive receptors. For CEQA purposes, a sensitive receptor is generically defined as a location where human populations are found, and there is reasonable expectation of continuous human exposure according to the averaging period for the ambient air quality standard (e.g., 24-hour, 8-hour, and 1-hour). These typically include residences, hospitals, and schools. Residential areas are considered sensitive to poor air quality because people usually stay home for extended periods of time, with associated greater exposure to ambient air quality. Hospitals, schools, and convalescent homes are relatively sensitive to poor air quality because children, elderly people, and the infirm are more susceptible to respiratory distress and other air quality-related health problems than the public. Recreational users are also considered sensitive due to the greater exposure to ambient air quality conditions because vigorous exercise associated with recreation can place a high demand on the respiratory system.

The nearest sensitive receptors to Smith Basin are residents at the single-family homes located adjacent to the southwest, west, and north. The nearest schools are Oakridge Private School and Linda Vista Elementary School which are located adjacent to the southeast and approximately 0.25-mi southeast of Smith Basin, respectively. Regarding the Bond and Blue Diamond basins, the nearest sensitive receptors are residents at the single-family homes located adjacent to the northwest, west, south, east, and northeast. The nearest schools are Villa Park Elementary School, Prospect Elementary School, Orange County Classical Academy, El Modena High School, Santiago Charter Middle School, Orange County Classical Academy, El Modena High School, Santiago Charter Middle School, Linda Vista Elementary School, and Oakridge Private School which are located approximately 0.27-mi northwest, 0.43-mi south, 0.33-mi south, 0.59-mi south, 0.51-mi southeast, 0.39-mi east, and 0.23-mi northeast of the Bond and Blue Diamond basins, respectively. Regarding the lower Santiago Creek channel, the nearest sensitive receptors are the residents at the single-family homes located on either side of the channel and as close to the channel as approximately 35-ft. The nearest schools to the lower reach of Santiago Creek are Santiago Elementary School and Rancho Santiago Community College located approximately 0.27-mi south and 0.32-mi southeast of the channel, respectively. Other sensitive receptors within the vicinity of the lower reach of Santiago Creek include The Church of

Jesus Christ of Latter-Day Saints located approximately 0.04-mi north of the channel, Jack Fisher Park located adjacent to the north side of the channel (near North Flower Street and West Park Lane), and the Sarah May Downie Herb Garden located approximately 0.07-mi south of the channel.

3.4.2.3 Environmental Impacts

Significance Criteria

The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to air quality would be considered significant if the project would result in any of the following:

a) Conflict with or obstruct implementation of the applicable air quality plan;
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard;
c) Expose sensitive receptors to substantial pollutant concentrations; or
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people.

The CEQA thresholds of significance were obtained from supplemental information provided on the SCAQMD website. Currently the SCAQMD is in the process of developing an "Air Quality Analysis Guidance Handbook" (Handbook) to replace the 1993 CEQA Air Quality Handbook (SCAQMD, 2021a). The supplemental information available on the website lists NOx (oxides of nitrogen) threshold of 100 pounds per day (lbs/day) for construction and 55 lbs/day for operation; a PM_{10} threshold of 150 lbs/day for construction and 150 lbs/day for operation; and a $PM_{2.5}$ threshold of 55 lbs/day for construction and 55 lbs/day for operation (SCAQMD, 2021b). A quantitative analysis of effects to air quality is provided in Appendix 4: Air Quality and General Conformity Analysis.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not conflict with or obstruct implementation of the applicable air quality plan; result in a cumulatively considerable net increase of any criteria pollutant; expose sensitive receptors to substantial pollutant concentrations; or result in other emissions that would adversely affect a substantial number of people. Air quality would continue to be influenced by emissions due to the ongoing and future construction of other improvement projects, climate and geographic conditions, local and regional emissions from vehicles, and local commercial and industrial land uses.

(a) *Conflict with or obstruct implementation of the applicable air quality plan?*

No Change Alternative

Less Than Significant with Mitigation Incorporated. An Air Quality and General Conformity Analysis was performed to document determination of conformity of the No Change Alternative, meet CEQA guidelines, and determine the significance of the project on air quality and greenhouse gases (GHGs). The California Emissions Estimator Model (CalEEMod Version 2020.4.0) modelling software supported by SCAQMD estimates potential emissions from construction and operation of land use projects. CalEEMod was used to calculate the daily maximum and annual average criteria pollutant and annual GHG emissions for the project. This model uses widely accepted methodologies for estimating emissions and quantifying air quality and climate change impacts as part of CEQA initial study preparation, combining user-defined data with default data when site-specific information is not available. It can also incorporate adjustments for mitigation. Inputs include project size and location, construction schedule and phasing, equipment numbers and activity hours, vehicle trips, and material movements and

amounts. This information was derived from project-specific data for the project including the construction schedule, USACE equipment log, USACE Engineer Pamphlet (EP) 1110-1-8 December 2020 Hourly Equipment Ownership and Operating Expense tables - Region 2, and project quantities. When data are unavailable, conservative assumptions are used to develop the modeling scenario, specifications, and inputs to obtain cautious yet realistic screening estimates. The results of the General Conformity Applicability analysis indicates if the No Change Alternative conflicts with implementation of air quality plans; specifically, if project-related emissions exceed General Conformity *de minimis* levels as established in 40 CFR 93.153(b).

Criteria pollutant emissions were calculated in CalEEMod and compared to *de minimis* rates. During the final year of construction (2027), the estimated NOx emission rate (13.6 tons/year) exceeded the *de minimis* level of 10 tons/year. Volatile organic compounds (VOCs), PM_{10}, $PM_{2.5}$, and all other emissions were well below their respective *de minimis* pollutant levels each year.

Estimates were recalculated in CalEEMod assuming use of Tier 4 engines for off-road construction equipment, as well as the watering of the construction site. Results showed a significant reduction in NOx emissions to a maximum of 4.7 tons/year, and pollutants generated from construction activities were all *de minimis*. With mitigation measures (i.e., MM AQ-1 and MM AQ-2), no conformity determination is required, and the project would not obstruct SCAQMD air quality plans to achieve ozone, PM_{10}, or $PM_{2.5}$ air quality standards.

Proposed Action Alternative

Less Than Significant. An Air Quality and General Conformity Analysis was performed (Appendix 4: Air Quality and General Conformity Analysis Appendix) to document determination of conformity of the Proposed Action Alternative, meet CEQA guidelines, and determine the significance of the project on air quality and greenhouse gases (GHGs). The California Emissions Estimator Model (CalEEMod Version 2020.4.0) modelling software supported by SCAQMD estimates potential emissions from construction and operation of land use projects. CalEEMod was used to calculate the daily maximum and annual average criteria pollutant and annual GHG emissions for the project. This model uses widely accepted methodologies for estimating emissions and quantifying air quality and climate change impacts as part of CEQA initial study preparation, combining user-defined data with default data when site-specific information is not available. It can also incorporate adjustments for mitigation. Inputs include project size and location, construction schedule and phasing, equipment numbers and activity hours, vehicle trips, and material movements and amounts. This information was derived from project-specific data for the Proposed Action including the Santiago Creek Engineering Documentation Report (EDR) December 2022 Draft Construction Schedule, USACE Equipment Log dated 12/20/2022, USACE Engineer Pamphlet (EP) 1110-1-8 December 2020 Hourly Equipment Ownership and Operating Expense tables - Region 7, and project quantities. When data were unavailable, conservative assumptions are used to develop the modeling scenario, specifications, and inputs to obtain cautious yet realistic screening estimates. Additional details can be found in Appendix 4: Air Quality and General Conformity Analysis.

The results of the General Conformity Applicability analysis indicates if the Proposed Action conflicts with implementation of air quality plans; specifically, if project-related emissions exceed General Conformity de minimis levels as established in 40 CFR 93.153(b).

Criteria pollutant emissions were calculated in CalEEMod and compared to de minimis rates. No estimated pollutant emission rates exceeded the de minimis levels during either year of construction. The maximum NOx emission rate was about 58 percent of the de minimis level, while VOC, CO, SO2, PM10 and PM2.5 emissions were well below their respective de minimis pollutant levels. The project would not obstruct SCAQMD air quality plans to achieve ozone, PM10, or PM2.5 air quality standards.

Estimates were also calculated in CalEEMod assuming use of Tier 4 engines for off-road

construction equipment, as well as the watering of the construction site. Results show a significant reduction in NOx, VOC, PM10 and PM2.5 emissions with mitigation. Although CO emissions increase with Tier 4 engine use, they remain well below de minimis levels. With mitigation measures, air quality impacts would be further reduced.

(b) *Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?*

No Change Alternative

Less Than Significant with Mitigation Incorporated. SCAQMD established regional mass emission thresholds to help attain or maintain attainment of applicable criteria pollutants, and to determine if a regional air quality impact would be considered significant. The SCAQMD CEQA Handbook states that any project in the Air Basin with daily emissions that exceed any of the identified significance thresholds should be considered as having an individually and cumulatively significant air quality impact.

CalEEMod daily maximum emissions estimates were compared with SCAQMD regional criteria pollutant thresholds. No emissions exceed the SCAQMD regional thresholds with mitigation in place. However, NOx maximum daily emissions exceed the applicable regional threshold without mitigation. Therefore, with use of construction equipment meeting Tier 4 emission standards (i.e., mitigation measures MM AQ-1 and MM AQ-2), cumulatively considerable net increases in pollutants in the air basin are considered less than significant and would not increase the frequency or severity of existing or projected air quality violations or delay timely attainment of air quality standards.

Proposed Action Alternative

Less Than Significant. SCAQMD established regional mass emission thresholds to help attain or maintain attainment of applicable criteria pollutants, and to determine if a regional air quality impact would be considered significant. The SCAQMD CEQA Handbook states that any project in the Air Basin with daily emissions that exceed any of the identified significance thresholds should be considered as having an individually and cumulatively significant air quality impact.

CalEEMod daily maximum emissions estimates were compared with SCAQMD regional criteria pollutant thresholds. No emissions exceed the SCAQMD regional thresholds, even with no mitigation in place. Although the project will cause a temporary decrease in air quality, the emission increase results in a less than significant cumulatively considerable net increases in pollutants in the air basin and would not increase the frequency or severity of existing or projected air quality violations or delay timely attainment of air quality standards.

(c) *Expose sensitive receptors to substantial pollutant concentrations?*

No Change Alternative

Less Than Significant with Mitigation Incorporated. SCAQMD developed Localized Significant Thresholds (LSTs) for determining localized air quality impacts from select criteria pollutants to nearby sensitive receptors from a project. Nearby potential sensitive receptors to the project site include residents adjacent to the lower Santiago Creek channel, and Oakridge Private School adjacent to Smith Basin. Emission thresholds developed for source areas up to 5 acres and receptor distances down to 82-ft from a project site were used as a screening tool to determine if local air quality impacts could be considered significant.

CalEEMod estimated emissions for mitigated construction were compared to applicable LSTs, and no pollutant emissions from construction activity were found to exceed the thresholds. With implementation of MM AQ-1, MM AQ-2, and BMPs, sensitive receptors are not expected to be

exposed to substantial pollutant concentrations.

Proposed Action Alternative

Less Than Significant. SCAQMD developed Localized Significant Thresholds (LSTs) for determining localized air quality impacts from select criteria pollutants to nearby sensitive receptors from a project. Nearby potential sensitive receptors to the project site include residents adjacent to the lower Santiago Creek channel, and Oakridge Private School adjacent to Smith Basin. Emission thresholds developed for source areas up to 5 acres and receptor distances down to 82-ft from a project site were used as a screening tool to determine if local air quality impacts could be considered significant.

CalEEMod estimated emissions for unmitigated construction were compared to applicable LSTs, and no pollutant emissions from construction activity were found to exceed the thresholds. Implementation of mitigation measures and BMPs would further aid in the protection of receptor population health. Sensitive receptors are not expected to be exposed to substantial pollutant concentrations.

(d) *Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?*

No Change Alternative

No Impact: The project would not create objectionable odors affecting a substantial number of people. Short-term, potential sources that may emit odors directly during construction activities include the operation of construction equipment. The objectionable odors that may be produced during construction would be short-term and would not likely be noticeable for extended periods of time beyond the project areas' boundaries. Due to the transitory nature of construction odors, no direct/indirect short-term impacts associated with odors would occur and no mitigation would be required. Long-term, potential sources that may directly emit odors during operations would be related to equipment used for annual maintenance activities by the non-federal sponsor. Overall, no impacts associated with objectionable odors due to construction or operation of the project would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.2.4 Environmental Commitments

Mitigation Measures

The following mitigation measures are only applicable for the No Change Alternative. No mitigation measures are required for the Proposed Action Alternative since there are less than significant impacts to air quality.

MM AQ-1: All off-road diesel-powered equipment that is greater than 50 horsepower and utilized during implementation of the No Change Alternative shall be registered with CARB and labelled detailing that the equipment meets Tier 4 Final emissions standards.

MM AQ-2: All haul trucks utilized during implementation of the No Change Alternative shall be licensed in California and shall meet the model year 2010 (Tier 4 Final) or newer emissions

standards.

Best Management Practices
The following BMPs would be implemented during construction of the project:

Basic Construction Emission Control Practices
The construction contractor would be required to implement the following basic construction emission control practices:

- Water all exposed surfaces two times daily. Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads.
- Cover or maintain at least two feet of free board space on haul trucks transporting soil, sand, or other loose material on the site. Any haul trucks that would be traveling along freeways or major roadways should be covered.
- Use wet vacuum street sweepers to remove any visible track out mud or dirt onto adjacent public roads at least once a day. Use of dry power sweeping is prohibited.
- Limit vehicle speeds on unpaved roads to 15 miles per hour (mph).
- Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to five minutes (as required by the state airborne toxics control measure [Title 13, Section 249(d)(3) and 2485 of the California Code of Regulations]). Provide clear signage that posts this requirement for workers at the entrances to the site.
- Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated.

Enhanced Exhaust Control Practices

- Provide a plan for approval by the lead agency and SCAQMD demonstrating that the heavy-duty (50 horsepower or more) off-road vehicles to be used in the construction project, including owned, leased, and subcontractor vehicles, would achieve a project-wide fleet-average 20 percent NOx reduction and 45 percent particulate reduction compared to the most recent California Air Resources Board (ARB) fleet average. Acceptable options for reducing emissions may include use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, and/or other options as they become available. The SCAQMD's Construction Mitigation Calculator can be used to identify an equipment fleet that achieves this reduction. The subject plan would be submitted in conjunction with the equipment inventory discussed below.
- Submit to the lead agency and SCAQMD a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 hp, that would be used an aggregate of 40 or more hours during any portion of the construction project. The inventory would include the horsepower rating, engine model year, and projected hours of use for each piece of equipment. The inventory would be updated and submitted monthly throughout the duration of the project, except that an inventory would not be required for any 30-day period in which no construction activity occurs. At least 4 business days prior to the use of subject heavy-duty off-road equipment, the contractor would provide SCAQMD with the anticipated construction timeline including start date, and name and phone number of the project manager and on-site foreman. The SCAQMD's Model Equipment List can be used to submit this information.
- Ensure that emissions from all off-road diesel-powered equipment used on the project site do not exceed 40 percent opacity for more than 3 minutes in any 1 hour. Any equipment found to exceed 40 percent opacity (or Ringelmann 2.0) would be repaired immediately. Non-compliant equipment would be documented, and a summary provided to the lead agency and SCAQMD monthly. A visual survey of all in-operation equipment would be made at least weekly, and a monthly summary of the visual survey results would be submitted throughout the duration of the project, except that the monthly summary would not be required for any 30-day period in which no construction activity

occurs. The monthly summary would include the quantity and type of vehicles surveyed as well as the dates of each survey.
- If at the time of construction, SCAQMD has adopted a regulation applicable to construction emissions, compliance with the regulation may completely or partially replace this mitigation. Consultation with the SCAQMD prior to construction would be necessary to make this determination.

Fugitive Dust Emission Mitigation Measures
The construction contractor would be required to implement the fugitive dust mitigation measures listed below:

- Limit vehicle speeds on unpaved roads to 15 mph.
- Water at least every 2 hours of active construction activities or sufficiently often to keep disturbed areas adequately wet.
- Remove all visible track-out from a paved public road at any location where vehicles exit the work site. This would be accomplished using a wet sweeping by a HEPA filter-equipped vacuum device daily.
- Install one or more of the following track-out prevention measures:
    - A gravel pad to clean the tires of exiting vehicles,
    - A tire shaker,
    - A wheel wash system,
    - Pavement extending at least 50-ft from the intersection with the paved public road, or
    - Any other measure(s) as effective as the measures listed above.
- Pre-wet the grout to the depth of anticipated cuts.
- Suspend any excavation operations when wind speeds are high enough to result in emissions across the property line, despite application of other dust mitigation measures.

Enhanced Fugitive Particulate Matter (PM) Dust Control Practices
The construction contractor would be required to implement the following enhanced fugitive PM dust control practices:

- For Soil Disturbance Areas:
    - Water exposed soil with adequate frequency for continued moist soil, but do not overwater to the extent that sediment flows off the project site.
    - Suspend excavation, grading, and/or demolition activity when wind speeds exceed 20 mph.
    - Install wind breaks (ex., solid fencing) on the windward side(s) of construction areas.
    - Plant vegetative ground cover in disturbed areas as soon as possible.
- For Unpaved Roads:
    - Install wheel washers for exiting trucks or wash off all trucks and equipment leaving the site.
    - Treat site access to 100-ft from the paved road with a 6 to 12-inch layer of wood chips, mulch, or gravel to reduce generation of road dust and road dust carryout onto public roads.
    - Post a publicly visible sign with the telephone number and person to contact at the lead agency regarding dust complaints. This person would respond and take corrective action within 48 hours or receiving a complaint. The phone number of SCAQMD would also be provided on the sign to help ensure compliance.

Additional Air Quality Mitigation Measures
The USACE would also continue to implement the following mitigation measures to reduce the potential adverse air quality effects of the project. The construction contractor would be required to comply with the following:

- Model year 2010 (MY2010) or newer haul trucks would typically be used for the duration of the project. Use of these trucks would provide the best available emission controls for

NOx and PM emissions. There would potentially be occasions when the availability of MY2010 or newer haul trucks is limited, thereby forcing the need to use older trucks to meet construction schedule goals. Should a situation like this arise, the construction contractor would first be required to demonstrate that MY2010 or newer trucks are not available in the general project region before the use of older trucks is authorized by USACE.

- All off-road diesel-powered construction equipment greater than 50 hp would meet Tier-4 off-road emission standards (reference 40 CFR Part 1039), where available. In addition, if not already supplied with a factory-equipped diesel particulate filter, all construction equipment would be outfitted with Best Available Control Technology (BACT) devices certified by CARB. Any emissions control device used by the construction contractor would achieve emissions reductions that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations. If a certain tier engine is not available for any off-road equipment larger than 50 hp, that equipment would be equipped with the next lower tier engine (e.g., if Tier 3 is not available use Tier 2), or an engine that is equipped with retrofit controls to reduce exhaust emissions of NOx and diesel PM to no more than the next available tier, unless certified by engine manufacturers that the use of such devices is not practical for specific engine types. If the construction contractor proposes to use off-road diesel-powered construction equipment greater than 50 hp that does not meet Tier 4 off-road emissions standards, such usage would first have to be approved by the USACE.
- Construction equipment would incorporate emissions-reducing technology such as specific fuel economy standards. Idling would be restricted to a maximum of 5 minutes, except as provided in the CARB 13CCR, Section 2485 exceptions.

3.4.3 Biological Resources

3.4.3.1 Regulatory Background

- Federal Endangered Species Act
- Fish and Wildlife Coordination Act
- Federal Clean Water Act
- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- Magnuson-Stevens Fishery Conservation and Management Act
- CEQA
- California Endangered Species Act
- California Fish and Game Code, Section 1600
- California Fish and Game Code Fully Protected Species
- California Fish and Game Code Section 3503, 2505, 3513, 3800, 3801
- California Native Plant Protection Act

3.4.3.2 Existing Conditions

Vegetation Communities

Vegetation communities were mapped during site visits on January 12 and 26, 2022 (Aspen Environmental Group, 2022). These boundaries were then digitized into GIS shapefiles. Vegetation maps were field verified for accuracy on March 3, 2022. Vegetation was classified according to the Manual of California Vegetation (Sawyer et al., 2009). It's important to note that native and disturbed communities are at times interspersed. Therefore, breaks in community type are determined based on dominant species type and professional judgment of the biologist surveying. There are a total of 14 vegetation and other cover types within the project area. Maintenance roads and trails have been included in the developed cover type. Vegetation within the Proposed Action area consists of riparian and wetland vegetation, upland vegetation, and other land cover types. The riparian and wetland vegetation communities in the project area are

considered sensitive habitat types for their part in the ecological function of the watershed. These communities play important roles in the life histories for a broad diversity of both common and special status wildlife species. While non-native habitats are not protected, these communities still provide important foraging and refugia habitat for a variety of sensitive wildlife species.

The 14 vegetation and other cover types within the project area are described in detail below and acreages of the vegetation and land cover areas are presented in Table 6 and shown in Figure 13 through Figure 15.

Table 6: Vegetation and Other Cover Types on the Project Site (Acres)

Vegetation Type	**Project Site (Acres)**
Blue elderberry thickets	1.84
Brittle bush scrub	16.57
California live oak woodland and forest	0.38
California sagebrush – black sage scrub	35.90
Fountain grass swards	5.58
Goodding's willow – red willow riparian woodland and forest	21.73
Laurel sumac scrub	6.10
Mulefat thickets	4.49
Upland mustards or star-thistle fields	2.00
Wild oats and annual brome grasslands	3.78
Eucalyptus – tree of heaven – black locust groves	8.29
Other Cover Types	**Project Site (Acres)**
Open water	175.77
Unvegetated channels and slopes	10.43
Developed	36.73
Total	**329.59**

Riparian and Wetland Vegetation Types

Goodding's willow – red willow riparian woodland and forest (Salix gooddingii – Salix laevigata Forest and Woodland Alliance): Gooding's willow – red willow riparian woodland and forest are a winter deciduous woodland that are dominated by Goodding's willow (*Salix gooddingii*). Additional species such as Pacific willow (*Salix lasiandra*), red willow (*Salix laevigata*), California sycamore (*Platanus racemosa*), and mulefat (*Baccharis salicifolia*) are also present. Goodding's willow – red willow riparian woodland and forest are present along Santiago Creek in the northern portion of the project site and are the dominant cover type in the seasonally inundated portions of Smith Basin. They are also present in isolated locations around Bond and Blue Diamond basins and are abundant near the earthen overflow channel. Goodding's willow – red willow riparian woodland and forest have a State Rank of S3 and are therefore recognized as a sensitive natural community by CDFW (CDFW, 2021).

Mulefat thickets (Baccharis salicifolia Shrubland Alliance): Mulefat thickets are a winter deciduous shrubland that are dominated by mulefat. Additional species such as oleander (*Nerium oleander*), coyote brush (*Baccharis pilularis*), and shrubby willows (*Salix* spp.) are also present. Mulefat thickets are present along Santiago Creek in the northern portion of the project site and around the margins of the Santiago Recharge Basins. Mulefat thickets have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Although there are riparian and wetland vegetation types present within Smith Basin and portions of the Blue Diamond and Bond basins, there are no federal jurisdictional wetlands within either project footprint. This is based on the conclusions of the Aquatic Resources Delineation Report (Appendix 1) and how USACE Regulatory defines wetlands versus Waters of the United States. Specifically, all of the riparian and wetland vegetation is located below the OHWM and thus falls

within the federal jurisdiction of the Waters of the U.S., rather than being identified as a wetland. Impacts to the areas falling within Waters of the U.S. are described in detail in the Section 404(b)(1) analysis in Appendix 3.

Upland Vegetation Types

Blue elderberry thickets (Sambucus nigra ssp. caerulea Provisional Shrubland Alliance): Although not defined as a vegetation type in the current online version of *A Manual of California Vegetation*, blue elderberry thickets are present in the project area. This vegetation is dominated by blue elderberry (*Sambucus nigra* ssp. *caerulea*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species. Within the project area coyote brush and Peruvian pepper tree (*Schinus mole*) are also present. Blue elderberry thickets are present in the uplands near Santiago Creek in the northern portion of the project area and in the upland east of the Santiago Recharge Basins. Blue elderberry thickets do not have a State Rank and therefore is not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Brittle bush scrub (Encelia farinose Shrubland Alliance): Brittle bush scrub is a type of coastal sage scrub vegetation that is dominated by brittle bush (*Encelia farinosa*). Additional species such as coastal sage brush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (Salvia mellifera), giant wild rye (*Elymus condensatus*), and Laurel sumac (*Malosma laurina*) are also present in low numbers. Within the project site it appears that all the brittle bush scrub was planted for mitigation. It is unclear if brittle bush is native to the project area. Brittle bush scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

California sagebrush – black sage scrub (Artemisia californica – Salvia mellifera Shrubland Alliance): California sagebrush – black sage scrub is a type of coastal sage scrub that is dominated by coastal sage brush. Within the project area, black sage is uncommon, but the vegetation still matches this description the best. Additional species such as sweetbush (*Bebbia juncea*) and California buckwheat are also present. Within the project area it appears that all the California sagebrush – black sage scrub has been planted for mitigation. California sagebrush – black sage scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Coast live oak woodland and forest (Quercus agrifolia Forest and Woodland Alliance): Coast live oak woodland and forest are dominated by coast live oaks (*Quercus agrifolia*). Within the project area, the coast live oak woodland and forest is limited to several patches along Santiago Creek Channel, in the vicinity of north Flower Street. The understory vegetation includes non-native ornamental species such as Canary ivy (*Hedera canariensis*). Coast live oak woodland and forest have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Eucalyptus – tree of heaven – black locust groves (Eucalyptus spp. – Ailanthus altissima – Robinia pseudoacacia Woodland Semi-Natural Alliance): Eucalyptus – tree of heaven – black locust groves are used to map all vegetation dominated by non-native trees within the project site including gum trees (*Eucalyptus* spp.), Peruvian pepper trees, yew plum pine (*Podocarpus macrophyllus*), prairie sumac (*Rhus lanceolata*), and many others. Native tree species such as California sycamore and coast live oak may also be present but generally represent single trees. Eucalyptus – tree of heaven – black locust groves have a State Rank of SNA (Not Applicable) and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Fountain grass swards (Pennisetum setaceum – Pennisetum ciliare Herbaceous Semi-Natural Alliance): Fountain grass swards are a non-native grassland dominated by fountain grass (*Pennisetum setaceum*), a robust perennial bunchgrass. Other non-native species such as gazania (*Gazania linearis*) and mustard (*Hirschfeldia incana*), are also present on the large, landscaped slope to the north of Smith Basin and along the eastern slope of the Bond and Blue

Diamond basins. Fountain grass swards have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Laurel sumac scrub (Malosma laurina Shrubland Alliance): Laurel sumac scrub is dominated by Laurel sumac (*Malosma laurina*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species such as coastal sage bush and California buckwheat. Additional species such as tamarisk (*Tamarix* sp.) are also present. Laurel sumac scrub is present in the upland surrounding Santiago Creek, Smith Basin, and Bond and Blue Diamond basins. Laurel sumac scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland mustards or star-thistle fields (Brassica nigra – Centaurea (solstitialis, melitensis) Herbaceous Semi-Natural Alliance): Upland mustards or star-thistle fields are a non-native plant community and within the project area are dominated by black mustard (*Brassica nigra*). Other non-native species are also present including white horehound (*Marrubium vulgare*), talcote (*Centaurea melitensis*), fennel (*Foeniculum vulgare*), and others. This vegetation type is present in previously disturbed portion of the updates surrounding the Bond and Blue Diamond basins. Upland mustards or star-thistle fields have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Wild oats and annual brome grasslands (Avena spp. – Bromus spp. Herbaceous Semi-Natural Alliance): This grassland vegetation is dominated by a variety of non-native grasses such as wild oat (*Avena* spp.), ripgut brome (*Bromus diandrus*), and red brome (*Bromus rubens*). Non-native herbs are also present including Bermuda buttercup (*Oxalis pes-caprae*), fine leaved fumitory (*Fumaria parviflora*), mustard, and others. Wild oats and annual brome grasslands are present in disturbed sites within the project area, especially around the perimeter of the site adjacent to residential development. Wild oats and annual brome grasslands have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Other Land Cover Types

Developed: This cover type includes disturbed and developed areas within the project area including paved roads, unpaved roads, buildings, residential areas, and other unvegetated areas. It also includes a large area in the central portion of Bond and Blue Diamond basins that was recently impacted by construction activities. Developed is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Open water: Open water is used to map portions of the project site that had surface water present during early 2022. This included the Santiago Recharge Basins. The water depths in these basins' changes throughout the year and most of the open water in these basins will eventually become dry in the late summer and fall. Open water is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Unvegetated channels and slopes: This cover type includes flood control channels, unvegetated slopes, and other maintained areas within the project area. Vegetation is either absent or very sparse. Unvegetated channels and slopes is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW, 2021).



Figure 13: Vegetation Communities within the Project Area (Lower Santiago Creek Channel).



Figure 14: Vegetation Communities within the Project Area (Blue Diamond and Bond Basins).

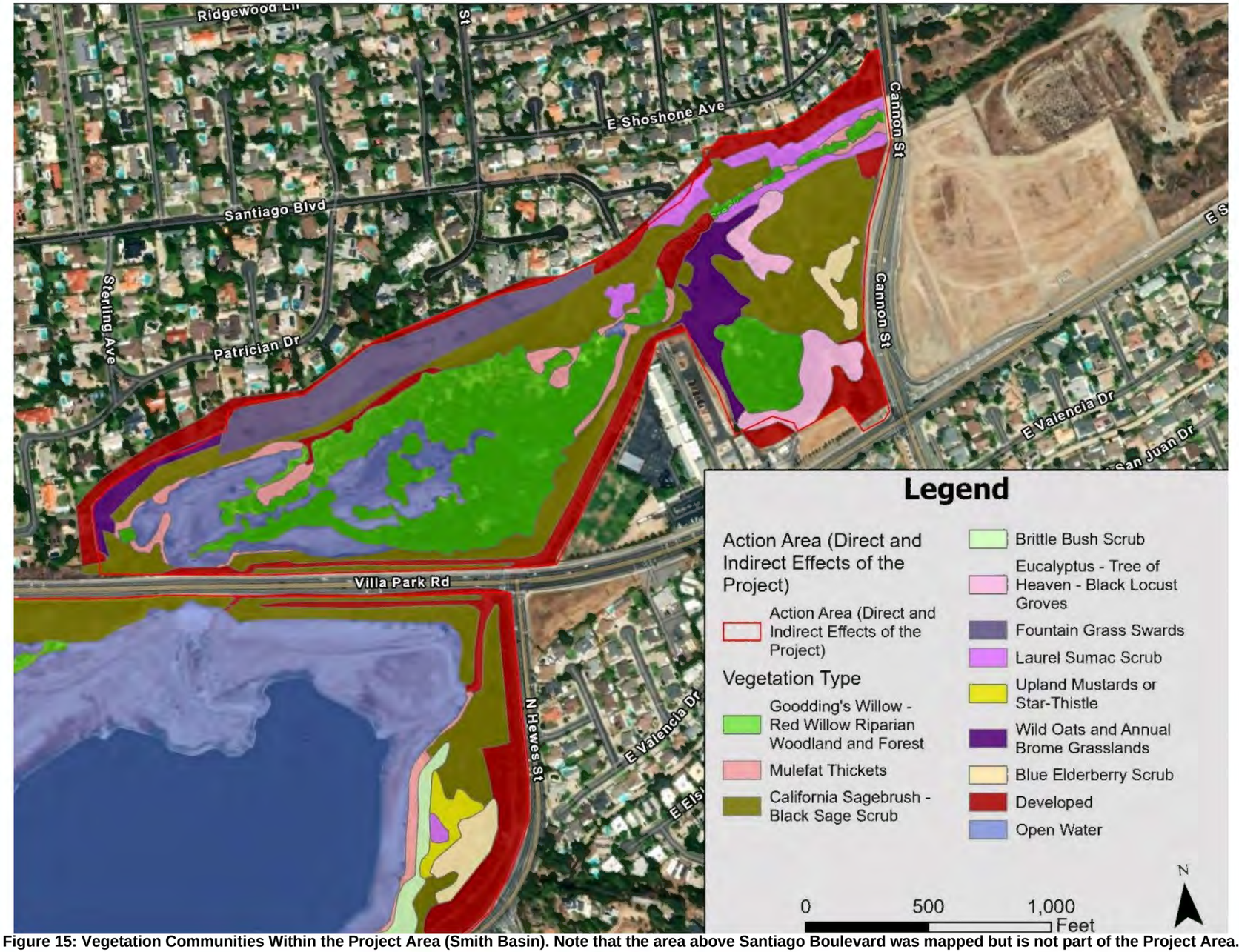


Figure 15: Vegetation Communities Within the Project Area (Smith Basin). Note that the area above Santiago Boulevard was mapped but is not part of the Project Area.

Special Status Plant Species

A complete list of the special status plant communities with the potential to occur in the project area is provided in Table 7. The table includes scientific nomenclature, regulatory status, habitat requirements, and the potential to occur. A database search of special status plant species listed in the California Native Plant Society (CNPS) Online Survey of Rare Plants (CNPS, 2021), FWS Information for Planning and Consultation (IPaC) Database, and the CDFW Natural Diversity Data Base (CNDDB) for the Orange and Anaheim USGS 7.5' Quadrangle was conducted to determine the potential for special status plant species to occur. After the database search, USACE contracted a field survey of the project area to determine the presence of any special status species or habitat. Based on the database search and site surveys, the potential for the species to occur within the project area was determined. The determination regarding the potential occurrence of the species was based on the following criteria:

Present: The species is commonly observed or observed within the project area within the last year.

High: The project area supports suitable habitat, and the species has been observed within the last 2 years.

Moderate: The project area supports suitable habitat, and the species has not been observed within the last 2 years.

Low: The project area lacks suitable habitat for the species, or the species has not been observed for over 5 years.

Table 7: Sensitive Plant Species List with Potential of Occurring in Project Area (Source: Aspen Environmental Group, 2022).

Species	Conservation Status	Flowering or Activity Season	Habitat Requirements	Potential to Occur
Braunton's milk-vetch *Astragalus brauntonii*	Fed: **END** CA: 1B.1, S2	Jan-Aug	Fire adapted plant that requires fire and other disturbances to propagate. Occurs in recently burned or disturbed areas in chaparral, coastal scrub and valley and foothill grasslands, sea level to about 2,000 ft. elevation; Los Angeles, Orange, and Ventura Counties.	**Low**; not observed, marginally suitable habitat is present; known from within 4.5 miles.
Malibu baccharis *Baccharis malibuensis*	Fed: None CA: 1B.1, S1	Aug	Occurs in chaparral habitats and grassy openings, cismontane woodlands, coastal scrub and riparian; 500-1,000 ft. elevation; Los Angeles, Orange, and Ventura Counties.	**Low**; not observed, marginally suitable habitat is present; known from within 6 miles.
Catalina mariposa lily *Clochettes catalinae*	Fed: None CA: 4.2, S3S4	Feb-Jun	Perennial herb (bulb); chaparral, woodlands, coastal sage scrub, and grasslands with heavy soils; 50-2,300 ft. elevation; Riverside County north to Santa Barbara County.	**Moderate**; not observed, marginally suitable habitat is present; known from within 1 mile.
Plummer's mariposa-lily *Calochortus plummerae*	Fed: None CA: 4.2, S4	May-Jul	Occurs in chaparral, cismontane woodland, coastal scrub, valley and foothill grassland; 300-5,600 ft. elevation; Ventura and Riverside counties south to San Diego County.	**Low**; no observed, marginally suitable habitat is present; known from within 7 miles.
Intermediate mariposa-lily *Calochortus weedii* var. *intermedius*	Fed: None CA: 1B.2, S3	May-Jul	Occurs on dry, rocky slopes of coastal scrub, chaparral and valley and foothill grasslands; 350-2,800 ft. elevation; Los Angeles, Orange, Riverside, and San Bernardino counties.	**Moderate**; not observed, suitable habitat is present upstream of Smith Basin; known from within 1.5 miles.
Lucky morning-glory *Calystegia felix*	Fed: None CA: 1B.1, S1	Mar-Sep	Occurs on gentle alluvial slopes with silty loam soils and coastal swamps, riparian, and wetlands; 100-700 ft. elevation; Santa Barbara County south to San Diego County and Baja, California.	**Low**; not observed, marginally suitable habitat is present; known from within about 14 miles.
Southern tarplant *Centromadia parryi ssp. australis*	Fed: None CA: 1B.1, S2	May-Nov	Occurs in mesic grasslands, vernal pools, and various marsh habitats, sea level to about 1,500 ft. elevation; Santa Barbara County south to San Diego County and Baja, California.	**Moderate**; not observed, marginally suitable habitat is present, known from within 0.5 miles.
Many-stemmed dudleya *Dudleya multicaulis*	Fed: None CA: 1B.2, S2	Apr-Jul	Occurs in coastal plains, chaparral often in clay soils and sandstone outcrops; 50-2,600 ft. elevation; Los Angeles and San Bernardino counties south to San Diego County.	**Moderate**; not observed, suitable habitat is present upstream of Smith Basin;

Species	Conservation Status	Flowering or Activity Season	Habitat Requirements	Potential to Occur
				known from within 0.5 miles.
Mesa horkelia *Horkelia cuneata var. puberula*	Fed: None CA: 1B.1, S1	Feb-Jul (Sep)	Dry, sandy, coastal chaparral, and cismontane woodland; 200-2,700 ft. elevation; San Luis Obispo County south to San Diego County.	**Low**; not observed, marginally suitable habitat is present; known from within 7 miles.
Southern California black walnut *Juglans californica*	Fed: None CA: 4.2, S4	Mar-Aug	Small tree; chaparral, woodlands, coastal scrub, and riparian woodlands; 165-3000 ft. elevation; San Diego County north throughout much of coastal California.	**Present**; two individuals observed upstream of Smith Basin, additional individuals likely present.
Robinson's pepper grass *Lepidium virginicum var. robinsonii*	Fed: None CA: 4.3, S3	Jan-Jul	Chaparral and coastal sage scrub; sea level to about 2,900 ft. elevation; Los Angeles and San Bernardino counties south to San Diego County.	**Low**; not observed, marginally suitable habitat is present; known from within 4.5 miles.
Chaparral nolina *Nolina cismontana*	Fed: None CA: 1B.2, S3	(Mar) May-Jul	Dry chaparral and coastal sage scrub of coastal mountains; 450-4,200 ft. elevation; Los Angeles, Orange, Riverside, San Diego, and Ventura counties.	**Low**; not observed, marginally suitable habitat is present; known from within 6 miles.
Allen's pentachaeta *Pentachaeta aurea ssp. allenii*	Fed: None CA: 1B.1, S1	Mar-Jun	Coastal scrub openings, valley, and foothill grasslands; 250-1,700 ft. elevation; endemic to Orange County.	**Low**; not observed, marginally suitable habitat is present; known from within 8 miles.
White rabbit-tobacco *Pseudognaphalium leucocephalum*	Fed: None CA: 2B.2, S2	(Jul) Aug-Nov (Dec)	Chaparral, coastal scrub, and riparian woodlands. Sandy or gravelly beaches, dry stream bottoms, canyon bottoms; sea level to about 7,000 ft. elevation; much of southern California and east into Arizona, New Mexico, and Texas.	**Low**; not observed, marginally suitable habitat is present; known from within 6 miles.
Coulter's matilija poppy *Romneya coulteri*	Fed: None CA: 4.2, S4	Mar-Jul	Chaparral and coastal scrub, often in burned areas, 65-4,000 ft. elevation; San Diego County north throughout much of coastal southern California.	**Present**; several individuals planted along Hewes Street along east side of Santiago Recharge Basins.

Conservation Status
Federal Designations (FED): (federal ESA, FWS)
END: Federally listed, endangered
THR: Federally listed, threatened
Candidate: Sufficient data are available to support federal listing, but not yet listed.
Proposed: Formally proposed for the federal status shown.
State Designations (CA): (CESA, CDFW)

Species	Conservation Status	Flowering or Activity Season	Habitat Requirements	Potential to Occur
END: State listed, endangered. THR: State listed, threatened. CAND: Sufficient data area available to support federal listing, but not yet listed. RARE: State listed as rare (applied only to certain plants). CSC: California Species of Special Concern. Considered vulnerable to extinction due to declining numbers, limited geographic ranges, or ongoing threats. WL: Species that were either previously listed as SC and have not been state listed under CESA; or were previously state or federally listed and now are on neither list; or are on the list of "Fully Protected" species. FP: Fully protected. May not be taken or possessed without permit from CDFW. *CDFW Natural Diversity Data Base Designations: Applied to special-status plants and sensitive plant communities; where correct category is uncertain, CDFW uses two categories or question marks.* S1: Fewer than 6 occurrences or fewer than 1000 individuals or less than 2000 acres. S1.1: Very threatened. S1.2 Threatened. S1.3: No current threats known. S2: 6-20 occurrences or 1,000-3,000 individuals or 2,000-10,000 acres (decimal suffixes same as above). S3: 21-100 occurrences of 3,000-10,000 individuals or 10,000-50,000 acres (decimal suffixes same as above). S4: Apparently secure in California; this rank is clearly lower than S3 but factors exist to cause some concern, i.e., there is some threat or somewhat narrow habitat. No threat rank. S5: Demonstrably secure or ineradicable in California. No threat rank. SH: All California occurrences historical (i.e., no records in > 20 years). SX: Presumed extirpated in California. *California Rare Plant Rank Designations. Note: According to the California Native Plant Society (http://www.cnps.org/cnps/rareplants/ranking.php), plants ranked as CRPR 1A, 1B, and 2 meet definitions as threatened or endangered and are eligible for state listing. That interpretation of the state Endangered Species Act is not in general use.*				

Federal- and State-Listed Plant Species
An official species list for the lower Santiago Creek channel (Project Code: 2023-0019345) and the Santiago Recharge Basins (Project Code: 2023-0019344) was obtained from the FWS IPaC website. In addition, CDFW and CNPS maintain lists of plants of conservation concern. The CDFW compiles these species including CDFW and CNPS rankings as CRPR 1, 2, 3, or 4 in its compendium of "Special Plants" (CDFW, 2022b). These plants are treated here as "special-status species." Two additional high-priority special-status plants (i.e., CRPR 1B) have at least a moderate potential to be present (Table 7). Several CRPR 4 species were observed or have a potential to be present and are discussed below.

Ventura Marsh Milk-vetch
The Ventura marsh milk-vetch is a federally listed endangered species. This species of plant occurs in low-elevation coastal dune-swale areas where freshwater levels (in the form of saturate soils or groundwater) are high enough to reach the roots of the plants (FWS, 2010a). The species was presumed extinct from southern California when surveys did not detect the species in the 1970's and 1980's. However, the species was rediscovered in 1997 in a degraded coastal dune system near Oxnard, California. Since the species rediscovery in 1997, it has been reintroduced to three locations in Ventura County and two locations in Santa Barbara County (FWS, 2010a). Based on there being no preferred habitat within the vicinity of the project area the probability of this species being within the project area is low.

California Rare Plant Ranked Species
Six special-status plants have a potential to occur in the project area based on suitable habitat, soil types, and known ranges. These include:

- Southern tarplant (*Centromadia parryi ssp. australis*) - Moderate
- Many stemmed dudleya (*Dudleya multicaulis*) - Moderate
- Intermediate mariposa-lily (*Calochortus weedii* var. *intermedius*) - Moderate
- California black walnut (*Juglans californica*) - Present
- Coulter's matilija poppy (*Romenya coulteri*) - Present
- Catalina mariposa lily (*Calochortus catalinae*) - Moderate

Southern tarplant
Southern tarplant has a CRPR of 1B.1 (CDFW, 2022a). It is an annual that grows in mesic native grasslands, vernal pools, seasonal marshes, and coastal marshes (CDFW, 2022a). It is known from 94 occurrences in California, about 46 of which are known from within the last 20 years (CNPS, 2022). These occurrences extend from Santa Barbara County south into San Diego County and Baja California (CDFW, 2022a). Southern tarplant was not observed within the project site but was reported in 2003 less than 0.5 miles upstream of Cannon Street in the vicinity of Santiago Creek (CCH, 2022). Marginally suitable habitat for southern tarplant is present and there is a moderate potential for this species to be present.

Many stemmed dudleya
Many stemmed dudleya has a CRPR of 1B.2 (CDFW, 2022a). It is an ephemeral perennial that grows on heavy soils and rocky outcrops in coastal sage scrub. It is known from approximately 154 occurrences that stretch from Ventura and Los Angeles counties south to San Diego County (CDFW, 2022a). Many stemmed dudleya was not observed within the project site but has a moderate potential to be present in the coastal sage scrub habitat upstream of Smith Basin within 0.15 miles of Cannon Street.

Intermediate mariposa-lily
Intermediate mariposa-lily has a CRPR of 1B.2 (CDFW, 2022a). It is a perennial bulb that grows on steep slopes and cliffs in coastal sage scrub. It is known from approximately 194 occurrences primarily within Los Angeles, Riverside, and Orange counties (CDFW, 2022a). Intermediate mariposa-lily was not observed within the project site but has a moderate potential to be present on the exposed slopes within the coastal sage scrub habitat upstream of Smith Basin within about

0.2 miles from Cannon Street.

California Rare Plant Rank (CRPR) 4 Species
Two CRPR 4 species (i.e., a "watch list," not indicating rarity) were found during biological surveys including southern California black walnut (Juglans californica) and Coulter's matilija poppy (*Romneya coulteri*). Two southern California black walnut trees were observed along Santiago Creek upstream of Smith Basin and several planted Coulter's matilija poppy were observed along Hewes Street in ornamental landscaped areas. Several additional planted Coulter's matilija poppy were observed within restored coastal sage scrub habitat near East Bond Avenue and Prospect Avenue. One additional CRPR 4 species, Catalina mariposa lily (*Calochortus catalinae*) has a moderate potential to be present in the uplands upstream of Smith Basin.

Survey Results
Two special-status plants including Southern California black walnut and Coulter's matilija poppy were observed on the project site. In addition, several additional special-status species have at least a moderate potential to be present and include many stemmed dudleya, intermediate mariposa-lily, and Catalina mariposa lily.

One sensitive natural community was also present within the project site and includes Goodding's willow – red willow riparian woodland and forest, is present on the project site.

Wildlife
The project area contains both riparian and upland habitat for wildlife. Riparian communities support some of the most diverse assemblages of wildlife and provide access to water, shade, and cover. In addition, riparian systems and wetlands are frequently considered one of the most productive forms of wildlife habitat in North America. Portions of Santiago Creek support extensive riparian and aquatic habitat. Many bird species are wholly or partially dependent on riparian plant communities to perpetuate their kind (Warner et al., 1984). In the project area the vegetation is also critical to many aquatic and semi-aquatic wildlife species that rely on adjacent terrestrial habitats to complete their life cycles (Semlitsch and Bodie, 2003; Burke and Gibbons, 1995). Riparian vegetation provides necessary foraging and nesting habitat for many bird species (Rottenborn, 1999; Bolger et al., 1997).

The riparian and upland habitats that occur within the project area provide habitat for a variety of resident and migratory wildlife species, including several special-status species. Of particular importance are riparian and reservoir areas that provide potential habitat for least Bell's vireo (LBVI) and coastal California gnatcatcher (CAGN).

The development surrounding the riparian portion of the project area makes it part of a key movement corridor and/or dispersal habitat for a number of wildlife species that use Santiago Creek to connect to other areas within the watershed and/or within the Santa Ana River watershed. Continuous riparian riverine habitat is located primarily upstream of the Santiago Recharge Basins, increasing the likelihood of wildlife presence within the project area and directly adjacent. Some species, such as mourning dove and northern mockingbird, are positively correlated with urbanization, but most species are negatively correlated with urbanization and prefer to inhabit undeveloped areas. Factors associated with urbanization that are expected to contribute to lower species richness and densities in riparian zones near developed areas include an increase in the number of domestic cats (Rottenborn, 1997), an increase in people recreating in riparian areas, noise, collision on roads, and movement of people and domestic animals (Rottenborn, 1999). Therefore, the frequency of human visitation along Santiago Creek and along the Santiago Creek Bike Trail may adversely affect wildlife use in the project area to some degree. Several studies have documented the effects of pedestrian traffic on birds (Nowakowski, 1994; Fernandez-Juricic, 2000; Miller and Hobbs, 2000), but, as with development generally, species vary in their sensitivity to this type of disturbance.

Special Status Wildlife Species

Special-status wildlife for this SEA/IS/MND include those listed as threatened or endangered under the federal or California Endangered Species Acts, species proposed for listing, species of special concern, and other species which have been identified by the FWS and CDFW. A database search of special status wildlife species listed in the FWS IPaC Database, and the CDFW CNDDB for the Orange and Anaheim USGS 7.5' Quadrangle was conducted to determine the potential for special status plant and wildlife species to occur. After the database search, the USACE contracted a field survey of the Proposed Action area to determine the presence of any special status species or habitat within the study area (Aspen Environmental Group, 2022). Based on the database search and project site surveys, the potential for the species to occur on the project sites was determined. A complete listing of special status plant and wildlife species with potential to occur within the study area is shown in Table 8. The determination regarding the potential occurrence of the species was based on the following criteria:

Present: The species is commonly observed or observed within the project area within the last year.

High: The project area supports suitable habitat, and the species has been observed within the last 2 years.

Moderate: The project area supports suitable habitat, and the species has not been observed within the last 2 years.

Low: The project area lacks suitable habitat for the species, or the species has not been observed for over 5 years.

Table 8: Sensitive Wildlife and Aquatic Species List with Potential of Occurring in Project Area.

Species	Conservation Status	Activity Season	General Habitat	Potential to Occur
INSECT				
Crotch bumble bee *Bombus crotchii*	Fed: None CA: S1S2	Spring-Summer	Colonial insect; open grassland and scrub; underground colonies, often in old rodent burrows. Many food plants including *Chaenactis*, *Lupinus*, *Phacelia*, *Salvia*, and *Eriogonum*. Much of southern and central California, southwest Nevada, and Baja.	**High**; not observed, suitable habitat and food plants present; known from within 3 miles.
Monarch butterfly – California overwintering population *Danaus plexippus* pop. 1	Fed: **CAN** CA: S2S3	Year-round	Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby. Closed-cone coniferous forest.	**High**; not observed, likely to be present however they are unlikely to overwinter this far inland.
FISH				
Santa Ana sucker *Catostomus santaanae*	FED: **THR** CA: S1, CSC	Year-round	Major cismontane stream systems in southern California including Santa Ana River, formerly below about 3,000 ft elevation; extant populations near Riverside and downstream. Critical habitat is located about 6 miles downstream of the project site.	**Low**; not observed, only potential in Santiago Creek channel during periods of heavy flow.
Steelhead – southern California DPS *Oncorhynchus mykiss* irideus pop. 10	Fed: **END** CA: **CAN**, S1	Year-round	Federal listing refers to populations from Santa Maria River south to southern extent of range (San Mateo Creek in San Diego County).	**Low**; not observed, only potential in Santiago Creek channel during periods of heavy flow.
Santa Ana speckled dace *Rhinichthys osculus* ssp. 8	Fed: None CA: S1, CSC	Year-round	Endemic to Santa Ana and San Gabriel River watersheds, historically in Big Tujunga Canyon Santa Ana River populations in lower San Bernardino Mountain foothills and washes.	**Moderate**; not observed, suitable habitat present upstream of Smith Basin, known from within 10 miles.
REPTILES				
Southern California legless lizard *Anniella stebbinsi*	Fed: None CA: S3, CSC	Spring-Summer	Occurs in a variety of habitats, chaparral, coastal scrub generally in moist, loose soil.	**Low**; not observed, marginally suitable habitat in uplands upstream of Smith Basin.
California glossy snake *Arizona elegans occidentalis*	Fed: None CA: S2, CSC	Feb-Nov	Generalist occurring in a range of scrub and grassland habitats, often with loose or sandy soils.	**Low**; not observed, marginally suitable habitat in uplands upstream of Smith Basin.

Species	Conservation Status	Activity Season	General Habitat	Potential to Occur
Orange-throated whiptail *Aspidoscelis hyperythra*	Fed: None CA: S2S3, WL	Year-round	Prefers washes and other sandy areas with patches of brush and rocks. Perennial plants necessary for its major food source; termites.	**High**; not observed, suitable habitat present, known from within 1 mile.
Coastal whiptail *Aspidoscelis tigris stejnegeri*	Fed: None CA: S3, CSC	Year-round	Occurs in deserts and semi-arid areas with sparse vegetation in firm soil, sandy, or rocky soils.	**High**, not observed, suitable habitat present, known from within 1 mile.
Red-diamond rattlesnake *Crotalus ruber*	Fed: None CA: S3, CSC	Spring-Summer	Prefers coastal sage scrub, rocky hillsides, and lower woodlands.	**Moderate**; not observed, suitable habitat present, known from within 4 miles.
Western pond turtle *Emys marmorata*	Fed: None CA: S3, CSC	Spring-Summer	Inhabits permanent or nearly permanent bodies of water in various habitat types; requires basking sites such as partially submerged logs, vegetation mats, or open mud banks.	**Low**; minimally suitable habitat; likely to be present in the vicinity.
Coast horned lizard *Phrynosoma blainvillii*	Fed: None CA: S3S4, CSC	Temp dependent	Forest, shrubland or grassland; sandy soils; western California from Los Angeles County south through northern Baja California, below about 6,000 ft elevation.	**Moderate**; not observed, suitable habitat present, known from within 5 miles.
Coast patch-nosed snake *Salvadora hexalepis virgultea*	Fed: None CA: S2S3, CSC	Year-round	Burrows in loose soil in semi0arid bushy areas and chaparral in canyon, rocky hillsides, and plains.	**Low**; not observed, suitable habitat present, known from within 8 miles.
Two-striped gartersnake *Thamnophis hammondii*	Fed: None CA: S3S4, CSC	Year-round	Riparian and wetland habitat below about 7,000 ft. elevation; coastal California from southern San Joaquin Valley to northwestern Baja California.	**Low**; not observed, suitable habitat present, known from within 10 miles.
BIRDS				
Cooper's hawk *Accipiter cooperii*	Fed: None CA: S4, WL	Year-round	Woodland, chiefly of open, interrupted, or marginal type; nest sites mainly in riparian growths of deciduous trees.	**Present**; suitable foraging and nesting habitat throughout.
Tricolor blackbird *Agelaius tricolor*	Fed: None CA: THR, S1S2, CSC	Year-round	Highly colonial species; requires open water, protected nesting substrate, and foraging areas with insect prey within a few kilometers of colony.	**Low**; not observed, minimally suitable habitat present, known from within 10 miles.
Southern California rufous-crowned sparrow *Aimophila ruficeps canescens*	Fed: None CA: S3, WL	Spring-Summer	Arid and steep rocky areas chaparral and coastal sage scrub including low grasses and shrubs.	**High**; not observed, suitable habitat present, known from within 1 mile.

Species	Conservation Status	Activity Season	General Habitat	Potential to Occur
Grasshopper sparrow *Ammodramus savannarum*	Fed: None CA: S3, CSC	Spring-Summer	Favors native grasslands with a mix of grasses, forbs, and scattered shrubs. Loosely colonial when nesting.	**Low**, not observed, marginally suitable habitat present, known from within 5 miles.
Golden eagle *Aquila chrysaetos*	Fed: **BGEPA** CA: S3, FP	Year-round	Forages in open grasslands, desert scrub and agricultural fields. Nests on ledges on cliff faces, rock outcrops, and occasionally in large trees.	**Minimal** (nesting); **Moderate** (foraging only); no suitable nesting habitat; observed on site in 2011.
Great blue heron *Ardea herodias*	Fed: None CA: S4	Year-round	Rookery sites in close proximity to foraging areas; marshes, lake margins, tide-flats, rivers and streams, wet meadows.	**Moderate** (nesting); **Present** (foraging only); multiple individuals observed foraging, suitable nesting habitat present.
Long-eared owl *Asio otus*	Fed: None CA: S3 CSC	Year-round	Riparian bottomlands grown to tall willows and cottonwoods; also, belts of live oak paralleling stream courses.	**Minimal** (nesting); **Low** (foraging only); no suitable nesting habitat; marginal foraging habitat, known within 10 miles.
Burrowing owl *Athene cunicularia*	Fed: None CA: S3, CSC	Year-round	Nests mainly in rodent burrows, usually in open grassland or shrubland; forages in open habitat; increasingly uncommon in southern California; through western United States and Mexico.	**Low** (nesting); **Moderate** (foraging only); limited suitable nesting habitat; marginal foraging habitat, known within 5 miles.
Ferruginous hawk *Buteo regalis*	Fed: None CA: S3S4, WL	Year-round	Open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon and juniper habitats.	**Minimal** (nesting); **Low** (foraging only); not within nesting range, suitable foraging habitat, known within 10 miles.
Swainson's hawk *Buteo swainsoni*	Fed: None CA: THR, S3	Year-round	Grasslands with scattered trees, juniper-sage flats, riparian areas, and agricultural lands.	**Minimal** (nesting); **High** (foraging only); not within nesting range, suitable foraging habitat, observed on site in 2011.
Coastal cactus wren *Campylorhynchus*	Fed: None CA: S3,	Year-round	Coastal sage scrub requires tall opuntia cactus for nesting and roosting.	**High**; not observed, suitable habitat present, known from

Species	Conservation Status	Activity Season	General Habitat	Potential to Occur
brunneicapillus sandiegensis	CSC			within 1 mile.
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	Fed: **THR** CA: **END**, S1	Spring-Summer	Riparian forest, willows mixed with cottonwoods with a lower story of blackberry, nettles, or wild grape.	**Minimal** (nesting); **Low** (foraging only); no recent nesting in southern California, suitable habitat present.
White-tailed kite *Elanus leucurus*	Fed: None CA: S3S4, FP	Spring-Summer	Typically nests at lower elevations in riparian trees, including oaks, willows, and cottonwoods; forages over open country. Throughout much of cismontane California.	**Low** (nesting); **Moderate** (foraging only); limited suitable nesting habitat, marginal foraging habitat, known within 5 miles.
Southwestern willow flycatcher *Empidonax traillii extimus*	Fed: **END** CA: **END**, S1	Spring-Summer	Riparian woodlands in California.	**Minimal** (nesting); **Low** (foraging only); no recent nesting in southern California, suitable habitat present.
California horned lark *Eremophila alpestris actia*	Fed: None CA: S4, WL	Year-round	Open, flat lands including sparse sagebrush or grassland, meadows, alkali flats; wide elevation range; breeds in western California (San Diego County through Humboldt County) and Baja California, winters in same range.	**High** (seasonal foraging); **Low** (nesting); marginally suitable nesting habitat, expected to forage on the project site.
American peregrine falcon *Falco peregrinus anatum*	Fed: DEL CA: DEL, S3S4, FP	Year-round	Near wetlands, lakes, rivers, or other water; on cliffs, banks, dunes, and human-made structures.	**Low** (nesting); **High** (foraging only); limited suitable nesting habitat; known within 1 mile.
Bald eagle *Haliaeetus leucocephalus*	Fed: DEL, **BGEPA** CA: **END**, S3, FP	Year-round	Lower montane, old growth, coniferous forests, near lakes and rivers.	**Low** (nesting); **High** (foraging only); limited suitable nesting habitat; marginal foraging habitat, observed on site in 2012.
Yellow-breasted chat *Icteria virens*	Fed: None CA: S3, CSC	Spring-Summer	Inhabits riparian thickets of willow and other brushy tangles near water courses; nests in low, dense riparian vegetation; nests and forages within 10 feet of ground.	**High**; not observed, assumed to nest on site, known from within 1 mile.
Osprey *Pandion haliaetus*	Fed: None CA: S4, WL	Year-round	Ocean shores, bays, freshwater lakes and large streams.	**Present**; 1 individual observed foraging on site,

Species	Conservation Status	Activity Season	General Habitat	Potential to Occur
				known to nest on site.
Coastal California gnatcatcher *Polioptila californica*	Fed: **THR** CA: S2, CSC	Year-round	Permanent resident of coastal sage scrub in arid washes, on mesas, and slopes.	**Present**; 12 territories present in 2021, suitable habitat present.
Bank swallow *Riparia riparia*	Fed: None CA: **THR**, S2	Spring-Summer	Colonial nesters, nests primarily in riparian habitats. Requires vertical banks/cliffs with fine-textured soils.	**Minimal** (nesting); **Low** (foraging only); suitable foraging habitat, known from within 10 miles.
Yellow warbler *Setophaga petechia*	Fed: None CA: S3S4, CSC	Spring-Summer	Riparian vegetation; prefers willows, cottonwoods, aspens, sycamores, and alders for nesting and foraging. Throughout much of southern California.	**High**; suitable nesting and foraging habitat present, observed onsite in 2008 and 2011.
Least Bell's vireo *Vireo bellii pusillus*	Fed: **END** CA: **END**, S2	Spring-Summer	Summer resident of southern California in low riparian habitats in vicinity of water or dry river bottoms; found below about 2,600 ft elevation, nests typically built in willow, mesquite, *Baccharis*.	**Present**; 6 territories present in 2021, suitable habitat present.
MAMMALS				
Pallid bat *Antrozous pallidus*	Fed: None CA: S3, CSC	Spring-Summer	Desert, grassland, shrubland, woodland, forest; most common in open, dry habitats with rocky areas for roosting.	**Minimal** (roosting); **Moderate** (foraging); suitable foraging habitat is present, suitable roosting habitat is absent.
Mexican long-tongued bat *Choeronycteris mexicana*	Fed: None CA: S1, CSC	Spring-Summer	Pinyon and juniper woodlands, riparian scrub. Roosts in relatively well-lit caves and in and around buildings.	**Minimal** (roosting); **Moderate** (foraging); suitable foraging habitat is present; suitable roosting habitat is absent.
Western mastiff bat *Eumops perotis californicus*	Fed: None CA: S3S4, CSC	Year-round	Lowlands (rare exceptions); central and southern California, southern Arizona, New Mexico, southwestern Texas, northern Mexico; roosts in deep rock crevices, forages over wide area.	**Minimal** (roosting); **Moderate** (foraging); suitable foraging habitat is present; suitable roosting habitat is absent.
Hoary bat *Lasiurus cinereus*	Fed: None CA: S4	Spring-Summer	Prefers deciduous and coniferous woodlands; primarily roosts in tree foliage.	**Low** (roosting); **High** (foraging); suitable foraging habitat is present; suitable roosting habitat is limited.

Species	Conservation Status	Activity Season	General Habitat	Potential to Occur
Yuma myotis *Myotis yumanensis*	Fed: None CA: S4	Spring-Summer	Distribution tied to water bodies, optimal habitats are open forests and woodlands.	**Low** (roosting); **High** (foraging); suitable foraging habitat is present; suitable roosting habitat is limited.
San Diego desert woodrat *Neotoma lepida intermedia*	Fed: None CA: S3S4, CSC	Year-round	Arid shrublands, especially around rocky outcrops and crevices; cismontane California from San Luis Obispo to San Diego County, and northwestern Baja California.	**Moderate**; not observed, suitable habitat present.
Pocketed free-tailed bat *Nyctinomops femorosaccus*	Fed: None CA: S3, CSC	Year-round	Deserts and arid lowlands, southwestern United States, Baja California, mainland Mexico; roost mainly in crevices of high cliffs; forage over water and open shrubland.	**Minimal** (roosting); **Moderate** (foraging); suitable foraging habitat is present; suitable roosting habitat is absent.
Big free-tailed bat *Nyctinomops macrotis*	Fed: None CA: S3, CSC	Spring-Summer	Arid lowlands throughout southern California' roosts on high cliffs in rocky outcrops. Forages in a variety of habitats and feeds on moths.	**Minimal** (roosting); **Moderate** (foraging); suitable foraging habitat is present; suitable roosting habitat is absent.

Conservation Status

Federal Designations (FED): (federal ESA, FWS)

END: Federally listed, endangered

THR: Federally listed, threatened

CAN: Candidate: Sufficient data are available to support federal listing, but not yet listed.

Proposed: Formally proposed for the federal status shown.

DEL: Delisted

BGEPA: Bald and Golden Eagle Protection Act

State Designations (CA): (CESA, CDFW)

END: State listed, endangered.

THR: State listed, threatened.

CAND: Sufficient data area available to support federal listing, but not yet listed.

RARE: State listed as rare (applied only to certain plants).

CSC: California Species of Special Concern. Considered vulnerable to extinction due to declining numbers, limited geographic ranges, or ongoing threats.

WL: Species that were either previously listed as SC and have not been state listed under CESA; or were previously state or federally listed and now are on neither list; or are on the list of "Fully Protected" species.

FP: Fully protected. May not be taken or possessed without permit from CDFW.

CDFW Natural Diversity Data Base Designations: Applied to special-status plants and sensitive plant communities; where correct category is

Species	Conservation Status	Activity Season	General Habitat	Potential to Occur
uncertain, CDFW uses two categories or question marks. S1: Fewer than 6 occurrences or fewer than 1000 individuals or less than 2000 acres. S1.1: Very threatened. S1.2 Threatened. S1.3: No current threats known. S2: 6-20 occurrences or 1,000-3,000 individuals or 2,000-10,000 acres (decimal suffixes same as above). S3: 21-100 occurrences of 3,000-10,000 individuals or 10,000-50,000 acres (decimal suffixes same as above). S4: Apparently secure in California; this rank is clearly lower than S3 but factors exist to cause some concern, i.e., there is some threat or somewhat narrow habitat. No threat rank. S5: Demonstrably secure or ineradicable in California. No threat rank. SH: All California occurrences historical (i.e., no records in > 20 years). SX: Presumed extirpated in California. *California Rare Plant Rank Designations. Note: According to the California Native Plant Society (http://www.cnps.org/cnps/rareplants/ranking.php), plants ranked as CRPR 1A, 1B, and 2 meet definitions as threatened or endangered and are eligible for state listing. That interpretation of the state Endangered Species Act is not in general use.*				

Federal- and State- Listed Wildlife
An official species list for the lower Santiago Creek channel (Project Code: 2023-0019345) and the Santiago Recharge Basins (Project Code: 2023-0019344) was obtained from the FWS IPaC website. Four federally listed wildlife species have the potential of occurring within the vicinity of the project area: LBVI (*Vireo bellii pusillus*), CAGN (*Polioptila californica*), Santa Ana sucker (*Catostomus santaanae*), and the candidate species monarch butterfly (*Canaus plexippus*). In addition, 41 state-listed species were identified as having the potential to occur within the project area.

Least Bell's Vireo
LBVI is listed as endangered under both the FESA and the CESA (CDFW, 2022a). It is a small songbird that nests in riparian vegetation throughout much of southern California. LBVI were once widespread in southern California, but their range was greatly reduced due to parasitism by brown-headed cowbirds concurrent with development of riparian habitats. Suitable riparian habitat for LBVI is present in the Santiago Recharge Basins and along Santiago Creek. Protocol-level surveys were completed in 2022 within the Santiago Recharge Basins and five territories were detected (Figure 16 and Figure 17).

Coastal California Gnatcatcher
CAGN is listed as threatened under the FESA (CDFW, 2022a). Its geographic range is primarily coastal southern California from Ventura County, inland to the Santa Clarita area, Banning area, and southward through northwestern Baja California. Its habitat is coastal sage scrub largely composed of California sagebrush, California buckwheat, and other low-growing, drought-deciduous shrubs. CAGN are known to nest on the project site and in 2022 up to 12 territories were detected (Figure 16 and Figure 17). Continued habitat restoration within the project site by OCWD has undoubtedly favored the CAGN and caused recent increases in the local population.



Figure 16: 2022 LBVI and CAGN Territories within Blue Diamond and Bond Basins.



Figure 17: 2022 LBVI and Coastal CAGN Territories within Smith Basin.

Santa Ana Sucker

The Santa Ana Sucker is listed as threated under the FESA. The Santa Ana Sucker is a small fish endemic to southern California and is native only to the Los Angeles, San Gabriel, Santa Ana, and Santa Clara River systems. The sucker is found within clear, small to medium size streams with gravel, rubble, and rock substrates, as well as vegetation on the side. Extant populations of the Santa Ana Sucker are found near Riverside and downstream. Critical habitat has been designated for the species and is located about 6 miles downstream of the project site. Due to hydrological modification (i.e., Santiago Creek being primarily dry where it meets the Santa Ana River), the project site has a low probability of supporting Santa Ana Sucker. The only potential for the species to occur in Santiago Creek channel is likely during periods of heavy flow.

Monarch Butterfly

Overwintering populations of monarch butterfly in California are a candidate for federal listing under the ESA. The listing would only protect these overwintering sites and not individual butterflies or their food plants. Monarch and their food plants are widespread in California and although milkweed was not seen on the project site, monarchs have a high potential to be present. Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico, and roosts are generally located in wind-protected tree groves. The project site is likely too far inland to support winter roosting habitat.

Bald Eagle

Bald eagle has been state-listed as endangered in California since 1971 (CDFW, 2022a). It was federally listed as endangered in 1978, then down-listed to threatened 1995, and delisted in 2007 (FWS, 1978 and 2007b). It is also protected under the federal Bald and Golden Eagle Protection Act and is a FWS Bird Conservation Concern. The FWS regulates activities that may “take” bald or golden eagles (FWS, 2007a). The bald eagle is an opportunistic, generalized predator and scavenger adapted to hunting and foraging over aquatic habitats. Breeding bald eagles require relatively large bodies of water containing resident populations of suitable-sized fish. Most bald eagles in California breed near reservoirs or lakes. They typically nest in large trees in close proximity to large bodies or water and may occasionally nest on large powerline structures, and steep cliff faces. A single immature bald eagle was reported from the project site in 2012 (ebird.org, 2022) and the species has a high potential to forage on the project site in the future. Bald eagle nesting habitat is present in the project site, and they are known to nest approximately 5 miles to the east, near Irvine Lake. Bald eagles have a low potential of nesting at the project site, but a high potential to forage.

Swainson’s Hawk

Swainson’s hawks are listed as threatened under the CESA (CDFW, 2022a). In California, they nest in the San Joaquin Valley, western Antelope Valley, and Owens Valley. They migrate to South American every fall and return to California every spring. Swainson’s hawks migrate along the Pacific flyway, and several have been observed in the vicinity of the project site during migration. One was reported from the project site in 2011 (ebird.org, 2022). The project site is well outside of the breeding range, but Swainson’s hawks may migrate over the area biannually. Swainson’s hawks have a high potential to be present during migration.

Golden Eagle

Golden eagle is a California Fully Protected species and a FWS Bird of Conservation Concern (CDFW, 2022a). Golden eagles are year-round residents throughout most of their range in the western United States. In the Southwest, they are more common during winter months. They breed from late January through August (Pagel et al., 2010). In the Santa Ana Mountains they nest in steep, rugged, remote terrain. Golden eagles are wide-ranging predators, especially outside of the nesting season, when they have no need to return daily to eggs or young at their nests. A single golden eagle was reported from the project site in 2011 (ebird.org, 2022) and the species has a moderate potential to forage on the project site in the future. Golden eagle nesting habitat is absent from the project site.

Santa Ana Speckled Dace
Santa Ana speckled dace are found in coastal Southern California streams from Los Angeles, Orange, Riverside, and San Bernardino counties (CDFW, 2022a). They are known to occur in the San Gabriel River and the Santa Ana River but may have been extirpated from the Los Angeles River. Santa Ana speckled dace require cool (<20°C) shaded mountain streams and are typically found in shallow habitats dominated by cobbles and gravels (CDFW, 2022a). Santa Ana speckled dace known from Santiago Creek approximately 10 miles upstream of the project site and have a high potential to be present within the project site, just upstream of Smith Basin.

Coastal Whiptail
Coastal whiptail are found in coastal southern California, mostly west of the Peninsular Ranges and south of the Transverse Ranges. Their range extends north into Ventura County and south to Baja California. The coastal whiptail occurs in a variety of habitats including various upland and riparian habitats. It is most commonly associated with areas of dense vegetation but is also found around sandy areas along gravelly arroyos or washes (Stebbins, 2003). Coastal whiptail were not observed within the project site but have a high potential to be present throughout the project site.

Red-Diamond Rattlesnake
Red-diamond rattlesnake live between sea level and about 5,000 feet elevation throughout most of Orange County and western Riverside County, south through San Diego and Baja California and inland to the Colorado Desert margins. Their habitats include coastal sage scrub, chaparral, and woodlands through most of their geographic ranges, and desert scrub at the eastern margins of their range. There are numerous records of red diamond rattlesnakes from the Santa Ana Mountains to the east of the project site. The nearest known occurrence is about 0.4 miles to the east. Red diamond rattlesnake have not been reported on the project site, but habitat throughout the site appears suitable and there is a moderate potential to be present.

Coast Horned Lizard
Coast horned lizard are found throughout much of coastal southern California, inland as far as the southern Mojave Desert and to about 6,000 ft elevation in the mountains. Coast horned lizards occur in sandy soils in a variety of shrubland, grassland, and woodland habitat types. They have been extirpated from much of their historic range by land use changes, but they remain fairly common in natural open space areas where their primary prey (native ants) are found. Coast horned lizard were not observed within the project site but have a moderate potential to be present on the project site, primarily in the upland habitat upstream of Smith Basin.

Burrowing Owl
Burrowing owl are uncommon throughout much of southern California with the highest densities occurring near agricultural lands in the Imperial Valley. Burrowing owl have been extirpated from portions of Orange County because of development. Burrowing owl are still periodically observed in Orange County and have been observed within about 3 miles of the project site (inaturalist.org, 2021). The habitat at the site is marginally suitable for this species, but with a sufficient prey base, and an abundant ground squirrel population (for producing burrows), it is possible that breeding or wintering burrowing owls could persist at the site.

Coastal Cactus Wren
Coastal cactus wren are found in coastal southern California, from Orange and Riverside counties south in San Diego County and Baja California. Coastal cactus wren occur in coastal sage scrub habitat, primarily in areas with patches of cactus (*Opuntia* sps.). Coastal cactus wren were not observed within the project site but have a high potential to be present in the upland habitat upstream of Smith Basin.

Yellow-breasted Chat
Yellow-breasted chat is a migratory species, occurring in California only during the breeding season which is typically between April and August. In California, it primarily breeds in the northern portion of the state and is scarce in the central and southern portions. It typically utilizes

dense riparian thickets and brushy tangles near watercourses for breeding (CDFW, 2022a). Yellow-breasted chat have not been previously detected on the project site but have a high potential to be present during the nesting season.

Yellow Warbler
Yellow warbler is a migratory species, occurring in California only during the breeding season, which is typically between April and August. In California, it is widespread in riparian habitat throughout much of the state. It typically nests in dense riparian vegetation near watercourses (CDFW, 2022a). Yellow warbler were previously detected on the project site in 2008 and 2011 but were not detected during the recent surveys (ebird.org, 2022). Suitable habitat is present throughout the project site, and they are likely to be present during the nesting season.

San Diego Desert Woodrat
San Diego desert woodrat is known from coastal and desert scrub and rocky outcrops throughout much of southern California (CDFW, 2022). It frequently builds large middens (piles of sticks and debris arranged to form a shelter) in rock outcrops or around the bases of shrubs. In some portions of its range, it builds middens primarily at the bases of cactus (*Opuntia* sps.) and yucca (*Yucca* sps.) plants (Feldhamer et al., 2003). Habitat in the project site is suitable for San Diego desert woodrat and it has been documented within about 5 miles of the project site.

Bats
Several special-status bat species have at least a low potential to forage over the Project site: pallid bat, western mastiff bat, Mexican long-tongued bat, hoary bat, Yuma myotis, big free-tailed bat, and pocketed free-tailed bat. The pallid bat and western mastiff bat forage in open areas over grasslands, agricultural areas, and other shrublands and roost in a variety of habitats including buildings, rock crevices, and caves. The pocketed free-tailed bat forages over water and open shrublands and roosts in crevices in cliffs. Hoary bats may roost in tree foliage within the project site. The remaining species are unlikely to roost in the project site because of a lack of suitable roosting habitat.

Crotch Bumble Bee
Crotch bumble bee was recently petitioned for listing under CESA but was determined to not be eligible for protection under CESA. It is currently recognized as a special animal but may be petitioned again in the future based on a recent interpretation of CESA which indicates that some invertebrates may be eligible for protection. Crotch bumble bee is a widespread secretive species that is known from more than two hundred locations over a broad geographic range (CDFW, 2022a). It is typically found in openings in grassland and scrub habitats where it burrows into the ground and lives in colonies. It feeds on native plants including milkweed, pincushion, lupine, phacelia, sage, snapdragon, clarkia, bush poppy, and buckwheat. Many of these food plants are present on the project site and suitable burrowing habitat is also present. Crotch bumblebee has a high potential to be present on the site and is known from numerous observations in the region.

Orange-throated Whiptail
Orange-throated whiptail are found in coastal southern California, mostly from Riverside and Orange counties south in San Diego County and Baja California. The orange-throated whiptail occurs in a variety of habitats including woodlands, coastal sage scrub, and chaparral. It is often found in sandy areas with patches of brush and rocks (CDFW, 2022a). Orange-throated whiptail were not observed within the project site but have a high potential to be present throughout the project site.

Raptors
In addition to the raptors discussed above, several other special-status birds of prey including Cooper's hawk, white-tailed kite, American peregrine falcon, and osprey were observed on the project site or have at least a moderate potential to be present. These raptors are found seasonally in the region, especially during winter and during migration. Both an individual Cooper's hawk and an individual Osprey were observed flying over the project site in 2022.

Other Special-status Birds

Southern California rufous-crowned sparrow, great blue heron, and California horned lark are the only “Watch List” wildlife species with at least a moderate potential to be present on the project site. None of these species are afforded specific protection under either state or federal regulations.

Aquatic Resources

Santiago Creek originates more than 15 miles upstream of the project area in the Santa Ana Mountains. Prior to reaching the project site, water enters Santiago Creek from numerous upstream tributaries including Silverado Canyon, Black Star Canyon, and Modjeska Canyon. Santiago Creek then flows through two upstream flood control facilities including the Villa Park Dam and Santiago Dam before entering the project area. At the downstream end of the project area, flows from Santiago Creek enter the Santa Ana River and continue downstream approximately 10.5 miles before reaching the Pacific Ocean. The Pacific Ocean is recognized by USACE as a traditional navigable water (TNW) thereby establishing surface connectivity of the project area to navigable waters. Santiago Creek is a direct tributary to the Santa Ana River which is a direct tributary to the Pacific Ocean.

The lower Santiago Creek channel that is part of the project area is typically dry most of the year. This is due to the City of Orange indicating that surface water released by OCWD along Santiago Creek should not flow into Hart Park parking area (located approximately 1.16 miles upstream of Interstate 5). To ensure that surface water does not enter the Hart Park parking area, OCWD has incorporated into their groundwater recharge facilities maintenance plan a coordination measure that requires OCWD to monitor the flowrate and make needed adjustments to ensure that flows percolate before reaching the parking lot for Hart Park (OCWD, 2012).

The lower Santiago Creek channel and the Santiago Recharge Basins all lack suitable habitat to support native fish species, such as the Santa Ana Sucker (*Catostomus santaanae*), Arroyo Chub (*Gila orcutti*), or Santa Ana Speckled Dace (*Rhinichthys osculus*). The Santiago Recharge Basins do contain some populations of non-native fish species. Common fish species within the basins include Common Carp (*Cyprinus carpio*), Fathead Minnow (*Pimephales promelas*), Green Sunfish (*Lepomis cyanellus*), Largemouth Bass (*Micropterus salmoides*), Bluegill (*Lepomis macrochirus*), Threadfin Shad (*Dorosoma pretense*), Channel Catfish (*Ictalurus punctatus*), and Tilapia (*Oreochromis* spp.) (OCWD, 2012). Common carp and green sunfish are considered invasive species in California. Green sunfish have large mouths which gives them the ability to consume a wide variety of prey. The green sunfish will often prey on the young of other fish species and quickly grow in numbers, while limiting the populations or stunting the growth of other native fish species. Common carp are prolific spawners making them invasive species. Larvae feed on algae and zooplankton whereas adults feed on aquatic insect larvae, small mollusks, crustaceans, and annelid worms. Common carp can often root up native aquatic vegetation as they root through soil for their prey.

A preliminary jurisdictional determination of wetland waters of the U.S. and non-wetland waters of the U.S. within the project area was prepared based on surveys conducted on January 12, 26, and March 3, 2022 (refer to the Aquatic Resources Delineation Report in Appendix 1). Although there are riparian and wetland vegetation types present within Smith Basin and portions of the Blue Diamond and Bond basins, there are no federal jurisdictional wetland waters of the U.S. within either project footprint. This is based on how USACE Regulatory defines wetlands versus Waters of the United States. Specifically, all of the riparian and wetland vegetation is located below the OHWM and thus falls within the federal jurisdiction of the Waters of the U.S. rather than being identified as a wetland. Although there are no federal jurisdictional wetland waters of the U.S. within the project footprint, there are 197.55 acres of federal jurisdictional non-wetland waters of the U.S. in the project area. Non-wetland waters of the U.S. are delineated based on the limits of the OHWM as determined by changes in physical and biological features, such as bank erosion, deposited vegetation or debris, and vegetative characteristics.

At the state level, wetlands and waters are regulated primarily by the State Water Resources Control Board (SWRCB), the Regional Water Quality Control Board (RWQCB), and the California Department of Fish and Wildlife (CDFW). Under Section 3831(w) of Title 23 of the California Code of Regulations, "[a]ll waters of the United States are also 'waters of the state." Under this definition, there are 197.55 acres of jurisdictional waters of the state within the project area. Regarding wetlands, the SWRCB adopted a state wetland definition in 2019 which allows for the presence of hydric substrates as a criterion for wetland identification (not just wetland soils) and wetland hydrology for an area devoid of vegetation (less than 5% cover) to be considered a wetland. Based on the definition of a wetland by the state, there are examples of waters that would be considered wetlands by the state, but not by the federal wetland definition. Therefore, based on the above reasoning, the Aquatic Resources Delineation Report (Appendix 1) identifies 2.74 acres of wetland waters of the state within the project area.

In addition to USACE and the State Water Resources Control Board overseeing potential impacts to waters of the U.S. and waters of the state, the California Department of Fish and Wildlife (CDFW) evaluates if a proposed project may impact fish and wildlife resources under Section 1602 of the California Fish and Game Code. In the Aquatic Resources Delineation Report (Appendix 1), CDFW jurisdictional waters were delineated to the tops of channel banks or the edge of adjacent riparian vegetation where present. It is important to note that CDFW has jurisdiction over a larger area than the federal jurisdiction, therefore the total acreage of CDFW jurisdictional waters and adjacent vegetation generally includes all federally jurisdictional waters, as well as additional adjacent state jurisdictional waters and habitats. Therefore, based on the above details, the Aquatic Resources Delineation Report (Appendix 1) identifies 218.05 acres as CDFW jurisdictional waters under state law.

Wildlife Movement

Habitat linkages and movement corridors facilitate regional animal movement and are generally centered near waterways, riparian corridors, flood control channels, contiguous habitat, and upland habitat. Drainage ways generally serve as movement corridors because they are natural elements in the landscape that guide animal movement (Noss, 1991; Ndubisi et al., 1995; Walker and Craighead, 1997; Hilty et al., 2006). Larger river and stream riparian corridors provide the best remaining option for sustaining and improving ecological connectivity in much of the state, and in particular southern California (Spencer, 2010). Corridors also offer wildlife unobstructed terrain for foraging and for dispersal of young individuals. It is also necessary to consider spatial and temporal scales when analyzing potential corridors. Species may require varying spatial scales to fulfill their life history requirements and use of corridors can be important on temporal scales ranging from time periods as short as hours to as long as generations, depending on the desired use of the corridor.

Undisturbed landscapes contain a variety of movement corridors, habitat linkages, travel routes, wildlife crossings and other features that facilitate wildlife movement through the landscape and contribute to population stability. The relative size and characteristics of these features are different for each species that uses them. When human activities fragment landscapes, movement corridors, habitat linkages, travel routes, and wildlife crossings may be altered or eliminated. Continued use of these features by wildlife depends on their ability to find adequate space, cover, food, and water, in the absence of obstacles or distractions (e.g., man-made noise, lighting) that might interfere with wildlife movements.

Santiago Creek provides wildlife movement from the Santa Ana Mountains to the Santiago Recharge Basins. From the Santiago Recharge Basins, Santiago Creek continues downstream to where it joins the Santa Ana River at the River View Golf Course. Between the Santiago Recharge Basins and the River View Golf Course, Santiago Creek meanders through patches of open space that provides habitat for some wildlife. However, downstream of the golf course, there are limited amounts of open space and the Santa Ana River transitions into a lined flood control channel with limited habitat and access and its ability to function as a wildlife corridor is severely

diminished.

The project site is not located within any identified Essential Habitat Connectivity Areas of Natural Landscape Blocks. The project site is more likely to support more localized movement within the region and some upstream and downstream movement corridors along Santiago Creek as described above.

Existing Mitigation Sites

The Santiago Recharge Basins fall under OCWD's Habitat Management Plan (HMP) (OCWD, 2020). OCWD's HMP was prepared to identify restoration activities that provide compensatory mitigation for ongoing routine maintenance impacts to waters of the U.S. and waters of the state associated with OCWD groundwater management operations.

OCWD's maintenance and groundwater management operations are conducted under USACE Regional Permit 90 (RGP 90) which was first initiated in 2012 and recently renewed in 2022. The HMP mitigation requirements are incorporated as a condition of the USACE RGP 90 permit. RGP 90 states that "authorization under this Corps [USACE] permit is conditional upon your compliance with all of the [FWS] required avoidance and minimization measures, which are incorporated by reference in this permit." (RGP 90 at page 6). Attached as Enclosure 1 to the RGP 90, the 2021 USFWS Endangered Species Act consultation letter requires implementation of the HMP as Conservation Measure 1. Specifically, the USFWS concurrence states:

> *"Our effects analysis is based on maintenance of preserved, restored, and created habitat as identified in the HMP. If this habitat cannot be maintained due to insufficient water supply or if it must be impacted for another project (e.g., Santiago Creek component of the Santa Ana River Project), re-initiation of consultation should be considered."*

RGP 90, Enclosure 1 at page 45 also states that issuance of the 2013 Water Quality Certification by the RWQCB and the Streambed Alteration Agreement by CDFW are contingent upon the implementation of the mitigation sites as identified in OCWD's HMP.

The HMP requires that OCWD "preserve and manage a total of 107.29 acres of native habitats within 7 basins, including 29.5 acres of native riparian and upland vegetation and freshwater marsh to be created and restored (HMP at page 44). OCWD estimates that their operation and maintenance activities for the recharge basins between 2013 to 2027 will permanently impact 3.19 acres of wetland waters of the U.S. and State, and temporarily impact 1,018.74 acres of non-wetland waters of the U.S. and State (see HMP, Table 1). To compensate for these impacts, the mitigation plan in the HMP requires OCWD to create a total of 8.6 acres of native vegetation, restore 21.04 acres of native vegetation, and preserve and manage 77.99 acres of existing native vegetation. OCWD is required to create/restore native vegetation at a rate of two acres per year. OCWD's HMP designates areas within seven of their groundwater recharge basins where the creation, restoration, and preservation of native vegetation will occur.

In the HMP, Smith Basin and the Blue Diamond and Bond basins are identified as two of the seven recharge basins where native habitat restoration and preservation will occur. Under the HMP, OCWD is required to preserve and manage a total of 31.80 acres in Smith Basin and 48.08 acres in Blue Diamond and Bond basins (referred to as Santiago Basin in the HMP). Of the 31.80 acres to be preserved in Smith Basin, 27.47 acres is existing native vegetation (includes 8.6 acres of open water habitat), and 4.33 acres is non-native vegetation that OCWD is required to restore. Of the 48.08 acres to be preserved in the Blue Diamond and Bond basins, 34.44 acres is existing native vegetation, and 13.64 acres is non-native vegetation that is to be restored by OCWD. To date, OCWD has restored 6.47 acres of native vegetation in Blue Diamond and Bond basins, and no restoration has yet occurred in Smith Basin. These mitigation sites are currently required by the FWS as a condition of their concurrence per Section 7 Consultation for USACE's

initial issuance and renewal of RGP 90.

Issuance of the 2013 Water Quality Certification by the RWQCB and the Streambed Alteration Agreement by CDFW are also contingent upon the implementation of the mitigation sites as identified in OCWD's HMP. USACE Regulatory is currently in discussions with the FWS, RWQCB, and CDFW as to whether the mitigation sites specifically in Smith, Blue Diamond, and Bond basins can be removed as a requirement for OCWD to implement because OCWD has potentially already implemented sufficient mitigation within other basins under their purview to offset realized permanent impacts to wetland vegetation since 2013. OCWD has confirmed that 3.19 acres of permanent impacts to wetland vegetation has occurred since the RGP 90 permit was first issued in 2014.

Since discussions about removal of the Smith, Blue Diamond, and Bond basins mitigation sites from OCWD's HMP are ongoing and are expected to be resolved prior to construction of the proposed Santiago Creek project, the FWS's 2023 amendment, to the FWS's 2001 Biological Opinion (BiOp) for the Santa Ana River Mainstem Project and the FWS's 2012 amendment to the 2001 BiOp for the Santa Ana River Mainstem Project, assumes that the federal requirement for OCWD mitigation has been fully satisfied in other locations. If the agencies whose permits/consultations include these existing mitigation sites do not agree to remove the Smith, Blue Diamond, and/or Bond basins mitigation sites from OCWD's HMP, then Section 7 consultation for the Santiago Creek project will be reinitiated at that time.

Prior to implementation of the project, RGP 90 will need to be amended to exclude or relocate the HMP mitigation requirements that would be impacted by the project activities. If this does not happen, then a supplemental Environmental Assessment with a revised 404(b)(1) analysis and a new ESA Section 7 concurrence from FWS must be completed prior to implementation of the project.

3.4.3.3 Environmental Effects

Significance Criteria

The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects on biological resources would be considered significant if the project would result in any of the following:

a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the CDFW or FWS;
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the CDFW or FWS;
c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; or
f) Conflict with the provisions of an adopted HCP, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

It is important to note that the impacts to federally listed species, wildlife, and water resources are also evaluated under the Endangered Species Act, the Fish and Wildlife Coordination Act, and the Clean Water Act. Coordination under these acts is further described under Section 4.1.

It is also important to note that an analysis of the potential impacts to existing mitigation sites is

included under Section 3.4.10 Land Use Planning, since that section analyzes environmental effects to an existing land use plan and OCWD's HMP would fall under that designation.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not have a substantial direct or indirect adverse effect on any special status species; have a substantial adverse effect on any riparian habitat or other sensitive natural community; have a substantial adverse effect on state or federally protected wetlands; interfere substantially with the movement of any native resident or migratory fish or wildlife species; conflict with any local policies or ordinances protecting biological resources; or conflict with the provisions of an adopted HCP, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.
The types of vegetation, wildlife, and their associated habitats would remain generally the same as current conditions.

(a) *Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?*

No Change Alternative

Less than Significant with Mitigation Incorporated:

Federal-listed Wildlife Species

In accordance with Section 7(c) of the Endangered Species Act, the USACE obtained a list of federally listed and proposed species likely to occur in the project action area (Appendix 8). While USACE has initiated formal consultation with the FWS, formal consultation was only initiated on the "Proposed Alternative" and did not include the "No Change Alternative." Therefore, please refer to the "Proposed Alternative" subheading for details on formal consultation. Although formal consultation was not conducted on the No Change Alternative it is assumed in the following analysis for this alternative that similar mitigation measures would be implemented. However, if the No Change Alternative were to be implemented, then formal consultation for this alternative would need to be undertaken with the FWS.

Least Bell's Vireo
Habitat within or in the vicinity of the project area has the potential to support federally- and state-listed wildlife species. Federally-listed species include LBVI (nesting territories) and CAGN (known foraging and nesting territories). A complete list of special-status species with potential to occur in the project area is listed in Table 8.

Four (4) LBVI territories were observed in the No Change Alternative project footprint. A total of approximately 1.46 acres of occupied habitat would be permanently impacted during implementation of shoreline stabilization within Smith Basin due to the rehabilitation of a maintenance road along the north side of the basin (0.17 acres mulefat thicket) and placement of buried riprap (1.29 acres Goodding's willow – red willow riparian woodland and forest) where willow may not be able to reestablish (Table 9). An alternative to rehabilitating the old maintenance road on the north side of Smith Basin was analyzed by USACE in an effort to minimize impacts to LBVI habitat. The alternative considered included building a maintenance road down to the bottom of Smith Basin that would connect to the existing maintenance road located along Villa Park Road. However, this alternative was not feasible because 1) the gradient of the slope along Villa Park Road is too steep to create a road that could be safely traversed down into the basin, 2) there is little to no shoulder along Villa Park Road when approaching the

existing Smith Basin maintenance road which is a safety hazard for maintenance vehicles getting on and off the maintenance road, and 3) there would be a safety hazard for vehicles traveling along Villa Park Road and slow maintenance vehicles entering and exiting the roadway (i.e., no traffic light). For comparison, Villa Park Road is a four-lane highway with a speed limit of 50 miles per hour in the vicinity of Smith Basin. Conversely, Santiago Boulevard which would provide access to the rehabilitated maintenance road is a two-lane road with a speed limit of 35 miles per hour.

In addition to the above permanent impacts, a total of approximately 11.17 acres of occupied habitat will be temporarily impacted (Table 9) during implementation of shoreline stabilization within Smith Basin, but this acreage will be replanted with native riparian and wetland vegetation once construction is complete. Approximately 26.2 acres of the project area provide preferred suitable biological characteristics for LBVI within the mapped areas. Therefore, permanent impacts would affect approximately 5.6% of available wetland and riparian vegetation within the Santiago Recharge Basins. Temporary impacts would affect approximately 42.6% of available wetland and riparian vegetation within the Santiago Recharge Basins. Approximately 51.8% of available wetland and riparian vegetation within the Santiago Recharge Basins that provide preferred suitable biological characteristics for LBVI would not be impacted by the project at all.

Direct and indirect impacts to LBVI would have included displacement of established territories causing adverse effects to four territories within the No Change Alternative project footprint. This would have resulted in potential temporary displacement of four territories. This was assumed to have been temporary displacement as there are 13.57 acres of suitable LBVI habitat within the project area that would not be impacted by the No Change Alternative. Based on observations of LBVI territory size which can range between 0.5 to 7.5 acres, the unaffected 13.57 acres of suitable LBVI habitat within the project area would provide sufficient acreage for between 27 to two LBVI territories while construction of the No Change Alternative would be occurring (FWS, 1998b). Once construction is complete, 11.17 acres of wetland and riparian vegetation temporarily impacted would be replanted with wetland and riparian vegetation with suitable biological characteristics for LBVI. The replanted wetland and riparian vegetation would be dominated by willow species which typically take between two to 10 years to become mature and begin producing seeds (Reed, 1993). Since LBVI have been characterized as preferring early successional habitat, the reestablishment of native willow vegetation within the temporarily impacted areas of the No Change Alternative would provide early successional habitat that LBVI prefer to nest in (FWS, 1998b). The restoration of the temporarily impacted areas would ultimately provide acreage for 22 to one LBVI territories once construction is complete. Therefore, as detailed above, riparian and wetland vegetation that contains preferred biological characteristics for LBVI would for the most part be temporarily impacted and riparian and wetland vegetation unaffected during construction of the project should provide sufficient habitat for LBVI with temporarily displaced territories within the No Change Alternative project footprint.

Indirect impacts from construction of the No Change Alternative would have included noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair vireos and degrade air quality and human presence can cause vireos to abandon territories and nests.

To avoid and minimize potential impacts to LBVI the USACE, pursuant to formal consultation with the FWS, will implement all the mitigation measures identified in full detail in Section 3.4.3.4. In addition, the USACE will implement all reasonable and prudent measures identified in the FWS's BiOp once the Final BiOp is provided to USACE.

To offset effects to LBVI from the No Change Alternative, the USACE would propose restoration of 18.47 acres of wetland and riparian vegetation within Prado Basin and/or within the Santa Ana River watershed below Prado Dam. Figure 18, Figure 19, and Figure 20 show potential parcels that may be used as mitigation for the Santiago Creek project. The potential riparian parcels are

approximately 12.09 acres (Figure 18), 68.64 acres (Figure 19), and 11.35 acres (Figure 20). Two parcels are located on USACE land identified as “environmentally sensitive areas”. USACE continues to work to ensure the proposed mitigation sites for the Santiago Creek project do not already contain mitigation for other components of SARMP. The availability of these sites as mitigation sites for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The third parcel is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The 18.47 acres of wetland/riparian habitat restored offsite will be monitored and managed according to MM BIO-2, MM BIO-6, MM BIO-7, and MM BIO-11 (refer to Section 3.4.3.4 for a full description of these mitigation measures). In addition, 12.46 acres of wetland and riparian vegetation would be replanted on site to offset temporary impacts to wetland and riparian vegetation within the No Change Alternative project footprint. The 12.46 acres of native wetland and riparian vegetation within the project footprint will be monitored and managed according to MM BIO-1 and MM BIO-11 (refer to Section 3.4.3.4 for a full description of these mitigation measures).

Based on the analysis described above, the USACE has determined that the No Change Alternative may affect, and is likely to adversely affect, LBVI.

Table 9: Summary of Proposed Offset and Vegetation Categories within the Santiago Recharge Basins for the No Change Alternative.

Plant Community Type	Total Acreage	Impact Type	Acres Impacted	Mitigation Ratio	Acres of Mitigation Onsite	Acres of Mitigation Offsite
Riparian and Wetland Vegetation Types						
Goodding’s Willow – Red Willow Riparian Woodland and Forest	21.73	Permanent	1.29	5:1	0.00	6.45
		Temporary	9.74	2:1	9.74	9.74
Mulefat Thickets	4.47	Permanent	0.17	5:1	0.00	0.85
		Temporary	1.43	2:1	2.72	1.43
Upland Vegetation Types						
California Sagebrush – Black Sage Scrub	35.87	Permanent	1.97	3:1	0.00	5.91
		Temporary	7.14	2:1	7.14	7.14
Brittle Bush Scrub	16.57	Permanent	0.29	3:1	0.00	0.87
		Temporary	0.23	2:1	0.23	0.23
Fountain Grass Swards	5.58	Permanent	0.29	3:1	0.00	0.87
		Temporary	0.64	2:1	0.64	0.64
Laurel Sumac Scrub	6.10	Permanent	0.34	3:1	0.00	1.02
		Temporary	0.53	2:1	0.53	0.53
Upland Mustards or Star-Thistle	1.97	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.29	2:1	0.29	0.29
Wild Oats and Annual Brome Grasslands	3.78	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.19	2:1	0.19	0.19
Other Vegetation Types						
Unvegetated Channels and Slopes	3.81	Permanent	2.37	NA[1]	0.00	0.00
		Temporary	0.09	NA[1]	0.00	0.00
Developed	33.98	Permanent	1.14	NA[1]	0.00	0.00

Plant Community Type	Total Acreage	Impact Type	Acres Impacted	Mitigation Ratio	Acres of Mitigation Onsite	Acres of Mitigation Offsite
		Temporary	5.80	NA[1]	0.00	0.00
Total Vegetation Acres	**133.86**	**Total Vegetation Acres Impacted**	**33.94**	**Total Mitigation Acres**	**21.48**	**36.16**

[1] No offsite mitigation is required for temporary impacts to non-riparian habitat.

Coastal California Gnatcatcher

One (1) CAGN territory was observed within the No Change Alternative project footprint. Approximately 2.89 acres of occupied habitat would be permanently impacted due to the rehabilitation of an existing maintenance road along the north side of Smith Basin (1.31 acres California sagebrush – black sage scrub and 0.29 acres of fountain grass swards) as well as the construction of the overflow, inlet, and outlet structures within the Blue Diamond and Bond basins (0.44 acres California sagebrush – black sage scrub, 0.29 acres brittle bush scrub, and 0.34 acres laurel sumac scrub) and tie-back walls in the Blue Diamond and Bond basins (0.22 acre California sagebrush – black sage scrub) (Table 9). An alternative to rehabilitating the old maintenance road on the north side of Smith Basin was analyzed by USACE to minimize impacts to CAGN habitat. The alternative considered included building a maintenance road down to the bottom of Smith Basin that would connect to the existing maintenance road located along Villa Park Road. However, this alternative was not feasible because 1) the gradient of the slope along Villa Park Road is too steep to create a road that could be safely traversed down into the basin, 2) there is little to no shoulder along Villa Park Road when approaching the existing Smith Basin maintenance road which is a safety hazard for maintenance vehicles getting on and off the maintenance road, and 3) there would be a safety hazard for vehicles traveling along Villa Park Road and slow maintenance vehicles entering and exiting the roadway (i.e., no traffic light). For comparison, Villa Park Road is a four-lane highway with a speed limit of 50 miles per hour in the vicinity of Smith Basin. Conversely, Santiago Boulevard which would provide access to the rehabilitated only maintenance road is a two-lane road with a speed limit of 35 miles per hour.

In addition to the above permanent impacts, approximately 9.02 acres of occupied habitat would be temporarily impacted during implementation of shoreline stabilization features within the project footprint, but this acreage would be replanted with coastal sage scrub vegetation once construction was complete (Table 9). Approximately 58.54 acres within the No Change Alternative project footprint provide preferred suitable biological characteristics for CAGN. Therefore, permanent impacts would affect approximately 5% of available native upland vegetation types within the project footprint. Temporary impacts would affect approximately 15% of available native upland vegetation types within the project footprint. Approximately 80% of available native upland vegetation types within the project area that provide preferred suitable biological characteristics for CAGN would not have been impacted by the No Change Alternative.

Direct and indirect impacts to CAGN include displacement of established territories causing adverse effects to one territory within the No Change Alternative project footprint. This would result in potential temporary displacement of one territory. This was assumed to be a temporary displacement as there are 46.63 acres of suitable CAGN habitat within the project action area that would not be impacted by the No Change Alternative. Based on observations of CAGN territory size which can range between two and 14 acres (FWS, 2010), the unaffected 46.63 acres of suitable CAGN habitat within the project action area would provide sufficient acreage for between 23 and three CAGN territories while construction would have been occurring. Once construction is complete, 9.02 acres of native and non-native upland vegetation temporarily impacted would be replanted with coastal sage scrub vegetation with suitable biological characteristics for CAGN. The replanted native vegetation would include similar species that are already present within the project area (i.e., black sage scrub, California sagebrush, laurel sumac, brittlebush scrub, etc.). In general, coastal sage scrub vegetation is considered early

successional and can have growth ranging from 12 to 22 inches after approximately two years (Howard, 1992; Tesky, 1993; and Hauser, 2006). The restoration of the temporarily impacted areas would provide acreage for up to five CAGN territories once the coastal sagebrush community reestablishes (i.e., within approximately two years). Therefore, as detailed above, native upland vegetation that contains preferred biological characteristics for CAGN would for the most part be temporarily impacted and native upland vegetation types unaffected during construction of the No Change Alternative should be able to provide sufficient habitat for CAGN with temporarily displaced territories within the project footprint.

Indirect impacts from construction of the No Change Alternative would have included noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair gnatcatchers and degrade air quality and human presence can cause vireos to abandon territories and nests.

To avoid and minimize potential impacts to CAGN, the USACE pursuant to formal consultation with the FWS will implement all the mitigation measures identified in full detail in Section 3.4.3.4. In addition, the USACE will implement all reasonable and prudent measures identified in the FWS's BiOp once the Final BiOp is provided to USACE.

To offset effects to CAGN from the No Change Alternative, the USACE would propose restoration of 17.69 acres of coastal sage scrub habitat within Prado Basin and/or within the Santa Ana River watershed below Prado Dam. Figure 18 and Figure 20 show potential parcels that may be available as coastal sage scrub mitigation for the Santiago Creek project. The potential parcels are approximately 11.46 acres (Figure 18) and 69.64 acres (Figure 20). The parcel shown in Figure 18 is located on USACE land identified as an "environmentally sensitive area". USACE continues to work to ensure the proposed mitigation site for the Santiago Creek project does not already contain mitigation for other components of SARMP. The availability of this site as mitigation sites for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The second (Figure 20) is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The 17.69 acres of coastal sage scrub habitat restored offsite will be monitored and managed according to MM BIO-5, MM BIO-8, and MM BIO (refer to Section 3.4.3.4 for a full description of these mitigation measures). In addition, 9.02 acres of coastal sage scrub would be replanted on site to offset temporary impacts to upland vegetation within the No Change Alternative project footprint. The 9.02 acres of native upland vegetation within the project footprint will be monitored and managed according to MM BIO-4 and MM BIO-10 (refer to Section 3.4.3.4 for a full description of these mitigation measures).

Based on the analysis described above, the USACE has determined that the No Change Alternative may affect, and is likely to adversely affect, CAGN.



Figure 18: Location of Potential Mitigation Sites Within Prado Basin for the Santiago Creek Project.



Figure 19: Additional Location of Potential Mitigation Sites Within Prado Basin for the Santiago Creek Project.



Figure 20: Additional Location of Potential Mitigation Sites within the Santa Ana River Watershed Below Prado Dam.

Other Special-Status Birds

The project would temporarily and permanently impact riparian and upland habitat, as detailed in previous sections. Based on recent surveys, vegetation removal would have the potential to impact breeding and foraging habitat for special-status bird species such as yellow warbler and osprey.

Measures described previously for listed species would also benefit these special-status species. Measures include scheduling vegetation removal activities outside of the nesting bird season, implementing biological monitoring, and requiring construction workers to take environmental training. Construction noise and increased human presence could potentially deter these species, open channel and adjacent open space areas upstream of the project area would allow these species to avoid these areas and utilize existing resources nearby. Therefore, the project would have a less than significant impact with mitigation incorporated on other special-status bird species.

Other Special-Status Species

The project area has suitable habitat present for other special-status species such as San Diego desert woodrat and coast whiptail, although neither species was observed during surveys. In addition, the project area also provides suitable foraging habitat for various bat species although none were observed during surveys. Measures to minimize and avoid impacts to other special-status species would include environmental training for crewmembers, pre-construction surveys for sensitive species, biological monitoring during construction, and development and implementation of a lighting plan to reduce potential effects to residents and wildlife. Considering the discussion above regarding the potential presence of other special-status species within the

project area, the project would have a less than significant impact with mitigation incorporated on other species-status species.

Proposed Action Alternative

Less than Significant with Mitigation Incorporated:

Federal-listed Wildlife Species
In accordance with Section 7(c) of the Endangered Species Act, the USACE obtained a list of federally listed and proposed species likely to occur in the Proposed Action area (Appendix 8). In addition, the USACE initiated formal consultation with the FWS regarding the Proposed Action Alternative and submitted a Biological Evaluation (BE) to the FWS on December 1, 2022 (Appendix 8). Upon receipt of the BA, the FWS reviewed the document for completeness to initiate formal consultation. In an email response dated December 21, 2022, the FWS stated that USACE's request and supplementary information did not include all the information necessary to initiate formal consultation and requested additional information for the initiation package to be considered complete. The USACE provided the additional information that was requested and/or a statement explaining why the information could not be made available at the time on February 24, 2023. Following the receipt of the additional information, the FWS acknowledged on April 5, 2023, that formal consultation was initiated upon receipt of the USACE's response letter from February. However, the FWS provided three additional comments and a fourth comment was provided on May 17, 2023. Due to the complexity of the comments, FWS requested an extension of the formal consultation period on July 7, 2023. The formal consultation period was completed on August 8, 2023, and it is anticipated that the FWS will issue their Final BiOp by September 22, 2023. Refer to Appendix 8 for Agency Coordination correspondence.

Least Bell's Vireo
Three (3) LBVI territories were observed within the action area. A total of approximately 1.46 acres of occupied habitat will be permanently impacted during implementation of shoreline stabilization within Smith Basin due to the rehabilitation of a maintenance road along the north side of the basin (0.17 acres mulefat thicket) and placement of buried riprap (1.29 acres Goodding's willow – red willow riparian woodland and forest) where willow may not be able to reestablish (Table 12). An alternative to rehabilitating the old maintenance road on the north side of Smith Basin was analyzed by USACE to minimize impacts to LBVI habitat. The alternative considered included building a maintenance road down to the bottom of Smith Basin that would connect to the existing maintenance road located along Villa Park Road. However, this alternative was not feasible because 1) the gradient of the slope along Villa Park Road is too steep to create a road that could be safely traversed down into the basin, 2) there is little to no shoulder along Villa Park Road when approaching the existing Smith Basin maintenance road which is a safety hazard for maintenance vehicles getting on and off the maintenance road, and 3) there would be a safety hazard for vehicles traveling along Villa Park Road and slow maintenance vehicles entering and exiting the roadway (i.e., no traffic light). For comparison, Villa Park Road is a four-lane highway with a speed limit of 50 miles per hour in the vicinity of Smith Basin. Conversely, Santiago Boulevard which would provide access to the rehabilitated maintenance road is a two-lane road with a speed limit of 35 miles per hour.

In addition to the above permanent impacts, a total of approximately 10.62 acres of occupied habitat will be temporarily impacted during implementation of shoreline stabilization within Smith Basin, but this acreage will be replanted with native riparian and wetland vegetation once construction is complete (Table 12). Approximately 26.2 acres of the project area provide preferred suitable biological characteristics for LBVI within the mapped areas. Therefore, permanent impacts would affect approximately 5.6% of available wetland and riparian vegetation within the Santiago Recharge Basins. Temporary impacts would affect approximately 40.5% of available wetland and riparian vegetation within the Santiago Recharge Basins. Approximately 53.9% of available wetland and riparian vegetation within the Santiago Recharge Basins that provide preferred suitable biological characteristics for LBVI would not be impacted by the

Proposed Action at all.

Direct and indirect impacts to LBVI include displacement of established territories causing adverse effects to three (3) territories within the action area. This would result in potential temporary displacement of three (3) territories. This is assumed to be a temporary displacement of these three (3) territories as there are 14.12 acres of suitable LBVI habitat within the Santiago Recharge Basins that would not be impacted by the Proposed Action. Based on observations of LBVI territory size which can range between 0.5 to 7.5 acres, the unaffected 14.12 acres of suitable LBVI habitat within the Santiago Recharge Basins provides sufficient acreage for between 28 to two (2) LBVI territories while construction of the Proposed Action is occurring (FWS, 1998b). Once construction of the Proposed Action is complete, 10.62 acres of wetland and riparian vegetation temporarily impacted would be replanted with wetland and riparian vegetation with suitable biological characteristics for LBVI. The replanted wetland and riparian vegetation would be dominated by willow species which typically take between two (2) to 10 years to become mature and begin producing seeds (Reed, 1993). Since LBVI have been characterized as preferring early successional habitat, the reestablishment of native willow vegetation within the temporarily impacted areas of the Proposed Action would provide early successional habitat that LBVI prefer to nest in (FWS, 1998b). Therefore, as detailed above, riparian and wetland vegetation that contains preferred biological characteristics for LBVI will for the most part only be temporarily impacted and riparian and wetland vegetation unaffected during the construction of the Proposed Action should provide sufficient habitat for LBVI with temporarily displaced territories within the action area.

Indirect impacts from construction of the Proposed Action includes noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair vireos and degrade air quality and human presence can cause vireos to abandon territories and nests.

To avoid and minimize potential impacts to LBVI the USACE pursuant to formal consultation with the FWS will implement all the mitigation measures identified in full detail in Section 3.4.3.4. In addition, the USACE will implement all reasonable and prudent measures identified in the FWS's BiOp once the Final BiOp is provided to USACE.

To offset effects to LBVI from the Proposed Action, the USACE would restore 17.92 acres of wetland and riparian vegetation within Prado Basin and/or within the Santa Ana River watershed below Prado Dam. Figure 18, Figure 19, and Figure 20 show potential riparian areas that may be used as mitigation for the Santiago Creek project. The potential riparian parcels are approximately 12.09 acres (Figure 18), 68.64 acres (Figure 19), and 11.35 acres (Figure 20). Two parcels are located on USACE land identified as "environmentally sensitive areas". USACE continues to work to ensure the proposed mitigation sites for the Santiago Creek project do not already contain mitigation for other components of SARMP. The availability of these sites as mitigation sites for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The third parcel is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The 17.92 acres of wetland/riparian habitat restored offsite will be monitored and managed according to MM BIO-2, MM BIO-6, MM BIO-7, and MM BIO-11 (refer to Section 3.4.3.4 for a full description of these mitigation measures). In addition, 11.91 acres of wetland and riparian vegetation would be replanted on site to offset temporary impacts to wetland and riparian vegetation within the project footprint. The 11.91 acres of native wetland and riparian vegetation within the project footprint will be monitored and managed according to MM BIO-1 and MM BIO-11 (refer to Section 3.4.3.4 for a full description of these mitigation measures).

Based on the analysis described above, the USACE has determined that the Proposed Action may affect, and is likely to adversely affect, LBVI. The USACE provided its determination to the FWS in a Biological Evaluation that was originally submitted December 1, 2022 (Appendix 8).

Formal consultation on the Proposed Action occurred from February 24, 2023, to August 8, 2023. USACE anticipates that the FWS will provide their Final BiOp for the Proposed Action on September 22, 2023. For additional details about consultation under Section 7 of the Endangered Species Act refer to Section 4.1.

Table 10: Summary of Proposed Offset and Vegetation Categories for the Proposed Action Alternative.

Plant Community Type	Total Acreage	Impact Type	Acres Impacted	Mitigation Ratio	Acres of Mitigation Onsite	Acres of Mitigation Offsite
Riparian and Wetland Vegetation Types						
Goodding's Willow – Red Willow Riparian Woodland and Forest	21.73	Permanent	1.29	5:1	0.00	6.45
		Temporary	9.19	2:1	9.19	9.19
Mulefat Thickets	4.47	Permanent	0.17	5:1	0.00	0.85
		Temporary	1.43	2:1	2.72	1.43
Upland Vegetation Types						
California Sagebrush – Black Sage Scrub	35.87	Permanent	1.53	3:1	0.00	4.59
		Temporary	7.18	2:1	7.18	7.18
Brittle Bush Scrub	16.57	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00
Fountain Grass Swards	5.58	Permanent	0.29	3:1	0.00	0.87
		Temporary	0.64	2:1	0.64	0.64
Laurel Sumac Scrub	6.10	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.24	2:1	0.24	0.24
Upland Mustards or Star-Thistle	1.97	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00
Wild Oats and Annual Brome Grasslands	3.78	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.19	2:1	0.19	0.19
Other Vegetation Types						
Unvegetated Channels and Slopes	3.81	Temporary	0.16	NA[1]	0.00	0.00
		Permanent	0.00	NA[1]	0.00	0.00
Developed	33.98	Temporary	3.53	NA[1]	0.00	0.00
		Permanent	0.15	NA[1]	0.00	0.00
Total Vegetation Acres	**133.86**	**Total Vegetation Acres Impacted**	**25.99**	**Total Mitigation Acres**	**20.16**	**31.63**

[1] No offsite mitigation is required for temporary impacts to non-riparian habitat.

Coastal California Gnatcatcher

One (1) CAGN territory was observed within the action area. A total of approximately 1.82 acres of occupied habitat will be permanently impacted within Smith Basin due to the rehabilitation of a maintenance road along the north side of the basin (1.31 acres California sagebrush – black sage scrub and 0.29 acre of fountain grass swards) and two tie-back walls in the Blue Diamond and Bond basins (0.22 acre California sagebrush – black sage scrub) (Table 12). An alternative to

rehabilitating the old maintenance road on the north side of Smith Basin was analyzed by USACE to minimize impacts to CAGN habitat. The alternative considered building a maintenance road down to the bottom of Smith Basin that would connect to the existing maintenance road located along Villa Park Road. However, this alternative was not feasible because 1) the gradient of the slope along Villa Park Road is too steep to create a road that could be safely traversed down into the basin, 2) there is little to no shoulder along Villa Park Road when approaching the existing Smith Basin maintenance road which is a safety hazard for maintenance vehicles getting on and off the maintenance road, and 3) there would be a safety hazard for vehicles traveling along Villa Park Road and slow maintenance vehicles entering and exiting the roadway (i.e., no traffic light). For comparison, Villa Park Road is a four-lane highway with a speed limit of 50 miles per hour in the vicinity of Smith Basin. Conversely, Santiago Boulevard which would provide access to the rehabilitated only maintenance road is a two-lane road with a speed limit of 35 miles per hour.

In addition to the above permanent impacts, a total of approximately 8.25 acres of occupied habitat (including 1.24 acre of existing mitigation sites will be temporarily impacted during implementation of shoreline stabilization within the Santiago Recharge Basins, but this acreage will be replanted with coastal sage scrub vegetation once construction is complete (Table 12). Approximately 58.54 acres of the project footprint provide preferred suitable biological characteristics for CAGN within the mapped areas. Therefore, permanent impacts would affect approximately 3.1% of available sage scrub vegetation within the Santiago Recharge Basins. Temporary impacts would affect approximately 14.1% of available sage scrub vegetation within the Santiago Recharge Basins. Approximately 82.8% of available sage scrub vegetation within the Santiago Recharge Basins that provide preferred suitable biological characteristics for CAGN would not be impacted by the Proposed Action at all.

Direct and indirect impacts to CAGN include displacement of established territories causing adverse effects to one (1) territory within the action area. This would result in potential temporary displacement of one territory. This is assumed to be a temporary displacement as there are 48.47 acres of suitable CAGN habitat within the Santiago Recharge Basins that would not be impacted by the Proposed Action. Based on observations of CAGN territory size which can range between two (2) and 14 acres (FWS, 2010), the unaffected 48.47 acres of suitable CAGN habitat within the Santiago Recharge Basins provides sufficient acreage for between 24 and three (3) CAGN territories while construction of the Proposed Action is occurring. Once construction of the Proposed Action is complete, 8.25 acres of upland vegetation temporarily impacted would be replanted with coastal sage scrub vegetation with suitable biological characteristics for CAGN. The replanted coastal sage scrub vegetation would include similar species that are within the Santiago Recharge Basins currently (i.e., black sage scrub, California sagebrush, laurel sumac, brittlebush scrub, etc.). In general, coastal sage scrub vegetation is considered early successional and can have growth ranging from 12 to 22 inches after approximately two (2) years (Howard, 1992; Tesky, 1993; and Hauser, 2006). Therefore, as detailed above, upland vegetation that contains preferred biological characteristics for CAGN will for the most part only be temporarily impacted and upland vegetation unaffected during the construction of the Proposed Action should provide sufficient habitat for CAGN with permanent and temporarily displaced territories within the action area.

Indirect impacts from construction of the Proposed Action includes noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair gnatcatchers and degrade air quality and human presence can cause vireos to abandon territories and nests.

To avoid and minimize potential impacts to CAGN, the USACE pursuant to formal consultation with the FWS will implement all the mitigation measures identified in full detail in Section 3.4.3.4. In addition, the USACE will implement all reasonable and prudent measures identified in the FWS's BiOp once the Final BiOp is provided to USACE.

To offset effects to CAGN from the Proposed Action, the USACE would restore 13.71 acres of coastal sage scrub habitat within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam. Figure 18 and Figure 20 show potential parcels that may be available as coastal sage scrub mitigation for the Santiago Creek project. The potential parcels are approximately 11.46 acres (Figure 18) and 69.64 acres (Figure 20). The parcel shown in Figure 18 is located on USACE land identified as an "environmentally sensitive areas". USACE continues to work to ensure the proposed mitigation site for the Santiago Creek project does not already contain mitigation for other components of SARMP. The availability of the site as mitigation sites for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The second (Figure 20) is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The 13.71 acres of coastal sage scrub habitat restored offsite will be monitored and managed according to MM BIO-5 and MM BIO-9 (refer to Section 3.4.3.4 for details). In addition, 8.25 acres of coastal sage scrub would be replanted on site to offset temporary impacts to upland vegetation within the project footprint. The 8.25 acres of native upland vegetation within the project footprint will be monitored and managed according to MM BIO-4 (refer to Section 3.4.3.4 for details).

Based on the analysis described above, the USACE has determined that the Proposed Action may affect, and is likely to adversely affect, CAGN. The USACE provided its determination to the FWS in a Biological Evaluation that was originally submitted December 1, 2022 (Appendix 8). Formal consultation on the Proposed Action occurred from February 24, 2023, to August 8, 2023. USACE anticipates that the FWS will provide their Final BiOp for the Proposed Action on September 22, 2023. For additional details about consultation under Section 7 of the Endangered Species Act refer to Section 4.1.

Other Special-Status Birds
Impacts of the Proposed Action would be similar to those described under the No Change Alternative for "Other Special-Status Birds;" therefore, refer to the analysis under the No Change Alternative (*a*).

Other Special-Status Species
Impacts of the Proposed Action would be similar to those described under the No Change Alternative for "Other Special-Status Species;" therefore, refer to the analysis under the No Change Alternative (*a*).

(b) *Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?*

No Change Alternative

Less than Significant with Mitigation Incorporated: As discussed above under the No Change Alternative (*a*), there are permanent and temporary adverse impacts to riparian habitat. MM BIO-2, MM BIO-8, and MM BIO-1 detail restoration of riparian habitat both onsite and offsite to offset these potential permanent and temporary impacts. Refer to the discussion under the No Change Alternative (*a*) for the specifics on the acres of vegetation impacted and how impacts to vegetation would be minimized. In addition to potential impacts to riparian habitat within the Santiago Recharge Basin, there is also the potential for impacts to mostly nonnative riparian habitat within the lower Santiago Creek channel. Those potential impacts are discussed here and not above under No Change Alternative (*a*) since the lower Santiago Creek channel under its existing condition does not provide suitable habitat for special status species nor have special status species been observed during surveys in the lower Santiago Creek channel.

In order to stabilize banks within the lower Santiago Creek channel, existing vegetation would need to be cleared for equipment to excavate the channel, place riprap, and bury the riprap with native substrates harvested during channel excavation. The clearing of existing vegetation would

result in the permanent loss of up to 0.38 acres coast live oak woodland and forest and 4.15 acres eucalyptus-tree of heaven-black locust groves (nonnative species). Approximately 0.42 acre of eucalyptus-tree of heaven-black locust groves (nonnative species) would be permanently impacted due to floodwall construction. In addition, approximately 5.82 acres unvegetated channels and slopes and 0.32 acre of developed land would be temporarily impacted. Although these habitats are dominated by non-native species individual native trees, including willows, Mexican elderberry and mulefat, occur throughout the lower Santiago Creek. The exact number of native trees that would be removed, including coast live oak would be determined in the next stage of design and appropriate mitigation implemented to offset the loss of these trees. Areas that are temporarily disturbed and where no flood wall is located would be restored to the extent feasible with native coastal sage scrub vegetation which would provide habitat and foraging benefits for native wildlife. Areas that are temporarily disturbed and where a floodwall is constructed would be restored to the extent feasible with native grasses. Native grasses would be necessary in the areas of the floodwalls since vegetation in these locations would need to be maintained in accordance with Corps [USACE] of Engineers Engineering Pamphlet (EP) 1110-2-18. EP 1110-2-18 requires that a minimum 15-feet down slope of a floodwall needs to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except for grasses for the purpose of erosion control.

The removal of 0.28 acres of California coast live oak woodland would constitute an adverse impact to native riparian habitat. In order to minimize potential impacts to California coast live oak woodland, a survey for California coast live oak trees and other native tree species within the project limits would be completed during detailed design when the channel design is further refined. The tree survey would identify the different species of trees more precisely. The refined channel design may allow for some native trees to remain in the channel where they currently exist. California coast live oak trees will be protected in place, if possible. All trees within the channel areas where floodwalls are required would likely need to be removed permanently for channel conveyance and to meet the design criteria. The native trees and vegetation to be avoided within the project limits will be flagged for trimming or protect in place. Once construction is complete, the lower Santiago Creek channel would be revegetated with native species and a strategy to replace California coast live oak would also be implemented. Overall, the potential impact to riparian habitat or other sensitive natural communities would potentially be significant, but with the implementation of MM BIO-2, MM BIO-8, and MM BIO-1, restoration of native vegetation in the lower Santiago Creek channel, and conducting a survey for California coast live oak trees and other native tree species during the next phase of design, the potential impact would be reduced to less than significant with mitigation incorporated.

Proposed Action Alternative

Less than Significant with Mitigation Incorporated: As discussed above under the Proposed Action Alternative (*a*), there are permanent and temporary adverse impacts to riparian habitat. MM BIO-2, MM BIO-8, and MM BIO-1 detail restoration/creation of riparian habitat both onsite and offsite to offset these potential permanent and temporary impacts. Refer to the discussion under the Proposed Action Alternative (*a*) for the specifics on the acres of vegetation impacted and how impacts to vegetation would be minimized. In addition to potential impacts to riparian habitat within the Santiago Recharge Basin, there is also the potential for impacts to mostly nonnative riparian habitat within the lower Santiago Creek channel. Those potential impacts are discussed here and not above under Proposed Action Alternative (*a*) since the lower Santiago Creek channel under its existing condition does not provide suitable habitat for special status species nor have special status species been observed during surveys in the lower Santiago Creek channel.

In order to stabilize banks within the lower Santiago Creek channel, existing vegetation would need to be cleared for equipment to excavate the channel, place riprap, and bury the riprap with native substrates harvested during channel excavation. The clearing of existing vegetation would result in the permanent loss of up to 0.38 acres of coast live oak woodland and forest and 4.15

acres of eucalyptus-tree of heaven-black locust groves (nonnative species). Approximately 0.42 acres of eucalyptus-tree of heaven-black locust groves (nonnative species) would be permanently impacted due to floodwall construction. In addition, approximately 5.82 acres of unvegetated channels and slopes and 0.32 acres of developed land would be temporarily impacted. Although these habitats are dominated by non-native species individual native trees, including willows, Mexican elderberry and mulefat, occur throughout the lower Santiago Creek channel. The exact number of native trees that would be removed, including coast live oak, would be determined in the next stage of design and appropriate mitigation implemented to offset the loss of these trees. Areas that are temporarily disturbed and where no flood wall is located would be restored to the extent feasible with native coastal sage scrub vegetation which would provide habitat and foraging benefits for native wildlife. Areas that are temporarily disturbed and where a floodwall is constructed would be restored to the extent feasible with native grasses. Native grasses would be necessary in the areas of the floodwalls since vegetation in these locations would need to be maintained in accordance with Corps [USACE] of Engineers Engineering Pamphlet (EP) 1110-2-18. EP 1110-2-18 which requires that a minimum 15-feet down slope of a floodwall needs to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except for grasses for the purpose of erosion control.

The potential removal of up to 0.38 acres of California coast live oak woodland would constitute an adverse impact to native riparian habitat. In order to minimize potential impacts to California coast live oak woodland, a survey for California coast live oak trees and other native tree species within the project limits would be completed during detailed design when the channel design is further refined. The tree survey would identify the different species of trees more precisely. The refined channel design may allow for some native trees to remain in the channel where they currently exist. California coast live oak trees will be protected in place, if possible. All trees within the channel areas where floodwalls are required would likely need to be removed permanently for channel conveyance and to meet the design criteria. The native trees and vegetation to be avoided within the project limits will be flagged for trimming or protect in place. Once construction is complete, the lower Santiago Creek channel would be revegetated with native species and a strategy to replace California coast live oak would also be implemented. Overall, the potential impact to riparian habitat or other sensitive natural communities would potentially be significant, but with the implementation of MM BIO-2, MM BIO-8, and MM BIO-1; restoration of native vegetation in the lower Santiago Creek channel; and conducting a survey for California coast live oak trees and other native tree species during the next phase of design, the potential impact would be reduced to less than significant with mitigation incorporated.

(c) *Have a substantial adverse effect on state or federally protected wetlands (including but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?*

No Change Alternative

Less than Significant with Mitigation Incorporated: The No Change Alternative would result in the permanent loss of non-wetland waters of the U.S. and State as shown in Table 11 as well as a temporary impact to non-wetland waters of the U.S. and State. It is important to note that in addition, the No Change Alternative would result in no permanent or temporary loss of wetland waters of the U.S but would result in the temporary loss of wetland waters of the State (Table 11). Finally, there would also be temporary and permanent impacts to CDFW jurisdictional waters and vegetation (Table 11).

Table 11: No Change Alternative Impacts to Jurisdictional Areas of the U.S./State.

Project Area	Impacts	USACE and SARWQCB Non-Wetland Waters of the U.S./State[a]	SARWQCB Wetland Waters of the State[b]	CDFW Jurisdictional Waters and Vegetation[c]
Lower Santiago Creek Channel	Permanent	0.0 ac	0.0 ac	0.0 ac
	Temporary	4.34 ac	0.0 ac	7.25 ac
Blue Diamond and Bond Basins	Permanent	1.40 ac	0.0 ac	2.36 ac
	Temporary	10.70 ac	0.03 ac	11.22 ac
Smith Basin	Permanent	0.0 ac	0.0 ac	0.0 ac
	Temporary	12.26 ac	1.62 ac	16.88 ac

[a] Non-wetland waters of the U.S. and non-wetland waters of the State are the same as based on California Code of Regulations, title 23, section 3831(w) which states that "[a]ll waters of the United States are also 'waters of the state.'" Therefore, as an example there are 4.34 acres of non-wetland waters of the U.S. and 4.34 acres of non-wetland waters of the state that would be temporarily impacted in the lower Santiago Creek channel under the No Change Alternative. Consistent with USACE regulatory practice, this category includes all areas below the OHWM even where wetland vegetation may be present.

[b] Wetland waters of the State allows for the presence of hydric substrates as a criterion for wetland identification (not just wetland soils) and wetland hydrology for an area devoid of vegetation (less than 5% cover) to be considered a wetland. Therefore, there are examples where waters may be considered wetlands by the state, but not by the federal wetland definition. Therefore, this category refers to wetland waters of the State only as there are no wetland waters of the U.S. present within the No Change Alternative project footprint.

[c] CDFW has jurisdiction over a larger area than the federal jurisdiction, therefore, the total acreage of CDFW jurisdictional waters and adjacent vegetation generally includes all federally jurisdictional waters, as well as additional adjacent state jurisdictional waters and habitats.

The No Change Alternative would permanently impact 1.40 acres of jurisdictional non-wetland waters of the U.S. and state due to the discharge or permanent fill required for construction of the above ground control structures (i.e., overflow, inlet, and outlet structures). In addition, the No Change Alternative would temporarily impact 27.30 acres of jurisdictional non-wetland waters of the U.S. and state. Temporary impacts would occur due to shoreline stabilization activities within the Santiago Recharge Basins as well as channel improvements within the lower Santiago Creek channel. Temporary impacts would also occur during the recontouring of Smith Basin. Permanent fill in the form of riprap would be placed within the lower Santiago Creek channel, but there would be no change in the channel invert meaning there would be no loss of jurisdictional non-wetland waters of the U.S. and state. Similarly, the shoreline stabilization activities include excavating material from the Blue Diamond/Bond basins and Smith Basin to then be used as fill material for the slope stabilization features. The act of cutting and filling would mean there would be no net loss of jurisdictional non-wetland waters of the U.S. and state. Once construction activities are complete, temporarily impacted areas would be recontoured to pre-project condition to the extent possible. A 404(b)(1) analysis was not prepared for the 'No Change Alternative' regarding temporary and permanent impacts to non-wetland waters of the U.S. as the No Change Alternative is not the preferred alternative for implementation.

Also as shown in Table 11, there are no jurisdictional wetland waters of the U.S. within the project area. Regarding the state, implementation of the No Change Alternative would not result in the permanent loss of wetland waters of the state. The No Change Alternative's would have temporary impacts to about 1.65 acres of wetland waters of the State. This was considered a temporary impact since once the project is completed the disturbed areas would be replanted with native riparian vegetation so the functions and values of the wetland habitat would return to the site once construction is done. In addition, under Section 7 consultation, USACE agreed to compensate for temporarily impacted wetland vegetation (which is habitat for the federally listed least Bell's vireo) not only onsite but also offsite at a 1:1 ratio (MM BIO-1 and MM BIO-2; Section 3.4.3.4). With the implementation of MM BIO-1 and MM BIO-2 (detailed in Section 3.4.3.4) there would be no net loss of wetland waters of the state and potential impacts would be less than significant with mitigation incorporated.

Regarding CDFW, the No Change Alternative would have a permanent impact on 2.36 acres and a temporary impact on 35.35 acres of CDFW jurisdictional waters and vegetation. If a Streambed Alteration Agreement is required of the non-federal sponsor for the permanent impacts to CDFW jurisdictional waters and vegetation an application will be completed during the next phase of design.

Proposed Action Alternative

Less than Significant with Mitigation Incorporated: The Proposed Action would not result in the permanent loss of non-wetland waters of the U.S. and State as shown in Table 12, but would result in temporary impacts to non-wetland waters of the U.S. and State. It is important to note that in addition, the Proposed Action would result in no permanent or temporary loss of wetland waters of the U.S but would result in the temporary loss of wetland waters of the State (Table 12). Finally, there would also be temporary impacts to CDFW jurisdictional waters and vegetation (Table 12).

Table 12: Proposed Action Alternative Impacts to Jurisdictional Areas of the U.S./State.

Project Area	Impacts	USACE and SARWQCB Non-Wetland Waters of the U.S./State[a]	SARWQCB Wetland Waters of the State[b]	CDFW Jurisdictional Waters and Vegetation[c]
Lower Santiago Creek Channel	Permanent	0.0 ac	0.0 ac	0.0 ac
	Temporary	4.34 ac	0.0 ac	7.25 ac
Blue Diamond and Bond Basins	Permanent	0.0 ac	0.0 ac	0.0 ac
	Temporary	8.11 ac	0.0 ac	8.11 ac
Smith Basin	Permanent	0.0 ac	0.0 ac	0.0 ac
	Temporary	12.26 ac	1.62 ac	16.88 ac

[a] Non-wetland waters of the U.S. and non-wetland waters of the State are the same as based on California Code of Regulations, title 23, section 3831(w) which states that "[a]ll waters of the United States are also 'waters of the state.'" Therefore, as an example there are 4.34 acres of non-wetland waters of the U.S. and 4.34 acres of non-wetland waters of the state that would be temporarily impacted in the lower Santiago Creek channel under the Proposed Change Alternative. Consistent with USACE regulatory practice, this category includes all areas below the OHWM even where wetland vegetation may be present.

[b] Wetland waters of the state allows for the presence of hydric substrates as a criterion for wetland identification (not just wetland soils) and wetland hydrology for an area devoid of vegetation (less than 5% cover) to be considered a wetland. Therefore, there are examples where waters may be considered wetlands by the state, but not by the federal wetland definition. Therefore, this category refers to wetland waters of the State only as there are no wetland waters of the U.S. present within the Proposed Action Alternative project footprint.

[c] CDFW has jurisdiction over a larger area than the federal jurisdiction, therefore, the total acreage of CDFW jurisdictional waters and adjacent vegetation generally includes all federally jurisdictional waters, as well as additional adjacent state jurisdictional waters and habitats.

The Proposed Action Alternative would not permanently impact any jurisdictional non-wetland waters of the U.S. and state since the above ground control structures are not included under this alternative. The Proposed Action Alternative would have temporary impacts to 24.71 acres of non-wetland waters of the U.S. and state. Temporary impacts would occur due to shoreline stabilization activities within the Santiago Recharge Basins as well as channel improvements within the lower Santiago Creek channel. Temporary impacts would also occur during the recontouring of Smith Basin and the creation a new low-flow channel. Permanent fill in the form of riprap would be placed within the lower Santiago Creek channel, but there would be no change in the channel invert meaning there would be no loss of jurisdictional non-wetland waters of the U.S. and state. Similarly, the shoreline stabilization activities and the recontouring of Smith Basin/low-flow channel include excavating material from the Blue Diamond/Bond basins and Smith Basin to then be used as fill material for the repairs. The act of cutting and filling would mean there would

be no net loss of jurisdictional non-wetland waters of the U.S. and state. Once construction activities are complete, temporarily impacted areas would be recontoured to pre-project condition to the extent possible. A 404(b)(1) analysis was prepared for the Proposed Action Alternative regarding temporary impacts to non-wetland waters of the U.S. The 404(b)(1) analysis can be found in Appendix 3.

Also as shown in Table 12, there are no jurisdictional wetland waters of the U.S. within the project area. Regarding the state, implementation of the Proposed Action Alternative would not result in the permanent loss of wetland waters of the state. The Proposed Action Alternative would have temporary impacts to about 1.62 acres of wetland waters of the state. This was considered a temporary impact since once the project is completed the disturbed areas would be replanted with native riparian vegetation so the functions and values of the wetland habitat would return to the site once construction is done. In addition, under Section 7 consultation, USACE agreed to compensate for temporarily impacted wetland vegetation (which is habitat for the federally listed least Bell's vireo) not only onsite but also offsite at a 1:1 ratio (MM BIO 1 and MM BIO-2; Section 3.4.3.4). With the implementation of MM BIO-1 and MM BIO-2 (detailed in Section 3.4.3.4) there would be no net loss of wetland waters of the state and potential impacts would be less than significant with mitigation incorporated.

Regarding CDFW, the Proposed Action Alternative would have a temporary impact on 32.24 acres of CDFW jurisdictional waters and vegetation. If a Streambed Alteration Agreement is required of the non-federal sponsor for the temporary impacts to CDFW jurisdictional waters and vegetation an application will be completed during the next phase of design.

(d) *Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?*

No Change Alternative

Less than Significant Impact with Mitigation Incorporated: Santiago Creek is the only wildlife movement corridor within the vicinity of the project area. Although the project includes burying riprap and then covering the riprap with native substrates to stabilize the lower Santiago Creek channel, no physical barrier would be constructed that would restrict the movement of native wildlife. Wildlife will be allowed to move freely through the project area. Additionally, project-related activities would occur during the day and would not interfere with any wildlife movement activity that occurs primarily at night. All vegetation clearing activities required for construction would occur outside of the nesting season to avoid impacts to nesting migratory birds (MM BIO-21; Section 3.4.3.4). Therefore, with the implementation of MM BIO-21 (detailed in Section 3.4.3.4) potential impacts to wildlife movement and nesting migratory birds would be less than significant with mitigation incorporated.

Proposed Action Alternative

Less than Significant Impact with Mitigation Incorporated: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction or an overflow channel or an outlet channel within the Santiago Recharge Basins.

(e) *Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?*

No Change Alternative

Less than Significant Impact: Table 11 shows the relevant local policies and ordinances within the project area that refer to the protection of biological resources. In addition to the local policies and ordinances listed in Table 11, the City of Santa Ana Code of Ordinances, Chapter 5, Article 1, Section 5.5 (Bird Sanctuary) notes that the City of Santa Ana is designated as a bird sanctuary. Signs bearing the legend "Santa Ana is a Bird Sanctuary" have been placed at appropriate locations at or near the city limits at principal entrances to the city to denote this designation, including a sign at the pedestrian bridge located where Baker Street dead ends at Santiago Creek (Figure 22). According to the Code of Ordinances, the designation of the City of Santa Ana as a bird sanctuary means that "[N]o person shall kill or injure any species of wild birds or molest or damage the nest or the eggs of any wild birds within the city. It shall be unlawful for any person to willfully kill or injure any song bird, or to molest, or damage the nest of such bird."



Figure 21: Picture of the "Santa Ana is a Bird Sanctuary" sign where Baker Street Dead Ends and a Pedestrian Bridge Crosses Santiago Creek.

The project would have temporary direct impacts to biological resources as construction would require the clearing of vegetation to access areas of the downstream channel reach for channel excavation, placement of riprap, and burying of riprap with harvested native substrates. The project would result in the permanent removal of up to 0.38 acres of coast live oak along the lower Santiago Creek channel. During the next phase of project design USACE will look at areas within the project footprint, if feasible, where California coast live oak can potentially be planted as replacement for any California coast live oak needing to be removed as part of the project. In addition, the clearing of vegetation would be required in certain areas of the Santiago Recharge Basins where access would be required and where project features would be constructed. However, the project also includes revegetating areas with native vegetation once construction is complete (MM BIO-1 and MM BIO-4 as detailed in Section 3.4.3.4). Native vegetation would be restored along the lower Santiago Creek channel and along shoreline stabilization features of the Santiago Recharge Basins. Only the outlet and overflow features would be unable to have native vegetation restored once construction is complete. Therefore, while construction is occurring the project would not meet objectives of land policies, but this would only be a temporary short-term

impact lasting only as long as construction is occurring. Once construction is complete and native vegetation has been reestablished the project would be anticipated to meet the objectives of the land policies shown in Table 13 long-term. Additionally, the restoration of native vegetation within the lower Santiago Creek channel, where existing condition vegetation is primarily non-native, could have a long-term overall beneficial impact for native birds and other wildlife. This is because native vegetation provides more choices of food and shelter for native birds and other wildlife than nonnative vegetation. Through native vegetation restoration the diversity and abundance of native wildlife within the lower Santiago Creek channel would be expected to increase over the existing condition. Overall, the project is expected to have a less than significant impact since there would be short-term temporary impacts to biological resources, but a long-term beneficial impact to biological resources.

Table 13: Relevant Local Policies and Ordinances for the Protection of Biological Resources within the City of Orange, Santa Ana, Villa Park, and County of Orange.

General Plan	Resource Element	Policy/Action Program	Description
City of Orange	Natural Resources	Policy 2.3	Reduce the amount of water used for landscaping through the use of native and drought-tolerant plants, proper soil preparation, and efficient irrigation systems as parks and other facilities are built or renovated.
		Policy 2.11	Protect the ecological integrity and overall health of Orange's watersheds.
		Policy 2.16	Protect in-stream habitat and natural stream and channel features.
		Policy 4.1	Preserve and protect native and habitat-supporting plant resources throughout the city.
		Policy 4.2	Work with agencies, including the Orange County Flood Control District, to identify opportunities to enhance the natural qualities of Santiago Creek to protect habitat and reintroduce native plants and animals.
		Policy 4.4	Repair or improve ecological and biological conditions in the urban and natural environments when reviewing proposals for site development and redevelopment, as well as public improvements.
		Policy 4.5	Protect the Santiago Creek and Santa Ana River corridors from premature urbanization to ensure the continued availability of important sand and gravel, flood control, water recharge, biological, and open space resources.
City of Santa Ana	Conservation Element	Policy	Preserve vegetation along watercourse channels.
City of Villa Park	Open Space/Conservation Element	Action Program	Continue to develop a water sensitive and drought tolerant landscaping program for medians and greenbelt areas to minimize costs and maximize functionality as open space.
			Maintain publicly owned space along

General Plan	Resource Element	Policy/Action Program	Description
			Santiago Creek to ensure that the existing recharge areas are preserved.
County of Orange	Resources Element	Policy 2.1	To ensure the health and safety of county residents by identifying, planning, and managing open space areas subject to flooding, landslides, noise, high fire hazards, and earthquake potential.
		Policy 3.1	To encourage the conservation of open space lands which prevent erosion, siltation, flood, and drought, and to discourage the early conversion of open space to some other land use.

Proposed Action Alternative

Less than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*e*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(f) *Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?*

No Change Alternative

No Impact: The Santiago Recharge Basins are located within the Natural Community Conservation Plan (NCCP) & Habitat Conservation Plan (HCP) for the County of Orange Central & Coastal Subregion for which a permit was issued in 1996. Although located within the boundaries of the NCCP & HCP, the Santiago Recharge Basins are depicted as having a low conservation value and is not included in the proposed NCCP Reserve boundaries. Therefore, the project would not conflict with the provisions of the NCCP and HCP and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*f*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.3.4 Environmental Commitments

Mitigation Measures

The following mitigation measures are the same as the conservation measures identified in USACE's Biological Evaluation (Appendix 8) required as part of formal consultation with the FWS under Section 7 of the Endangered Species Act. These conservation measures were first presented in the FWS 2001 BiOp for the Santa Ana River Mainstem Project, of which Santiago Creek is a component. Several of these conservation measures were then changed in FWS's 2012 amendment to the 2001 BiOp. A complete description of the changed conservation

measures was included as an attachment to the FWS's 2012 amendment. During the formal consultation period for the Santiago Creek project, USACE and FWS reviewed the conservation measures from the 2001 BiOp and the 2012 amendment for applicability to the Santiago Creek project. The following are the conservation measures (i.e., mitigation measures) for the Santiago Creek project that will be implemented as detailed below. Some of these conservation measures were modified specifically for the Santiago Creek project some of the conservation measures are worded the same as they were in the 2001 BiOp and/or the 2012 amendment.

Temporary Disturbance of Riparian/Wetland Habitat

MM BIO-1: Successfully restore each acre of riparian vegetation that is temporarily disturbed during construction-related activities. Keep all temporarily disturbed areas free of exotic plants until riparian vegetation is re-established. If the site(s) have not begun to recover within 5 years (i.e., 50 percent of the disturbed areas are not vegetated with young riparian vegetation), then the site(s) will be replanted with cuttings from native riparian species.

MM BIO-2: Remove 1 acre of giant reed from the upper Santa Ana River watershed and/or action area for each acre of riparian/wetland vegetation that is temporarily disturbed during construction related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage giant reed-free for the life of the project;

OR:

Remove 3 acres of giant reed for each acre of temporary impact and maintain this acreage giant reed-free for a minimum of 5 years.

MM BIO-3: Conduct brown-headed cowbird (*Molothrus ater*, "cowbird") removal trapping at a minimum of 2 sites in the Santiago Basins (or other areas along the Santa Ana River and environs where trapping would likely be more effective for vireo productivity, subject to review and approval by the Service [FWS], during all years when construction of the Project is occurring and 5 years following construction. Trapping will occur during the vireo egg-laying season (March 15 to July 30). This effort is intended to supplement on-going cowbird trapping activities elsewhere in the Santa Ana River Watershed.

Temporary Disturbance of Non-riparian (Upland) Habitat Within the Flood Plain

MM BIO-4: Successfully restore each acre of non-riparian vegetation that is temporarily disturbed during construction-related activities.[1] Non-riparian areas that are temporarily disturbed will be maintained free of exotic/invasive plants[2] for a minimum of 8 years. Container plants will be planted and irrigated in upland areas to expedite the restoration process. Restoration plantings will achieve 70 percent plant cover, including 60 percent native shrub cover, after 5 years, with understory species and less than 10 percent cover by non-native species. If 70 percent of the disturbed areas are not vegetated with woody native shrub species within 5 years, then the site will be replanted or re-seeded as needed until a minimum of 70 percent cover is attained.

MM BIO-5: Restore 1 acre of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat (i.e., both native and non-native)[3] that is temporarily disturbed during construction-related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside,

[1] Restoration is defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed [Source: Society of Ecological Restoration and Policy Working Group. 2002. The SER primer on ecological restoration. Science & Policy Working Group.] Existing native vegetation within a proposed restoration area will not be counted towards the acreage restored.

[2] Plants identified by the California Invasive Plant Council as invasive plants for southern California.

[3] All upland vegetation types (BE, Table 6) are considered occupied gnatcatcher habitat.

and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage free of non-native/exotic plant species for the life of the project.

Permanent Loss of Riparian Habitat
MM BIO-6: Successfully restore 3 acres of riparian vegetation within the action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities.

OR

MM BIO-7: Remove 5 acres of giant reed from the upper Santa Ana River watershed and/or action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities; actively monitor and manage this acreage for a period of 5 years; and then arrange for the local sponsors and/or another approved entity such as the SAWA to maintain this acreage giant reed-free for the life of the project; and conduct cowbird removal trapping in the vicinity of the restored habitat for the life of the project.

Note: A combination of these alternatives can be used to fulfill the requirements of this conservation measure.

Permanent Loss of Non-riparian (Upland) Habitat Within the Flood Plain
MM BIO-8: Successfully restore 3 acres of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat that is permanently destroyed or isolated from the flood plain during construction-related activities (estimated total of destroyed or isolated gnatcatcher habitat is approximately 1.82 acres and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino)) and/or another approved entity such as the SAWA to maintain this acreage free of exotic/invasive plants for the life of the project.

General Habitat Restoration Measures
MM BIO-9: Restoration activities will be initiated as soon as project activities within the restoration area are completed. Restoration activities will be initiated immediately following the completion of project activities within the restoration area. Restoration activities will occur during the non-breeding season for vireos (if adjacent to occupied vireo habitat).
MM BIO-10: Restoration of coastal sage scrub habitat will be considered successful when the following target/threshold objectives are met: 1) a minimum absolute ground cover of 70 percent native woody plant species and 10 percent native herbaceous species; 2) no more than 10 percent absolute ground cover of exotic/invasive plants, including no plants identified by the California Invasive Plant Council as invasive plants for southern California with an invasive rating of "high"[4]; 3) the shrub layer will consist of a minimum of 30 percent absolute ground cover of California sagebrush (*Artemisia californica*), and a minimum of 5 percent absolute ground cover of each of 4 or more of the following: California buckwheat (*Eriogonum fasciculatum*), California brittlebush (*Encelia californica*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), coast goldenbush (*Isocoma menzesii*); coyote bush (*Baccharis pilularis*), and bush monkey flower (*Diplacus aurantiacus*); 4) the herbaceous layer will consist of a minimum of 5 percent relative cover of each of 5 or more species from the seed mix provided in the BE or the following species: ladies' tobacco (*Pseudognaphalium californicum*), clustered tarplant (*Deinandra fasciculata*), golden yarrow (*Eriophyllum confertiflorum*), purple needlegrass (*Stipa pulchra*), California poppy (*Eschscholzia californica*), small fescue (*Festuca microstachys*), California brome (*Bromus carinatus*), dwarf goldfields (*Lasthenia californica*), dove lupine (*Lupinus bicolor*), and giant wild rye (*Elymus condensatus*); 5) the recruitment of native plant seedlings must be documented to occur within the replanted areas; 6) a positive trend in the diversity and absolute ground cover of

[4] These species must be treated with lethal control methods and removed, cut down, or destroyed prior to seed production in any given year.

native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 7) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to suitable coastal sage scrub habitat occupied by gnatcatchers in the vicinity. Alternatively, coastal sage scrub restoration efforts can be considered successful if the habitat is occupied by a breeding pair of gnatcatchers. In addition, habitat must sustain itself for 2 consecutive years without supplemental water.

MM BIO-11: Restoration of riparian habitat will be considered successful when the following target/threshold objectives are met: 1) a minimum of 30 percent absolute ground cover of native plant species; 2) less than 10 percent absolute ground cover of exotic plant species (including 0 percent giant reed); 3) the absolute ground cover of native species must be represented by, at least, five dominant or co-dominant plant species; 4) the recruitment of native plant seedlings must be documented to occur within the replanted areas; 5) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 6) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to habitat occupied by vireos in the vicinity. Alternatively, riparian vegetation efforts can be considered successful if the habitat is occupied by a breeding pair of vireos, flycatchers, and/or yellow-breasted chats (*Icteria virens*). In addition, habitat must sustain itself for 2 consecutive years without supplemental water.

MM BIO-12: All acres of restored coastal sage scrub and riparian habitat for offset of permanent impacts will be protected in perpetuity through proper legal instruments for the conservation of federal and state listed species and their habitats.

MM BIO-13: The Corps [USACE] will ensure that the local sponsors commit to funding a cowbird trapping program in the vicinity of the restored riparian habitat for the life of the project. Program specifics (e.g., number and locations of traps) will be determined in conjunction with permitting processes for the CDFW and FWS.

MM BIO-14: Mitigation will be initiated as soon as practicable for impacts that occur during the first year of construction. Afterwards, mitigation will be initiated-prior to construction of individual project features. For restoration options that include management for the life of the project, the Corps [USACE] will continue exotic species removal (e.g., giant reed) and cowbird control until such time as the Service [FWS] receives written documentation that the local sponsors and/or another approved entity (such as SAWA) have accepted responsibility for management of the restored area(s). Written documentation will include an estimate of costs associated with management responsibilities and a description of the funding mechanism(s) that will be used to ensure management will continue for the life of the project. If SAWA or another non-public entity accepts management responsibility and then becomes unwilling or unable to continue, then responsibility for continued management will revert to the local sponsors. Any advance mitigation that exceeds the requirements of the project (i.e., if actual project impacts are less than what was anticipated when the mitigation was initiated), may be credited as compensation for the effects of future projects.

MM BIO-15: Identify and delineate on well-labeled maps the specific areas in the upper Santa Ana River watershed and/or action area from which giant reed will be or has been removed, and riparian vegetation restored, as compensation for the proposed action. These areas must be approved by the local sponsors, CDFW, FWS, and USACE. An annual report will be prepared for the Service [FWS] by the approved management entity (e.g., SAWA) that address the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management; and 4) updated mapping that delineates areas in the upper Santa Ana River watershed and/or action area from which giant reed has been removed.

MM BIO-16: Identify and delineate on well-labeled maps the specific areas in the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado

Basin that coastal sage scrub will be restored, as compensation for the proposed action. These areas must be approved by the local sponsors, and the Service [FWS] prior to initiation of coastal sage scrub restoration. An annual report will be prepared for the Service [FWS] by the Corps [USACE] until coastal sage scrub is considered successful that addresses the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management and; 4) progress towards meeting success criteria.

MM BIO-17: Request that the administrator of the Trust Fund identify those acres within the Santa Ana watershed where giant reed was previously removed and/or habitat restored using the $1,000,000 contributed by the OCWD in lieu of restoring 133 acres of riparian habitat in the Prado Basin. This acreage will be actively monitored and managed until riparian habitat is completely restored, and then maintained giant-reed free for the life of the project.

General Conservation Measures for the Vireo, Gnatcatcher, and Flycatcher

MM BIO-18: During Project design, the Corps [USACE] will consider an alternative for the proposed maintenance road in Smith Basin that allows for permanent access to Smith Basin from Villa Park Road.

MM BIO-19: A monitoring program will be developed and implemented within the Project site that entails surveys for the vireo and gnatcatcher during spring and early summer of the year prior to construction and, also, during each year of construction. Construction activities will be monitored to assure that vegetation is removed only in the designated areas. The limits of riparian/coastal sage scrub areas not to be disturbed will be flagged and not encroached upon.

MM BIO-20: Each employee, contractor, or subcontractor involved in the project construction (including temporary contractors and subcontractors) will be briefed on the following information prior to working within or near areas that may affect federally listed species and proposed species: 1) general types and locations of sensitive habitats and federally listed and proposed species that may occur in the action area; 2) measures that will be taken to avoid and minimize incidental take during construction activities; 3) location of conservation and protected areas within the action area; 4) reporting procedures for observations of federally listed and proposed species; 5) reporting procedures for incidents involving the take or potential for take of listed and proposed species; 6) information regarding whom to contact at FWS to report non-compliance with the conservation measures in the biological opinions and terms and conditions of the incidental take statement (or other potential violations of the Act); and 7) applicable permit conditions stipulated by the CDFW and/or other regulatory agencies.

MM BIO-21: Vegetation clearing associated with project construction will take place only during periods when the vireo and gnatcatcher are not nesting (August 15 through February 15).

MM BIO-22: The construction contractor will minimize grading activities and leave root systems intact, to the extent practicable.

MM BIO-23: To the maximum extent practicable, haul routes and staging areas will be located outside of the flood plain (e.g., along bike trails, levees, and roads). All equipment maintenance, staging, and dispensing of fuel, oil, coolant, or any other toxic substance will occur in developed or designated non-sensitive upland areas. Best Management Practices (BMPs) will be implemented in these areas to prevent runoff carrying potentially toxic substances from entering the Santiago Creek and associated drainages. If a spill occurs outside of a designated area, the cleanup will be immediate and documented.

MM BIO-24: During construction, riparian vegetation adjacent to de-watering areas will be monitored. Supplemental water will be added to this vegetation as necessary to avoid water stress.

MM BIO-25: To reduce fire hazards, a water truck will always be present during construction activities. Fire suppression equipment including shovels, water, and extinguishers will also be available onsite during the fire season (as determined by Orange County Fire District) and when activities may produce sparks. Construction activities will comply with the fire prevention and protection practices set forth in the USACE's Safety and Health Requirements Manual (EM 385-1-1). The provisions of EM 385-1-1 will be incorporated into all construction specifications, and the contractor will be required to prepare a fire prevention and protection plan for the construction project.

MM BIO-26: Dust control measures will be implemented during construction to reduce excessive dust emissions. Methods for reducing dust emissions may include wetting work areas, such as dirt access roads and sediment stockpiles, on a regular basis, as well as covering truck beds carrying material and stockpiles.

MM BIO-27: To the extent feasible, the contractor will prevent exotic weeds from establishing within the work site during construction. Construction equipment will be cleaned of mud or other debris prior to mobilizing and before leaving the site to reduce the potential spread of invasive plants and/or seeds.

MM BIO-28: Excavated materials will be backfilled over the toe stabilization structures. The contractor will replace surface material and re-grade disturbed soft-bottomed substrate areas, in particular the low-flow river channel, to replicate pre-project conditions. USACE will continue to coordinate with FWS to develop and improve measures for re-establishing habitat values within the construction area.

<u>General Conservation Measures to Maintain Wildlife Movement Through Action Area</u>
MM BIO-29: Native plant species will be used to revegetate disturbed upland areas.

MM BIO-30: A monitoring protocol will be developed and implemented for raptor monitoring, including bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) potentially occurring in the proposed Project footprint during construction. If eagles are foraging or otherwise using the Project footprint, the Corps [USACE] will coordinate with the Service [FWS] to develop appropriate avoidance measures.

MM BIO-31: Prior to any ground-disturbing activities (e.g., mechanized clearing or rough grading) for all project related construction activities, a Corps [USACE] biologist (or biological monitor) will conduct pre-construction surveys of the proposed Project area for terrestrial special-status species. During these surveys, the biologist will:

a. Inspect the proposed Project area for any sensitive wildlife species; and

b. In the event of the discovery of a non-listed, special-status ground-dwelling animal, such as burrowing owl or special-status reptile, attempts will be made to recover and relocate the animal to adjacent suitable habitat within the Proposed Project area at least 200 feet from the limits of construction activities. Burrowing owl surveys and relocations would follow the Burrowing Owl Survey Protocol and Mitigation Guidelines (California Burrowing Owl Consortium 1993).

MM BIO-32: For construction activities within or adjacent to occupied vireo, or gnatcatcher habitat, the following measures shall be implemented to reduce or avoid noise impacts:

1. Prior to the commencement of construction activities, ambient noise levels will be measured at 50 feet and 100 feet from the proposed boundaries of the construction sites and recorded in a graphic format.

2. Sound walls shall be constructed at the boundary of the proposed construction site

and/or haul route prior to February 15. Sound walls will probably consist of ½ inch-thick, 8 feet-high plywood sheets. The construction contractor may use other materials or procedures that attenuate sound to acceptable levels, defined below (MM BIO-32 #3 and #4).

3. Where ambient noise is less than 60 dBA and it is determined that construction-related noise levels may exceed 60 dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction-related noise does not exceed 60 dBA within these areas. If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within occupied habitat areas outside the project footprint cannot be reduced below 60 dBA Leq hourly during the period of February 15 through August 15 of any year, the Corps [USACE] will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat outside the project footprint[5] subject to noise levels over 60 dBA Leq hourly during the noted period, per the number of breeding seasons will result in 2 acres of restoration; 1 acre of riparian habitat affected by two separate project phases or segments in a single breeding season will result in 1 acre of restoration). The area affected will be determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps [USACE] will identify restoration areas in coordination with the Service [FWS].

4. Where pre-construction ambient noise is greater than 60 dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction does not result in a significant increase over ambient conditions (i.e., noise level increases shall not exceed 5 dBA over ambient). If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within riparian/coastal sage scrub habitat areas outside the project footprint cannot be reduced to or below 5 dBA Leq hourly over ambient noise levels during the period of February 15 through August 15 of any year, the Corps [USACE] will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat subject to noise levels more than 5 dBA Leq hourly over ambient during the noted period, as determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps [USACE] will identify restoration areas in coordination with the Service [FWS].

Best Management Practices

There are no BMPs proposed for biological resources, although the mitigation measures detailed above include actions that could be considered BMPs.

3.4.4 Cultural Resources

This section describes the existing conditions for cultural resources, regulatory background, significance thresholds, effect analysis, and a qualitative analysis of effects.

[5] Includes all riparian and upland vegetation types (BE, Table 6) outside the mapped project footprint (Figures 1 and 2). Leq hourly noise level contours for project construction activities during the vireo and gnatcatcher breeding and nesting season will be calculated and reported for the areas adjacent to the project footprint based on noise monitoring to be performed, as appropriate.

3.4.4.1 Regulatory Setting

- National Historic Preservation Act (NHPA)
- Native American Grave Protection and Repatriation Act (NAGPRA)
- Archaeological Resources Protection Act (ARPA)
- American Indian Religious Freedom Act (AIRFA)
- EO 12898
- CEQA
- California Health and Safety Code, Section 7050.5
- AB 52
- SB 18

3.4.4.2 Existing Conditions

Cultural resources include prehistoric archaeological sites, historic archaeological sites, historic structures, and artifacts made by people in the past.

Prehistoric archaeological sites are places that contain in the material remains of activities carried out by the native population of the area (Native Americans) prior to the arrival of Europeans in southern California. Prehistoric sites contain three or more artifacts, or where there is a feature such as a foundation or bedrock mortar. A site that contains three or less artifacts is called an isolate. Artifacts found in prehistoric sites include flaked stone tools such as projectile points, knives, scrapers, and drills; ground stone tools such as manos, metates, mortars, and pestles for grinding seeds and nuts; and bone tools. Prehistoric facilities and features include hearths, bedrock mortars, rock shelters, rock art, and burials.

Historic archaeological sites are places that contain the material remains of activities carried out by people during the period when written records were produced after the arrival of Europeans. Historic archaeological material usually consists of refuse, such as bottles, cans, and food waste, deposited near structure foundations. Archaeological investigation of historic period sites is usually supplemented by historical research using written records.

Historic structures include houses, commercial structures, industrial facilities, and other structures and facilities more than 50 years old.

Project Area Record Searches

A record search was conducted by South Central Coastal Information Center within a ½ mile radius of the area of potential effect (APE) to identify any known historic properties (USACE, 2023). There have been twelve previous surveys performed within the project APE, covering the entirety of the project area. There are no properties listed or eligible for the National Register of Historic Places (NRHP) or recorded archaeological sites within the project APE. There are seven archaeological sites within a ½ mile radius that will not be affected by the proposed project. Due to the level of disturbance and modification within the APE, it is unlikely that intact archaeological deposits would be present and further archaeological testing is not recommended.

3.4.4.3 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects on cultural resources would be considered significant if the project would result in any of the following:

a) Cause a substantial adverse change in the significance of a historical resource pursuant to § 15064.5;
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to § 15064.5; or
c) Disturb any human remains, including those interred outside of formal cemeteries.

In California, under CEQA, effects to a historic resource or unique archaeological resource are adverse if they materially impair the significance of a historical or archaeological resource.

No Construction Alternative

Under the No Construction alternative, no project would be constructed. As a result, the No Construction alternative would not cause a substantial adverse change in the significance of a historical resource; cause a substantial adverse change in the significance of an archaeological resource; or disturb any human remains.

(a) *Cause a substantial adverse change in the significance of a historical resource pursuant to § 15064.5?*

No Change Alternative

Less than Significant Impact: There are no historic resources present within the project area. The lower Santiago Creek channel portion of the project is adjacent to the Floral Park Historic District; however, the historic homes are located outside of the project footprint and special equipment such as the Giken Silent Piler will be used during construction to limit both noise and vibratory disturbances. Furthermore, the no change alternative would increase flood protection of homes located within the Floral Park Historic District. In addition, a determination of no affect was sent to SHPO on March 21, 2023. Under 36 C.F.R. 800.5(c)(1),SHPO concurrence has been waived since after the close of the original 30-day review period (i.e., April 20, 2023) SHPO had not provided a response and no consulting party had objected. As a result, this alternative would not cause a substantial adverse change in the significance of a historical resource.

Proposed Action Alternative

Less than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) *Cause a substantial adverse change in the significance of an archaeological resource pursuant to § 15064.5?*

No Change Alternative

Less than Significant Impact: There are no historic resources present within the project area. The lower Santiago Creek channel portion of the project is adjacent to the Floral Park Historic District; however, the historic homes are located outside of the project footprint and special equipment such as the Giken Silent Piler will be used during construction to limit both noise and vibratory disturbances. Furthermore, the No Change Alternative would increase flood protection of homes located within the Floral Park Historic District. In addition, a determination of no affect was sent to SHPO on March 21, 2023. Under 36 C.F.R. 800.5(c)(1), SHPO concurrence has been waived since after the close of the original 30-day review period (i.e., April 20, 2023) SHPO had not provided a response and no consulting party had objected. As a result, this alternative would not cause a substantial adverse change in the significance of an archaeological resource.

Proposed Action Alternative

Less than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be

similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c) *Disturb any human remains, including those interred outside of formal cemeteries?*

No Change Alternative

Less than Significant Impact: Due to the level of past disturbance in the project area, it is not anticipated that human remains, including those interred outside of formal cemeteries, would be encountered during earth removal or disturbance activities. However, in the unexpected event human remains are found, those remains would require proper treatment, in accordance with applicable laws. Procedures of conduct following the discovery of human remains on non-federal lands have been mandated by California Health and Safety Code (CHSC) § 7050.5, Public Resources Code (PRC) § 5097.98, and the California Code of Regulations (CCR) Title 14 § 15064.5(e). According to the provisions in the CEQA, should human remains be encountered, all work in the immediate area must be halted. The Construction Contractor shall notify the county coroner of the find immediately and no further disturbance shall occur until the county coroner has decided the origin and disposition pursuant to PRC Section 5097.98 (State of California, 2006). If human remains are found during grading and excavation work, all work in the immediate area (a radius of at least 100-ft) shall stop, and all parties shall follow all applicable state laws regarding human remains. If the remains are Native American, the coroner is responsible for contacting the California Native American Heritage Commission (NAHC) within 24 hours. The NAHC, pursuant to Section 5097.98, shall immediately notify those persons it believes to be the Most Likely Descendent (MLD). The MLD shall complete the inspection of the project site within 48 hours of being allowed access to the project site and shall recommend preservation in place, reburial, or the scientific removal and nondestructive analysis of human remains and items associated with Native American burials. Therefore, potential impacts associated with human remains would be less than significant with compliance with existing regulations and procedures outlined in the CHSC and the CCR and no mitigation would be required.

Proposed Action Alternative

Less than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.4.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be less than significant impacts to cultural resources.

3.4.5 Energy

This section describes the existing conditions for energy usage, regulatory background, significance thresholds, effect analysis, and a qualitative analysis of effects.

3.4.5.1 Regulatory Background

- Federal Power Act
- Warren-Alquist Act
- Building Energy Efficiency Standards

3.4.5.2 Existing Conditions

Southern California Edison (SCE) provides electrical services to the project area through state-regulated public utility contracts. SCE, the largest subsidiary of Edison International, is the

primary electricity supply company for much of southern California. It provides 14 million people with electricity across a service territory of approximately 50,000-mi^2. SCE has met or exceeded all Renewable Portfolio Standard requirements to date, procuring renewable energy from diverse sources, including biomass, biowaste, geothermal, hydroelectric, solar, and wind. This standard directs all California utilities to generate 60 percent of their electricity from renewables by 2030 and 100 percent by 2045.

The Southern California Gas Company (SoCalGas) provides natural gas services to the project area. As the nation's largest natural gas distribution utility, SoCalGas delivers natural gas energy to 212.6 million consumers through 5.0 million meters in more than 500 communities. SoCalGas's service territory encompasses approximately 20,000-mi^2 through central and southern California from Visalia to the Mexican border.

Electricity use is measured in kilowatt-hours (kWh), and natural gas is measures in therms. Vehicle fuel use is typically measured in gallons (e.g., of gasoline or diesel fuel), although energy use for electric vehicles is measured in kWh.

The electricity consumption attributable to non-residential land uses (commercial and industrial) in Orange County from 2015 to 2019 (the most recent year that data is available) is shown in Table 14. As indicated, the demand has decreased since 2015.

Table 14: Non-Residential Electricity Consumption in Orange County 2015-2019.

Year	Non-Residential Electricity Consumption (kWh)
2019	12,798,262,948
2018	13,169,931,037
2017	13,391,341,065
2016	13,520,248,181
2015	13,827,791,386
Source: ECDMS, 2021a	

The natural gas consumption attributable to non-residential land uses in Orange County from 2015 to 2019 (the most recent year that data is available) is shown in Table 15. As shown, natural gas demand has declined slightly since 2015.

Table 15: Non-Residential Natural Gas Consumption in Orange County 2015-2019.

Year	Non-Residential Natural Gas Consumption (therms)
2019	241,010,480
2018	236,073,479
2017	232,285,127
2016	232,223,485
2015	227,551,930
Source: ECDMS 2021b	

Gasoline and diesel fuel consumption for the entire state of California from 2015 to 2019 is shown in Table 16.

Table 16: Gasoline and Diesel Fuel Consumption in California 2015-2019.

Year	Gasoline Fuel Consumption (Gasoline Gallon Equivelents)	Diesel Fuel Consumption (Gasoline Gallon Equivalents)
2019	14,448,717,202	3,983,389,783
2018	14,682,849,701	4,026,196,876
2017	14,742,832,821	3,968,835,038
2016	14,674,036,965	3,843,118,327

Year	Gasoline Fuel Consumption (Gasoline Gallon Equivelents)	Diesel Fuel Consumption (Gasoline Gallon Equivalents)
2015	14,397,788,078	3,859,354,066
Source: U.S. Department of Energy 2021		

3.4.5.3 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, the project would result in a potentially significant impact to energy if it would:

a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation; or
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency.

No Construction Alternative

Under the No Construction alternative, no project would be constructed. As a result, the No Construction alternative would not result in potentially significant environmental impact due to unnecessary consumption of energy resources, or conflict with or obstruct a state or local plan for renewable energy or energy efficiency. Maintenance activities within the flood control channel and the Santiago Recharge Basins would continue to be carried out by OCPW.

(a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?

No Change Alternative

Less Than Significant Impact: Short-term the project would directly consume energy during construction activities primarily from on- and off-road vehicle fuel consumption in the form of diesel, gasoline, and electricity from water conveyance for dust control. Long-term, project operation would directly consume energy from maintenance activities. The analysis below includes the project's energy requirements and energy use efficiencies by energy type for each stage of the project (i.e., construction and operations).

Construction (Short-term)

The estimated fuel usage for off-road equipment is based on the number and type of equipment that would be used during construction activities, hour usage estimates, the total duration of construction activities, and hourly equipment fuel consumption factors from the CARB OFFROAD model, which was used in the air quality analysis. On-road vehicles would include trucks to haul material to and from the project site, vendor trucks to deliver supplies necessary for construction, and fuel used for employee commute trips. Construction activities typically do not involve the consumption of natural gas. Table 17 summarizes the project's total fuel and electricity consumption from construction activities.

Table 17: Summary of Energy Consumption During Project Construction

Fuel Type	Quantity
Gasoline	***Gallons***
On-Road Construction Trips	76,401
Off-Road Construction Equipment	1,607
Total Gasoline	***78,008***
Diesel	***Gallons***
On-Road Construction Trips	498,855

Fuel Type	Quantity
Off-Road Construction Equipment	313,685
Total Diesel	***812,540***

The energy use summary provided above in Table 17 represents the amount of energy that could potentially be consumed during project construction based on a conservative set of assumptions. As shown, on- and off-road vehicles would consume an estimated 78,008 gallons of gasoline and approximately 812,540 gallons of diesel fuel. For comparison purposes, the fuel usage during project construction would represent less than 0 percent of the 2019 annual on-road gasoline-related energy consumption and 0.02 percent of the 2019 annual diesel fuel-related energy consumption in Orange County.

The construction contractors would comply with applicable CARB regulation governing the accelerated retrofitting, repowering, or replacement of heavy-duty diesel on- and off-road equipment. CARB adopted an Airborne Toxic Control Measure to limit heavy-duty diesel motor vehicle idling time in order to reduce public exposure to diesel particulate matter and other toxic air contaminants. CARB approved the Truck and Bus regulation to reduce NO_X, PM_{10}, and $PM_{2.5}$ emissions from existing diesel vehicles operating in California. In addition to limiting exhaust from idling trucks, CARB recently promulgated emission standards for off-road diesel construction equipment of greater than 25-hp to reduce emissions by requiring the installation of diesel soot filters and encouraging the retirement, replacement, or repower of older, dirtier engines with newer emission-controlled models.

While intended to reduce construction criteria pollutant emissions, compliance with the above listed anti-idling and emissions regulations would also result in efficient use of construction-related energy and the minimization or elimination of wasteful and unnecessary consumption of energy. According to the CARB staff report that was prepared at the time the anti-idling ATCM was being proposed for adoption in late 2004/early 2005, the regulation was estimated to reduce non-essential idling and associated emissions of diesel particulate matter and NO_X emissions by 64 and 78 percent respectively in analysis year 2009.

These reductions in emissions are directly attributable to overall reduced idling times and fuel combustion because of compliance with regulation. Heavy-duty engines continue to become more efficient and reduction amounts may lessen in the future due to this. Although the energy savings cannot be accurately quantified, the project would still reduce consumption of diesel fuel under the anti-idling measure. Construction electricity use would be temporary, sporadic, and would cease upon completion of construction. Electricity for water conveyance would only be used when necessary to prevent fugitive dust and would decrease after completion of excavation and construction when the site has less dust to control. Thus, construction of the project would directly use energy necessary to build the project, but would not result in the wasteful, inefficient, and unnecessary use of energy and impacts would be less than significant and no mitigation measures are required.

Operation and Maintenance (Long-term)

Long-term, operation activities would not have any direct impacts on consumption of energy since energy is not used for the operation of the project. Long-term maintenance activities would have direct impacts on consumption of energy for the use of equipment to carry out the maintenance activities listed in Section 2.3. However, since maintenance activities already occur by OCPW in the project area, maintenance of the project would not directly increase energy consumption beyond that which is already occurring. Thus, the operation and maintenance of the project would require consumption of energy for maintenance activities, but would not result in the wasteful, inefficient, and unnecessary use of energy and impacts would be less than significant and no mitigation measures are required.

Proposed Action Alternative

Less than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?

No Change Alternative

Less Than Significant Impact: Construction of the project would directly result in a temporary increase in demand for electricity, gasoline, and diesel. The project's energy consumption primarily would result from on- and off-road fuel use from construction related vehicles and electricity from water conveyance for dust control. Natural gas would not be used during construction. These short-term activities make up small percentages of total energy supplies and would cease after the construction period. Thus, construction would not cause a permanent increase in demand and impacts would be less than significant and no mitigation measures are required.

Mobile source emissions long-term would result from maintenance activities. Mobile source emissions are based on the number of inbound and outbound truck trips to and from the project site. Mobile emissions from these sources were estimated using emission factors from CARB's Motor Vehicle Emissions Inventory EMFAC model. The most recent version is EMFAC 2017, which "represents [California Air Resources Board's] current understanding of motor vehicle travel activities and their associated emission levels." Since maintenance activities already occur by OCPW in the project area, operation of the project would not directly increase the demand for fuel resources. Demand for electricity, diesel, or gasoline would not result in an increase that exceeds available supply or distribution infrastructure capabilities; thus, impacts would be less than significant and no mitigation is required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.5.4 Environmental Commitments

Mitigation Measures

No mitigation measures associated with impacts to Energy Resources apply to the project.

Best Management Practices

Implementation of the BMPs provided below would reduce to the extent feasible, energy usage impacts associated with the project.

- Phase haul-in/haul-out of materials to avoid empty haul-back and reduce number of trips.
- The number of pieces of construction equipment operating simultaneously shall be minimized through efficient management practices to ensure that the smallest practical number are operating at any one time.
- Substitute electric equipment or alternative fuels whenever possible for diesel- or

gasoline-powered equipment.
- Maintain all equipment as recommended by manufacturer's manuals.
- Construction worker trips should be minimized by requiring carpooling and by providing for lunch onsite.
- Shut down any equipment when not in use.
- Maintain on-road and off-road vehicle tire pressure to manufacturer specifications. Check tires and re-inflate at regular intervals.
- Use locally made materials for construction to the extent feasible.

3.4.6 Geology and Soils

This section describes the existing conditions for earth resources, regulatory background, significance thresholds, and a qualitative analysis of effects.

3.4.6.1 Regulatory Setting

- Federal soil Protection Act
- Paleontological Resources Preservation Act
- California Earthquake Fault Zoning Act ('Alquist-Priolo' Act)
- Seismic Hazards Zone Mapping Act
- California Public Resources Code Related to Paleontological Resources
- California Building Standards Code (CBSC)

3.4.6.2 Existing Conditions

Geological Resources and Soils

The Santiago Creek watershed is located within the Peninsular Range Physiographic Province, a geomorphic province that extends 900-mi south from the Los Angeles Basin to the tip of Baja California and is bound on the east by the Colorado Desert. The Peninsular Range Province is characterized by elongated northwest-trending mountain ridges separated by sediment-floored valleys. The topography is like the Coast Ranges, but the geology is more like the Sierra Nevada, with granitic rock intruding the older metamorphic rocks.

One of the most significant landforms is the coastal plain of Orange County from the City of Irvine to the Orange/Los Angeles County border. The coastal plain is divided into two sub-plains, the Downey Plain and the Tustin Plain. The Downey Plain comprises the alluvial fans of the Los Angeles, San Gabriel, and Santa Ana Rivers (Poland et al., 1956). The Downey Plain has a uniform grade with an average grade of 20 feet per mile and was formed by deposits from ancestral streams. The Tustin Plain is a sedimentary basin and is bounded on the north and east by the Santa Ana Mountains, on the south by the San Joaquin Hills, and on the northwest by the Los Angeles Basin. The Tustin Plain is nearly flat and gently slopes to the southwest. The alluvial fan soils that comprise the Tustin Plain are derived from deposits from the Santa Ana Mountains.

Soils

Foundation materials along Santiago Creek consist primarily of loose to medium dense gravelly sands, silty gravelly sands, and silty sands with cobbles and boulders up to 14 inches in diameter. Stiff to very stiff sandy clay and sandy silty layers ranging in thickness from 1- to 5-ft are also present along the channel alignment. The Santiago Recharge Basins foundation materials consist primarily of medium dense to dense gravelly sand and sandy gravel. Frequent cobbles typically range from 9 to 12 inches. Occasional layers of sandy clay, sandy silt, and clay with a consistency ranging from very soft to stiff are present in the basin area in thickness ranging from 0.5- to 8-ft.

Seismicity

The area within the vicinity of the Santiago Recharge Basins is seismically active and could be subject to seismic shaking impacts from several surrounding active earthquake faults situated within the region, most notably the El Modena Fault (CDC, 2021c). The El Modena Fault runs

from its intersection with the Peralta Hills Fault at the base of the Peralta Hills, southeasterly to Chapman Avenue and extends through the Santiago Recharge Basins. The El Modena Fault is classified as possibly active by the Southern California Earthquake Data Center. The El Modeno fault is a reverse fault (i.e., a fault in which the displacement is predominantly vertical, and the hanging wall is moved upward with respect to the footwall) about 10 km in length (SCEDC, 2021). Additionally, the cities of Orange and Villa Park are vulnerable to ground shaking caused by seismic events along large regional faults in the area. These faults include the Newport-Inglewood Fault (located approximately 15-mi southwest of Orange and 14-mi southeast of Villa Park—along the coast near Newport Beach), the Elsinore Fault (which crosses the Santa Ana River Canyon about 5-mi northeast of Orange), and the San Andreas Fault (which is parallel to the Elsinore, located approximately 40-mi northeast of Orange and 38-mi northwest of Villa Park). Each of these faults have numerous branches and associated faults and, therefore, any movement along any of these fault zones has the potential to cause widespread upset in the City of Orange. The potential for ground shaking within each city depends on the distance to the fault and the intensity of a specific seismic event along the fault. According to the City of Orange General Plan - Public Safety Element (City of Orange, 2010c), the Santiago Recharge Basins could experience a 5.0 to 6.9 magnitude earthquake on the Richter Magnitude Scale. Regarding the lower Santiago Creek channel, although there are no active, potentially active, or inactive faults known to exist in the City of Santa Ana, the region is seismically active and could be subject to seismic shaking impacts from several surrounding active earthquake faults, most notably the Newport-Inglewood, Whittier-Elsinore, San Andreas, and Raymond Fault Zones. Of these faults, the Newport-Inglewood Fault Zone is considered the most likely source for future earthquakes that could cause the area to experience ground shaking. According to the City of Santa Ana General Plan - Seismic Safety Element (City of Santa Ana, 1982c), the lower Santiago Creek channel could experience a 7.1 magnitude maximum credible event due to rupture of the nearby Newport-Inglewood Fault.

3.4.6.3 Environmental Effects

Significance Criteria

The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, the project would result in a potentially significant impact to earth resources if it would:

a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury or death involving:
    a-i) Rupture of a known earthquake fault as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the state Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42;
    a-ii) Strong seismic ground shaking;
    a-iii) Seismic-related ground failure, including liquefaction; or
    a-iv) Landslides.
b) Result in substantial soil erosion or the loss of topsoil;
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life on property;
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water; or
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not directly or indirectly cause potential substantial adverse effects as a result of rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, or landslides; result in substantial soil erosion; be located on a geologic unit or soil that is unstable; be located on expansive soil; have soils incapable of adequately supporting the use of septic tanks; or directly or indirectly destroy a unique paleontological resource. It is important to note that geological resources were historically impacted due to mining which instigated the creation of the Santiago Recharge Basins. The lower Santiago Creek channel has been historically impacted by channelization and channel stabilization features such as wire and riprap. Due to these historical impacts, the Santiago Recharge Basins and the lower Santiago Creek channel under the No Construction Alternative would continue to be subject to unstable shorelines and shoreline/channel erosion. Therefore, the No Construction Alternative would continue to have an adverse impact on soils in the area due to continued erosion.

(a-i) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the state Geologist for the area or based on other substantial evidence of a known fault?

No Change Alternative

No Impact: According to the City of Orange General Plan – Public Safety Element (City of Orange, 2010c), the El Modena Fault runs from the northwest to the southeast through the northern portion of Blue Diamond Basin and the southern portion of Smith Basin. However, according to the California Earthquake Hazards Zone Application EQ Zapp online map (California Department of Conservation, 2021d), there are no Alquist-Priolo Earthquake Fault Zones located within the Santiago Recharge Basins or the lower Santiago Creek channel. The City of Orange General Plan – Public Safety Element (City of Orange, 2010c) states “displacement along [the El Modena Fault] are smaller than those along the more prominent regional faults, and the maximum probable earthquake magnitudes would be much less than those along the regional faults.” Similarly, the City of Villa Park General Plan – Safety Element (City of Villa Park, 2010b) states “little impact is anticipated from [the El Modena] fault.” In addition, the City of Santa Ana (i.e., city where the lower Santiago Creek channel is located) General Plan – Seismic Safety Element (City of Santa Ana, 1982c) states, “no faults, active, potentially active, or inactive are known to exist in Santa Ana.”

Alquist-Priolo Earthquake Fault Zone requirements limit the development of structures used for human occupancy; however, as discussed above the project site is located outside the Alquist-Priolo fault zone and limitations do not apply to flood-control improvements and/or repairs. Thus, the project would not be subject to Alquist-Priolo Earthquake Fault Zone limitations and would not directly/indirectly expose people or structures to significant impacts related to fault rupture short-term or long-term and no mitigation measures would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a-i*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(a-ii) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking?

No Change Alternative

Less Than Significant Impact with Mitigation Incorporated: According to the City of Orange General Plan – Public Safety Element (City of Orange, 2010c), the Santiago Recharge Basins could experience a 5.0 to 6.9 magnitude earthquake on the Richter Magnitude Scale. Similarly, according to the City of Santa Ana General Plan – Seismic Safety Element (City of Santa Ana, 1982c), the lower Santiago Creek channel could experience a 7.1 magnitude maximum credible event due to rupture of the nearby Newport-Inglewood Fault. In the event of an earthquake of this size (either within the vicinity of the Santiago Recharge Basins or Santiago Creek), the project sites would have the potential for periodic shaking, possibly of considerable intensity. However, features of the project would follow seismic design requirements which would provide structural stability long-term. Also, the project is not expected to draw a substantial amount of people, either short-term during project construction activities (less than 40 construction personnel would be on site during construction) or long-term (no structures intended for human occupancy would be built), and the small number of personnel required for maintenance and operation activities long-term would be like those associated with the existing site. The project design is such that maintenance is expected to be minimal. Maintenance activities are discussed in Section 2.3. Finally, implementation of MM GEO-1 (refer to Section 3.4.6.4 for details) would further reduce anticipated impacts directly related to the proximity of earthquake faults by requiring the project to be built taking into consideration the area's geologic and subsurface conditions and specific recommendations found in the site-specific Geotechnical Investigation Report (Appendix 6). Therefore, direct and indirect impacts would be less than significant with incorporation of mitigation.

Proposed Action Alternative

Less Than Significant Impact with Mitigation Incorporated: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a-ii*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(a-iii) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction?

No Change Alternative

Less Than Significant Impact with Mitigation Incorporated: According to the City of Orange General Plan – Public Safety Element, the City of Villa Park General Plan – Safety Element, and the City of Santa Ana General Plan – Seismic Safety Element, the project sites are all located within a liquefaction hazard area. Similarly, according to the California Earthquake Hazards Zone Application EQ Zapp online map (California Department of Conservation, 2021d), the project area is located within a liquefaction zone. However, features of the project would follow seismic design requirements which would provide structural stability long-term. Moreover, project features would not include structures intended for human occupancy. Long-term operation activities would be like existing channel conditions and project design is such that maintenance is expected to be minimal. Finally, implementation of MM GEO-1 (refer to Section 3.4.6.4 for details) would require the incorporation of conclusions and recommendations included in the Geotechnical Investigation Report (Appendix 6), which would further reduce potential direct impacts related to liquefaction by requiring the project to be built by taking into consideration the area's geologic and subsurface conditions. Therefore, direct and indirect impacts would be less than significant with mitigation incorporated.

Proposed Action Alternative

Less Than Significant Impact with Mitigation Incorporated: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a-iii*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(a-iv) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides?

No Change Alternative

Less Than Significant Impact with Mitigation Incorporated: According to the California Earthquake Hazards Zone Application EQ Zapp online map (California Department of Conservation, 2021), the lower Santiago Creek channel has no landslide zones located within the project area. However, there are landslide zones located in the southwest corner of Smith Basin near Villa Park Road. The landslide area for Bond and Blue Diamond basins is located in the northwest corner near Villa Park Road. All the Santiago Recharge Basins are experiencing localized slope erosion due primarily to the steepness of the slopes. As part of the proposed modifications to the basins, surrounding slopes would be required to ensure slope stability long-term. Due to repairs and slope stabilization further slope erosion within the Santiago Recharge Basins would be minimized long-term. Furthermore, implementation of MM GEO-1 (refer to Section 3.4.6.4 for details) would require the incorporation of conclusions and recommendations included in the Geotechnical Investigation Report (Appendix 6), which would further reduce potential direct and indirect impacts related to landslides by requiring the project to be built taking into consideration on-site geologic conditions. Therefore, direct and indirect impacts would be less than significant with mitigation incorporated.

Proposed Action Alternative

Less Than Significant Impact with Mitigation Incorporated: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a-iv*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) Result in substantial soil erosion or the loss of topsoil?

No Change Alternative

Less Than Significant Impact: The project would directly involve excavation and grading activities that would expose soils in the short-term. The exposed soils could be subject to erosion impacts caused by water and wind. Additionally, construction equipment and vehicles could indirectly transport sediment to offsite locations. Construction projects which disturb one or more acres of soil are required to obtain coverage under a General Construction Permit by the State Water Resources Control Board. The project would directly disturb more than one acre and would be required to obtain a General Construction Permit. The General Construction Permit would require the filing of a Notice of Intent with the State Water Resources Control Board and the preparation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP would provide a list of BMPs to minimize potential soil erosion impacts. Additionally, after the project is completed, disturbed areas would be established and/or reestablished with native vegetation (MM BIO-1 and

MM BIO-4; refer to Section 3.4.3.4 for details) to minimize long-term erosion impacts. Therefore, potential direct and indirect impacts associated with erosion would be less than significant with mandatory compliance with existing regulations and procedures outlined in the General Construction Permit and implementation of a SWPPP and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

No Change Alternative

Less Than Significant Impact with Mitigation Incorporated: On-site sandy and silty soils between ground surface and 50-ft are considered potentially liquefiable. The project includes slope stabilization features within the Santiago Recharge Basins and the lower Santiago Creek channel. Therefore, project activities would directly result in greater stability of the project area long-term than in the existing condition. In addition, due to the nature of the project, it would not directly create substantial risks as project design does not include habitable structures and overall stability of the side slopes within the Santiago Recharge Basins and Santiago Creek would be improved. Furthermore, implementation of MM GEO-1 (refer to Section 3.4.6.4 for details) would require the incorporation of conclusions and recommendations included in the Geotechnical Investigation Report (Appendix 6), which would further reduce potential direct and indirect impacts related to unstable soils by requiring the project to be built taking into consideration on-site soils and geologic conditions. Therefore, impacts would be less than significant with mitigation incorporated.

Proposed Action Alternative

Less Than Significant Impact with Mitigation Incorporated: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?

No Change Alternative

Less Than Significant Impact with Mitigation Incorporated: Due to the nature of the project, it would not create substantial risks to life or property directly or indirectly as project design does not include habitable structures and the project includes shoreline/channel stabilization features within the Santiago Recharge Basins and the lower Santiago Creek channel. These shoreline/channel stabilization features would result in greater stability of the project area long-term than in the existing condition. Furthermore, implementation of MM GEO-1 (refer to Section 3.4.6.4 for details) would require the incorporation of conclusions and recommendations included in the Geotechnical Investigation Report (Appendix 6), which would further reduce potential

impacts related to unsuitable soils by requiring the project to be built taking into consideration subsurface conditions. Therefore, direct and indirect impacts would be less than significant with mitigation incorporated.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

No Change Alternative

No Impact: The project does not include the construction of any habitable structures that would include the construction of septic tanks or alternative waste disposal systems would occur. No mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*e*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

No Change Alternative

Less Than Significant Impact: A paleontological survey has not been conducted, but a records search for paleontological records has been conducted in the past for projects within the Santiago Recharge Basins. According to the records search for the Santiago Recharge Basins, there are no vertebrate fossil localities recorded within the project area, but there is a nearby locality from the same sedimentary deposits that occur in the Santiago Recharge Basins. The closest vertebrate fossil locality to the Santiago Recharge Basins is approximately 3-mi northwest of the project area (OCWD, 2016 and OCWD, 2019b). At this locality, fossil specimens of horse, *Equus*, at a depth of 8- to 10-ft below the surface have been found. No paleontological survey for the project area within Santiago Creek has been conducted and there are no recent record searches from other projects in the area. However, it is noted in other CEQA documents from projects within the Santiago Creek watershed that in the Santiago Creek drainage the surface deposits consist of younger Quaternary sands and gravels that are unlikely to contain significant vertebrate fossils, at least in the uppermost layers. In addition, according to the Orange County General Plan, the Santiago Creek project area is outside any general areas of sensitivity for paleontological resources (Orange County, 2012b). Because of the information above, potential direct and indirect impacts to a unique paleontological resource or site or unique geologic feature would be less than significant, and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed

Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*f*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.6.4 Environmental Commitments

Mitigation Measures
Implementation of the mitigation measures provided below would reduce to the extent feasible, geological resources and soils impacts associated with the project.

MM GEO-1: During construction activities, the USACE will incorporate the conclusions and recommendations included in the Geotechnical Investigation Report. Geotechnical conclusions and recommendations are in Appendix 6 and discuss geologic hazards such as slope stability, liquefaction, settlement potential, soil suitability, soil corrosivity, etc.

Best Management Practices
The following standard BMPs would be implemented by the contractor or by USACE to avoid or minimize any effects of potential erosion. Implementation of these BMPs would ensure that effects from erosion would remain at less-than-significant levels.

- Appropriate erosion control measures would be incorporated into the SWPPP to prevent sediment from entering waterways. The contractor would use a water truck or other appropriate measures to control fugitive dust on haul roads, construction areas, and stockpiles.
- Construction activities that would involve topographic alterations and soil disturbance would be scheduled to avoid as much of the wet season as possible.
- Disturbed areas slated for revegetation would be planted with native grass and forb seeds in a timely manner to control erosion.

3.4.7 Greenhouse Gas Emissions
This section describes the existing conditions for climate change, regulatory setting, significance thresholds, and a qualitative analysis of effects.

Ongoing scientific research has identified the general impacts of anthropogenic GHG emissions and changes in biological carbon sequestration due to land management activities on global climate. The term ‘greenhouse gas’ or ‘greenhouse gases’ includes but is not limited to CO_2, methane (CH_4), and NO_2.

GHGs naturally trap heat by impeding the exit of solar radiation that has hit the Earth and is reflected into space. Some GHGs occur naturally and are necessary for keeping the Earth’s surface inhabitable. However, increases in the concentrations of these gases in the atmosphere during the last 100 years have decreased the amount of solar radiation that is reflected into space, intensifying the natural greenhouse effect, and resulting in the increase of global average temperature.

Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks cause a net warming effect on the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although GHG levels have varied for millennia, historic industrialization and burning of fossil carbon sources have caused carbon dioxide equivalent concentrations to increase dramatically, and clearly contribute to overall global climate changes. The Intergovernmental Panel on Climate Change (IPCC) concluded that “warming of the climate system is unequivocal” and “Most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the

observed increase in anthropogenic greenhouse gas concentrations (IPCC, 2007)."

Global mean surface temperatures have increased nearly 1.8 degrees Fahrenheit (°F) from 1890 to 2006 (IPCC, 2007). Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24° North) have exhibited temperature increases of nearly 2.1°F since 1900, with nearly a 1.8°F increase since 1970 (IPCC, 2007). Continued warming is projected to increase global average temperature between 2 and 11°F over the next 100 years.

3.4.7.1 Regulatory Background

No federal regulations regarding climate change apply to the Proposed Action. The USEPA has started the process of regulating large sources of GHG emissions (e.g., power plants, cement manufacturing, etc.), but these proposed regulations are not applicable to the project. California laws and executive orders that address GHGs and climate change include:

- Senate Bill (SB) 1771
- SB 1078
- SB 107 SB 1368
- SB 97
- SB 375
- AB 1473
- AB 32
- Executive Order (EO) S-14-08
- EO S-3-05
- EO S-1-07
- EO S-13-08
- EO B-30-15

3.4.7.2 Existing Conditions

Local Climatic Conditions

The regional climate in Orange County is classified as Mediterranean, characterized by cool, dry summers and mild, wet winters. During the fall and winter months, build-up of high pressure in the Great Basin region can produce a 'Santa Ana' condition, characterized by warm, dry northeast winds, that if sufficiently strong, may ventilate the air basin and prevent the build-up of high pollutant concentrations. Average high and low temperatures in July at the Anaheim monitoring station are 82°F and 62°F, respectively. January average high and low temperatures at this monitoring station are 65°F and 45°F, respectively. Temperatures at the Costa Mesa monitoring station are generally less extreme due to the moderating effects of the Pacific Ocean. Most rainfall occurs during the late fall, winter, and early spring months (November through March). Southern California is one of the regions being continuously impacted by El Niño events, which bring warmer than normal winters with severe rainstorms.

Greenhouse Gases (GHG)

The six principal GHGs of concern are CO_2, CH_4, N_2O, sulfur hexafluoride (SF_6), hydrofluorocarbons (HFC), and perfluorocarbons (PFC). The USEPA does not currently regulate the GHG pollutants that could contribute to climate change. However, on December 7, 2009, the Administrator of the USEPA signed two findings regarding the threat to public health and welfare from GHGs under 202(a) of the federal Clean Air Act (CAA). Accordingly, in the future, the USEPA can promulgate regulations pertaining to emissions of GHGs under the authority of the federal CAA.

While the federal government has not regulated emissions of GHG, the State of California has been proactive in the study of effect of climate change with a 20-year history of doing so. State actions to address global climate change target automobile emissions, stationary sources and power generation, land-use planning, and the development of sustainable communities.

California is a substantial contributor of global GHG as it is the second largest contributor in the U.S. and the sixteenth largest in the world (CEC, 2006). While California has a high amount of GHG emissions, it has low emissions per capita. California produced in 2008 approximately 478 million metric tons of CO_2 equivalent (478 $MMTCO_2e$), equal to about 525 million tons, or about one percent of 49,000 $MMTCO_2e$ emitted globally (IPCC, 2007). The main sources of GHG emissions in California are the transportation and energy sectors.

3.4.7.3 Environmental Effects

Significance Criteria

The impacts of the project related to climate change are evaluated using the criteria listed below. For this analysis, an effort pertaining to climate change was analyzed based on draft NEPA guidance published by CEQ and state CEQA Guidelines Appendix G (14 CCR 15000 et seq.). An effect was considered significant if it would:

- Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment, or
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.

The following significance criteria will be used to determine the significance of GHG emissions from the project:

a) If the relative amounts of GHG emissions resulting from implementation of the proposed project are substantial compared to emissions major facilities are required to report (25,000 metric tons CO_2e per year), or
b) If the proposed project has the potential to contribute to a substantially lower carbon future.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not directly or indirectly generate GHG emissions that may have a significant impact on the environment or conflict with an applicable plan adopted for the purpose of reducing the emissions of GHGs. Climate change would continue to be influenced by local and regional emissions from vehicles, and local commercial and industrial land uses.

(a) *Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?*

No Change Alternative

Less Than Significant Impact: Construction of the project would require the short-term use of multiple pieces of equipment. Use of construction equipment would result directly in GHG emissions. GHG emissions were calculated using the CalEEMod (Version 2020.4.0) authorized by the SCAQMD. As described in Section 3.4.2 Air Quality, model inputs include project size and location, construction schedule and phasing, equipment numbers and activity hours, vehicle mileage, and transported soil and material amounts based on best-available project data.

Emission estimates indicate a maximum of 5,323 $MTCO_{2e}$/yr are emitted from fossil fuel combustion during construction. Total construction emissions generated are 9,282 $MTCO_{2e}$. Construction emissions amortized over 30 years, a conservative assumed project life, are 309 $MTCO_{2e}$/yr. Since the project would not generate GHG emissions in excess of 3,000 MTCO2e per year (i.e., SCAQMD adopted threshold of significance for a cumulative global change impact), potential direct and indirect impacts associated with greenhouse gas emissions due to construction would be less than significant and no mitigation would be required.

Annually, OCPW would carry out maintenance activities listed in Section 2.3. Accordingly, the alternative would not result in any new long-term operational greenhouse gas emissions beyond

those that occur under the existing condition. Therefore, no direct or indirect impacts associated with operational emissions would occur and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: Similar to the No Change Alternative, the Proposed Action would require the short-term use of multiple pieces of equipment during construction. Use of construction equipment would result directly in GHG emissions. GHG emissions for the Proposed Action were calculated using the CalEEMod (Version 2020.4.0) authorized by the SCAQMD. As described in Section 3.4.2 Air Quality, model inputs include project size and location, construction schedule and phasing, equipment numbers and activity hours, vehicle mileage, and transported soil and material amounts based on best-available project data.

Emission estimates indicate a maximum of 2,176 $MTCO_{2e}$/yr are emitted from fossil fuel combustion during construction (see Appendix 4 Air Quality and General Conformity Analysis for details). Total construction emissions generated are 3,407 $MTCO_{2e}$. Construction emissions amortized over 30 years, a conservative assumed Proposed Action life, are 114 $MTCO_{2e}$/yr. Since the project would not generate GHG emissions in excess of 3,000 MTCO2e per year (i.e., SCAQMD adopted threshold of significance for a cumulative global change impact), potential direct and indirect impacts associated with greenhouse gas emissions due to construction would be less than significant and no mitigation would be required.

Annually, OCPW would carry out maintenance activities listed in Section 2.3. Accordingly, the Proposed Action would not result in any new long-term operational greenhouse gas emissions beyond those that occur in the existing condition at the Proposed Action area. Therefore, no direct or indirect impacts associated with operational emissions would occur and no mitigation would be required.

(b) *Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?*

No Change Alternative

No Impact: The project would not conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing GHG emissions. The project would involve geotechnical improvements to areas in the Santiago Recharge Basins that have experienced substantial erosion on basin embankment slopes, construction of an outlet and overflow structure in the Bond Basin, and geotechnical improvements to areas along the lower Santiago Creek channel that have experienced substantial erosion or could experience future substantial erosion due to upstream improvements. Ongoing maintenance and operation of the flood control channel in the lower Santiago Creek channel and the Santiago Recharge Basins would not require the use of any off-road equipment. As discussed above, the project would not generate GHG emissions in excess of 3,000 MTCO2e per year, the SCAQMD adopted threshold of significance. Additionally, it is important to note that CARB guidance does not provide any direction for flood risk management type projects such as the No Change Alternative. Therefore, no direct or indirect impacts associated with conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of GHG would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow

channel or an outlet channel within the Santiago Recharge Basins. This is important to note since the Proposed Action Alternative decreases the overall construction activities and therefore decreases the total GHG output, when compared to the No Change Alternative.

3.4.7.4 Environmental Commitments

Mitigation Measures
No mitigation measures associated with impacts to GHG Emissions apply to the project.

Best Management Practices
Section 3.4.2.4 discusses various BMPs that would be used for the project to help minimize potentially adverse air quality impacts. Many of these actions would also help reduce GHG emissions to a less-than-cumulatively considerable level. The following BMPs could be implemented by the contractor, USACE, and/or OCPW to further reduce GHG emissions if necessary:

- Improve fuel efficiency from construction equipment by minimizing idling time either by shutting equipment off when not in use or reducing the time of idling to no more than three minutes (five-minute limit is required by the state airborne toxics control measure [Title 13, Section 2485 of the California Code of Regulations]). Provide clear signage that posts this requirement for workers at the entrances to the site.
- Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated.
- Use equipment with new technologies (e.g., repowered engines, electric drive trains, etc.).
- Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than the off-road engines).
- Encourage and provide carpools, shuttle vans, transit passes, and/or secure bicycle parking for construction worker commutes.
- Use of a CARB approved low carbon fuel for construction equipment.
- Purchase of CO_2 offsets to mitigate GHG emissions to less than 25,000 metric tons CO_2e per year. Potential offset could be purchased from the following sources:
    - AB 32 U.S. Forest and Urban Forest Project Resources
    - AB 32 Livestock Projects
    - AB 32 Ozone Depleting Substance Projects
    - AB 32 Urban Forest Projects
    - Other California-based Offsets
    - United States Based Offsets
    - International Offsets (e.g., clean development mechanisms)
- Funding incentive programs from SCAQMD or supplementing existing programs to obtain GHG reductions.

3.4.8 Hazards and Hazardous Materials (Hazardous, Toxic, and Radioactive Waste [HTRW])

This section describes the existing conditions for HTRW, regulatory setting, significance thresholds, and a qualitative analysis of effects.

3.4.8.1 Regulatory Background

The principal federal regulatory agency for hazardous substances is the USEPA. The key federal regulations pertaining to hazardous substances are as follows.

- Resources Conservation and Recovery Act (RCRA): RCRA gives USEPA the authority to control hazardous waste from the "cradle-to-grave". This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled USEPA to address environmental problems that could result from

underground tanks storing petroleum and other hazardous substances.

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): CERCLA – otherwise known as CERCLA of Superfund – provides a federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. Through CERCLA, USEPA was given power to seek out those parties responsible for any release and assure their cooperation in the cleanup.

State regulations may implement federal requirements where the state regulations are authorized to implement federal regulatory programs under a delegated authority. State requirements that are not implemented under a delegated federal authority would apply to the actions of the non-federal sponsor for operation and maintenance activities.

Hazardous Waste Control Law (HWCL): HWCL is the state law similar to the federal RCRA program. HWCL describes the requirements for the proper management of hazardous wastes including:

- Criteria for identification and classifications of hazardous wastes
- Generation and transportation of hazardous waste
- Design and permitting of facilities that recycle, treat, store, and dispose hazardous wastes
- Treatment Standards
- Operation of facilities
- Closure of facilities and liability requirements principal federal

3.4.8.2 Existing Conditions

An HTRW Phase I Environmental Site Assessment (ESA) was completed to identify the risk of encountering HTRW and non-HTRW environmental issues and to determine if any recognized environmental conditions (REC) present have impacted the project site or will impact implementation of the project (Appendix 5: HTRW Report). The information used to complete the HTRW Phase I ESA was obtained from existing information review, historical topographic map and aerial photograph review, database research, and a site visit. No RECs, or HTRW issues, were identified in the project area. The site is not listed in a database for the storage, use, disposal, or release of hazardous substances or petroleum products, no HTRW was observed during the site visit, and owners/operators had no knowledge of the presence or threat of contamination on site. Boring logs from a geotechnical investigation conducted in October 2021 also did not indicate the presence of solid waste, petroleum, or other HTRW issues. Potential non-HTRW issues were identified at the channel and reservoirs however, such as the potential for buried channel bank debris following emergency back stabilization measures (cars provided bank stabilization post-1969 flood event) and construction, demolition, or washout debris (broken concrete, metal rebar and culverts, and spoil piles observed in Smith Basin and buried in Bond and Blue Diamond Basin from bridge washout following 1982 or 1983 flood).

3.4.8.3 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, the project would result in a potentially significant impact to HTRW if it would:

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials;
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school;
d) Be located on a site which is included on a list of hazardous materials sites compiled

pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment;

e) For a project located within an airport land use plan or where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area;

f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan; or

g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury or death involving wildland fires.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not create a significant hazard to the public or environment through routine transport or use of hazardous materials; create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment; emit hazardous emissions or handle hazardous or acutely hazardous materials within one-quarter mile of an existing school; be located on a site which is included on a list of hazardous materials sites; result in a safety hazard or excessive noise for people residing or working in an airport land use plan; impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan; or expose directly or indirectly people or structures to a significant risk of loss, injury, or death involving wildland fires.

(a) *Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?*

No Change Alternative

Less Than Significant Impact: Construction of the project is expected to take just under two years and nine months to complete. During this time, routine transport, use, and disposal of hazardous materials such as fuel, solvents, paints, oils, and grease would occur. Such transport, use, and disposal must be compliant with applicable regulations such as RCRA, Department of Transportation (DOT) Hazardous Materials Regulations, and the Occupational Safety and Health Administration (OSHA). Although small amounts of solvents, paints, oils, and grease would be transported, used, and disposed of directly during construction, these materials are typically used in construction projects and would not represent the transport, use, and disposal of acutely hazardous materials over the short-term.

Long-term, no hazardous materials would be used or stored on site during normal project operations long-term. Operational activities associated with the project would be similar to existing conditions and project design is such that maintenance is expected to be minimal. Therefore, potential direct and indirect impacts to hazards to the public or the environment from hazardous materials would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) *Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials*

into the environment?

No Change Alternative

Less Than Significant Impact: As discussed above under (a), construction-related hazardous materials would be used during construction of the project. It is possible that any of these substances could be directly released during construction activities. However, the project would comply with the provisions of the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit), Order No. 2009-0009-DWQ, NPDES NO. CAS000002 (the permit applies to construction activities disturbing 1-acre or more). Compliance with federal, state, and local regulations, in combination with construction BMPS implemented from a SWPPP required as part of the Construction General Permit, would ensure that all hazardous materials are used, stored, and disposed properly, which would minimize potential short-term direct and indirect impacts.

Long-term, no hazardous materials would be used or stored on site during normal project operations. Operation activities associated with the project would be like existing conditions and project design is such that maintenance is expected to be very minimal to non-existent. Therefore, potential long-term direct and indirect impacts to hazards to the public or the environment from accidental release of hazardous materials would be less than significant and no mitigation would be required.

Off-site Properties

Off-site environmental conditions were identified in the database search and observed during the site visit. Reeves Basin (adjacent to Smith Basin) and Villa Park Landfill (0.25-mi from Smith Basin) are solid waste facilities closed prior to current solid waste regulations and continuously monitored and maintained for groundwater and vapor impacts. Groundwater monitoring in 2021 at Reeve's Basin detected VOCs at trace, background levels not associated with a release from the disposal site. The off-site properties do not represent a significant risk for the project because they will be avoided and will not be encroached upon during construction. Groundwater monitoring indicates only trace concentrations near the project site, no impacts on the project site or groundwater recharge have occurred since monitoring and groundwater recharge operations began in the early 1990s, and no HTRW response actions are expected or required prior to project implementation. The potential that construction and continued operation of the site may release or expose persons to HTRW is low.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c) *Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?*

No Change Alternative

No Impact: The nearest school site to Smith Basin is the Oakridge Private School which is adjacent to the project area to the east. Linda Vista Elementary school is also located within 0.25-mi of Smith Basin. Lastly, Oakridge Private School is also within a little less than 0.25-mi of the Bond and Blue Diamond basins. There are no schools within 0.25-mi of the lower Santiago Creek channel. As mentioned above under significance criteria (*a*), routine transport, use, and disposal

of hazardous materials would occur during construction of the project. Such transport, use, and disposal would be compliant with applicable regulations such as the RCRA, DOT, and OSHA regulations. Although small amounts of hazardous materials would be transported, used, and disposed of during construction, these materials are typically used in construction projects and would not represent the transport, use, and disposal of acutely hazardous materials in the short-term. Hazardous material spills would be small, localized, and cleaned up as they occur. Thus, the project would not emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of a school, including those listed above.

Long-term, no hazardous materials (including acutely hazardous materials) would be used or stored on site during normal project operations. Operation activities would be like existing conditions and project design is such that maintenance is expected to be very minimal to non-existent. Therefore, no long-term direct or indirect impacts of hazardous materials to a school would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(d) *Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create significant hazard to the public or the environment?*

No Change Alternative

No Impact: According to the California Environmental Protection Agency Cortese List Data Resources, the project area is not listed on the Department of Toxic Substances Control EnviroStor list (CalEPA, 2022), the State Water Resources Control Board GeoTracker database (State Water Resources Control Board, 2022a), or a solid waste disposal site (State Water Resources Control Board, 2022b). Therefore, no direct/indirect or short-term/long-term impacts associated with sites listed pursuant to Government Code Section 65962.5 would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(e) *For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?*

No Change Alternative

No Impact: Neither the Santiago Recharge Basins nor the lower Santiago Creek channel are located within the Airport Land Use Commission for Orange County Airport Planning Areas (Airport Land Use Commission for Orange County, 2008). The closest airport to the Santiago Recharge Basins is the John Wayne Airport which is located approximately 8.43-mi from the

project area. The closest airport to the lower Santiago Creek channel is the John Wayne Airport which is located approximately 5.66-mi from the project area. Therefore, no direct/indirect or short-term/long-term impacts associated with safety hazards for people residing or working in the project area would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*e*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(f) *Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?*

No Change Alternative

No Impact: The City of Orange General Plan – Public Safety Element (City of Orange, 2010c) states that "[T]he City's Emergency Operations Plan does not indicate evacuation routes for emergency situations." However, the City of Orange General Plan indicates that emergency egress will most often take place on main thoroughfares. Two major arterials listed in the General Plan, Katella Avenue and Hewes Street, are adjacent to the Santiago Recharge Basins. The Villa Park General Plan – Safety Element (City of Villa Park, 2010b) states the street circulation system is adequate to handle the evacuation of residents but does not specifically list evacuation routes. Major arterials in the area include Villa Park Road (i.e., Katella Avenue and Santiago Canyon Road) and Collins Avenue/Prospect Street and would likely be used as evacuation routes during an emergency situation. However, according to the City of Santa Ana General Plan – Circulation Element (City of Santa Ana, 1982d), Bristol Street is a Major Arterial along with Garden Grove Freeway (State Road 22) and the Santa Ana Freeway (I-5). Therefore, it is likely that in the event of an emergency requiring evacuation, the above major arterials near the lower Santiago Creek channel would be utilized as evacuation routes. Short-term, construction equipment would likely utilize all the above roadways to access the maintenance roads within the Santiago Recharge Basins and the lower Santiago Creek channel. Since construction equipment would only utilize these roads briefly and would not stage along these roadways, no direct or indirect impacts to an adopted emergency response or evacuation plan would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*f*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(g) *Expose people or structures, either directly or indirectly, to a significant risk of loss, injury or death involving wildland fires?*

No Change Alternative

Less Than Significant Impact: Portions of Smith Basin are designated as a Wildland High Fire or Very High Fire Hazard Area in the City of Orange General Plan – Public Safety Element (City of Orange, 2010c). The northern boundary of the Blue Diamond Basin is designated as a

Wildland High Fire Hazard Area in the City of Orange General Plan – Public Safety Element (City of Orange, 2010c). The remaining boundaries of the Blue Diamond and Bond basins are not designated as Wildland High Fire or Very High Fire Hazard Areas in either the City of Orange General Plan – Public Safety Element (City of Orange, 2010c) nor the City of Villa Park General Plan – Safety Element (City of Villa Park, 2010b). Lastly, the lower Santiago Creek channel is not within a designated Wildland High Fire or Very High Fire Hazard Area according to the Orange County General Plan – Safety Element (Orange County, 2012a). Although portions of the project area are within a designated Wildland High Fire or Very High Fire Hazard Area, most of the project sites are not within one of these designated areas. In addition, the project would not directly involve the construction of any habitable structures, nor would the flood control features be constructed of flammable materials that could expose people to wildfire hazard risks in the short-term or long-term. Instead, the project involves flood risk management measures. Therefore, potential direct/indirect and short-term/long-term impacts associated with wildland fires would be less than significant and no mitigation measures would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*g*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.8.4 Environmental Commitments

Mitigation Measures

No mitigation measures associated with Hazards and Hazardous Materials apply.

Best Management Practices

Implementation of the following BMPs would help ensure that effects on HTRW would remain at less-than-significant levels. Standard BMPs include:

- Compliance with all applicable local, regional, state, and federal laws, policies, and regulations regarding the transportation, storage, handling, management, and disposal of hazardous materials and wastes.
- Construction contractors are responsible for development of an Environmental Protection Plan to ensure that all environmental resources are protected during construction and that all construction activities conducted on the project site comply with federal, state, and local environmental laws and regulations. The Contractors solid and hazardous materials and waste management plan will be included in the Environmental Protection Plan.
- Contractors are responsible for development of an accidental spill prevention and response plan for all hazardous materials that may be used onsite. In the event of a spill or release of hazardous substances at the construction site, the contaminated soil shall be immediately contained, excavated, and treated per federal and state regulations developed by the USEPA, as well as local hazardous waste ordinances.
- Prior to the start of construction, the applicant would prepare an Emergency Evacuation Plan that contains procedures for the demobilization of construction equipment and evacuation of personnel from the study area in the event of a pending significant storm event or other emergency that jeopardizes the safety of personnel or equipment.
- Prior to the start of construction, the applicant would prepare a traffic control plan that would be approved by the city and county. The traffic control plan will include provisions for notification of emergency services prior to construction.

3.4.9 Hydrology and Water Quality

This section describes the existing conditions of the water resources and jurisdictional Waters of the United States that could be affected and evaluates the effects of the project on water

resources, water quality, and Waters of the United States in the project area.

3.4.9.1 Regulatory Setting

- Clean Water Act, Section 401, Section 402, and Section 404
- Porter-Cologne Water Quality Control Act

3.4.9.2 Existing Conditions

Surface Water

Santiago Creek is the largest tributary of the Santa Ana River downstream of Prado Dam. The creek's headwaters are in the vicinity of Santiago Peak of the Santa Ana Mountains in the northern part of Orange County. The creek flows in a northwest direction for approximately 15-mi to Villa Park Road in the City of Orange, then turns southwest for about another 7-mi before joining the Santa Ana River in the City of Santa Ana. The main stem of Santiago Creek is in the Cleveland National Forest. The creek extends through the Santa Ana Mountains and drains into Irvine Lake. At Irvine Lake the creek flows through Irvine Regional Park and then is dammed at the Villa Park Dam as a flood control reservoir. At Villa Park Dam, the creek flows in a flood control channel through the cities of Orange and Santa Ana to its confluence with the Santa Ana River at the Riverview Golf Course.

The creek is approximately 34-mi in length and drains most of the northern Santa Ana Mountains. The total drainage area of Santiago Creek is 102-mi^2. The runoff from 80 percent of the drainage area is controlled by the existing Santiago Dam and Villa Park Dam. The drainage area remaining downstream from Villa Park Dam is approximately 19-mi^2.

Presently, groundwater recharge occurs along the soft bottom segments of Santiago Creek between the Santiago Recharge Basins and Hart Park. The primary sources of water for groundwater recharge are water releases from the Santiago Recharge Basins and Villa Park Dam, water released from municipal wells, storm flow, and urban runoff. The depth to groundwater along Santiago Creek decreases in a downstream direction from approximately 150-ft near the Santiago Recharge Basins to 65-ft (elevation 50-ft) near the confluence with the Santa Ana River. These depths represent the highest recorded levels during most years. It is important to note that the primary purpose of lower Santiago Creek is flood control, with groundwater recharge being the secondary purpose.

The Santiago Recharge Basins are owned and operated by OCWD. The Santiago Recharge Basins are OCWD's largest surface water storage reservoirs at over 13,000 ac-ft (OCWD, 2021). When full, the Santiago Recharge Basins serve as a flow through feature of Santiago Creek. Blue Diamond and Bond basins of the Santiago Recharge Basins join at approximately elevation 220-ft mean seal level (msl) while Smith Basin joins Bond and Blue Diamond basins at elevation 250-ft msl. Surface water can enter the Santiago Recharge Basins from 1) Upper Santiago Creek into Smith Basin, 2) Bond Basin from Burris Basin while pumping Burris Basin and discharging into the Burris-Santiago Pipeline through a butterfly valve located east of Collins Street and north of Bond Street, and 3) numerous storm drains discharges. Surface water leaves the Santiago Recharge Basins by 1) spilling from Blue Diamond Basin when the elevation is above 285.3-ft msl or 2) being pumped out of Bond Basin into the Burris-Santiago pipeline. Surface water flow from the Santiago Recharge Basins can also be pumped to Burris Basin, Riverview Basin, Fletcher Basin, and Lower Santiago Creek (OCWD, 2021).

Groundwater

The Orange County Groundwater Basin underlies central and northern Orange County and is bordered by the Santa Ana Mountains to the east, the Pacific Ocean to the west, the Newport-Inglewood Fault to the southwest and Coyote Hills to the north. The basin is contiguous and directly connected with the Central Basin of Los Angeles County to the northwest. The basin reaches depths of over 2,000-ft and is comprised of a complex series of interconnected sand and gravel deposits. The aquifer is divided into three sections, shallow, principal, and deep. The

shallow aquifer supplies approximately five percent of the total water produced from the basin. Most of the water in the basin is extracted from the principal aquifer.

The groundwater basin is divided into two segments, the forebay and pressure areas. The forebay soils consist mainly of highly permeable sands and gravels with a few feet of clay and silt deposits. Surface infiltration recharge systems are generally only effective within the forebay area. OCWD's modeling of the Orange County Groundwater Basin indicates that the basin can be managed effectively to yield 460,000 to 490,000-ac-ft per year without adversely affecting the condition of the basin provided that sufficient recharge is available.

The Orange County Groundwater Basin is recharged with treated wastewater baseflow of the Santa Ana River. The water quality of the wastewater discharges is regulated by the SARWQCB to protect the quality of the Orange County Groundwater Basin. OCWD maintains a monitoring program to assess long-term water quality trends that could affect the groundwater basin.

The National Water Research Institute (NWRI) completed an independent review of a major study of Santa Ana River water quality in 2004 (NWRI, 2004). Data from the Santa Ana River Water Quality and Health Study indicated that improvements in water quality that occur during recharge occurred with and without a vadose zone beneath the recharge facilities. For example, removal of at least 50 percent of the dissolved organic carbon in the recharge water occurred within one month of recharge and subsurface travel regardless of whether a vadose zone was present. NWRI's review concluded that the recharge of Santa Ana River water to the groundwater basin does not threaten water quality or public health and that groundwater transit of recharge Santa Ana River water produces a quality and composition of dissolved organic carbon that is comparable to other sources of drinking water, such as the Colorado River.

Aquatic Resources
Refer to Section 3.4.3.2, Existing Conditions, Aquatic Resources under Biological Resources for a detailed description of aquatic resources present within the project area including potential jurisdictional waters and wetlands. Additional information can also be found in the Aquatic Resources Delineation Report in Appendix 1.

Existing Mitigation Sites
The Santiago Recharge Basins fall under OCWD's HMP (OCWD, 2020). OCWD's HMP was prepared to identify restoration activities that provide compensatory mitigation for ongoing routine maintenance impacts to waters of the U.S. and waters of the state associated with OCWD groundwater management operations. Refer to Section 3.4.3.2, Existing Conditions, Existing Mitigation Sites under Biological Resources for a detailed description of existing mitigation sites present within Smith Basin and the Blue Diamond and Bond basins.

OCWD's maintenance and groundwater management operations are conducted under USACE Regional Permit 90 (RGP 90) which was first initiated in 2012 and recently renewed in 2022. The HMP mitigation requirements are incorporated as a condition of the USACE RGP 90 permit. RGP 90 states that "authorization under this Corps [USACE] permit is conditional upon your compliance with all of the [FWS] required avoidance and minimization measures, which are incorporated by reference in this permit." (RGP 90 at page 6). Attached as Enclosure 1 to the RGP 90, the 2021 USFWS Endangered Species Act consultation letter requires implementation of the HMP as Conservation Measure 1. Specifically, the USFWS concurrence states:

> *"Our effects analysis is based on maintenance of preserved, restored, and created habitat as identified in the HMP. If this habitat cannot be maintained due to insufficient water supply or if it must be impacted for another project (e.g., Santiago Creek component of the Santa Ana River Project), re-initiation of consultation should be considered."*

RGP 90, Enclosure 1 at page 45 also states that issuance of the 2013 Water Quality Certification

by the RWQCB and the Streambed Alteration Agreement by CDFW are contingent upon the implementation of the mitigation sites as identified in OCWD's HMP.

Issuance of the 2013 Water Quality Certification by the RWQCB and the Streambed Alteration Agreement by CDFW are also contingent upon the implementation of the mitigation sites as identified in OCWD's HMP. USACE Regulatory is currently in discussions with the FWS, RWQCB, and CDFW as to whether the mitigation sites specifically in Smith, Blue Diamond, and Bond basins can be removed as a requirement for OCWD to implement because OCWD has potentially already implemented sufficient mitigation within other basins under their purview to offset realized permanent impacts to wetland vegetation since 2013. OCWD has confirmed that 3.19 acres of permanent impacts to wetland vegetation has occurred since the RGP 90 permit was first issued in 2014.

Since discussions about removal of the Smith, Blue Diamond, and Bond basins' mitigation sites from OCWD's HMP are ongoing and are expected to be resolved prior to construction of the proposed Santiago Creek project, the FWS's 2023 amendment, to the FWS's 2001 Biological Opinion (BiOp) for the Santa Ana River Mainstem Project and the FWS's 2012 amendment to the 2001 BiOp for the Santa Ana River Mainstem Project, assumes that the federal requirement for OCWD mitigation has been fully satisfied in other locations. If the agencies whose permits/consultations include these existing mitigation sites do not agree to remove the Smith, Blue Diamond, and Bond basins' mitigation sites from OCWD's HMP, then Section 7 consultation for the Santiago Creek project will be reinitiated at that time.

Prior to implementation of the project, RGP 90 will need to be amended to exclude or relocate the HMP mitigation requirements that would be impacted by the project activities. If this does not happen, then a supplemental Environmental Assessment with a revised 404(b)(1) analysis must be completed prior to implementation of the project.

3.4.9.3 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to water quality would be considered significant if the project would result in any of the following:

a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality;
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin;
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surface in a manner which would:
    c-i) result in substantial erosion or siltation on- or off-site,
    c-ii) substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site,
    c-iii) create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff, or
    c-iv) impede or redirect flood flows;
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation; or
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.

It is important to note that an analysis of the potential impacts to existing mitigation sites for Wetland Waters of the U.S./State and Non-Wetland Waters of the U.S./State is included under

Section 3.4.10 Land Use Planning, since that section analyzes environmental effects to an existing land use plan and OCWD's HMP would fall under that designation.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not violate any water quality standards or waste discharge requirements; substantially decrease groundwater supplies or interfere substantially with groundwater recharge; substantially alter the existing drainage pattern of the site or area; risk release of pollutants due to project inundation from flood hazard, tsunami, or seiche zones; or conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.

(a) *Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?*

No Change Alternative

Less Than Significant Impact: The Santiago Recharge Basins are active groundwater recharge facilities that are part of the OCWD groundwater recharge network. The lower Santiago Creek channel is a river/stream channel. The SARWQCB sets water quality standards for all ground and surface waters within the project area. Water quality standards are defined under the Clean Water Act to include both the beneficial uses of specific water bodies and the levels of water quality that must be met and maintained to protect those uses (water quality objectives). Neither the Santiago Recharge Basins nor the lower Santiago Creek channel are listed on the state's 303(d) list of impaired waters.

Construction of the project would include grading, excavation, and other earthmoving activities that have the potential to directly cause erosion that could indirectly degrade water quality and/or violate water quality standards in the short-term. As required by the Clean Water Act, the project would comply with the Santa Ana Municipal Separate Storm Sewer (MS4) NPDES Permit. The NPDES MS4 Permit Program, which is administered in the project area by Orange County and is issued by the SARWQCB, regulates storm water and urban runoff discharges from developments to natural and constructed storm drain systems in the City of Orange, City of Villa Park, and City of Santa Ana. Since the project would disturb one or more acres of soil, construction activities would be subject to the Construction General Permit (NPDES) General Permit Order 2009-009-DWQ issued by the SARWQCB. The Construction General Permit requires implementation of a SWPPP for site clearing, grading, and disturbances such as stockpiling or excavation. The SWPPP would generally contain a site map showing the construction perimeter, proposed structures (e.g., outlet structure, inlet structure, etc.) storm water collection and discharge points, general pre- and post-construction topography, drainage patterns across the site, and adjacent roadways. A 404(b)(1) analysis was not prepared for the No Change Alternative as it is not the preferred alternative for implementation. A 404(b)(1) analysis would need to be prepared and a 401 water quality certification obtained prior to construction if the No Change Alternative became viable. Overall, with the implementation of regulatory requirements pursuant to MS4 NPDES Permit, SWPPP, potential direct/indirect and short-term/long-term impacts to water or water discharge requirements would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: The Santiago Recharge Basins are active groundwater recharge facilities that are part of the OCWD groundwater recharge network. The lower Santiago Creek channel is a river/stream channel. The SARWQCB sets water quality standards for all ground and surface waters within the project area. Water quality standards are defined under the Clean Water Act to include both the beneficial uses of specific water bodies and the levels of water quality that must be met and maintained to protect those uses (water quality objectives). Neither

the Santiago Recharge Basins nor the lower Santiago Creek channel are listed on the state's 303(d) list of impaired waters.

Construction of the project would include grading, excavation, and other earthmoving activities that have the potential to directly cause erosion that could indirectly degrade water quality and/or violate water quality standards in the short-term. As required by the Clean Water Act, the project would comply with the Santa Ana Municipal Separate Storm Sewer (MS4) NPDES Permit. The NPDES MS4 Permit Program, which is administered in the project area by Orange County and is issued by the SARWQCB, regulates storm water and urban runoff discharges from developments to natural and constructed storm drain systems in the City of Orange, City of Villa Park, and City of Santa Ana. Since the project would disturb one or more acres of soil, construction activities would be subject to the Construction General Permit (NPDES) General Permit Order 2009-009-DWQ issued by the SARWQCB. The Construction General Permit requires implementation of a SWPPP for site clearing, grading, and disturbances such as stockpiling or excavation. The SWPPP would generally contain a site map showing the construction perimeter, proposed structures (e.g., outlet structure, inlet structure, etc.) storm water collection and discharge points, general pre- and post-construction topography, drainage patterns across the site, and adjacent roadways.

A 404(b)(1) analysis has been prepared for the Proposed Action Alternative and can be found in Appendix 3. The 404(b)(1) analysis concluded that there would be no permanent impacts to non-wetland waters of the U.S. and there are no wetland waters of the U.S. present within the project footprint. The Proposed Action would have temporary impacts to non-wetland waters of the U.S. due to cut and fill activity, but there would be no net loss of non-wetland waters of the U.S. once construction of the project is complete. No compensatory mitigation measures are required to offset temporary impacts to non-wetland waters of the U.S. However, BMPs as detailed in Section 3.4.9.4 would be implemented during construction to minimize potential impacts to non-wetland waters of the U.S. In addition, some of the mitigation measures required per formal consultation under Section 7 of the Endangered Species Act, such as restoring native vegetation to temporarily disturbed areas within the project footprint, would help to minimize potential impacts to non-wetland waters of the U.S. (refer to Section 3.4.3.4 for mitigation measures related to biological resources). USACE will apply for a 401 water quality certification during the next phase of the project and anticipates no issues with obtaining certification prior to construction of the Proposed Action Alternative.

(b) *Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?*

No Change Alternative

Less Than Significant Impact: The Santiago Recharge Basins are active groundwater recharge facilities that are part of the OCWD groundwater recharge network. The lower Santiago Creek channel is a river/stream channel that is not part of a groundwater recharge network, but the existing soft bottom of the stream does allow for percolation of water to the groundwater table. As part of the project, shoreline stabilization would occur in the Santiago Recharge Basins, an outlet and overflow structure would be constructed in the Bond Basin, and the channel slopes of the lower Santiago Creek channel would be stabilized with buried riprap covered with natural substrates.

Groundwater recharge activities primarily take place in the Bond and Blue Diamond basins. The bottom elevation of Bond Basin is 148-ft msl, and the bottom elevation of Blue Diamond Basin is 168-ft msl. The bottoms of both basins are generally flat with sloping sidewalls, and the average water depths during construction would range from 30- to 50-ft. This depth of water is within the typical operating parameters for summer and fall months in the Santiago Recharge Basins.

Flows in Santiago Creek are highly variable throughout the year, with the highest flows typically occurring during the rainy season (November – April) with low flows during the remainder of the year. In addition, during the rainy season when the Blue Diamond and Bond basins are full, water becomes impounded in Smith Basin, covering approximately two-thirds of the bottom of the basin.

During construction of the project, OCWD which manages the Santiago Recharge Basins would be able to effectively manage the groundwater recharge during the construction period without a substantial long-term impact to the Santiago Recharge Basins. In addition, channel stabilization along the lower Santiago Creek channel would not substantially decrease groundwater supplies or interfere substantially with groundwater recharge directly since the project includes stabilizing the channel with buried riprap covered with natural substrates and native coastal sage scrub vegetation along the stream banks. Long-term, the stabilized channel would still provide a permeable surface for water to percolate through to the groundwater table. Because of the above, potential direct/indirect and short-term/long-term impacts associated with groundwater supplies would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. The Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins. This is important to note, because incorporation of the overflow channel and outlet channel would allow for the Santiago Recharge Basins to hold more water for potential recharge, as under the No Change Alternative. The Proposed Action Alternative does not include these features; therefore, the recharge capability of the Santiago Recharge Basins remains the same as it is under the No Construction Alternative.

(c-i) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would result in substantial erosion or siltation on- or off-site?

No Change Alternative

Less Than Significant Impact: The project does include creating a new low-flow channel for Santiago Creek within Smith Basin. The current channel flows directly into two of the slopes that are needing slope stabilization repairs. In order to make the slope stabilization repairs, the channel would need to be rerouted away from the slopes, so instead of flowing primarily along the south side of Smith Basin, the channel would flow primarily through the center of Smith Basin. A sinuous channel design would be implemented for the low-flow channel. Long-term, it is anticipated that the stream could begin to meander through the basin and may once again approach the slopes along the south of Smith Basin. However, the slope stabilization which includes toe slope protection is expected to protect the slopes from erosion for design storm of the project (i.e., 100-year flood). Therefore, it is not anticipated that there would be a need to go back in and redo the low-flow channel. Overall, although the project does include creating a low-flow channel within Smith Basin for Santiago Creek, the alteration of the course of the stream is not expected to significantly result in substantial erosion or siltation on- or off-site since one of the goals of the project is to reduce the erosion that is currently occurring along the slopes within Smith Basin and the Blue Diamond and Bond basins.

In addition to the creation of a low-flow channel through Smith Basin for Santiago Creek, the project also includes the addition of impervious surfaces specifically within the Bond Basin in the form of a concrete outlet structure and a grouted riprap overflow structure. The project also includes burying riprap and covering the riprap with natural substrates along the lower Santiago

Creek channel; however, this is still a permeable surface and would continue to allow water to percolate through to the groundwater table long-term.

Although the project includes the addition of impervious surfaces as discussed above, the addition of these impervious surfaces would not substantially increase erosion or siltation on- or off-site long-term. That is because the project also includes stabilization of side slopes within the Santiago Recharge Basins, and stabilization of the channel slopes along the lower Santiago Creek channel. The stabilization features would reduce erosion and siltation on and off-site long-term. Without stabilization of the slopes around the Santiago Recharge Basins it is likely that erosion of the slopes would continue, and the slopes would continue to fail, potentially posing safety risks when maintenance activities in the basins are occurring and risking slope failure, which would directly harm or destroy riparian vegetation and environmental resources. Similarly, without stabilization of the channel slopes along the lower Santiago Creek channel, erosion and incision of the channel would continue, potentially posing safety risks for maintenance activities as well as adjacent homeowners long-term.

The Santiago Recharge Basins are active groundwater recharge basins that are part of the OCWD groundwater recharge network. The lower Santiago Creek channel is a river/stream channel that is not part of a groundwater recharge network, but the existing soft bottom of the stream does allow for percolation of water to the groundwater table. Storm water within the project area would flow directly into either the Santiago Recharge Basins or Santiago Creek and would be infiltrated into the groundwater recharge network or groundwater table, respectively. No runoff from the project area would flow directly into a storm water drainage system short-term or long-term. Therefore, potential direct/indirect and short-term/long-term impacts associated with alteration of the existing drainage pattern resulting in erosion or flooding on or off-site would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c-i*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or outlet structure within the Santiago Recharge Basins.

(c-ii) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?

No Change Alternative

Less Than Significant Impact: The project would not change the drainage pattern of the area or increase the risk of flooding long-term. The purpose of the project is to reduce the risk of flooding within the Santiago Creek watershed by creating additional flood storage capacity within the Santiago Recharge Basins as well as creating capacity within the lower Santiago Creek channel to withstand the 100-year storm event. In addition, as stated above under (*c-i*) storm water within the project area would flow either directly into the Santiago Recharge Basins or Santiago Creek and would be infiltrated into the groundwater table. No runoff from the project area would flow directly into a storm water drainage system short-term or long-term. Therefore, potential direct/indirect and short-term/long-term impacts associated with alteration of the existing drainage pattern resulting in flooding on- or off-site would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c-ii*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c-iii) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?

No Change Alternative

Less Than Significant Impact: The Santiago Recharge Basins are active groundwater recharge facilities that are part of the OCWD groundwater recharge network. The lower Santiago Creek channel would continue to have a pervious bottom that would allow infiltration of water to the groundwater table long-term. Storm water within the project area would flow directly into the Santiago Recharge Basins or Santiago Creek and would be infiltrated into the groundwater table. No runoff from the project area would flow directly into a storm water drainage system short-term or long-term. Therefore, potential impacts associated with runoff would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c-iii*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c-iv) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would impede or redirect flood flows?

No Change Alternative

Less Than Significant Impact: The project does include the addition of impervious surfaces specifically within the Bond Basin in the form of a concrete outlet structure and a grouted riprap overflow structure. The project also includes shoreline stabilization within the Santiago Recharge Basins as well as burying riprap and covering the riprap with natural substrates along the lower Santiago Creek channel. None of these features would directly or indirectly impede or redirect flood flows. Instead, project features would increase storage capacity of flood flows within the Santiago Recharge Basins over the long-term. The project would also reduce impediments to flow within the lower Santiago Creek channel and increase flood flow capacity up to the 100-year storm event. Therefore, potential direct/indirect and short-term/long-term impacts associated with impeding or redirecting flood flows would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: The Proposed Action does include the addition of impervious

surfaces specifically within the lower Santiago Creek channel in the form of sheetpile floodwalls capped with concrete. The Proposed Action also includes shoreline stabilization within the Santiago Recharge Basins as well as burying riprap and covering the riprap with natural substrates along the lower Santiago Creek channel. None of the features within the Proposed Action would impede or redirect flood flows. Instead, Proposed Action features would reduce erosion and siltation on and off-site. Without stabilization of the slopes around the Santiago Recharge Basins it is likely that erosion of the slopes would continue, and the slopes would continue to fail, potentially posing safety risks when maintenance activities in the basins are occurring and risking slope failure, which would harm or destroy riparian vegetation and environmental resources. Similarly, without stabilization of the channel slopes along the lower Santiago Creek channel, erosion and incision of the channel would continue, potentially posing safety risks for maintenance activities as well as adjacent homeowners. Therefore, potential impacts associated with impeding or redirecting flood flows would be less than significant and no mitigation would be required.

(d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?

No Change Alternative

No Impact: The project does not include construction or operational activities that would directly or indirectly create flood, tsunami, or seiche hazards that would risk the release of pollutants. The project does not include the construction of any habitable structures which would store potential pollutants as a part of operation long-term. Therefore, no direct/indirect or short-term/long-term impacts associated with the risk of release of pollutants due to project inundation would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?

No Change Alternative

Less Than Significant Impact: As discussed above, the Santiago Recharge Basins are active groundwater recharge facilities that are part of the OCWD groundwater recharge network. The lower Santiago Creek channel is not part of the OCWD groundwater recharge network but would allow for the continued percolation of surface water into the groundwater table long-term. The project would comply with the MS4 NPDES Permit and implement a SWPPP. Therefore, with implementation of regulatory requirements pursuant to the MS4 NPDES Permit, SWPPP, 404(b)(1) Analysis, and Water Quality Certification, potential direct/indirect and short-term/long-term impacts to water quality would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*e*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction

of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.9.4 Environmental Commitments

Mitigation Measures
No mitigation measures associated with impacts to Hydrology and Water Quality apply.

Best Management Practices
Implementation of the following BMPs would help ensure that effects on water quality and WOTUS/State would remain at less-than-significant levels. Standard BMPs include:

- Appropriate erosion control measures would be incorporated into the SWPPP by the construction contractor to prevent sediment from entering waterways and to minimize temporary turbidity impacts. Examples include, but are not limited to, strawbales/wattles, erosion blankets, silt fencing, silt curtains, mulching, revegetation, and temporary covers. Sediment and erosion control measures would always be maintained by the contractor during construction. Control measures would be inspected periodically by the construction contractor, particularly during and after significant rain events.
- The contractor would use a water truck or other appropriate measures to control fugitive dust on haul roads, construction areas, and stockpiles.
- A fuels spill management plan would be developed for the project by the construction contractor and would be implemented by the contractor.
- Construction equipment and vehicles would be fueled and maintained in specific staging areas only, which would be designed to capture potential spills. These areas cannot be near any ditch, stream, or other body of water or feature that may convey water to a nearby body of water.
- Fuels and hazardous materials would not be stored on site. Any spills of hazardous material would be cleaned up immediately by the construction contractor.
- Construction vehicles and equipment would be inspected frequently and appropriately maintained by the construction contractor to help prevent dripping of oil, lubricants, or any other fluids.
- Some construction activities would likely have to occur during the wet season since construction activities need to avoid bird nesting windows during the spring and summer to minimize impacts to federally listed species. To minimize impacts to water quality during construction, personnel would be trained in storm water pollution prevention practices by the construction contractor. In addition, construction work would likely be suspended during periods of significant rainfall, as feasible.
- In areas proposed for revegetation, initiation and completion of revegetation work would be done by the contractor in a timely manner to control erosion.
- Excavation work would be performed in the dry if possible.
- Implementation and adherence to any additional requirements as mandated by the Construction General Permit and the Section 401 Water Quality Certification. The construction contractor would obtain the Construction General Permit while USACE would obtain the Section 401 Water Quality Control Certification. The contractor would be responsible for implementing requirements set forth in these two permits.

3.4.10 Land Use and Planning

This section describes the existing conditions for land use and planning in the vicinity of the project area, including regulatory setting, significance thresholds, effect analysis, and mitigation measures.

3.4.10.1 Regulatory Setting

- OCWD's HMP
- City of Santa Ana General Plan
- City of Villa Park General Plan
- City of Orange General Plan

- Orange County General Plan

3.4.10.2 Existing Conditions

Santiago Creek is designated as Open Space in the City of Santa Ana General Plan (City of Santa Ana, 1982b). The Santiago Recharge Basins are designated as Open Space in the County of Orange General Plan (OCPW, 2012b) and the General Plans for the Cities of Orange (City of Orange, 2010b) and Villa Park (City of Villa Park, 2010c), respectively. Although designated as Open Space, neither site is accessible to the public for recreational uses. The Santiago Bike Trail is located immediately east of the project area along Hewes Street.

The Santiago Recharge Basins are designated as Open Space and water uses and zoned for Sand and Gravel uses in the City of Orange General Plan and Zoning Code (OCPW, 2012b). In the City of Villa Park General Plan and Zoning Code, the Santiago Recharge Basins are designated as passive Open Space and a part of the Orange County Flood Control District (City of Villa Park, 2010c). In the City of Orange General Plan and Zoning Code, the Santiago Recharge Basins are designated as passive Open Space and a part of the Orange County Flood Control District (City of Orange, 2010b). Although designated as Open Space, neither site is accessible to the public for recreational uses. The Santiago Creek Bike Trail is located immediately east of the project area along Hewes Street. The lower Santiago Creek channel is designated and zoned for Open Space with single-family residential zoned adjacent to the stream channel (City of Santa Ana, 1982b).

The Santiago Recharge Basins also fall under OCWD's HMP (OCWD, 2022). OCWD's HMP was prepared to identify restoration activities that provide compensatory mitigation for ongoing routine maintenance impacts to waters of the U.S. and waters of the state associated with OCWD groundwater management operations.

OCWD's maintenance and groundwater management operations are conducted under USACE RGP 90 which was first initiated in 2012 and recently renewed in 2022. The HMP mitigation requirements are incorporated as a condition of the USACE RGP 90 permit. RGP 90 states that "authorization under this Corps permit is conditional upon your compliance with all of the [USFWS] required avoidance and minimization measures, which are incorporated by reference in this permit." (RGP 90 at page 6). Attached as Enclosure 1 to the RGP 90, the 2021 USFWS Endangered Species Act consultation letter requires implementation of the HMP as Conservation Measure 1. Specifically, the USFWS concurrence states:

> *"Our effects analysis is based on maintenance of preserved, restored, and created habitat as identified in the HMP. If this habitat cannot be maintained due to insufficient water supply or if it must be impacted for another project (e.g., Santiago Creek component of the Santa Ana River Project), re-initiation of consultation should be considered."*

Issuance of the 2013 Water Quality Certification by the RWQCB and the Streambed Alteration Agreement by CDFW are also contingent upon the implementation of the mitigation sites as identified in OCWD's HMP (RGP 90, Encl. 1 at page 45). The HMP requires that OCWD "preserve and manage a total of 107.29 acres of native habitats within 7 basins, including 29.5 acres of native riparian and upland vegetation and freshwater marsh to be created and restored (Id. At page 44)." OCWD estimates that their operation and maintenance activities for the recharge basins between 2013 to 2027 will permanently impact 3.19 acres of wetland waters of the U.S. and State, and temporarily impact 1,018.74 acres of non-wetland waters of the U.S. and State (see HMP, Table 1). To compensate for these impacts, the mitigation plan in the HMP requires OCWD to create a total of 8.6 acres of native vegetation, restore 21.04 acres of native vegetation, and preserve and manage 77.99 acres of existing native vegetation. OCWD is required to create/restore native vegetation at a rate of 2 acres per year. OCWD's HMP designates areas within seven of their groundwater recharge basins where the creation, restoration, and preservation of native vegetation will occur.

In the HMP, Smith Basin and Santiago Basin (i.e., Blue Diamond and Bond basins) are identified as two of the seven recharge basins where native habitat restoration and preservation will occur. Under the HMP, OCWD is required to preserve and manage a total of 31.80 acres in Smith Basin and 48.08 acres in Blue Diamond and Bond basins (referred to as Santiago Basin in the HMP). Of the 31.80 acres to be preserved in Smith Basin, 27.47 acres is existing native vegetation (includes 8.6 acres of open water habitat), and 4.33 acres is non-native vegetation that OCWD is required to restore. Of the 48.08 acres to be preserved in the Blue Diamond and Bond basins, 34.44 acres is existing native vegetation, and 13.64 acres is non-native vegetation that is to be restored by OCWD. To date, OCWD has restored 6.47 acres of native vegetation in the Blue Diamond and Bond basins, and no restoration has yet occurred in Smith Basin.

USACE Regulatory is currently in discussions with the USFWS, RWQCB, and CDFW as to whether the mitigation sites specifically in Smith, Blue Diamond, and Bond basins can be removed as a requirement for OCWD to implement because OCWD has potentially already implemented sufficient mitigation within other basins under their purview to offset realized permanent impacts to wetland vegetation since 2013. OCWD has confirmed that 3.19 acres of permanent impacts to wetland vegetation has occurred since the RGP 90 permit was first issued in 2014.

Since discussions about removal of the Smith, Blue Diamond, and Bond basins' mitigation sites from OCWD's HMP are ongoing and are expected to be resolved prior to construction of the proposed Santiago Creek project, the USFWS's 2023 amendment, to the USFWS's 2001 BiOp for the Santa Ana River Mainstem Project and the USFWS's 2012 amendment to the 2001 BiOp for the Santa Ana River Mainstem Project, assumes that the federal requirement for OCWD mitigation has been fully satisfied in other locations. If the agencies whose permits/consultations include these existing mitigation sites do not agree to remove the Smith, Blue Diamond, and Bond basins' mitigation sites from OCWD's HMP, then Section 7 consultation for the Santiago Creek project will be reinitiated at that time.

Prior to implementation of the project, RGP 90 will need to be amended to exclude or relocate the HMP mitigation requirements that would be impacted by the project activities. If this does not happen, then a Supplemental Environmental Assessment with a revised 404(b)(1) analysis and a new ESA Section 7 concurrence from USFWS must be completed prior to implementation of the project.

3.4.10.3 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects on land use and planning would be considered significant if the project would result in any of the following:

a) Physically divide an established community; or
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not physically divide an established community or cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect.

(a) Physically divide an established community?

No Change Alternative

No Impact: The Santiago Recharge Basins are located within an existing groundwater management basin. The project in these areas includes implementation of shoreline stabilization features, an overflow channel, and an outlet channel. Upon completion, the slopes of the Santiago Recharge Basins would be stabilized, and the Blue Diamond and Bond Basins would have increased capacity to hold flood flows during large storm events. The project area within the lower Santiago Creek channel is located within an existing stream channel. The project includes stabilization of the channel by burying riprap and then covering the buried riprap with native substrate. Upon completion, the capacity of the stream channel to carry flood flows would be increased and the channel slopes would be stabilized. During construction of the project, heavy equipment would be operating within the Santiago Recharge Basins and the lower Santiago Creek channel short-term. The heavy equipment operating in the Santiago Recharge Basins would be like equipment used for ongoing routine maintenance activities that occur in the basins. Once construction is complete, the project area would remain inaccessible to the public. Therefore, there would be no direct/indirect or long-term/short-term impacts associated with physically dividing an established community and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note that the Proposed Action Alternative does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins. Therefore, upon completion of the Proposed Action Alternative, the slopes of the Santiago Recharge Basins would be stabilized, but the Blue Diamond and Bond Basins would not have increased capacity to hold flood flows as they would under the No Change Alternative. All other features of the Proposed Action would be the same as those under the No Change Alternative.

(b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?

No Change Alternative

Less Than Significant Impact with Mitigation Incorporated:

In Smith Basin, Table 6 of OCWD's 2020 HMP details that 27.47 acres of existing native vegetation (including 8.6 acres of open water habitat) will be preserved, and 4.33 acres of native vegetation will be restored for a total of 31.80 acres of native vegetation (including 8.6 acres of open water habitat) being maintained and preserved in the basin. Therefore, Smith Basin accounts for 35% of the 77.99 acres of habitat that OCWD has committed to preserving in their HMP. In addition, Smith Basin accounts for 21% of the 21.04 acres of native habitat that OCWD has committed to restoring in their HMP. Similarly, Table 6 of OCWD's 2020 HMP details that 34.44 acres of existing native vegetation will be preserved, and 13.64 acres of native vegetation will be restored for a total of 48.08 acres of native vegetation being maintained and preserved in the Blue Diamond and Bond basins. The Blue Diamond and Bond basins account for 44% of the 77.99 acres of habitat that OCWD has committed to preserving in their HMP. In addition, the Blue Diamond and Bond basins account for 65% of the 21.04 acres of native habitat that OCWD has committed to restoring in their HMP. The remaining acreages to be created, restored, or preserved are in Conrock Basin, Huckleberry Basin, Five Coves Basin, Burris Basin, and Mills Pond (Table 18).

Table 18: Mitigation Plan Summary (Acres) for OCWD's 2020 HMP.

Basin	Existing Native Vegetation (Preserved)	Native Vegetation To Be Created	Native Vegetation Created to Date (Aug 2023)	Native Vegetation To Be Restored	Native Vegetation Restored to Date (Aug 2023)	Overall Amount of Native Vegetation Maintained
Smith Basin	27.47[a]	0.0	0.0	4.33	0.0	**31.80[a]**
Conrock Basin	4.71	1.6	2.0	2.27	2.27	**8.58**
Huckleberry Basin	1.07	0.0	0.0	0.80	0.80	**1.87**
Blue Diamond and Bond Basins	34.44	0.0	0.0	13.64	6.47	**48.08**
Five Coves Basin	1.9	1.7	1.7	0.0	0.0	**3.6**
Burris Basin	8.4 (includes 2.6-ac sand island)	0.34	0.0	0.0	0.0	**8.74**
Mills Pond	0.0	5.1	5.0	0.0	0.0	**5.1**
Total	**77.99**	**8.6**	**8.7**	**21.04**	**9.54**	**107.68**

[a] Includes 8.6 acres of open water habitat that would not be disturbed.

Under the No Change Alternative, the project would temporarily impact a combined total of 16.94 acres of existing native vegetation to be preserved, 4.13 acres of non-native weed upland to be restored with native vegetation, and 1.11 acres of restored native vegetation in Smith Basin and the Blue Diamond and Bond basins as outlined in OCWD's 2020 HMP (Table 19). The project would also permanently impact a combined total of 0.49 acres of existing native vegetation to be preserved, 1.99 acres of non-native weed upland to be restored with native vegetation, and 0.35 acres of restored native vegetation habitat types in Smith Basin and Blue Diamond and Bond basins as outlined in OCWD's 2020 HMP (Table 19). The No Change Alternative would also temporarily impact 1.29 acres of disturbed habitat, 0.63 acres of open water, and 2.01 acres of bare ground. In addition, the No Change Alternative would permanently impact 3.24 acres of bare ground.

Table 19: No Change Alternative's (NCA) Temporary and Permanent Impacts to the Mitigation Plan Summary (Acres) for OCWD's 2020 HMP.

Basin	Existing Native Vegetation (Preserved)	Native Vegetation To Be Created	Native Vegetation Created to Date (Aug 2023)	Native Vegetation To Be Restored	Native Vegetation Restored to Date (Aug 2023)	Overall Amount of Native Vegetation Maintained	Net Overall Amount of Native Vegetation Maintained with SC Project
Smith Basin	**27.47[a]**	**0.0**	**0.0**	**4.33**	**0.0**	**31.80[a]**	**-**
NCA Temp Impacts	16.83[b]	-	-	2.16[c]	-	-	**29.85[d]**
NCA Perm Impacts	0.49	-	-	1.46	-	-	
Blue Diamond and Bond Basins	**34.44**	**0.0**	**0.0**	**13.64**	**6.47**	**48.08**	**-**
NCA Temp Impacts	0.11[e]	-	-	1.97	1.11	-	**47.2[f]**
NCA Perm Impacts	-	-	-	0.53	0.35	-	
Total	**61.91**	**0.0**	**0.0**	**17.97**	**6.47**	**79.88**	**77.05[g]**

[a] Includes 8.6 acres of open water habitat that would not be disturbed.
[b] Includes 6.05-ac open water temporarily disturbed; 1.36-ac open water disturbed by buried riprap; and 0.76-ac disturbed by buried riprap and converted from willow to mulefat as part of the Santiago Creek FRM project.
[C] Includes 0.08-ac non-native weed upland disturbed by buried riprap that would be planted with mulefat as part of the Santiago Creek FRM project.
[d] Includes 8.6-ac of open water habitat.
[e] All 0.11-ac is open water habitat to be preserved.
[f] Includes 0.11-ac of open water habitat.
[g] Includes 8.6-ac of open water habitat in Smith Basin.

In summary, the No Change Alternative will reduce the overall amount of native vegetation maintained in OCWD's 2020 HMP from 107.68 acres to 104.94 acres (Table 20). However, this loss of maintained vegetation would be offset with the implementation of MM BIO-6, MM BIO-7, and MM BIO-8 (refer to Section 3.4.3.4 for details) which offset permanent losses to riparian habitat and upland habitat by restoring the respective habitat types within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam. In addition, temporary impacts would be offset by restoring native vegetation to temporarily disturbed areas within the project footprint (refer to Section 3.4.3.4, MM BIO-1 and MM BIO-4) as well as restoring native vegetation at a 1:1 ratio within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam (refer to Section 3.4.3.4, MM BIO-2 and MM BIO-5).

Table 20: Summary Table Showing Changes to the Mitigation Summary Plan (Acres) for OCWD's HMP with Implementation of the No Change Alternative.

Basin	Existing Native Vegetation (Preserved)	Native Vegetation To Be Created	Native Vegetation Created to Date (Aug 2023)	Native Vegetation To Be Restored	Native Vegetation Restored to Date (Aug 2023)	Overall Amount of Native Vegetation Maintained	Net Overall Amount of Native Vegetation Maintained with SC Project
Smith Basin	27.47[a]	0.0	0.0	4.33	0.0	**31.80[a]**	**29.85[a]**
Conrock Basin	4.71	1.6	2.0	2.27	2.27	**8.58**	**8.58**
Huckleberry Basin	1.07	0.0	0.0	0.80	0.80	**1.87**	**1.87**
Blue Diamond and Bond Basins	34.44	0.0	0.0	13.64	6.47	**48.08**	**47.2**
Five Coves Basin	1.9	1.7	1.7	0.0	0.0	**3.6**	**3.6**
Burris Basin	8.4 (includes 2.6-ac sand island)	0.34	0.0	0.0	0.0	**8.74**	**8.74**
Mills Pond	0.0	5.1	5.0	0.0	0.0	**5.1**	**5.1**
Total	**77.99**	**8.6**	**8.7**	**21.04**	**9.54**	**107.68**	**104.94[a]**

[a] Includes 8.6 acres of open water habitat that would not be disturbed.

Since the federally required mitigation sites under RGP 90 within Smith Basin and Blue Diamond and Bond basins would be restored with native vegetation that would provide equivalent or better ecological functions than the habitat to be disturbed and temporal/permanent impacts to mitigation sites would be offset offsite within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam, the No Change Alternative final mitigation result is similar to the OCWD's HMP objectives. The No Change Alternative is also consistent with the existing General Plan and Zoning Code Open Space designations and neither USACE nor OCPW would request any change to these designations and uses. Therefore, potential impacts associated with conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the No Change Alternative would be less than significant with mitigation incorporated. Refer to environmental commitments listed under Biological Resources category, Section 3.4.3.4 Environmental Commitments, Mitigation Measures.

Proposed Action Alternative
Less Than Significant Impact with Mitigation Incorporated:

In Smith Basin, Table 6 of OCWD's 2020 HMP details that 27.47 acres of existing native vegetation (including 8.6 acres of open water habitat) will be preserved, and 4.33 acres of native vegetation will be restored for a total of 31.80 acres of native vegetation (including 8.6 acres of open water habitat) being maintained and preserved in the basin. Therefore, Smith Basin accounts for 35% of the 77.99 acres of habitat that OCWD has committed to preserving in their HMP. In addition, Smith Basin accounts for 21% of the 21.04 acres of native habitat that OCWD has committed to restoring in their HMP. Similarly, Table 6 of OCWD's 2020 HMP details that 34.44 acres of existing native vegetation will be preserved, and 13.64 acres of native vegetation will be restored for a total of 48.08 acres of native vegetation being maintained and preserved in the Blue Diamond and Bond basins. The Blue Diamond and Bond basins account for 44% of the 77.99 acres of habitat that OCWD has committed to preserving in their HMP. In addition, the Blue Diamond and Bond basins account for 65% of the 21.04 acres of native habitat that OCWD has committed to restoring in their HMP. The remaining acreages to be created, restored, or preserved are in Conrock Basin, Huckleberry Basin, Five Coves Basin, Burris Basin, and Mills Pond (Table 18).

Under the Proposed Action Alternative, the project would temporarily impact a combined total of 16.94 acres of existing native vegetation to be preserved, 4.13 acres of non-native weed upland to be restored with native vegetation, and 1.11 acres of restored native vegetation in Smith Basin and the Blue Diamond and Bond basins as outlined in OCWD's 2020 HMP (Table 21). The project would also permanently impact a combined total of 0.49 acres of existing native vegetation to be preserved, 1.56 acres of non-native weed upland to be restored with native vegetation, and 0.12 acres of restored native vegetation in Smith Basin and the Blue Diamond and Bond basins as outlined in OCWD's 2020 HMP (Table 21). The Proposed Action Alternative would also temporarily impact 1.29 acres of disturbed habitat and 2.01 acres of bare ground.

Table 21: Proposed Action Alternative's (PAA) Temporary and Permanent Impacts to the Mitigation Plan Summary (Acres) for OCWD's 2020 HMP.

Basin	Existing Native Vegetation (Preserved)	Native Vegetation To Be Created	Native Vegetation Created to Date (Aug 2023)	Native Vegetation To Be Restored	Native Vegetation Restored to Date (Aug 2023)	Overall Amount of Native Vegetation Maintained	Net Overall Amount of Native Vegetation Maintained with SC Project
Smith Basin	**27.47[a]**	**0.0**	**0.0**	**4.33**	**0.0**	**31.80[a]**	**-**
PAA Temp Impacts	16.83[b]	-	-	2.16[c]	-	-	**29.85[d]**
PAA Perm Impacts	0.49	-	-	1.46	-	-	
Blue Diamond and Bond Basins	**34.44**	**0.0**	**0.0**	**13.64**	**6.47**	**48.08**	**-**
PAA Temp Impacts	0.11[e]	-	-	1.97	1.11	-	**47.86[f]**
PAA Perm Impacts	-	-	-	0.10	0.12	-	
Total	**61.91**	**0.0**	**0.0**	**17.97**	**6.47**	**79.88**	**77.71[g]**

[a] Includes 8.6 acres of open water habitat that would not be disturbed.
[b] Includes 6.05-ac open water temporarily disturbed; 1.36-ac open water disturbed by buried riprap; and 0.76-ac disturbed by buried riprap and converted from willow to mulefat as part of the Santiago Creek FRM project.
[C] Includes 0.08-ac non-native weed upland disturbed by buried riprap that would be planted with mulefat as part of the Santiago Creek FRM project.
[d] Includes 8.6-ac of open water habitat.
[e] All 0.11-ac is open water habitat to be preserved.
[f] Includes 0.11-ac of open water habitat.
[g] Includes 8.6-ac of open water habitat in Smith Basin.

In summary, the Proposed Action Alternative would reduce the overall amount of native vegetation maintained in OCWD's 2020 HMP from 107.68 acres to 105.60 acres (Table 22). However, this loss of maintained vegetation would be offset with the implementation of MM BIO-6, MM BIO-7, and MM BIO-8 (refer to Section 3.4.3.4 for details) which offset permanent losses to riparian habitat and upland habitat by restoring the respective habitat types within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam. In addition, temporary impacts would be offset by restoring native vegetation to temporarily disturbed areas within the project footprint (refer to Section 3.4.3.4, MM BIO-1 and MM BIO-4) as well as restoring native vegetation at a 1:1 ratio within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam (refer to Section 3.4.3.4, MM BIO-2 and MM BIO-5).

Table 22: Summary Table Showing Changes to the Mitigation Summary Plan (Acres) for OCWD's HMP with Implementation of the Proposed Action Alternative.

Basin	Existing Native Vegetation (Preserved)	Native Vegetation To Be Created	Native Vegetation Created to Date (Aug 2023)	Native Vegetation To Be Restored	Native Vegetation Restored to Date (Aug 2023)	Overall Amount of Native Vegetation Maintained	Net Overall Amount of Native Vegetation Maintained with SC Project
Smith Basin	27.47[a]	0.0	0.0	4.33	0.0	31.80[a]	29.85[a]
Conrock Basin	4.71	1.6	2.0	2.27	2.27	8.58	8.58
Huckleberry Basin	1.07	0.0	0.0	0.80	0.80	1.87	1.87
Blue Diamond and Bond Basins	34.44	0.0	0.0	13.64	6.47	48.08	47.86
Five Coves Basin	1.9	1.7	1.7	0.0	0.0	3.6	3.6
Burris Basin	8.4 (includes 2.6-ac sand island)	0.34	0.0	0.0	0.0	8.74	8.74
Mills Pond	0.0	5.1	5.0	0.0	0.0	5.1	5.1
Total	**77.99**	**8.6**	**8.7**	**21.04**	**9.54**	**107.68**	**105.60[a]**

[a] Includes 8.6 acres of open water habitat that would not be disturbed.

Since the federally required mitigation sites under RGP 90 within Smith Basin and the Blue Diamond and Bond basins would be restored with native vegetation that would provide equivalent or better ecological functions than the habitat to be disturbed and temporal/permanent impacts to mitigation sites would be offset offsite by a combined total of 17.92 acres of wetland/riparian habitat and 13.71 acres of coastal sage scrub habitat to be restored offsite within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam, the Proposed Action Alternative final mitigation result is similar to the OCWD's HMP objectives. The No Change Alternative is also considered consistent with the existing General Plan and Zoning Code Open Space designations and neither USACE nor OCPW would request any change to these designations and uses. Therefore, potential impacts associated with conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Proposed Action Alternative would be less than significant with mitigation incorporated. Refer to environmental commitments listed under Biological Resources category, Section 3.4.3.4 Environmental Commitments, Mitigation Measures.

Prior to the implementation of the project, the USACE RGP 90 will need to be amended to exclude or relocate the HMP mitigation requirements that would be impacted by the project activities. If this does not happen, then a supplemental Environmental Assessment with a revised 404(b)(1) analysis and a new ESA Section 7 concurrence from USFWS must be completed prior to implementation of the project.

3.4.10.4 Environmental Commitments

Mitigation Measures
Refer to mitigation measures listed under Section 3.4.3.4 Environmental Commitments, Mitigation Measures.

Best Management Practices
No BMPs would be implemented since there would be no impact to Land Use or Planning.

3.4.11 Noise
This section describes the existing conditions for noise in the vicinity of the project area, regulatory setting, significant thresholds, effect analysis, and mitigation measures.

3.4.11.1 Regulatory Background
The adverse impact of noise was officially recognized by the federal government in the Noise Control Act of 1972. The most relevant federal agency to the Proposed Action would be OSHA, which limits noise exposure of workers to 90 decibels (dB) equivalent continuous sound level (L_{eq}) or less over eight hours or 105 dB L_{eq} or less over one hour.

The California Office of Noise Control has set the land use compatibility noise standards for different types of land uses and has encouraged local jurisdictions to adopt them. According to the land use compatibility noise standards, for commercial and industrial uses, long-term noise levels up to 65 Community Noise Equivalent Level (CNEL) are normally acceptable; noise levels between 65 and 75 dBA CNEL are "conditionally acceptable," which means that noise levels are acceptable only when a detailed noise analysis is conducted and needed noise insultation features are included in the design. Long term noise levels between 70 and 80 dBA CNEL are generally acceptable.

For residential development and schools, long-term exterior noise levels ranging up to 60 dBA CNEL are classified as "normally acceptable," based upon the assumption that the homes are built with normal conventional construction. Long term noise levels ranging up to 70 dBA CNEL are conditionally acceptable and noise levels in the 70- to 75-dBA CNEL range are classified as "generally unacceptable but may proceed if a detailed noise analysis is conducted and needed noise insultation features are included in the design."

The local noise regulations that are applicable to the Proposed Action would be the City of Santa Ana, City of Orange, and City of Villa Park General Plan Noise Elements and Municipal Code Ordinances.

City of Santa Ana General Noise Plan Element
The City of Santa Ana Municipal Code restricts exterior noise levels to 55 dBA between 7:00 a.m. and 10:00 p.m. and 50 dBA between 10:00 p.m. and 7:00 a.m. (Article VI-Noise Control, Section 18-312-Exterior Noise Standards). Regarding interior noise levels, the noise standard is 55 dBA between 7:00 a.m. and 10:00 p.m. and 45 dBA between 10:00 p.m. and 7:00 a.m. (Article VI-Noise Control, Section 18-313-Interior Noise Standards). Noises associated with construction, repair, remodeling, or grading of any real property, provided the activities do not take place between the hours of 8:00 p.m. and 7:00 a.m. on weekdays, including Saturday, or any time on Sunday or a federal holiday (Article VI-Noise Control, Section 18-341(e)).

City of Villa Park General Plan Noise Element
The City of Villa Park has adopted, as part of its Noise Element, the State of California Office of Noise Control standards. The Noise Element indicates that exterior noise levels at residential locations should not exceed 65 dB CNEL, while interior levels shall not exceed 45 dB CNEL in any habitable room from stationary or mobile sources. These standards do not apply to noise generated from construction activity.

City of Villa Park Noise Ordinance
The City of Villa Park has the authority to set land use noise standards and place restrictions on private activities that generate excessive or intrusive noise. The applicable standards for these activities are specified in the Villa Park Municipal Code. The Municipal Code limits sound levels for stationary sources of noise radiated for extended periods from any premises more than 55 dBA between the hours of 7:00 a.m. and 10:00 p.m. and 50 dBA between the hours of 10:00 p.m. and 7:00 a.m. Sound created by construction within the city is exempt from the requirements of the Municipal Code if it is conducted from 7:00 a.m. to 8:00 p.m. Monday through Friday, or from 8:00 a.m. to 8:00 p.m. on Saturday (Article 6-6.-Noise Control, Section 6-6.5-6.7).

City of Orange General Plan
The City of Orange has developed its own land use compatibility standards based on recommended parameters from the California Governor's Office of Planning and Research. Using the state's land use compatibility guidelines, the city has established interior and exterior noise standards. The city's compatibility standards provide only for normally acceptable conditions based on state recommendations and city land use designations. For single-family and multiple-family residential and school uses the maximum allowable noise levels are 45 dBA CNEL for interior areas and 65 dBA CNEL for exterior areas. For business and commercial uses, the maximum allowable noise levels are 50 dBA CNEL for interior areas and no exterior threshold is defined.

The city's maximum allowable noise exposure levels are shown in Table 23. The maximum stationary noise levels identified in Table 18 are for operational noise sources and not for construction noise sources.

Table 23: City of Orange Maximum Allowable Noise Exposure – Stationary Noise Sources.

Noise Level Descriptor	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly Equivalent Level (L_{eq}), dBA	55	45
Maximum Level (Lmax), dBA	70	65

City of Orange Municipal Code
Under Section 8.24.070 of the City of Orange Municipal Code, construction and maintenance activities are exempt from the maximum stationary noise levels when:

- Construction activities take place between the hours of 7:00 a.m. and 8:00 p.m. on

weekdays, including Saturday, except on a federal holiday; and
- Maintenance activities take place between the hours of 7:00 a.m. and 8:00 p.m. on any day except Sunday or a federal holiday, or between the hours of 9:00 a.m. and 8:00 p.m. on Sunday or a federal holiday.

3.4.11.2 Existing Conditions

Background
Noise is defined as unwanted sound. Sound becomes unwanted when it creates a nuisance that interferes with normal activities, or when it causes physical harm or otherwise adversely affects human health. The standard unit of measurement of the loudness of sound is dB. The zero point on the dB scale is based on the lowest sound level that a healthy, unimpaired human ear can detect. Changes of three dB or fewer are only perceptible in laboratory environments. An increase of 10 dB represents a 10-fold increase in acoustic energy, while 20 dB is 100 times more intense, and 30 dB is 1,000 times more intense. Each 10 dB increase in sound level is perceived as approximately a doubling of loudness.

Numerous methods have been developed to measure sound over a period, including L_{eq}, CNEL, Day/Night Average Sound Level (L_{dn}) and Maximum Noise event (L_{max}). Noise level can vary depending on the noise source and duration. Below is a description of the units of measure used in this analysis to describe the noise environment.

- L_{eq}: Time variations in noise exposure are typically expressed as a statistical description of the sound pressure level that is exceeded over some fraction of a given observation period (called L_{eq}). For example, the noise levels exceeded on 10 percent of readings is called L_{10}, the median (50th percentile) reading is called L_{50}, etc.
- CNEL: Because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, state law requires that, for planning purposes, an artificial dB increment penalty be added to quiet-time noise levels in a 24-hour noise descriptor called CNEL.
- L_{dn}: Another commonly used method is the day/night average level or L_{dn}. The L_{dn} is a measure of the 24-hour average noise level at a given location. It was adopted by the USEPA for developing criteria for the evaluation of community noise exposure.
- L_{max}: The maximum noise level recorded during a noise event is typically expressed as L_{max}.

Effects of Noise
Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Extended periods of noise exposure above 90 dBA could result in permanent hearing damage. When the noise level reaches 120 dBA, a tickling sensation occurs in the human ear even with short-term exposure. This level of noise is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by the feeling of pain in the ear. A sound level of 190 dBA will rupture the eardrum and permanently damage the inner ear. Table 24 summarizes typical noise sources, levels, and responses.

Table 24: Noise Levels and Human Response.

Noise Source	Noise Level (dBA)	Response
Library	30	Very quiet
Refrigerator humming	40	Quiet
Quiet Office	50	Quiet
Normal Conversation	60	Intrusive
Vacuum Cleaner	70	Telephone use difficult
Freight train at 50 feet	80	Interferes with conversation
Heavy-duty truck at 50 feet	90	Annoying

Noise Source	Noise Level (dBA)	Response
Jet takeoff at 2,000 feet	100	Very annoying; hearing damage at sustained exposure levels
Unmuffled motorcycle	110	Maximum vocal effect; physical discomfort
Jet takeoff at 200 feet	120	Regular exposure over one-minute risks permanent hearing loss
Shotgun firing	130	Pain threshold
Carrier jet operation	140	Harmfully loud
Source: M.D. Branch and R.D. Beland, 1970.		

The project area is in an urban setting surrounded by residential and commercial uses. Ambient noise levels in the project area consist of traffic noise and noise associated with residential and commercial operations. Roadway traffic consisting of cars, buses, and commercial trucks generate the highest ground vibrations. These vibrations vary with pavement conditions. Potholes, pavement joints, and the differences in the settlement of pavement all increase vibration levels from traffic.

3.4.11.3 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects of noise and vibration would be considered significant if the project would result in any of the following:

a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
b) Generation of excessive groundborne vibration or groundborne noise levels; or
c) For a project located within the vicinity of a private airstrip or an airport land use plan, or where such a plan has not been adopted, within two miles of a public airport use airport, would the project expose people residing or working in the project area to excessive noise levels.

Short-term construction noise impacts are considered significant if construction generated noise levels exceed the applicable exterior noise standards of the City of Villa Park, City of Orange, or City of Santa Ana at times that are outside noise exempt hours at nearby noise sensitive land uses.

Short- and long-term vibration impacts would be significant if the project construction would expose sensitive receptors to or would generate vibration levels that exceed Caltrans recommended standards of 0.2 inch per second (in/sec) peak particle velocity (PPV) or the Federal Transit Administration's (FTA's) maximum acceptable vibration standard of 80 vibration decibels (VdB) at nearby sensitive land uses.

Methodology

Construction of the project would require the use of heavy equipment that would temporarily increase noise and/or groundborne vibration levels at properties near the work sites. Construction equipment required for each project feature and project site preparation was identified and the typical noise level (i.e., dBA) at 50 feet for that construction equipment was compiled using the U.S. Department of Transportation Construction Noise Handbook (USDOT, 2006). For each design feature and site preparation, the loudest piece of equipment was used to estimate construction noise impact on nearby sensitive receptors. It is important to note, that although the loudest piece of equipment was used in the analysis, construction activities would be intermittent. Therefore, actual noise levels could be somewhat lower than the estimated values. Noise from construction activity generally attenuates (decreases) at a rate of 6.0 to 7.5 dBA per doubling of

distances from the source. Any shielding effects that may result from local barriers such as topography, fences, vegetation, etc., are not incorporated, so the calculated noise levels represent a conservative or “worse-case” estimation.

Like noise, vibration also attenuates with increasing distance, as a complex function of energy transfer into the ground and the soil conditions through which the vibration is transmitted. Calculations of vibration attenuation followed standard FTA methods (FTA, 2006).

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not result in the generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of established standards; generate excessive groundborne vibration or groundborne noise levels; or expose people residing or working within the vicinity of a private airstrip or an airport land use plan to excessive noise levels.

(a) *Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?*

No Change Alternative

Less Than Significant Impact with Mitigation Incorporated:

Construction Related Noise Impacts

The project would require the use of multiple pieces of construction equipment short-term. The overall construction could take just under two years and nine months. All construction activities would occur between 7:00 a.m. and 8:00 p.m. Monday through Friday and 8:00 a.m. and 8:00 p.m. on Saturday to comply with the City of Villa Park noise ordinance, which has the most stringent noise standards for the project area. No construction would be permitted on Sundays or federal holidays to comply with the noise ordinances for the City of Santa Ana, Villa Park, and Orange. For information on the noise ordinances for the cities of Santa Ana, Villa Park, and Orange refer to Section 3.4.11.1. Although the cities construction noise standards do not provide any limits to the noise levels that may be created from construction activities and even with adherence to the various cities’ standards, the resultant construction noise levels may result in a significant substantial temporary noise increase to nearby sensitive receptors.

The Transit Noise and Vibration Impact Assessment, prepared by the FTA (2006), which is the only agency that has defined what constitutes a significant construction noise impact, has been utilized to determine if the proposed construction activities would create a significant substantial temporary noise increase. The FTA determined that an 80 dBA L_{eq} daytime construction noise level at nearby homes would constitute a significant construction noise impact. The nearest sensitive receptors to Smith Basin are residents at the single-family homes adjacent to the southwest, west, and north. The nearest schools are Oakridge Private School and Linda Vista Elementary School which are adjacent to the southeast and approximately 0.25-mi southeast of Smith Basin, respectively. Regarding the Blue Diamond and Bond basins, the nearest sensitive receptors are residents at the single-family homes adjacent to the northwest, west, south, east, and northeast. The nearest schools are Villa Park Elementary School, Prospect Elementary School, Orange County Classical Academy, El Modena High School, Santiago Charter Middle School, Orange County Classical Academy, El Modena High School, Santiago Charter Middle School, Linda Vista Elementary School, and Oakridge Private School which are located approximately 0.27-mi northwest, 0.43-mi south, 0.33-mi south, 0.59-mi south, 0.51-mi southeast, 0.39-mi east, and 0.23-mi northeast of the Blue Diamond and Bond basins, respectively. Regarding the lower Santiago Creek channel, the nearest sensitive receptors are the residents at the single-family homes adjacent to either side of the channel and as close to the channel as

approximately 35-ft. The nearest schools to the lower Santiago Creek channel are Santiago Elementary School and Rancho Santiago Community College located approximately 0.27-mi south and 0.32-mi southeast of the channel, respectively. Other sensitive receptors within the vicinity of the lower Santiago Creek channel include The Church of Jesus Christ of Latter-Day Saints located approximately 0.04-mi north of the channel, Jack Fisher Park located adjacent to the north side of the channel (near North Flower Street and West Park Lane), and the Sarah May Downie Herb Garden located approximately 0.07-mi south of the channel.

Typical construction equipment noise emissions for each piece of construction equipment for site preparation and each project feature are found in Table 25.

Table 25: Construction Equipment Required and Typical Sound Level at 50 ft (dBA) for Each Piece of Equipment. Project features are listed along the top row with an "X" designating a piece of construction equipment required for construction of the project features.

Equipment Type	Typical Sound Level at 50 ft (dBA)	Site Preparation	Shoreline Stabilization	Overflow Structure	Outlet Structure	Channel Tie-In Structure	Lower Santiago Creek Channel Stabilization
Asphalt Paver	89				X		X
Backhoe	80					X	
Brush Chipper	85	X					
Bulldozer	85						X
Chain Saw	85	X					
Circular Saw	85						X
Compactor	80						X
Concrete Mixer	85		X	X	X	X	
Concrete Pump	82		X	X			
Concrete Saw	90		X		X		
Concrete Vibrator	80		X		X	X	
Crane	83		X				X
Crawler Dozer	85	X	X	X	X	X	X
Drill Crawler	85		X				
Dump Truck	84	X	X	X	X	X	X
Excavator	85	X	X	X	X		X
Flatbed Truck	88	X			X		X
Front End Loader	80	X	X	X	X	X	X
Generator	82		X	X		X	X
Grader	85				X		
Post Driver	85				X		
Roller	74				X	X	X
Skid Steer	80	X					X
Water Pump	76		X		X		
Water Truck	88	X	X	X	X	X	X
Welder	73		X				
Source: FTA 2006							

The loudest pieces of equipment that are anticipated to be used during construction are shown in Table 26 through Table 28, which shows the anticipated worst-case scenario noise level at the nearest sensitive receptors. The loudest piece of construction equipment for Site Preparation is 88 dBA at 50-ft. The loudest piece of construction equipment for Shoreline Stabilization is 90 dBA at 50-ft. The loudest piece of construction equipment for the Overflow Structure is 88 dBA at 50-ft. The loudest piece of construction equipment for the Outlet Structure is 90 dBA at 50-ft. The loudest piece of construction equipment for the Tie-In Structure is 88 dBA at 50-ft. Lastly, the loudest piece of construction equipment for Channel Stabilization is 89 dBA at 50-ft.

Table 26 shows that worst-case construction activities could have a noise level as high as 82-88 dBA L_{eq} at homes on the north side of Smith Basin, Oakridge Private School, and Linda Vista Elementary School. Table 27 shows that worst-case construction activities could have a noise level as high as 78-84 dBA L_{eq} at homes on the west, east, and south side of the Blue Diamond and Bond basins. Table 28 shows that worst-case construction activities could have a noise level as high as 89 dBA L_{eq} at homes on the north and south side of the lower Santiago Creek channel. As stated earlier in this section, the FTA determined that an 80 dBA L_{eq} daytime construction noise level at nearby homes would constitute a significant construction noise impact. Therefore, certain features of the project would exceed the FTA daytime construction noise standard of 80 dBA L_{eq}. Since construction of certain features of the project would exceed the FTA daytime construction noise standard, mitigation measures MM NV-1 through MM NV-6 (refer to Section 3.4.11.4 for details on the mitigation measures) would be implemented during construction to reduce potentially significant direct noise impacts to nearby sensitive receptors to less than significant.

Table 26: Construction Noise Levels at Nearby Sensitive Receptors for Smith Basin based on the Loudest Piece of Construction Equipment for Each Construction Phase.

Nearby Sensitive Receptors	Variable	Construction Phase: Site Preparation (Clearing and Grubbing)	Construction Phase: Slope Stabilization
Homes on the South Side of Smith Basin	Distance (Ft)	1,028	1,028
	Noise Level (dBA Leq)	-	-
Homes on the West Side of Smith Basin	Distance (Ft)	1,973	1,973
	Noise Level (dBA Leq)	-	-
Homes on the North Side of Smith Basin	Distance (Ft)	80	80
	Noise Level (dBA Leq)	88-82	88-82
Oakridge Private School and Linda Vista Elementary School	Distance (Ft)	93	93
	Noise Level (dBA Leq)	88-82	88-82
(-) noise attenuates to below background levels before reaching sensitive receptor(s).			

Table 27: Construction Noise Levels at Nearby Sensitive Receptors for Blue Diamond and Bond Basins.

Nearby Sensitive Receptors	Variable	Construction Phase: Site Preparation (Clearing and Grubbing)	Construction Phase: Outlet Structure	Construction Phase: Overflow Structure	Construction Phase: Slope Stabilization
Homes on the Northwest Side of Blue Diamond and Bond Basins	Distance (Ft)	100	240	100	915
	Noise Level (dBA Leq)	82	66-72	82	-
Homes on the West Side of Blue Diamond and Bond Basins	Distance (Ft)	144	144	450	117
	Noise Level (dBA Leq)	76-82	78-84	-	78-84
Homes on the East Side of Blue Diamond and Bond Basins	Distance (Ft)	144	2,500	2,300	144
	Noise Level (dBA Leq)	76-82	-	-	78-84
Homes on the South	Distance (Ft)	118	1,200	1,500	118

Nearby Sensitive Receptors	Variable	Construction Phase: Site Preparation (Clearing and Grubbing)	Construction Phase: Outlet Structure	Construction Phase: Overflow Structure	Construction Phase: Slope Stabilization
Side of Blue Diamond and Bond Basins	Noise Level (dBA Leq)	82	-	-	78-84
Oakridge Private School and Linda Vista Elementary School	Distance (Ft)	3,000	5,750	5,150	3,000
	Noise Level (dBA Leq)	-	-	-	-
(-) noise attenuates to below background levels before reaching sensitive receptor(s).					

Table 28: Construction Noise Levels at Nearby Sensitive Receptors for the Lower Santiago Creek Channel.

Nearby Sensitive Receptors	Variable	Construction Phase: Site Preparation (Clearing and Grubbing)	Construction Phase: Tie-In Structure	Construction Phase: Channel Stabilization
Homes on the North Side of Santiago Creek	Distance (Ft)	30	150	30
	Noise Level (dBA Leq)	88	76	89
Homes on the South Side of Santiago Creek	Distance (Ft)	30	150	30
	Noise Level (dBA Leq)	88	76	89
Santiago Elementary School	Distance (Ft)	1,050	2,350	1,050
	Noise Level (dBA Leq)	-	-	-
Rancho Santiago Community College	Distance (Ft)	1,650	3,000	1,650
	Noise Level (dBA Leq)	-	-	-
(-) noise attenuates to below background levels before reaching sensitive receptor(s).				

Operational Noise Impacts
OCPW would conduct operation and maintenance activities that are listed in Section 2.3. No changes are proposed to the annual maintenance activities that currently occur within the Santiago Recharge Basins or the lower Santiago Creek channel, and all maintenance activities would be conducted in accordance with the OCPW Regional Maintenance Plan. Ongoing operation of the Santiago Recharge Basins and the Santiago Creek Flood Control Channel would primarily be passive and would not typically require the use of any off-road equipment long-term. Therefore, no impacts associated with operational noise would occur.

Proposed Action Alternative

Less Than Significant with Mitigation Incorporated:

Construction Related Noise Impacts
The discussion regarding the timing of construction activities and the nearest noise receptors would be the same for the Proposed Action as it is under the No Action Alternative. Therefore, that discussion is incorporated by reference only here (refer to No Action Alternative (*a*)). Construction equipment used for site preparation and shoreline stabilization under the Proposed Action Alternative would be the same as that presented in Table 25 under the No Change Alternative. The Proposed Action does not include the construction of the overflow structure, outlet structure, or channel tie-in structure, therefore, construction equipment shown in Table 25 for those specific project features under the No Action Alternative are not applicable to the Proposed Action Alternative. Lastly, construction equipment needed within the lower Santiago Creek channel would be slightly different than equipment listed in Table 25. The primary difference is that additional equipment would be needed under the Proposed Action Alternative for the lower Santiago Creek channel since floodwalls would also be constructed in addition to channel improvements. Table 29 shows the construction equipment required for channel improvements and floodwall construction within the Lower Santiago Creek Channel.

Table 29: Construction Equipment Required for Stabilization of the Lower Santiago Creek Channel and Floodwall Construction.

Equipment Type	Typical Sound Level at 50 ft (dBA)
Asphalt Paver	89
Bull Dozer	85
Circular Saw	85
Compactor	80
Concrete Mixer	85
Concrete Pump	82
Crane	83
Crawler Dozer	85
Dump Truck	84
Excavator	85
Flatbed Truck	88
Front End Loader	85
Generator	82
Pile Driver	101
Roller	74
Skid Steer	80
Water Truck	88
Source: FTA 2006	

The loudest pieces of equipment that are anticipated to be used during construction of the Proposed Action are similar to those shown in Table 26 and Table 27 under the No Change

Alternative. Note that Table 27 shows construction noise levels at nearby sensitive receptors for the following construction phases: site preparation, outlet structure, overflow structure, and slope stabilization. Only site preparation and slope stabilization construction phases would be applicable to the Proposed Action Alternative. As stated above, the Proposed Action Alternative does not include the construction of the outlet structure or overflow structure. Table 30 is specific to the Proposed Action Alternative in that it has been updated to include noise levels due to floodwall construction. The loudest piece of construction equipment for floodwall construction is 101 dBA at 50-ft. Therefore, the worst-case construction activities could have a noise level as high as 101 dBA L_{eq} at homes on the north and south side of the lower Santiago Creek channel due to floodwall construction. As stated earlier, the FTA determined than an 80 dBA Leq daytime construction noise at nearby homes would constitute a significant construction noise impact. Therefore, certain features of the Proposed Action, including floodwall construction, would exceed the FTA daytime construction noise standard of 80 dBA Leq. Since certain features of the Proposed Action would exceed the FTA daytime construction noise standard, mitigation measures MM NV-1 through MM NV-6 (refer to Section 3.4.11.4 for details on the mitigation measures) would be implemented during construction to reduce potentially significant direct noise impacts to nearby sensitive receptors to less than significant.

Table 30: Construction Noise Levels at Nearby Sensitive Receptors for the Lower Santiago Creek Channel.

Nearby Sensitive Receptors	Variable	Construction Phase: Site Preparation (Clearing and Grubbing)	Construction Phase: Floodwalls	Construction Phase: Channel Stabilization
Homes on the North Side of Santiago Creek	Distance (Ft)	30	30	30
	Noise Level (dBA Leq)	88	101	89
Homes on the South Side of Santiago Creek	Distance (Ft)	30	30	30
	Noise Level (dBA Leq)	88	101	89
Santiago Elementary School	Distance (Ft)	1,050	2,350	1,050
	Noise Level (dBA Leq)	-	-	-
Rancho Santiago Community College	Distance (Ft)	1,650	3,000	1,650
	Noise Level (dBA Leq)	-	-	-
(-) noise attenuates to below background levels before reaching sensitive receptor(s).				

Operational Noise Impacts

OCPW would conduct operation and maintenance activities that are listed in Section 2.3. No changes are proposed to the annual maintenance activities that currently occur within the Santiago Recharge Basins or the lower Santiago Creek channel, and all maintenance activities would be conducted in accordance with the OCPW Regional Maintenance Plan. Ongoing operation of the Santiago Recharge Basins and the Santiago Creek Flood Control Channel would primarily be passive and would not typically require the use of any off-road equipment long-term. Therefore, no impacts associated with operational noise would occur.

(b) *Generation of excessive groundborne vibration or groundborne noise levels?*

No Change Alternative

Less Than Significant Impact:

Construction Related Vibration Impacts

The project would require the use of multiple pieces of construction equipment for potentially just

under two years and nine months of construction. The nearest sensitive receptors to the proposed construction activities were detailed above in (*a*). The FTA has compiled vibration level data regarding vibration generating characteristics of several types of construction equipment that are shown in Table 31.

Table 31: Vibration Source Levels for General Construction Equipment.

Equipment Type	Peak Particle Velocity at 25 feet (in/sec.)
Vibratory Roller	0.21
Hoe Ram	0.089
Large Bulldozer	0.089
Caisson Drill	0.089
Loaded Trucks	0.076
Jackhammer	0.035
Small Bulldozer	0.003
Source: FTA, 2006	

As shown in Table 31, a vibratory roller would be the type of equipment anticipated to be used during construction activities that would create the highest vibration level of 0.210 in/sec PPV at 25-ft. Based on typical vibration propagation rates, the vibration level at the nearest offsite receptor at Smith Basin (i.e., homes located on the north side that are as near as 80-ft from construction activities) would be 0.0367 in/sec PPV. The vibration level at the nearest offsite receptor at Blue Diamond and Bond basins (i.e., homes located on the northwest side that are as near as 100-ft from construction activities) would be 0.0263 in/sec PPV. The vibration level at the nearest offsite receptor at the lower Santiago Creek channel (i.e., homes located on the south and north side that are as near as 30-ft from construction activities) would be 0.1598 in/sec PPV.

Thresholds to which the above peak particle velocities would potentially cause building damage or cause human annoyance are found in Table 32 and Table 33.

Table 32: Vibration Thresholds for Structural Damage

Structure and Condition	Maximum Vibration Level (in/sec PPV): Transient Sources	Maximum Vibration Level (in/sec PPV): Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
Newer residential structures	1.0	0.5
Modern industrial/commercial buildings	1.0	0.5
Notes: Transient sources create a single vibration event, such as blasting or ball drops. Continuous/frequent intermittent sources include pile drivers, pogo-stick compactors, and vibratory pile drivers. Source: Caltrans 2004		

Table 33: Vibration Thresholds for Human Annoyance

Human Annoyance Level	Maximum Vibration Level (in/sec PPV): Transient Sources	Maximum Vibration Level (in/sec PPV): Continuous/Frequent Intermittent Sources
Barely perceptible	0.04	0.01

Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.1
Severe	2.0	0.4
Notes: Transient sources create a single vibration event, such as blasting or ball drops. Continuous/frequent intermittent sources include pile drivers, pogo-stick compactors, and vibratory pile drivers. Source: Caltrans 2004		

Based on the thresholds above, only construction activities within the lower Santiago Creek channel have the potential to indirectly damage “extremely fragile historic buildings, ruins, and ancient monuments”. All other residential type structures within the vicinity of the lower Santiago Creek channel would not be threatened by structural damage as the thresholds are not met by construction activities. In addition, none of the construction activities within the Santiago Recharge Basins reach the thresholds for structural damage to buildings/structures due to vibration. Regarding human annoyance, only construction activities within the lower Santiago Creek channel have the potential of being “strongly perceptible” by humans due to the proximity of residences to construction activities. None of the construction activities within the Santiago Recharge Basins reach the thresholds for human annoyance. Because vibration generated by construction activities would mostly not meet the thresholds for structural damage and human annoyance, the impact due to groundborne vibration or groundborne noise would be less than significant.

Proposed Action Alternative

Less Than Significant with Mitigation Incorporated:

Construction Related Vibration Impacts

The Proposed Action would require the use of multiple pieces of construction equipment for potentially just under two years and nine months of construction. The nearest sensitive receptors to the proposed construction activities were detailed above in (*a*). The FTA has compiled vibration level data regarding vibration generating characteristics of several types of construction equipment that are shown in Table 34.

Table 34: Vibration Source Levels for General Construction Equipment.

Equipment Type	Peak Particle Velocity at 25 feet (in/sec.)
Pile Driver (Impact)	0.644 to 1.518
Vibratory Roller	0.210
Pile Driver (Sonic/Vibratory)	0.170 to 0.734
Hoe Ram	0.089
Large Bulldozer	0.089
Caisson Drill	0.089
Loaded Trucks	0.076
Jackhammer	0.035
Small Bulldozer	0.003
Source: FTA, 2006	

As shown in Table 34, an impact pile driver would be the type of equipment anticipated to be used during construction activities that would create the highest vibration level of 0.644 in/sec to 1.518 in/sec PPV at 25-ft. The pile driver would only be used in the lower Santiago Creek channel for construction of the floodwalls, therefore, the vibration analysis for Smith Basin and the Blue Diamond and Bond basins would be the same for the Proposed Action Alternative as it was for the No Change Alternative. Regarding the lower Santiago Creek channel, the vibration level at the nearest offsite receptor (i.e., homes located on the south and north side that are as near as 30-ft from construction activities) could range from 0.4899 in/sec to 1.1548 in/sec PPV if an impact pile driver is used. Based on the structural damage and human annoyance thresholds in

Table 32 and Table 33, use of an impact pile driver for floodwall construction within the lower Santiago Creek channel has the potential to damage “modern industrial/commercial buildings.” In addition, use of an impact pile driver within the lower Santiago Creek channel has the potential to cause “strongly perceptible” to “severe” annoyance to residences within the vicinity of the floodwall construction. Due to the potential significant impact to structures and humans within the vicinity of where floodwalls will be constructed, the use of a silent pile driver (MM NV-7; refer to Section 3.4.11.4 for details) during floodwall construction would occur instead of an impact pile driver or vibratory pile driver. A silent pile driver only requires the use of a crane and generator to operate. Operation of the crane and generator would produce a PPV equivalent to that of a small bulldozer (0.003 in/sec PPV at a reference of 25 feet). This vibration level would attenuate to approximately 0.0023 in/sec PPV for the nearby residences along the lower Santiago Creek channel. This value is below the thresholds for structural damage to buildings and is only potentially “barely perceptible” in terms of human annoyance if the equipment is used continuously and/or frequently. Therefore, with the implementation of MM NV-7 (refer to Section 3.4.11.4 for details) the impact due to implementation of the Proposed Action would be less than significant with mitigation incorporated.

(c) *For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?*

No Change Alternative

No Impact: The project area is not located within the Airport Land Use Commission for Orange County’s Heliports and Airport Environs Land Use Plan Airport Planning Area (Airport Land Use Commission for Orange County, 2008). Therefore, no direct/indirect or short-term/long-term impacts associated with noise levels for people residing or working in the project area would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction or an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.11.4 Environmental Commitments

Mitigation Measures

The following mitigation measures would be implemented by the contractor during construction activities to further reduce any potential noise effects.

MM NV-1: Appropriate level of sound attenuation would be used during construction to meet local ordinances. Potential sound attenuation measures that could be considered include, but are not limited to, temporary sound barriers between the sources of construction noise and noise-sensitive receptors, as appropriate.

MM NV-2: Residents and businesses near the project area would be provided with advance notices of project activities, schedule, anticipated traffic, and potential noise issues. The advance notice would describe the potential noise disruption and the steps that would be taken to minimize the noise.

MM NV-3: Heavy truck deliveries would be scheduled during exempt working hours and,

whenever possible, avoid multiple deliveries during a single house, especially during non-exempt hours. Haul trucks operating near noise sensitive receptor sites would be spaced apart to avoid noise effects from simultaneous operation.

MM NV-4: Engineer brake (jake brake) use within city limits would be prohibited. Many noise complaints arise from heavy truck use of engine brakes to slow the truck down. Use of this type of braking can be avoided by proper speed control.

MM NV-5: The contractor would properly maintain and tune engines of all equipment and maintain properly functioning mufflers on all internal combustion engines to minimize noise levels.

MM NV-6: A standard 24-hour hotline for noise complaints would be maintained.

MM NV-7: A silent pile driver may be used instead of an impact or vibratory pile driver where sensitive receptors are located nearby.

Best Management Practices
No BMPs associated with impacts due to Noise apply.

3.4.12 Recreation

3.4.12.1 Regulatory Setting
There are no federal/state laws or regulations associated with recreation.

3.4.12.2 Existing Conditions
The Santiago Recharge Basins are an active groundwater recharge facility with the surrounding non-water areas designated as Open Space in the General Plans for the City of Orange (City of Orange, 2010b) and the City of Villa Park (City of Villa Park, 2010c). Although designated as Open Space, the Santiago Recharge Basins are not accessible to the public for recreational use. The Santiago Creek Bike Trail is located immediately east of the Santiago Recharge Basins along Hewes Street.

Regarding the lower reach of Santiago Creek, the City of Santa Ana General Plan (City of Santa Ana, 1982b) designates it as Open Space. Although designated as Open Space, the lower reach of Santiago Creek is not easily accessible to the public for recreational use. Recreational areas immediately adjacent to this portion of Santiago Creek include the River View Golf Course and Jack Fisher Park. The River View Golf Course is located within the Santa Ana River/Floodplain and a portion of the course is at the confluence of Santiago Creek with the Santa Ana River. Jack Fisher Park is located east of Flower Street, south of Park Lane, and north of Riverside Drive. Although not adjacent to the creek, the Sarah May Downie Herb Garden is located at the intersection of Flower Street and Park Boulevard, approximately 0.07 mile south of the creek.

3.4.12.3 Environmental Impacts

Significance Criteria
The significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to recreation would be considered significant if the project would result in any of the following:

a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur be accelerated; or
b) Include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not cause an increase in the use of existing neighborhood and regional parks or other recreational facilities or require the construction or expansion of recreational facilities.

(a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?

No Change Alternative

Less Than Significant Impact: The project area does not include the construction of any habitable structures that would induce population growth that would result in increased usage or demands for existing neighborhood and regional parks or other recreational facilities by new residents long-term. Although designated as Open Space, the Santiago Recharge Basins are not accessible to the public for recreational use. The lower Santiago Creek channel is accessible to the public from bridge crossings and adjacent residences for recreation such as wildlife watching. The Santiago Creek Bike Trail is located immediately east of the Santiago Recharge Basins. Public access to the Santiago Creek Bike Trail would be maintained throughout the duration of the construction; however, there may need to be rerouting/detours where the bike trail comes into proximity of construction sites (specifically the outlet structure). To minimize temporary short-term direct impacts to recreation along the Santiago Creek Bike Trail while construction is occurring, a detour would be set up at the corner of Prospect Street and Bond Avenue which would direct bicyclists to use the Prospect Street bike lane. Bicyclists heading south would be redirected onto the Prospect Street bike lane where they would continue to travel south. Bicyclists would then turn west into Grijalva Park where they could reconnect with the Santiago Creek Bike Trail. Similarly, bicyclists heading north would exit the Santiago Creek Bike Trail at Grijalva Park, head north on the Prospect Street bike lane where they would then reconnect with the Santiago Creek Bike Trail at the corner of Prospect Street and Bond Avenue. Because access to portions of the Santiago Creek Bike Trail would be impacted temporarily due to construction, there is a less than significant impact associated with an increase in the use of parks or recreational facilities since a detour to other recreational facilities would be required. Long-term, there would be no direct or indirect impact to recreational users of the Santiago Creek Bike Trail as access to the trail would be fully restored once construction of the Proposed Action is complete. Overall, a less than significant impact associated with an increase in the use of parks or recreational facilities would occur and no mitigation measures would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?

No Change Alternative

No Impact: The project does not include recreational facilities and would not require the construction or expansion of recreational facilities. Therefore, no impacts associated with recreational facilities would occur and no mitigation measures would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.12.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be less than significant impacts to recreation.

3.4.13 Transportation

Traffic is defined for this analysis as the movement of vehicles from one place to another through a roadway network. The focus of this traffic and circulation analysis is the roadway network adjacent to the project area.

3.4.13.1 Regulatory Background

Regulatory conditions for traffic and analysis are generally dictated by overall transportation industry standards as published by the Federal Highway Authority and the U.S. Department of Transportation. These organizations serve as oversight agencies ensuring the respective regional, state, and local jurisdictions follow the appropriate guidelines and parameters. For traffic analysis parameters, delays are generally considered the leading indicators of traffic flow and operations; the shorter the delay, the better the roadway segment flows, and the intersections operate. Federal regulations do not dictate specific levels of operation or minimum delays. Instead, it is primarily the local jurisdiction's judgment, supported by the analyst's qualitative calculations, that establishes the best option.

3.4.13.2 Existing Conditions

The Orange County Transportation Authority is Orange County's designated Congestion Management Agency and administers the Congestion Management Program (CMP). The nearest CMP facility to the Santiago Recharge Basins is the intersection of Katella Avenue and State Route 55, located approximately 1.5-mi to the northwest.

The Orange County Transportation Authority operates Community Route 167 from Orange to Irvine. Route 167 serves the project area within the Santiago Recharge Basins. The bus stop is located near the beginning of the maintenance access road for Bond Basin on East Collins Avenue. In relation to Smith Basin, the bus stop is located approximately 0.7-mi west of the area.

The City of Orange General Plan *Circulation and Mobility Element Figure CM-3: Plan for Recreational Trails and Bikeways* shows the existing Santiago Creek Bike Trail located immediately east of Smith Basin along Hewes Street and the existing Class II bike lanes on Villa Park Road immediately south of the project area.

3.4.13.3 Environmental Impacts

Significance

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to transportation would be considered significant if the project would result in any of the following:

a) Conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities;
b) Conflict or be inconsistent with CEQA Guidelines Section 15064.3, subdivision (b);
c) Substantially increase hazards due to a geometric design feature (e.g., sharper curves or dangerous intersections) or incompatible uses (e.g., farm equipment); or

d) Result in inadequate emergency access.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not conflict with a program, plan, ordinance or policy addressing the circulation system; conflict or be inconsistent with CEQA Guidelines Section 15064.3, subdivision (b); substantially increase hazards due to a geometric design feature or incompatible uses; or result in inadequate emergency access.

(a) Conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?

No Change Alternative

Less than Significant Impact with Mitigation Incorporated: Although the project features are located entirely within existing OCPW or OCWD right-of-way, there is a potential for project-related construction traffic to directly affect adjacent roadways providing access to the project site during construction. No full roadway closures are expected to result from construction activities. The project would require temporary construction worker parking at parking and staging areas that would be located on OCPW or OCWD property away from existing streets and parking areas. These areas would be of adequate size to accommodate the anticipated number of worker vehicles and construction equipment and would not serve the parking demand of any other land use.

Site access to Smith Basin would be via maintenance roads with entrances to the maintenance roads located off Villa Park Road, Santiago Boulevard, and Cannon Street. The Blue Diamond and Bond basins would also be accessed by the existing maintenance roads with entrances to the maintenance roads located off Villa Park Road, Hewes Street, Prospect Street, and Collins Avenue. The lower Santiago Creek channel would be accessed from the maintenance roads off Bristol Street (access ramp on the west and east side of the road). Access to the remainder of the lower Santiago Creek channel would be via the channel. Vehicular trips to the project sites would be limited to delivery and removal of the construction equipment. Additionally, up to 40 worker vehicle trips would occur daily during the peak activity. These vehicular trips would be minimal in relation to the capacity of the circulation system. Per the City of Orange Traffic Impact Analysis Guidelines (City of Orange, 2020b) and the City of Santa Ana Traffic Impact Study Guidelines (City of Santa Ana, 2019) (no Traffic Impact Analysis Guidelines were available for the City of Villa Park), construction and operation of the project would not meet the criteria that would require a Traffic Impact Analysis, and none was prepared. Construction and operation of the project would take place off-street, within the Santiago Recharge Basins and the lower Santiago Creek channel.

The Orange County Transportation Authority (OCTA) operates community Route 167 from Orange to Irvine (OCTA, 2021). Route 167 serves the Santiago Recharge Basins with bus stops located near the beginning of the maintenance access road for Blue Diamond and Bond basins – at the intersection of Collins Avenue and Homestead Circle (0.14-mi northwest of maintenance access road), and at the intersection of Prospect Street and Bond Avenue (0.02-mi south of maintenance access road). The nearest bus stop to the Smith Basin maintenance access road is at the intersection of Walnut Avenue and Earlham Street (approximately 1.5-mi southwest of maintenance access road). Regarding the lower Santiago Creek channel, the OCTA operates Community Route 57 from Brea to Newport Beach (OCTA, 2021b) within the Proposed Action area. The nearest bus stop is approximately 0.08-mi south of the maintenance access roads at Bristol Street. Similarly, there is also a bus stop approximately 0.16-mi north of the maintenance access roads at Bristol Street.

Regarding Smith Basin, the City of Orange General Plan – Circulation and Mobility Element (City

of Orange, 2010d) shows the existing Santiago Creek Bike Trail located immediately east of Smith Basin along Hewes Street and the existing Class II bike lanes on Villa Park Road immediately south of Smith Basin. Regarding the Blue Diamond and Bond basins, the City of Orange General Plan – Circulation and Mobility Element shows the existing Santiago Creek Bike Trail located immediately east of the project area along Hewes Street and the existing Class II bike lane and sidewalks on East Collins Avenue, Prospect Avenue, and Bond Avenue in the vicinity of the project area. Sidewalks are also present along Villa Park Road to the north of the Santiago Recharge Basins project area. Regarding the lower Santiago Creek channel, there are no sidewalks along the channel; however, a pedestrian bridge crosses the channel near the intersection of Riviera Drive and Baker Street. Sidewalks also run along either side of the vehicular bridges that cross the channel at Flower Street and Bristol Street. Public access to the Santiago Creek Bike Trail, the Class II bike lanes, and sidewalks would be maintained throughout the duration of the project.

Overall, construction activities would generate short-term construction-related traffic, which could create a temporary increase in localized traffic. Additionally, construction related traffic could potentially disrupt or reduce pedestrian, bicycle, and vehicular accessibility short-term in the area during construction hours. To address this issue, mitigation measure MM TR-1 (refer to Section3.4.13.4 for details), which would require the construction contractor to prepare and submit a detailed traffic control plan for approval by USACE. The purpose of the traffic control plan would be to minimize temporary construction traffic impacts and would cover issues related to construction signing, vehicular traffic control, pedestrian traffic control and safety, and access to adjacent properties where necessary. Any lane closure would be communicated to the community through advance notices and all construction contractors would be required to comply with the traffic control plan. With the implementation of the traffic control plan, temporary construction traffic impacts would be less than significant. Long-term, the operation and maintenance activities outlined in Section 2.3 are not expected to conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities. OCPW already conducts routine maintenance activities within the project area, and the maintenance activities listed in Section 2.3 are no different than what OCPW does under the existing condition. Because routine maintenance for the project would be no different than existing condition routine maintenance, there would be no long-term direct impacts to traffic due to maintenance activities.

Proposed Action Alternative

Less than Significant Impact with Mitigation Incorporated: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) Would the project conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?

No Change Alternative

No Impact: The OCTA is Orange County's designated Congestion Management Agency and administers the CMP (OCTA, 2021c). The nearest CMP facility to the Santiago Recharge Basins is the intersection of Katella Avenue and State Route 55, located approximately 1.5-mi to the northwest. The nearest CMP facility to the lower Santiago Creek channel is the intersection of Route 22 and Harbor Boulevard, located approximately 1.75-mi west of the confluence of Santiago Creek with the Santa Ana River. Vehicular trips generated because of construction and operation of the project would be minimal. CMP traffic analysis is required for CMP segments

where the project would generate 2,400 or more daily trips. For developments that would directly access a CMP Highway System link, the threshold for requiring a traffic impact analysis is 1,600 or more trips per day. The project would not directly access a CMP Highway System link, and therefore the threshold for trip generation would be 2,400 or more daily trips. Since the total trip generation during project construction is minimal, the project would generate less traffic than the CMP volume threshold. In addition, as discussed above in response to impact (a), although construction of the project would generate construction-related traffic creating a temporary increase in localized traffic, this short-term construction-related traffic would not create a substantial impact on traffic volumes or change traffic patterns in such a way as to conflict with any CMPs. In addition, operations would not result in any long-term increases over existing traffic conditions. Since the project would not introduce any new facilities that would generate long-term changes in traffic, the project would not conflict with the applicable CMP. Therefore, no impacts associated with the CMP network would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?

No Change Alternative

No Impact: Construction and operation of the project would utilize existing streets and the existing maintenance access roads on Villa Park Road (for the Santiago Recharge Basins), Hewes Street (for Blue Diamond and Bond basins), Prospect Street (for Blue Diamond and Bond basins), Collins Avenue (for Blue Diamond and Bond basins) and Bristol Street (Santiago Creek). There would be no change in use of the project sites from the existing use. Therefore, no impacts associated with hazards due to a design feature or incompatible uses would occur and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(d) Result in inadequate emergency access?

No Change Alternative

Less than Significant Impact with Mitigation Incorporated: Emergency access to the project area could be affected by project construction; specifically, if temporary lane closures are required and construction-related traffic could delay or obstruct the movement of emergency vehicles. However, the project would implement MM TR-1 (refer to Section 3.4.13.4 for details) to ensure unrestricted access and passage for emergency vehicles. With implementation of MM TR-1 (refer to Section 3.4.13.4 for details), impacts on emergency access would be less than significant.

Proposed Action Alternative

Less than Significant Impact with Mitigation Incorporate: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.13.4 Environmental Commitments

Mitigation Measures
The following mitigation measures as discussed above would be implemented.

MM TR-1: The construction contractor shall develop a construction traffic control plan subject to approval by USACE prior to the start of construction. The contractor shall also develop a plan for notifications and a process for communication with affected residences and transit agencies prior to the start of construction subject to approval by USACE. Advanced public notification will include providing in written notification to adjacent residences and transit agencies at least 10 days prior to construction start and providing appropriate signage of construction activities. The written notification will include the construction schedule, exact location and duration of activities, and a local telephone number for receiving questions and complaints.

Best Management Practices
No BMPs associated with impacts to Transportation apply.

3.4.14 Tribal Cultural Resources

3.4.14.1 Regulatory Setting

- National Historic Preservation Act (NHPA)
- Native American Grave Protection and Repatriation Act (NAGPRA)
- Archaeological Resources Protection Act (ARPA)
- American Indian Religious Freedom Act (AIRFA)
- EO 12898
- CEQA
- California Health and Safety Code, Section 7050.5
- AB 52
- SB 18

3.4.14.2 Existing Conditions

Refer to Section 3.4.4.2 for existing cultural resources conditions.

3.4.14.3 Native American Consultation

On October 6, 2021, the USACE sent scoping letters to the federal Advisory Council on Historic Preservation and to the California Office of Historic Preservation and California Native American Heritage Commission. In addition, the scoping letter was sent to the following Native American tribes:

- Gabrieleño Band of Mission Indians - Kizh Nation
- Gabrieleno/Tongva San Gabriel Band of Mission Indians
- Gabrielino /Tongva Nation
- Gabrielino Tongva Indians of California Tribal Council
- Gabrielino-Tongva Tribe
- Juaneno Band of MissionIndians Acjachemen Nation -Belardes
- Pala Band of Mission Indians

- Santa Rosa Band of Cahuilla Indians
- Soboba Band of Luiseno Indians

On April 14, 2022, the County of Orange, OC Development Services/Planning initiated sent Initial Consultation letters to the following four Native American tribes with standing requests to be notified of discretionary projects:

- Gabrieleño Band of Mission Indians - Kizh Nation
- San Gabriel Band of Mission Indians
- Juaneño Band of Mission Indians, Acjachemen Nation
- Soboba Band of Luiseno Indians.

On May 17, 2022, the Juaneño Band of Mission Indians, Acjachemen Nation requested the CHRIS report, which was subsequently provided along with suggested Mitigation Measures. Consultation is ongoing with the Juaneño Band.

3.4.14.4 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to tribal cultural resources would be considered significant if the project would result in any of the following:

a) Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:

  a-i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k); or

  a-ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not cause a substantial adverse change in the significance of a tribal cultural resource that is listed or eligible for listing in the California Register of Historical Resources; or a resource determined by the lead agency to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1.

(a-i) Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k).

No Change Alternative

No Impact: As discussed in Section 3.4.4.2, there are no existing buildings or other cultural resources on the project sites that are listed or eligible for listing in the California Register of Historical Resources. None of the historic documents reviewed as part of the cultural resource assessment indicate that the project sites are associated with any significant historical event.

Therefore, no impacts associated with historical resources listed or eligible for listing in the California Register of Historical Resources would occur.

Proposed Action

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a-i*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

> *(a-ii) Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is a resource determine by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.*

No Change Alternative

Less than Significant Impact with Mitigation Incorporated: The USACE is unaware of any tribal resources within the project footprint; however, there is potential for the inadvertent discovery of intact subsurface historical, tribal cultural, or archaeological resources. Mitigation measures MM TCR-1 and MM TCR-2 (refer to Section 3.4.14.4 for details) would be implemented, which will require monitoring and a treatment protocol if resources are discovered. With the implementation of mitigation measures MM TCR-1 and MM TCR-2 (refer to Section 3.4.14.4 for details), the potential impact to Tribal Cultural Resources would be reduced to less than significant.

Proposed Action

Less than Significant Impact with Mitigation Incorporated: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a-ii*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.14.4 Environmental Commitments

Mitigation Measures

The following mitigation measures would be implemented to reduce potential impacts to Tribal Cultural Resources during construction of the project.

MM TCR-1: Preparing and implementing a monitoring and discovery plan if previously undiscovered resources are identified during an undertaking, suspend work while the resource is evaluated and mitigated to avoid any further impact. Continue to consult with Native American groups to identify any tribal cultural resources or resource uses and address impacts.

MM TCR-2: If previously unknown tribal cultural resources are discovered, work in the immediate area would cease until the requirements in 36 C.F.R. 800.13 are complied with. The on-site

supervisor shall contact the USACE's Project Manager and District Archaeologist, and an approved archaeological consultant immediately. The on-site supervisor shall additionally divert all Proposed Action-related activities to other areas until the discovery has been evaluated by the approved archaeological consultant. The USACE will determine if further mitigation measures are warranted in consultation with the SHPO and consulting parties.

Best Management Practices
No BMPs associated with impacts to Tribal Cultural Resources apply.

3.4.15 Utilities and Service Systems

3.4.15.1 Regulatory Setting
There are no federal/state laws or regulations associated with utilities and service systems.

3.4.15.2 Existing Conditions
The project area is located within Orange County, California and includes the communities of Santa Ana, Villa Park and Orange. Since the communities above are largely built out, their utility systems are in place and generally fixed in nature. Increased development density in these areas may require expansion of system capacities and/or accelerated repair and maintenance programs.

3.4.15.3 Environmental Effects

Significance Criteria
The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to utilities and service systems would be considered significant if the project would result in any of the following:

a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects;
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years;
c) Result in the determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the providers existing commitments;
d) Generate solid waste more than state or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals; or
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not require the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities; have sufficient water supplies available to serve the project during normal, dry, and multiple dry years; result in the determination by the wastewater treatment provider which serves the project that it has adequate capacity to serve the project's projected demand in addition to the providers existing commitments; generate solid waste more than state or local standards; or comply with federal, state, and local management and reduction statutes and regulations related to solid waste.

(a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental

effects?

No Change Alternative

Less Than Significant Impact: The project does not involve the construction of any habitable structures, and would not result in new employment, as the project sites would be maintained consistent with existing conditions. The project in Smith Basin does not involve new or the expansion of existing stormwater drainage facilities. In addition, utilities present on the site such as fiber optics cables and an electric power conduit will be maintained and not disturbed by the project. The project in the Blue Diamond and Bond basins does involve the expansion of existing stormwater drainage facilities by constructing an overflow structure in the Bond Basin. Habitat in the proposed location of the overflow structure is primarily developed. In addition, some existing utilities will need to be relocated on top of the overflow that is part of the project. Utilities to be relocated on top of the overflow weir include a power pole with security camera, light pole, guy wire, vent for water line, junction boxes, and transformer for pump control house and pad. All of these utilities are associated with the pump house located within Bond Basin and would not impact utility supplies to any nearby residences. In addition, any impacts associated with relocation of the above utilities would be temporary in duration, lasting only if it takes to relocate the utilities on top of the overflow weir. Regarding the outlet structures, utilities within the vicinity of this structure would also need to be relocated. Utilities to be relocated include a power pole with security camera, monitoring well, and irrigation line. All these utilities are associated with the pump house or maintaining visual security of the Blue Diamond and Bond Basins and would not impact utility supplies to any nearby residences. In addition, any impacts associated with relocation of the above utilities would be temporary in duration, lasting only as long as it takes to relocate the utilities around the new outlet structure. Construction of the outlet channel on the downstream side of the Prospect Street culvert would require the temporary reroute of a water main pipe for the City of Santa Ana. This would be a temporary reroute occurring only during construction. There may be temporary less than significant impacts as the reroute line is constructed and then deconstructed once construction of the outlet channel is complete. Surrounding residences would only see a potential short disruption (i.e., a few hours) as the reroute is constructed and then deconstructed. Service would continue, for the most part, throughout construction of the project. There would be no long-term impacts to utility service for residents. Lastly, modification of the lower Santiago Creek channel would not disturb any utilities; all utilities would be maintained where they currently exist. The only relocation that would be required is a monitoring well, which has no impact on adjacent residences utility services. Overall, there would be a less than significant impact to surrounding residences with the relocation of utilities during construction of the project.

Proposed Action

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry, and multiple dry years?

No Change Alternative

No Impact: The project does not involve the construction of any habitable structures, and would not result in new employment, as the project sites would be maintained consistent with existing conditions. Therefore, no impacts associated with water supplies would occur and no mitigation would be required.

Proposed Action

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c) Result in the determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the providers existing commitments?

No Change Alternative

No Impact: The project does not involve the construction of any habitable structures, and would not result in new employment, as the project sites would be maintained consistent with existing conditions. Therefore, no impacts associated with wastewater treatment capacity would occur and no mitigation would be required.

Proposed Action

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(d) Generate solid waste more than state or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?

No Change Alternative

Less than Significant Impact: Orange County Waste and Recycling operates three active landfills in Orange County: Olinda Alpha Landfill near Brea; the Frank R. Bowerman Landfill near Irvine; and the Prima Deschecha Landfill in San Juan Capistrano. The Olinda Alpha Landfill is the closest facility to the project sites and has a daily maximum of 8,000 tons per day. During construction of the project, approximately 646,424 cubic yards of material would be excavated for construction of project features. Construction of the project does not require fill and the intent is to reuse material excavated on site as fill material for project features. The estimated amount of fill required for the project is 288,010 cubic yards of material. Therefore, approximately 358,414 cubic yards of excavated material would not be needed for reuse on site. The excess excavated material would be disposed of offsite at one of the landfills listed above. This excess material would not be disposed of offsite all at once, but daily. The quantities of material that would be transported to a local landfill for disposal daily would be minor in relation to the capacity of the landfills listed above. Annual maintenance of the Santiago Recharge Basins and the lower Santiago Creek channel generally results in recovery of trash/debris; however, the quantities recovered and disposed of per day would be nominal in relation to the capacity of the Olinda Alpha Landfill. Moreover, the project would not result in any alterations to the maintenance activities within the Santiago Recharge Basins or the lower Santiago Creek channel that would affect the quantity of solid waste collected at the project sites. All maintenance activities would be conducted in accordance with the OCPW Maintenance Plan, which includes provisions for solid waste disposal on the project sites that may be generated by workers. Therefore, less than significant impacts associated with solid waste disposal would occur and no mitigation would be required.

Proposed Action

Less than Significant Impact: Orange County Waste and Recycling operates three active landfills in Orange County: Olinda Alpha Landfill near Brea; the Frank R. Bowerman Landfill near Irvine; and the Prima Deschecha Landfill in San Juan Capistrano. The Olinda Alpha Landfill is the closest facility to the project sites and has a daily maximum of 8,000 tons per day. During construction of the proposed project, approximately 287,128 cubic yards of material would be excavated for construction of project features. Construction of the project does require fill and the intent is to reuse material excavated on site as fill material for project features, the exception being where riprap is required. The estimated amount of fill required for the project is 280,149 cubic yards of material. Therefore, approximately 33,482 cubic yards of excavated material would not be needed for reuse on site. The excess excavated material would be disposed of offsite at one of the landfills listed above. This excess material would not be disposed of offsite all at once, but daily. The quantities of material that would be transported to a local landfill for disposal daily would be minor in relation to the capacity of the landfills listed above. Annual maintenance of the Santiago Recharge Basins and the lower Santiago Creek channel generally results in recovery of trash/debris; however, the quantities recovered and disposed of per day would be nominal in relation to the capacity of the Olinda Alpha Landfill. Moreover, the Proposed Action would not result in any alterations to the maintenance activities within the Santiago Recharge Basins or the lower Santiago Creek channel that would affect the quantity of solid waste collected at the project sites. All maintenance activities would be conducted in accordance with the OCPW Maintenance Plan, which includes provisions for solid waste disposal on the project sites that may be generated by workers. Therefore, less than significant impacts associated with solid waste disposal would occur and no mitigation would be required.

(e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?

No Change Alternative

No Impact: As discussed above, solid waste generated by construction of the project would be disposed of at one of the three landfills in Orange County. Disposal of solid waste would be required to comply with all federal, state, and local statutes and regulations related to solid waste. In addition, organic waste (i.e., vegetation removed by the project during construction) could be diverted to composting operations at Frank R. Bowerman Landfill and Olinda Alpha Landfill. Diversion of organic waste to composting operations versus a landfill would comply with SB 1383, which aims to reduce organic waste disposal in the state by 75 percent before 2025. Therefore, no impacts associated with compliance with solid waste statutes and regulations would occur and no mitigation would be required.

Proposed Action

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*e*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

3.4.15.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be less than significant impacts to utilities and service systems.

3.4.16 Wildfire

3.4.16.1 Regulatory Setting

There are no federal laws or regulations associated with prevention of wildfire. State laws include the following:

- SB 901
- AB 1432
- AB 38
- Public Resources Code 4291
- CA Code of Regulations Title 14
- CA Building Code Chapter 7A
- CA Fire Code Chapter 47

3.4.16.2 Existing Conditions

The CalFire *Fire and Resources Assessment Program's Recommended Very High Fire Hazard Severity Zones in LRA Map* shows the lower Santiago Creek channel in a non-very high fire hazard severity zone (CalFire, n.d.). The City of Orange *General Plan Public Safety Element Figure PS-1: Environmental and Natural Hazard Policy Map*, shows the Santiago Recharge Basins being in a Wildland High or Very High Fire Hazard Area (City of Orange, 2010c).

3.4.16.3 Environmental Effects

Significance Criteria

The impact criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA. For purposes of this analysis, effects to wildfire risk would be considered significant if the project would result in any of the following:

a) Substantially impair an adopted emergency response plan or emergency evacuation plan;
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of wildfire;
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines, or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment; or
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes.

No Construction Alternative

Under the No Construction Alternative, no project would be constructed. As a result, the No Construction Alternative would not substantially impair an adopted emergency response plan or emergency evacuation plan; exacerbate wildfire risks thereby exposing project occupants to pollutant concentrations from a wildfire; require the installation or maintenance of associated infrastructure that may exacerbate fire risk; or expose people or structures to significant risks as a result of runoff, post-fire slope instability, or drainage changes.

(a) Substantially impair an adopted emergency response plan or emergency evacuation plan?

No Change Alternative

No Impact: Portions of Smith Basin are designated as a Wildland High Fire or Very High Fire Hazard Area in the City of Orange General Plan – Public Safety Element (City of Orange, 2010c).

The northern boundary of the Bond and Blue Diamond basins is designated as a Wildlife High Fire Hazard Area in the City of Orange General Plan – Public Safety Element (City of Orange, 2010c). The remaining boundaries of the Bond and Blue Diamond basins are not designated as Wildland High Fire or Very High Fire Hazard Areas in either the City of Orange General Plan – Public Safety Element (City of Orange, 2010c) nor the City of Villa Park General Plan – Safety Element (City of Villa Park, 2010b). Lastly, the lower Santiago Creek channel is not within a designated Wildland High Fire or Very High Fire Hazard Area according to the Orange County General Plan – Safety Element (Orange County, 2012a). Although portions of the project area are within a designated Wildland High Fire or Very High Fire Hazard Area, most of the project area is not within one of these designated areas. The project does not include the construction of any habitable structures that would have the potential to impair an adopted emergency response plan or emergency evacuation plan. Therefore, no impacts associated with the impairment of an adopted emergency plan would occur, and no mitigation would be required.

Proposed Action Alternative

No Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*a*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of wildlife?

No Change Alternative

Less Than Significant Impact: Although portions of the project area are located within Wildland High or Very High Fire Hazard Area as discussed above, the project does not include the construction of any habitable structures. The Santiago Recharge Basins would continue to be used as groundwater recharge basins and floodwater storage reservoirs. The lower Santiago Creek channel would continue to act as a flood control channel. Shoreline stabilization features within the Santiago Recharge Basins would include establishment of native vegetation to areas of these project sites and would require management by OCPW to ensure non-native species do not reestablish. Similarly, native vegetation would be established along the banks of the lower Santiago Creek channel and would require management by OCPW long-term to ensure non-native species do not establish. Therefore, impacts associated with the exacerbation of wildfire risks would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*b*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines, or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?

No Change Alternative

Less Than Significant Impact: Construction equipment would access the project area using existing streets and existing maintenance access roads on Villa Park Road (for the Santiago Recharge Basins), Hewes Street (Blue Diamond and Bond basins), Prospect Street (for Blue Diamond and Bond basins), Collins Avenue (for Blue Diamond and Bond basins), and Bristol Street (Santiago Creek). Additional infrastructure such as the creation of new roads, fuel breaks, emergency water sources, power lines and other utilities would not occur as part of the project. Therefore, impacts associated with installation or maintenance of infrastructure resulting in impacts to the environment would be less than significant, and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*c*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins.

(d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?

No Change Alternative

Less Than Significant Impact: The No Change Alternative would improve the drainage pattern of the area by increasing the storage capacity of flood flows within the Santiago Recharge Basins and the lower Santiago Creek channel. The project would also prevent future damage to shoreline/channel slopes within the above project sites from erosion with the implementation of slope stabilization features along the Santiago Recharge Basins and Santiago Creek. To ensure future stability of the damaged slopes in the Santiago Recharge Basins, buried riprap would be installed at the base of the affected slope areas to provide additional reinforcement. With the remedial grading, the potential for further slope erosion would be minimized. Without the project, the slopes around the basins and the lower Santiago Creek channel would continue to fail and erode, potentially posing safety risks when maintenance activities primarily in the basins are occurring and risking slope failure, which would harm or destroy riparian vegetation and environmental resources. No habitable structures are proposed as part of this project.

The project sites within the Santiago Recharge Basins are active groundwater recharge basins that are part of the OCWD groundwater recharge network. The project site within the lower Santiago Creek channel is Open Space but is used and maintained as a flood control channel. Storm water on the project sites would flow directly into either the Santiago Recharge Basins or Santiago Creek and would be infiltrated into the groundwater recharge network. No runoff from the project sites would flow directly into a storm water drainage system or create runoff to areas developed with habitable structures or occupied areas. Therefore, potential impacts associated with downslope or downstream flooding as landslides, due to runoff, post-fire slope instability, or drainage changes would be less than significant and no mitigation would be required.

Proposed Action Alternative

Less Than Significant Impact: In general, the type of project features included in the Proposed Action would have similar construction, operation, and maintenance requirements as the No Change Alternative, such that the nature and degree of impacts are generally expected to be similar. Therefore, refer to the analysis under the No Change Alternative (*d*) for Proposed Action project impacts. It is important to note, that the Proposed Action does not include the construction of an overflow channel or an outlet channel within the Santiago Recharge Basins. Therefore,

upon completion of the Proposed Action Alternative, the slopes of the Santiago Recharge Basins would be stabilized, but the Blue Diamond and Bond Basins would not have increased capacity to hold flood flows as they would under the No Change Alternative. All other features of the Proposed Action would be the same as those under the No Change Alternative.

3.4.15.4 Environmental Commitments

No mitigation measures or best management practices (BMPS) are recommended since there would be less than significant impacts to wildfire potential.

3.5 Mandatory Findings of Significance

The mandatory findings of significance criteria below were taken from Appendix G of the CEQA guidelines and are also being adopted for NEPA.

3.5.1 Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?

Less Than Significant Impact with Mitigation Incorporated: Construction activities would temporarily and permanently impact habitat for the federally-listed LBVI and CAGN. Due to temporary and impacts to occupied LBVI and CAGN habitat, formal consultation under Section 7 of the Endangered Species Act was triggered. During the formal consultation period, which extended from February 24, 2023, to August 8, 2023, conservation measures (i.e., mitigation measures) were discussed with the FWS and appropriate mitigation ratios for offsetting impacts were developed. Therefore, as discussed in Section 3.4.3 Biological Resources, a total of approximately 1.46 acres of LBVI occupied habitat and approximately 1.82 acres of CAGN occupied habitat will be permanently impacted by the Proposed Action Alternative. To offset permanent impacts to LBVI occupied habitat, the USACE would restore 7.3 acres of wetland/riparian habitat within the action area, which includes Prado Basin, and the Santa Ana watershed downstream of Prado Dam. To offset permanent impacts to CAGN, the USACE would restore 5.46 acres of upland vegetation (i.e., coastal sage scrub) within the action area, which includes Prado Basin, and the Santa Ana watershed downstream of Prado Dam. In addition, to offset temporary impacts to 10.62 acres of LBVI occupied habitat, the USACE would restore 10.62 acres of wetland/riparian habitat within the action area, which includes Prado Basin, and the Santa Ana watershed downstream of Prado Dam. USACE would also offset temporary impacts to 8.25 acres of CAGN occupied habitat by restoring 8.25 acres of upland vegetation (i.e., coastal sage scrub) within the action area, which includes Prado Basin, and the Santa Ana watershed downstream of Prado Dam. Figure 18, Figure 19, and Figure 20 show potential riparian areas that may be suitable as mitigation for the Santiago Creek project's temporary and permanent impacts to LBVI occupied habitat. The potential riparian parcels are approximately 12.09 acres (Figure 18), 68.64 acres (Figure 19), and 11.35 acres (Figure 20). Two of the identified riparian parcels are located on USACE land and are considered "environmentally sensitive areas." USACE continues to work to ensure the proposed mitigation sites for the Santiago Creek project do not already contain mitigation for other components of SARMP. The availability of the sites as mitigation for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The third parcel is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The combined total of 17.92 acres of wetland/riparian habitat to be restored offsite will be monitored and managed according to MM BIO-2 and MM BIO-8 (refer to Section 3.4.3.4 for details). In addition, 11.91 acres of temporarily disturbed wetland/riparian habitat within the project footprint would be restored once construction of the project is complete. The 11.91 acres of native wetland/riparian vegetation within the project footprint will be monitored and managed according

to MM BIO-1 (refer to Section 3.4.3.4 for details).

Figure 18 and Figure 20 also show potential parcels that may be suitable as coastal sage scrub mitigation for the Santiago Creek project's temporary and permanent impacts to CAGN occupied habitat. The potential parcels are approximately 11.46 acres (Figure 18) and 69.64 acres (Figure 20). The parcel shown in Figure 18 is located on USACE land and is considered an "environmental sensitive area." USACE continues to work to ensure the proposed mitigation site for the Santiago Creek project does not already contain mitigation for other components of SARMP. The availability of the site as mitigation for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The second (Figure 20) is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The combined total of 13.71 acres of coastal sage scrub habitat to be restored offsite will be monitored and managed according to MM BIO-5 and MM BIO-9 (refer to Section 3.4.3.4 for details). In addition, 8.25 acres of temporarily disturbed upland habitat (i.e., coastal sage scrub) within the project footprint would be restored once construction of the project is complete. The 8.25 acres of native upland vegetation (i.e., coastal sage scrub) within the project footprint will be monitored and managed according to MM BIO-4 (refer to Section 3.4.3.4 for details).

As discussed in Section 3.4.3 Biological Resources, to avoid and minimize potential impacts to LBVI and CAGN, the USACE pursuant to formal consultation with the FWS would implement all the mitigation measures identified in full detail in Section 3.4.3.4. In addition, USACE will implement all reasonable and prudent measures identified in the FWS's BiOp once the Final BiOp is provided.

It is important to note that as discussed under Section 3.4.3 and Section 3.4.10 that the Smith, Blue Diamond, and Bond basins are designated as mitigation sites in a HMP prepared for OCWD's Groundwater Recharge Facilities Maintenance Plan (OCWD, 2020). These mitigation sites are currently required by the FWS as a condition of their concurrence per Section 7 Consultation for USACE's initial issuance and renewal of RGP 90. Regional General Permit 90 allows OCWD to perform operation and maintenance activities within their groundwater recharge basins. Issuance of the 2013 Water Quality Certification by the RWQCB and the Streambed Alteration Agreement by CDFW are also contingent upon the implementation of the mitigation sites as identified in OCWD's HMP. USACE Regulatory is currently in discussions with FWS, RWQCB, and CDFW as to whether the mitigation sites specifically in Smith, Blue Diamond, and Bond basins can be removed as a requirement for OCWD to implement because OCWD has potentially already implemented sufficient mitigation within other basins under their purview to offset realized permanent impacts to wetland vegetation since 2013. OCWD has confirmed that only 3.19 acres of permanent impacts to wetland vegetation has occurred since the RGP 90 permit was first issued in 2014. Since discussions about removal of the Blue Diamond and Bond basins and Smith Basin mitigation sites from OCWD's HMP are ongoing and are expected to be resolved prior to construction of the proposed project, the FWS's 2023 amendment assumes that the federal requirement for OCWD mitigation has been fully satisfied in other locations. If the agencies whose permits/consultations include these existing mitigation sites do not agree to remove the Smith Basin and Blue Diamond and Bond basins mitigation sites from OCWD's HMP, then Section 7 consultation for the Santiago Creek project will need to be reinitiated.

There is little potential for the inadvertent discovery of intact subsurface historical or archaeological resources on the project sites. However, out of an abundance of caution, the potential for undiscovered historical and/or archaeological resources are a potentially significant impact to Tribal Cultural Resources. Therefore, mitigation measures MM TCR-1 and MM TCR-2 (refer to Section 3.4.4.4 for details) would be implemented, which will require monitoring and a treatment protocol if resources are discovered. With the implementation of mitigation measures MM TCR-1 and MM TCR-2 (refer to Section 3.4.4.4 for details), the potential impact to Tribal Cultural Resources would be less than significant. A determination of no affect was sent to SHPO on March 21, 2023. The SHPO requested additional information on the project in letters dated

May 22, 2023, and June 27, 2023, although the timing of when the letters were received exceeded the 30 days afforded to SHPO for a response to consultation. In addition, SHPO provided to USACE on July 28, 2023, a comment received from the public which USACE provided a response to on August 1, 2023. Under 36 C.F.R. 800.5(c)(1), SHPO concurrence was waived since after the close of the original 30-day review period (i.e., April 20, 2023) SHPO had not provided a response and no consulting party had objected. As stated in Section 3.4.4, USACE has found that there will be no adverse effect to any of the properties within the Floral Park Historic District. The historic homes are located outside of the project area and special equipment such as the Giken Silent Piler will be used during construction to limit both noise and vibratory disturbances. Furthermore, the proposed action would increase flood protection of homes located within the Floral Park Historic District.

3.5.2 Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)

Less Than Significant Impact: A cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time in the proposed action area. Those actions could be undertaken by various agencies (federal, state, or local) or private entities. A discussion of cumulative impacts resulting from actions and projects that are proposed, under implementation, or reasonably anticipated to be implemented in the near future is required.

Cumulative environmental impacts are most likely to arise when a relationship exists between a proposed action and other projects expected to occur in a similar location, time period, and/or involving similar actions. Projects in proximity to the Proposed Action would be expected to have more potential for a relationship that could result in potential cumulative impacts than those more geographically separated. Temporal and geographical limits for the Proposed Action must be established to frame the cumulative impacts analysis. These limits can vary by the resources that are affected. The temporal limits for assessment of this impact would initiate with the construction of the Santiago Creek Dam in 1931 and end 50 years after construction of the Proposed Action is complete in 2077. The geographical boundaries for this discussion of cumulative impacts would be broadened to consider the effects beyond the Proposed Action. The geographic extent is considered to be the lower Santiago Creek Watershed which extends from the Santiago Creek Dam to the confluence of Santiago Creek with the Santa Ana River.

Past and Present Actions within the Lower Santiago Creek Watershed
In 1931 construction of the Santiago Creek Dam was completed along Santiago Creek and controls water from about two thirds of the Santiago Creek watershed. The Santiago Creek Dam also marks the usual ending point for surface flow in Santiago Creek, as all the upstream discharge from Santiago Creek is retained in Irvine Lake (reservoir created by the dam). Flow within Santiago Creek downstream of the Santiago Creek Dam is therefore limited to seepage from Santiago Creek Dam and stormwater.

Downstream of the Santiago Creek Dam is the Villa Park Dam which was completed in 1963. The Villa Park Dam forms a flood control reservoir to control spills from the Santiago Creek Dam. Due to flood control requirements, the Villa Park Dam was designed to stay dry during normal weather conditions and hold back most flood releases from the upstream Santiago Creek Dam. Therefore, the Villa Park Dam further regulates surface flow within Santiago Creek and typically prevents the creek from flowing except during heavy storm events. Water that does get discharged from the Villa Park Dam flows downstream where it is captured by the Santiago Recharge Basins.

The Santiago Recharge Basins (i.e., from north to south – Smith Basin, Blue Diamond Basin, and Bond Basin) originally operated as sand and gravel quarries from the early 1950's to 1990. In the

early 1990's the active quarries were purchased by OCWD and converted into groundwater recharge reservoirs. The conversion of the quarries to groundwater recharge reservoirs was part of the Santiago Creek Recharge Project which was completed in 1991. This project by OCWD included the purchase and development of the Santiago Recharge Basins along Santiago Creek, construction of a pump station at Burris Basin, and construction of a pipeline (i.e., Santiago pipeline) to convey water back and forth from recharge basins along the Santa Ana River and the Santiago Recharge Basins. Two rubber dams were also installed on the Santa Ana River, allowing more efficient diversion of river water to the downstream recharge facilities.

The Santiago Creek Recharge Project was followed by the Santiago Basin Pump Station, which was completed in 2003. This project by OCWD included the construction of an underwater pump station in Bond Basin to increase recharge capacity. With completion of the pump station, OCWD was able to move water both directions in the Santiago pipeline. This allowed for faster draining of the Santiago Basins (i.e., Blue Diamond and Bond basins), freeing up storage for stormwater capture and increasing OCWD's recharge capacity.

The Santiago Basin Pump Station project was followed by the Santiago Basin Floating Pump Station. This project in 2012 by OCWD included the replacement of the underwater pump station with a floating pump station. The floating pump station provided OCWD with the capability to dewater the Santiago Recharge Basins to increase storm flow capture and percolation, to make storage available for winter season use, to provide water to Santiago Creek downstream of the basins for percolation, and to allow for the transfer of stored water from the Santiago Recharge Basins to other OCWD facilities.

Lastly, the Santiago Basin Floating Pump Station project was followed by the Santiago Recharge Basins Saddle Repair project by OCWD in 2021. This project included reconstruction of the flow equalization box culvert for protection of the saddle apron (i.e., area that connects Blue Diamond Basin to Bond Basin) and reconstruction of failed slopes in the saddle apron area. This project was implemented to (1) alleviate safety concerns when maintenance activities are occurring, and (2) reduce risk of future slope failure that would harm or destroy riparian vegetation and environmental resources.

Therefore, the baseline conditions within the Lower Santiago Creek Watershed for the cumulative effects analysis are due to the implementation of the above projects over time within the project area. The construction of the Santiago Creek Dam in 1931 resulted in modification of historical flows within the portion of Santiago Creek below the dam. As discussed above, flows within Santiago Creek downstream of the dam are essentially limited to seepage from the dam and large storm events. Historical flows within Santiago Creek were further modified over time by the construction of the Villa Park Dam downstream of Santiago Creek Dam and the Santiago Recharge Basins. In addition, the lower Santiago Creek Channel (i.e., reach from I-5 downstream to creek's confluence with the Santa Ana River) is almost always dry with no flows due to coordination between OCWD and the City of Orange to ensure water released from the Santiago Recharge Basins percolates before reaching the parking lot for Hart Park, which is located within the Santiago Creek channel approximately 1.16 miles upstream of I-5. To ensure that surface flows do not enter the Hart Park parking area, OCWD has incorporated into their groundwater recharge facilities maintenance plan a coordination measure that requires OCWD to monitor the rate flow and make needed adjustments to ensure that flows released into Santiago Creek percolate before reaching the parking lot for Hart Park (OCWD, 2012).

Due to modification of flows within Santiago Creek, riparian vegetation and associated wildlife within the lower Santiago Creek Channel (i.e., reach from I-5 downstream to creek's confluence with the Santa Ana River) has been altered. As discussed in the following sub-sections, vegetation within the lower Santiago Creek channel is primarily ornamental non-native and invasive species. There are a few remnant coastal oak trees within the reach that represent the only native riparian vegetation still present. The lack of native riparian vegetation is to be expected with the modification of riverine processes in the Santiago Creek watershed due to the

presence of dams and recharge basins. Although riparian vegetation can exist in areas with intermittent flow, water is the major limiting factor upon which riparian vegetation is dependent.

Conversely, vegetation and associated wildlife within the Santiago Recharge Basins have benefited from the conversion of the basins from quarries to groundwater recharge facilities. Since 1991, native vegetation has reestablished within Smith Basin, and Blue Diamond and Bond Basins have seen native vegetation reestablished through on-site mitigation. The reestablishment of native riparian and wetland vegetation within the Santiago Recharge Basins since the 1990's has allowed the LBVI to recolonize the area and establish breeding territories. Similarly, native coastal sage scrub vegetation has also reestablished within the Santiago Recharge Basins over time allowing CAGN to recolonize the area year-round. The following subsections further detail the current baseline environmental conditions within the lower Santiago Creek channel and the Santiago Recharge Basins.

Reasonably Foreseeable Actions within the Lower Santiago Creek Watershed

Table 35 provides an overview of reasonably foreseeable actions within the lower Santiago Creek Watershed.

Table 35: Reasonably Foreseeable Actions Within the Lower Santiago Creek Watershed

Project Name	General Location	City	Description
OCWD Smith Basin Improvement Project	Smith Basin, north of Santiago Recharge Basin.	Orange	Proposed Action is intended to repair and remediate erosion within Smith Basin caused by Santiago Creek. The Proposed Action activities includes re-establishing the historical access road on the north; re-grading the bottom of Smith Basin to restore Santiago Creek in its former alignment nearer the middle of the basin; repairing and reconstructing the slopes in the basin; constructing six groins to slow water flow along the southern slope; and restoration of removed vegetation. Proposed Action would temporarily impact 2.65-ac of upland native vegetation, 2.43-ac of non-native upland vegetation, and 7.56-ac of mixed riparian vegetation. Following completion of grading and slope repair/construction activities, the disturbed areas on the Project Site would be restored with native upland coastal sage scrub and native riparian vegetation. Once the proposed restoration activities are implemented, there would be a net increase of 1.55-ac of native upland coastal sage scrub vegetation. The native riparian vegetation would be addressed through the direct replanting of 4.8-ac of riparian habitat and an additional 9.0-ac of bottom acres managed for recruitment through utilization of flood irrigation and from inundation events and additional planting if needed.
OCWD Groundwater Recharge Facilities Maintenance Plan	Seven Recharge Basins, including Smith Basin and Santiago Recharge Basin.	Orange, Villa Park, Santa Ana	Proposed Action is a groundwater recharge facilities maintenance plan that proposes a series of ongoing routine maintenance activities to maintain OCWD's existing groundwater recharge facilities. Routine maintenance activities include: a) sediment disturbance and removal, b) vegetation removal, c) maintenance and repair of existing access roads and ramps, d) maintaining existing water conveyance structures, and e) sand levee creation and repair.
Santiago Creek Multipurpose Trail Final Leg (City of Orange)	Cannon Street north of Santiago Creek to Santiago Oaks Regional Park.	Orange	Includes creation of final leg of trail for the Santiago Creek Multipurpose Trail. The trail is planned from Cannon Street north of Santiago Creek to Santiago Oaks Regional Park, with a trail bridge over the creek to accommodate access to the park.

Project Name	General Location	City	Description
Trails at Santiago Creek (or potential other named development)	Between Orange Park Boulevard and Cannon Street, south side of Mabury Street.	Orange	Potential project includes residential development on formal gravel mine site. The City of Orange has approved a tract map to subdivide an approximately 15.4-ac site into 22 single-family residential lots on approximately 10.9-ac and open space dedication of approximately 4.5-ac along the Santiago Creek corridor. Grading or other on-site improvements have not yet occurred. The Trails at Santiago Creek EIR was overturned by a referendum.
Backfilling of Chandler Pit Site	West of the Trails at Santiago Creek proposed site, west of Cannon Street, north of Santiago Canyon Road, south of Santiago Creek, and east of the Blue Ribbon Nursery.	Orange	Potential project includes backfilling the pit left behind from long-ago terminated sand and gravel mining activities. The project requires approval of an environmental document through the Regional Water Quality Control Board.
Senior Apartment Complex and Storage Facility	South of Santiago Creek on vacant land between the terminuses of Yorba Street McPherson Road.	Orange	Potential project includes construction of a 158 senior apartment complex and storage facility on vacant land. No environmental document has been created at this time.
Kornerstone Cemetery	East of Santiago Creek and the State Route 55 Freeway, south of Yorba Park, north of Palmyra Avenue, and west of the Orange Unified School District Child Development Center.	Orange	Potential development of a cemetery. The environmental document is under development and has not yet been released for public review.
Bristol Street Corridor	3.9-mile section of the Bristol Street Corridor from Warner Avenue to Memory Lane.	Santa Ana	The Bristol Street Corridor Specific Plan, adopted in 1991, provides the framework for future redevelopment of a 3.9-mi section of the Bristol Street Corridor. The current effort is to amend the plan to incorporate changed conditions along the corridor due to the ongoing Bristol Improvement and Widening Project. Includes widening of Bristol Street to a six-lane arterial with an extended medium to control left turn movements.

The assessment below focuses on addressing the following: (1) the area(s) in the which the effects of the Proposed Action would be felt; (2) the effects that are expected in the area(s) from the Proposed Action; (3) past, present, and reasonably foreseeable future actions that have or that are expected to have impacts in the same area; (4) the impacts or expected impacts from these other actions; (5) and the overall impact(s) that can be expected if the individual impacts are allowed to accumulate.

Analysis of Cumulative Impacts

Aesthetics
The activities associated with the Proposed Action would be short term, localized, and would have a less than significant impact with mitigation incorporated on visual resources (see Section 3.4.1). Long-term, in combination with mitigation proposed at Santiago Recharge Basin and Smith Basin in the OCWD Groundwater Recharge Facilities Maintenance Plan and mitigation proposed for the Proposed Action there would be a minor beneficial impact with the increase of native vegetation and decrease of non-native vegetation. The increase in native vegetation would be aesthetically pleasing and promote local wildlife. Therefore, the Proposed Action would not substantially contribute to degradation or alteration of the scenic viewscape. As such, no cumulative aesthetic impacts would occur.

Air Quality

Air Pollutants
The Proposed Action impacts have been determined to be less than significant, as discussed in Section 3.4.2. The cumulative projects would also be assumed to have less than significant air pollutant impacts due to minimal emissions and short project duration. Therefore, the cumulative air pollutants impacts are also considered to be less than significant.

Greenhouse Gases
Impacts related to GHG emissions and global climate change are inherently cumulative. As discussed in Section 3.4.7, Proposed Action would have a less than significant impact in contributing to GHG emissions, either directly or indirectly on the environment, under CEQA. The SCAQMD adopted threshold of significance for a cumulative global change impact is GHG emissions more than 3,000 MTCO2e per year, which the conservative assumption of emissions generated by the project over the life of the project (i.e., 30 years) is 114 MTCO2e per year; well below the SCAQMD threshold for a cumulative global change impact. Based on the above, impacts would be less than significant under CEQA.

Biological Resources
Implementation of the Proposed Action would result in less than significant impacts to biological resources with the implementation of mitigation measures (see Section 3.4.3). The Proposed Action combined with other projects would not contribute to cumulative biological resources impacts within the region. As noted in Section 3.4.3, Smith Basin and the Blue Diamond and Bond basins are currently federal mitigation sites required by the FWS as a condition of their concurrence per Section 7 Consultation for USACE's initial issuance and renewal of RGP 90. Regional General Permit 90 allows OCWD to perform operation and maintenance activities within their groundwater recharge basins. Issuance of the 2013 Water Quality Certification by the RWQCB and the Streambed Alteration Agreement by CDFW are also contingent upon the implementation of the mitigation sites as identified in OCWD's HMP. USACE Regulatory is currently in discussions with the FWS, RWQCB, and CDFW as to whether the mitigation sites specifically in Smith Basin and the Blue Diamond and Bond basins can be removed as a requirement for OCWD to implement because OCWD has potentially already implemented sufficient mitigation within other basins under their purview to offset realized permanent impacts to wetland vegetation since 2013. OCWD has confirmed that only 3.19 acres of permanent impacts to wetland vegetation has occurred since the RGP 90 permit was first issued in 2014. Since discussions about removal of the Smith, Blue Diamond, and Bond basins' mitigation sites

from OCWD's HMP are ongoing and are expected to be resolved prior to construction of the proposed Santiago Creek project, the FWS's 2023 amendment, to the FWS's 2001 BiOp for the Santa Ana River Mainstem Project and the FWS's 2012 amendment to the 2001 BiOp for the Santa Ana River Mainstem Project, assumes that the federal requirement for OCWD mitigation has been fully satisfied in other locations. If the agencies whose permits/consultations include these existing mitigation sites do not agree to remove the Smith, Blue Diamond, and Bond basins' mitigation sites from OCWD's HMP, then Section 7 consultation for the Santiago Creek project will be reinitiated at that time.

Although the Proposed Action would have temporary and permanent impacts to existing federal mitigation sites at this time, the Proposed Action combined with other past, current, and reasonably foreseeable future project is not expected to contribute to cumulative biological resources impacts within the region. This is because the Proposed Action includes restoration of native vegetation for all temporarily disturbed areas within the project footprint as well as 1:1 compensatory mitigation offsite for all temporary impacts. In addition, all permanent impacts to native vegetation within the project footprint would be offset offsite at either a 5:1 or 3:1 mitigation ratio depending on the habitat type. Since the federally required mitigation sites under RGP 90 within Smith Basin and the Blue Diamond and Bond basins would be restored with native vegetation that would provide equivalent or better ecological functions than the habitat to be disturbed and temporal/permanent impacts to mitigation sites would be offset offsite within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam, impacts of the Proposed Action Alternative would be reduced to less than significant levels and effects of the project would not be considered cumulatively significant with mitigation.

Cultural Resources
The Proposed Action would not result in the destruction of any historic properties. It is expected that the Proposed Action in conjunction with ongoing and future actions would not contribute significantly to the loss of cultural values or data within the Lower Santiago Creek Watershed, especially if the resources are effectively mitigated (i.e., with the implementation of MM TCR-1 and MM TCR-2 (refer to Section 3.4.14.4 for details)).

Energy
No significant impacts to energy usage would occur from implementation of the Proposed action. As potential effects to energy usage would be less than significant, no contribution to cumulative impacts would occur.

Geology and Soils
No significant impacts to geology or soils would occur from implementation of the Proposed Action. As potential effects to geology and soils would be site-specific and less than significant, no contribution to cumulative impacts in the region would occur.

Hazards and Hazardous Materials
As discussed in Section 3.4.8, the Proposed Action would result in less than significant increased risks to public safety. Long-term, the construction of the Proposed Action would be a beneficial impact as flood risks and impacts would be reduced within the Lower Santiago Creek Watershed. Therefore, safety risks associated with the Proposed Action would not result in a significant cumulative impact.

Hydrology and Water Quality
The cumulative scenario relevant to the Proposed Action is largely characterized by other flood control projects in and downstream of the Villa Park Dam. However, the Proposed Action is the last major component of the SARM project to be implemented, as all other components have already been constructed during the time since completion of the 1975 Survey Report and EIS. As such, potential impacts to water resources and hydrology would be site-specific and not substantial. Water resources and hydrology impacts of the Proposed Action would not combine

with similar impacts of other projects in the cumulative scenario. Furthermore, the Proposed Action creates additional flood storage capacity within the Santiago Recharge Basins and the lower Santiago Creek channel to withstand the 100-year storm event.

Noise

With regards to a cumulative increase in temporary noise levels of the Proposed Action construction in conjunction with construction of cumulative projects identified in Table 35, construction of the Proposed Action would temporarily increase ambient noise levels in the vicinity of the Proposed Action area. As discussed in Section 3.4.11, the nearest sensitive receptors to Smith Basin are residents at the single-family homes located immediately adjacent to the southwest, west, and north; the nearest sensitive receptors to the Santiago Recharge Basins are residents at the single-family homes located immediately adjacent to the northwest, west, south, east, and northeast of the site; and the nearest sensitive receptors to the lower Santiago Creek channel are the residents at the single-family homes located on either side of the channel and as close to the channel as approximately 35-ft. Construction activities associated with other projects near the Proposed Action could potentially occur at the same time as the Proposed Action and further increase noise levels at these sensitive receptor locations. However, due to the distances and construction timing of projects, it is unlikely that construction noise from the Proposed Action would combine with construction noise from those projects to increase potential cumulative construction noise impacts to sensitive receptors. In the event this occurred, these impacts would be temporary and of short duration. While mobile construction vehicles bringing construction supplies to cumulative project sites could share travel routes with the Proposed Action, it is assumed these shared routes would be limited to regional access roadways (Interstate 5, Route 22, Route 55, and Route 57). Due to traffic volumes on these roadways, no significant cumulative noise from mobile construction sources would occur to sensitive receptors along shared travel routes. Each cumulative project identified in Table 35 would be required to comply with local noise ordinances. However, per discussion in Section 3.4.11, if construction activities occur between 7:00 a.m. and 8:00 p.m., Monday through Friday and occasionally on Saturday (i.e., 8:00 a.m. to 8:00 p.m.) — which are the exempted time periods per the City of Villa Park noise ordinance (which has the most stringent noise standards for the project area) — construction projects would be compliant with local (city and county) noise ordinances. Any changes to schedule, including occasional overtime work, would require obtaining a variance from local authorities. As a result, the Proposed Action would not result in significant construction or operation noise impact. Therefore, noise impacts of the Proposed Action would not combine with impacts of present and reasonably foreseeable projects to result in a significant cumulative impact.

Transportation

Cumulative projects within the area (as identified in Table 35) will generate trips to and from the respective project sites using local roadways. The combined contribution of these vehicle trips could result in an increase to existing roadway network levels of service. However, each project identified in Table 35 would be required to comply with the performance standards identified in the City of Orange, City of Santa Ana, City of Villa Park, and Orange County general plans. While development of cumulative projects will result in cumulative addition to traffic volumes on project area roadways, the Proposed Action's contribution to this impact would be minimal during both construction and operation (refer to Section 3.4.13). Therefore, the contribution of the Proposed Action to cumulative impacts would be less than significant.

Tribal Cultural Resources

The Proposed Action would not result in the destruction of any tribal cultural resources. It is expected that the Proposed Action in conjunction with ongoing and future actions would not contribute significantly to the loss of cultural values or data within the Lower Santiago Creek Watershed, especially if the potential impacts to resources are effectively mitigated (i.e., with the implementation of MM TCR-1 and MM TCR-2 (refer to Section 3.4.14.4 for details)).

Utilities and Service Systems
The Proposed Action would have no significant impacts on public services and utilities (see Section 3.4.15). As such, the Proposed action would not contribute to an incremental impact on public services and utilities that would be cumulatively considerable.

Wildfire
The Proposed Action would have less than significant impacts on increasing the risk of wildfire in the project area (see Section 3.4.16). Although portions of the project area within Smith Basin and Blue Diamond and Bond basins are designated as a Wildland High Fire or Very High Fire Hazard Area, a majority of the project area (including the lower Santiago Creek channel) is not located within a designated Wildland High Fire or Very High Fire Hazard Area. As such, the Proposed Action would not contribute to an incremental increase in wildfire risk that would be cumulatively considerable.

3.5.3 Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?

Less Than Significant Impact with Mitigation Incorporated: Certain features of the Proposed Action would exceed the FTA daytime construction noise standard of 80 dBA Leq. Since certain features of the Proposed Action would exceed the FTA daytime construction noise standard, mitigation measures MM NV-1 through MM NV-7 would be implemented during construction to reduce potentially significant noise impacts to nearby sensitive receptors to less than significant.

3.6 Growth-Inducing Effects
The Proposed Action would not directly remove obstacles to growth, result in population increase, or encourage and facilitate other activities that could significantly affect the environment. New development must be consistent with existing city and county general plan policies and zoning ordinances regarding land use, open space, conservation, flood protection, and public health and safety. Local population growth and development would be consistent with the most current Land Use Element of the County of Orange General Plan.

The project area is zoned specifically for flood control and groundwater recharge activities. These land uses would not change due to the construction of the Proposed Action, or any of the related projects in the area. In addition, construction, operation, and maintenance of the improvements would not result in a substantial increase in the number of permanent workers or employees.

3.7 Summary of Environmental Commitments
Table 36 shows the environmental commitments that have been incorporated into the Proposed Action for the purpose of minimizing environmental effects.

Table 36: Summary of Environmental Commitments

Resource Category	Environmental Commitments / Mitigation Measures
Biological Resources	**MM BIO-1:** Successfully restore each acre of riparian vegetation that is temporarily disturbed during construction-related activities. Keep all temporarily disturbed areas free of exotic plants until riparian vegetation is re-established. If the site(s) have not begun to recover within 5 years (i.e., 50 percent of the disturbed areas are not vegetated with young riparian vegetation), then the site(s) will be replanted with cuttings from native riparian species. **MM BIO-2:** Remove 1 acre of giant reed from the upper Santa Ana River watershed and/or action area for each acre of riparian/wetland vegetation that is temporarily disturbed during construction related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange

Resource Category	Environmental Commitments / Mitigation Measures
	for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage giant reed-free for the life of the project; OR: Remove 3 acres of giant reed for each acre of temporary impact and maintain this acreage giant reed-free for a minimum of 5 years. **MM BIO-3:** Conduct brown-headed cowbird (*Molothrus ater*, "cowbird") removal trapping at a minimum of 2 sites in the Santiago Basins (or other areas along the Santa Ana River and environs where trapping would likely be more effective for vireo productivity, subject to review and approval by the Service [FWS], during all years when construction of the Project is occurring and 5 years following construction. Trapping will occur during the vireo egg-laying season (March 15 to July 30). This effort is intended to supplement on-going cowbird trapping activities elsewhere in the Santa Ana River Watershed. **MM BIO-4:** Successfully restore each acre of non-riparian vegetation that is temporarily disturbed during construction-related activities.[6] Non-riparian areas that are temporarily disturbed will be maintained free of exotic/invasive plants[7] for a minimum of 8 years. Container plants will be planted and irrigated in upland areas to expedite the restoration process. Restoration plantings will achieve 70 percent plant cover, including 60 percent native shrub cover, after 5 years, with understory species and less than 10 percent cover by non-native species. If 70 percent of the disturbed areas are not vegetated with woody native shrub species within 5 years, then the site will be replanted or re-seeded as needed until a minimum of 70 percent cover is attained. **MM BIO-5:** Restore 1 acre of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat (i.e., both native and non-native)[8] that is temporarily disturbed during construction-related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage free of non-native/exotic plant species for the life of the project. **MM BIO-6:** Successfully restore 3 acres of riparian vegetation within the action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities. OR

[6] Restoration is defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed [Source: Society of Ecological Restoration and Policy Working Group. 2002. The SER primer on ecological restoration. Science & Policy Working Group.] Existing native vegetation within a proposed restoration area will not be counted towards the acreage restored.
[7] Plants identified by the California Invasive Plant Council as invasive plants for southern California.
[8] All upland vegetation types (BE, Table 6) are considered occupied gnatcatcher habitat.

Resource Category	Environmental Commitments / Mitigation Measures
	MM BIO-7: Remove 5 acres of giant reed from the upper Santa Ana River watershed and/or action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities; actively monitor and manage this acreage for a period of 5 years; and then arrange for the local sponsors and/or another approved entity such as the SAWA to maintain this acreage giant reed-free for the life of the project; and conduct cowbird removal trapping in the vicinity of the restored habitat for the life of the project. *Note: A combination of these alternatives can be used to fulfill the requirements of this conservation measure.* **MM BIO-8:** Successfully restore 3 acres of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat that is permanently destroyed or isolated from the flood plain during construction-related activities (estimated total of destroyed or isolated gnatcatcher habitat is approximately 1.82 acres and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino)) and/or another approved entity such as the SAWA to maintain this acreage free of exotic/invasive plants for the life of the project. **MM BIO-9:** Restoration activities will be initiated as soon as project activities within the restoration area are completed. Restoration activities will be initiated immediately following the completion of project activities within the restoration area. Restoration activities will occur during the non-breeding season for vireos (if adjacent to occupied vireo habitat). **MM BIO-10:** Restoration of coastal sage scrub habitat will be considered successful when the following target/threshold objectives are met: 1) a minimum absolute ground cover of 70 percent native woody plant species and 10 percent native herbaceous species; 2) no more than 10 percent absolute ground cover of exotic/invasive plants, including no plants identified by the California Invasive Plant Council as invasive plants for southern California with an invasive rating of "high"[9]; 3) the shrub layer will consist of a minimum of 30 percent absolute ground cover of California sagebrush (*Artemisia californica*), and a minimum of 5 percent absolute ground cover of each of 4 or more of the following: California buckwheat (*Eriogonum fasciculatum*), California brittlebush (*Encelia californica*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), coast goldenbush (*Isocoma menzesii*); coyote bush (*Baccharis pilularis*), and bush monkey flower (*Diplacus aurantiacus*); 4) the herbaceous layer will consist of a minimum of 5 percent relative cover of each of 5 or more species from the seed mix provided in the BE or the following species: ladies' tobacco (*Pseudognaphalium californicum*), clustered tarplant (*Deinandra fasciculata*), golden yarrow (*Eriophyllum confertiflorum*), purple needlegrass (*Stipa pulchra*), California poppy (*Eschscholzia californica*), small fescue (*Festuca microstachys*) California brome (*Bromus carinatus*), dwarf goldfields (*Lasthenia californica*), dove lupine (*Lupinus bicolor*), and giant

[9] These species must be treated with lethal control methods and removed, cut down, or destroyed prior to seed production in any given year.

Resource Category	Environmental Commitments / Mitigation Measures
	wild rye (*Elymus condensatus*); 5) the recruitment of native plant seedlings must be documented to occur within the replanted areas; 6) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 7) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to suitable coastal sage scrub habitat occupied by gnatcatchers in the vicinity. Alternatively, coastal sage scrub restoration efforts can be considered successful if the habitat is occupied by a breeding pair of gnatcatchers. In addition, habitat must sustain itself for 2 consecutive years without supplemental water. **MM BIO-11:** Restoration of riparian habitat will be considered successful when the following target/threshold objectives are met: 1) a minimum of 30 percent absolute ground cover of native plant species; 2) less than 10 percent absolute ground cover of exotic plant species (including 0 percent giant reed); 3) the absolute ground cover of native species must be represented by, at least, five dominant or co-dominant plant species; 4) the recruitment of native plant seedlings must be documented to occur within the replanted areas; 5) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 6) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to habitat occupied by vireos in the vicinity. Alternatively, riparian vegetation efforts can be considered successful if the habitat is occupied by a breeding pair of vireos, flycatchers, and/or yellow-breasted chats (*Icteria virens*). In addition, habitat must sustain itself for 2 consecutive years without supplemental water. **MM BIO-12:** All acres of restored coastal sage scrub and riparian habitat for offset of permanent impacts will be protected in perpetuity through proper legal instruments for the conservation of federal and state listed species and their habitats. **MM BIO-13:** The Corps [USACE] will ensure that the local sponsors commit to funding a cowbird trapping program in the vicinity of the restored riparian habitat for the life of the project. Program specifics (e.g., number and locations of traps) will be determined in conjunction with permitting processes for the CDFW and FWS. **MM BIO-14:** Mitigation will be initiated as soon as practicable for impacts that occur during the first year of construction. Afterwards, mitigation will be initiated-prior to construction of individual project features. For restoration options that include management for the life of the project, the Corps [USACE] will continue exotic species removal (e.g., giant reed) and cowbird control until such time as the Service [FWS] receives written documentation that the local sponsors and/or another approved entity (such as SAWA) have accepted responsibility for management of the restored area(s). Written documentation will include an estimate of costs associated with management responsibilities and a description of the funding mechanism(s) that will be used to ensure management will continue for the life of the project. If SAWA or another non-public entity accepts management responsibility and then becomes unwilling or unable to continue, then responsibility for continued management will revert to the local sponsors.

Resource Category	Environmental Commitments / Mitigation Measures
	Any advance mitigation that exceeds the requirements of the project (i.e., if actual project impacts are less than what was anticipated when the mitigation was initiated), may be credited as compensation for the effects of future projects. **MM BIO-15:** Identify and delineate on well-labeled maps the specific areas in the upper Santa Ana River watershed and/or action area from which giant reed will be or has been removed, and riparian vegetation restored, as compensation for the proposed action. These areas must be approved by the local sponsors, CDFW, FWS, and USACE. An annual report will be prepared for the Service [FWS] by the approved management entity (e.g., SAWA) that address the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management; and 4) updated mapping that delineates areas in the upper Santa Ana River watershed and/or action area from which giant reed has been removed. **MM BIO-16:** Identify and delineate on well-labeled maps the specific areas in the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Basin that coastal sage scrub will be restored, as compensation for the proposed action. These areas must be approved by the local sponsors, and the Service [FWS] prior to initiation of coastal sage scrub restoration. An annual report will be prepared for the Service [FWS] by the Corps [USACE] until coastal sage scrub is considered successful that addresses the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management and; 4) progress towards meeting success criteria. **MM BIO-17:** Request that the administrator of the Trust Fund identify those acres within the Santa Ana watershed where giant reed was previously removed and/or habitat restored using the $1,000,000 contributed by the OCWD in lieu of restoring 133 acres of riparian habitat in the Prado Basin. This acreage will be actively monitored and managed until riparian habitat is completely restored, and then maintained giant-reed free for the life of the project. **MM BIO-18:** During Project design, the Corps [USACE] will consider an alternative for the proposed maintenance road in Smith Basin that allows for permanent access to Smith Basin from Villa Park Road. **MM BIO-19:** A monitoring program will be developed and implemented within the Project site that entails surveys for the vireo and gnatcatcher during spring and early summer of the year prior to construction and, also, during each year of construction. Construction activities will be monitored to assure that vegetation is removed only in the designated areas. The limits of riparian/coastal sage scrub areas not to be disturbed will be flagged and not encroached upon. **MM BIO-20:** Each employee, contractor, or subcontractor involved in the project construction (including temporary contractors and subcontractors) will be briefed on the following information prior to working within or near areas that may affect federally listed species and proposed species: 1) general types and locations of sensitive habitats and federally listed and

Resource Category	Environmental Commitments / Mitigation Measures
	proposed species that may occur in the action area; 2) measures that will be taken to avoid and minimize incidental take during construction activities; 3) location of conservation and protected areas within the action area; 4) reporting procedures for observations of federally listed and proposed species; 5) reporting procedures for incidents involving the take or potential for take of listed and proposed species; 6) information regarding whom to contact at FWS to report non-compliance with the conservation measures in the biological opinions and terms and conditions of the incidental take statement (or other potential violations of the Act); and 7) applicable permit conditions stipulated by the CDFW and/or other regulatory agencies. **MM BIO-21:** Vegetation clearing associated with project construction will take place only during periods when the vireo and gnatcatcher are not nesting (August 15 through February 15). **MM BIO-22:** The construction contractor will minimize grading activities and leave root systems intact, to the extent practicable. **MM BIO-23:** To the maximum extent practicable, haul routes and staging areas will be located outside of the flood plain (e.g., along bike trails, levees, and roads). All equipment maintenance, staging, and dispensing of fuel, oil, coolant, or any other toxic substance will occur in developed or designated non-sensitive upland areas. Best Management Practices (BMPs) will be implemented in these areas to prevent runoff carrying potentially toxic substances from entering the Santiago Creek and associated drainages. If a spill occurs outside of a designated area, the cleanup will be immediate and documented. **MM BIO-24:** During construction, riparian vegetation adjacent to de-watering areas will be monitored. Supplemental water will be added to this vegetation as necessary to avoid water stress. **MM BIO-25:** To reduce fire hazards, a water truck will always be present during construction activities. Fire suppression equipment including shovels, water, and extinguishers will also be available onsite during the fire season (as determined by Orange County Fire District) and when activities may produce sparks. Construction activities will comply with the fire prevention and protection practices set forth in the USACE's Safety and Health Requirements Manual (EM 385-1-1). The provisions of EM 385-1-1 will be incorporated into all construction specifications, and the contractor will be required to prepare a fire prevention and protection plan for the construction project. **MM BIO-26:** Dust control measures will be implemented during construction to reduce excessive dust emissions. Methods for reducing dust emissions may include wetting work areas, such as dirt access roads and sediment stockpiles, on a regular basis, as well as covering truck beds carrying material and stockpiles. **MM BIO-27:** To the extent feasible, the contractor will prevent exotic weeds from establishing within the work site during construction. Construction equipment will be cleaned of mud or other debris prior to mobilizing and before leaving the site to reduce the potential spread of invasive plants

Resource Category	Environmental Commitments / Mitigation Measures
	and/or seeds. **MM BIO-28:** Excavated materials will be backfilled over the toe stabilization structures. The contractor will replace surface material and re-grade disturbed soft-bottomed substrate areas, in particular the low-flow river channel, to replicate pre-project conditions. USACE will continue to coordinate with FWS to develop and improve measures for re-establishing habitat values within the construction area. **MM BIO-29:** Native plant species will be used to revegetate disturbed upland areas. **MM BIO-30:** A monitoring protocol will be developed and implemented for raptor monitoring, including bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) potentially occurring in the proposed Project footprint during construction. If eagles are foraging or otherwise using the Project footprint, the Corps [USACE] will coordinate with the Service [FWS] to develop appropriate avoidance measures. **MM BIO-31:** Prior to any ground-disturbing activities (e.g., mechanized clearing or rough grading) for all project related construction activities, a Corps [USACE] biologist (or biological monitor) will conduct pre-construction surveys of the proposed Project area for terrestrial special-status species. During these surveys, the biologist will: a. Inspect the proposed Project area for any sensitive wildlife species; and b. In the event of the discovery of a non-listed, special-status ground-dwelling animal, such as burrowing owl or special-status reptile, attempts will be made to recover and relocate the animal to adjacent suitable habitat within the Proposed Project area at least 200 feet from the limits of construction activities. Burrowing owl surveys and relocations would follow the Burrowing Owl Survey Protocol and Mitigation Guidelines (California Burrowing Owl Consortium 1993). **MM BIO-32:** For construction activities within or adjacent to occupied vireo, or gnatcatcher habitat, the following measures shall be implemented to reduce or avoid noise impacts: 1. Prior to the commencement of construction activities, ambient noise levels will be measured at 50 feet and 100 feet from the proposed boundaries of the construction sites and recorded in a graphic format. 2. Sound walls shall be constructed at the boundary of the proposed construction site and/or haul route prior to February 15. Sound walls will probably consist of ½ inch-thick, 8 feet-high plywood sheets. The construction contractor may use other materials or procedures that attenuate sound to acceptable levels, defined below (MM BIO-32 #3 and #4). 3. Where ambient noise is less than 60 dBA and it is determined that

Resource Category	Environmental Commitments / Mitigation Measures
	construction-related noise levels may exceed 60 dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction-related noise does not exceed 60 dBA within these areas. If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within occupied habitat areas outside the project footprint cannot be reduced below 60 dBA Leq hourly during the period of February 15 through August 15 of any year, the Corps [USACE] will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat outside the project footprint[10] subject to noise levels over 60 dBA Leq hourly during the noted period, per the number of breeding seasons will result in 2 acres of restoration; 1 acre of riparian habitat affected by two separate project phases or segments in a single breeding season will result in 1 acre of restoration). The area affected will be determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps [USACE] will identify restoration areas in coordination with the Service [FWS]. 4. Where pre-construction ambient noise is greater than 60 dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction does not result in a significant increase over ambient conditions (i.e., noise level increases shall not exceed 5 dBA over ambient). If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within riparian/coastal sage scrub habitat areas outside the project footprint cannot be reduced to or below 5 dBA Leq hourly over ambient noise levels during the period of February 15 through August 15 of any year, the Corps [USACE] will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat subject to noise levels more than 5 dBA Leq hourly over ambient during the noted period, as determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps [USACE] will identify restoration areas in coordination with the Service [FWS].

[10] Includes all riparian and upland vegetation types (BE, Table 6) outside the mapped project footprint (Figures 1 and 2). Leq hourly noise level contours for project construction activities during the vireo and gnatcatcher breeding and nesting season will be calculated and reported for the areas adjacent to the project footprint based on noise monitoring to be performed, as appropriate.

Resource Category	Environmental Commitments / Mitigation Measures
Geological Resources and Soils	**MM GEO-1:** During construction activities, the project applicant shall incorporate the conclusions and recommendations included in the Geotechnical Investigation Report Geotechnical conclusions and recommendations are in Appendix 6 and discuss geologic hazards such as slope stability, liquefaction, settlement potential, soil suitability, soil corrosivity, etc.
Land Use and Planning	**Refer to Mitigation Measures listed under Biological Resources.**
Noise	**MM NV-1:** Appropriate level of sound attenuation would be used during construction to meet local ordinances. Potential sound attenuation measures that could be considered include, but are not limited to, temporary sound barriers between the sources of construction noise and noise-sensitive receptors, as appropriate. **MM NV-2:** Residents and businesses near the project area would be provided with advance notices of project activities, schedule, anticipated traffic, and potential noise issues. The advance notice would describe the potential noise disruption and the steps that would be taken to minimize the noise. **MM NV-3:** Heavy truck deliveries would be scheduled during exempt working hours and, whenever possible, avoid multiple deliveries during a single house, especially during non-exempt hours. Haul trucks operating near noise sensitive receptor sites would be spaced apart to avoid noise effects from simultaneous operation. **MM NV-4:** Engineer brake (jake brake) use within city limits would be prohibited. Many noise complaints arise from heavy truck use of engine brakes to slow the truck down. Use of this type of braking can be avoided by proper speed control. **MM NV-5:** The contractor would properly maintain and tune engines of all equipment and maintain properly functioning mufflers on all internal combustion engines to minimize noise levels. **MM NV-6:** A standard 24-hour hotline for noise complaints would be maintained. **MM NV-7:** A silent pile driver may be used instead of an impact or vibratory pile driver where sensitive receptors are located nearby.
Transportation	**MM TR-1:** The construction contractor shall develop a construction traffic control plan subject to approval by USACE prior to the start of construction. The contractor shall also develop a plan for notifications and process for communication with affected residences and transit agencies prior to the start of construction subject to approval by USACE. Advanced public notification will include providing in written notification to adjacent residences and transit agencies at least 10 days prior to construction start and providing appropriate signage of construction activities. The written notification will include the construction schedule, exact location and duration of activities, and a local telephone number for receiving questions and complaints.
Tribal Cultural Resources	**MM TCR-1:** Preparing and implementing a monitoring and discovery plan if previously undiscovered resources are identified during an undertaking, suspend work while the resource is evaluated and mitigated to avoid any

Resource Category	Environmental Commitments / Mitigation Measures
	further impact. Continue to consult with Native American groups to identify any tribal cultural resources or resource uses and address impacts. **MM TCR-2:** If previously unknown tribal cultural resources are discovered, work in the immediate area would cease until the requirements in 36 C.F.R. 800.13 are complied with. The on-site supervisor shall contact the USACE's Project Manager and District Archaeologist, and an approved archaeological consultant immediately. The on-site supervisor shall additionally divert all Proposed Action-related activities to other areas until the discovery has been evaluated by the approved archaeological consultant. The USACE will determine if further mitigation measures are warranted in consultation with the SHPO and consulting parties.

SECTION 4 - COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

4.1 Federal Requirements

Clean Air Act of 1972, as amended, 42 U.S.C. 7401, et seq. *Full Compliance.* The Proposed Action is not expected to violate any federal or state air quality standards, exceed the USEPA's general conformity *de minimis* threshold, or hinder the attainment of air quality objectives in the local air basin. Implementation of BMPs would reduce NO_x emissions to below local thresholds. Thus, the USACE has determined that the Proposed Action would have no significant effects on the future air quality in the area.

Clean Water Act of 1972, as amended, 33 U.S.C. 1251, et seq. *Partial Compliance*. The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating water quality standards for surface waters. A 404(b)(1) analysis has been prepared for the Proposed Action Alternative and can be found in Appendix 3. The 404(b)(1) analysis concluded that there would be no permanent impacts to non-wetland waters of the U.S. and there are no wetland waters of the U.S. present within the project footprint. The Proposed Action would have temporary impacts to non-wetland waters of the U.S. due to cut and fill activity, but there would be no net loss of non-wetland waters of the U.S. once construction of the project is complete. No compensatory mitigation measures are required to offset temporary impacts to non-wetland waters of the U.S. USACE will apply for a 401 water quality certification during the next phase of the project and anticipates no issues with obtaining certification prior to construction of the Proposed Action Alternative.

Endangered Species Act of 1973, as amended, 16 U.S.C. 1531, et seq. *Partial Compliance.* In accordance with Section 7(c), the USACE obtained a list of federally listed and proposed species likely to occur in the Proposed Action area. In addition, the USACE initiated formal consultation with the FWS regarding the Proposed Action and submitted a Biological Evaluation (BE) to the FWS on December 1, 2022 (Appendix 8). Upon receipt of the BE, the FWS reviewed the document for completeness to initiate formal consultation. In an email response dated December 21, 2022, the FWS stated that USACE's request and supplementary information did not include all the information necessary to initiate formal consultation and requested additional information for the initiation package to be considered complete. The USACE provided the additional information that was requested and/or a statement explaining why the information could not be made available at the time on February 24, 2023. Following the receipt of the additional information, the FWS acknowledged on April 5, 2023, that the formal consultation was initiated upon receipt of the USACE's response letter from February. However, the FWS provided three additional comments and a fourth comment was provided on May 17, 2023. Due to the complexity of the comments, FWS requested an extension of the formal consultation period on July 7, 2023. The formal consultation period was completed on August 8, 2023, and it is anticipated that the FWS will issue the BiOp by September 22, 2023. Refer to Appendix 8 for Agency Coordination correspondence.

As the action agency, the USACE has determined that no effects would occur to any listed species under the jurisdiction of the National Marine Fisheries Service (NMFS). As a result, neither informal nor formal consultation is required with NMFS under Section 7 of the Endangered Species Act.

Executive Order 11988, Floodplain Management. *Full Compliance.* The objective of this Executive Order is the avoidance, to the extent possible, of long and short-term adverse effects associated with the occupancy and modification of the base floodplain (1 in 100 annual flood event), and the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative. The Proposed Action is the only practicable way to reduce flood risk to the communities of Villa Park and Orange that are part of the Santa Ana River

watershed. The Proposed Action, in combination with other area flood risk projects, protects the existing urban population while providing residual risk information to the appropriate agencies making land use decisions in the area. Therefore, the Proposed Action does not contribute to increased development in the floodplain and is in compliance with the executive order.

Executive Order 11990, Protection of Wetlands. *Full Compliance.* This Executive Order directs federal agencies in carrying out their responsibilities to minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. A 404(b)(1) analysis has been prepared for the Proposed Action Alternative and can be found in Appendix 3. The 404(b)(1) analysis concluded that there would be no permanent impacts to non-wetland waters of the U.S. and there are no wetland waters of the U.S. present within the project footprint. The Proposed Action would have temporary impacts to non-wetland waters of the U.S. due to cut and fill activity, but there would be no net loss of non-wetland waters of the U.S. once construction of the project is complete. No compensatory mitigation measures are required to offset temporary impacts to non-wetland waters of the U.S.

Executive Order 12989, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. *Full Compliance.* This Executive Order states that federal agencies are responsible to conduct their programs, policies, and activities that substantially affect human health of the environment in a manner that ensures that such programs, policies, and activities do not exclude persons from participation in, or deny persons the benefits of, or subject persons to discrimination under such programs, policies, and activities because of their race, color, or national origin. USEPA's environmental justice (EJ) mapping and screening tool was used to query the project area. In the EJScreen, a two-mile buffer was drawn around each project area (i.e., lower Santiago Creek channel and the Santiago Recharge Basins). The EJScreen tool was used to ascertain if the Proposed Action would have a disproportionate adverse impact on a minority population, low-income population, or child population (i.e., persons under five years of age). For the lower Santiago Creek channel, regionally a minority population, low-income population, and child population are considered to be present within the vicinity of the project area since all of these populations are above the 50th percentile (Figure 23). However, these regional percentiles are similar to the state and to the United States (Figure 23), therefore, a disproportionate impact to these populations with implementation of the Proposed Action would not occur. In addition, the implementation of the Proposed Action would reduce flood risk and flood impacts for these populations which is expected to be a beneficial impact. For the Santiago Recharge Basins, a significant minority population, low-income population, or child population is not present within the vicinity of the project area since regionally, these populations are below the 50th percentile (Figure 24). Therefore, the implementation of the Proposed Action would have no disproportionate impact to these populations within the vicinity of the Santiago Recharge Basins.

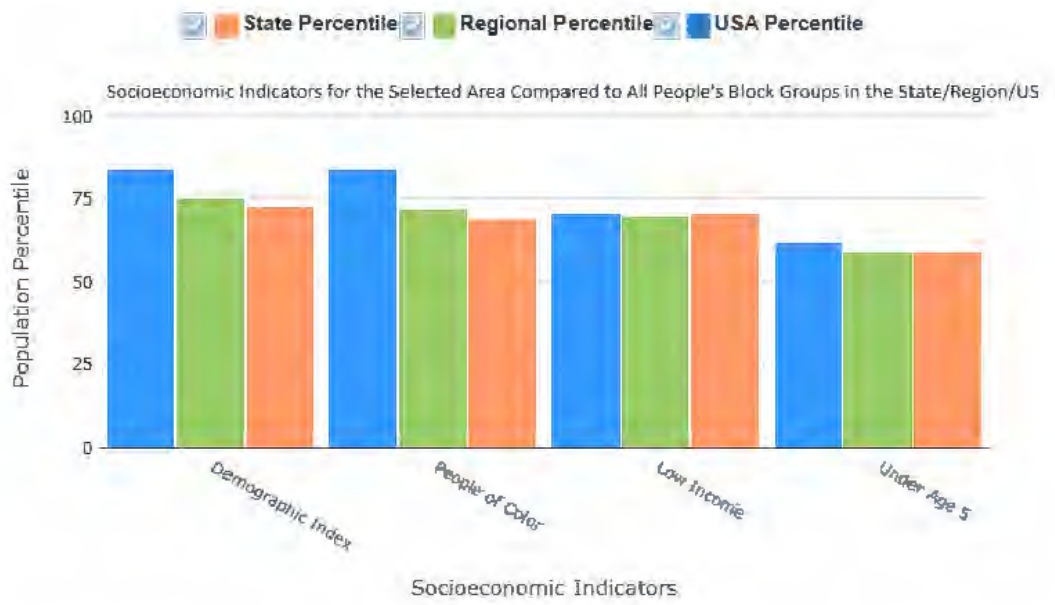


Figure 22: EJScreen Graph Depicting Socioeconomic Indicators within a Two-mile Radius of the Lower Santiago Creek Channel

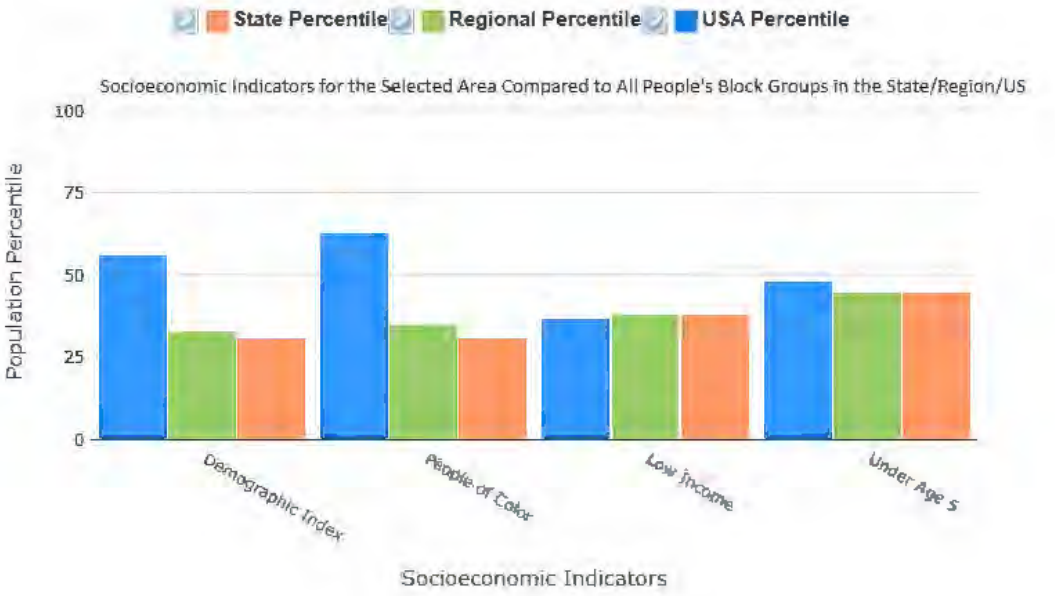


Figure 23: EJScreen Graph Depicting Socioeconomic Indicators within a Two-mile Radius of the Santiago Recharge Basins

Farmland Protection Policy Act, 7 U.S.C. 4201, et seq. *Full Compliance.* This act requires a federal agency to consider the effects of its actions and programs on the Nations' farmland. There are no designated prime or unique farmlands within the Proposed Action area, and therefore there would be no adverse effects to farmland.

Fish and Wildlife Coordination Act of 1958, as amended, 16 U.S.C. 661, et seq. *Partial Compliance.* This act requires federal agencies to consult with the FWS and state fish and wildlife agencies before undertaking or approving water projects that control or modify surface water. Federal agencies undertaking water projects are required to fully consider recommendations

made by the FWS. The USACE sent a formal request and Scope of Work (SOW) to FWS for a Fish and Wildlife Coordination Act Report on March 10, 2022 (Appendix 8). A second SOW was sent to the FWS on September 20, 2022. USACE received the Draft Fish and Wildlife Coordination Act from FWS on June 2, 2023. Comments from USACE on the Draft Fish and Wildlife Coordination Act dated June 2, 2023, were provided to FWS on June 30, 2023. An updated Draft CAR with USACE comments considered and incorporated where applicable has not been received to date. For the June 2, 2023, Draft CAR refer to Appendix 7.

Magnuson-Stevens Fishery Conservation and Management Act. *Full Compliance.* This legislation requires that all federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect essential fish habitat. Essential fish habitat is defined as 'waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." There is no essential fish habitat within or immediately adjacent to the components of the Proposed Action, therefore, the USACE has determined that the project would have no effect on essential fish habitat.

Migratory Bird Treaty Act of 1936, as amended, 16 U.S.C. 703, et seq. *Full Compliance.* This Act provides protection for migratory birds as defined in 16 USC 715. To ensure the project would not affect migratory birds, a biologist would conduct preconstruction surveys and follow-up surveys in the project site and areas adjacent to the project site. If breeding birds or active nests are found in the area, a protective buffer would be delineated, and the FWS and CDFW would be consulted for further action prior to implementation of construction.

Bald and Golden Eagle Protection Act of 1940, as amended, 16 U.S.C. 668-668d. *Full Compliance*. This Act prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald or golden eagles, including their parts (including feathers), nests, or eggs. In addition to immediate impacts, this Act also covers effects that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habitats, and causes injury, death, or nest abandonment. USACE will develop and implement a monitoring protocol for raptors, including bald and golden eagles, within the project footprint during construction activities. If eagles are foraging, USACE will coordinate with the Service [FWS] to develop appropriate avoidance measures (MM BIO-29, Section 3.4.3.4). With the implementation of MM BIO-29 (Section 3.4.3.4), the USACE would be in full compliance with the Act.

National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321, et seq. *Partial Compliance.* This Draft SEA/IS/MND is in partial compliance with this act. Comments received during the public review period will be incorporated into the Final SEA/IS/MND as appropriate and a comments and responses appendix will be prepared. The Final SEA/IS/MND will be accompanied by a signed Mitigated FONSI if determined to be appropriate by the District Engineer after consideration of public comments. These actions will provide full compliance with this act.

National Historic Preservation Act of 1966, as amended (54 U.S.C. 306101, et seq.). *Partial Compliance.* Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of a proposed undertaking on properties that have been determined to be eligible for, or included in, the NRHP. The implementing regulations for Section 106 are 36 CFR § 800. USACE submitted a determination of "No Historic Properties Affected" to the California SHPO on March 21, 2023. The SHPO requested additional information on the project in letters dated May 22, 2023, and June 27, 2023, although the timing of when the letters were received exceeded the 30 days afforded to SHPO for a response to consultation. In addition, SHPO provided to USACE on July 28, 2023, a comment received from the public which USACE provided a response to the SHPO on August 1, 2023. Under 36 C.F.R. 800.5(c)(1), SHPO concurrence was waived since after the close of the original 30-day review period (i.e., April 20, 2023) SHPO had not provided a response and no consulting party had objected.

4.2 State of California Requirements

California Environmental Quality Act. *Partial Compliance.* This joint Draft NEPA/CEQA document is in partial compliance with CEQA requirements. Comments received during the public review period will be considered and incorporated into the final SEA/IS/MND, as appropriate. The OCPW will consider adopting the IS and adopting the Statement of Findings and Mitigation Monitoring and Reporting Plan (MMRP) to obtain full compliance for CEQA.

California Endangered Species Act. *Partial Compliance.* This act requires the non-federal agency to consider the potential adverse effect on state-listed species. This joint NEPA/CEQA document considers the potential effects on state-listed species. Based on the analysis presented in the final SEA/IS/MND, OCPW will determine whether take authorization from the California Department of Fish and Wildlife is appropriate.

SECTION 5 - COORDINATION AND REVIEW OF THE SEA/IS/MND

5.1 Scoping

Scoping letters were distributed via email on October 6, 2021, to federal, state, and local agencies/governments and tribal nations. Input on the scoping distribution list was provided by the USACE Los Angeles District and OCPW. The scoping letter requested feedback on any resources or habitats of concern in the study area, information on ongoing projects in the study area, and feedback on the 1988 authorized project design. Agencies and governments on the scoping distribution list were given until November 12, 2021, to provide comments. A total of 20 comments were received during the scoping period. For a summary of the scoping comments received as well as the individual letters refer to Appendix 9.

5.2 Public Involvement

This section will be updated once it has occurred.

5.3 Review of the SEA/IS/MND

This section will be updated once it has occurred.

5.4 Coordination with Other Federal, State, Regional, and Local Agencies

Chapter 4 describes how the project complies with applicable federal, state, and local laws, regulations, and other requirements and discusses required consultations and coordination. The following briefly summarizes the consultation and coordination efforts.

Beyond formal public scoping, USACE and OCPW communicated with federal, state, and local agencies in the course of preparation of the SEA. The environmental stakeholders included CDFW, state Water Board, FWS, and USEPA. These communications included in-person meetings, telephone conversations, and written correspondence between 2021 through June 2023. The communications addressed consistency with other SARMP projects in the region, pursuit of agency approvals, information to be considered in the document, and opportunities for partnership.

USACE coordinated and formally consulted with FWS under Section 7 of the Endangered Species Act and the Fish and Wildlife Coordination Act to help analyze potential effects to biological resources, including federal threatened and endangered species. The formal consultation process under the ESA is described in more detail in Section 4.1. In their Draft CAR (Sobiech, 2023), FWS provided the recommendations shown in Section 5.4.1.

5.4.1 Coordination with Other Federal, State, Regional, and Local Agencies

A Draft Coordination Act Report (CAR), dated June 2, 2023, was prepared by the FWS (Sobiech, 2023). The Draft CAR describes existing environmental resources within the project action area and potential effects of the project on these resources. Recommendations in the Draft CAR are currently being considered by USACE and responses to the recommendations will be provided in the Final SEA. The following is a summary of the recommendations provided by the FWS for the project in the Draft CAR. For the entire Draft CAR refer to Appendix 7: Draft Fish and Wildlife Coordination Act Report.

FWS Recommendation 1: The Corps [USACE] should fully replace any lost or degraded riparian, aquatic, and coastal sage scrub functions and values likely to result from the project, so as to at least ensure no net loss of these resources, including temporal losses. This should include practicable compensatory measures of restoration, establishment (creation), and/or enhancement of in-kind riparian, oak woodland, coastal sage scrub, and other resources for the purpose of offsetting unavoidable adverse impacts. This should also include in-kind replacement/creation of sensitive species habitats that would be affected by the project, including ensuring that specific mitigation areas are likely to support and benefit vireo or gnatcatcher with implementation of conservation measures. For example, the project proposes offsetting temporary impacts to willow

forest/woodland/scrub with restoration of riparian southern willow scrub within Smith Basin in areas that are currently open water that would be subject to project excavation. These areas are unlikely to support willow scrub in the future, as the frequent and prolonged inundation that currently maintains them as open water would likely be increased with a lower final grade as ground level (continuing to maintain them as open water). We suggest that the elevations in Smith Basin that currently demarcate the edge between open water and willow forest/woodland/scrub be utilized for the predicted edge of proposed restoration of riparian southern willow scrub per the project's final grade elevations within Smith Basin. Similarly, the current elevations that demarcate the edge between willow forest/woodland/scrub and upland natural communities should be utilized for the predicted edge of proposed mulefat thickets or willow scrub restoration and coastal sage scrub restoration within Smith Basin.

FWS Recommendation 2: We recommend the Corps [USACE] minimize impacts to existing biological mitigation sites in the Santiago Basins. While the current existence of some of these mitigation sites remains in question, much of the Smith Basin floor and slopes may be existing mitigation sites and managed open space. If these mitigation sites are extant, offsetting measures for likely adverse effects to existing mitigation resources (i.e., mitigation sites within the project footprint) should occur at higher ratio of at least twice the otherwise appropriate ratio for the natural community/habitats to be affected than for areas that are not existing mitigation sites, due to the extra conservation value, long term protection expectations, importance afforded these sites, and the current management and quantifications as compensation for impacts from other previous projects.

FWS Recommendation 3: We encourage the Corps [USACE] to design and implement appropriate soil covering over riprap that is compatible with the target natural communities planned for restoration/mitigation replacement over that riprap. We predict that soil coverings over riprap that include more than minor amounts of rock, cobble, or gravel would not function effectively as growing soil media for any of the project target restoration vegetation types. We anticipate that soil coverings that are less than 4 feet deep would not function effectively as growing soil media for restoration of riparian scrub or riparian woodland/forest vegetation. We predict that soil coverings that are less than 3 feet deep would not function effectively as soil media for restoration of coastal sage scrub vegetation. The goal of providing at least the minimum specified soil depths is to provide appropriate minimum topsoil/subsoil covering for both sufficient rooting depth of target native plants and root access for these plants to obtain adequate soil nutrients and moisture, including through predicted extended drought periods. We suggest project conservation measures involving soil over riprap include a minimum of 3 feet of appropriate friable soil growing matrix (to be placed over slope protection armoring) for the growth of subshrubs, and a minimum soil depth of 4 feet for shrubs and riparian trees (i.e., willow and cottonwood). This recommended soil covering should have very little gravel, cobble, or rocks.

FWS Recommendation 4: The Corps [USACE] should not direct mitigation for Project potential biological impacts into the lower Santiago Creek project reach, considering the herein noted constraints in that area. Overall project impacts to oak woodland, coastal sage scrub, and riparian natural communities should be mitigated within Santiago Basins, upstream of Santiago Basins, or other locations with both high potentials to support these natural communities and the target sensitive species and to maintain appropriate ecological connectivity. The lower Santiago Creek area is highly constrained and ecologically isolated; these conditions greatly diminish or eliminate this area's effective mitigation potential. Compounding this is the proposed project would essentially use all the channel right-of-way space with construction/operation of an armored trapezoidal channel, further constraining the project footprint area. This would effectively not allow space for riparian trees, oak trees, or larger woody shrubs once constructed, based on both proposed project channel design and project O&M vegetation restrictions for the channel. Additionally, the proposed riprap armoring (and sheet pile in some locations) would preclude the ability to restore oak woodland in this area due to the resultant barriers to root growth of mature oaks from the riprap or riprap and sheet pile combined. The proposed substrate covering over the channel riprap armoring in this reach would be mostly rock and only 12 inches deep. This mostly

rock substrate on top of riprap would preclude the ability to restore coastal sage scrub or most other types of vegetation.

FWS Recommendation 5: More than 17 relatively large coast live oak and California sycamore trees occur within the project footprint in lower Santiago Creek portion of the project. Project impacts to these trees and the associated 0.38 acre of oak woodland natural community in the project footprint should be offset, including replacement in-kind of at least 10:1 per tree and minimum 2:1 coast live oak woodland creation per acre affected, with appropriate plant establishment periods. This oak woodland mitigation should be accomplished in one of the areas noted in Recommendation #9 below or within other appropriate locations in the Project region, such as disturbed open areas within Santiago Oaks Regional Park or Corps [USACE]-owned lands within Prado Basin that are upland areas currently dominated by eucalyptus trees where groundwater is about 10-25 feet from the ground surface (e.g., along the south side of Prado Basin).

FWS Recommendation 6: The Corps [USACE] should incorporate native nectar and host plants for monarch butterflies into project restoration and revegetation plans, where appropriate. The propagules for such plantings should be from Orange County ecotypes to the maximum extent practicable. In addition, food plants for Crotch's bumble bee should be incorporated into such plans where appropriate, including regionally appropriate seed and plant stock of: *Chaenactis sp.*, *Lupinus sp.*, *Clarkis sp*., *Phacelia sp.*, *Salvia sp.*, and *Eriogonum fasciculatum*.

FWS Recommendation 7: The Corps [USACE] should investigate alternative stream slope erosion control measures for the Santiago Basins portion of the proposed project. Specifically, alternatives that potentially provide for improved restoration or riparian woodland/scrub on top of armoring should be evaluated and considered. For example, utilization of an open cell system of articulated concrete blocks that are interconnected by polyester or galvanized steel cables (product types such as Contech Armor-Flex or Shoretec Shorebloc) should be evaluated/considered as alternatives to riprap slope protection within this project reach. These concrete block mattresses have open cells (approximately 20 percent open area) within the blocks for providing increased (albeit limited) vegetated/root growth compared to most riprap applications with otherwise similar applications of soil on top of armoring.

FWS Recommendation 8: The Corps [USACE] should design and implement, to the extent practicable and appropriate, Project stream storm flow energy dissipating structures within Santiago Creek at or above the upstream end of Smith Basin. Stream flows upstream and entering Smith Basin are likely out of "Lane's balance" due to existing artificial fluvial and stream flow changes to the creek and are thus erosive within the local floodplain and floodway, causing downcutting of the streambed upstream and within Smith Basin. This is evidenced by the currently eroded slopes in the project footprint and downcut creek bed upstream of Smith Basin. These stream-energy-dissipating structures would be ecologically designed and function to reduce the flow energy of storm flows, thereby reducing the velocity of storm flows entering the Basin, in order to prevent scour and erosion at the upstream end of Smith Basin and effectively reduce future streambed and bank/slope erosion in the area of the Basin. Reducing erosion and scour in this area of the project should materially reduce the need for future operations and maintenance activities (e.g., periodic slope repair, Basin channel grading, such as could occur with the proposed Project) that would likely repeatedly adversely affect riparian and coastal sage scrub communities that currently (or are expected to occur in the future with revegetation/restoration) along the bank slopes and floor of Smith Basin.

FWS Recommendation 9: The Corps [USACE] should investigate, and implement if practicable, the acquisition of a property(ies) or conservation easements along Santiago Creek that are upstream of Smith Basin. For example, vacant former sand and gravel mining parcels downstream of Santiago Oaks Regional Park (approximately 1 mile upstream of Smith Basin) should be considered. This acquisition, possibly in partnership with OCWD or Orange County Public Works, would: (a) provide space for riparian, oak woodland, and coastal sage scrub

natural community mitigation for the Project; (b) conserve and protect open space to help maintain the partially constrained wildlife linkage and connectivity for east-west wildlife movement between the Santiago Basins and expansive natural open space areas to northeast and east; (c) provide space for potential storm flow energy dissipation features upstream of Smith Basin, including Santiago Creek channel and floodplain rewidening/restoration measures; and (d) provide needed project soil fill (borrow) material (to be excavated from the noted upstream conservation properties) for the proposed reconstruction/stabilization of the Smith Basin slopes, thus potentially reducing the project impact footprint within the floor of Smith Basin.

FWS Recommendation 10: The Corps [USACE] should minimize proposed project clearing/grading within the riparian vegetation areas occurring within the floor of Smith Basin. This would include implementing the minimum grading of the Basin floor necessary to re-direct the existing thalweg of Santiago Creek away from Basin slopes proposed for project repair. This would also include minimizing the excavation of fill from the Basin floor to be utilized for re-building the eroded slopes of Smith Basin. As an alternative, we recommend that the Corps [USACE] utilize parcel(s) upstream of Smith Basin (mentioned above) for maintaining cut and fill balance for the project. The upstream parcel(s) could be used to provide most of the necessary fill for the Smith Basin slope repair work, potentially reducing the disturbance footprint within the floor of Smith Basin.

FWS Recommendation 11: We recommend that the Corps [USACE] incorporate project designs that specifically include minimization of future needs for potential O&M associated with flood risk management within Smith Basin. Project designs for Smith Basin should anticipate and clearly minimize the associated needs for future O&M by OCWD or OCPW within the Basin that would potentially affect natural communities, particularly riparian scrub/woodland/forest and coastal sage scrub. A potential example of such future O&M would include re-grading of the Smith Basin floor following flood-caused scour of slopes or invert, deposition, or considerable stream alignment changes during larger flood events. The suggested design changes would include designing maintenance roads and slope armoring (as well as the stream-energy-dissipation structures suggested above) that would provide allowance for future natural meandering (without structure or armoring damage concerns) of the Santiago Creek thalweg horizontally over time within Smith Basin. This would also include designing all pertinent project structural features in and near riparian areas to be highly flood damage resistant, such that appreciable damage (e.g., to the Basin floor or slopes armoring) would have a very low likelihood of occurrence from associated future stream scour, erosion, or deposition during modest flow events, such as at least the 4 percent chance exceedance flood event. This would include structure designs with a high likelihood of remaining undamaged if/when the thalweg of Santiago Creek does again naturally meander across Smith Basin to areas along its slopes.

FWS Recommendation 12: Proposed project vegetation clearing in vireo and gnatcatcher habitats would only occur during periods when vireo and gnatcatchers are not breeding. We recommend that the Corps [USACE] require all proposed project vegetation clearing and grubbing (not just within potential vireo or gnatcatcher habitats) only occur outside the breeding season for all native migratory and resident birds, including raptors.

FWS Recommendation 13: Considering the heavily “built” environment surrounding most of the action area, and the lack of standing tree snags and suitable rock cavities within the project region, we suggest the Corps [USACE] provide artificial nesting and roosting structures for specific wildlife within the Santiago Basins to help offset temporal ecological losses associated with the proposed project and to quickly enhance fish and wildlife resources in the area beyond offsetting mitigation. This would include providing and incorporating artificial nesting and roosting structures for local bats, owls, swifts, swallows, and other native species that would likely utilize such features in the project region, including artificial snags and nest/roost boxes. Some of these features should be designed to remain intact for at least several decades, through the use of slowly degrading materials that are also low in potential exposure of wildlife to contaminants (e.g., avoiding the use of treated wood). Additionally, development of artificial and semi-natural rookery

sites for herons and egrets within the Santiago Basins area should be considered.

FWS Recommendation 14: The Corps [USACE] should ensure that relocation of any burrowing owls performed as part of the project be accomplished consistent with the current CDFW burrowing owl relocation protocol or other protocol approved by the Service [FWS]. The CDFW 2012 Staff Report on Burrowing Owl Mitigation describes CDFW's comprehensive conservation and mitigation strategy for the species (CDFW, 2012).

FWS Recommendation 15: We encourage the Corps [USACE] to incorporate the use of Soft Engineering and Engineering with Nature into the proposed project, including designs for slope protection/armoring, where practicable. These practices utilize ecologically compatible features and measures that are essentially self-sustaining or very low in periodic or ongoing maintenance needs. Such design practices would likely reduce future disturbances to the noted project natural communities, such as within Smith Basin. We recommend the Corps [USACE] also utilize "bioengineered" slope protection practices where technologically feasible in the project designs. Bioengineered materials can often be effective for use in floodways on eroding banks of streams. Bioengineering integrates live plant materials with structural support to create a living system capable of stabilizing stream banks and providing erosion, sediment, and flood control.

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Appendix 1 – Aquatic Resources Delineation Report

AQUATIC RESOURCES DELINEATION REPORT
Santiago Creek Project

Prepared for:

United States Army Corps of Engineers, Los Angeles District
915 Wilshire Boulevard
Los Angeles, CA 90017

Prepared by:

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Last Updated March 2023

Aquatic Resources Delineation Report

Santiago Creek Project
California

The undersigned certify that this report is a complete and accurate account of the findings and conclusions of a jurisdictional determination and delineation for the above-referenced project.

Justin M. Wood, M.S.
Senior Biologist
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Last Updated March 2023

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1.0 Introduction

This report was prepared under contract to the United States Army Corps of Engineers (USACE) to describe jurisdictional wetlands, streambeds, drainages, and other resources at the Santiago Creek Recharge Basin, Smith Basin, and along the lower reach of Santiago Creek. Throughout this report, "project" refers to the total action proposed by the USACE, while "project site" refers to all areas that may be directly or indirectly impacted by project activities as well as a slightly larger survey area. The USACE is currently designing modifications to Santiago Creek to prevent significant flood damages. The design modifications will be directed toward increasing the flood control capacity and reducing flooding induced erosion along the urbanized areas of Santiago Creek. Reservoir improvements are also proposed at Santiago Recharge Basin which are necessary to accommodate storage and regulation of flood waters released from the upstream dams. Generally, the existing Santiago Recharge Basin would be modified to allow storage of additional flood control volume and to give the basin operators additional flexibility in managing water levels to accommodate both groundwater conservation and flood storage needs.

1.1 Lead Agency Name and Address

United States Army Corp of Engineers, Los Angeles District
915 Wilshire BLVD, Suite 930
Los Angeles, CA 90017

1.2 Contact Person and Phone Number

Tiffany Bostwick
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1.3 Site Access

Driving directions to the project site are provided below in Table 1.

Table 1. Driving Directions to the Project Site

From The Greater Los Angeles Area of Southern California:
Take Interstate 5 south towards San Diego.
Smith Basin
Merge onto Highway 91 east towards Riverside.
Merge onto Highway 55 south towards Newport Beach.
Take Katella Ave. exit and turn left.
Continue 1.6 miles to project site via locked gate on north side of Villa Park Rd. (Katella Ave.).
Santiago Recharge Basin
Merge onto Highway 91 east towards Riverside.
Merge onto Highway 55 south towards Newport Beach.
Take Katella Ave. exit and turn left.
Continue 0.6 miles and turn right on Wanda Rd.
Continue 0.5 miles and turn left on Collins Ave.
Continue 0.4 miles and turn left into the project site.

Table 1. Driving Directions to the Project Site
From The Greater Los Angeles Area of Southern California:
Lower Santiago Creek Take the exit towards Bristol St. Keep right onto La Veta Ave. Turn left on La Veta Ave. Continue 0.8 miles to project site on right.

2.0 Project and Property Description

2.1 Project Description

The USACE proposes to make several modifications to various features within the project site. These features would be directed toward reducing flooding induced erosion of the slopes within the Santiago Recharge Basin and along the urbanized areas of Santiago Creek. The following are major elements of the Proposed Action:

Reservoir Slope Stabilization. The existing slopes of the reservoir require repair. Stabilization along the slopes of the Santiago Recharge Basin is necessary to accommodate the 1% annual exceedance probability (AEP) water surface elevation. Several locations have been identified along the basins which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H): 1 Vertical (V), installation of retaining walls, or installation of armoring.

In addition to reservoir slope stabilization within Smith, the flood of Smith Basin will also require rehabilitation to protect the repaired slopes from future erosion. Therefore, the Smith Basin slope stabilization feature also includes grading a floodway through the floor of Smith Basin and armoring the toe of the slopes to be repaired.

Lastly, reservoir slope stabilization also includes the rehabilitation of a historic maintenance access road within Smith Basin. The access road is located along the toe of the northern slope of Smith Basin and would be restored and graded to its original condition. This road would become the main access into and out of the bottom of Smith Basin and would be accessed from Santiago Road located along the northeast edge of Smith Basin.

Channel Improvements. Flow velocities within Santiago Creek are erosive during large storm events (approximately 9-13 feet per second during the 1% AEP), potentially compromising adjacent properties along the highly urbanized floodway. To rehabilitate and improve the creek's flood conveyance capability, the Proposed Action will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will then be covered with native substrate to (i) enhance access for ongoing operation and maintenance; (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) maintain existing aesthetics; and (iv) enhance environmental integrity of the stream corridor. The Proposed Action will involve excavating surficial material from the channel bottom and installing the buried riprap. Replacing that excavated surficial substrate overlying the riprap layer will stabilize the slopes, maintain the channel's natural appearance, and allow for establishment of native, ecologically desirable vegetation. A channel operation and maintenance program will be necessary to prevent invasive vegetation, large woody debris growth, debris, and other flow inhibiting concerns from re-establishing within the channel.

In total, the proposed stream stabilization measures include 6,400-feet of trapezoidal channel armored with buried riprap. The proposed cross section includes a gravel bedding layer and riprap armor layer. The riprap armor layer would be covered with approximately one (1) foot of native substrate harvested from the channel. The surficial layer will provide suitable substrate for native vegetation growth. The planting palette is comprised of two native vegetations species mixes, a low-growth mix for the channel invert and a coastal sage scrub mix for the channel bank. The channel invert width varies from 30-feet to 80-feet, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitation and will be installed to a slope of 1.75H:1V.

The removal of trees in the downstream channel right-of-way would be necessary to complete grading and channel construction. The trees in the downstream reach are primarily invasive species such as eucalyptus, black locust, and tree of heaven. To improve the vegetation quality in the channel, native vegetation would be restored along the top of the bank and side slopes of the lower Santiago Creek channel, where feasible, after earthmoving and channel construction is complete. Native plantings would consist of container plantings and hydroseed. Drip irrigation would be installed for approximately 2 to 3 years to allow plant establishment, and monitoring and maintenance of the restored areas would occur for a 5-year period. The goal of the restored habitat is to create a self-sustaining ecosystem that would require minimal long-term maintenance. Once the 5-year monitoring and maintenance period is over, the Corps would provide the non-federal sponsor with an Operations and Maintenance (O&M) manual.

Floodwalls. Floodwalls are required in select locations along Santiago Creek under the Proposed Action. Floodwalls will extend for approximately 2,600 feet between Bristol Avenue and Flower Street on both the north and south sides of the lower Santiago Creek channel, and for 900 feet on the north side of the lower Santiago Creek channel west of Bristol Avenue. The floodwalls will be steel sheetpile varying in total length from 19 to 30 feet with a reinforced concrete cap extending two feet below the existing grade to the design elevation based on the hydraulic model for the system. Typical total height of the concrete cap is four to five feet. The location of the wall alignment is at the top of the proposed bank in all areas defined above. Native vegetation would be restored within the portions of channel where the floodwall is located; however, the vegetation would have to be low-lying grasses in order to comply with Corps of Engineers Engineering Pamphlet (EP) 1110-2-18. EP 1110-2-18 requires that a minimum 15-feet down slope of a floodwall needs to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except for grasses for the purpose of erosion control.

2.2 Project Location

The project site is located in the cities of Orange, Santa Ana, Villa Park, and unincorporated territory within Orange County, California (see Figure 1, Attachment 1). It is within the California United States Geological Survey (USGS) Orange 7.5-minute Quadrangle. The 330-acre project site includes Smith Basin (67 acres) and Santiago Recharge Basin (248 acres) shown in Figure 2a, and Santiago Creek Channel (15 acres) shown in Figure 2b (Attachment 1).

3.0 Existing Conditions

3.1 Topography and Surrounding Land Uses

The project site is generally located on the western slope of the Santa Ana Mountains near their transition with the valley floor below. Smith Basin and Santiago Recharge Basin are in an area with hilly terrain

surrounded by dense residential development. Upstream of these basins are larger areas of open space such as Santiago Oaks Regional Park and Irvine Lake Regional Park. Lower Santiago Creek is in an area with flat topography and is also surrounded by residential development. A small narrow strip of open space is present to the west along the Santa Ana River and also to the east along Santiago Creek.

3.2 Vegetation

Vegetation mapping was done by drawing tentative boundaries onto high-resolution aerial images during site visits on January 12 and 26, 2022. These boundaries were then digitized into GIS shapefiles. Vegetation maps were field verified for accuracy on March 3, 2022. Vegetation was classified according to the *Manual of California Vegetation* (Sawyer, et al. 2009). Vegetation was mapped digitally using ArcGIS (version 10.7) and one-foot pixel aerial imagery on a 22-inch diagonal flat screen monitor. The smallest mapping unit was approximately 0.05 acre and most mapped vegetation boundaries are accurate to within approximately five feet. Any vegetation map is subject to imprecision for several reasons:

1. Vegetation types tend to intergrade on the landscape so that there are no true boundaries in the vegetation itself. In these cases, a mapped boundary represents best professional judgment.
2. Vegetation types as they are named and described tend to intergrade; that is, a given stand of real-world vegetation may not fit into any named type in the classification scheme used. Thus, a mapped and labeled polygon is given the best name available in the classification, but this name does not imply that the vegetation unambiguously matches its mapped name.
3. Vegetation tends to be patchy. Small patches of one named type are often included within mapped polygons of another type. The size of these patches varies, depending on the minimum mapping units and scale of available aerial imagery.

Vegetation within the project site consists of riparian and wetland vegetation, upland vegetation, and other land cover types. They are described in detail below and acreages of the vegetation and land cover areas are presented in Table 2 and shown in Figures 4a through 4c (Attachment 1).

Table 2. Vegetation and other cover types on the project site (acres)

Vegetation Type	Project Site (Acres)
Blue elderberry thickets	1.84
Brittle bush scrub	16.57
California live oak woodland and forest	0.38
California sagebrush - black sage scrub	35.87
Fountain grass swards	5.58
Goodding's willow - red willow riparian woodland and forest	21.73
Laurel sumac scrub	6.10
Mulefat thickets	4.47
Upland mustards or star-thistle fields	1.97
Wild oats and annual brome grasslands	3.78
Eucalyptus - tree of heaven - black locust groves	8.29
Other Cover Types	
Open water	174.91
Unvegetated channels and slopes	10.43
Developed	37.67
Total	329.61

Riparian and Wetland Vegetation Types

Goodding's willow - red willow riparian woodland and forest (*Salix gooddingii – Salix laevigata* Forest & Woodland Alliance). Goodding's willow - red willow riparian woodland and forest are a winter deciduous woodland that are dominated by Goodding's willow (*Salix gooddingii*). Additional species such as Pacific willow (*Salix lasiandra*), red willow (*Salix laevigata*), California sycamore (*Platanus racemosa*), and mulefat (*Baccharis salicifolia*) are also present. Goodding's willow - red willow riparian woodland and forest are present along Santiago Creek in the northern portion of the project site and are the dominant cover type in the seasonally inundated portions of Smith Basin. They are also present in isolated locations around Santiago Recharge Basin and are abundant near the earthen overflow channel. Goodding's willow - red willow riparian woodland and forest have a State rank of S3 and are therefore recognized as a sensitive natural community by California Department of Fish and Wildlife (CDFW) (CDFW 2021).

Mulefat thickets (*Baccharis salicifolia* Shrubland Alliance). Mulefat thickets are a winter deciduous shrubland that are dominated by mulefat. Additional species such as oleander (*Nerium oleander*), coyote brush (*Baccharis pilularis*), and shrubby willows (*Salix* spp.) are also present. Mulefat thickets are present along Santiago Creek in the northern portion of the project site and also around the margins of Smith Basin and Santiago Recharge Basin. Mulefat thickets have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland Vegetation Types

Blue elderberry thickets (*Sambucus nigra* ssp. *caerulea* Provisional Shrubland Alliance). Although not defined as a vegetation type in the current online version of *A Manual of California Vegetation*, blue elderberry thickets are present in the project site. This vegetation is dominated by blue elderberry (*Sambucus nigra* ssp. *caerulea*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species. Within the project site coyote brush and Peruvian pepper tree (*Schinus molle*) are also present. Blue elderberry thickets are present in the uplands near Santiago Creek in the northern portion of the project site and in the upland east of the Santiago Creek Basin. Blue elderberry thickets do not have a State Rank and therefore is not recognized as a sensitive natural community by CDFW (CDFW 2021).

Brittle bush scrub (*Encelia farinosa* Shrubland Alliance). Brittle bush scrub is a type of coastal sage scrub vegetation that is dominated by brittle bush (*Encelia farinosa*). Additional species such as coastal sage brush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Salvia mellifera*), giant wild rye (*Elymus condensatus*), and Laurel sumac (*Malosma laurina*) are also present in low numbers. Within the project site it appears that all the brittle bush scrub was planted for mitigation. It is unclear if brittle bush is native to the project site. Brittle bush scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

California sagebrush - black sage scrub (*Artemisia californica - Salvia mellifera* Shrubland Alliance). California sagebrush - black sage scrub is a type of coastal sage scrub that is dominated by coastal sage brush. Within the project site, black sage is uncommon, but the vegetation still matches this description the best. Additional species such as sweetbush (*Bebbia juncea*) and California buckwheat are also present. Within the project site it appears that all the California sagebrush - black sage scrub has been planted for mitigation. California sagebrush - black sage scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Coast live oak woodland and forest (*Quercus agrifolia* Forest & Woodland Alliance). Coast live oak woodland and forest are dominated by coast live oaks (*Quercus agrifolia*). Within the project site, the

coast live oak woodland and forest is limited to several patches along Santiago Creek Channel, in the vicinity of North Flower Street. The understory vegetation includes non-native ornamental species such as Canary ivy (*Hedera canariensis*). Coast live oak woodland and forest have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Eucalyptus - tree of heaven - black locust groves (*Eucalyptus* spp. - *Ailanthus altissima* - *Robinia pseudoacacia* Woodland Semi-Natural Alliance). Eucalyptus - tree of heaven - black locust groves are used to map all vegetation dominated by non-native trees within the project site including gum trees (*Eucalyptus* spp.), Peruvian pepper trees, yew plum pine (*Podocarpus macrophyllus*), prairie sumac (*Rhus lanceolata*), and many others. Native tree species such as California sycamore and coast live oak may also be present but generally represent single trees. Eucalyptus - tree of heaven - black locust groves have a State Rank of SNA (Not Applicable) and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Fountain grass swards (*Pennisetum setaceum* - *Pennisetum ciliare* Herbaceous Semi-Natural Alliance). Fountain grass swards are a non-native grassland dominated by fountaingrass (*Pennisetum setaceum*), a robust perennial bunchgrass. Other non-native species such as gazania (*Gazania linearis*) and mustard (*Hirschfeldia incana*), are also present as well as scattered natives such as desert wishbone bush (*Mirabilis laevis*). Fountain grass swards are present on the large, landscaped slope to the north of Smith Basin and along the eastern slope of the Santiago Recharge Basin. Fountain grass swards have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Laurel sumac scrub (*Malosma laurina* Shrubland Alliance). Laurel sumac scrub is dominated by Laurel sumac (*Malosma laurina*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species such as coastal sage brush and California buckwheat. Additional species such as tamarisk (*Tamarix* sp.) are also present. Laurel sumac scrub is present in the upland surrounding Santiago Creek, Smith Basin, and the Santiago Recharge Basin. Laurel sumac scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland mustards or star-thistle fields (*Brassica nigra* - *Centaurea* (*solstitialis*, *melitensis*) Herbaceous Semi-Natural Alliance). Upland mustards or star-thistle fields are a non-native plant community and within the project site are dominated by black mustard (*Brassica nigra*). Other non-native species are also present including white horehound (*Marrubium vulgare*), tocalote (*Centaurea melitensis*), fennel (*Foeniculum vulgare*), and others. This vegetation type is present in previously disturbed portion of the updates surrounding the Santiago Recharge Basin. Upland mustards or star-thistle fields have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Wild oats and annual brome grasslands (*Avena* spp. - *Bromus* spp. Herbaceous Semi-Natural Alliance). This grassland vegetation is dominated by a variety of non-native grasses such as wild oat (*Avena* spp.), ripgut brome (*Bromus diandrus*), and red brome (*Bromus rubens*). Non-native herbs are also present including Bermuda buttercup (*Oxalis pes-caprae*), fine leaved fumitory (*Fumaria parviflora*), mustard, and others. Wild oats and annual brome grasslands are present in disturbed sites within the project site, especially around the perimeter of the site adjacent to residential development. Wild oats and annual brome grasslands have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Other Land Cover Types

Developed. This cover type includes disturbed and developed areas within the project site including paved roads, unpaved roads, buildings, residential areas, and other unvegetated areas. It also includes a large

area in the central portion of Santiago Recharge Basin that was recently impacted by construction activities. Developed is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Open water. Open water is used to map portions of the project site that had surface water present during early 2022. This included Smith Basin and Santiago Creek Basins. The water depths in these basins changes throughout the year and most of the open water in these basins will eventually become dry in the late summer and fall. Open water is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Unvegetated channels and slopes. This cover type includes flood control channels, unvegetated slopes, and other maintained areas within the project site. Vegetation is either absent or very sparse. Unvegetated channels and slopes is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

3.3 Climate

Climate in the region is temperate, with mild winters and hot, dry summers. Average temperatures near the project site in Anaheim, California include an average low temperature of 56 degrees Fahrenheit and an average high temperature of 78 degrees Fahrenheit. Rainfall is greatest during the months of November through March, with an average annual precipitation total of 13.43 inches (U.S. Climate Data 2022). Rainfall to-date has been below 50 percent of average with approximately 6.15 inches falling in the region since July 2021 (Orange County Public Works 2022).

3.4 Hydrology

Santiago Creek originates more than 15 miles upstream of the project site in the Santa Ana Mountains. Prior to reaching the project site, water enter Santiago Creek from numerous upstream tributaries including Silverado Canyon, Black Star Canyon, and Modjeska Canyon. Santiago Creek then flows through two upstream flood control facilities including the Via Park Dam and Santiago Dam before entering the project site. At the downstream end of the project site, flows from Santiago Creek enter the Santa Ana River and continue downstream approximately 10.5 miles before reaching the Pacific Ocean. The Pacific Ocean is recognized by the USACE as traditional navigable water (TNW) thereby establishing surface connectivity of the project area to navigable waters. Santiago Creek is a direct tributary to the Santa Ana River which is a direct tributary to the Pacific Ocean.

The National Hydrography Dataset (NHD) defines nested hydrologic units, beginning with Regions that are subdivided into subregions, basins, subbasins and watersheds. The project site is located within the South Coast Hydrologic Region of southern California (CDWR 2004). It is also located within the Coastal Plain of Orange County Groundwater Basin which is not further split into sub-regions (CDWR 2004). The project site is located within the larger Santa Ana River Watershed, an area of more than 2,400-square-mile (6,200 km^2). Elevations in the watershed range from 5,687 ft (1,733 m) at Santiago Peak to 108 ft (33 m) at the Santa Ana River confluence.

3.5 Soils and Geology

3.5.1 Soils

Historic soil data from the Natural Resources Conservation Service (NRCS) was used to determine potential soil types, including where hydric soils have historically occurred, in the project site (NRCS 2022).

Figures 3a through 3c (Attachment 1) illustrates the location of historic soil types identified in the project site. Detailed information on elevation ranges, parent material, flooding potential, and drainage classes for each map unit symbol is provided below.

Table 3. Soil units occurring in the project site (acres)

Map Unit Symbol	Map Unit Name	Hydric Soil (Yes or No)	Agency Preferred Alternative (Acres)
132	Botella clay loam, 2 to 9 percent slopes	No	0.08
158	Hueneme fine sandy loam, drained	No	1.60
168	Modjeska gravelly loam, 0 to 2 percent slopes	No	5.23
178	Myford sandy loam, thick surface, 0 to 2 percent slopes	No	0.33
185	Pits	No	83.90
191	Riverwash	No	12.16
194	San Emigdio fine sandy loam, 0 to 2 percent slopes	No	29.80
197	Soboba gravelly loamy sand, 0 to 5 percent slopes	No	10.89
W	Water	No	185.63
		Total	329.61

Botella clay loam, 2 to 9 percent slopes. Botella clay loam soil is found in alluvial fans from the parent material of alluvium derived from sedimentary rock and is well drained soil. It is found in areas with 2 to 9 percent slopes at elevations of about 80 to 1,450 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of clay loam (0 to 8 inches), silty clay loam (8 to 35 inches), and clay loam (35 to 66 inches).

Hueneme fine sandy loam, drained. Hueneme fine sandy loam soil is found in alluvial fans from the parent material of stratified alluvium derived from sedimentary rock and is a poorly drained soil. It is found in areas with 0 to 2 percent slopes at elevations of about 0 to 430 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of cobbly sandy loam (0 to 20 inches), extremely cobbly sand (20 to 24 inches), and bedrock (24 to 39 inches).

Modjeska gravelly loam, 0 to 2 percent slopes. Modjeska gravelly loam contains alluvium derived from mixed parent material between 0 to 2 percent slopes. It is a well-drained soil with more than 80 inches to the water table. The substrate is comprised of gravelly loam (0 to 14 inches), very cobbly loam (14 to 63 inches) and very gravelly loamy sand (63 to 71 inches). It is not a hydric soil.

Myford sandy loam, thick surface, 0 to 2 percent slopes. Myford sandy loam found on terraces containing alluvium and is a moderately well-drained soil. Water table depth is typically more than 80 inches and these areas do not flood. The substrate is composed of sandy loam (0 to 22 inches), sandy clay (22 to 28 inches), sandy clay loam (28 to 38 inches), sandy clay loam (38 to 71 inches), and sandy loam (71 to 70 inches).

Pits. Pits contain parent material of igneous, metamorphic, and sedimentary rock. The substrate is composed of extremely gravelly coarse sand (0 to 6 inches), and very gravelly coarse sand (6 to 60 inches). In general, pits are known to contain a hydric soil rating.

Riverwash. Riverwash soils contains sandy and gravelly alluvium is a well-drained soil. It is found in areas with 0 to 5 percent slopes. Water table depth is typically 0 to 24 inches and subject to flooding. The substrate is comprised of gravelly sand (0 to 6 inches) and stratified gravelly coarse sand to sandy loam (6 to 60 inches). Riverwash does have a hydric soil rating.

San Emigdio fine sandy loam, 0 to 2 percent slopes. San Emigdio fine sandy loam soil that is found in alluvial fans from the parent material of alluvium derived from sedimentary rock and is well drained soil. It is found in areas with 0 to 2 percent slopes at elevations of about 30 to 1,190 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of fine sandy loam (0 to 7 inches) and stratified gravelly loamy coarse sand to fine sandy loam (7 to 61 inches).

Soboba gravelly loamy sand, 0 to 5 percent slopes. Soboba gravelly loamy sand soil is found in alluvial fans derived from sandy and gravelly alluvium derived from mixed sources. It is an excessively drained soil. It is found in areas with 0 to 5 percent slopes at elevations of about 30 to 4,200 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of gravelly loamy sand (0 to 10 inches) and very gravelly sand (10 to 60 inches).

3.5.2 Geology

The dominant geological feature in the Santiago Creek watershed is the Santa Ana Mountains. The northern portion of the mountains, which Santiago Creek drains, is composed of rocks from the pre-Triassic to the Quaternary (about 250 to 2.5 million years ago). These rocks consist primarily of sedimentary rocks such as slate, sandstone, conglomerate, and limestone. The uplift of the Santa Ana Mountains began approximately 5.5 million years ago along the Elsinore Fault Zone, which extends north from near its namesake Lake Elsinore area.

4.0 Regulatory Background

Jurisdictional waters, including some wetlands and riparian habitats, are regulated by the USACE, the Regional Water Quality Control Board (RWQCB), and CDFW. The USACE Regulatory Program regulates activities pursuant to Section 404 of the federal Clean Water Act (33 U.S.C. 1344; CWA); the CDFW regulates activities under the Fish and Game Code Section 1600-1607; and the RWQCB regulates activities under Section 401 of the CWA and the California Porter-Cologne Water Quality Control Act.

4.1 Section 404 of the Clean Water Act

Section 404 of the CWA regulates the discharge of dredged material, placement of fill material, or certain types of excavation within "waters of the U.S." (resulting in more than incidental fallback of material) and authorizes the Secretary of the Army, through the Chief of Engineers, to issue permits for such actions. Permits can be issued for individual projects (individual permits) or for general categories of projects (general permits). "Waters of the U.S." are defined by the CWA as "rivers, creeks, streams, and lakes extending to their headwaters and any associated wetlands." Wetlands are defined by the CWA as "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions." USACE has adopted several revisions to their regulations in order to more clearly define "waters of the U.S." Until the beginning of 2001, "waters of the U.S." included, among other things, isolated wetlands and lakes, intermittent streams, prairie potholes, and other waters that are not part of a tributary system to interstate waters or to navigable "waters of the U.S."

The jurisdictional extent of USACE regulation changed with the 2001 SWANCC (Solid Waste Agency of Northern Cook County) ruling. The U.S. Supreme Court held that the USACE could not apply Section 404 of the CWA to extend their jurisdiction over an isolated quarry pit. The Court ruled that the CWA does not extend Federal regulatory jurisdiction over non-navigable, isolated, intra-state waters. However, the

Court made it clear that non-navigable wetlands adjacent to navigable waters are still subject to USACE jurisdiction.

In 2020, the U.S. Environmental Protection Agency (EPA) updated the CWA and their definition of navigable waters (USACE and USEPA, 2020). The Navigable Waters Protection Rule regulates the nation's navigable waters and the core tributary systems that provide perennial or intermittent flows into these systems. As such, "Waters of the U.S." encompass traditional navigable waters; perennial and intermittent tributaries that contribute surface waters flow to such waters; certain lakes, ponds, and impoundments of jurisdictional waters; and wetlands adjacent to other jurisdictional waters. Based on this ruling, ephemeral waters were not mapped as "Waters of the U.S." In 2021, the EPA and USACE were directed by the Biden Administration and the U.S. District Court to vacate the 2020 Navigable Waters Protection Rule and revert back to the pre-2020 rule. This revision of the Waters of the U.S. rule meant that ephemeral drainages were once again being treated as Waters of the U.S.

On April 6, 2022, the U.S. Supreme Court issued a stay of the 2021 order by the U.S. District Court for the Northern District of California that vacated the EPA's 2020 Clean Water Act Section 401 Certification Rule. Therefore, the CWA section 401 certification process is once again governed by the CWA section 401 certification regulations promulgated by EPA in 2020 (40 CFR 121). On June 1, 2022, the EPA Administrator signed a proposed rule to improve the CWA section 401 certification process. The proposed rule would replace and update the existing regulations at 40 CFR 121, to be more consistent with the statutory text of the 1972 CWA and clarify elements of section 401 certification practice that has evolved over the 50 years since the 1971 regulation was promulgated. On June 9, 2022, the proposed rule was published in the Federal Register (EPA, 2022). Based on a high degree of uncertainly and on-going changes in policy, ephemeral drainages are treated as jurisdictional Waters of the U.S. in this report.

4.2 Porter Cologne Water Quality Control Act and Section 401 of the Clean Water Act

The RWQCBs regulate activities affecting 'waters of the State' according to the Porter-Cologne Water Quality Control Act and Section 401 of the federal CWA. The Porter-Cologne Act defines waters of the State as all surface and subsurface waters. The RWQCBs may issue permits (called Waste Discharge Requirements or WDRs) or may issue a waiver for a given application. In addition, the California Water Resources Control Board (CWRCB) has started to implement a new regulatory program for all waters of the state in 2020 (CWRCB 2019). For non-wetland waters of the state, CWRCB procedures and guidelines recognize the ordinary high-water mark (OHWM) as defined by federal guidelines (CWRCB 2019, 2020; see also USACE 2008a, 2008b) as the limits of jurisdiction. However, waters of the State include isolated waters and need not have downstream surface connection to federally jurisdictional waters. The new program uses the soils, hydrology, and vegetation criteria to identify wetlands, but may define certain unvegetated sites (e.g., mud flats or playas) as wetlands based on only the soils and hydrology criteria. The Project Area is within the jurisdictional boundaries of the Colorado River RWQCB.

Section 401 of the CWA requires that:

> *…any applicant for a Federal permit for activities that involve a discharge to "waters of the State," shall provide the Federal permitting agency a certification from the State in which the discharge is proposed that states that the discharge will comply with the applicable provisions under the Federal Clean Water Act.*

Therefore, before the USACE may issue a Section 404 permit, a permittee must apply for and receive a Section 401 Water Quality Certification from the RQWCB, Colorado River Region. The RWQCB may add conditions to their certification to remove or mitigate potential impacts to water quality standards.

On April 2, 2019, the State Water Resources Control Board (State Water Board) adopted a State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State. The adopted definitions and procedure allow for the presence of hydric substrates as a criterion for wetland identification (not just wetland soils) and wetland hydrology for an area devoid of vegetation (less than 5% cover) to be considered a wetland. Waters of the State were delineated based on the OHWM in the field.

4.4 Section 1602 of the California Fish and Game Code

Section 1602 of the California Fish and Game Code requires any person, State or local governmental agency, or public utility which proposes a project that will substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake, or use materials from a streambed, or result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake, to first notify the CDFW of the proposed project. Notification is generally required for any project that will take place in or in the vicinity of a river, stream, lake, or their tributaries. This includes rivers or streams that flow at least periodically or permanently through a bed or channel with banks that support fish or other aquatic life and watercourses having a surface or subsurface flow that support or have supported riparian vegetation. Based on the notification materials submitted, the CDFW will determine if the proposed project may impact fish or wildlife resources.

If the CDFW determines that a proposed project may substantially adversely affect existing fish or wildlife resources, a Lake or Streambed Alteration Agreement (SAA) will be required. A completed CEQA document must be submitted to CDFW before a SAA will be issued.

5.0 Waters and Wetlands Delineation Methodology

The assessment of jurisdictional wetlands, waters of the United States (U.S.), waters of the State, and other jurisdictional habitats was conducted by Aspen biologists Justin Wood and Jacob Aragon on January 12, 26, and March 3, 2022. Prior to conducting the field assessment Wood reviewed current and historic aerial photographs, the Orange County Soil Survey (NRCS, 2022), and the local and state hydric soil list (NRCS, 2022) to evaluate the potential active channels and wetland features in the project site. Wood also reviewed the National Wetland Inventory (USFWS 2022) and the 2016 wetland plant ratings in the National Wetland Plant List (Lichvar et al., 2016).

Site maps were generated with available aerial photographs and potentially jurisdictional features were identified and marked with lines and global positioning system (GPS) coordinates to assist in field verification. During the field assessment, vegetation and hydrology were mapped using an Arrow GPS unit and identified on aerial photographs (Figures 4 and 5, Attachment 1). Field maps were digitized using Global Information System (GIS) and total state and federal jurisdictional areas were calculated. Representative site photos were captured during the survey and are included in this report (see Attachment 2).

5.1 Wetland Waters of the U.S.

Federal wetlands were delineated using the USACE Wetland Delineation Manual (1987) and the Arid West Supplement (2008) based on three wetland parameters: hydrophytic vegetation, wetland hydrology, and hydric soils. A total of six transects were selected along evenly spaced lines perpendicular to the flow direction of Santiago Creek. Two paired wetland sample locations were assessed along each transect to determine if federal wetlands were present. These wetland sample locations were selected in drainage 2 and 3, which appeared to have the highest potential to support wetland parameters and are shown on Figures 5a (Attachment 1). Drainages 1 and 4 lacked evidence of wetland hydrology and drainage 4 lacked vegetation.

5.2 Non-wetland Waters of the U.S.

Jurisdictional non-wetland waters of the U.S. were delineated based on the limits of the ordinary high-water mark (OHWM) as determined by changes in physical and biological features, such as bank erosion, deposited vegetation or debris, and vegetative characteristics. In the Arid West region, the Ordinary High-Water Mark (OHWM) indicates the limits of high flows in low- to moderate-discharge events (USACE 2006). See Tables 1-1 and 1-2 in Attachment 3 (Federal Non-Wetland and Wetland Waters Indicator Information Potential Geomorphic and Vegetative Indicators of Ordinary High-Water Marks for the Arid West) for a list of key physical features for determining the OHWM identified by the arid west manual. OHWM datasheets were completed for each transect that crossed through the drainages 2 through 4, using the methods described in Curtis and Lichvar (2010) and shown on Figure 5 (Attachment 1).

5.3 RWQCB Waters of the State

RWQCB waters of the state generally match the limits of the waters of the U.S. described above. The RWQCB waters of the state are generally delineated based on the limits of the OHWM as determined by changes in physical and biological features, such as bank erosion, deposited vegetation or debris, and vegetative characteristics. The Santa Ana Regional Water Quality Control Board (SARWQCB) is the state agency responsible throughout the project site.

5.4 CDFW Jurisdictional Waters

CDFW jurisdiction was delineated to the tops of the channel banks or to the edge of the adjacent riparian vegetation, where present. CDFW jurisdictional waters were mapped to the top of the banks which was in the adjacent coastal sage scrub vegetation. CDFW has jurisdiction over a larger area than the federal jurisdiction, therefore the total acreage of CDFW jurisdictional waters and adjacent vegetation generally includes all federally jurisdictional waters, as well as additional adjacent state jurisdictional waters and habitats.

6.0 Results

Three categories of jurisdictional features were documented within the project site: USACE/SARWQCB jurisdictional non-wetland Waters of the U.S./Waters of the State, SARWQCB jurisdictional wetland Waters of the State, and CDFW jurisdictional waters and vegetation (refer to Figures 5a through 5c, Attachment 1). The SARWQCB jurisdictional wetland Waters of the State within the project site are also treated as non-wetland waters of the US with 3 parameter wetland conditions. Recent guidance from the USACE has indicated that federal wetland Waters of the U.S. cannot be present within a defined OHWM. Table 4 and Figure 5 show locations and acreages of jurisdictional features in the project site. Attachment

4 contains the Wetland Determination Data Forms for the Arid West Region and the Arid West Ephemeral and Intermittent Streams OHWM Datasheets that were completed during the assessment. Attachment 5 includes all plants observed on the project site and includes their wetland indicator status. The drainages with jurisdictional features are summarized in Table 4, and descriptions of the drainages follow the table. A complete aquatic resource table is also provided as Attachment 6.

Table 4. Acreage of Jurisdictional Wetland Waters

	USACE/SARWQCB Waters of the U.S./Waters of the State						
Drainage_ID	Area (acres)	Length (ft.)	Data Sheet Number	OHWM vs. Wetland	Cowardin Classification[1]	SARWQCB Wetlands (acres)	CDFW Jurisdiction (acres)[2]
1	--	--	N/A	N/A	R4UB	--	1.93
2	21.22	3,832	Wetland 1 & 2 OHWM 1 & 2	OHWM	R3UB, R3SB	2.30	27.57
3	83.09	4,968	Wetland 3 & 4 OHWM 3 & 4	OHWM	R3UB, L1UB	0.44	88.96
4	88.72	2,967	--	OHWM	L1UB	--	91.63
5	4.53	6,045	OHWM 5 & 6	OHWM	R4SB	--	7.95
Project Total	197.55	17,812	--	--	--	2.74	218.05

Note:
[1] = The dominant Cowardin Classification was used for each sub-drainage.
[2] = CDFW jurisdiction include streambeds, lakebeds, and adjacent vegetation.

- **Drainage 1** – Drainage 1 is a small, isolated water body more than 300 feet away from Santiago Creek. It appears to have historically been a rock quarry and now receives runoff from a very small watershed with two ephemeral channels with clearly defined beds and banks. Because of the isolated nature of this drainage, Waters of the U.S./Waters of the State are not present and instead this drainage falls only under the jurisdiction of CDFW. Drainage 1 is mapped as freshwater forested/shrub wetland (PSSCx) and freshwater pond (PUBHx) in the National Wetland Inventory (USFWS 2022). Riparian vegetation is also present around the perimeter of this isolated drainage.

- **Drainage 2** – Drainage 2 is a perennial portion of Santiago Creek from Canon St. to Villa Park Rd. Santiago Creek flows over bedrock and a series of waterfalls before entering Smith Basin. When Smith Basin is inundated, Santiago Creek is about 1,200 feet long before entering the flooded basin. Under dry conditions, Smith Basin is empty, and flows continue approximate 3,400 feet before going under Villa Park Dr. and entering Santiago Recharge Basin. The full length of Santiago Creek and Smith Basin up to the OHWM is likely to be under the jurisdiction of the USACE and SARWQCB. Waters of the U.S./Waters of the State were also determined to be present throughout Santiago Creek and the low-flow channel within Smith Basin. SARWQCB jurisdictional wetlands were also determined to be present within the OHWM in Santiago Creek and the low-flow channel within Smith Basin. Smith Basin does not inundate for a long enough period to develop extensive wetlands. Drainage 2 is mapped as freshwater forested/shrub wetland (PFOCh and PFCO), lake (L2USKx), and riverine (R4SBC) in the National Wetland Inventory (USFWS 2022). Drainage 2 has a well-established riparian corridor that supports several sensitive bird species and the CDFW jurisdiction extends to the edge of this vegetation.

- **Drainage 3** – Drainage 3 is composed of a perennial basin known as Blue Diamond Pit which forms the northern half of Santiago Recharge Basin. Drainage 3 receives surface flows from Santiago Creek and Smith Basin to the north and Handy Creek to the east. It also receives diverted water

from the Santa Ana River, which is pumped into Bond Pit, seeps into Blue Diamond Pit to the north and under certain conditions can spill into Santiago Creek Channel downstream of the basins. Lastly, a small water recharge release location is also located along the spillway channel and occasionally releases water into the Blue Diamond Pit. A narrow strip of SARWQCB jurisdictional wetlands were mapped near the earthen spillway where water from the recharge release locations makes its way north back into the basin. Except for the channel that flows from Santiago Basin to the spillway, Santiago Recharge Basin has steep slopes and frequent changes in water elevation which does not support development of wetlands. Drainage 3 is mapped as freshwater forested/shrub wetland (PSSCx), lake (L1UBKx and L2USKx), freshwater emergent wetland (PEM1Cx), and riverine (R4SBCx) in the National Wetland Inventory (USFWS 2022). Drainage 3 has a well-established riparian corridor near the spillway that supports several sensitive bird species and the CDFW jurisdiction extends to the edge of this vegetation. Riparian vegetation around the remainder of the basin is sparse and patchy.

- **Drainage 4** – Drainage 4 is composed of a perennial basin known as Bond Pit which forms the southern half of Santiago Recharge Basin. Drainage 4 receives water that is diverted from the Santa Ana River and is pumped through and existing pipeline to Santiago Recharge Basin. Water from Bond Pit seeps north into Blue Diamond Pit and under certain conditions spills into Santiago Creek Channel downstream of the basins. Bond Pit has steep slopes and frequent changes in water elevation which does not support development of wetlands. Bond Pit is mapped as freshwater forested/shrub wetland (PSSCx), and lake (L1UBKx and L2USKx) in the National Wetland Inventory (USFWS 2022).

- **Drainage 5 –** Drainage 4 includes lower Santiago Creek Channel which is an ephemeral channel fed by urban runoff and infrequent releases of water from Santiago Recharge basin. Within the project site, flows in Santiago Creek Channel travel approximately 6,300 feet from Interstate 5 before its confluence with the Santa Ana River. Drainage 4 does not support wetland hydrology or a dominance of hydrophytic vegetation. The channel bottom is composed of coarse gravels and cobbles making hydric soil development unlikely. Santiago Creek Channel has a well-established OHWM and sparse riparian vegetation. Drainage 4 is mapped as riverine (R4SBAx) in the National Wetland Inventory (USFWS 2022).

6.1 Wetland Waters of the U.S.

Based on the field assessment, including the wetland sample locations, no federal wetlands were determined to be present within the project site (see Figure 5, Attachment 1). The assessment did however determine that hydrology, hydric soils, and hydrophytic vegetation were all present in portions of drainage 2 (Smith Basin) and drainage 3 (Santiago Recharge Basin) however these locations were all below the OHWM and are therefore not treated as federal wetlands per recent guidance from the USACE. Wetland hydrology included the presence of surface water and a high ground-water table. Hydric soils were present as indicated by a strong hydrogen sulfur odor and a sandy gleyed-matrix. A dominance of hydrophytic vegetation was also present and includes several species of willow, mulefat, and other wetland and riparian species. The Wetland Determination Data Forms for the Arid West Region are included in Attachment 4.

6.2 Non-wetland Waters of the U.S.

Based on this assessment of OHWMs and Aspen's professional opinion, 197.55 acres of the project site meet the definition of non-wetland Waters of the U.S. as outlined in 33 CFR Part 328 (Table 4 and Figure

5 of Attachment 1). This includes portions of Drainages 2, 3, and 4 as discussed above. Some of the key hydrology indicators noted during the delineation included the indicators listed below. See Tables 3-1 and 3-2 in Attachment 3 for additional information.

- A11 – Scour holes downstream of obstructions
- A16 – Desiccation/med cracks
- B3 – Benches
- B6 – Break in bank slope
- B8 – Change in particle size distribution
- B10 – Exposed root hairs below intact soil layer
- B11 – Silt deposits
- B12 – Litter (organic debris, small twigs and leaves)
- B13 – Drift (organic debris, larger than twigs)
- C8 – Soil development

6.3 RWQCB Waters of the State

Based on this assessment of OHWMs and Aspen's professional opinion, 194.82 acres of the project site meet the definition of non-wetland waters of the State (Table 4 and Figure 5 of Attachment 1). This includes portions of Drainages 2, 3, and 4 as discussed above. An additional 2.73 acres of the project site meet the definition of wetland Waters of the State as described above is Section 6.1 (Table 4 and Figure 5 of Attachment 1).

6.4 CDFW Jurisdictional Waters

Based on this assessment and Aspen's professional opinion, approximately 218.05 acres within the project site meet the definition of CDFW jurisdictional streambeds and adjacent jurisdictional vegetation (Table 4 and Figure 5 of Attachment 1). This includes portions of Drainages 1, 2, 3, and 4 as discussed above. This conclusion is primarily based on the presence of bed and bank and riparian vegetation.

7.0 Summary and Conclusions

The project site includes jurisdictional waters of the U.S. including federally regulated wetlands and non-wetlands, jurisdictional waters of the State, and CDFW jurisdictional streambeds and adjacent jurisdictional vegetation:

- 197.55 acres of jurisdictional non-wetland waters of the U.S. were mapped in portions of the project site that did not meet the hydrophytic vegetation or hydric soils criteria for wetlands but did have evidence of hydrology or a discernible OHWM.
- 194.82 acres of non-wetland Waters of the State and 2.73 acres of wetland Waters of the State were mapped within the project site. The wetlands contained wetland hydrology, hydric soils, and hydrophytic vegetation present.
- 218.05 acres of CDFW jurisdictional streambeds and adjacent jurisdictional vegetation were mapped based on the presence of clearly defined bed and banks and field observations.

The conclusions presented above represent Aspen's professional opinion based on our knowledge and experience with the USACE, SARWQCB, and CDFW, including the applicable regulatory guidance documents and manuals. However, the USACE, SARWQCB, and CDFW have final authority in determining the status and presence of jurisdictional wetlands and waters and the extent of their boundaries.

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Attachment 1 – Figures



Figure 1

Project Overview

August 2022



Figure 2a

Project Site
Smith Basin and Santiago Creek Recharge

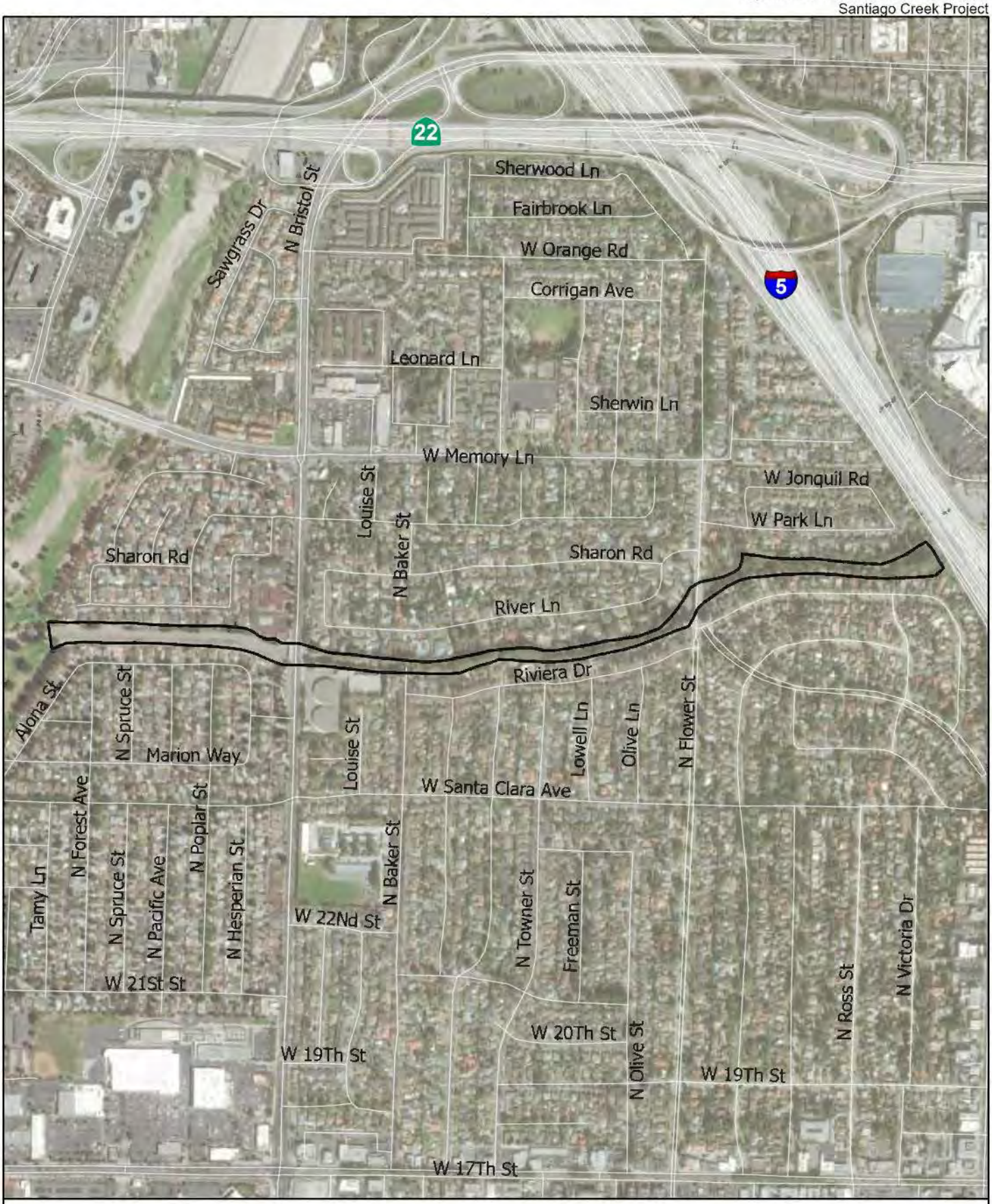


Figure 2b

Project Site
Santiago Creek Channel

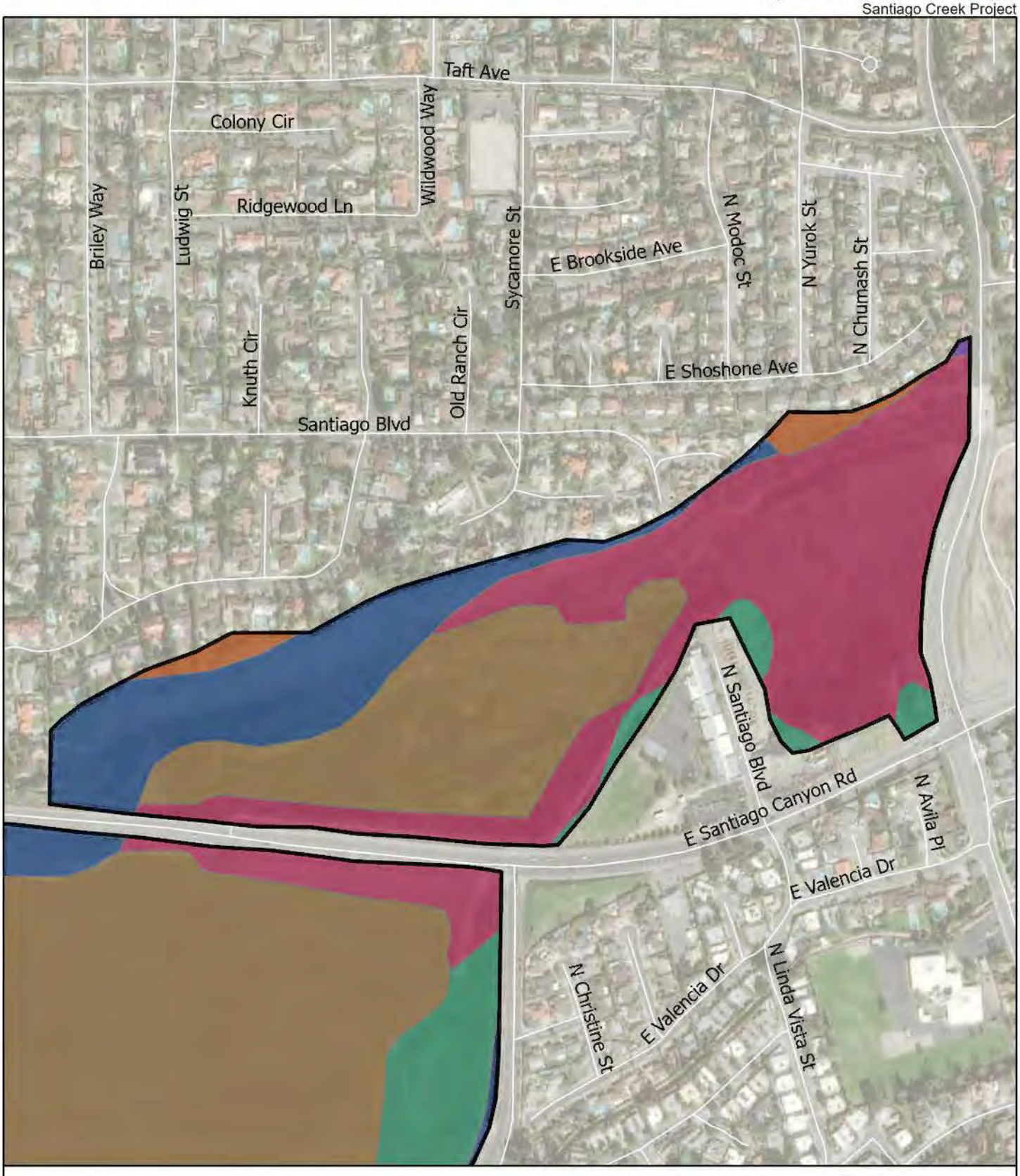


Figure 3a

Soils
Smith Basin

August 2022

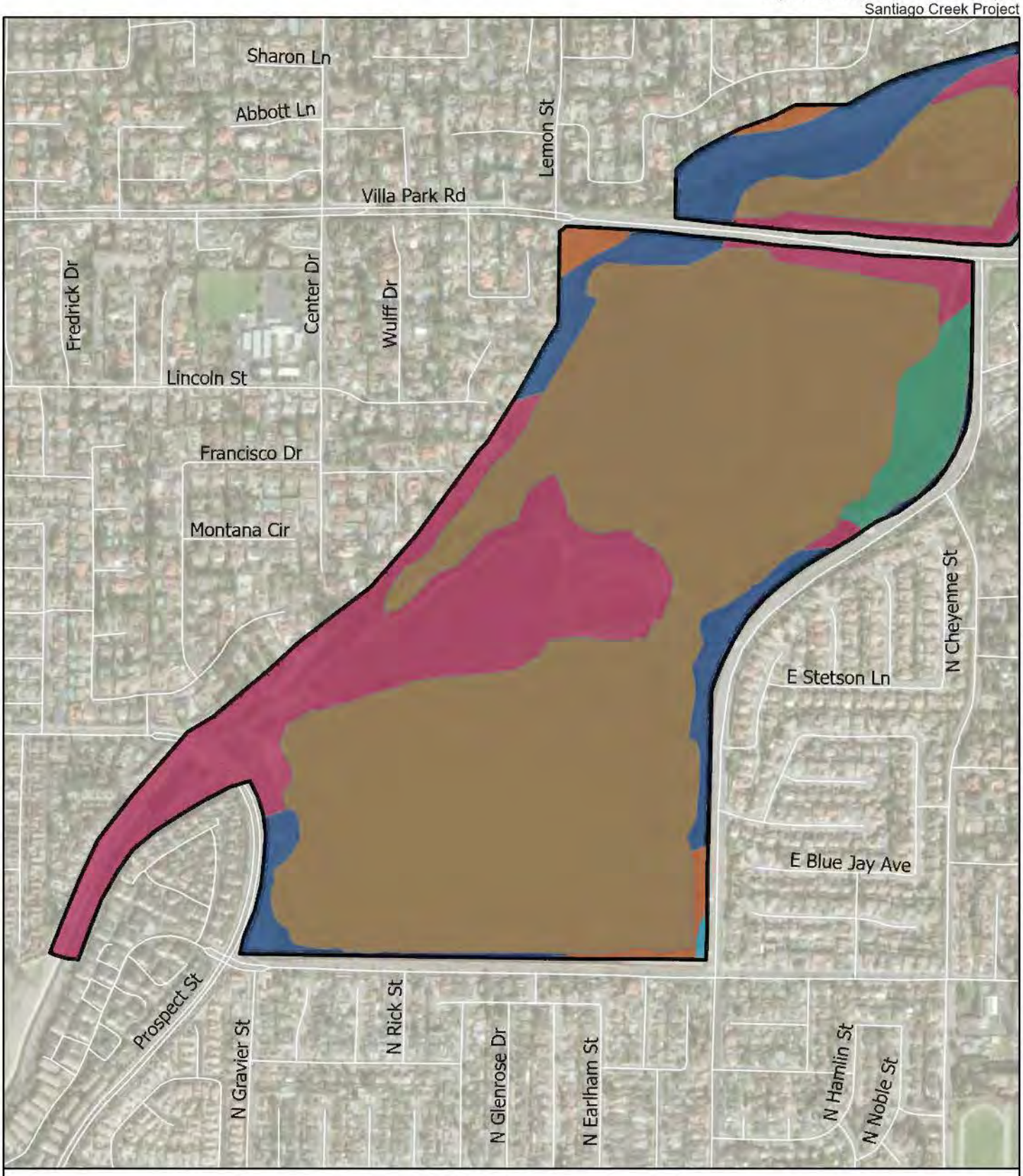


Figure 3b

Soils
Santiago Creek Recharge Basin

August 2022



Figure 3c

Soils
Santiago Creek Channel

August 2022

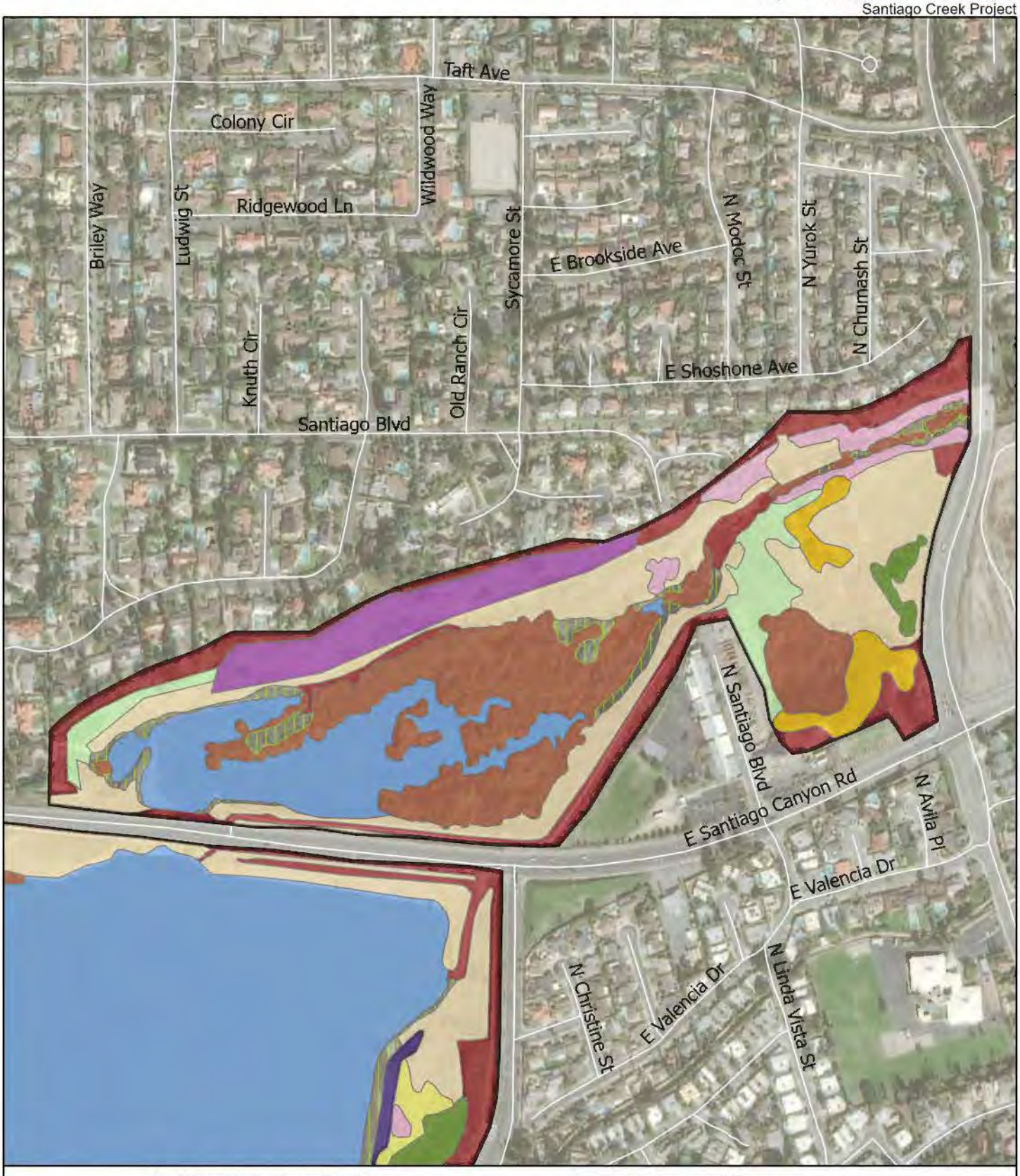


Figure 4a

Vegetation and Land Cover
Smith Basin



Figure 4b

Vegetation and Land Cover
Santiago Creek Recharge



Project Site

Vegetation and Cover Types

- Coast live oak woodland and forest (0.38 acres)
- Developed (37.67 acres)
- Eucalyptus - tree of heaven - black locust groves (8.29 acres)
- Unvegetated channel and slopes (10.43 acres)

N

0 500 1,000 Feet

Figure 4c

Vegetation and Land Cover
Santiago Creek Channel

August 2022

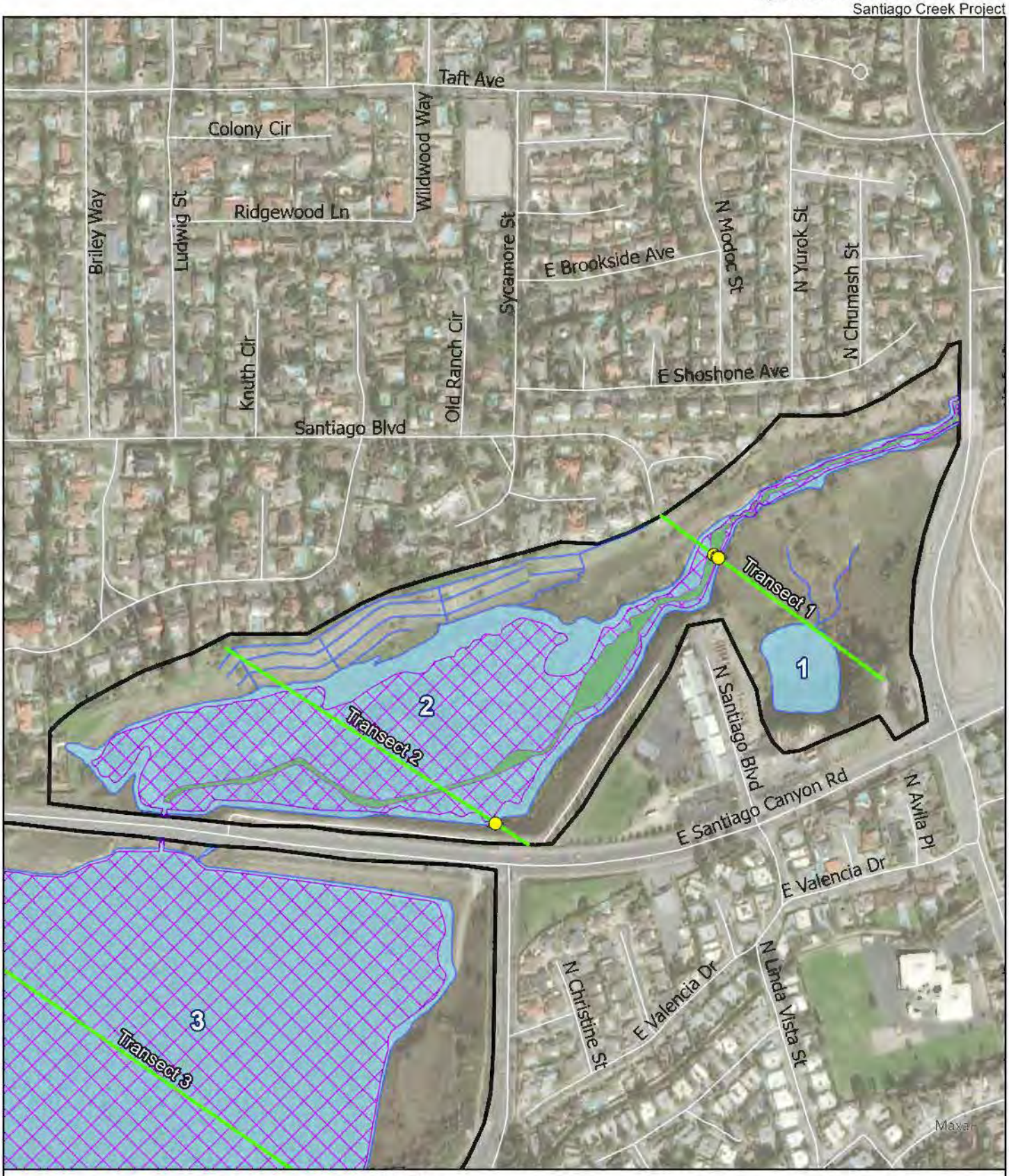


Figure 5a

Aquatic Resources Delineation Map
Smith Basin

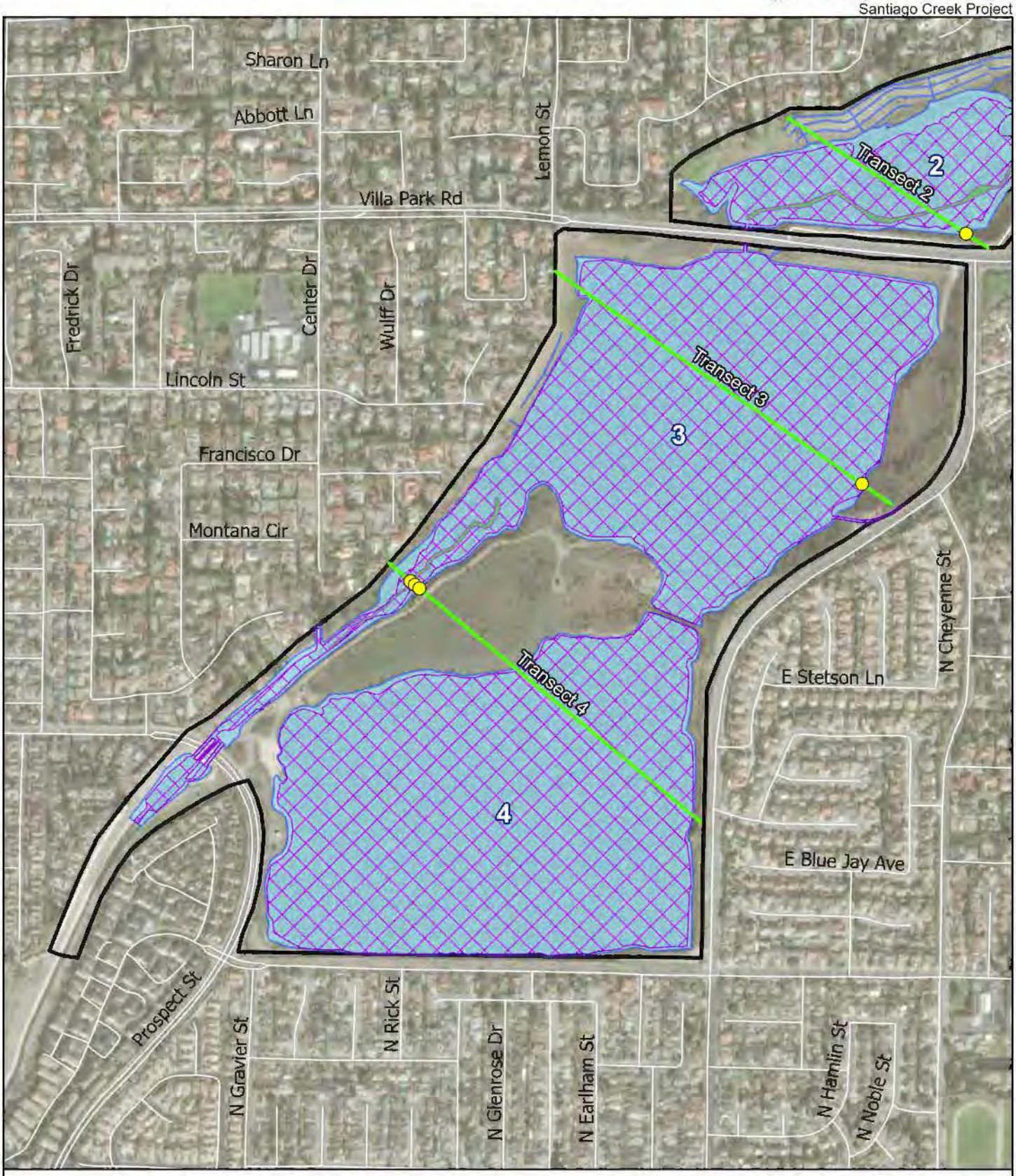
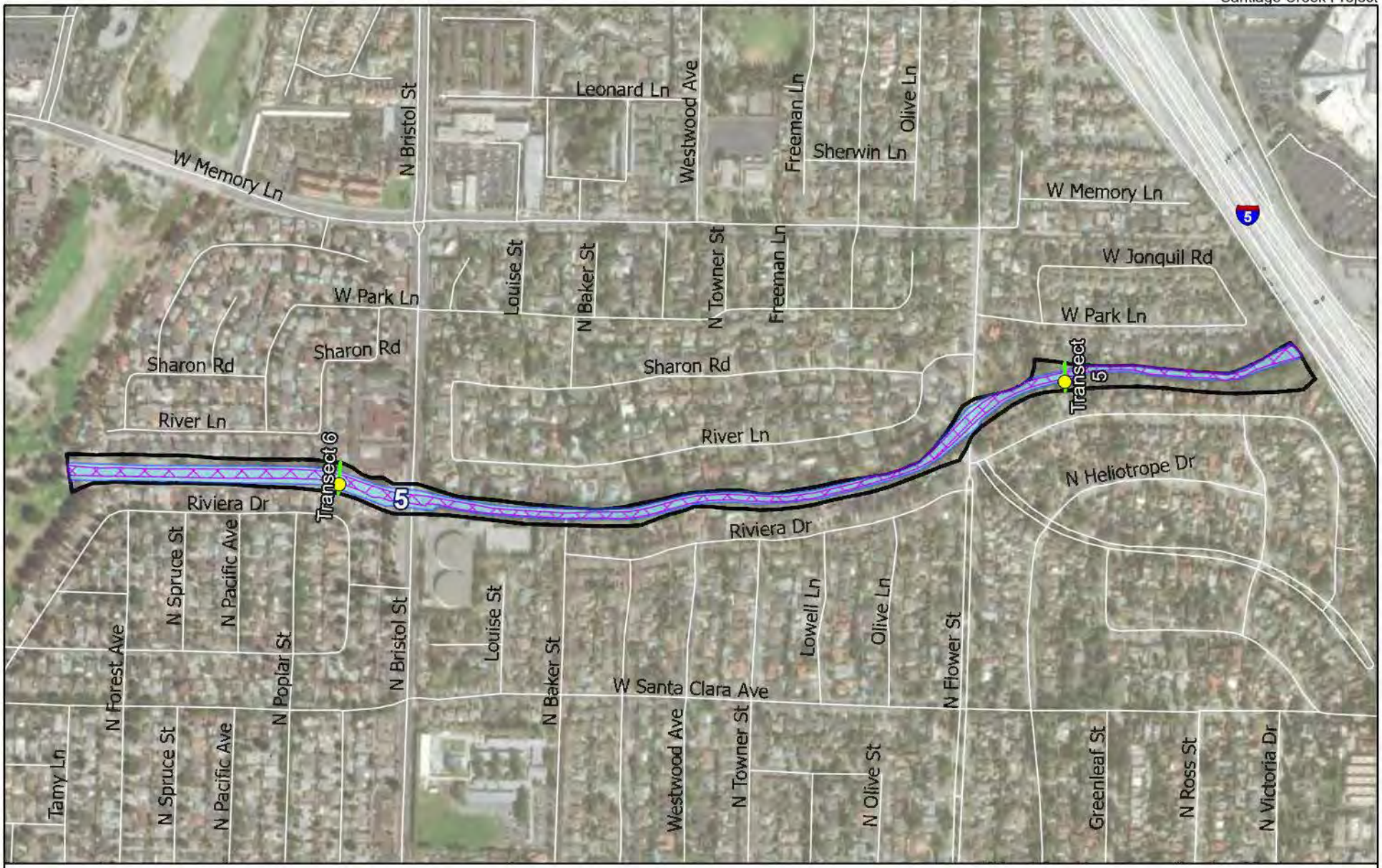


Figure 5b

Aquatic Resources Delineation Map
Santiago Creek Recharge Basin



Jurisdiction

- Project Site
- Transects
- Sample Locations
- CDFW Jurisdictional Waters and Vegetation (218.05 acres)
- USACE Waters of the U.S./ SARWQCB Waters of the State (194.82 acres)

0 500 1,000 Feet

Figure 5c

Aquatic Resources Delineation Map
Santiago Creek Channel

August 2022

Attachment 2 – Photo Exhibit



Photo 1: Close-up photos of dense riparian vegetation within drainage 1.



Photo 2: Water cascading over bedrock near the central portion of Santiago Creek (drainage 2).



Photo 3: Close-up view of SARWQCB wetlands at the upstream end of Santiago Creek (drainage 2), near Cannon Street.



Photo 4: Rock waterfall near the central portion of Santiago Creek (drainage 2).



Photo 5: Rock pool near the central portion of Santiago Creek (drainage 2).



Photo 6: East-facing overview of Smith Basin (drainage 2).



Photo 7: Close-up view of wetland sample location #1 within Santiago Creek (drainage 2).



Photo 8: Overview of recently constructed land bridge between the Blue Diamond and Bond Pits within Santiago Recharge Basin (drainage 3).



Photo 9: Close-up view of SARWQCB wetlands near the spillway within Santiago Recharge Basin (drainage 3).



Photo 10: Close-up view of SARWQCB wetlands near the spillway within Santiago Recharge Basin (drainage 3).



Photo 11: North-facing view of the existing outlet channel of drainage 3 and the undercrossing of E Collins Ave.



Photo 12: West-facing view of Handy Creek near the northeast corner of Santiago Recharge Basin (drainage 3).



Photo 13: West-facing view of the upstream portion of Santiago Creek Channel (drainage 4).



Photo 14: West-facing view of the downstream portion of Santiago Creek Channel (drainage 4).



Photo 15: East-facing view of the downstream portion of Santiago Creek Channel (drainage 4).



Photo 16: East-facing view of the central portion of Santiago Creek Channel (drainage 4).

Attachment 3 – Federal Non-wetland and Wetland Water Indicator Information

Table 1. Potential Geomorphic Indicators of Ordinary High-Water Marks for the Arid West

(A) Below OHW	(B) At OHW	(C) Above OHW
1. In-stream dunes	1. Valley flat	1. Desert pavement
2. Crested ripples	2. Active floodplain	2. Rock varnish
3. Flaser bedding	3. Benches: low, mid, most prominent	3. Clast weathering
4. Harrow marks	4. Highest surface of channel bars	4. Salt splitting
5. Gravel sheets to rippled sands	5. Top of point bars	5. Carbonate etching
6. Meander bars	6. Break in bank slope	6. Depositional topography
7. Sand tongues	7. Upper limit of sand-sized particles	7. Caliche rubble
8. Muddy point bars	8. Change in particle size distribution	8. Soil development
9. Long gravel bars	9. Staining of rocks	9. Surface color/tone
10. Cobble bars behind obstructions	10. Exposed root hairs below intact soil layer	10. Drainage development
11. Scour holes downstream of obstructions	11. Silt deposits	11. Surface relief
12. Obstacle marks	12. Litter (organic debris, small twigs and leaves)	12. Surface rounding
13. Stepped-bed morphology in gravel	13. Drift (organic debris, larger than twigs)	
14. Narrow berms and levees		
15. Streaming lineations		
16. Desiccation/mud cracks		
17. Armored mud balls		
18. Knick Points		

Table 2. Potential Vegetation Indicators of Ordinary High-Water Marks for the Arid West

	(D) Below OHW	(E) At OHW	(F) Above OHW
Hydroriparian indicators	1. Herbaceous marsh species 2. Pioneer tree seedlings 3. Sparse, low vegetation 4. Annual herbs, hydromesic ruderals 5. Perennial herbs, hydromesic clonals	1. Annual herbs, hydromesic ruderals 2. Perennial herbs, hydromesic clonals 3. Pioneer tree seedlings 4. Pioneer tree saplings	1. Annual herbs, xeric ruderals 2. Perennial herbs, non-clonal 3. Perennial herbs, clonal and non-clonal co-dominant 4. Mature pioneer trees, no young trees 5. Mature pioneer trees w/upland species 6. Late-successional species
Mesoriparian Indicators	6. Pioneer tree seedlings 7. Sparse, low vegetation 8. Pioneer tree saplings 9. Xeroriparian species	5. Sparse, low vegetation annual herbs, hydromesic 6. ruderals 7. Perennial herbs, hydromesic clonals 8. Pioneer tree seedlings 9. Pioneer tree saplings 10. Xeroriparian species 11. Annual herbs, xeric ruderals	7. Xeroriparian species 8. Annual herbs, xeric ruderals 9. Perennial herbs, non-clonal 10. Perennial herbs, clonal and non-clonal codominant 11. Mature pioneer trees, no young trees 12. Mature pioneer trees, xeric understory 13. Mature pioneer trees w/upland species 14. Late-successional species 15. Upland species
Xeroriparian indicators	10. Sparse, low vegetation 11. Xeroriparian species 12. Annual herbs, xeric ruderals	12. Sparse, low vegetation 13. Xeroriparian species 14. Annual herbs, xeric ruderals	16. Annual herbs, xeric ruderals 17. Mature pioneer trees w/upland species 18. Upland species

Table 3. Summary of Wetland Indicator Status

Category		Probability
Obligate Wetland	OBL	Almost always occur in wetlands (estimated probability >99%)
Facultative Wetland	FACW	Usually occur in wetlands (estimated probability of 67–99%)
Facultative	FAC	Equally likely to occur in wetlands/non-wetlands (estimated probability of 34–66%)
Facultative Upland	FACU	Usually occur in non-wetlands (estimated probability 67–99%)
Obligate Upland	UPL	Almost always occur in non-wetlands (estimated probability >99%)
Non-Indicator	NI	No indicator status has been assigned

Source: Reed, 1988

Table 4. Wetland Hydrology Indicators*

Primary Indicators	Secondary Indicators
Watermarks	Oxidized Rhizospheres Associated with Living Roots
Water-Borne Sediment Deposits	FAC-Neutral Test
Drift Lines	Water-Stained Leaves
Drainage Patterns Within Wetlands	Local Soil Survey Data

*Table adapted from 1987 USACE Manual and Related Guidance Documents.

Table 5. Wetland Hydrology Indicators for the Arid West*

	Primary Indicator (any one indicator is sufficient to determine that wetland hydrology is present)	Secondary Indicator (two or more indicators are required to determine that wetland hydrology is present)
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface Water	X	
A2 – High Water Table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water Marks	**X** (Non-riverine)	**X** (Riverine)
B2 – Sediment Deposits	**X** (Non-riverine)	**X** (Riverine)
B3 – Drift Deposits	**X** (Non-riverine)	**X** (Riverine)
B6 – Surface Soil Cracks	X	
B7 – Inundation Visible on Aerial Imagery	X	
B9 –Water-Stained Leaves	X	
B10 – Drainage	X	X
B11 – Salt Crust	X	
B12 – Biotic Crust	X	
B13 – Aquatic Invertebrates	X	
Group C – Evidence of Current or Recent Soil Saturation		
C1 – Hydrogen Sulfide Odor	X	
C2 – Dry-Season Water Table		X
C3 – Oxidized Rhizospheres along Living Roots	X	
C4 – Presence of Reduced Iron	X	
C6 – Recent Iron Reduction in Tilled Soils	X	

Table 5. Wetland Hydrology Indicators for the Arid West*

	Primary Indicator (any one indicator is sufficient to determine that wetland hydrology is present)	Secondary Indicator (two or more indicators are required to determine that wetland hydrology is present)
C7 – Thin Muck Surface	X	
C8 – Crayfish Burrows		X
C9 – Saturation Visible on Aerial Imagery		X
Group D – Evidence from other Site Conditions or Data		
D3 – Shallow Aquitard		X
D5 – FAC-Neutral Test		X

*Table adapted from Regional Supplement to the USACE of Engineers Wetland Delineation Manual: Arid West Region, Version 2.0.

Table 6. Field Indicators of Hydric Soil Conditions*

1. Indicators of Historical Hydric Soil Conditions	2. Indicators of Current Hydric Soil Conditions
a. Histosols b. Histic epipedons; c. Soil colors (e.g., gleyed or low-chroma colors, soils with bright mottles (Redoximorphic features) and/or depleted soil matrix d. High organic content in surface of sandy soils e. Organic streaking in sandy soils f. Iron and manganese concretions g. Soil listed on county hydric soils list	a. Aquic or peraquic moisture regime (inundation and/or soil saturation for *7 continuous days) b. Reducing soil conditions (inundation and/or soil saturation for *7 continuous days) c. Sulfidic material (rotten egg smell)

*Table adapted from 1987 USACE Manual and Related Guidance Documents.

Table 7. Hydric Soil Indicators for the Arid West*

Hydric Soil Indicators			Hydric Soil Indicators for Problem Soils**
All Soils	Sandy Soils	Loamy and Clay Soils	
A1 – Histosol	S1 – Sandy Mucky Mineral	F1 – Loamy Mucky Mineral	A9 – 1 cm Muck
A2 – Histic Epipedon	S4 – Sandy Gleyed Matrix	F2 – Loamy Gleyed Matrix	A10 – 2 cm Muck
A3 – Black Histic	S5 – Sandy Redox	F3 – Depleted Matrix	F18 – Reduced Verti
A4 – Hydrogen Sulfide	S6 – Stripped Matrix	F6 – Redox Dark Surface	TF2 – Red Parent Material
A5 – Stratified Layers	—	F7 – Depleted Dark Surface	Other (See Section 5 of Regional Supplement, Version 2.0)
A9 – 1 cm Muck	—	F8 – Redox Depressions	—
A11 – Depleted Below Dark Surface	—	F9 – Vernal Pools	—
A12 – Thick Dark Surface	—	—	—

* Table adapted from Regional Supplement to the USACE of Engineers Wetland Delineation Manual: Arid West Region, Version 2.0.

** Indicators of hydrophytic vegetation and wetland hydrology must be present

Attachment 4 – Arid West OHWM and Wetland Determination Data Sheets

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Santiago Creek City/County: Orange/Orange County Sampling Date: 1/26/2022

Applicant/Owner: U.S. Army Corps of Engineers State: CA Sampling Point: Wetland #1

Investigator(s): Justin Wood, Jacob Aragon Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Canyon Local relief (concave, convex, none): Concave Slope (%): 8

Subregion (LRR): Mediterranean California Lat: 33.813282 Long: -117.798409 Datum: WGS84

Soil Map Unit Name: Pits NWI classification: Riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil ✔, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks:

Bedrock is preventing hydric soil development, clear indicators of wetlands present.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m x 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 5m x 1m)			
1. Baccharis salicifolia	30	Yes	FAC
2. Salix gooddingii	12	Yes	FACW
3.			
4.			
5.			
	42 = Total Cover		
Herb Stratum (Plot size: 1m x 1m)			
1. Pulicaria paludosa	30	Yes	FAC
2. Typha latifolia	15	Yes	OBL
3. Nasturtium officinale	5	No	OBL
4. Foniculum vulgare	5	No	NL
5.			
6.			
7.			
8.			
	55 = Total Cover		
Woody Vine Stratum (Plot size: 5m x 1m)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 85 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species 20	x 1 = 20
FACW species 12	x 2 = 24
FAC species 60	x 3 = 180
FACU species	x 4 =
UPL species	x 5 =
Column Totals: 92 (A)	224 (B)

Prevalence Index = B/A = 2.43

Hydrophytic Vegetation Indicators:

✔ Dominance Test is >50%

✔ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks:

Extenisve bedrock, vegetation growing on small soil accumulations.

SOIL

Sampling Point: Wetland #1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-8	7.5YR 3/1	100					Sandy Loar	Shallow soil over bedrock.

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ✔ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Bedrock

Depth (inches): 8

Hydric Soil Present? Yes ____ No ✔

Remarks:

Bedrock is problemmatic and preventing hydric soil development. All other parameters show strong wetland indicators.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✔ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ✔ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ✔ Sediment Deposits (B2) (**Riverine**)
- ✔ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✔ No ____ Depth (inches): ____

Water Table Present? Yes ____ No ____ Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No ____ Depth (inches): ____

Wetland Hydrology Present? Yes ✔ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETL N ETERMIN TION T FORM – id West Region

Pr ject/Site: Santiago Cr k D City/C unty: Orang /Orang County D Sam pling Date: / 6/ 0

A licant/Owner: U.S. Army Corp o ngin r State: CA Sam pling P int: Wetland #2

Inve tigat r( ): Ju tin Woo , Jacob Aragon D Secti n, T wn hi , Range: N/A

Land rm (hill l e, terrace, etc.): Canyon D L cal relie (c ncave, c nvex, n ne): Concave D Sl e (%): 8

Subregi n (LRR): Mediterranean California D Lat: 33.813257 D L ng: -117.798366 D Datum: WGS84

S il Ma Unit Name: Pits D NWI cla i icati n: Riverine D

Are climatic / hydr l gic c nditi n n the ite ty ical r thi time year? Ye ✔ N _____ (I n , ex lain in Remark .)

Are Vegetati n _____, S il _____, r Hydr l gy _____ igni icantly di turbed? Are "N rmal Circum stance " re ent? Ye ✔ N D_____

Are Vegetati n _____, S il _____, r Hydr l gy _____ naturally r blematic? (I needed, ex lain any an wer in Remark .)

SUMMARY OF FIN INGS – Attach site map showing sampling point locations, transects, important features, etc. D

Hydr hytic Vegetati n Pre ent?	Ye _____	N ✔	**Is the Sampled Area within a Wetland?**	**Yes** _____ **No D** ✔
Hydric S il Pre ent?	Ye _____	N ✔		
Wetland Hydr l gy Pre ent?	Ye _____	N ✔		

Remark :

Adjacent to sample location Wetland #1, approximately three feet beyond surface flows.

VEGETATION – Use scientific names of plants.

Tree Stratum (Pl t ize: 5m x 5m)	Ab lute % C ver	D minant S ecie ?	Indicat r Statu
1. Malosma laurina	5	Yes	NL
2.			
3.			
4. D			
D	_____ = T Dtal C Dver		
Sa Dling/Sh Dub St Dtratum D(Pl DDDze: D 5m x 1 Dm D)			
1. Encelia d Dalifornid D D	70 D	Yes D D	NL DD
2. Bacd Dharis salicifolia D	5 D	No DD	FA DD
3.			
4.			
5. D			
	75 D = T Dtal C Dver		
He Db St Dtratum D(Pl DDDze: D 1m x 1m D)			
1.			
2.			
3.			
4. D			
5.			
6.			
7.			
8. D			
D	_____ = T Dtal C Dver		
Wo Dy V Dne St Dtratum D(Pl DDDze: D 5m x 1m D)			
1.			
2. D			
D D	_____ = T Dtal C Dver		
% Ba DeDr und in D Be Db St Dtratum D 100 D	% C Dver DBi DDDCrD D D D0 D		

ominance Test worksheet:

Number D minant S ecie That Are OBL, FA DCW, r FAC: 1 D (A) D

T tal Nu Dnber DD Dminan Dt S Decie D A D D All D St Ddata: D 2 (B) D

Pe Dcent DD Dminant S Decie D That Are D OBL, FA DDDW, r FA DDDD D 50 D (A/B) D

Pr Dvalence D Index DD Worksh Dt:

T Dtal % C Dver D D Multi lyDby: D

OBL D ecie _____ x 1 = _____

FA DCW D ecie D DD _____ x 2 = _____

FAC D ecie D D _____ x 3 = D _____

FA DDDDD ecie D D _____ x 4 = _____

UP DD D ecie D D _____ x 5 = D _____

C Dlumn T Dtal : DD _____ (A) DD D (B) D

Pr Dvalence I Dndex = B/A = D DD

Hy Dr Dp Dy Dic Ve Dgetation DD Dd Dicators: D

___ D Dminan De Te DDDi s 50% D

___ Pr Dvalence Index i s 3.0[1]

___ M Dr Dp Dy D Dgical Ada Dtati Dn [1] (Pr DDvide Du D rting data in Re Dmark D r D n a e D arate D heet)

___ Pr DDblematic Hy Dr Dphytic Ve Dgetati n D (D plain)

[1]Indicat rDD hydric D l and D ve Dland hydr l Dgy mu t be p e Dent, unle D di t Dbed r D n DDblematic.

Hy Dr Dp Dy Dic Ve Dgetation Pr Dsent? DDD Yes D _____ No DD ✔

Re Dmark D

Qu Dck D ransition to upland vegetation dominated by Encelia california and Malosma laurina, both upland spe Dies. D

SOIL

Sampling Point: Wetland #2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Feature Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	5YR 3/2	100					Sandy loam	Shallow soil over bedrock.

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ✔ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Bedrock

Depth (inches): 3

Hydric Soil Present? Yes ___ No ✔

Remarks

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicator (minimum one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicator (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches):

Water Table Present? Yes ___ No ✔ Depth (inches):

Saturation Present? Yes ___ No ✔ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Santiago Creek City/County: Orange/Orange County Sampling Date: 1/26/2022

Applicant/Owner: U.S. Army Corps of Engineers State: CA Sampling Point: Wetland #3

Investigator(s): Justin Wood, Jacob Aragon Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Basin Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): Mediterranean California Lat: 33.804804 Long: -117.811527 Datum: WGS84

Soil Map Unit Name: Water NWI classification: Lake

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔	No _____	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m x 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix gooddingii	60	Yes	FAC
2.			
3.			
4.			
	60 = Total Cover		
Sapling/Shrub Stratum (Plot size: 5m x 1m)			
1. Baccharis salicifolia	20	Yes	FAC
2.			
3.			
4.			
5.			
	20 = Total Cover		
Herb Stratum (Plot size: 1m x 1m)			
1. Cyperus eragrostis	5	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 95 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

✔ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks:

SOIL

Sampling Point: Wetland #3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	7.5 YR 3/2						Sandy Loai	
4-12	GLEY 1 4/10BG						Sandy Loai	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ✔ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ✔ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✔ Surface Water (A1)
- ___ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ✔ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ✔ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✔ No ___ Depth (inches): _____

Water Table Present? Yes ✔ No ___ Depth (inches): 4

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): _____

Wetland Hydrology Present? **Yes** ✔ **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Santiago Creek City/County: Orange/Orange County Sampling Date: 1/26/2022

Applicant/Owner: U.S. Army Corps of Engineers State: CA Sampling Point: Wetland #4

Investigator(s): Justin Wood, Jacob Aragon Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Basin Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): Mediterranean California Lat: 33.804751 Long: -117.811446 Datum: WGS84

Soil Map Unit Name: Water NWI classification: Lake

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m x 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix gooddingii	10	Yes	FAC
2.			
3.			
4.			
	10 = Total Cover		
Sapling/Shrub Stratum (Plot size: 5m x 1m)			
1. Baccharis salicifolia	30	Yes	FAC
2.			
3.			
4.			
5.			
	30 = Total Cover		
Herb Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

✔ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks:

SOIL

Sampling Point: Wetland #4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-11	7.5 YR 3/1						Sandy Loar	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

Located on elevated lakebed, several feet above the surface water.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Aragon

Date: 1/26/2022 **Time:** 08:30
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
Santiago Creek 1,150 ft. downstream of Cannon St.

Projection: **Datum:** WGS84
Coordinates: 33.813248, -117.798351

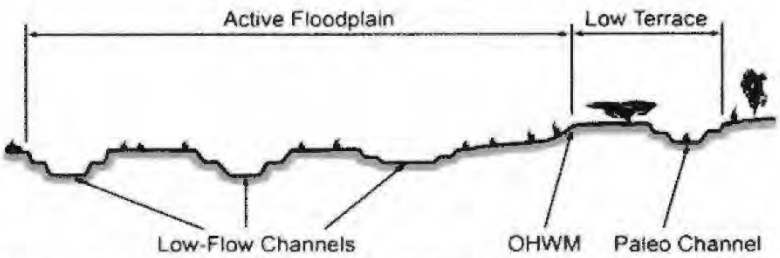
Potential anthropogenic influences on the channel system:
None

Brief site description:
Santiago Creek just downstream of narrow channel as creek tumbles down bedrock before entering Smith Basin.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/85 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

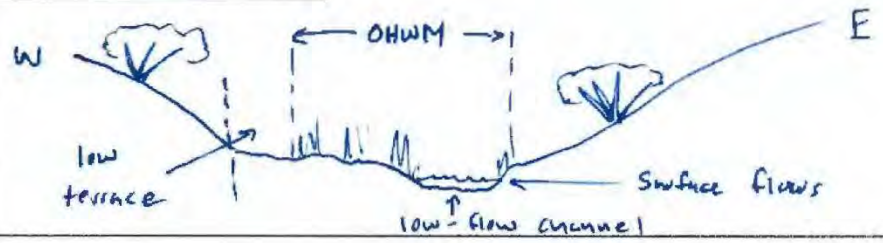


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** #1 **Date:** 1/26/2022 **Time:** 0830

Cross section drawing:



OHWM

GPS point: 33.813248, -117.798351

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Clear change in veg. composition and cover percent.

Floodplain unit: [ ] Low-Flow Channel [x] Active Floodplain [ ] Low Terrace

GPS point: 33.813273, -117.798376

Characteristics of the floodplain unit:

Average sediment texture: Bedrock

Total veg cover: 5 % Tree: 0 % Shrub: 0 % Herb: 5 %

Community successional stage:

- [ ] NA
- [x] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [x] Other: Scoured bedrock
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** # 1 **Date:** 1/26/2022 **Time:** 0830

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 33.813309, -117.798437

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 30 % Tree: 0 % Shrub: 25 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☐ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Aragon

Date: 1/26/2022 **Time:** 0930
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y ☐ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☐ Is the site significantly disturbed?

Location Details:
Smith Basin upstream of Villa Park Rd.

Projection: **Datum:**
Coordinates: 33.810437, -117.801098

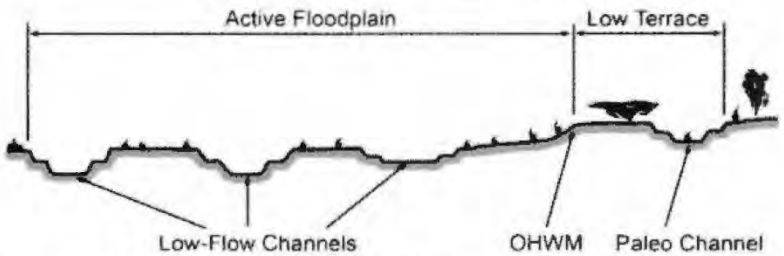
Potential anthropogenic influences on the channel system:
Smith Basin is an anthropogenic feature constructed for flood control. Villa Park Rd. is restricting flows.

Brief site description:
Smith Basin, fed by Santiago Creek and discharges into Santiago Recharge Basin on south side of Villa Park Rd.

Checklist of resources (if available):

- ☒ Aerial photography
  Dates: 12/05 – 3/21
- ☒ Topographic maps
- ☒ Geologic maps
- ☒ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☐ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  Gage number:
  Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

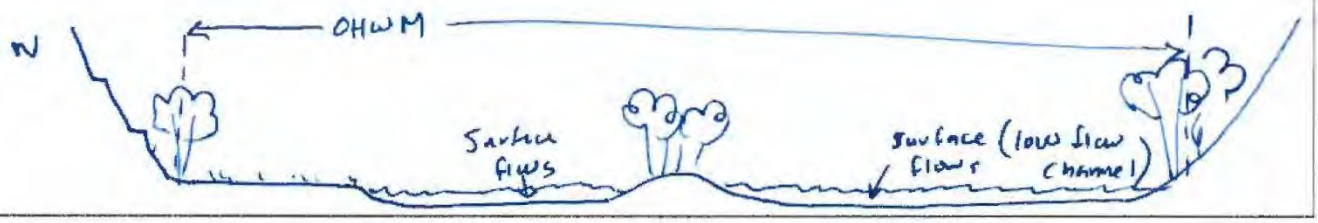


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☒ Digitized on computer
   - ☐ GPS
   - ☐ Other:

Project ID: 3556.001 **Cross section ID:** #2 **Date:** 1/26/22 **Time:** 0930

Cross section drawing:



OHWM

GPS point: 33.810437, -117.801098

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☒ Active Floodplain ☐ Low Terrace

GPS point: 33.810990, -117.802135

Characteristics of the floodplain unit:

Average sediment texture: Silt

Total veg cover: 20 % Tree: 20 % Shrub: 0 % Herb: 0 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [x] Other: Inundated at time of survey
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** #2 **Date:** 1/26/22 **Time:** 0930

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 33.811764, -117.803594

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 50 % Tree: 0 % Shrub: 40 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Arago

Date: 1/26/22 **Time:** 1045
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [X] / N [X] Is the site significantly disturbed?

Location Details:
Santiago Basin, South of Villa Park Rd.
Projection: **Datum:** WGS 84
Coordinates: 33.806475, -117.802989

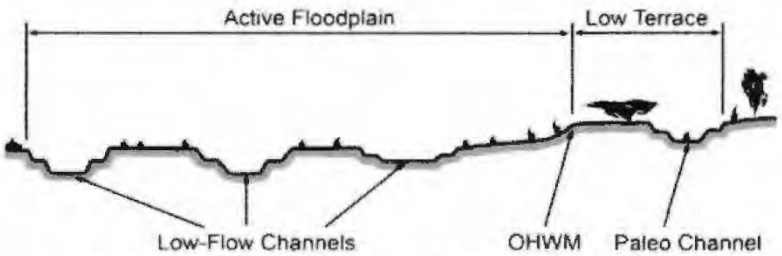
Potential anthropogenic influences on the channel system:
Santiago Basin is old quarry. Extensive modifications to the system have been made.

Brief site description:
Santiago Basin, South of Villa Park Rd., West of Hewes St, north of Bond Ave.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/05 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
- [ ] History of recent effective discharges
- [ ] Results of flood frequency analysis
- [ ] Most recent shift-adjusted rating
- [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

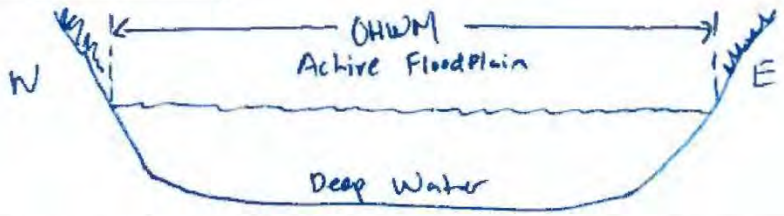


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** # 3 **Date:** 1/26/22 **Time:** 1045

Cross section drawing:



OHWM

GPS point: 33.806475, -117.802989

Indicators:

- ☐ Change in average sediment texture
- ☒ Change in vegetation species
- ☒ Change in vegetation cover
- ☐ Break in bank slope
- ☒ Other: clear line from regular inundation
- ☐ Other: _____

Comments:

Due to the steep walls of the reservoir and difficult access, additional data is not provided for ID # 3.

Floodplain unit:

☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____% Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Aragon

Date: 1/26/2022 **Time:** 1135
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [X] / N [ ] Is the site significantly disturbed?

Location Details:
Santiago Basin, South of Villa Park Rd.

Projection: **Datum:** WGS84
Coordinates: 33.804703, -117.811349

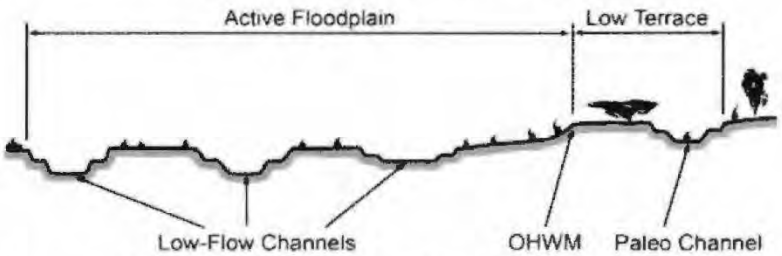
Potential anthropogenic influences on the channel system:
Santiago Basin is an anthropogenic feature. It is routinely maintained and was previously a rock quarry.

Brief site description:
Santiago Basin south of Villa Park Rd., west of Hewes St.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/85 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

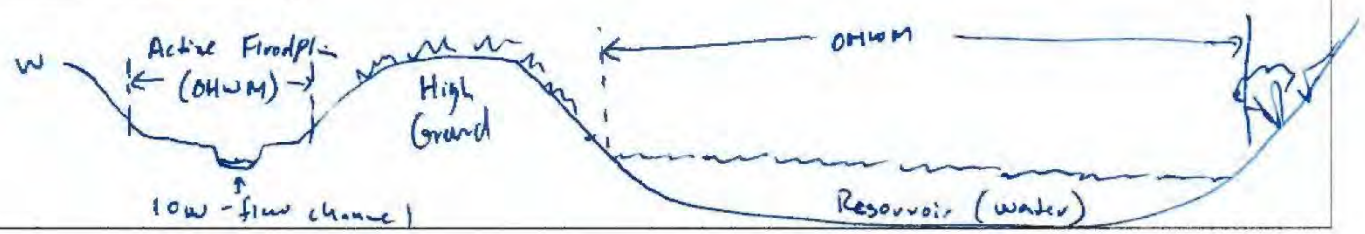


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** #4 **Date:** 1/26/22 **Time:** 1135

Cross section drawing:



OHWM

GPS point: 33.804703, -117.811349

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

clearly defined OHWM because of frequent inundation.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: 33.804824, -117.811510

Characteristics of the floodplain unit:

Average sediment texture: Silt

Total veg cover: 80 % Tree: 80 % Shrub: 0 % Herb: 0 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [x] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** #4 **Date:** 1/26/22 **Time:** 1155

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: 37.804699, -117.811303

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 60 % Tree: 20 % Shrub: 40 % Herb: 0 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Aragon

Date: 1/26/2022 **Time:** 1435
Town: Santa Ana **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
Santiago Creek channel

Projection: **Datum:** WGS 84
Coordinates: 33.771140, -117.874659

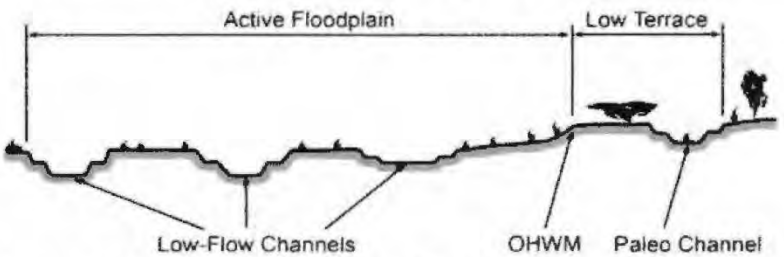
Potential anthropogenic influences on the channel system:
Constructed flood control channel. Altered flow regime and reinforced channel slopes.

Brief site description:
Santiago Creek channel, about 1,200 ft downstream of Interstate 5, just upstream of Flower St.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/85 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

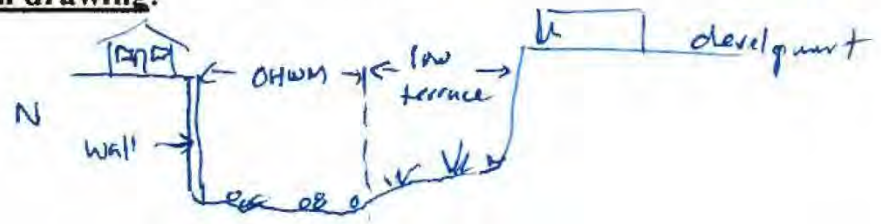


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** # 5 **Date:** 1/26/22 **Time:** 1435

Cross section drawing:



OHWM

GPS point: 33.771233, -117.874643

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: 33.771260, -117.874637

Characteristics of the floodplain unit:

Average sediment texture: Cobble

Total veg cover: 5 % Tree: 0 % Shrub: 0 % Herb: 5 %

Community successional stage:

- [ ] NA
- [x] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [x] Other: Coarse Cobbles
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** #5 **Date:** 1/26/22 **Time:** 1435

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 33.771256, -117.874640

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 40 % Tree: 20 % Shrub: 10 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s):

Date: 1/26/22 **Time:** 1515
Town: Santa Ana **State:** CA
Photo begin file#: **Photo end file#:**

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☒ / N ☐ Is the site significantly disturbed?

Location Details:
Santiago Creek Channel

Projection: **Datum:** WGS84
Coordinates: 33.769663, -117.885957

Potential anthropogenic influences on the channel system:

Heavily modified flood control channel. Heavy use by homeless.

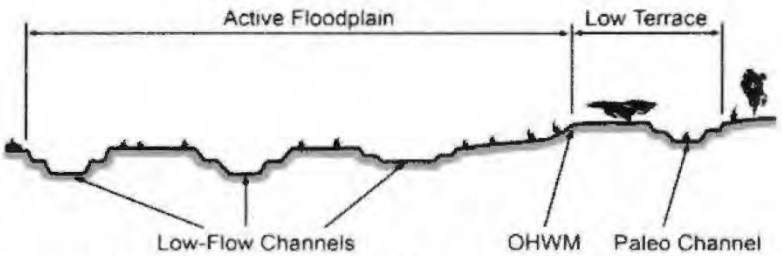
Brief site description:

Santiago Creek channel, just downstream of Bristol St.
0.4 miles upstream of Santa Ana River

Checklist of resources (if available):

- ☒ Aerial photography
  Dates: 12/85 - 3/21
- ☒ Topographic maps
- ☒ Geologic maps
- ☒ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☐ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  Gage number:
  Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

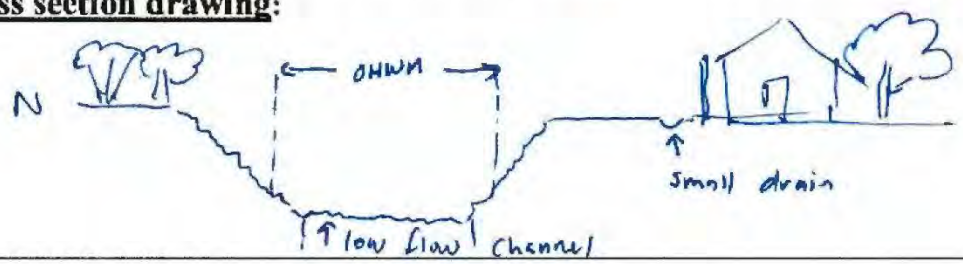


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

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   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☒ Digitized on computer
   - ☐ GPS
   - ☐ Other:

Project ID: 3556.001 **Cross section ID:** #6 **Date:** 1/26/22 **Time:** 1515

Cross section drawing:



OHWM

GPS point: 33.769661, -117.885957

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☐ Break in bank slope
- ☒ Other: woody debris on bank.
- ☐ Other: _____

Comments:

Rip-rap lined channel, very little change with the exception of recent wood debris. No additional points collected.

Floodplain unit:

☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____% Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

SOIL

Sampling Point: Wetland #4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Feature Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-11	7.5YR 3/1						and Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

Located on elevated lakebed, several feet above the surface water.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicator (minimum one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicator (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? Yes _____ No ✔ Depth (inches): _____
(includes capillary fringe)

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Attachment 5 – Observed Plant Species List and Wetland Indicator Status

	Latin Name		Common Name	Wetland Indicator Status[1]
VASCULAR PLANTS				
Dicotyledons				
CUPRESSACEAE		CYPRESS FAMILY		
	Hesperocyparis sp.		Unid. cypress	NI
PINACEAE		PINE FAMILY		
*	*Pinus* sp.		Unid. ornamental	NI
PODOCARPACEAE		PODOCARP FAMILY		
*	*Podocarpus macrophyllus*		Yew plum pine	NI
ADOXACEAE		MUSKROOT FAMILY		
	Sambucus nigra ssp. *cerulea*		Mexican elderberry, blue elderberry	NI
AIZOACEAE		FIG-MARIGOLD or ICEPLANT FAMILY		
*	*Carpobrotus edulis*		Freeway iceplant, hottentot fig	NI
ANACARDIACEAE		SUMAC or CASHEW FAMILY		
	Malosma laurina		Laurel sumac	NI
*	*Pistacia* sp.		Unid. pistachio	NI
	Rhus integrifolia		Lemonade berry	NI
*	*Rhus lanceolata*		Prairie sumac	NI
	Rhus ovata		Sugar bush	NI
*	*Schinus molle*		Peruvian pepper tree	FACU
*	*Schinus terebinthifolius*		Brazilian pepper tree	FACU
	Toxicodendron diversilobum		Western poison oak	FACU
APIACEAE		CELERY FAMILY		
*	*Conium maculatum*		Poison hemlock	FACW
*	*Foeniculum vulgare*		Fennel	NI
APOCYNACEAE		DOGBANE FAMILY		
*	*Nerium oleander*		Common ornamental oleander	NI
*	*Vinca major*		Greater periwinkle, blue periwinkle	NI
ARALIACEAE		GINSENG FAMILY, IVY FAMILY		
*	*Hedera helix*		English ivy	FACU
ASTERACEAE		ASTER FAMILY		
*	*Ageratina adenophora*		Crofton weed, sticky eupatorium	FACU
	Ambrosia psilostachya		Western ragweed	FACU
	Artemisia californica		California sagebrush	NI
	Artemisia douglasiana		Douglas mugwort	FACU
	Artemisia dracunculus		Tarragon	NI
	Baccharis pilularis		Coyote brush	NI
	Baccharis salicifolia		Mule fat	FAC
	Baccharis sarothroides		Broom baccharis	FACU
	Bebbia juncea var. aspera		Sweetbush	NI
	Bidens frondosa		Sticktight	FACW
	Brickellia californica		California brickellbush	FACU
*	*Carduus pycnocephalus*		Italian thistle	NI
*	*Centaurea melitensis*		Tocalote	NI
*	*Cynara cardunculus*		Artichoke thistle, cardoon	NI
*	*Delarea odorata*		German ivy, cape ivy	NI
	Encelia californica		California encelia	NI
	Encelia farinosa		Brittlebush	NI
*	*Erigeron bonariensis*		Flax-leaved horseweed	FACU
*	*Gazania linearis*		Treasure flower, ornamental gazania	NI
*	*Glebionis coronaria*		Garland daisy	NI
*	*Helminthotheca echioides*		Bristly ox-tongue	FAC
	Heterotheca grandiflora		Telegraph weed	NI
	Heterotheca sessiliflora		Sessileflower goldenaster	NI
*	*Hypochaeris glabra*		Smooth cat's-ear	NI
	Laennecia coulteri		Coulter's horseweed	FACW
	Lepidospartum squamatum		Scale-broom	FACU
	Malacothrix saxatilis		Quillwort	NI
	Pluchea odorata		Saltmarsh-fleabane	FACW
	Pseudognaphalium biolettii		Bicolored cudweed	NI
	Pseudognaphalium californicum		California everlasting	NI
	Pseudognaphalium canescens		Wright's cudweed	FACU
*	*Pulicaria paludosa (P. hispanica)*		False flea-bane, Spanish sunflower	FAC
*	*Senecio vulgaris*		Common groundsel	FACU

*	*Sonchus asper*		Prickly sow thistle	FAC
*	*Sonchus oleraceus*		Common sow thistle	UPL
*	*Verbesina encelioides*		Golden crownbeard	NI
	Xanthium strumarium		Cocklebur	FAC
BETULACEAE		BIRCH FAMILY		
	Alnus rhombifolia		White alder	FACW
BIGNONIACEAE		TRUMPET-CREEPER or JACARANDA FAMILY		
*	*Tecoma capensis*		Cape honeysuckle	NI
BORAGINACEAE		BORAGE OR WATERLEAF FAMILY		
	Amsinckia intermedia		Large flower rancher's fiddleneck	NI
	Cryptantha sp.		Unid. annual cryptantha	NI
	Eriodictyon crassifolium		Thick-leaf yerba santa	NI
	Eucrypta chrysanthemifolia		Common eucrypta	NI
	Heliotropium curassavicum		Seaside heliotrope	FACU
	Phacelia ramosissima		Branching phacelia	FACU
BRASSICACEAE		MUSTARD FAMILY		
*	*Brassica nigra*		Black mustard	NI
*	*Brassica rapa*		Field mustard	FACU
*	*Brassica tournefortii*		Sahara mustard, wild turnip	NI
*	*Capsella bursa-pastoris*		Shepherd's purse	FACU
*	*Cardamine hirsuta*		Hairy bitter cress	FACU
*	*Hirschfeldia incana*		Shortpod mustard	NI
*	*Lepidium didymum*		Lesser swine cress, lesser wort-cress	NI
*	*Lobularia maritima*		Sweet alyssum	NI
*	*Sisymbrium irio*		London rocket	NI
*	*Sisymbrium orientale*		Hare's ear cabbage	NI
CACTACEAE		CACTUS FAMILY		
*	*Opuntia ficus-indica*		Mission prickly-pear, Indian fig	NI
	Opuntia oricola		Chaparral pricklypear	NI
CARYOPHYLLACEAE		PINK FAMILY, CARNATION FAMILY		
*	*Cerastium glomeratum*		Sticky mouse-ear chickweed	UPL
CHENOPODIACEAE		GOOSEFOOT FAMILY		
*	*Atriplex semibaccata*		Australian saltbush	FAC
*	*Atriplex suberecta*		Sprawling saltbush, Australian saltbush	FACU
*	*Chenopodium album*		Lamb's quarters, common goosefoot	FACU
*	*Salsola tragus*		Russian thistle	FACU
CONVOLVULACEAE		MORNING-GLORY FAMILY		
	Cuscuta californica		Chaparral dodder, witch's hair	NI
CRASSULACEAE		STONECROP FAMILY		
	Crassula connata		Pygmy-weed	FAC
CUCURBITACEAE		GOURD FAMILY, CUCUMBER FAMILY		
	Cucurbita foetidissima		Calabazilla	NI
	Marah macrocarpa		Chilicothe, wild cucumber	NI
EUPHORBIACEAE		SPURGE FAMILY		
*	*Euphorbia maculata*		Spotted spurge	UPL
*	*Euphorbia peplus*		Petty spurge	NI
*	*Ricinus communis*		Castor bean	FACU
FABACEAE		LEGUME FAMILY, PEA FAMILY		
*	*Acacia* sp.		Unid. escaped ornamental	NI
	Acmispon glaber		Deerweed	NI
	Lupinus succulentus		Arroyo lupine	NI
*	*Medicago polymorpha*		California burclover	FACU
*	*Melilotus albus*		White sweetclover	NI
*	*Melilotus indicus*		Sourclover, India sweetclover	FACU
FAGACEAE		OAK FAMILY		
	Quercus agrifolia		Coast live oak	NI
*	*Quercus ilex*		Holly oak	NI
GERANIACEAE		GERANIUM FAMILY		
*	*Erodium botrys*		Long-beak filaree	FACU
*	*Erodium cicutarium*		Redstem filaree	NI
*	*Erodium moschatum*		Greenstem filaree, white-stemmed filaree	NI
JUGLANDACEAE		WALNUT FAMILY		
**	*Juglans californica*		Southern California black walnut	FACU
LAMIACEAE		MINT FAMILY		

*	*Lamium amplexicaule*		Common henbit	NI
*	*Marrubium vulgare*		Horehound	NI
*	*Rosmarinus officinalis*		Rosemary	NI
	Salvia apiana		White sage	NI
	Salvia mellifera		Black sage	NI
	Trichostema lanatum		Woolly blue curls	NI
MALVACEAE		MALLOW FAMILY		
	Malacothamnus fasciculatus		Chaparral bush-mallow	NI
*	*Malva parviflora*		Cheeseweed	NI
MELIACEAE		MAHOGANY FAMILY		
*	*Melia azedarach*		China berry	UPL
MORACEAE		MULBERRY FAMILY, FIG FAMILY		
*	*Ficus carica*		Common fig, edible fig	FACU
*	*Morus alba*		White mulberry	FACU
MYRTACEAE		MYRTLE FAMILY, EUCALYPTUS FAMILY		
*	*Callistemon citrinus*		Crimson bottlebrush	NI
*	*Eucalyptus sp.*		Ornamental eucalyptus	NI
NYCTAGINACEAE		FOUR O'CLOCK FAMILY		
	Mirabilis laevis (M. californica)		Wishbone bush	NI
OLEACEAE		OLIVE FAMILY		
*	*Fraxinus udhei*		Shamel ash (escaped ornamental)	NI
*	*Olea europaea*		Russian olive	NI
ONAGRACEAE		EVENING-PRIMROSE FAMILY		
	Epilobium canum		California fuchsia	NI
OXALIDACEAE		OXALIS FAMILY		
*	*Oxalis pes-caprae*		Bermuda buttercup	NI
PAPAVERACEAE		POPPY FAMILY		
*	*Fumaria parviflora*		Fine leaved fumitory	NI
**	*Romneya coulteri*		Coulter's matilija poppy	NI
PLANTAGINACEAE		PLANTAIN FAMILY		
	Keckiella cordifolia		Climbing bush-penstemon	NI
*	*Plantago lanceolata*		English plantain, rib-grass	FAC
PLATANACEAE		PLANE-TREE or SYCAMORE FAMILY		
	Platanus racemosa		Western sycamore	FAC
*	*Platanus X acerifolia*		London planetree	NI
POLYGONACEAE		BUCKWHEAT FAMILY		
	Emex spinosa		Devil's thorn	NI
	Eriogonum fasciculatum		California buckwheat	NI
*	*Rumex crispus*		Curly dock	FAC
ROSACEAE		ROSE FAMILY		
	Heteromeles arbutifolia		Toyon, Christmas berry	NI
*	*Pyracantha sp.*		Ornamental pyracantha	NI
	Rosa californica		California wild rose	FAC
RUBIACEAE		MADDER FAMILY, COFFEE FAMILY		
	Galium aparine		Goose grass, stickywilly	FACU
SALICACEAE		WILLOW FAMILY		
	Populus fremontii		Fremont cottonwood	FAC
	Populus trichocarpa		Black cottonwood	FAC
	Salix gooddingii		Goodding's black willow	FACW
	Salix lasiandra		Lance-leaved willow	FACW
	Salix lasiolepis		Arroyo willow	FACW
SAPINDACEAE		SOAPBERRY FAMILY		
*	*Koelreuteria bipinnata*		Goldenrain tree	NI
SCROPHULARIACEAE		FIGWORT FAMILY, SNAPDRAGON FAMILY		
*	*Myoporum laetum*		Myoporum	FACU
SIMAROUBACEAE		QUASSIA or SIMAROUBA FAMILY		
*	*Ailanthus altissima*		Tree of heaven	FACU
SOLANACEAE		NIGHTSHADE FAMILY		
	Datura wrightii (D. meteloides)		Jimsonweed, tolguacha	UPL
*	*Nicotiana glauca*		Tree tobacco	FAC
TAMARICACEAE		TAMARISK FAMILY		
*	*Tamarix ramosissima*		Saltcedar, tamarisk	NI
ULMACEAE		ELM FAMILY		
*	*Ulmus parviflora*		Chinese elm	UPL

URTICACEAE		NETTLE FAMILY		
*	*Urtica urens*		Dwarf nettle	NI
VERBENACEAE		VERVAIN FAMILY		
	Phyla nodiflora		Common lippia	FACW
	Verbena lasiostachys		Western verbena	FAC
VITACEAE		GRAPE FAMILY		
	Vitis girdiana		Wild grape	FAC
Monocotyledons				
AGAVACEAE		CENTURY PLANT FAMILY, AGAVE FAMILY		
*	*Agave sp.*		Escaped ornamental	NI
*	*Yucca aloifolia*		Spanish bayonet (ornamental)	NI
ARECACEAE		PALM FAMILY		
*	*Phoenix canariensis*		Canary Island palm	NI
*	*Washingtonia robusta*		Mexican fan palm, ornamental fan palm	FACW
ASPARAGACEAE		ASPARAGUS FAMILY		
*	*Asparagus asparagoides*		Smilax asparagus	NI
CYPERACEAE		SEDGE FAMILY		
	Cyperus eragrostis		Tall umbrella sedge	FACW
*	*Cyperus involucratus*		Umbrella sedge	FACW
POACEAE		GRASS FAMILY		
*	*Arundo donax*		Giant reed	FACW
*	*Avena barbata*		Slender wild oat	NI
*	*Avena fatua*		Wild oat	NI
*	*Bromus diandrus*		Ripgut brome	NI
*	*Bromus hordeaceus*		Soft chess	FACU
*	*Bromus madritensis* ssp. *rubens*		Red brome	UPL
*	*Cortaderia selloana*		Argentine pampas grass	FACU
*	*Cynodon dactylon*		Bermuda grass	FACU
	Elymus condensatus		Giant wild-rye	FACU
*	*Festuca myuros*		Rattail sixweeks grass	FACU
*	*Hordeum murinum*		Wall barley, hare barley	FACU
*	*Pennisetum setaceum*		Crimson fountain grass, African fountain grass	
*	*Schismus barbatus*		Mediterranean schismus	
*	*Stipa miliacea*		Smilo grass	
TYPHACEAE		CATTAIL FAMILY		
	Typha domingensis		Southern cattail, slender cattail	

* Wetland Indicator Status (WIS):
OBL = occurs in aquatic resources > 99% of time
FACW = occurs in aquatic resources 67-99% of time
FAC = occurs in aquatic resources 34-66% of time
FACU = occurs in aquatic resources 1-33% of time
UPL = occurs in uplands > 99% of time
NI = indicator status not known in this region
~ = unsure as to FAC or FACU

Attachment 6 – Aquatic Resource Table

Waters_Name	State	Cowardin_Code	HGM_Code	Meas_Type	Amount	Units	Waters_Type	Latitude	Longitude	Local_Waterway
DRAINAGE_2	CA	R3SB	RIVERINE	AREA	18.92	ACRES	RPW	33.813222	-117.798453	SANTIAGO_CREEK
DRAINAGE_2	CA	R3UB	RIVERINE	AREA	2.30	ACRES	RPW	33.811501	-117.800303	SANTIAGO_CREEK
DRAINAGE_3	CA	R3UB	LACUSTRINE	AREA	0.44	ACRES	RPW	33.803803	-117.812939	SANTIAGO_CREEK
DRAINAGE_3	CA	L1UB	LACUSTRINE	AREA	82.65	ACRES	RPW	33.807157	-117.805649	SANTIAGO_CREEK
DRAINAGE_4	CA	L1UB	LACUSTRINE	AREA	88.72	ACRES	RPW	33.800890	-117.809333	SANTIAGO_CREEK
DRAINAGE_5	CA	R4SB	RIVERINE	AREA	4.53	ACRES	NRPW	33.770826	-117.875913	SANTIAGO_CREEK

Appendix 2 – Biological Resources Technical Report

BIOLOGICAL RESOURCES TECHNICAL REPORT
Santiago Creek Project

Prepared for:

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1.0 Introduction

This report was prepared under contract to the United States Army Corps of Engineers (USACE) to describe biological resources at the Santiago Creek Recharge Basin, Smith Basin, and along the lower reach of Santiago Creek. Throughout this report, "project" refers to the total action proposed by the USACE, while "project site" refers to all areas that may be directly or indirectly impacted by project activities as well as a slightly larger survey area. The USACE is currently designing modifications to Santiago Creek to prevent significant flood damages. The design modifications will be directed toward increasing the flood control capacity and reducing flooding induced erosion along the urbanized areas of Santiago Creek. Reservoir improvements are also proposed at Santiago Recharge Basin which are necessary to accommodate storage and regulation of flood waters released from the upstream dams. Generally, the existing Santiago Recharge Basin would be modified to allow storage of additional flood control volume and to give the basin operators additional flexibility in managing water levels to accommodate both groundwater conservation and flood storage needs.

2.0 Project and Property Description

2.1 Project Description

The USACE proposes to make several modifications to various features within the project site. These features would be directed toward reducing flooding induced erosion of the slopes within the Santiago Recharge Basin and along the urbanized areas of Santiago Creek. The following are major elements of the Proposed Action:

Reservoir Slope Stabilization. The existing slopes of the reservoir require repair. Stabilization along the slopes of the Santiago Recharge Basin is necessary to accommodate the 1% annual exceedance probability (AEP) water surface elevation. Several locations have been identified along the basins which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H): 1 Vertical (V), installation of retaining walls, or installation of armoring.

In addition to reservoir slope stabilization within Smith, the flood of Smith Basin will also require rehabilitation to protect the repaired slopes from future erosion. Therefore, the Smith Basin slope stabilization feature also includes grading a floodway through the floor of Smith Basin and armoring the toe of the slopes to be repaired.

Lastly, reservoir slope stabilization also includes the rehabilitation of a historic maintenance access road within Smith Basin. The access road is located along the toe of the northern slope of Smith Basin and would be restored and graded to its original condition. This road would become the main access into and out of the bottom of Smith Basin and would be accessed from Santiago Road located along the northeast edge of Smith Basin.

Channel Improvements. Flow velocities within Santiago Creek are erosive during large storm events (approximately 9-13 feet per second during the 1% AEP), potentially compromising adjacent properties along the highly urbanized floodway. To rehabilitate and improve the creek's flood conveyance capability, the Proposed Action will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will then be covered with native substrate to (i) enhance access for ongoing operation and maintenance; (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) maintain existing aesthetics; and (iv) enhance environmental integrity of the stream corridor.

The Proposed Action will involve excavating surficial material from the channel bottom and installing the buried riprap. Replacing that excavated surficial substrate overlying the riprap layer will stabilize the slopes, maintain the channel's natural appearance, and allow for establishment of native, ecologically desirable vegetation. A channel operation and maintenance program will be necessary to prevent invasive vegetation, large woody debris growth, debris, and other flow inhibiting concerns from re-establishing within the channel.

In total, the proposed stream stabilization measures include 6,400-feet of trapezoidal channel armored with buried riprap. The proposed cross section includes a gravel bedding layer and riprap armor layer. The riprap armor layer would be covered with approximately one (1) foot of native substrate harvested from the channel. The surficial layer will provide suitable substrate for native vegetation growth. The planting palette is comprised of two native vegetations species mixes, a low-growth mix for the channel invert and a coastal sage scrub mix for the channel bank. The channel invert width varies from 30-feet to 80-feet, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitation and will be installed to a slope of 1.75H:1V.

The removal of trees in the downstream channel right-of-way would be necessary to complete grading and channel construction. The trees in the downstream reach are primarily invasive species such as eucalyptus, black locust, and tree of heaven. To improve the vegetation quality in the channel, native vegetation would be restored along the top of the bank and side slopes of the lower Santiago Creek channel, where feasible, after earthmoving and channel construction is complete. Native plantings would consist of container plantings and hydroseed. Drip irrigation would be installed for approximately 2 to 3 years to allow plant establishment, and monitoring and maintenance of the restored areas would occur for a 5-year period. The goal of the restored habitat is to create a self-sustaining ecosystem that would require minimal long-term maintenance. Once the 5-year monitoring and maintenance period is over, the Corps would provide the non-federal sponsor with an Operations and Maintenance (O&M) manual.

Floodwalls. Floodwalls are required in select locations along Santiago Creek under the Proposed Action. Floodwalls will extend for approximately 2,600 feet between Bristol Avenue and Flower Street on both the north and south sides of the lower Santiago Creek channel, and for 900 feet on the north side of the lower Santiago Creek channel west of Bristol Avenue. The floodwalls will be steel sheetpile varying in total length from 19 to 30 feet with a reinforced concrete cap extending two feet below the existing grade to the design elevation based on the hydraulic model for the system. Typical total height of the concrete cap is four to five feet. The location of the wall alignment is at the top of the proposed bank in all areas defined above. Native vegetation would be restored within the portions of channel where the floodwall is located; however, the vegetation would have to be low-lying grasses in order to comply with Corps of Engineers Engineering Pamphlet (EP) 1110-2-18. EP 1110-2-18 requires that a minimum 15-feet down slope of a floodwall needs to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except for grasses for the purpose of erosion control.

2.2 Project Location

The project site is located in the cities of Orange, Santa Ana, Villa Park, and unincorporated territory within Orange County, California (see Figure 1, Attachment 1). It is within the California United States Geological Survey (USGS) Orange 7.5-minute Quadrangle. The 330-acre project site includes Smith Basin (67 acres) and Santiago Recharge Basin (248 acres) shown in Figure 2a, and Santiago Creek Channel (15 acres) shown in Figure 2b (Attachment 1).

3.0 Methods

3.1 Literature Review

Prior to conducting field surveys, Aspen biologists reviewed available literature to identify special-status biological resources known from the vicinity of the project site. The literature and databases listed below were reviewed.

- U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) for the project site (USFWS 2022).
- CNDDB (CDFW 2022a) for the following 7.5-minute USGS topographic quads: La Habra, Yorba Linda, Prado Dam, Anaheim, Orange, Black Star Canyon, Newport Beach, Tustin, and El Toro.
- CNPS Electronic Inventory of Rare and Endangered Vascular Plants of California (CNPS 2022), for the same topographic quads.
- Santa Ana Watershed Association's Status and Management of the Least Bell's Vireo and Southwestern Willow Flycatcher in the Santa Ana River Watershed, 2021, and Summary Data by Site and Watershed-wide, 2000-2021 (SAWA, 2022).
- Orange County Water District's Least Bell's Vireo and California Gnatcatcher Territories 2021 (OCWD, 2022).

The CNDDB results are listed in Attachment 2 and the IPaC Resource List is provided as Attachment 3. Several special-status species identified during the literature review only occur in specialized native habitats that are absent from the project site or occur at higher or lower elevations. These plants and animals are listed in Attachment 4 but are not addressed further in this report.

3.2 Field Surveys

Aspen biologists Justin Wood, Jacob Aragon, and Nikolai Starzak completed field surveys of the project site on January 12, 26, March 3, and May 2, 2022. During the site visit, the biologists conducted 100 percent coverage biological survey of the project site where safely accessible. Portions of the project site that were not surveyed generally include slopes greater than 50 degrees. During the field surveys, all plant and wildlife species observed were recorded in field notes and sensitive species locations were recorded using hand-held GPS units. All plant and wildlife species observed during the surveys are listed in Attachment 5. Representative site photos were captured during the survey and are included in Attachment 6.

The botanical surveys were conducted in conformance with California Department of Fish and Wildlife (CDFW) guidelines (CDFW 2018). The surveys were (a) conducted during flowering seasons for the special status plants known from the area, (b) floristic in nature, (c) consistent with conservation ethics, (d) systematically covered all habitat types on the sites, and (e) well documented by this report and by voucher specimens to be deposited at California Botanic Garden (formerly Rancho Santa Ana Botanic Garden) and other herbaria. Plants of uncertain identity were collected and identified later using keys, descriptions, and illustrations in Baldwin et al. (2012).

Vegetation mapping was done by drawing tentative boundaries onto high-resolution aerial images during site visits on January 12 and 26, 2022. These boundaries were then digitized into Geographic Information System (GIS) shapefiles. Vegetation maps were field verified for accuracy on March 3, 2022 (see

Attachment 1; Figure 4: Vegetation and Land Cover). Vegetation within the project site is further described below using the names and descriptions in *A Manual of California Vegetation* (Sawyer et al., 2009). Vegetation was mapped digitally using ArcGIS (version 10.7) and one-foot pixel aerial imagery. The smallest mapping unit was approximately 0.05-acre and most mapped vegetation boundaries are accurate to within approximately 5-ft. Any vegetation map is subject to imprecision for several reasons:

1. Vegetation types tend to intergrade on the landscape so that there are no true boundaries in the vegetation itself. In these cases, a mapped boundary represents best professional judgment.
2. Vegetation types as they are named and described tend to intergrade; that is, a given stand of real-world vegetation may not fit into any named type in the classification scheme used. Thus, a mapped and labeled polygon is given the best name available in the classification, but this name does not imply that the vegetation unambiguously matches its mapped name.
3. Vegetation tends to be patchy. Small patches of one named type are often included within mapped polygons of another type. The size of these patches varies, depending on the minimum mapping units and scale of available aerial imagery.

Rainfall: Rainfall is greatest during the months of November through March, with an average annual precipitation total of 13.43 inches (U.S. Climate Data 2022). Rainfall to-date has been below 50 percent of average with approximately 6.15 inches falling in the region since July 2021 (Orange County Public Works 2022).

4.0 General Biological Survey Results

4.1 Vegetation and Cover Types

Vegetation within the project site consists of riparian and wetland vegetation, upland vegetation, and other land cover types. They are described in detail below and acreages of the vegetation and land cover areas are presented in Table 1 and shown in Figures 3a through 3c (Attachment 1).

Table 1. Vegetation and other cover types on the project site (acres)

Vegetation Type	Project Site (Acres)
Blue elderberry thickets	1.84
Brittle bush scrub	16.57
Coast live oak woodland and forest	0.38
California sagebrush - black sage scrub	35.87
Fountain grass swards	5.58
Goodding's willow - red willow riparian woodland and forest	21.73
Laurel sumac scrub	6.10
Mulefat thickets	4.47
Upland mustards or star-thistle fields	1.97
Wild oats and annual brome grasslands	3.78
Eucalyptus - tree of heaven - black locust groves	8.29
Other Cover Types	
Open water	174.91
Unvegetated channels and slopes	10.43
Developed	37.67
Total	329.61

Riparian and Wetland Vegetation Types

Goodding's willow - red willow riparian woodland and forest (*Salix gooddingii – Salix laevigata* Forest & Woodland Alliance). Goodding's willow - red willow riparian woodland and forest are a winter deciduous woodland that are dominated by Goodding's willow (*Salix gooddingii*). Additional species such as Pacific willow (*Salix lasiandra*), red willow (*Salix laevigata*), California sycamore (*Platanus racemosa*), and mulefat (*Baccharis salicifolia*) are also present. Goodding's willow - red willow riparian woodland and forest are present along Santiago Creek in the northern portion of the project site and are the dominant cover type in the seasonally inundated portions of Smith Basin. They are also present in isolated locations around Santiago Recharge Basin and are abundant near the earthen overflow channel. Goodding's willow - red willow riparian woodland and forest have a State rank of S3 and are therefore recognized as a sensitive natural community by CDFW (CDFW 2021).

Mulefat thickets (*Baccharis salicifolia* Shrubland Alliance). Mulefat thickets are a winter deciduous shrubland that are dominated by mulefat. Additional species such as oleander (*Nerium oleander*), coyote brush (*Baccharis pilularis*), and shrubby willows (*Salix* spp.) are also present. Mulefat thickets are present along Santiago Creek in the northern portion of the project site and also around the margins of Smith Basin and Santiago Recharge Basin. Mulefat thickets have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland Vegetation Types

Blue elderberry thickets (*Sambucus nigra* ssp. *caerulea* Provisional Shrubland Alliance). Although not defined as a vegetation type in the current online version of *A Manual of California Vegetation*, blue elderberry thickets are present in the project site. This vegetation is dominated by blue elderberry (*Sambucus nigra* ssp. *caerulea*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species. Within the project site coyote brush and Peruvian pepper tree (*Schinus mole*) are also present. Blue elderberry thickets are present in the uplands near Santiago Creek in the northern portion of the project site and in the upland east of the Santiago Creek Recharge Basin. Blue elderberry thickets do not have a State Rank and therefore is not recognized as a sensitive natural community by CDFW (CDFW 2021).

Brittle bush scrub (*Encelia farinosa* Shrubland Alliance). Brittle bush scrub is a type of coastal sage scrub vegetation that is dominated by brittle bush (*Encelia farinosa*). Additional species such as coastal sage brush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Salvia mellifera*), giant wild rye (*Elymus condensatus*), and Laurel sumac (*Malosma laurina*) are also present in low numbers. Within the project site it appears that all the brittle bush scrub was planted for mitigation. It is unclear if brittle bush is native to the project site. Brittle bush scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

California sagebrush - black sage scrub (*Artemisia californica - Salvia mellifera* Shrubland Alliance). California sagebrush - black sage scrub is a type of coastal sage scrub that is dominated by coastal sage brush. Within the project site, black sage is uncommon, but the vegetation still matches this description the best. Additional species such as sweetbush (*Bebbia juncea*) and California buckwheat are also present. Within the project site it appears that all the California sagebrush - black sage scrub has been planted for mitigation. California sagebrush - black sage scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Coast live oak woodland and forest (*Quercus agrifolia* Forest & Woodland Alliance). Coast live oak woodland and forest are dominated by coast live oaks (*Quercus agrifolia*). Within the project site, the

coast live oak woodland and forest is limited to several patches along Santiago Creek Channel, in the vicinity of North Flower Street. The understory vegetation includes non-native ornamental species such as Canary ivy (*Hedera canariensis*). Coast live oak woodland and forest have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Eucalyptus - tree of heaven - black locust groves (*Eucalyptus* spp. - *Ailanthus altissima* - *Robinia pseudoacacia* Woodland Semi-Natural Alliance). Eucalyptus - tree of heaven - black locust groves are used to map all vegetation dominated by non-native trees within the project site including gum trees (*Eucalyptus* spp.), Peruvian pepper trees, yew plum pine (*Podocarpus macrophyllus*), prairie sumac (*Rhus lanceolata*), and many others. Native tree species such as California sycamore and coast live oak may also be present but generally represent single trees. Eucalyptus - tree of heaven - black locust groves have a State Rank of SNA (Not Applicable) and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Fountain grass swards (*Pennisetum setaceum* - *Pennisetum ciliare* Herbaceous Semi-Natural Alliance). Fountain grass swards are a non-native grassland dominated by crimson fountain grass (*Pennisetum setaceum*), a robust perennial bunchgrass. Other non-native species such as gazania (*Gazania linearis*) and mustard (*Hirschfeldia incana*), are also present as well as scattered natives such as desert wishbone bush (*Mirabilis laevis*). Fountain grass swards are present on the large, landscaped slope to the north of Smith Basin and along the eastern slope of the Santiago Recharge Basin. Fountain grass swards have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Laurel sumac scrub (*Malosma laurina* Shrubland Alliance). Laurel sumac scrub is dominated by Laurel sumac (*Malosma laurina*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species such as coastal sage brush and California buckwheat. Additional species such as tamarisk (*Tamarix* sp.) are also present. Laurel sumac scrub is present in the upland surrounding Santiago Creek, Smith Basin, and the Santiago Recharge Basin. Laurel sumac scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland mustards or star-thistle fields (*Brassica nigra* - *Centaurea* (*solstitialis*, *melitensis*) Herbaceous Semi-Natural Alliance). Upland mustards or star-thistle fields are a non-native plant community and within the project site are dominated by black mustard (*Brassica nigra*). Other non-native species are also present including white horehound (*Marrubium vulgare*), tocalote (*Centaurea melitensis*), fennel (*Foeniculum vulgare*), and others. This vegetation type is present in previously disturbed portion of the updates surrounding the Santiago Recharge Basin. Upland mustards or star-thistle fields have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Wild oats and annual brome grasslands (*Avena* spp. - *Bromus* spp. Herbaceous Semi-Natural Alliance). This grassland vegetation is dominated by a variety of non-native grasses such as wild oat (*Avena* spp.), ripgut brome (*Bromus diandrus*), and red brome (*Bromus rubens*). Non-native herbs are also present including Bermuda buttercup (*Oxalis pes-caprae*), fine leaved fumitory (*Fumaria parviflora*), mustard, and others. Wild oats and annual brome grasslands are present in disturbed sites within the project site, especially around the perimeter of the site adjacent to residential development. Wild oats and annual brome grasslands have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Other Land Cover Types

Developed. This cover type includes disturbed and developed areas within the project site including paved roads, unpaved roads, buildings, residential areas, and other unvegetated areas. It also includes a large

area in the central portion of Santiago Recharge Basin that was recently impacted by construction activities. Developed is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Open water. Open water is used to map portions of the project site that had surface water present during early 2022. This included Smith Basin and Santiago Recharge Basin. The water depths in these basins' changes throughout the year and most of the open water in these basins will eventually become dry in the late summer and fall. Open water is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Unvegetated channels and slopes. This cover type includes flood control channels, unvegetated slopes, and other maintained areas within the project site. Vegetation is either absent or very sparse. Unvegetated channels and slopes is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

4.2 Sensitive Natural Communities

Sensitive vegetation communities are defined by CDFW (2018) as, "...communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects." The literature review identified twelve sensitive vegetation communities recorded near the project site. These included southern dune scrub, southern foredunes, southern interior cypress forest, southern California arroyo chub/Santa Ana sucker stream, southern coastal salt marsh, southern coast live oak riparian forest, southern cottonwood willow riparian forest, southern riparian scrub, southern sycamore alder riparian woodland, southern willow scrub, Riversidean alluvial fan sage scrub, and California walnut woodland (CDFW 2022a). Of these, southern willow scrub closely matches the description of Goodding's willow - red willow riparian woodland and forest, discussed above. This vegetation is recognized by CDFW as a sensitive natural community (CDFW 2022a).

4.3 Wildlife Habitat

The term habitat refers to the environment and ecological conditions where a species is found. Wildlife habitat is often described in terms of vegetation, though a more thorough explanation includes detail such as availability or proximity to water, suitable nesting or denning sites, shade, foraging perches, cover sites to escape from predators, soils that are suitable for burrowing or hiding, proximity of noise and disturbance, and other factors that are unique to each species. For many wildlife species, vegetation reflects important components of habitat, including regional climate, physical structure, and biological productivity and food resources. Thus, the vegetation descriptions in Section 4.1 are useful overarching descriptors for wildlife habitat.

Wildlife and wildlife sign observed during the field surveys included species common in the region, such as western fence lizard (*Sceloporus occidentalis*), night snake (*Hypsiglena torquata*), lesser goldfinch (*Spinus psaltria*), Bewick's wren (*Thryomanes bewickii*), turkey vulture (*Cathartes aura*), and California ground squirrel (*Otospermophilus beecheyi*). Several active bird nests were observed within the project site including two active red-tailed hawk (*Buteo jamaicensis*) nests. Several special-status wildlife species were observed or otherwise detected during the surveys and are discussed below in Section 5.0.

5.0 Special-Status Species Results

Based on review of the literature and databases listed above, and on local expertise with the flora and fauna of the project site, lists of special-status plants and wildlife with potential to occur on the project site or in the project vicinity were compiled (Table 3). Plant and wildlife taxa were considered to be special-status species if they were classified in one or more of the categories listed in Table 2. All special-status plants and wildlife occurring in the region in habitats similar to those found on the Project site are addressed in Table 3, with brief descriptions of habitat and distribution, conservation status, and probability of occurrence on the site.

Table 2. Definitions of Special-Status Species

Species Designation	Agency	Definition
Federal Endangered	USFWS	A species that is in danger of extinction throughout all or a significant portion of its range.
Federal Threatened	USFWS	A species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Federal Candidate	USFWS	A species the US Fish and Wildlife Service (USFWS) has designated as a candidate for listing under Section 4 of the federal Endangered Species Act (ESA), published in its annual candidate review, and defined as a species that has sufficient information on its biological status and threats to propose it as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.
Federal Proposed	USFWS	A species that the USFWS has proposed for listing under Section 4 of the ESA, by publishing a Proposed Rule in the Federal Register.
Protected under the federal Bald and Golden Eagle Protection Act (BGEPA)	USFWS	Bald and golden eagles are protected from take, including harassment, except as permitted by USFWS.
State Endangered	CDFW	A species that is in serious danger of becoming extinct throughout all or a significant portion of its range due to one or more causes, including loss or change in habitat, overexploitation, predation, competition, or disease.
State Threatened	CDFW	A species that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts.
State Candidate	CDFW	A species that has been officially noticed by the California Fish and Game Commission as being under review by the CDFW for addition to the threatened or endangered species lists. CDFW candidate species are given no extra-legal protection under state laws.
Fully Protected	CDFW	Animal species fully protected under the California Fish and Game Code. The CDFW may not issue take authorization except for scientific purposes or as provided under SB 618 (2011).
Species of Special Concern	CDFW	A species, subspecies, or distinct population of an animal native to California that currently satisfies one or more of the following (not necessarily mutually exclusive) criteria: Is extirpated from the state or, in the case of birds, in its primary seasonal or breeding role. Is on the federal, but not state list, of threatened or endangered species. Meets the state definition of threatened or endangered but has not formally been listed.

Table 2. Definitions of Special-Status Species

Species Designation	Agency	Definition
		Is experiencing or formerly experienced serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for state threatened or endangered status; or Has naturally small populations exhibiting high susceptibility to risk from any factor(s) that if realized, could lead to declines that would qualify it for state threatened or endangered status. This is an administrative designation and carries no formal legal status. This designation is intended to focus attention on animals at conservation risk, to stimulate research on poorly known species, and to achieve conservation and recovery before these species meet the California Endangered Species Act (CESA) criteria for listing. California Species of Special Concern are considered under the California Environmental Quality Act (CEQA) and require a discussion of impacts and appropriate mitigation to reduce impacts.
Watch List	CDFW	Taxa that were previously Species of Special Concern, but no longer merit that status or which do not meet criteria for designation as Species of Special Concern, but for which there is concern and a need for additional information to clarify status.
Special Animal	CDFW	An animal species that is tracked in the CNDDB but has no other status at the state or federal level.
California Rare Plant Rank (CRPR) 1A	CDFW	Plants presumed to be extinct in California.
CRPR 1B	CDFW	Plants rare or endangered in California and elsewhere.
CRPR 2A	CDFW	Plants presumed extinct in California but more common elsewhere.
CRPR 2B	CDFW	Plants rare or endangered in California but more common elsewhere.
CRPR 3	CDFW	Plants about which more information is needed – a review list.
CRPR 4	CDFW	Plants of limited distribution – a watch list.

Plants or wildlife may be ranked as special-status species due to declining populations, vulnerability to habitat change, or restricted distributions. Certain species have been listed as threatened or endangered under the Federal Endangered Species Act (FESA) or California Endangered Species Act (CESA). Others have not been listed, but declining populations or habitat availability cause concern for their long-term viability. These species of conservation concern appear on lists compiled by resource agencies or private conservation organizations. In this report, "special-status species" includes all plants and wildlife listed as threatened or endangered or included in these other compilations. All special-status plants and wildlife occurring in the region in habitats similar to those found on the Project site are addressed in Table 3, with brief descriptions of habitat and distribution, conservation status, and probability of occurrence on the site.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
PLANTS				

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Astragalus brauntonii Braunton's milk-vetch	Fire adapted plant that requires fire and other disturbances to propagate. Occurs in recently burned or disturbed areas in chaparral, coastal scrub and valley and foothill grasslands, sea level to about 2,000 ft. elev.; Los Angeles, Orange, and Ventura, Cos.	Jan-Aug	Fed: END CA: 1B.1, S2	Low; not observed, marginally suitable habitat is present; known from within 4.5 miles.
Baccharis malibuensis Malibu baccharis	Occurs in chaparral habitats and grassy openings, cismontane woodlands, coastal scrub and riparian; 500-1000 ft. elev.; Los Angeles, Orange, and Ventura, Cos.	Aug	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within 6 miles.
Calochortus catalinae Catalina mariposa lily	Perennial herb (bulb); chaparral, woodlands, coastal sage scrub, and grasslands with heavy soils; 50-2,300 ft. elev., Riverside Co. north to Santa Barbara Co.	Feb - Jun	Fed: None CA: 4.2, S3S4	Moderate; not observed, marginally suitable habitat is present; known from within 1 mile.
Calochortus plummerae Plummer's mariposa-lily	Occurs in chaparral, cismontane woodland, coastal scrub, valley and foothill grassland; 300-5,600 ft. elev.; Ventura and Riverside Cos south to San Diego Co.	May-Jul	Fed: None CA: 4.2, S4	Low; not observed, marginally suitable habitat is present; known from within 7 miles.
Calochortus weedii var. *intermedius* Intermediate mariposa-lily	Occurs on dry, rocky slopes of coastal scrub, chaparral and valley and foothill grasslands; 350-2,800 ft. elev.; Los Angeles, Orange, Riverside, and San Bernardino Cos.	May-Jul	Fed: None CA: 1B.2, S3	Moderate; not observed, suitable habitat is present upstream of Smith Basin; known from within 1.5 miles.
Calystegia felix Lucky morning-glory	Occurs on gentle alluvial slopes with silty loam soils and coastal swamps, riparian, and wetlands; 100-700 ft. elev.; Los Angeles, Riverside, and San Bernardino Cos.	Mar-Sep	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within about 14 miles.
Centromadia parryi ssp. australis Southern tarplant	Occurs is mesic grasslands, vernal pools, are various marsh habitats, sea level to about 1,500 ft. elev.; Santa Barbara Co. south to San Diego Co. and Baja CA.	May-Nov	Fed: None CA: 1B.1, S2	Moderate; not observed, marginally suitable habitat is present, known from within 0.5 miles.
Dudleya multicaulis Many-stemmed dudleya	Occurs in coastal plains, chaparral often in clay soils and sandstone outcrops; 50-2,600 ft. elev.; Los Angeles and San Bernardino Cos. south to San Diego Co.	Apr-Jul	Fed: None CA: 1B.2, S2	Moderate; not observed, suitable habitat is present upstream of Smith Basin; known from within 0.5 miles.
Horkelia cuneata var. *puberula* Mesa horkelia	Dry, sandy, coastal chaparral, and cismontane woodland; 200-2,700 ft. elev.; San Luis Obispo Co. south to San Diego Co.	Feb-Jul (Sep)	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within 7 miles.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Juglans californica Southern California black walnut	Small tree; chaparral, woodlands, coastal scrub, and riparian woodlands; 165-3000 ft. elev.; San Diego Co. north throughout much of coastal California.	Mar-Aug	Fed: none CA: 4.2, S4	Present; two individuals observed upstream of Smith Basin, additional individuals likely present.
Lepidium virginicum var. *robinsonii* Robinson's pepper grass	Chaparral and coastal sage scrub; sea level to about 2,900 ft. elev.; Los Angeles and San Bernardino Cos. south to San Diego Co.	Jan-Jul	Fed: None CA: 4.3, S3	Low; not observed, marginally suitable habitat is present; known from within 4.5 miles.
Nolina cismontana Chaparral nolina	Dry chaparral and coastal sage scrub of coastal mountains; 450-4,200 ft. elev.; Los Angeles, Orange, Riverside, San Diego, and Ventura Cos.	(Mar) May-Jul	Fed: None CA: 1B.2, S3	Low; not observed, marginally suitable habitat is present; known from within 6 miles.
Pentachaeta aurea ssp. *allenii* Allen's pentachaeta	Coastal scrub openings, valley, and foothill grasslands; 250-1,700 ft. elev.; endemic to Orange Co.	Mar-Jun	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within 8 miles.
Pseudognaphalium leucocephalum White rabbit-tobacco	Chaparral, coastal scrub, and riparian woodlands. Sandy or gravelly beaches, dry stream bottoms, canyon bottoms; sea level to about 7,000 ft. elev.; much of southern CA and east into AZ, NM, and TX.	(Jul)Aug-Nov (Dec)	Fed: None CA: 2B.2, S2	Low; not observed, marginally suitable habitat is present; known from within 6 miles.
Romneya coulteri Coulter's matilija poppy	Chaparral and coastal scrub, often in burned areas, 65-4000 ft. elev.; San Diego Co. north throughout much of coastal southern California.	Mar-Jul	Fed: None CA: 4.2, S4	Present; several individuals planted along Hewes St. along east side of Santiago Recharge Basin.
INVERTEBRATES				
Bombus crotchii Crotch bumble bee	Colonial insect; open grassland and scrub; underground colonies, often in old rodent burrows. Many food plants including *Chaenactis, Lupinus, Phacelia, Salvia*, and *Eriogonum*. Much of southern and central CA, SW Nevada and Baja.	Spring – Summer	Fed: None CA: S1S2	High; not observed, suitable habitat and food plants present; known from within 3 miles.
Danaus plexippus pop. 1 Monarch – California overwintering population	Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby. Closed-cone coniferous forest	Year-round	Fed: CAN CA: S2S3	High; not observed, likely to be present however they are unlikely to overwinter this far inland.
FISH				

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Catostomus santaanae Santa Ana sucker	Major cismontane stream systems in S Calif. incl. Santa Ana Riv., formerly below about 3000 ft. elev.; extant populations near Riverside and downstream. Critical habitat is located about 6 miles downstream of the project site.	Year-round	Fed: THR CA: S1, CSC	Low; not observed, only potential in Santiago Creek Channel during periods of heavy flow.
Oncorhynchus mykiss irideus pop. 10 Steelhead - southern California DPS	Federal listing refers to populations from Santa Maria River south to southern extent of range (San Mateo Creek in San Diego County).	Year-round	Fed: END CA: CAN, S1	Low; not observed, only potential in Santiago Creek Channel during periods of heavy flow.
Rhinichthys osculus ssp. 8 Santa Ana speckled dace	Endemic to Santa Ana and San Gabriel Riv. watersheds, historically in Big Tujunga Cyn. Santa Ana Riv. populations in lower San Bernardino Mtn foothills and washes.	Year-round	Fed: None CA: S1, CSC	Moderate; not observed, suitable habitat present upstream of Smith Basin, known from within 10 miles.
REPTILES				
Anniella stebbinsi Southern California legless lizard	Occurs in a variety of habitats, chaparral, coastal scrub generally in moist, loose soil.	Spring – Summer	Fed: None CA: S3, CSC	Low; not observed. marginally suitable habitat in uplands upstream of Smith Basin.
Arizona elegans occidentalis California glossy snake	Generalist occurring in a range of scrub and grassland habitats, often with loose or sandy soils.	Feb-Nov	Fed: None CA: S2, CSC	Low; not observed. marginally suitable habitat in uplands upstream of Smith Basin.
Aspidoscelis hyperythra Orange-throated whiptail	Prefers washes and other sandy areas with patches of brush and rocks. Perennial plants necessary for its major food source; termites.	Year-round	Fed: None CA: S2S3, WL	High; not observed, suitable habitat present, known from within 1 mile.
Aspidoscelis tigris stejnegeri Coastal whiptail	Occurs in deserts and semi-arid areas with sparse vegetation in firm soil, sandy, or rocky soils.	Year-round	Fed: None CA: S3, CSC	High; not observed, suitable habitat present, known from within 1 mile.
Crotalus ruber Red-diamond rattlesnake	Prefers coastal sage scrub, rocky hillsides, and lower woodlands	Spring – Summer	Fed: None CA: S3, CSC	Moderate; not observed, suitable habitat present, known from within 4 miles.
Emys marmorata Western pond turtle	Inhabits permanent or nearly permanent bodies of water in various habitat types; requires basking sites such as partially submerged logs, vegetation mats, or open mud banks.	Spring – Summer	Fed: None CA: S3, CSC	Low; minimally suitable habitat; likely to be present in the vicinity.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Phrynosoma blainvillii Coast horned lizard	Forest, shrubland or grassland; sandy soils; W Calif. from LA Co S through N Baja Calif., below about 6000 ft. elev.	Temp dependent	Fed: None CA: S3S4, CSC	Moderate; not observed, suitable habitat present, known from within 5 miles.
Salvadora hexalepis virgultea Coast patch-nosed snake	Burrows in loose soil in semi-arid bushy areas and chaparral in canyon, rocky hillsides and plains.	Year-round	Fed: None CA: S2S3, CSC	Low; not observed, suitable habitat present, known from within 8 miles.
Thamnophis hammondii Two-striped gartersnake	Riparian and wetland habitat below about 7,000 ft elev.; coastal California from southern San Joaquin Valley to NW Baja California.	Year-round	Fed: None CA: S3S4, CSC	Low; not observed, suitable habitat present, known from within 10 miles.
BIRDS				
Accipiter cooperii Cooper's hawk	Woodland, chiefly of open, interrupted, or marginal type; nest sites mainly in riparian growths of deciduous trees.	Year-round	Fed: None CA: S4, WL	Present; suitable foraging and nesting habitat throughout.
Agelaius tricolor Tricolor blackbird	Highly colonial species; requires open water, protected nesting substrate, and foraging areas with insect prey within a few kilometers of colony.	Year-round	Fed: None CA: THR, S1S2, CSC	Low; not observed, minimally suitable habitat present, known from within 10 miles.
Aimophila ruficeps canescens Southern California rufous-crowned sparrow	Arid and steep rocky areas chaparral and coastal sage scrub including low grasses and shrubs.	Spring – Summer	Fed: None CA: S3, WL	High; not observed, suitable habitat present, known from within 1 mile.
Ammodramus savannarum Grasshopper sparrow	Favors native grasslands with a mix of grasses, forbs and scattered shrubs. Loosely colonial when nesting.	Spring – Summer	Fed: None CA: S3, CSC	Low; not observed, marginally suitable habitat present, known from within 5 miles.
Aquila chrysaetos Golden eagle	Forages in open grasslands, desert scrub and agricultural fields. Nests on ledges on cliff faces, rock outcrops and occasionally in large trees.	Year-round	Fed: BGEPA CA: S3, FP	Minimal (nesting); Moderate (foraging only); no suitable nesting habitat; observed on site in 2011.
Ardea herodias Great blue heron	Rookery sites in close proximity to foraging areas: marshes, lake margins, tide-flats, rivers and streams, wet meadows.	Year-round	Fed: None CA: S4	Moderate (nesting); Present (foraging only); multiple individuals observed foraging, suitable nesting habitat present.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Asio otus Long-eared owl	Riparian bottomlands grown to tall willows and cottonwoods; also, belts of live oak paralleling stream courses.	Year-round	Fed: None CA: S3?, CSC	Minimal (nesting); Low (foraging only); no suitable nesting habitat; marginal foraging habitat, known within 10 miles.
Athene cunicularia Burrowing owl	Nests mainly in rodent burrows, usually in open grassland or shrubland; forages in open habitat; increasingly uncommon in S Calif.; through W US and Mexico.	Year-round	Fed: None CA: S3, CSC	Low (nesting); Moderate (foraging only); limited suitable nesting habitat; marginal foraging habitat, known within 5 miles.
Buteo regalis Ferruginous hawk	Open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon and juniper habitats.	Year-round	Fed: None CA: S3S4, WL	Minimal (nesting); Low (foraging only); not within nesting range, suitable foraging habitat, known within 10 miles.
Buteo swainsoni Swainson's hawk	Grasslands with scattered trees, juniper-sage flats, riparian areas and agricultural lands.	Year-round	Fed: None CA: THR, S3	Minimal (nesting); High (foraging only); not within nesting range, suitable foraging habitat, observed on site in 2011.
Campylorhynchus brunneicapillus sandiegensis Coastal cactus wren	Coastal sage scrub requires tall opuntia cactus for nesting and roosting.	Year-round	Fed: None CA: S3, CSC	High; not observed, suitable habitat present, known from within 1 mile.
Coccyzus americanus occidentalis Western yellow-billed cuckoo	Riparian forest, willows mixed with cottonwoods with a lower story of blackberry, nettles, or wild grape.	Spring – Summer	Fed: THR CA: END, S1	Minimal (nesting); Low (foraging only); no recent nesting in southern California, suitable habitat present.
Elanus leucurus White-tailed kite	Typically nests at lower elevations in riparian trees, including oaks, willows, and cottonwoods; forages over open country. Throughout much of cismontane California.	Spring – Summer	Fed: None CA: S3S4, FP	Low (nesting); Moderate (foraging only); limited suitable nesting habitat; marginal foraging habitat, known within 5 miles.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Empidonax traillii extimus Southwestern willow flycatcher	Riparian woodlands in California.	Spring – Summer	Fed: END CA: END, S1	Minimal (nesting); Low (foraging only); no recent nesting in southern California, suitable habitat present.
Eremophila alpestris actia California horned lark	Open, flat lands incl. sparse sagebrush or grassland, meadows, alkali flats; wide elev. range; breeds in western Calif (San Diego Co through Humboldt Co) and Baja Calif; winters in same range.	Year-round	Fed: None CA: S4, WL	High (seasonal foraging); Low (nesting); Marginally suitable nesting habitat, expected to forage on the project site.
Falco peregrinus anatum American peregrine falcon	Near wetlands, lakes, rivers or other water; on cliffs, banks, dunes, and human-made structures.	Year-round	Fed: DEL CA: DEL, S3S4, FP	Low (nesting); High (foraging only); limited suitable nesting habitat; known within 1 mile.
Haliaeetus leucocephalus Bald eagle	Lower montane, old growth, coniferous forests, near lakes and rivers.	Year-round	Fed: DEL CA: END, S3, FP	Low (nesting); High (foraging only); limited suitable nesting habitat; marginal foraging habitat, observed on site in 2012.
Icteria virens Yellow-breasted chat	Inhabits riparian thickets of willow and other brushy tangles near water courses; nests in low, dense riparian vegetation; nests and forages within 10 feet of ground.	Spring – Summer	Fed: None CA: S3, CSC	High; not observed, assumed to nest on site, known from within 1 mile.
Pandion haliaetus Osprey	Ocean shores, bays, freshwater lakes and large streams.	Year-round	Fed: None CA: S4, WL	Present; 1 individual observed foraging on site, known to nest on site.
Polioptila californica Coastal California gnatcatcher	Permanent resident of coastal sage scrub in arid washes, on mesas and slopes	Year-round	Fed: THR CA: S2, CSC	Present; 12 territories present in 2021, suitable habitat present.
Riparia Bank swallow	Colonial nesters, nests primarily in riparian habitats. Requires vertical banks/cliffs with fine- textured soils.	Spring – Summer	Fed: None CA: THR, S2	Minimal (nesting); Low (foraging only); suitable foraging habitat; known from within 10 miles.
Setophaga petechia Yellow warbler	Riparian vegetation; prefers willows, cottonwoods, aspens, sycamores, and alders for nesting and foraging. Throughout much of southern Calif.	Spring – Summer	Fed: None CA: S3S4, CSC	High; suitable nesting and foraging habitat present, observed onsite in 2008 and 2011.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Vireo bellii pusillus Least Bell's vireo	Summer resident of southern California in low riparian habitats in vicinity of water or dry river bottoms; found below about 2600 ft; nests typically built-in willow, mesquite, *Baccharis*.	Spring – Summer	Fed: END CA: END, S2	**Present**; 6 territories present in 2021, suitable habitat present.
MAMMALS				
Antrozous pallidus Pallid bat	Desert, grassland, shrubland, woodland, forest; most common in open, dry habitats with rocky areas for roosting.	Spring – Summer	Fed: None CA: S3, CSC	**Minimal** (roosting); **Moderate** (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent.
Choeronycteris mexicana Mexican long-tongued bat	Pinyon and juniper woodlands, riparian scrub. Roosts in relatively well-lit caves and in and around buildings.	Spring – Summer	Fed: None CA: S1, CSC	**Minimal** (roosting); **Moderate** (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent.
Eumops perotis californicus Western mastiff bat	Lowlands (rare exceptions); cent. and S Calif., S Ariz., NM, SW Tex., N Mexico; roost in deep rock crevices, forage over wide area.	Year-round	Fed: None CA: S3S4, CSC	**Minimal** (roosting); **Moderate** (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent
Lasiurus cinereus Hoary bat	Prefers deciduous and coniferous woodlands; primarily roosts in tree foliage.	Spring – Summer	Fed: None CA: S4	**Low** (roosting); **High** (foraging). Suitable foraging habitat is present; suitable roosting habitat is limited.
Myotis yumanensis Yuma myotis	Distribution tied to water bodies, optimal habitats are open forests and woodlands.	Spring – Summer	Fed: None CA: S4	**Low** (roosting); **High** (foraging). Suitable foraging habitat is present; suitable roosting habitat is limited.
Neotoma lepida intermedia San Diego desert woodrat	Arid shrublands, esp. around rocky outcrops & crevices; cismontane Calif from San Luis Obispo to San Diego Co, and NW Baja Calif.	Year-round	Fed: None CA: S3S4, CSC	**Moderate**; not observed, suitable habitat present.
Nyctinomops femorosaccus Pocketed free-tailed bat	Deserts and arid lowlands, SW US, Baja Calif., mainland Mexico; Roost mainly in crevices of high cliffs; forage over water and open shrubland.	Year-round	Fed: None CA: S3, CSC	**Minimal** (roosting); **Moderate** (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Nyctinomops macrotis Big free-tailed bat	Arid lowlands throughout S. Calif., roosts on high cliffs in rocky outcrops. Forages in a variety of habitats and feeds on months.	Spring – Summer	Fed: None CA: S3, CSC	**Minimal** (roosting); **Moderate** (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent

General references (botany): Baldwin et al., 2012; CDFW, 2022a; CDFW, 2022b; CNPS, 2022; and CCH, 2022. General references (wildlife): American Ornithologists Union, 1998 (including supplements through 2013); Barbour and Davis, 1969; Ebird.org, 2022; Feldhamer et al., 2003; Garrett and Dunn, 1981; Hall, 1981; Jennings and Hayes, 1994; Stebbins, 2003; Wilson and Ruff, 1999; and Zeiner et al., 1990.

Conservation Status

Federal designations (*Fed*): (federal ESA, USFWS).

END: Federally listed, endangered.
THR: Federally listed, threatened.
Candidate: Sufficient data are available to support federal listing, but not yet listed.
Proposed: Formally proposed for the federal status shown.
BGEPA: Bald and Golden Eagle Protection Act
DEL: Delisted

State designations (*CA*): (CESA, CDFW)

END: State listed, endangered.
THR: State listed, threatened.
CAND. Sufficient data are available to support federal listing, but not yet listed.
RARE: State listed as rare (applied only to certain plants).
CSC: California Species of Special Concern. Considered vulnerable to extinction due to declining numbers, limited geographic ranges, or ongoing threats.
WL: Species that were either previously listed as SC and have not been state listed under CESA; or were previously state or federally listed and now are on neither list; or are on the list of "Fully Protected" species.
FP: Fully protected. May not be taken or possessed without permit from CDFW.

CDFW Natural Diversity Data Base Designations: Applied to special-status plants and sensitive plant communities; where correct category is uncertain, CDFW uses two categories or question marks.

S1: Fewer than 6 occurrences or fewer than 1000 individuals or less than 2000 acres.
S1.1: Very threatened
S1.2: Threatened
S1.3: No current threats known
S2: 6-20 occurrences or 1,000-3,000 individuals or 2,000-10,000 acres (decimal suffixes same as above).
S3: 21-100 occurrences or 3,000-10,000 individuals or 10,000-50,000 acres (decimal suffixes same as above).
S4: Apparently secure in California; this rank is clearly lower than S3 but factors exist to cause some concern, i.e., there is some threat or somewhat narrow habitat. No threat rank.
S5: Demonstrably secure or ineradicable in California. No threat rank.
SH: All California occurrences historical (i.e., no records in > 20 years).
SX: Presumed extirpated in California.

California Rare Plant Rank designations. Note: According to the California Native Plant Society (http://www.cnps.org/cnps/rareplants/ranking.php), plants ranked as CRPR 1A, 1B, and 2 meet definitions as threatened or endangered and are eligible for state listing. That interpretation of the state Endangered Species Act is not in general use.

1A: Plants presumed extinct in California.
1B: Plants rare and endangered in California and throughout their range.
2A: Plants presumed extinct in California but more common elsewhere in their range.
2B: Plants rare, threatened or endangered in California but more common elsewhere in their range.
3: Plants about which we need more information; a review list.
4: Plants of limited distribution; a watch list.

California Rare Plant Rank Threat designation extensions:

.1 Seriously endangered in California (over 80% of occurrences threatened / high degree and immediacy of threat)
.2 Fairly endangered in California (20-80% occurrences threatened)
.3 Not very endangered in California (<20% of occurrences threatened or no current threats known)

Definitions of occurrence probability: Estimated occurrence probabilities are based on literature sources cited earlier, field surveys, and habitat analyses reported here.

Present: Observed on the site by qualified biologists.
High: Habitat is a type often utilized by the species and the site is within the known range of the species.
Moderate: Site is within the known range of the species and habitat on the site is a type occasionally used.
Low: Site is within the species' known range but habitat is rarely used, or the species was not found during focused surveys covering less than 100% of potential habitat or completed in marginal seasons.
Minimal: No suitable habitat on the site; or well outside the species' known elevational or geographic ranges; or a focused study covering 100% of all suitable habitat, completed during the appropriate season and during a year of appropriate rainfall, did not detect the species.

5.1 Special-Status Plants

5.1.1 Listed Threatened or Endangered Plants

This section describes plant species reported from the region that are listed as threatened or endangered under the federal ESA or CESA and are present or have a potential to be present on the project site. Several listed plant species were identified during the literature review but none of these species were observed or found to have at least a moderate potential to occur.

5.1.2 Other Special-Status Plants

In addition to the federal and state endangered species regulations noted above, CDFW and CNPS maintain lists of plants of conservation concern. The CDFW compiles these species including CDFW and CNPS rankings as CRPR 1, 2, 3, or 4 in its compendium of "Special Plants" (CDFW 2022b). These plants are treated here as "special-status species." Two additional high-priority special-status plants (i.e., CRPR 1B) have at least a moderate potential to be present (Table 3). Several CRPR 4 species were observed or have a potential to be present and are discussed below.

Southern tarplant (*Centromadia parryi* ssp. *australis*). Southern tarplant has a CRPR of 1B.1 (CDFW, 2022a). It is an annual that grows in mesic native grasslands, vernal pools, seasonal marshes, and coastal marshes (CDFW, 2022a). It is known from 94 occurrences in California, about 46 of which are known from within the last 20 years (CNPS, 2022). These occurrences extend from Santa Barbara County south into San Diego County and Baja California (CDFW, 2022a). Southern tarplant was not observed within the project site but was reported in 2003 less than 0.5 miles upstream of Cannon St. in the vicinity of Santiago Creek 0.5 miles (CCH, 2022). Marginally suitable habitat for southern tarplant is present and there is a moderate potential for this species to be present.

Many stemmed dudleya (*Dudleya multicaulis*). Many stemmed dudleya has a CRPR of 1B.2 (CDFW 2022a). It is an ephemeral perennial that grows on heavy soils and rocky outcrops in coastal sage scrub. It is known from approximately 154 occurrences that stretch from Ventura and Los Angeles Counties south to San Diego County (CDFW 2022a). Many stemmed dudleya was not observed within the project site but has a moderate potential to be present in the coastal sage scrub habitat upstream of Smith Basin within 0.15 miles of Cannon St.

Intermediate mariposa-lily (*Calochortus weedii* var. *intermedius*). Intermediate mariposa-lily has a CRPR of 1B.2 (CDFW 2022a). It is a perennial bulb that grows on steep slopes and cliffs in coastal sage scrub. It is known from approximately 194 occurrences primarily within Los Angeles, Riverside, and Orange Counties (CDFW 2022a). Intermediate mariposa-lily was not observed within the project site but has a moderate potential to be present on the exposed slopes within the coastal sage scrub habitat upstream of Smith Basin within about 0.2 miles of Cannon St.

California Rare Plant Rank (CRPR) 4 Species. Two CRPR 4 species (i.e., a "watch list," not indicating rarity) were found during biological surveys including southern California black walnut (*Juglans californica*) and Coulter's matilija poppy (*Romneya coulteri*). Two southern California black walnut trees were observed along Santiago Creek upstream of Smith Basin and several planted Coulter's matilija poppy were observed along Hewes St. in ornamental landscaped areas. Several additional planted Coulter's matilija poppy were observed within restored coastal sage scrub habitat near East Bond Ave. and Prospect Ave. One additional CRPR 4 species, Catalina mariposa lily (*Calochortus catalinae*) has a moderate potential to be present in the uplands upstream of Smith Basin.

5.2 Special-Status Wildlife

5.2.1 Listed Threatened or Endangered Wildlife

This section includes species listed as threatened or endangered under CESA or FESA which were detected or have a high potential to be present on the project site. Two listed species were observed on the project site during the survey and several additional species have a potential to be present. No designated critical habitat for federally listed wildlife species is present within the project site but is located nearby and is discussed below.

Least Bell's vireo (*Vireo bellii pusilus*). Least Bell's vireo is listed as endangered under both the FESA and the CESA (CDFW 2022a). It is a small songbird that nests in riparian vegetation throughout much of southern California. Least Bell's vireo were once widespread in southern California, but their range was greatly reduced due to parasitism by brown-headed cowbirds concurrent with development of riparian habitats. Suitable riparian habitat for least Bell's vireo is present in Smith Basin, Santiago Recharge Basin, and along Santiago Creek. Protocol-level surveys were not completed as part of this report however protocol-level surveys were completed in 2021 and six territories were detected (see Figure 4, Attachment 1). Two additional territorial males were detected along Santiago Creek, just downstream of Cannon St., however nesting could not be confirmed at these locations.

Coastal California gnatcatcher (*Polioptila californica californica*). Coastal California gnatcatcher is listed as threatened under the FESA (CDFW 2022a). Its geographic range is primarily coastal southern California from Ventura County, inland to the Santa Clarita area, Banning area, and southward through northwestern Baja California. Its habitat is coastal sage scrub largely composed of California sagebrush, California buckwheat, and other low-growing, drought-deciduous shrubs. Coastal California gnatcatcher are known to nest on the project site and in 2021 up to 12 territories were detected (see Figure 4, Attachment 1). Two additional territorial males were detected in the upland area, upstream of Smith Basin near Cannon St.; however, nesting could not be confirmed at these locations. Continued habitat restoration within the project site by Orange County Water District (OCWD) has undoubtedly favored the coastal California gnatcatcher and caused recent increases in the local population.

Bald eagle (*Haliaeetus leucocephalus*). Bald eagle has been State-listed as endangered in California since 1971 (CDFW 2022a). It was federally listed as endangered in 1978, then down-listed to threatened in 1995, and delisted in 2007 (USFWS, 1978 and 2007b). It is also protected under the Federal Bald and Golden Eagle Protection Act and is a USFWS Bird of Conservation Concern. The USFWS regulates activities that may "take" bald or golden eagles (USFWS 2007a). The bald eagle is an opportunistic, generalized predator and scavenger adapted to hunting and foraging over aquatic habitats. Breeding bald eagles require relatively large bodies of water containing resident populations of suitable-sized fish. Most bald eagles in California breed near reservoirs or lakes. They typically nest in large trees in close proximity to large bodies or water and may occasionally nest on large powerline structures, and steep cliff faces. A single immature

bald eagle was reported from the project site in 2012 (ebird.org 2022) and the species has a high potential to forage on the project site in the future. Bald eagle nesting habitat is present in the project site, and they are known to nest approximately 5 miles to the east, near Irvine Lake. Bald eagles have a low potential of nesting at the project site, but a high potential to forage.

Swainson's Hawk (*Buteo swainsoni*). Swainson's hawks are listed as threatened under the CESA (CDFW 2022a). In California, they nest in the San Joaquin Valley, western Antelope Valley, and Owens Valley. They migrate to South America every fall and return to California every spring. Swainson's hawks migrate along the Pacific flyway, and several have been observed in the vicinity of the project site during migration. One was reported from the project site in 2011 (ebird.org 2022). The project site is well outside of the breeding range, but Swainson's hawks may migrate over the area biannually. Swainson's hawks have a high potential to be present during migration.

Monarch (*Danaus plexippus* pop. 1). Overwintering populations of monarch in California are a candidate for federal listing under the ESA. The listing would only protect these overwintering sites and not individual butterflies or their food plants. Monarch and their food plants are widespread in California and although milkweed was not seen on the project site, monarchs have a high potential to be present. Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico and roosts are generally located in wind-protected tree groves. The project site is likely too far inland to support winter roosting habitat.

5.2.2 Species Protected Under the Federal Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668d; BGEPA) prohibits take of bald eagles and golden eagles. The BGEPA defines *take* to include "pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, and disturbing." The USFWS (2007a) further defines *disturb* as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

Golden eagle (*Aquila chrysaetos*). Golden eagle is a California Fully Protected species and a USFWS Bird of Conservation Concern (CDFW 2022a). Golden eagles are year-around residents throughout most of their range in the western United States. In the Southwest, they are more common during winter months. They breed from late January through August (Pagel et al. 2010). In the Santa Ana Mountains they nest in steep, rugged, remote terrain. Golden eagles are wide-ranging predators, especially outside of the nesting season, when they have no need to return daily to eggs or young at their nests. A single golden eagle was reported from the project site in 2011 (ebird.org 2022) and the species has a moderate potential to forage on the project site in the future. Golden eagle nesting habitat is absent from the project site.

5.2.3 California Wildlife Species of Special Concern

Santa Ana speckled dace (*Rhinichthys osculus* ssp. 8). Santa Ana speckled dace are found in coastal Southern California streams from Los Angeles, Orange, Riverside, and San Bernardino Counties (CDFW, 2022a). They are known to occur in the San Gabriel River and the Santa Ana River but may have been extirpated from the Los Angeles River. Santa Ana speckled dace require cool (<20° C) shaded mountain streams and are typically found in shallow habitats dominated by cobbles and gravels (CDFW, 2022a). Santa Ana speckled dace are known from Santiago Creek approximately 10 miles upstream of the project site and have a high potential to be present within the project site, just upstream of Smith Basin.

Coastal whiptail (*Aspidoscelis tigris stejnegeri*). Coastal whiptail are found in coastal southern California, mostly west of the Peninsular Ranges and south of the Transverse Ranges. There range extends north into Ventura County and south to Baja California. The coastal whiptail occurs in a variety of habitats including various upland and riparian habitats. It is most commonly associated with areas of dense vegetation but is also found around sandy areas along gravelly arroyos or washes (Stebbins 2003). Coastal whiptail were not observed within the project site but have a high potential to be present throughout the project site.

Red-diamond rattlesnake (*Crotalus ruber*). Red-diamond rattlesnake live between sea level and about 5,000 feet elevation throughout most of Orange County and western Riverside County, south through San Diego and Baja California and inland to the Colorado Desert margins. Their habitats include coastal sage scrub, chaparral, and woodlands through most of their geographic range, and desert scrub at the eastern margins of their range. There are numerous records of red diamond rattlesnakes from the Santa Ana Mountains to the east of the project site. The nearest known occurrence is about 0.4 miles to the east. Red diamond rattlesnake have not been reported on the project site, but habitat throughout the site appears suitable and there is a moderate potential to be present.

Coast horned lizard (*Phrynosoma blainvillii*). Coast horned lizard are found throughout much of coastal southern California, inland as far as the southern Mojave Desert and to about 6,000 ft elevation in the mountains. Coast horned lizards occur in sandy soils in a variety of shrubland, grassland, and woodland habitat types. They have been extirpated from much of their historic range by land use changes, but they remain fairly common in natural open space areas where their primary prey (native ants) are found. Coast horned lizard were not observed within the project site but have a moderate potential to be present on the project site, primarily in the upland habitat upstream of Smith Basin.

Burrowing owl (*Athene cunicularia*). Burrowing owl are uncommon throughout much of southern California with the highest densities occurring near agricultural lands in the Imperial Valley. Burrowing owl have been extirpated from portions of Orange County because of development. Burrowing owl are still periodically observed in Orange County and have been observed within about 3 miles of the project site (inaturalist.org 2021). The habitat at the site is marginally suitable for this species, but with a sufficient prey base, and an abundant ground squirrel population (for producing burrows), it is possible that breeding or wintering burrowing owls could persist at the site.

Coastal cactus wren (*Campylorhynchus brunneicapillus sandiegensis*). Coastal cactus wren are found in coastal southern California, from Orange and Riverside Counties south into San Diego County and Baja California. Coastal cactus wren occur in coastal sage scrub habitat, primarily in areas with patches of cactus (*Opuntia* sps.). Coastal cactus wren were not observed within the project site but have a high potential to be present in the upland habitat upstream of Smith Basin.

Yellow-breasted chat (*Icteria virens*). Yellow-breasted chat is a migratory species, occurring in California only during the breeding season which is typically between April and August. In California, it primarily breeds in the northern portion of the state and is scarce in the central and southern portions. It typically utilizes dense riparian thickets and brushy tangles near watercourses for breeding (CDFW 2022a). Yellow-breasted chat have not been previously detected on the project site but have a high potential to be present during the nesting season.

Yellow warbler (*Setophaga petechia*). Yellow warbler is a migratory species, occurring in California only during the breeding season, which is typically between April and August. In California, it is widespread in riparian habitat throughout much of the state. It typically nests in dense riparian vegetation near watercourses (CDFW 2022a). Yellow warbler were previously detected on the project site in 2008 and

2011 but were not detected during the recent surveys (ebirg.org 2022). Suitable habitat is present throughout the project site, and they are likely to be present during the nesting season.

San Diego desert woodrat (*Neotoma lepida intermedia*). San Diego desert woodrat is known from coastal and desert scrub and rocky outcrops throughout much of southern California (CDFW 2022). It frequently builds large middens (piles of sticks and debris arranged to form a shelter) in rock outcrops or around the bases of shrubs. In some portions of its range, it builds middens primarily at the bases of cactus (*Opuntia* sps.) and yucca (*Yucca* sps.) plants (Feldhamer et al. 2003). Habitat in the project site is suitable for San Diego desert woodrat and it has been documented within about 5 miles of the project site.

Bats. Several special-status bat species have at least a low potential to forage over the Project site: pallid bat (*Antrozous pallidus*), Western mastiff bat (*Eumops perotis californicus*), Mexican long-tongued bat (*Choeronycteris Mexicana*), hoary bat (*Lasiurus cinereus*), Yuma myotis (*Myotis yumanensis*), big free-tailed bat (*Nyctinomops macrotis*), and pocketed free-tailed bat (*Nyctinomops femorosaccus*). The pallid bat and Western mastiff bat forage in open areas over grasslands, agricultural areas, and other shrublands and roost in a variety of habitats including building, rock crevices, and caves. The pocketed free-tailed bat forages over water and open shrublands and roosts in crevices in cliffs. Hoary bats may roost in tree foliage within the project site. The remaining species are unlikely to roost in the project site because of a lack of suitable roosting habitat.

5.2.3 Other Special-Status Wildlife Species

Crotch bumble bee (*Bombus crotchii*). Crotch bumble bee was recently petitioned for listing under the CESA but was determined to not be eligible for protection under CESA. It is currently recognized as a special animal but may be petitioned again in the future based on a recent interpretation of CESA which indicates that some invertebrates may be eligible for protection. Crotch bumble bee is a widespread secretive species that is known from more than two hundred locations over a broad geographic range (CDFW 2022a). It is typically found in openings in grassland and scrub habitats where it burrows into the ground and lives in colonies. It feeds on native plants including milkweed, pincushion, lupine, phacelia, sage, snapdragon, clarkia, bush poppy, and buckwheat. Many of these food plants are present on the project site and suitable burrowing habitat is also present. Crotch bumblebee has a high potential to be present on the site and is known from numerous observations in the region.

Orange-throated whiptail (*Aspidoscelis hyperythra*). Orange-throated whiptail are found in coastal southern California, mostly from Riverside and Orange Counties south into San Diego County and Baja California. The orange-throated whiptail occurs in a variety of habitats including woodlands, coastal sage scrub, and chaparral. It is often found in sandy areas with patches of brush and rocks (CDFW 2022a). Orange-throated whiptail were not observed within the project site but have a high potential to be present throughout the project site.

Raptors. In addition to the raptors discussed above, several other special-status birds of prey including Cooper's hawk (*Accipiter cooperii*), white-tailed kite (*Elanus leucurus*), American peregrine falcon (*Falco peregrinus anatum*), and osprey (*Pandion haliaetus*) were observed on the project site or have at least a moderate potential to be present. These raptors are found seasonally in the region, especially during winter and during migration. Both an individual Cooper's hawk and an individual Osprey were observed flying over the project site in 2022.

Other Special-status Birds. Southern California rufous-crowned sparrow (*Aimophila ruficeps canescens*), great blue heron (*Ardea herodias*), and California horned lark (*Eremophila alpestris actia*) are the only

"Watch List" wildlife species with at least a moderate potential to be present on the project site. None of these species are afforded specific protection under either state or federal regulations.

5.3 Designated Critical Habitat

The literature review conducted prior to conducting field surveys determined that the project site is not within federally designated critical habitat for any species. The nearest designated critical habitat is for coastal California gnatcatcher and is located within approximately 0.4 miles east of the project site (USFWS 2007c).

5.4 Native Birds: Migratory Bird Treaty Act (MBTA) / California Fish and Game Code

The federal MBTA prohibits take of any migratory bird, including eggs or active nests, except as permitted by regulation (e.g., licensed hunting of waterfowl or upland game species). Under the MBTA, "migratory bird" is broadly defined as "any species or family of birds that live, reproduce or migrate within or across international borders at some point during their annual life cycle" and thus applies to most native bird species. California Fish and Game Code Section 3503 prohibits take, possession, or needless destruction of bird nests or eggs; Section 3503.5 prohibits take or possession of birds of prey or their eggs; and Section 3513 prohibits take or possession of any migratory nongame bird. With the exception of a few non-native birds, such as European starling, the take of any birds or loss of active bird nests or young is regulated by these statutes. Most of these species have no other special conservation status as defined above.

The project site has many trees, shrubs, and open areas that may provide nesting habitat. Numerous common and special-status birds are known to nest on the project site or have a potential to nest there. During the surveys two active red-tailed hawk nests were observed. Three lesser nighthawk nests were also observed by David McMichael of OCWD.

Many adult birds would flee from equipment during project construction; however, nestlings and eggs would be vulnerable. If project activities include site grading or brush removal during nesting season, then it would likely destroy bird nests, including eggs or nestling birds. For most birds, these impacts can be avoided by scheduling initial clearing and grading outside the nesting season. Or, if initial clearing and grading are undertaken during nesting season, work may be limited only to areas where no nesting birds are present, as documented by pre-construction nest surveys.

Some birds are likely to nest in the project site during construction, even after initial grading and clearing have been completed. Depending on the species, birds may nest on the ground; in adjacent vegetation; or on construction equipment that is left overnight or during a long weekend. The species most likely to nest in the project site during construction are common ravens, house finches, killdeer, and mourning doves, all of which are protected by the MBTA and Fish and Game Code. Due to the high probability that birds may nest on site during construction, regular monitoring and nest site management may be necessary throughout the breeding season.

5.5 Wildlife Movement

The ability for wildlife to move freely among populations and habitat areas is important to long-term genetic variation and demography. Fragmentation and isolation of natural habitat may cause loss of native species diversity in fragmented habitats. In the short term, wildlife movement may also be important to individual animals' ability to occupy their home ranges, if their ranges extend across a potential movement

barrier. These considerations are especially important for rare, threatened, or endangered species, and wide-ranging species such as large mammals, which exist in low population densities.

The California Essential Habitat Connectivity Project was commissioned by the California Department of Transportation (Caltrans) and CDFW to create a statewide assessment of essential habitat connectivity to be used for conservation and infrastructure planning (Caltrans and CDFW 2010). One of its goals was to create the Essential Connectivity Map, which depicts large, relatively natural habitat blocks that support native biodiversity (natural landscape blocks) and areas essential for ecological connectivity between them (essential connectivity areas). This map does not reflect the needs of particular species but is based on overall biological connectivity and ecological integrity. A more detailed analysis is required to assess local and regional needs for connectivity and develop linkage designs based on the requirements of individual species (Caltrans and CDFW 2010). The project site is not located within any identified Essential Habitat Connectivity Areas or Natural Landscape Blocks. The project site is more likely to support more localized movement within the region and some upstream and downstream movement corridors along Santiago Creek.

5.6 Tree Ordinances

As discussed above, the project site is located within the cities of Orange, Santa Ana, and Villa Park and within unincorporated Orange County. Coast live oak tree and other native trees within the project site may be protected by local tree ordinances. The cities of Villa Park and Orange do not have any tree protection ordinances. The city of Santa Ana does have a tree care ordinance, but this would not apply to trees within the project site because it applies to street trees and such. Orange County does not have an adopted tree ordinance however a draft tree ordinance does exist and if adopted before the start of the project, would likely require a permit for removal of native trees within unincorporated portions of Orange County (Orange County, 2016).

6.0. Conclusions

One State and federally listed species, least Bell's vireo is known to nest in the riparian vegetation within the project site. At least six vireo territories were present in 2021. One additional federally listed species, coastal California gnatcatcher, is known to nest in the coastal sage scrub within the project site. At least twelve gnatcatcher territories were present in 2021. Two additional State listed species, bald eagle and Swainson's hawk, were previously documented on the project site and both have a high potential to forage on the project site but with a minimal and low nesting potential, respectively. Bald eagle are known to nest in the region and have a moderate potential to nest on the project site in the future.

Several additional special-status wildlife species were observed or have at least a moderate potential to be present and include Crotch bumble bee, Santa Ana speckled dace, orange-throated whiptail, coastal whiptail, red-diamond rattlesnake, coast horned lizard, burrowing owl, golden eagle, coastal cactus wren, yellow-breasted chat, yellow warbler, Cooper's hawk, white-tailed kite, American peregrine falcon, osprey, Southern California rufous-crowned sparrow, great blue heron, California horned lark, Mexican long-tongued bat, hoary bat, Yuma myotis, big free-tailed bat, pocketed free-tailed bat, San Diego desert woodrat, pallid bat, and western mastiff bat (refer to Table 3).

In addition to special-status wildlife, two special-status plants including Southern California black walnut and Coulter's matilija poppy were observed on the project site. In addition, several additional special-status species have at least a moderate potential to be present and include many stemmed dudleya, intermediate mariposa-lily, and Catalina mariposa lily.

One sensitive natural community was also present within the project site and includes Goodding's willow - red willow riparian woodland and forest, is present on the project site. The project site is not within any designated wildlife corridors but expected to provide localized wildlife movement along Santiago Creek and within the region. The project site is likely to be used as a forage or dispersal area for wildlife in the immediate vicinity of the project site.

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Attachment 1 – Figures



Figure 1

Project Overview



Figure 2a

Project Site
Smith Basin and Santiago Creek Recharge

August 2022

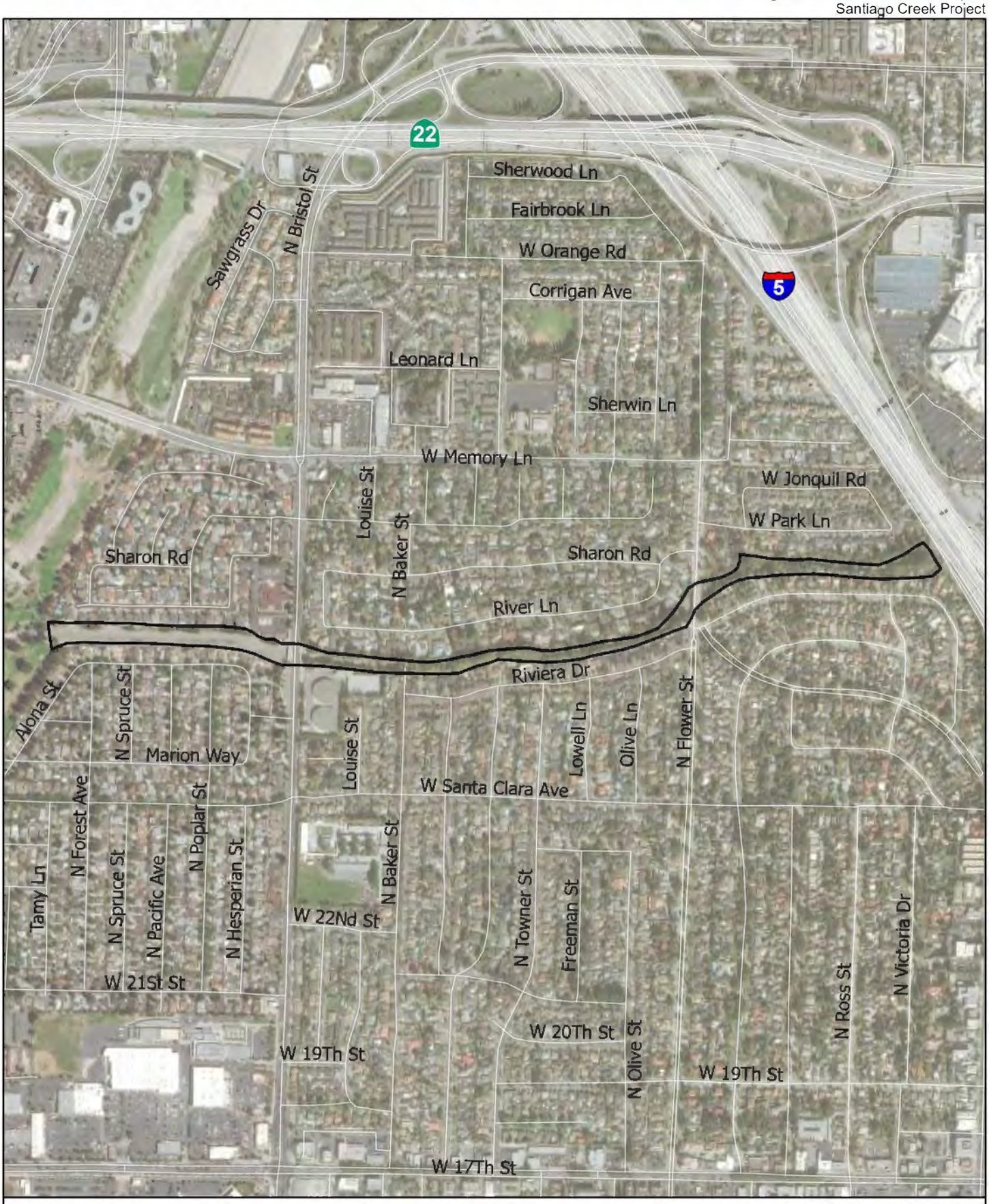


Figure 2b

Project Site
Santiago Creek Channel

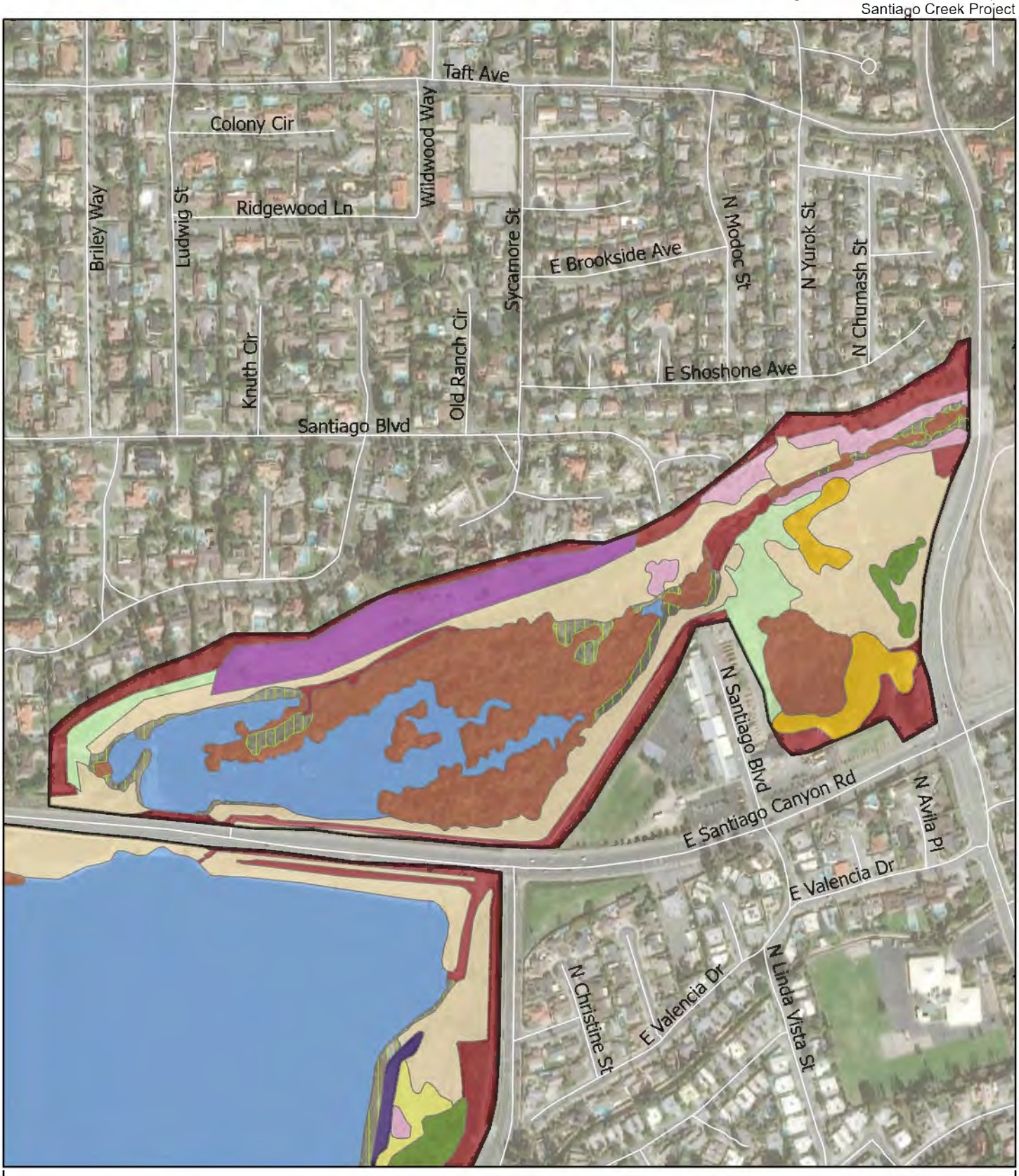


Figure 3a

Vegetation and Land Cover
Smith Basin

August 2022



Figure 3b

Vegetation and Land Cover
Santiago Creek Recharge

August 2022



Project Site

Vegetation and Cover Types

- Coast live oak woodland and forest (0.38 acres)
- Developed (37.67 acres)
- Eucalyptus - tree of heaven - black locust groves (8.29 acres)
- Unvegetated channel and slopes (10.43 acres)

N

0 500 1,000 Feet

Figure 3c

Vegetation and Land Cover
Santiago Creek Channel

August 2022



Figure 4
Biological Resources

Attachment 2 – CNDDB Query Results

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (Yorba Linda (3311787) OR Prado Dam (3311786) OR Anaheim (3311778) OR Orange (3311777) OR Black Star Canyon (3311776) OR Newport Beach (3311768) OR Tustin (3311767) OR El Toro (3311766) OR La Habra (3311788))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Abronia villosa var. aurita chaparral sand-verbena	PDNYC010P1	None	None	G5T2?	S2	1B.1
Accipiter cooperii Cooper's hawk	ABNKC12040	None	None	G5	S4	WL
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Threatened	G1G2	S1S2	SSC
Aimophila ruficeps canescens southern California rufous-crowned sparrow	ABPBX91091	None	None	G5T3	S3	WL
Allium marvinii Yucaipa onion	PMLIL02330	None	None	G1	S1	1B.2
Ammodramus savannarum grasshopper sparrow	ABPBXA0020	None	None	G5	S3	SSC
Anaxyrus californicus arroyo toad	AAABB01230	Endangered	None	G2G3	S2S3	SSC
Anniella stebbinsi Southern California legless lizard	ARACC01060	None	None	G3	S3	SSC
Antrozous pallidus pallid bat	AMACC10010	None	None	G4	S3	SSC
Aphanisma blitoides aphanisma	PDCHE02010	None	None	G3G4	S2	1B.2
Aquila chrysaetos golden eagle	ABNKC22010	None	None	G5	S3	FP
Ardea herodias great blue heron	ABNGA04010	None	None	G5	S4	
Arizona elegans occidentalis California glossy snake	ARADB01017	None	None	G5T2	S2	SSC
Asio otus long-eared owl	ABNSB13010	None	None	G5	S3?	SSC
Aspidoscelis hyperythra orange-throated whiptail	ARACJ02060	None	None	G5	S2S3	WL
Aspidoscelis tigris stejnegeri coastal whiptail	ARACJ02143	None	None	G5T5	S3	SSC
Astragalus brauntonii Braunton's milk-vetch	PDFAB0F1G0	Endangered	None	G2	S2	1B.1
Astragalus hornii var. hornii Horn's milk-vetch	PDFAB0F421	None	None	GUT1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Atriplex coulteri Coulter's saltbush	PDCHE040E0	None	None	G3	S1S2	1B.2
Atriplex pacifica south coast saltscale	PDCHE041C0	None	None	G4	S2	1B.2
Atriplex parishii Parish's brittlescale	PDCHE041D0	None	None	G1G2	S1	1B.1
Atriplex serenana var. davidsonii Davidson's saltscale	PDCHE041T1	None	None	G5T1	S1	1B.2
Baccharis malibuensis Malibu baccharis	PDAST0W0W0	None	None	G1	S1	1B.1
Bombus crotchii Crotch bumble bee	IIHYM24480	None	None	G2	S1S2	
Branchinecta sandiegonensis San Diego fairy shrimp	ICBRA03060	Endangered	None	G2	S2	
Brodiaea filifolia thread-leaved brodiaea	PMLIL0C050	Threatened	Endangered	G2	S2	1B.1
Buteo regalis ferruginous hawk	ABNKC19120	None	None	G4	S3S4	WL
Buteo swainsoni Swainson's hawk	ABNKC19070	None	Threatened	G5	S3	
California Walnut Woodland California Walnut Woodland	CTT71210CA	None	None	G2	S2.1	
Calochortus plummerae Plummer's mariposa-lily	PMLIL0D150	None	None	G4	S4	4.2
Calochortus weedii var. intermedius intermediate mariposa-lily	PMLIL0D1J1	None	None	G3G4T3	S3	1B.2
Calystegia felix lucky morning-glory	PDCON040P0	None	None	G1Q	S1	1B.1
Campylorhynchus brunneicapillus sandiegensis coastal cactus wren	ABPBG02095	None	None	G5T3Q	S3	SSC
Catostomus santaanae Santa Ana sucker	AFCJC02190	Threatened	None	G1	S1	
Centromadia parryi ssp. australis southern tarplant	PDAST4R0P4	None	None	G3T2	S2	1B.1
Centromadia pungens ssp. laevis smooth tarplant	PDAST4R0R4	None	None	G3G4T2	S2	1B.1
Chaetodipus fallax fallax northwestern San Diego pocket mouse	AMAFD05031	None	None	G5T3T4	S3S4	SSC
Charadrius nivosus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S2	SSC
Chloropyron maritimum ssp. maritimum salt marsh bird's-beak	PDSCR0J0C2	Endangered	Endangered	G4?T1	S1	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Choeronycteris mexicana Mexican long-tongued bat	AMACB02010	None	None	G3G4	S1	SSC
Chorizanthe parryi var. fernandina San Fernando Valley spineflower	PDPGN040J1	None	Endangered	G2T1	S1	1B.1
Chorizanthe polygonoides var. longispina long-spined spineflower	PDPGN040K1	None	None	G5T3	S3	1B.2
Cicindela hirticollis gravida sandy beach tiger beetle	IICOL02101	None	None	G5T2	S2	
Cicindela latesignata western beach tiger beetle	IICOL02110	None	None	G2G3	S1	
Coccyzus americanus occidentalis western yellow-billed cuckoo	ABNRB02022	Threatened	Endangered	G5T2T3	S1	
Coelus globosus globose dune beetle	IICOL4A010	None	None	G1G2	S1S2	
Coturnicops noveboracensis yellow rail	ABNME01010	None	None	G4	S1S2	SSC
Crotalus ruber red-diamond rattlesnake	ARADE02090	None	None	G4	S3	SSC
Danaus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	Candidate	None	G4T2T3	S2S3	
Dudleya multicaulis many-stemmed dudleya	PDCRA040H0	None	None	G2	S2	1B.2
Elanus leucurus white-tailed kite	ABNKC06010	None	None	G5	S3S4	FP
Empidonax traillii extimus southwestern willow flycatcher	ABPAE33043	Endangered	Endangered	G5T2	S1	
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Eremophila alpestris actia California horned lark	ABPAT02011	None	None	G5T4Q	S4	WL
Eriastrum densifolium ssp. sanctorum Santa Ana River woollystar	PDPLM03035	Endangered	Endangered	G4T1	S1	1B.1
Eryngium aristulatum var. parishii San Diego button-celery	PDAPI0Z042	Endangered	Endangered	G5T1	S1	1B.1
Eumops perotis californicus western mastiff bat	AMACD02011	None	None	G4G5T4	S3S4	SSC
Euphydryas editha quino quino checkerspot butterfly	IILEPK405L	Endangered	None	G5T1T2	S1S2	
Falco peregrinus anatum American peregrine falcon	ABNKD06071	Delisted	Delisted	G4T4	S3S4	FP
Glyptostoma gabrielense San Gabriel chestnut	IMGASB1010	None	None	G2	S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Habroscelimorpha gabbii western tidal-flat tiger beetle	IICOL02080	None	None	G2G4	S1	
Haliaeetus leucocephalus bald eagle	ABNKC10010	Delisted	Endangered	G5	S3	FP
Helianthus nuttallii ssp. parishii Los Angeles sunflower	PDAST4N102	None	None	G5TX	SX	1A
Hesperocyparis forbesii Tecate cypress	PGCUP040C0	None	None	G2	S2	1B.1
Horkelia cuneata var. puberula mesa horkelia	PDROS0W045	None	None	G4T1	S1	1B.1
Icteria virens yellow-breasted chat	ABPBX24010	None	None	G5	S3	SSC
Isocoma menziesii var. decumbens decumbent goldenbush	PDAST57091	None	None	G3G5T2T3	S2	1B.2
Lasiurus cinereus hoary bat	AMACC05030	None	None	G3G4	S4	
Lasthenia glabrata ssp. coulteri Coulter's goldfields	PDAST5L0A1	None	None	G4T2	S2	1B.1
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3T1	S1	FP
Lepechinia cardiophylla heart-leaved pitcher sage	PDLAM0V020	None	None	G3	S2S3	1B.2
Lepidium virginicum var. robinsonii Robinson's pepper-grass	PDBRA1M114	None	None	G5T3	S3	4.3
Monardella australis ssp. jokerstii Jokerst's monardella	PDLAM18112	None	None	G4T1?	S1?	1B.1
Monardella hypoleuca ssp. intermedia intermediate monardella	PDLAM180A4	None	None	G4T2?	S2?	1B.3
Myotis yumanensis Yuma myotis	AMACC01020	None	None	G5	S4	
Nama stenocarpa mud nama	PDHYD0A0H0	None	None	G4G5	S1S2	2B.2
Nasturtium gambelii Gambel's water cress	PDBRA270V0	Endangered	Threatened	G1	S1	1B.1
Navarretia prostrata prostrate vernal pool navarretia	PDPLM0C0Q0	None	None	G2	S2	1B.2
Nemacaulis denudata var. denudata coast woolly-heads	PDPGN0G011	None	None	G3G4T2	S2	1B.2
Neotoma lepida intermedia San Diego desert woodrat	AMAFF08041	None	None	G5T3T4	S3S4	SSC
Nolina cismontana chaparral nolina	PMAGA080E0	None	None	G3	S3	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Nyctinomops femorosaccus pocketed free-tailed bat	AMACD04010	None	None	G5	S3	SSC
Nyctinomops macrotis big free-tailed bat	AMACD04020	None	None	G5	S3	SSC
Oncorhynchus mykiss irideus pop. 10 steelhead - southern California DPS	AFCHA0209J	Endangered	Candidate Endangered	G5T1Q	S1	
Onychomys torridus ramona southern grasshopper mouse	AMAFF06022	None	None	G5T3	S3	SSC
Orcuttia californica California Orcutt grass	PMPOA4G010	Endangered	Endangered	G1	S1	1B.1
Pandion haliaetus osprey	ABNKC01010	None	None	G5	S4	WL
Panoquina errans wandering (=saltmarsh) skipper	IILEP84030	None	None	G4G5	S2	
Passerculus sandwichensis beldingi Belding's savannah sparrow	ABPBX99015	None	Endangered	G5T3	S3	
Penstemon californicus California beardtongue	PDSCR1L110	None	None	G3	S2	1B.2
Pentachaeta aurea ssp. allenii Allen's pentachaeta	PDAST6X021	None	None	G4T1	S1	1B.1
Perognathus longimembris pacificus Pacific pocket mouse	AMAFD01042	Endangered	None	G5T1	S1	SSC
Phrynosoma blainvillii coast horned lizard	ARACF12100	None	None	G3G4	S3S4	SSC
Polioptila californica californica coastal California gnatcatcher	ABPBJ08081	Threatened	None	G4G5T3Q	S2	SSC
Pseudognaphalium leucocephalum white rabbit-tobacco	PDAST440C0	None	None	G4	S2	2B.2
Rallus obsoletus levipes light-footed Ridgway's rail	ABNME05014	Endangered	Endangered	G3T1T2	S1	FP
Rhinichthys osculus ssp. 8 Santa Ana speckled dace	AFCJB3705K	None	None	G5T1	S1	SSC
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
Riversidian Alluvial Fan Sage Scrub Riversidian Alluvial Fan Sage Scrub	CTT32720CA	None	None	G1	S1.1	
Salvadora hexalepis virgultea coast patch-nosed snake	ARADB30033	None	None	G5T4	S2S3	SSC
Senecio aphanactis chaparral ragwort	PDAST8H060	None	None	G3	S2	2B.2
Setophaga petechia yellow warbler	ABPBX03010	None	None	G5	S3S4	SSC

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Sidalcea neomexicana salt spring checkerbloom	PDMAL110J0	None	None	G4	S2	2B.2
Sorex ornatus salicornicus southern California saltmarsh shrew	AMABA01104	None	None	G5T1?	S1	SSC
Southern California Arroyo Chub/Santa Ana Sucker Stream Southern California Arroyo Chub/Santa Ana Sucker Stream	CARE2330CA	None	None	GNR	SNR	
Southern Coast Live Oak Riparian Forest Southern Coast Live Oak Riparian Forest	CTT61310CA	None	None	G4	S4	
Southern Coastal Salt Marsh Southern Coastal Salt Marsh	CTT52120CA	None	None	G2	S2.1	
Southern Cottonwood Willow Riparian Forest Southern Cottonwood Willow Riparian Forest	CTT61330CA	None	None	G3	S3.2	
Southern Dune Scrub Southern Dune Scrub	CTT21330CA	None	None	G1	S1.1	
Southern Foredunes Southern Foredunes	CTT21230CA	None	None	G2	S2.1	
Southern Interior Cypress Forest Southern Interior Cypress Forest	CTT83230CA	None	None	G2	S2.1	
Southern Riparian Scrub Southern Riparian Scrub	CTT63300CA	None	None	G3	S3.2	
Southern Sycamore Alder Riparian Woodland Southern Sycamore Alder Riparian Woodland	CTT62400CA	None	None	G4	S4	
Southern Willow Scrub Southern Willow Scrub	CTT63320CA	None	None	G3	S2.1	
Spea hammondii western spadefoot	AAABF02020	None	None	G2G3	S3	SSC
Sternula antillarum browni California least tern	ABNNM08103	Endangered	Endangered	G4T2T3Q	S2	FP
Streptocephalus woottoni Riverside fairy shrimp	ICBRA07010	Endangered	None	G1G2	S1S2	
Suaeda esteroa estuary seablite	PDCHE0P0D0	None	None	G3	S2	1B.2
Symphyotrichum defoliatum San Bernardino aster	PDASTE80C0	None	None	G2	S2	1B.2
Taricha torosa Coast Range newt	AAAAF02032	None	None	G4	S4	SSC
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Thamnophis hammondii two-striped gartersnake	ARADB36160	None	None	G4	S3S4	SSC
Tryonia imitator mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	G2	S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Vireo bellii pusillus	ABPBW01114	Endangered	Endangered	G5T2	S2	
least Bell's vireo						

Record Count: 125

Attachment 3 – IPaC Resource List

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

NOT FOR CONSULTATION

Location

Orange County, California



Local office

Carlsbad Fish And Wildlife Office

(760) 431-9440
(760) 431-5901

2177 Salk Avenue - Suite 250
Carlsbad, CA 92008-7385

http://www.fws.gov/carlsbad/

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Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

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2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Birds

NAME	STATUS
Coastal California Gnatcatcher *Polioptila californica californica* Wherever found There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/8178	**Threatened**
Least Bell's Vireo *Vireo bellii pusillus* Wherever found There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/5945	Endangered

Fishes

NAME	STATUS
Santa Ana Sucker *Catostomus santaanae* There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3785	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* Wherever found **No critical habitat has been designated for this species.** https://ecos.fws.gov/ecp/species/9743	**Candidate**

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

NOT FOR CONSULTATION

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range **and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.**

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME

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BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)

Allen's Hummingbird Selasphorus sasin — Breeds Feb 1 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9637

Bald Eagle Haliaeetus leucocephalus — Breeds Jan 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Black Skimmer Rynchops niger — Breeds May 20 to Sep 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5234

Black-chinned Sparrow Spizella atrogularis — Breeds Apr 15 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9447

California Thrasher Toxostoma redivivum — **Breeds Jan 1 to Jul 31**

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Clark's Grebe Aechmophorus clarkii — **Breeds Jun 1 to Aug 31**

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

NOT FOR CONSULTATION

Common Yellowthroat Geothlypis trichas sinuosa — **Breeds May 20 to Jul 31**

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/2084

Golden Eagle Aquila chrysaetos — **Breeds Jan 1 to Aug 31**

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Lawrence's Goldfinch Carduelis lawrencei — Breeds Mar 20 to Sep 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9464

Long-eared Owl asio otus — Breeds Mar 1 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3631

Marbled Godwit Limosa fedoa — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — **Breeds Mar 15 to Jul 15**

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Olive-sided Flycatcher Contopus cooperi — **Breeds May 20 to Aug 31**

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3914

NOT FOR CONSULTATION

Short-billed Dowitcher Limnodromus griseus — **Breeds elsewhere**

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9480

Willet Tringa semipalmata — **Breeds elsewhere**

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Wrentit Chamaea fasciata — **Breeds Mar 15 to Aug 10**

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence ( )

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

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3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

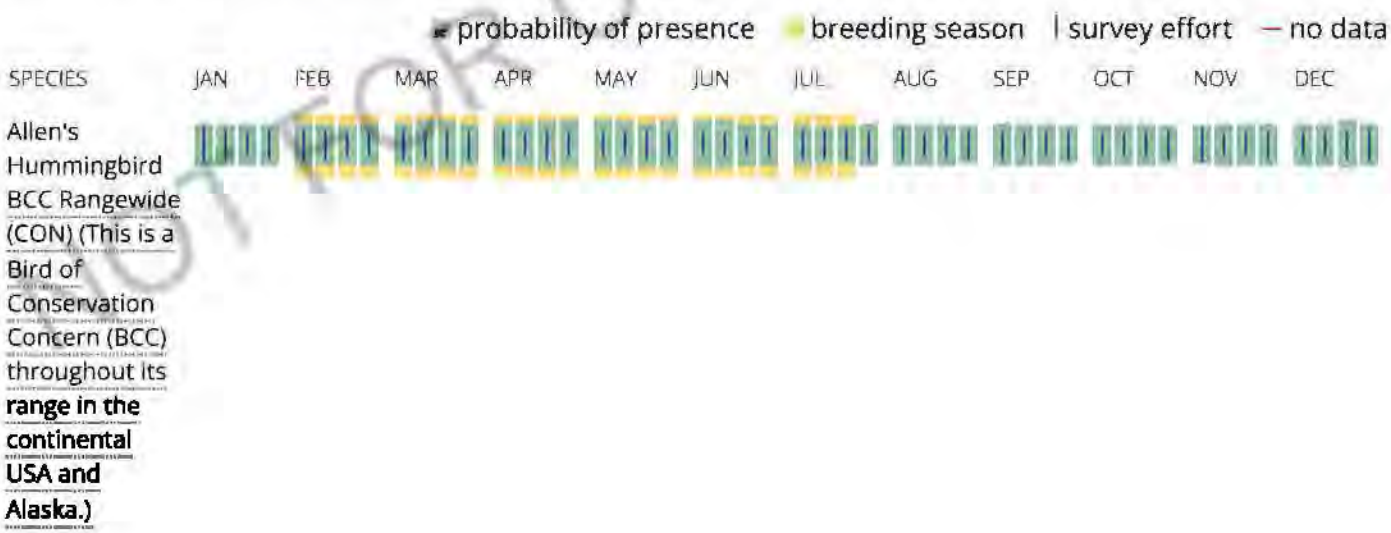
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

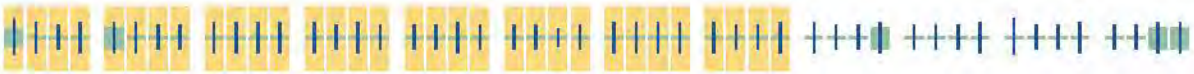
No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



NOT FOR CONSULTATION

Bald Eagle Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



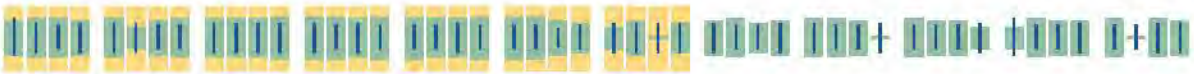
Black Skimmer BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Black-chinned Sparrow BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



California Thrasher BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



NOT FOR CONSULTATION

Clark's Grebe BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



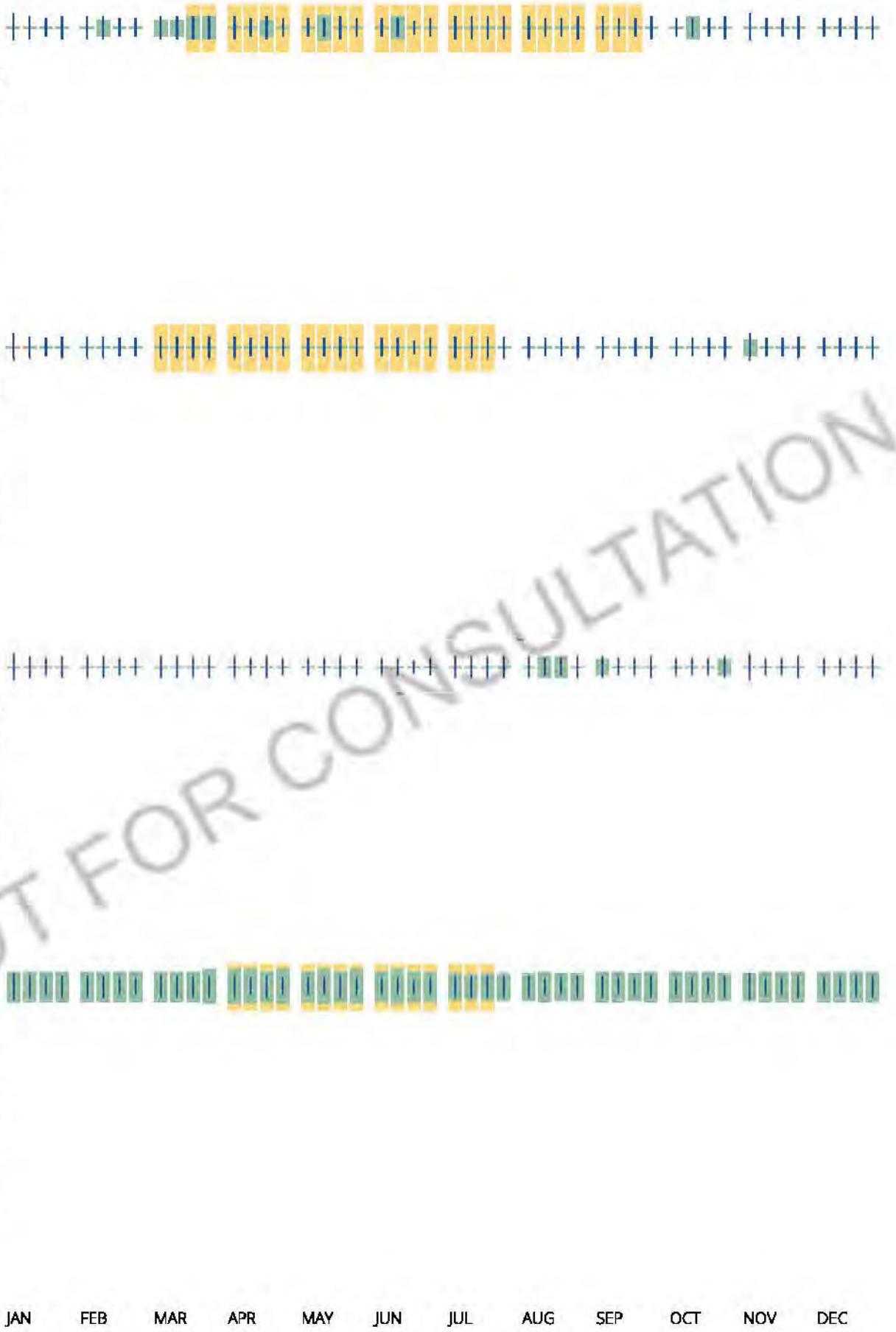
Common Yellowthroat BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Golden Eagle Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from **certain types of development or activities.)**



NOT FOR CONSULTATION



NOT FOR CONSULTATION

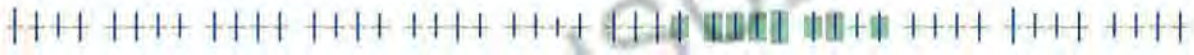
Oak Titmouse BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Olive-sided Flycatcher BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Short-billed Dowitcher BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Willet BCC Rangewide (CON) (This is a Bird of Conservation **Concern (BCC) throughout its range in the continental USA and Alaska.)**



NOT FOR CONSULTATION

Wrentit BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

NOT FOR CONSULTATION

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

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Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

WETLAND INFORMATION IS NOT AVAILABLE AT THIS TIME

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION

Attachment 4 – Special-Status Species Not Addressed

Attachment 4. Special-Status Species Not Addressed[1]

Latin Name	Common Name	Reason for Exclusion
PLANTS		
Abronia villosa var. *aurita*	Chaparral sand-verbena	Extirpated from Orange County.
Allium marvinii	Yucaipa onion	No suitable substrate and west of geographic range.
Aphanisma blitoides	Anaphanisma	No coastal bluff or coastal scrub habitat.
Astragalus hornii var. *hornii*	Horn's milk vetch	No alkali playa or saltbush scrub habitat.
Astragalus pycnostachyus var. *lanosissimus*	Ventura marsh milk vetch	No coastal saltmarsh habitat.
Atriplex coulteri	Coulter's saltbush	No alkali playa or saltbush scrub habitat.
Atriplex pacifica	South coast saltscale	No alkali playa or saltbush scrub habitat.
Atriplex parishii	Parish's brittlescale	No alkali playa or saltbush scrub habitat.
Atriplex serenana var. *davidsonii*	Davidson's saltscale	No alkali playa or saltbush scrub habitat.
Brodiaea filifolia	Thread-leaved brodiaea	No suitable clay soils.
Centromedia pungens ssp. *laevis*	Smooth tarplant	No alkali playa or saltbush scrub habitat.
Chloropyron maritimum ssp. *maritimum*	Salt marsh bird's-beak	No coastal saltmarsh habitat.
Chorizanthe parryi var. *fernandina*	San Fernando Valley spineflower	Extirpated from Orange County.
Chorizanthe polygonoides var. *longispina*	Long-spined spineflower	No suitable clay soils.
Eriastrum densifolium ssp. *sanctorum*	Santa Ana River woollystar	Extirpated from Orange County.
Eryngium aristulatum var. *parishii*	San Diego button-celery	No vernal pool habitat.
Helianthus nuttallii ssp. *parishii*	Los Angeles sunflower	Extinct species, no suitable seep or spring habitat.
Hesperocyparis forbesii	Tecate cypress	No suitable forest or chaparral habitat.
Isocoma menziesii var. *decumbens*	Decumbent goldenbush	No coastal saltmarsh habitat.
Lasthenia glabrata ssp. *coulteri*	Coulter's goldfields	No vernal pool or coastal playa habitat.
Lepechinia cardiophylla	Heart-leaved pitcher sage	Well outside of geographic range.
Nama stenocarpa	Mud nama	No vernal pool habitat.
Nasturtium gambelii	Gambel's water cress	Extirpated from Southern California.
Navarretia prostrata	Prostrate vernal pool navarretia	No vernal pool habitat.
Nemacaulis denudata var. *denudata*	Coast woolly-heads	No coastal dune habitat.
Monardella australis ssp. *jokerstii*	Jokerst's monardella	Well below the species elevation range.
Monardella hypoleuca ssp. *intermedia*	Intermediate monardella	Well below the species elevation range.
Orcuttia californica	California Orcutt grass	No vernal pool habitat.
Penstemon californicus	California beardtongue	No suitable habitat, well west of geographic range.
Senecio aphanactis	Chaparral ragwort	No suitable alkali soils present.
Sidalcea neomexicana	Salt spring checkerbloom	No suitable freshwater wetland habitat.
Suaeda esteroa	Estuary seablite	No coastal bluff or coastal scrub habitat.
Symphyotrichum defoliatum	San Bernardino aster	No suitable freshwater wetland habitat.
INVERTEBRATES		
Branchinecta sandiegonensis	San Diego fairy shrimp	No vernal pool habitat
Cicindela hirticollis gravida	Sandy beach tiger beetle	No coastal dune or strand habitat.
Cicindela latesignata	Western beach tiger beetle	No coastal dune or strand habitat.
Coelus globosus	Globose dune beetle	No coastal dune habitat.
Euphydryas editha quino	Quino checkerspot butterfly	Extirpated from Orange County.
Glyptostoma gabrielense	San Gabriel chestnut	Well outside of geographic range.
Habroscelimorpha gabbii	Western tidal-flat tiger beetle	No suitable tidal flats.

Attachment 4. Special-Status Species Not Addressed[1]

Latin Name	Common Name	Reason for Exclusion
Panoquina errans	Wandering (=saltmarsh) skipper	No coastal saltmarsh habitat.
Streptocephalus woottoni	Riverside fairy shrimp	No vernal pool habitat
Tryonia imitator	Mimic tryonia (=California brackishwater snail)	No coastal saltmarsh habitat.
AMPHIBIANS		
Anaxyrus californicus	Arroyo toad	No suitable sandy wash habitat.
Spea hammondii	Western spadefoot	No vernal pool habitat.
Taricha torosa	Coast Range newt	No suitable mesic canyon habitat.
BIRDS		
Charadrius nivosus nivosus	Western snowy plover	No coastal dune or strand habitat.
Coturnicops noveboracensis	Yellow rail	No suitable marsh or wetland habitat.
Laterallus jamaicensis coturniculus	California black rail	No suitable marsh or wetland habitat.
Passerculus sandwichensis beldingi	Belding's savannah sparrow	No coastal saltmarsh habitat.
Rallus obsoletus levipes	Light-footed Ridgeway's rail	No suitable marsh or wetland habitat.
Sternula antillarum browni	California least tern	No coastal dune or strand habitat.
MAMMALS		
Chaetodipus fallax fallax	Northwestern San Diego pocket mouse	Well outside of geographic range.
Onychomys torridus ramona	Southern grasshopper mouse	Well outside of geographic range.
Perognathus longimembris pacificus	Pacific pocket mouse	Well outside of geographic range.
Sorex ornatus salicornicus	Southern California saltmarsh shrew	No coastal saltmarsh habitat.
Taxidea taxus	American badger	Surrounded by development, not adequately sized to support animals.

Note:
[1] Special-status species reported from the region, but not addressed in this report due to habitat or geographic range.

Attachment 5 – Project Species List

Attachment 5. Project Species List	
Latin Name	Common Name
VASCULAR PLANTS	
Dicotyledons	
CUPRESSACEAE	CYPRESS FAMILY
Hesperocyparis sp.	Unid. cypress
PINACEAE	PINE FAMILY
* *Pinus* sp.	Unid. ornamental
PODOCARPACEAE	PODOCARP FAMILY
* *Podocarpus macrophyllus*	Yew plum pine
ADOXACEAE	MUSKROOT FAMILY
Sambucus nigra ssp. *cerulea*	Mexican elderberry, blue elderberry
AIZOACEAE	FIG-MARIGOLD or ICEPLANT FAMILY
* *Carpobrotus edulis*	Freeway iceplant, hottentot fig
ANACARDIACEAE	SUMAC or CASHEW FAMILY
Malosma laurina	Laurel sumac
* *Pistacia* sp.	Unid. pistachio
Rhus integrifolia	Lemonade berry
* *Rhus lanceolata*	Prairie sumac
Rhus ovata	Sugar bush
* *Schinus molle*	Peruvian pepper tree
* *Schinus terebinthifolius*	Brazilian pepper tree
Toxicodendron diversilobum	Western poison oak
APIACEAE	CELERY FAMILY
* *Conium maculatum*	Poison hemlock
* *Foeniculum vulgare*	Fennel
APOCYNACEAE	DOGBANE FAMILY
* *Asclepias curassavica*	Tropical milkweed
* *Nerium oleander*	Common ornamental oleander
* *Vinca major*	Greater periwinkle, blue periwinkle
ARALIACEAE	GINSENG FAMILY, IVY FAMILY
* *Hedera helix*	English ivy
ASTERACEAE	ASTER FAMILY
* *Ageratina adenophora*	Crofton weed, sticky eupatorium
Ambrosia psilostachya	Western ragweed
Artemisia californica	California sagebrush
Artemisia douglasiana	Douglas mugwort
Artemisia dracunculus	Tarragon
Baccharis pilularis	Coyote brush
Baccharis salicifolia	Mule fat
Baccharis sarothroides	Broom baccharis
Bebbia juncea var. *aspera*	Sweetbush
Bidens frondosa	Sticktight
Brickellia californica	California brickellbush
* *Carduus pycnocephalus*	Italian thistle
* *Centaurea melitensis*	Tocalote
* *Cynara cardunculus*	Artichoke thistle, cardoon
* *Delarea odorata*	German ivy, cape ivy

Attachment 5. Project Species List	
Latin Name	Common Name
Encelia californica	California encelia
Encelia farinosa	Brittlebush
* *Erigeron bonariensis*	Flax-leaved horseweed
* *Gazania linearis*	Treasure flower, ornamental gazania
* *Glebionis coronaria*	Garland daisy
* *Helminthotheca echioides*	Bristly ox-tongue
Heterotheca grandiflora	Telegraph weed
Heterotheca sessiliflora	Sessileflower goldenaster
* *Hypochaeris glabra*	Smooth cat's-ear
Laennecia coulteri	Coulter's horseweed
Lepidospartum squamatum	Scale-broom
Malacothrix saxatilis	Quillwort
Pluchea odorata	Saltmarsh-fleabane
Pseudognaphalium biolettii	Bicolored cudweed
Pseudognaphalium californicum	California everlasting
Pseudognaphalium canescens	Wright's cudweed
* *Pulicaria paludosa* (*P. hispanica*)	False flea-bane, Spanish sunflower
* *Senecio vulgaris*	Common groundsel
* *Sonchus asper*	Prickly sow thistle
* *Sonchus oleraceus*	Common sow thistle
* *Verbesina encelioides*	Golden crownbeard
Xanthium strumarium	Cocklebur
BETULACEAE	BIRCH FAMILY
Alnus rhombifolia	White alder
BIGNONIACEAE	TRUMPET-CREEPER or JACARANDA FAMILY
* *Tecoma capensis*	Cape honeysuckle
BORAGINACEAE	BORAGE OR WATERLEAF FAMILY
Amsinckia intermedia	Large flower rancher's fiddleneck
Cryptantha sp.	Unid. annual cryptantha
Eriodictyon crassifolium	Thick-leaf yerba santa
Eucrypta chrysanthemifolia	Common eucrypta
Heliotropium curassavicum	Seaside heliotrope
Phacelia ramosissima	Branching phacelia
BRASSICACEAE	MUSTARD FAMILY
* *Brassica nigra*	Black mustard
* *Brassica rapa*	Field mustard
* *Brassica tournefortii*	Sahara mustard, wild turnip
* *Capsella bursa-pastoris*	Shepherd's purse
* *Cardamine hirsuta*	Hairy bitter cress
* *Hirschfeldia incana*	Shortpod mustard
* *Lepidium didymum*	Lesser swine cress, lesser wort-cress
* *Lobularia maritima*	Sweet alyssum
* *Raphanus sativus*	Wild radish
* *Sisymbrium irio*	London rocket
* *Sisymbrium orientale*	Hare's ear cabbage
CACTACEAE	CACTUS FAMILY

Attachment 5. Project Species List	
Latin Name	Common Name
* *Opuntia ficus-indica*	Mission prickly-pear, Indian fig
Opuntia oricola	Chaparral pricklypear
CARYOPHYLLACEAE	PINK FAMILY, CARNATION FAMILY
* *Cerastium glomeratum*	Sticky mouse-ear chickweed
CHENOPODIACEAE	GOOSEFOOT FAMILY
* *Atriplex semibaccata*	Australian saltbush
* *Atriplex suberecta*	Sprawling saltbush, Australian saltbush
* *Chenopodium album*	Lamb's quarters, common goosefoot
* *Salsola tragus*	Russian thistle
CONVOLVULACEAE	MORNING-GLORY FAMILY
Calystegia macrostegia	Morning-glory
Cuscuta californica	Chaparral dodder, witch's hair
CRASSULACEAE	STONECROP FAMILY
Crassula connata	Pygmy-weed
CUCURBITACEAE	GOURD FAMILY, CUCUMBER FAMILY
Cucurbita foetidissima	Calabazilla
Marah macrocarpa	Chilicothe, wild cucumber
EUPHORBIACEAE	SPURGE FAMILY
* *Euphorbia maculata*	Spotted spurge
* *Euphorbia peplus*	Petty spurge
* *Ricinus communis*	Castor bean
FABACEAE	LEGUME FAMILY, PEA FAMILY
* *Acacia* sp.	Unid. escaped ornamental
Acmispon glaber	Deerweed
Lupinus succulentus	Arroyo lupine
* *Medicago polymorpha*	California burclover
* *Melilotus albus*	White sweetclover
* *Melilotus indicus*	Sourclover, India sweetclover
* *Parkinsonia aculeata*	Mexican palo verde (escaped ornamental)
FAGACEAE	OAK FAMILY
Quercus agrifolia	Coast live oak
* *Quercus ilex*	Holly oak
GERANIACEAE	GERANIUM FAMILY
* *Erodium botrys*	Long-beak filaree
* *Erodium cicutarium*	Redstem filaree
* *Erodium moschatum*	Greenstem filaree, white-stemmed filaree
JUGLANDACEAE	WALNUT FAMILY
** *Juglans californica*	Southern California black walnut
LAMIACEAE	MINT FAMILY
* *Lamium amplexicaule*	Common henbit
* *Marrubium vulgare*	Horehound
* *Rosmarinus officinalis*	Rosemary
Salvia apiana	White sage
Salvia mellifera	Black sage
Trichostema lanatum	Woolly blue curls
MALVACEAE	MALLOW FAMILY

Attachment 5. Project Species List	
Latin Name	Common Name
Malacothamnus fasciculatus	Chaparral bush-mallow
* *Malva parviflora*	Cheeseweed
MELIACEAE	MAHOGANY FAMILY
* *Melia azedarach*	China berry
MORACEAE	MULBERRY FAMILY, FIG FAMILY
* *Ficus carica*	Common fig, edible fig
* *Morus alba*	White mulberry
MYRTACEAE	MYRTLE FAMILY, EUCALYPTUS FAMILY
* Callistemon citrinus	Crimson bottlebrush
* *Eucalyptus* sp.	Ornamental eucalyptus
NYCTAGINACEAE	FOUR O'CLOCK FAMILY
Mirabilis laevis (*M. californica*)	Wishbone bush
OLEACEAE	OLIVE FAMILY
* Fraxinus udhei	Shamel ash (escaped ornamental)
* *Olea europaea*	Russian olive
ONAGRACEAE	EVENING-PRIMROSE FAMILY
Epilobium canum	California fuchsia
OXALIDACEAE	OXALIS FAMILY
* *Oxalis pes-caprae*	Bermuda buttercup
PAPAVERACEAE	POPPY FAMILY
* *Fumaria parviflora*	Fine leaved fumitory
** *Romneya coulteri*	Coulter's matilija poppy
PLANTAGINACEAE	PLANTAIN FAMILY
Keckiella cordifolia	Climbing bush-penstemon
* Plantago lanceolata	English plantain, rib-grass
* *Veronica anagallis-aquatica*	Water speedwell
PLATANACEAE	PLANE-TREE or SYCAMORE FAMILY
Platanus racemosa	Western sycamore
* *Platanus X acerifolia*	London planetree
PLUMBAGINACEAE	LEADWORT FAMILY
* *Limonium* sp.	Sea-lavender (escaped ornamental)
POLYGONACEAE	BUCKWHEAT FAMILY
Emex spinosa	Devil's thorn
Eriogonum fasciculatum	California buckwheat
* *Rumex crispus*	Curly dock
PORTULACACEAE	PURSLANE FAMILY
* *Portulaca oleracea*	Common purslane
ROSACEAE	ROSE FAMILY
Heteromeles arbutifolia	Toyon, Christmas berry
* *Pyracantha* sp.	Ornamental pyracantha
Rosa californica	California wild rose
RUBIACEAE	MADDER FAMILY, COFFEE FAMILY
Galium aparine	Goose grass, stickywilly
SALICACEAE	WILLOW FAMILY
Populus fremontii	Fremont cottonwood
Populus trichocarpa	Black cottonwood

Attachment 5. Project Species List	
Latin Name	Common Name
Salix gooddingii	Goodding's black willow
Salix lasiandra	Lance-leaved willow
Salix lasiolepis	Arroyo willow
SAPINDACEAE	SOAPBERRY FAMILY
* *Koelreuteria bipinnata*	Goldenrain tree
SCROPHULARIACEAE	FIGWORT FAMILY, SNAPDRAGON FAMILY
* *Myoporum laetum*	Myoporum
SIMAROUBACEAE	QUASSIA or SIMAROUBA FAMILY
* *Ailanthus altissima*	Tree of heaven
SOLANACEAE	NIGHTSHADE FAMILY
Datura wrightii (*D. meteloides*)	Jimsonweed, tolguacha
* *Nicotiana glauca*	Tree tobacco
Solanum nigrum	Black nightshade
TAMARICACEAE	TAMARISK FAMILY
* *Tamarix ramosissima*	Saltcedar, tamarisk
ULMACEAE	ELM FAMILY
* *Ulmus parviflora*	Chinese elm
URTICACEAE	NETTLE FAMILY
* *Urtica urens*	Dwarf nettle
VERBENACEAE	VERVAIN FAMILY
Phyla nodiflora	Common lippia
Verbena lasiostachys	Western verbena
VITACEAE	GRAPE FAMILY
Vitis girdiana	Wild grape
ZYGOPHYLLACEAE	CALTROP FAMILY
* *Tribulus terrestris*	Puncture vine
Monocotyledons	
AGAVACEAE	CENTURY PLANT FAMILY, AGAVE FAMILY
* *Agave* sp.	Escaped ornamental
* *Yucca aloifolia*	Spanish bayonet (ornamental)
ARECACEAE	PALM FAMILY
* *Phoenix canariensis*	Canary Island palm
* *Washingtonia robusta*	Mexican fan palm, ornamental fan palm
ASPARAGACEAE	ASPARAGUS FAMILY
* *Asparagus asparagoides*	Smilax asparagus
CYPERACEAE	SEDGE FAMILY
Cyperus eragrostis	Tall umbrella sedge
* *Cyperus involucratus*	Umbrella sedge
Eleocharis sp.	Unid. spike-sedge
POACEAE	GRASS FAMILY
* *Arundo donax*	Giant reed
* *Avena barbata*	Slender wild oat
* *Avena fatua*	Wild oat
* *Bromus diandrus*	Ripgut brome
* *Bromus hordeaceus*	Soft chess
* *Bromus madritensis* ssp. *rubens*	Red brome

Attachment 5. Project Species List	
Latin Name	Common Name
* *Cortaderia selloana*	Argentine pampas grass
* *Cynodon dactylon*	Bermuda grass
Elymus condensatus	Giant wild-rye
* *Festuca myuros*	Rattail sixweeks grass
* *Hordeum murinum*	Wall barley, hare barley
* *Pennisetum setaceum*	Crimson fountain grass, African fountain grass
* *Polypogon monspeliensis*	Rabbitfoot grass
* *Schismus barbatus*	Mediterranean schismus
* *Stipa miliacea*	Smilo grass
TYPHACEAE	CATTAIL FAMILY
Typha domingensis	Southern cattail, slender cattail
INVERTEBRATE ANIMALS	
INSECTA	INSECTS
LEPIDOPTERA	BUTTERFLIES AND MOTHS
Nymphalis antiopa	Mourning Cloak
CRUSTACEA	CRUSTACEANS
DECAPODA	DECAPODS
* *Procambarus clarkii*	Red swamp crayfish
VERTEBRATE ANIMALS	
ACTINOPTERYGII	RAY-FINNED FISHES
POECILIDAE	TOOTH CARPS
* *Gambusia affinis*	Western mosquitofish
AMPHIBIA	AMPHIBIANS
HYLIDAE	TREEFROGS
Pseudacris hypochondriaca hypochondriaca	Baja California treefrog
REPTILIA	REPTILES
Sceloporus occidentalis	Western fence lizard
Uta stansburiana	Side-blotched lizard
COLUBRIDAE	COLUBRIDS
Hypsiglena ochrorhyncha klauberi	San Diego nightsnake
VIPERIDAE	VIPERS
Crotalus oreganus helleri	Southern pacific rattlesnake
AVES	BIRDS
PODICIPEDIDAE	GREBES
Aechmophorus occidentalis	Western grebe
PHALACROCORACIDAE	CORMORANTS
Phalacrocorax auritus	Double-crested cormorant
ARDEIDAE	HERONS
** *Ardea herodias*	Great blue heron
Ardea alba	Great egret
Egretta thula	Snowy egret
** *Nycticorax nycticorax*	Black-crowned night heron
ANATIDAE	DUCKS, GEESE AND SWANS
Branta canadensis	Canada goose
Anas platyrhynchos	Mallard
Anas americana	American wigeon

Attachment 5. Project Species List	
Latin Name	Common Name
Oxyura jamaicensis	Ruddy duck
RALLIDAE	RAILS, GALLINULES, COOTS
Fulica americana	American coot
CATHARTIDAE	VULTURES
Cathartes aura	Turkey vulture
ACCIPITRIDAE	HAWKS, EAGLES, HARRIERS
** *Accipiter cooperii*	Cooper's hawk
Buteo jamaicensis	Red-tailed hawk
** *Pandion haliaetus*	Osprey
FALCONIDAE	FALCONS
Falco sparverius	American kestrel
PSITTACIDAE	AFRICAN AND NEW WORLD PARROTS
* *Amazona viridigenalis*	Red-crowned parrot
PHASIANIDAE	GROUSE AND QUAIL
Callipepla californica	California quail
CHARADRIIDAE	PLOVERS
Charadrius vociferus	Killdeer
RECURVIROSTRIDAE	STILTS AND AVOCETS
Himantopus mexicanus	Black-necked stilt
LARIDAE	GULLS AND TERNS
Larus californicus	California gull
Sterna forsteri	Forster's tern
COLUMBIDAE	PIGEONS AND DOVES
Zenaida macroura	Mourning dove
CUCULIDAE	CUCKOOS
Geococcyx californianus	Greater roadrunner
CAMPRIMULGIDAE	NIGHTJARS
Chordeiles acutipennis	Lesser nighthawk
APODIDAE	SWIFTS
Aeronautes saxatalis	White-throated swift
TROCHILIDAE	HUMMINGBIRDS
Calypte anna	Anna's hummingbird
Selasphorus sasin	Allen's hummingbird
ALCEDINIDAE	KINGFISHERS
Ceryle alcyon	Belted kingfisher
PICIDAE	WOODPECKERS
Picoides nuttallii	Nuttall's woodpecker
Colaptes auratus	Northern flicker
TYRANNIDAE	TYRANT FLYCATCHERS
Sayornis nigricans	Black phoebe
Tyrannus vociferans	Cassin's kingbird
Tyrannus verticalis	Western kingbird
HIRUNDINIDAE	SWALLOWS
Tachycineta bicolor	Tree swallow
Hirundo rustica	Barn swallow
CORVIDAE	CROWS AND JAYS

Attachment 5. Project Species List	
Latin Name	Common Name
Aphelocoma californica (*Aphelocoma coerulescens*)	California scrub-jay (Western scrub jay)
Corvus brachyrhynchos	American crow
Corvus corax	Common raven
AEGITHALIDAE	BUSHTITS
Psaltriparus minimus	Bushtit
TROGLODYTIDAE	WRENS
Thryomanes bewickii	Bewick's wren
Troglodytes aedon	House wren
MUSCICAPIDAE	THRUSHES AND ALLIES
Regulus calendula	Ruby-crowned kinglet
** *Polioptila californica*	California gnatcatcher
Sialia mexicana	Western bluebird
Chamaea fasciata	Wrentit
MIMIDAE	MOCKINGBIRDS AND THRASHERS
Mimus polyglottos	Northern mockingbird
Toxostoma redivivum	California thrasher
STURNIDAE	STARLINGS
* *Sturnus vulgaris*	European starling
VIREONIDAE	VIREOS
** *Vireo bellii*	Bell's vireo
EMBERIZIDAE	SPARROWS, WARBLERS, TANAGERS
Setophaga coronata	Yellow-rumped warbler
Geothlypis trichas	Common yellowthroat
Cardellina pusilla	Wilson's warbler
Pipilo maculatus	Spotted towhee
Melozone crissalis	California towhee
Passerculus sandwichensis	Savannah sparrow
Melospiza melodia	Song sparrow
Zonotrichia leucophrys	White-crowned sparrow
Icterus cucullatus	Hooded oriole
FRINGILLIDAE	FINCHES
Haemorhous mexicanus	House finch
Spinus psaltria	Lesser goldfinch
PASSERIDAE	WEAVERS
* *Passer domesticus*	House sparrow
MAMMALIA	MAMMALS
LEPORIDAE	HARES AND RABBITS
Sylvilagus audubonii	Desert cottontail
SCIURIDAE	SQUIRRELS
Otospermophilus beecheyi	Beechey (California) ground squirrel
* *Sciurus niger*	Eastern fox squirrel
CRICETIDAE	RATS AND MICE
Neotoma fuscipes	Dusky-footed wood rat
CANIDAE	FOXES, WOLVES AND COYOTES
Canis latrans	Coyote
PROCYONIDAE	RACCOONS

Attachment 5. Project Species List	
Latin Name	Common Name
Procyon lotor	Raccoon

Notes:

Species introduced to California are indicated by an asterisk. Special-status species are indicated by two asterisks. This list includes only species observed on the site. Invertebrate species observed throughout the site were not included in this list with the exception of Crustaceans. Other species may have been overlooked or unidentifiable due to season (amphibians are active during rains, reptiles during summer, some birds and bats migrate out of the area for summer or winter, some mammals hibernate, many plants are identifiable only in spring). Plants were identified using keys, descriptions, and illustrations in Baldwin et al (2012). Plant taxonomy and nomenclature generally follow Baldwin et al. (2012). Wildlife taxonomy and nomenclature generally follow Stebbins (2003) for amphibians and reptiles, AOU (1998) for birds, and Wilson and Ruff (1999) for mammals.

Attachment 6 – Project Photos



Photo 1: Close-up photos of dense riparian vegetation within Smith Basin.



Photo 2: Close-up of upland vegetation within Smith Basin.



Photo 3: Close-up view of the upstream end of Santiago Creek (Smith Basin), near Cannon Street.



Photo 4: Rock waterfall near the central portion of Santiago Creek (Smith Basin).



Photo 5: Rock pool near the central portion of Santiago Creek (Smith Basin).



Photo 6: East-facing overview of Smith Basin.



Photo 7: Southwest-facing overview of Smith Basin.



Photo 8: Overview of recently constructed land bridge between the Blue Diamond and Bond Pits within Santiago Recharge Basin.



Photo 9: East-facing overview of northern portion of Santiago Recharge Basin.



Photo 10: Overview of upland vegetation on the northeast corner of Santiago Recharge Basin.



Photo 11: Overview of the upland vegetation near the center of Santiago Recharge Basin.



Photo 12: North-facing view of the existing outlet channel of Santiago Recharge Basin, near the undercrossing of E Collins Ave.



Photo 13: West-facing view of the upstream portion of Santiago Creek Channel.



Photo 14: West-facing view of the downstream portion of Santiago Creek Channel.



Photo 15: East-facing view of the downstream portion of Santiago Creek Channel.



Photo 16: East-facing view of the central portion of Santiago Creek Channel.

Appendix 3 – 404(b)(1) Analysis

US Army Corps of Engineers®

CHICAGO DISTRICT

LEADERS IN CUSTOMER CARE

SANTA ANA RIVER MAINSTEM
SANTIAGO CREEK
ORANGE COUNTY, CALIFORNIA

Appendix 3 – Draft 404(b)(1) Analysis

September 2023

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 3 – DRAFT 404(B)(1) ANALYSIS

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 3 – DRAFT 404(B)(1) ANALYSIS

SECTION 1 – PROJECT DESCRIPTION

a. Location

Santiago Creek is the largest tributary of the Santa Ana River downstream from Prado Dam. The headwaters of the creek are in the vicinity of Santiago Peak of the Santa Ana Mountains in the northern part of Orange County. The stream flows in a northwest direction for approximately 15 miles to Villa Park Road in the City of Orange, then turns southwest for about another 7 miles before joining the Santa Ana River in the City of Santa Ana. The total drainage area of Santiago Creek is 102 square miles. The runoff from 80 percent of the drainage area is controlled by the existing Santiago Dam (a water supply reservoir built by the Irvine Company in 1933) and Villa Park Dam (a flood control structure constructed by Orange County in 1963). The drainage area remaining downstream from Villa Park Dam is approximately 19 square miles.

For the purposes of this document, the "project area" consists of the lower reach of Santiago Creek extending from the Santa Ana Freeway to the creek's confluence with the Santa Ana River. The "project area" also consists of the reach of Santiago Creek that flows through the Santiago Recharge Basins (i.e., Blue Diamond Basin, Bond Basin, and Smith Basin).

b. General Description

Major elements of the Proposed Action were based off the 1988 design in the Phase II General Design Memorandum (GDM), but were updated based on existing conditions, current design criteria, and current design practices. The following are major elements of the Proposed Action:

1. Reservoir Slope Stabilization

The existing slopes of the Santiago Recharge Basins require repair and is necessary to accommodate the 1% Annual Exceedance Probability (AEP) water surface elevation. Several locations have been identified along the basins which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H): 1 Vertical (V), installation of retaining walls, or installation of armoring. As shown in Figure 1, buttress fill will be used to stabilize slopes Line H, Line F, and Line E and to construct the bike trail berm within the Blue Diamond and Bond basins project site. At this stage of design, riprap is not necessary to stabilize the above slopes; however, two concrete tie-back walls measuring approximately three feet in width are required for stabilization of Line F. The tie-back walls would be like what has already been constructed to stabilize the slope that runs along Bond Avenue in the Blue Diamond and Bond basins. As shown in Figure 2, buttress fill will be used to stabilize slopes Line B, Line A, and Line I within the Smith Basin project site. At this stage of design, riprap is necessary to stabilize Line A and Line I, but not Line B. For Line A, riprap would extend from the toe of the slope an dup the slope for approximately 45 feet. Similarly, for Line I riprap would extend from the toe of the slope and up slope for approximately 40 feet. After the riprap, buttress fill with no riprap would be used to stabilize the slope. In addition, riprap placed to stabilize these two slopes would be buried with approximately two feet of soil allowing for native vegetation to be replanted on top of the riprap. Areas with just buttress fill would also be replanted with native vegetation. The replanting scheme would include mulefat on top of the buried riprap graduating to coastal sage scrub where only buttress fill is located.



Figure 1: Project Footprint within the Blue Diamond and Bond Basins.

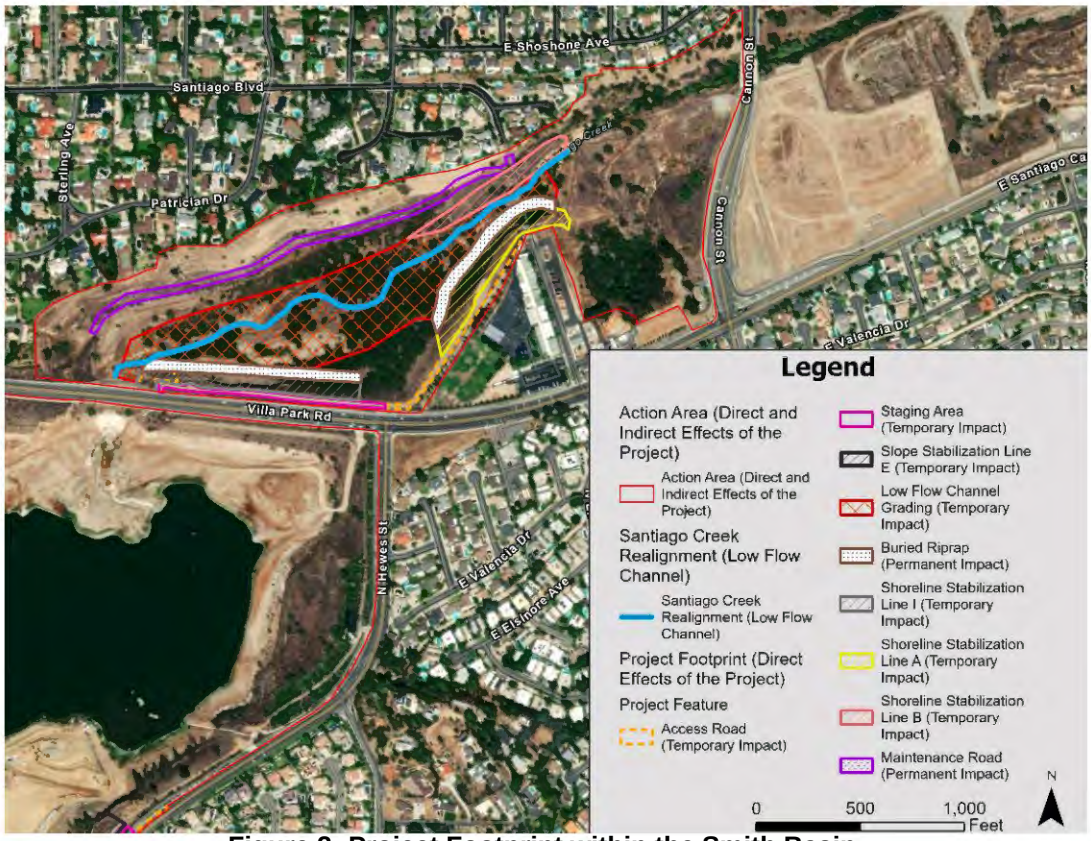


Figure 2: Project Footprint within the Smith Basin.

In addition to reservoir slope stabilization within Smith Basin, the floor of Smith Basin will also require rehabilitation to protect the repaired slopes from future erosion. Currently, the existing creek channel flows head on into Line A and portions of Line I. Just to repair and stabilize the slopes, the existing creek channel would need to be filled in. Therefore, the Proposed Action Alternative includes grading a low flow channel more through the center of Smith Basin and redirecting the existing channel to this location. If in the future the channel moves back south towards Line A and Line I there should be no need to redirect the channel a second time as the slopes will have been repaired and stabilized at the toe with buried riprap. The low flow channel through Smith Basin would be an approximately 1-foot depression by approximately 20 feet in width through the middle of Smith Basin. The design of the graded-out depression does not include stream veins or stream training structures. Once the low flow channel is created and the slopes have been stabilized, replanting of native riparian vegetation (i.e., willow and mulefat) within the bottom of Stream Basin would occur.

Lastly, reservoir slope stabilization also includes the rehabilitation of a historic maintenance access road within Smith Basin. The access road is located along the toe of the northern slope of Smith Basin and would be restored and graded to its original condition. This 12-foot-wide road would become the main access into and out of the bottom of Smith Basin and would be accessed from Santiago Road located along the northeast edge of Smith Basin.

2. Channel Improvements

Flow velocities within the Santiago Creek are erosive during large storm events (approximately 9-13 feet per second during the 1% AEP), potentially compromising adjacent properties along the highly urbanized floodway. To rehabilitate and improve the creek's flood conveyance capability, the Proposed Action will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will then be covered with native substrate to (i) enhance access for ongoing operation and maintenance, (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) maintain existing aesthetics; and (iv) enhance environmental integrity of the stream corridor. The Proposed Action will involve excavating surficial material from the channel bottom and installing the buried riprap. Replacing the excavated surficial substrate overlying the riprap layer will stabilize the slopes, maintain the channel's natural appearance, and allow for establishment of native, ecologically desirable vegetation. A channel operation and maintenance program will be necessary to prevent invasive vegetation, large woody growth, debris, and other flow inhibiting concerns from re-establishing within the channel.

In total, the proposed stream stabilization measures include 6,400-feet of trapezoidal channel armored with buried riprap Figure 3. The proposed cross section includes a gravel bedding layer and riprap armor layer. The riprap armor layer would be covered with approximately one (1) foot of native substrate harvested from the channel. The surficial layer will provide suitable substrate for native vegetation growth. The planting palette is comprised of two native vegetation species mixes, a low-growth mix for the channel invert and a coastal sage scrub mix for the channel bank (i.e., mitigation areas). The channel invert width varies from 30-feet to 80-feet, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitations and will be installed to a slope of 1.75H:1V.



Figure 3: Project Footprint within the Lower Santiago Creek Channel.

The removal of some trees (exact number to be defined during the next phase of design) in the downstream channel right-of-way would be necessary to complete grading and channel construction. The trees in the downstream reaches are primarily exotic and/or invasive species such as eucalyptus, black locust, Shamel ash, and tree of heaven. To improve the vegetation quality in the channel, native vegetation would be established along the top of the bank and side slopes of the lower Santiago Creek channel after earthmoving and channel construction is complete. Coast live oak trees will be protected when possible. Native plantings would consist of container plantings, cuttings, and hydroseed from the local region. Drip irrigation would be installed for approximately 2 to 3 years to allow plant establishment, and monitoring and maintenance of the restored areas would occur for a 5-year period. The goal of the restored habitat is to create a self-sustaining ecosystem that would require minimal long-term maintenance. Once the 5-year monitoring and maintenance period is over, USACE would provide the non-federal sponsor with an Operations and Maintenance (O&M) manual.

A survey for California coast live oak (*Quercus agrifolia*) trees and other native tree species within the project limits would be completed during detailed design when the channel design is further refined. The tree survey would identify the different species of trees more precisely. The refined channel design may allow for some native trees to remain in the channel where they currently exist. California coast live oak trees will be protected in place, if possible. All trees within the channel areas where floodwalls are required would likely need to be removed permanently for channel conveyance and to meet the design criteria. The native trees and vegetation to be avoided within the project limits will be flagged for trimming or protect in place.

The project limits and proposed haul routes for construction will be delineated and marked with flagging and stakes.

3. Floodwalls

Floodwalls are required in select locations along Santiago Creek under the Proposed Action Figure 3. Floodwalls will extend for approximately 2,600 feet between Bristol Avenue and Flower Street on both the north and south sides of the lower Santiago Creek channel, and for 900 feet on the north side of the lower Santiago Creek channel west of Bristol Avenue. The floodwalls will be steel sheetpile varying in total length from 19 to 30-feet with a reinforced concrete cap extending from two feet below the existing grade to the design elevation based on the hydraulic model for the system. Typical total height of the concrete cap is four to five feet. The location of the wall alignment is at the top of the proposed bank in all areas defined above.

4. Future Operation, Maintenance, Repair, Replacement, and Rehabilitation

Maintenance, including routine inspections and minor repairs, of the Santiago Creek project and its associated project features, would be required after construction is completed. The following activities may occur:

- Routine special inspection with pickup trucks and sport utility vehicles, as needed, and up to daily during flood events.
- Repair of maintenance roads and ramps is anticipated every few years.
- Ecological maintenance activities outside the bird nesting season, including weeding, herbicide application, and re-seeding.
- Vegetation management within the lower Santiago Creek channel and only where floodwalls are located. Vegetation management in the areas with floodwalls would be in accordance with Corps [USACE] of Engineers Engineering Pamphlet 1110-2-18; at a minimum 15-feet down slope of the floodwall would need to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except grasses for the purpose of erosion control.
- Periodic mending of fencing and gates.
- Periodic graffiti removal and vandalization repair.

Rarely, following large and erosive flood flows, larger-scale maintenance and repairs may be required along the channel and the toe of the basin slopes, which could require access and use of heavy equipment within the floodplain adjacent to the structure. Equipment would need to traverse the channel and maintenance roads along the Santiago Recharge Basins. A temporary work area may need to be established around repair sites. The local sponsor would be required to obtain emergency or standard permits from regulatory agencies, including USACE Regulatory, who would coordinate and consult if needed, with the U.S. Fish and Wildlife Service (FWS). These permits would likely active habitat restoration of temporary construction and access roads. It is likely that a storm event large enough to damage the channel or basin slopes would also have removed vegetation in the immediate area, but specific impacts cannot be evaluated until or unless damage occurs, and repair work is defined.

c. Authority and Purpose

The Santa Ana River Mainstem Project (SARMP) is located along a 75-mile reach of the Santa Ana River in Orange, Riverside, and San Bernardino counties, California. The SARMP is a comprehensive flood risk management system that was authorized for construction by Section 401(a) of the Water Resources Development Act (WRDA) of 1986.

The recommended plan for the SARMP is contained in the Phase I General Design Memorandum (GDM) for the SARMP (USACE, 1980) and included eight elements, which were subsequently reevaluated in the Phase II GDM (USACE, 1988). The Phase II GDM modified the SARMP by redefining the authorized SARMP features and clarifying that the Standard Project Flood term referred in most cases to the 190-year flood event. Construction of the SARMP commenced in fiscal year 1989.

The main purpose of the Proposed Action is to contain the 1% AEP floods, providing flood

protection for approximately 74,000 people living in the Santiago Creek project area (2017 population).

d. General Description of Dredged or Fill Material

(1) General Characteristics of Material

The type of fill material would vary depending on the project feature being implemented. For the downstream reach of Santiago Creek, the fill material would consist of clean, inert bedding layer and riprap purchased from a commercial supplier. Native substrate excavated from the site in order to bury the riprap will be reused on top of the commercially supplied bedding layer and riprap. The floodwalls will consist of clean, inert steel sheetpile and reinforced concrete purchased from a commercial supplier.

For the Santiago Recharge Basin (i.e., Blue Diamond and Bond basins), fill material for the shoreline stabilization features would include excavated material from the basins (i.e., cut and fill process). In addition, cut material would not cover the entire amount of fill material needed, therefore, additional fill material cut from Smith Basin would be hauled to be used as fill within the Blue Diamond and Bond basins. One of the shoreline stabilization features within the Blue Diamond and Bond basins requires the construction of two tieback walls. The tieback walls would require clean, inert anchors as well as reinforced concrete purchased from a commercial supplier.

For Smith Basin, fill material for the shoreline stabilization features would include excavated material from the basin (i.e., cut and fill process). Two of the shoreline stabilization features within Smith Basin require riprap armoring at the slopes of the toe to stabilize the slopes. The riprap would be clean, inert material purchased from a commercial supplier. Smith Basin also includes grading a floodway through the floor of the basin. The grading would involve cut and fill with no material being brought in as fill material from offsite. Lastly, Smith Basin also includes the rehabilitation of a 12-foot-wide maintenance road along the north side of the basin and the burying of a 12-inch RCP under the rehabilitated road. The maintenance road would require the purchase of clean, inert asphalt materials and RCP from a commercial supplier.

(2) Quantity of Material

The Proposed Action includes the excavation (i.e., cut) of approximately 646,424 cubic yards (CY) of material; and placement (i.e., fill) of approximately 288,010 CY of fill (e.g., native fill, riprap, bedding layer), 120,900 square feet of steel sheetpile, 1,120 each of anchors, 665 square yards of asphalt, and 100 linear feet of RCP pipe (Table 1).

Table 1: Quantities of Material for the Proposed Action.

Feature	Material Excavated	Material to be Placed
Lower Santiago Creek Channel		
Native Fill	48,723 CY	20,922 CY
Bedding Layer		10,300 CY
Riprap		25,650 CY
Floodwall – Reinforced Concrete		1,912 CY
Floodwall – Steel Sheetpile		120,900 Square Feet
Blue Diamond and Bond Basins		
Shoreline Stabilization		
Onsite Fill	106,911 CY	113,177 CY
Offsite Fill (from Smith Basin)		14,000 CY
Anchors		1,120 each
Tieback Walls – Reinforced Concrete		1,556 CY
Smith Basin		
Shoreline Stabilization/Grading/Maintenance Road		

Feature	Material Excavated	Material to be Placed
Onsite Fill	131,494 CY	130,530 CY
Riprap		2,139 CY
Asphalt		665 square yards
RCP Pipe		100 linear feet

(3) Source of Material

The source material for features in the lower Santiago Creek channel and the Santiago Recharge Basins be a combination of new and clean construction materials including concrete, metals, and rock, as well as excavated materials from onsite being reused as fill material. The new materials (i.e., materials not from onsite) would be clean and inert and are not expected to be a major source of contamination.

e. Description of the Proposed Discharge Site(s)

(1) Location

The lower Santiago Creek channel discharge site is located within the City of Santa Ana, California. The discharge site extends along Santiago Creek from its confluence with the mainstem Santa Ana River upstream to the Interstate 5 overpass. The Blue Diamond and Bond basins discharge site is located within the Cities of Villa Park and Orange, California. The Blue Diamond and Bond basins are generally located between Prospect Street to the southwest, Bond Avenue to the South, Hewes Street to the east, and Villa Park Road to the north. The Smith Basin discharge site is located within the Cities of Villa Park and Orange, California. The Smith Basin is generally located between Villa Park Road to the south and Cannon Street to the east.

(2) Size

The discharge site for the lower Santiago Creek channel is approximately 22.77 acres. The discharge site for the Blue Diamond and Bond basins is a combined acreage of approximately 9.38 acres. The discharge site for the Smith Basin is a combined acreage of approximately 5.06 acres.

(3) Type of Site

The lower Santiago Creek channel is an intermittent stream. The Blue Diamond and Bond basins are groundwater recharge basins that have the appearance of a large lake. The Smith Basin is also a groundwater recharge basin; however, the Smith Basin does not maintain the appearance of a large lake. Instead, Smith Basin maintains the appearance of a depressed land formation with vegetated portions of slope and floor bottom.

(4) Type of Habitat

The proposed discharge site within Santiago Creek is characterized as unvegetated channel and slopes (10.43 acres), Eucalyptus – tree of heaven – black locust groves (8.29 acres), developed (3.67 acres), and coast live oak woodland and forest (0.38 acres). The Blue Diamond and Bond basins are characterized as being comprised of the following habitat types: blue elderberry scrub (1.84 acres), brittle bush scrub (16.57 acres), brome grassland (3.78 acres), California sagebrush – black sage scrub (35.90 acres), developed (36.73 acres), Eucalyptus – tree of heaven – black locust (8.29 acres), fountain grass swards (5.58 acres), Goodding's willow – red willow riparian woodland and forest (21.73 acres), laurel sumac scrub (6.10 acres), mulefat thickets (4.49 acres), open water (175.77 acres), unvegetated channel and slopes (10.43 acres), and upland mustards or star-thistle fields (2.00 acres). The Smith Basin is characterized as being comprised of the following habitat types: blue elderberry scrub (1.84 acres), brittle bush scrub (16.57 acres), brome grassland (3.78 acres), California sagebrush – black sage scrub (35.90 acres), developed (36.73 acres), Eucalyptus – tree of heaven – black locust groves (8.29 acres), fountain grass swards (5.58 acres), Goodding's willow – red willow riparian woodland and forest (21.73 acres), laurel sumac scrub (6.10 acres), mulefat thickets (4.49 acres), open water (175.77 acres), and upland

marshes or star-thistle fields (2.00 acres).

(5) Timing and Duration of Discharge

The anticipated timeframe is several years in the future. Construction would occur in segments, with the overall work broken out into discrete portions. For example, features within the lower Santiago Creek channel would likely be a separate project from features being implemented within the Santiago Recharge Basins. The timing of any work that could impact habitat or sensitive species would be adjusted to account for environmental windows (i.e., to avoid nesting periods). The duration of construction is expected to last slightly more than 2 years.

f. Description of Placement Method

Placement of fill material within the lower Santiago Creek channel would occur from the bottom of the channel. Access to the channel is extremely limited since residences are located within 30 feet of the channel banks on either side of the channel (i.e., north and south sides). The following equipment would likely be used during preparation of the site (i.e., clearing and grubbing) for placement of fill material: brush chipper, chain saw, crawler dozer, dump truck, excavator, flatbed truck, front end loader, skid steer, and water truck. The following equipment would likely be used during placement of the fill material: asphalt paver, bulldozer, silent pile driver, circular saw, compactor, crane, crawler dozer, dump truck, excavator, flatbed truck, front end loader, generator, roller, skid steer, and water truck.

Placement of fill material within the Blue Diamond, Bond, and Smith basins would occur from the shoreline. Equipment likely required to prepare the site for the placement of fill material would be the same as that listed above for the lower Santiago Creek channel. In addition, the following equipment would likely be used during placement of the fill material for the various features: asphalt paver, backhoe, concrete mixer, concrete pump, concrete saw, concrete vibrator, crane, crawler dozer, drill crawler, dump truck, excavator, flatbed truck, front end loader, generator, grader, post driver, roller, water pump, water truck, and welder.

SECTION 2 – FACTUAL DETERMINATIONS

The purpose of the Section 404(b)(1) Guidelines is to restore and maintain the chemical, physical, and biological integrity of the waters of the U.S. through the control of discharges of dredged or fill material. Except as provided under the Clean Water act Section 404(b)(2), no discharge of dredged or fill material will be authorized if there were a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, as long as the alternative does not have other significant adverse environmental consequences. In accordance with the Section 404(b)(1) Guidelines, the potential short-term or long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment must be determined.

The following discussion evaluates impacts of the Proposed Action on environmental resources identified in Subpart C through Subpart F of the Section 404(b)(1) Guidelines.

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope

The Santiago Creek watershed is located within the Peninsular Range Physiographic Province, a geomorphic province that extends 900 miles south from the Los Angeles basin to the tip of Baja California and is bound on the east by the Colorado Desert. The Peninsular Range Province is characterized by elongated northwest-trending mountain ridges separated by sediment-floored valleys. The topography is like the Coast Ranges, but the geology is more similar to the Sierra Nevada, with granitic rock intruding the older metamorphic rocks.

One of the most significant landforms is the coastal plain of Orange County from the City of Irvine

to the Orange/Los Angeles County border. The coastal plain is divided into two sub-plains, the Downey Plain and the Tustin Plain. The Downey Plain comprises the alluvial fans of the Los Angeles, San Gabriel, and Santa Ana Rivers. The Downey Plain has a uniform grade with an average grade of 20 feet per mile and was formed by deposits from ancestral streams. The Tustin Plain is a sedimentary basin and is bounded on the north and east by the Santa Ana Mountains, on the south by the San Joaquin Hills, and on the northwest by the Los Angeles Basin. The Tustin Plain is nearly flat and gently slopes to the southwest. The alluvial fan soils that compromise the Tustin Plain are derived from deposits from the Santa Ana Mountains.

Placement of fill material as part of the Proposed Action would alter substrate elevations and slopes within Smith Basin and the Blue Diamond and Bond basins. The Proposed Action includes excavating (i.e., cutting) material from existing slopes within Smith Basin and the Blue Diamond and Bond basins and using the excavated material as fill for slopes in the basins requiring repair due to erosion. The lower Santiago Creek channel would not have substantially altered elevations or slopes with the placement of fill material as the design of the channel includes maintaining the current invert and carrying capacity of the channel.

(2) Substrate Type

Foundation materials along the lower Santiago Creek channel consist primarily of loose to medium dense gravelly sands, silty gravelly sands, and silty sands with cobbles and boulders up to 14 inches in diameter. Stiff to very stiff sandy clay and sandy silty layers ranging in thickness from 1 to 5 feet are also present along the channel alignment.

The foundation materials for the Santiago Recharge Basins consist primarily of medium to dense gravelly sand and sandy gravel. Frequent cobbles typically range from 9 to 12 inches. Occasional layers of sandy clay, sandy silt, and clay with a consistency ranging from very soft to stiff are present in the basin area in thickness ranging from 0.5 to 8 feet.

The Proposed Action would have no substantial adverse effect on substrate types within the action area. Most of the fill material being placed to stabilize the lower Santiago Creek channel and slopes within the Blue Diamond, Bond, and Smith basins is comprised of substrate excavated from the sites and reused. Therefore, the composition of most of the fill would be the same as that currently found within the existing environment of the lower Santiago Creek channel and the Blue Diamond, Bond, and Smith Basins. A small portion of the fill material would be clean inert materials purchased for use to provide additional shoreline stabilization. This fill material is a combination of riprap and concrete. Where riprap is placed as fill it would be covered by reused excavated material from on site. Overall, the placement of fill material is not expected to substantially alter the substrate characteristics in the short-term or long-term of the lower Santiago Creek channel or the Blue Diamond, Bond, and Smith basins since most of the fill material being used is existing material from within the project's action area.

(3) Dredged/Fill Material

Sediment and soil to be removed will be excavated mechanically, stockpiled upland, dewatered (as needed), and reused on site. Of the approximately 646,424 CY of material to be excavated from the lower Santiago Creek channel and the Santiago Recharge Basins, approximately 288,010 CY of that material will be reused on site for project features. The excavated material to be reused on site will be moved as needed by truck to where it will be reused and will be placed mechanically. The remaining approximately 358,414 CY of material to be excavated but not reused on site will be disposed of offsite at an appropriate disposal facility.

(4) Physical Effects on Benthos

The excavation and placement of fill material would potentially disturb existing periphyton, epibenthic plankton, and benthic macroinvertebrate habitat present within the lower Santiago Creek channel and the Blue Diamond, Bond, and Smith basins. Habitat and organisms could be destroyed by excavation activities or smothered with the placement of fill material. To minimize potential adverse short-term effects, excavation and fill material placement would occur in the dry.

It is important to note that the lower Santiago Creek channel and Smith Basin are both frequently dry except during heavy rainfall. In these areas, benthic macroinvertebrates may still be present, but aquatic benthic species have likely either burrowed down to seek refuge in the hyporheic zone or have followed the retreating waters to find refuge from dessication. Depending on the location of the hyporheic zone within Smith Basin and the lower Santiago Creek channel, excavation and the placement of fill material would have a low probability of impacting these areas of refuge. Long-term the placement of fill is not expected to adversely affect the reestablishment of periphyton, epibenthic plankton, or benthic macroinvertebrates as they recolonize the project footprint from adjacent areas. Overall, no detrimental loss of benthic organisms in the short-term or long-term is anticipated.

(5) Other Effects

Construction of the proposed project could cause water quality impacts if best management practices, including erosion control and stormwater pollution prevention practices, are not followed. Any environmental impacts caused by the short-term increases in suspended solids due to construction activities are anticipated to be temporary and minimal; the use of best management practices as a proactive approach is recommended.

(6) Actions Taken to Minimize Impacts

Construction projects which disturb one or more acres of soil are required to obtain coverage under a General Construction Permit by the State Water Resources Control Board. Since the Proposed Action would disturb more than one acre a General Construction Permit would be obtained. The General Construction Permit would require the filing of a Notice of Intent with the State Waters Resources Control Board and the preparation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP would provide a list of BMPs to minimize/prevent uncontrolled discharges into Santiago Creek and the Santiago Recharge Basins and to control erosion and stormwater runoff. Upland work areas will be subject to erosion control and will be permanently stabilized with native vegetation once construction is complete. Excavation activities will also use best management practices to minimize solid suspension where water is present. Excess substrate not to be reused would be stockpiled onsite with no return water unless treatment has occurred to prevent the release of anthropogenic compounds into Santiago Creek or the Santiago Recharge Basins. Excess substrate would then be hauled offsite for disposal in an approved landfill.

b. Water Circulation, Fluctuation, and Salinity Determinations

(1) Water

(a) Salinity

The Proposed Action would have no impact on salinity as the project sites — lower Santiago Creek Channel and the Santiago Recharge Basins — are sources of freshwater with no saltwater encroachment.

(b) Water Chemistry

Fill material would either be material excavated from onsite and reused or would be new, inert materials such as rock, concrete, and metals. Short-term effects on water quality are expected because of the temporary increase in the concentration of suspended solids and turbidity following the cut and fill operations. The potential temporary increase of suspended solids is expected to cause short-term decreases in water clarity and minor changes to the color of the water, particularly if erosion controls are not used. However, it is important to note that excavation and fill material placement would occur in the dry which would minimize the potential for a short-term increase in suspended solids occurring. As noted above, the lower Santiago Creek channel and Smith Basin are both frequently dry except during heavy rainfall. Overall, the long-term water chemistry of Santiago Creek and the Santiago Recharge Basins should not be impacted by construction of the project.

(c) Clarity

As discussed above, the excavated fill to be reused on site as well as the new construction materials are not expected to be a source of contamination, and excess excavated substrate will be stockpiled temporarily on site before disposal at an approved landfill. The stockpiled excess substrate would be placed upland with no direct return of untreated water prior to disposal. Short-term effects on clarity may occur because of a temporary increase in the concentration of suspended solids and turbidity during work activities that may extend in-water. The potential temporary increase of suspended solids is expected to cause short-term decreases in water clarity. However, it is important to note that excavation and fill material placement would occur in the dry which would minimize the potential for a short-term increase in suspended solids occurring. As noted above, the lower Santiago Creek channel and Smith Basin are both frequently dry except during heavy rainfall. Overall, the long-term water clarity of Santiago Creek and the Santiago Recharge Basins would not be reduced below the current baseline condition. The stabilization of slopes within the Santiago Recharge Basins and the lower Santiago Creek channel, would minimize erosion that is currently being experienced, which in turn could have a slight beneficial impact on water clarity.

(d) Color

The Proposed Action is not anticipated to cause any considerable long-term effects or changes to water color, but a temporary increase of suspended solids during construction could cause short-term and minor changes to the color of the water. However, it is important to note that excavation and fill material placement would occur in the dry which would minimize the potential for a short-term change in water color due to suspended solids. As noted above, the lower Santiago Creek channel and Smith Basin are both frequently dry except during heavy rainfall. Overall, the long-term color of the water within Santiago Creek and the Santiago Recharge Basins would not be substantially changed from the current baseline condition. The stabilization of slopes within the Santiago Recharge Basins and the lower Santiago Creek channel would minimize erosion that is currently being experienced, which in turn could have a slight beneficial impact on water color by reducing suspended solids.

(e) Odor

The Proposed Action is not anticipated to cause any considerable long-term effects on, or changes to, the odor of the water. The temporary stockpiling of excess excavated material not to be reused on site could cause temporary upland odor impacts in the immediate environs of a sediment staging or dewatering operation, due to the anaerobic nature of most sediment. These odors would dissipate over a relatively short time as the substrate dries and is slowly hauled off to an approved disposal site.

(f) Taste

The Proposed Action would not be anticipated to cause any short-term or long-term effects on, or changes to, the taste of the water. Water in the Santiago Recharge Basins is used to recharge the groundwater which is ultimately used for drinking water. The lower Santiago Creek channel is not used as a groundwater recharge area and is primarily dry except during heavy rainfall.

(g) Dissolved Gas Levels

The Proposed Action is not anticipated to alter dissolved gas levels in Santiago Creek or the Santiago Recharge Basins in the short-term or long-term.

(h) Nutrients

Temporary increases of turbidity during construction could produce minor, localized effects on nutrient levels in the water column. However, it is important to note that excavation and fill material placement would occur in the dry which would minimize the potential for short-term increases in turbidity during construction. As noted above, the lower Santiago Creek channel and Smith Basin are both frequently dry except during heavy rainfall. Overall, the long-term nutrient levels in the water column within Santiago Creek and the Santiago Recharge Basins would not be substantially different from the current baseline condition. The stabilization of slopes within the

Santiago Recharge Basins and the lower Santiago Creek channel would minimize erosion that is currently being experienced, which in turn could have a slight beneficial impact on reducing turbidity long-term which could have a localized effect on nutrient levels. Furthermore, the Proposed Action would not change the runoff area or sources of nutrients in stormwater runoff entering Santiago Creek or the Santiago Recharge Basins long-term.

(i) Eutrophication

Eutrophication is typically caused by excessive nutrient levels. As discussed above, the Proposed Action could produce minor, localized effects on nutrient levels in the water column during construction, but these effects are expected to be short-term and minor aesthetic impacts. These potential localized effects on nutrient levels in the water column during construction are likely to be minimized since construction would occur in the dry. Long-term, the stabilization of slopes within the Santiago Recharge Basins and the lower Santiago Creek channel would minimize erosion that is currently being experienced, which would in turn minimize turbidity and therefore minimize potential nutrients eroding into the water column that may cause eutrophication over time. Overall, the Proposed Action is not expected to impact eutrophication in Santiago Creek or the Santiago Recharge Basins.

(j) Others as Appropriate

No other impacts were identified.

(2) Current Patterns and Circulation, Current Flow, and Water Circulation

(a) Current Patterns and Flow

The primary sources of water flow within the lower Santiago Creek channel is water releases from the Santiago Recharge Basins and the Villa Park Dam, water released from municipal wells, storm flow, and urban runoff. The Blue Diamond and Bond basins typically hold water for groundwater recharge. The basins may be subject to currents during water releases from the basins into Santiago Creek as well as during water releases from Villa Park Dam located upstream of the basins. Smith Basin is typically not inundated. Inundation does occur, though, when the Blue Diamond and Bond basins back up into Smith Basin during large storm events. In addition, Smith Basin may experience flows within the portion of Santiago Creek that the basin contains during water releases from Villa Park Dam located upstream.

Since the Proposed Action would be constructed in the dry, short-term impacts to current patterns and flow are not anticipated. Long-term, the Proposed Action's shoreline stabilization features would not be expected to alter current patterns or flow since the features are designed to minimize slope erosion, and not impeded flow of surface water. The design of the lower Santiago Creek channel includes floodwalls on either side of the channel between approximately Bristol Street and extending upstream to Flower Street. Hydraulic model was conducted to ensure that the floodwalls would not impede flow within Santiago Creek. Overall, construction of the Proposed Action is not anticipated to have any short-term or long-term effects on current patterns and flow.

(b) Velocity

The velocity of water when present within the lower Santiago Creek channel can vary. Velocities in Santiago Creek during storm events and water releases may cause increases of current velocities. Construction of the Proposed Action is anticipated to occur in the dry, therefore, no short-term impacts to water velocity are anticipated. Long-term, the shoreline stabilization features within Blue Diamond, Bond, and Smith Basin would not impede or alter flow in such a way that velocities within Smith Basin would be adversely affected. The design of the lower Santiago Creek channel does include floodwalls on either side of the channel between approximately Bristol Street and extending upstream to Flower Street. Hydraulic modeling was conducted to ensure that the floodwalls would not substantially affect surface water velocity within Santiago Creek, although increased velocities within the channel are probably during storm events and water releases. However, the above would be sporadic and temporary increases in

water velocities. Overall, the Proposed Action is not expected to have a substantial adverse effect on flow velocities within the Santiago Recharge Basins or Santiago Creek.

(c) Stratification

Santiago Creek is not thermally stratified; much of the downstream channel infrequently holds water and the shallow depths do not allow for stratification. Stratification may occur within the Blue Diamond and Bond basins. Smith Basin only intermittently holds water (i.e., when the Blue Diamond and Bond basins back up during large storm events), which does not allow for stratification. Due to the lack of stratification occurring during the current condition, the Proposed Action is not anticipated to have an adverse effect to thermal stratification in the short-term or long-term.

(d) Hydrologic Regime

Flows in Santiago Creek are highly variable throughout the year, with the highest flows typically occurring during the rainy season (November – April) with low flows during the remainder of the year. Similarly, Smith Basin is infrequently inundated. Typically, only during the rainy season when the Blue Diamond and Bond basins are full, water becomes impounded in Smith Basin, covering approximately two-thirds of the bottom of the basin. The Blue Diamond and Bond basins always have surface water present and hold over 13,000 acre-feet of water. The Proposed Action does not include features that would long-term alter the hydrologic regime within the project area. Proposed Action features only stabilize the shoreline and channel areas with the intent to minimize erosion of these areas; the project features do not increase capacity or increase the flow of water in the system. Short-term, there could be temporary impacts downstream of the Blue Diamond and Bond Basins if OCWD modifies the amount of water being released downstream into Santiago Creek to allow for decreased surface water levels in the basins which in turn would allow construction of the shoreline stabilization features to occur in the dry within the basins. This would be a short-term, temporary impact and would have a less than significant effect on the overall hydrologic regime of Santiago Creek.

(3) Normal Water Level Fluctuations

Flows in Santiago Creek are highly variable throughout the year, with the highest flows typically occurring during the rainy season (November – April) with low flows during the remainder of the year. Similarly, Smith Basin is infrequently inundated. Typically, only during the rainy season when the Blue Diamond and Bond basins are full, water becomes impounded in Smith Basin, covering approximately two-thirds of the bottom of the basin. The Blue Diamond and Bond basins always have surface water present and are able to hold over 13,000 acre-feet of water. The Proposed Action does not include features that would long-term alter the normal water level fluctuations within the project area. Proposed Action features only stabilize the shoreline and channel areas with the intent to minimize erosion of these areas. Short-term, normal water level fluctuations could temporarily be impacted in the Blue Diamond and Bond Basins if OCWD modifies the amount of water held within the basins to allow construction of the shoreline stabilization features to occur in the dry. This would be a short-term, temporary impact and would have a less than significant effect on normal water level fluctuations.

(4) Salinity Gradients

There would be no changes to salinity gradients as the Proposed Action is located within sites that are freshwater with no encroachment of saltwater.

(5) Actions That Will Be Taken to Minimize Impacts

The Proposed Action would not result in any long-term effects on, or changes to, the water quality, current patterns or flow, water circulation, or the normal water level fluctuation within the Santiago Creek watershed. Temporary construction impacts, such as turbidity increases, are possible. Proactive erosion control and stormwater pollution prevention practices would be used to limit any temporary impacts. Hydraulic modeling has occurred to ensure the design of the project does not substantially adversely affect current patterns and circulation, current flow, and water circulation.

c. Suspended Particulate/Turbidity Determinations

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site

The Proposed Action has the potential to produce minor and temporary increases of suspended solids and turbidity in the local vicinity of any in-water work. Potential plumes of suspended particles may be visible and aesthetically displeasing until the particles gradually settle and the plumes dissipate. However, it is important to note that excavation and fill material placement would occur in the dry which would minimize the potential for a short-term increase in suspended particulates and/or turbidity levels in the vicinity of the fill areas. As noted above, the lower Santiago Creek channel and Smith Basin are both frequently dry except during heavy rainfall. Overall, the long-term presence of suspended particulates and turbidity levels in the vicinity of the fill areas would not be increased substantially above the current baseline condition. The stabilization of slopes within the Santiago Recharge Basins and the lower Santiago Creek channel would minimize erosion that is currently being experienced, which in turn could have a slight beneficial impact on minimizing the number of suspended particulates and turbidity levels within these surface waters. In addition, as discussed above excess excavated substrate will be stockpiled temporarily on site before disposal at an approved landfill. The stockpiled excess substrate would be placed upland with no direct return of untreated water prior to disposal.

(2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column

(a) Light Penetration

Construction of the Proposed Action is expected to occur mostly in the dry, especially within the lower Santiago Creek channel and Smith Basin which are both frequently dry except during heavy rainfall. Since the Blue Diamond and Bond basins continuously hold water to some extent, there may be instances where shoreline stabilization features within these basins may extend into wetted areas. However, since construction would occur mostly in the dry, less than significant impacts to light penetration are anticipated. If construction of shoreline stabilization features extends into wetted areas there could be minor, temporary, and localized increases of suspended solids that in turn could cause temporary decreases in the clarity of the water and reduce the penetration of light through the water column. If the penetration of light is reduced for an extended period, it can lower the rate of photosynthesis and “primary productivity” of an aquatic area. Primary productivity generally refers to the fixation of solar energy by green plants (i.e., autotrophs) in a terrestrial ecosystem, or phytoplankton for an aquatic ecosystem. Persistently high turbidity can cause adverse impacts to sight-dependent species because the reduced clarity can hinder the feeding ability of these species, and thereby limit their growth and increase their susceptibility to disease.

Regarding elevated suspended solids concentrations, it explains the following in 40 CFR 230.21:

> “The extent and persistence of these adverse impacts caused by discharges depend upon the relative increase in suspended particulates above the amount occurring naturally, the duration of the higher levels, the current patterns, water level, and fluctuations present when such discharges occur, the volume, rate, and duration of the discharge, particulate deposition, and the seasonal timing of the discharge.”

Since most of the construction work would occur in sites that are primarily dry except during high rainfall events, the Proposed Action is not expected to cause any long-term adverse impacts on the chemical or physical properties of the water column. Even if shoreline stabilization activities extend into wetted areas, the potential impacts are expected to only be minor, temporary, and localized increases of suspended solids. These minor, temporary, and localized increases of suspended solids are anticipated to

be low relative to the levels of suspended solids that typically result from storm events and adverse weather conditions.

(b) Dissolved Oxygen

Construction of the Proposed Action is expected to occur mostly in the dry, especially within the lower Santiago Creek channel and Smith Basin which are both frequently dry except during heavy rainfall. Since the Blue Diamond and Bond basins continuously hold water to some extent, there may be instances where shoreline stabilization features within these basins may extend into wetter areas. However, since construction would occur mostly in the dry, less than significant impacts to dissolved oxygen are anticipated. If construction of shoreline stabilization features extends into wetted areas there could be minor, temporary, and localized increases of suspended solids which could result in slight reductions in the level of dissolved oxygen in the water column. This is because biological and chemical content of the suspended material may react and in turn deplete some of the dissolved oxygen in the water column.

(c) Toxic Metals and Organics

Because of the urban nature of the Santiago Creek watershed, it is presumed that any sediment and soil will be of generally poor chemical quality; no sediment or soil would be placed in-water for disposal. Rather all excess soil and sediment disposal will occur upland with no direct return of untreated water. Proposed fill materials that are new (i.e., not excavated material to be reused on site) will be clean construction materials that are not expected to release toxic metals or organics.

(d) Pathogens

The drainage area is primarily an urban environment. The sediment and water within the lower Santiago Creek channel and the Santiago Recharge Basins may reflect the urban area and its potential pathogen sources such as uncontrolled waste disposal (dumping). Since all sediment will be disposed of upland with no direct return of untreated water, any pathogens entrained in the sediment will not be released to the environment. Proposed fill materials that are new (i.e., not excavated material to be reused on site) will be clean materials that are not anticipated to be a source of pathogens.

(e) Aesthetics

Construction of the Proposed Action is expected to occur mostly in the dry, especially within the lower Santiago Creek channel and Smith Basin which are both frequently dry except during heavy rainfall. Therefore, construction within these project sites would have less than significant short-term impacts to the aesthetics of the water column during construction of the project. Construction within the Blue Diamond and Bond basins could extend into wetted areas since these basins continuously hold water, although the elevation of water within the basins may be below where construction is occurring. Potential construction activities that extend into wetted areas could have minor, temporary, and localized increases in suspended solids at the construction site which could in turn impact the aesthetics of the water column. This would be a temporary increase and is expected to be no different in the observed change to the water column during a storm event or water release from the Villa Park Dam.

(f) Others as Appropriate

The Proposed Action is not expected to cause any other adverse effects on the chemical and physical properties of the water column.

(3) Effects on Biota

(a) Primary Production, Photosynthesis

Construction of the Proposed Action is expected to occur mostly in the dry, especially within the lower Santiago Creek channel and Smith Basin which are both frequently dry except during heavy rainfall. Since the Blue Diamond and Bond basins continuously hold water to some extent, there may be instances where shoreline stabilization features within these basins may extend into wetted areas. However, since construction would occur mostly in the dry, less than significant

impacts to light penetration are anticipated. If construction of shoreline stabilization features extends into wetted areas there could be minor, temporary, and localized increases of suspended solids that in turn could cause temporary decreases in the clarity of the water and reduce the penetration of light through the water column. If the penetration of light is reduced for an extended period, it can lower the rate of photosynthesis and "primary productivity" of an aquatic area. Primary productivity generally refers to the fixation of solar energy by green plants (i.e., autotrophs) in a terrestrial ecosystem, or phytoplankton for an aquatic ecosystem. Persistently high turbidity can cause adverse impacts to sight-dependent species because the reduced clarity can hinder the feeding ability of these species, and thereby limit their growth and increase their susceptibility to disease.

Regarding elevated suspended solids concentrations, it explains the following in 40 CFR 230.21:

> "The extent and persistence of these adverse impacts caused by discharges depend upon the relative increase in suspended particulates above the amount occurring naturally, the duration of the higher levels, the current patterns, water level, and fluctuations present when such discharges occur, the volume, rate, and duration of the discharge, particulate deposition, and the seasonal timing of the discharge."

Since a majority of the construction work would occur in sites that are primarily dry except during high rainfall events, the Proposed Action is not expected to cause any long-term adverse impacts on the chemical or physical properties of the water column. Even if shoreline stabilization activities extend into wetted areas, the potential impacts are expected to only be minor, temporary, and localized increases of suspended solids. These minor, temporary, and localized increases of suspended solids are anticipated to be low relative to the levels of suspended solids that typically result from storm events and adverse weather conditions.

(b) Suspension/Filter Feeders

Construction of the Proposed Action is expected to occur mostly in the dry, especially within the lower Santiago Creek channel and Smith Basin which are both frequently dry except during heavy rainfall. Since construction in these areas would occur mostly in the dry, less than significant effects to suspicion/filter feeders would be expected. The Blue Diamond and Bond basins continuously hold water to some extent, therefore, there may be instances where shoreline stabilization features within these basins may extend into wetted areas depending on the water levels within the basins at the time of construction. If construction of shoreline stabilization features extends into wetted areas there could be minor, temporary, and localized increases of suspended solids which in turn could impact the feeding ability of suspension and filter feeders. This would be expected to be only a minor short-term impact to these species and no different than an increase in suspended solids that is likely experienced during a storm event or water release from the Villa Park Dam.

(c) Sight Feeders

Construction of the Proposed Action is expected to occur mostly in the dry, especially within the lower Santiago Creek channel and Smith Basin which are both frequently dry except during heavy rainfall. Since construction in these areas would occur mostly in the dry, less than significant effects to sight feeders would be expected. The Blue Diamond and Bond basins continuously hold water to some extent, therefore, there may be instances where shoreline stabilization features within these basins may extent, therefore, there may be instances where shoreline stabilization features within these basins may extend into wetted areas depending on the water levels within the basins at the time of construction. If construction of shoreline stabilization features extends into wetted areas there could be minor, temporary, and localized increases of suspended solids which in turn could impact the feeding ability of sight feeders. This would be expected to be only a minor short-term impact to these species and no different than an increase in suspended solids that is likely experienced during a storm event or water release from

the Villa Park Dam.

(4) Actions Taken to Minimize Impacts

As required by the Clean Water Act, the project would comply with the Santa Ana Municipal Separate Storm Sewer (MS4) NPDES Permit. The NPDES MS4 Permit Program, which is administered in the project area by Orange County and is issued by the SARWQCB, regulates storm water and urban runoff discharges from developments to natural and constructed storm drain systems in the City of Orange, City of Villa Park, and City of Santa Ana. Since the project would disturb one or more acres of soil, construction activities would be subject to the Construction General Permit (NPDES) General Permit order 2009-009-DWQ issued by SARWQCB. The Construction General Permit requires implementation of a SWPPP for site clearing, grading, and disturbances such as stockpiling or excavation. The SWPPP would generally contain a site map showing the construction perimeter, proposed structures, storm water collection and discharge points, general pre- and post-construction topography, drainage patterns across the site, and adjacent roadways. Appropriate erosion control measures would be incorporated into the SWPPP by the construction contractor to prevent sediment from entering waterways and to minimize temporary turbidity impacts. Examples include, but are not limited to, strawbales/wattles, erosion blankets, silt fencing, silt curtains, mulching, revegetation, and temporary covers.

d. Contaminant Determinations

The exiting soil and sediment quality was not quantified, and sediment data that meet the requirements for the State of California Tiered Assessment of sediments approach are not available. However, a Hazardous, Toxic, and Radioactive Waste (HTRW) Phase I investigation was performed for the project site to identify the risk of encountering contamination on the site. Results of the Phase I indicate the potential for contaminated soils and sediments is not likely. The site is not listed in regulatory databases as having stored, used, disposed of, or released hazardous substances or petroleum products, and no HTRW was observed during the site visit or known by owners/operators to have contaminated the site. A geotechnical investigation of the site in October 2021 did not indicate the presence of solid waste, petroleum, or other HTRW issues. Fill materials used on the project would be a combination of new, clean, inert bedding and rip rap purchased from a commercial supplier and suitable native substrate excavated from portions of the project site. The lower Santiago Creek channel consist primarily of loose to medium dense gravelly sands, silty gravelly sands, and silty sands with cobbles and boulders, and the Santiago Recharge Basins consist primarily of medium to dense gravelly sand and sandy gravel. These materials are most likely to be free chemical, biological, or other pollutants. Therefore, the discharge of existing, onsite native material would not be expected to be a source of contamination. Furthermore, relocating in-situ fill from one project location to another would not result in introduction of additional pollutants that are not already in the soil. The quality of material at excavation sites would be similar to the quality of material at fill sites, and the discharge will not likely result in degradation of fill areas and pollutants will not be transported to less contaminated areas. Bioavailability of pollutants in disturbed soils of the arid southwest would also be minimal due to the ephemeral nature of flows. Discharges of new and relocated fill material are determined to have a low likelihood of contaminating the aquatic environment and are not anticipated to cause considerable long-term effects on, or changes to, the existing water quality or cause effects on biota.

e. Aquatic Ecosystem and Organism Determinations

(1) Effects on Plankton

Plankton are pelagic, which means they live within the water column itself, as opposed to benthic organisms that live along the bottom. Plankton generally drift along with the water currents and/or float on or near the water surface, as opposed to nekton, which are active swimmers that can propel themselves through water currents. Plankton are typically divided into phytoplankton, which includes photosynthesizing species like algae that derive energy from sunlight, water, and

carbon dioxide, and zooplankton, which consume food to derive energy. Although most planktonic species are small and often microscopic, there are large plankton organisms that are still considered to be plankton because they drift with the water current. Plankton are not anticipated to be present within the lower Santiago Creek channel or Smith Basin since both project sites only contain water intermittently, primarily during heavy rainfall events. Within the Blue Diamond and Bond basins there is not expected to be significant plankton resources, such that construction activities would substantially impact plankton. Overall, the Proposed Action is expected to have less than significant effects to plankton populations that may be present in the project area.

(2) Effects on Benthos

Benthos refers to the organisms (plants and animals) that inhabit the bottom of a sea, stream, or lake. While the lower Santiago Creek channel and portions of Smith Basin where Santiago Creek flows through may have suitable habitat for benthos, these sites only have water intermittently. It is possible, however, for benthos to survive in intermittent streams by burrowing down to the hyporheic zone during periods of surface water intermittency. The Blue Diamond and Bond basins which have surface water continuously likely have a thriving benthic community. The Proposed Action within the lower Santiago Creek channel includes burying riprap with native substrates to minimize erosion of the channel as well as construction of a floodwall in certain locations discussed earlier in this document. Due to the depth of the riprap to be placed, some benthic organisms that may be surviving in the hyporheic zone could be smothered and/or crushed with the placement of riprap and native substrate excavated from the channel to bury the riprap. However, the benthic community over time would be able to reestablish within this reach moving upstream from the Santa Ana River or from upstream portions of Santiago Creek when surface water is present. The riprap buried with native substrates would still provide habitat for benthic species.

The Proposed Action within Smith Basin includes shoreline stabilization and grading a floodway through the floor of Smith Basin. Shoreline stabilization is likely to have a minimal impact on benthic organisms due to these features being primarily constructed upland. Stabilization of the slope toes within the vicinity of the current path of the Santiago Creek through Smith Basin could destroy benthic organisms via excavation and placement of riprap. Similarly, regrading a floodway through the floor of Smith Basin could destroy benthic organisms although it is unknown how many benthic organisms are present in the area to be graded since this area is typically dry and the current path of the stream does not traverse the area to be graded. Therefore, while these actions are likely to have impacts on benthic organisms the effects are likely to be less than significant since there are likely relatively few benthic organisms present in the area (when compared to an area continuously inundated). In addition, the benthic community over time would be able to reestablish in these areas once construction is complete. Reestablishment could occur from the portion of Santiago Creek upstream of Smith Basin when surface water is present.

The Proposed Action within the Blue Diamond and Bond basins could have a potential impact on benthic species. The shoreline stabilization features occur in areas that are frequently inundated and/or continuously inundated depending on the water level of the basins. In these areas where shoreline stabilization is proposed to occur, the existing benthic community could be destroyed via excavation and placement of fill material. However, the benthic community over time would be able to reestablish in these areas by moving from non-impacted areas within the Blue Diamond and Bond basins. In addition, the shoreline stabilization features would ultimately provide habitat for benthic species once construction is complete.

(3) Effects on Nekton

Nekton refers to the aquatic life (organisms) that can swim freely and are generally independent of the water currents. This includes fish eggs and larvae. The Proposed Action within the lower Santiago Creek channel and Smith Basin is not expected to impact nekton as these areas contain water only intermittently. The Proposed Action within the Blue Diamond and Bond basins has the potential to impact nekton via the construction of shoreline stabilization features. In theses areas,

any nekton that may be present could be smothered and/or crushed with the placement of stabilization features if water levels are up in the basins. However, this would be a less than significant impact to nekton.

(4) Effects on Aquatic Food Web

The Proposed Action is not expected to impact the local food web because the project sites are not considered to be significant habitat supporting the food web.

(5) Effects on Special Aquatic Sites

(a) Sanctuaries and Refuges

There are no sanctuaries or refuges located within the project area.

(b) Wetlands

No federal wetlands were determined to be present within the project area, only state wetlands. Although there are riparian and wetland vegetation types present within Smith Basin and portions of the Blue Diamond and Bond basins, there are no federal jurisdictional wetlands within either project footprint. This is based on the conclusions of the Aquatic Resources Technical Report (Appendix 1 to the Draft SEA/IS/MND) and how USACE Regulatory defines wetlands versus Waters of the United States. Specifically, all of the riparian and wetland vegetation is located below the ordinary high-water mark (OHWM) and thus falls within the federal jurisdiction of the Waters of the U.S., rather than being identified as an adjacent federal wetland. See 33 C.F.R. § 328.4(c)(2) (adjacent wetlands "beyond the [OHWM]"); U.S. Army Corps of Engineers, 2008, A Field Guide to the Identification of the OHWM in the Arid West Region of the Western United States; and U.S. Army Engineer Research and Development Center, Environmental Laboratory, ERDC/CRREL TR-08-12. Therefore, the Proposed Action would not result in the permanent or temporary loss of wetland waters of the U.S.

The Proposed Action would also not result in the permanent loss of non-wetland waters of the U.S. but would result in temporary impacts to non-wetland waters of the U.S. (Table 2). It is important to note that in addition, the Proposed Action would result in no permanent or temporary loss of wetland waters of the U.S., as discussed above, but would result in the temporary loss of wetland waters of the State (Table 2).

Table 2: Proposed Action Alternative Impacts to Jurisdictional Areas of the U.S./State

Project Area	Impacts	USACE Non-Wetland Waters of the U.S./State[a]	SARWQCB Wetland Waters of the State[b]
Lower Santiago Creek Channel	Permanent	0.0 ac	0.0 ac
	Temporary	4.34 ac	0.0 ac
Blue Diamond and Bond Basins	Permanent	0.0 ac	0.0 ac
	Temporary	8.11 ac	0.0 ac
Smith Basin	Permanent	0.0 ac	0.0 ac
	Temporary	12.26 ac	1.62 ac

[a] Non-wetland waters of the U.S. and non-wetland waters of the State are the same as based on California Code of Regulations, title 23, section 3831(w) which states that "[a]ll waters of the United States are also 'waters of the state.'" Therefore, as an example there are 4.34 acres of non-wetland waters of the U.S. and 4.34 acres of non-wetland waters of the state that would be temporarily impacted in the lower Santiago Creek channel under the Proposed Change Alternative.

[b] Wetland waters of the state allows for the presence of hydric substrates as a criterion for wetland identification (not just wetland soils) and wetland hydrology for an area devoid of vegetation (less than 5% cover) to be considered a wetland. Therefore, there are examples where waters may be considered wetlands by the state, but not by the federal wetland definition. Therefore, this category refers to wetland waters of the State only as there are no wetland waters of the U.S. present within the Proposed Action Alternative project footprint.

The Proposed Action Alternative would not permanently impact any jurisdictional non-wetland

waters of the U.S. and state; however, the project would have temporary impacts to 24.71 acres of non-wetland waters of the U.S. and state. Temporary impacts would occur due to shoreline stabilization activities within the Santiago Recharge Basins as well as channel improvements within the lower Santiago Creek channel. Temporary impacts would also occur during the recontouring of Smith Basin and the creation of a new low-flow channel. Permanent fill in the form of riprap would be placed within the lower Santiago Creek channel, but there would be no change in the channel invert meaning there would be no loss of jurisdictional non-wetland waters of the U.S. and state. Similarly, the shoreline stabilization activities and the recontouring of Smith Basin/low-flow channel include excavating material from the Blue Diamond/Bond basins and Smith Basin to then be used as fill material for the repairs. The act of cutting and filling would mean there would be no net loss of jurisdictional non-wetland waters of the U.S. and state. Once construction activities are complete, temporarily impacted areas would be recontoured to pre-project condition to the extent possible.

Also, as shown in Table 2, there are no jurisdictional wetland waters of the U.S. within the project area. Regarding the state, implementation of the Proposed Action Alternative would not result in the permanent loss of wetland waters of the state. The Proposed Action Alternative would have temporary impacts to about 1.62 acres of wetland waters of the state. This was considered a temporary impact since once the project is completed the disturbed areas would be replanted with native riparian vegetation so the functions and values of the wetland habitat would return to the site once construction is done. In addition, under Section 7 consultation with the U.S. Fish and Wildlife Service, USACE agreed to compensate for temporary impacts to wetland vegetation (which is habitat for the federally listed least Bell's vireo) not only onsite but also offsite at a 1:1 ratio (refer to MM BIO-1 and MM BIO-2 below in Section II(e)(8)). With the implementation of mitigation measures (refer to MM BIO-1 and MM BIO-2 below in Section II(e)(8)) there would be no net loss of wetland waters of the state; therefore, potential impacts would be less than significant with mitigation incorporated.

(c) Mud Flats

There is no mud flat habitat located within the project sites.

(d) Vegetated Shallows

No vegetated shallows were determined to be present within the project area.

(e) Coral Reefs

There are no coral reefs located within the project area.

(f) Riffle and Pool Complexes

There are no riffle/pool complexes located within the lower Santiago Creek channel. When water is present the site has been so confined and channelized that it resembles only shallow pool habitat.

(6) Threatened and Endangered Species

The following federal and state listed terrestrial special-status species were identified as having the potential to occur in the vicinity of the project sites and potentially could be impacted by construction activities: chaparral sand-verbena (*Abronia villosa var. aurita*), Horn's milk-vetch (*Astragalus hornii var. hornii*), Ventura marsh milk-vetch (*Astragalus pycnostachyus var. lanosissimus*), Parish's brittlescale (*Atriplex parishii*), intermediate mariposa lily (*Calochortus weedii var. intermedius*), southern tarplant (*Centromadia parryi ssp. australis*), many-stemmed dudleya (*Dudleya multicaulis*), salt spring checkerbloom (*Sidalcea neomexicana*), San Bernardino aster (*Symphyotrichum defoliatum*), coast horned lizard (*Phrynosoma coronatum*), orange-throat whiptail (*Aspidoscelis hyperythra*), coastal cactus wren (*Campylorhynchus brunneicapillus sandiegensis*), least Bell's vireo (*Vireo bellii pusillus*), coastal California gnatcatcher (*Polioptila californica*), Cooper's hawk (*Accipiter cooperii*), white-tailed kite (*Elanus leucurus*), tricolored blackbird (*Agelaius tricolor*), western yellow billed cukoo (*Coccyzus americanus occidentalis*), California black rail (*Laterallus jamaicensis coturnicilus*), common yellowthroat (*Geothlypis*

trichas), Mexican long-tongued bat (*Choeronyceteris mexicana*), western mastiff bat (*Eumops perotis californicus*), and Santa Ana sucker (*Catostomus santaanae*).

A search of California Department of Fish and Wildlife California Natural Diversity Database and California Native Plant Society Database in conjunction with site reconnaissance of the project area has determined that there would be low potential for sensitive plant species to occur on the project sites. Therefore, no impacts to sensitive plant species would occur. Regarding sensitive wildlife species, the coast horned lizard, coastal cactus wren, tricolored blackbird, western yellow billed cuckoo, California black rail, Mexican long-tongued bat, western mastiff bat, and Santa Ana sucker have a low probability of occurring on the project sites due to lack of suitable habitat. The following species are present within the vicinity of the project sites and potential impacts and mitigation measures are discussed in detail below.

Least Bell's Vireo

The least Bell's vireo (LBVI) is listed as both a federal and state endangered species. Three LBVI territories were observed within the Proposed Action Area. A total of approximately 1.46 acres of occupied habitat will be permanently impacted during implementation of shoreline stabilization within Smith Basin due to the rehabilitation of a maintenance road along the north side of the basin (0.17 acres mulefat thicket) and placement of buried riprap (1.29 acres Goodding's willow – red willow riparian woodland and forest) where willow may not be able to reestablish (Table 3). An alternative to rehabilitating the old maintenance road on the north side of Smith Basin was analyzed by USACE to minimize impacts to LBVI habitat. The alternative considered included building a maintenance road down to the bottom of Smith Basin that would connect to the existing maintenance road located along Villa Park Road. However, this alternative was not feasible because 1) the gradient of the slope along Villa Park Road is too steep to create a road that could be safely traversed down into the basin, 2) there is little to no shoulder along Villa Park Road when approaching the existing Smith Basin maintenance road which is a safety hazard for maintenance vehicles getting on and off the maintenance road, and 3) there would be a safety hazard for vehicles traveling along Villa Park Road and slow maintenance vehicles entering and exiting the roadway (i.e., no traffic light). For comparison, Villa Park Road is a four-lane highway with a speed limit of 50 miles per hour in the vicinity of Smith Basin. Conversely, Santiago Boulevard which would provide access to the rehabilitated maintenance road is a two-lane road with a speed limit of 35 miles per hour.

Table 3: Summary of Proposed Offset and Vegetation Categories for the Proposed Action Alternative.

Plant Community Type	Total Acreage	Impact Type	Acres Impacted	Mitigation Ratio	Acres of Mitigation Onsite	Acres of Mitigation Offsite
Riparian and Wetland Vegetation Types						
Goodding's Willow – Red Willow Riparian Woodland and Forest	21.73	Permanent	1.29	5:1	0.00	6.45
		Temporary	9.19	2:1	9.19	9.19
Mulefat Thickets	4.47	Permanent	0.17	5:1	0.00	0.85
		Temporary	1.43	2:1	2.72	1.43
Upland Vegetation Types						
California Sagebrush – Black Sage Scrub	35.87	Permanent	1.53	3:1	0.00	4.59
		Temporary	7.18	2:1	7.18	7.18
Brittle Bush Scrub	16.57	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00

Plant Community Type	Total Acreage	Impact Type	Acres Impacted	Mitigation Ratio	Acres of Mitigation Onsite	Acres of Mitigation Offsite
Blue Elderberry Scrub	1.84	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00
Fountain Grass Swards	5.58	Permanent	0.29	3:1	0.00	0.87
		Temporary	0.64	2:1	0.64	0.64
Laurel Sumac Scrub	6.10	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.24	2:1	0.24	0.24
Upland Mustards or Star-Thistle	1.97	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00
Eucalyptus – Tree of Heaven – Black Locust Groves	3.16	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00
Wild Oats and Annual Brome Grasslands	3.78	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.19	2:1	0.19	0.19
Other Vegetation Types						
Unvegetated Channels and Slopes	3.81	Temporary	0.16	NA[1]	0.00	0.00
		Permanent	0.00	NA[1]	0.00	0.00
Developed	33.98	Temporary	3.53	NA[1]	0.00	0.00
		Permanent	0.15	NA[1]	0.00	0.00
Total Vegetation Acres	**133.86**	**Total Vegetation Acres Impacted**	**25.99**	**Total Mitigation Acres**	**20.16**	**31.63**

[1] No offsite mitigation is required for temporary impacts to non-riparian habitat.

In addition to the above permanent impacts, a total of approximately 10.62 acres of occupied habitat will be temporarily impacted during implementation of shoreline stabilization within Smith Basin, but this acreage will be replanted with native riparian and wetland vegetation once construction is complete (Table 3). Approximately 26.2 acres of the project area provide preferred suitable biological characteristics for LBVI within the mapped areas. Therefore, permanent impacts would affect approximately 5.6% of available wetland and riparian vegetation within the Santiago Recharge Basins. Temporary impacts would affect approximately 40.5% of available wetland and riparian vegetation within the Santiago Recharge Basins. Approximately 53.9% of available wetland and riparian vegetation within the Santiago Recharge Basins that provide preferred suitable biological characteristics for LBVI would not be impacted by the Proposed Action at all.

Direct and indirect impacts to LBVI include displacement of established territories causing adverse effects to three territories within the action area. This would result in potential temporary displacement of three territories. This is assumed to be a temporary displacement of these three territories as there are 14.12 acres of suitable LBVI habitat within the Santiago Recharge Basins that would not be impacted by the Proposed Action. Based on observations of LBVI territory size which can range between 0.5 to 7.5 acres, the unaffected 14.12 acres of suitable LBVI habitat within the Santiago Recharge Basins provides sufficient acreage for between 28 to two LBVI territories while construction of the Proposed Action is occurring (USFWS, 1998b). Once construction of the Proposed Action is complete, 10.62 acres of wetland and riparian vegetation temporarily impacted would be replanted with wetland and riparian vegetation with suitable

biological characteristics for LBVI. The replanted wetland and riparian vegetation would be dominated by willow species which typically take between two to 10 years to become mature and begin producing seeds (Reed, 1993). Since LBVI have been characterized as preferring early successional habitat, the reestablishment of native willow vegetation within the temporarily impacted areas of the Proposed Action would provide early successional habitat the LBVI prefer to nest in (USFWS, 1998b). Therefore, as detailed above, riparian and wetland vegetation that contains preferred biological characteristics for LBVI will for the most part be only temporarily impacted and riparian and wetland vegetation unaffected during the construction of the Proposed Action should provide sufficient habitat for LBVI with temporarily displaced territories within the action area.

Indirect impacts from construction of the Proposed Action includes noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair vireos and degrade air quality and human presence can cause vireos to abandon territories and nests.

To avoid and minimize potential impacts to LBVI, the USACE pursuant to formal consultation with the USFWS will implement all the mitigation measures identified in full detail below in Section II(e)(8). In addition, USACE will implement all reasonable and prudent measures identified in the USFWS's BiOp once the Final BiOp is provided to USACE.

To offset effects to LBVI from the Proposed Action, the USACE would restore 17.92 acres of wetland and riparian vegetation within Prado Basin and/or within the Santa Ana River watershed below Prado Dam. Figure 4, Figure 5, and Figure 6 show potential riparian areas that may be used as mitigation for the Santiago Creek project. The potential riparian parcels are approximately 12.09 acres (Figure 4), 68.64 acres (Figure 5), and 1.35 acres (Figure 6). Two parcels are located on USACE land identified as "environmentally sensitive areas." USACE continues to work to ensure the proposed mitigation sites for the Santiago Creek project do not already contain mitigation for other components of SARMP. The availability of these sites as mitigation sites for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The third parcel is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The 17.92 acres of wetland/riparian habitat restored offsite will be monitored and managed according to MM BIO-2, MM BIO-6, MM BIO-7, and MM BIO-11 (refer to Section II(e)(8) below for a full description of these mitigation measures). In addition, 11.91 acres of wetland and riparian vegetation would be replanted on site to offset temporary impacts to wetland and riparian vegetation within the project footprint. The 11.91 acres of native wetland and riparian vegetation within the project footprint will be monitored and managed according to MM BIO-1 and MM BIO 11 (refer to Section II(e)(8) below for a full description of these mitigation measures).



Figure 4: Location of Potential Mitigation Sites Within Prado Basin for the Santiago Creek Project.



Figure 5: Additional Location of Potential Mitigation Sites Within Prado Basin for the Santiago Creek Project.



Figure 6: Additional Location of Potential Mitigation Sites within the Santa Ana River Watershed Below Prado Dam.

Based on the analysis described above, the Corps has determined that the Proposed Action may affect, and is likely to adversely affect, LBVI. The USACE provided its determination to the USFWS in a Biological Evaluation that was originally submitted December 1, 2022 (Appendix 8 to the Draft SEA/IS/MND). Formal consultation on the Proposed Action occurred from February 24, 2023, to August 8, 2023. USACE anticipates that the USFWS will provide their Final BiOp for the Proposed Action on September 22, 2023. For additional details about consultation under Section 7 of the Endangered Species Act refer to Section 4.1 of the Draft SEA/IS/MND.

Coastal California Gnatcatcher

The coastal California gnatcatcher (CAGN) is listed as a threatened species under the federal Endangered Species Act. One CAGN territory was observed within the action area. A total of approximately 1.82 acres of occupied habitat will be permanently impacted within Smith Basin due to the rehabilitation of a maintenance road along the north side of the basin (1.31 acres California sagebrush – black sage scrub and 0.29 acres of fountain grass swards) and two tie-back walls in the Blue Diamond and Bond basins (0.22 acre of California sagebrush – black sage scrub) (Table 3). An alternative to rehabilitating the old maintenance road on the north side of Smith Basin was analyzed by USACE to minimize impacts to CAGN habitat. The alternative considered building a maintenance road down to the bottom of Smith Basin that would connect to the existing maintenance road located along Villa Park Road. However, this alternative was not feasible because 1) the gradient of the slope along Villa Park Road is too steep to create a road that could be safely traversed down into the basin, 2) there is little to no shoulder along Villa Park Road when approaching the existing Smith Basin maintenance road which is a safety hazard for maintenance vehicles getting on and off the maintenance road, and 3) there would be a safety hazard for vehicles traveling along Villa Park Road and slow maintenance vehicles entering and exiting the roadway (i.e., no traffic light). For comparison, Villa Park Road is a four-lane highway with a speed limit of 50 miles per hour in the vicinity of Smith Basin. Conversely, Santiago

Boulevard which would provide access to the rehabilitated only maintenance road is a two-lane road with a speed limit of 35 miles per hour.

In addition to the above permanent impacts, a total of approximately 8.25 acres of occupied habitat (including 1.24 acre of existing mitigation sites will be temporarily impacted during implementation of shoreline stabilization within the Santiago Recharge Basins, but this acreage will be replanted with coastal sage scrub vegetation once construction is complete (Table 3). Approximately 58.54 acres of the project footprint provide preferred suitable biological characteristics for CAGN within the mapped areas. Therefore, permanent impacts would affect approximately 3.1% of available sage scrub vegetation within the Santiago Recharge Basins. Temporary impacts would affect approximately 14.1% of available sage scrub vegetation within the Santiago Recharge Basins. Approximately 82.8% of available sage scrub vegetation within the Santiago Recharge Basins that provide preferred suitable biological characteristics for CAGN would not be impacted by the Proposed Action at all.

Direct and indirect impacts to CAGN include displacement of established territories causing adverse effects to one territory within the action area. This would result in potential temporary displacement of one territory. This is assumed to be a temporary displacement as there are 48.47 acres of suitable CAGN habitat within the Santiago Recharge Basins that would not be impacted by the Proposed Action. Based on observations of CAGN territory size which can range between two and 14 acres (USFWS, 2010), the unaffected 48.47 acres of suitable CAGN habitat within the Santiago Recharge Basins provides sufficient acreage for between 24 and three CAGN territories while construction of the Proposed Action is occurring. Once construction of the Proposed Action is complete, 8.25 acres of upland vegetation temporarily impacted would be replanted with coastal sage scrub vegetation with suitable biological characteristics for CAGN. The replanted coastal sage scrub vegetation would include similar species that are within the Santiago Recharge Basins currently (i.e., black sage scrub, California sagebrush, laurel sumac, brittlebush scrub, etc.). In general, coastal sage scrub vegetation is considered early successional and can have growth ranging from 12 to 22 inches after approximately two years (Howard, 1992; Tesky, 1993; and Hauser, 2006). Therefore, as detailed above, upland vegetation that contains preferred biological characteristics for CAGN will for the most part only be temporarily impacted and upland vegetation unaffected during the construction of the Proposed Action should provide sufficient habitat for CAGN with permanent and temporarily displaced territories within the action area.

Indirect impacts from construction of the Proposed Action includes noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair gnatcatchers and degrade air quality and human presence can cause vireos to abandon territories and nests.

To avoid and minimize potential impacts to CAGN, the USACE pursuant to formal consultation with the USFWS will implement all the mitigation measures identified in full detail below in Section II(e)(8). In addition, the USACE will implement all reasonable and prudent measures identified in the USFWS's BiOp once the Final BiOp is provided to USACE.

To offset effects to CAGN from the Proposed Action, the USACE would restore 13.71 acres of coastal sage scrub habitat within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam. Figure 4 and Figure 6 show potential parcels that may be available as coastal sage scrub mitigation for the Santiago Creek project. The potential parcels are approximately 11.46 acres (Figure 4) and 69.64 acres (Figure 6). The parcel shown in Figure 4 is located on USACE land identified as an "environmentally sensitive area." USACE continues to work to ensure the proposed mitigation site for the Santiago Creek project does not already contain mitigation for other components of SARMP. The availability of the site as mitigation sites for the Santiago Creek project will be confirmed prior to any construction of the project occurring. The second (Figure 6) is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project.

The 13.71 acres of coastal sage scrub habitat restored offsite will be monitored and managed according to MM BIO-5 and MM BIO-9 (refer to Section II(e)(8) below for details). In addition, 8.25 acres of coastal sage scrub would be replanted on site to offset temporary impacts to upland vegetation within the project footprint. The 8.25 acres of native upland vegetation within the project footprint will be monitored and managed according to MM BIO-4 (refer to Section II(e)(8) below for details).

Based on the analysis described above, the Corps has determined that the Proposed Action may affect, and is likely to adversely affect, CAGN. The USACE provided its determination to the USFWS in a Biological Evaluation that was originally submitted December 1, 2022 (Appendix 8 of the Draft SEA/IS/MND). Formal consultation on the Proposed Action occurred from February 24, 2023, to August 8, 2023. USACE anticipates that the USFWS will provide their Final BiOp for the Proposed Action on September 22, 2023. For additional details about consultation under Section 7 of the Endangered Species Act refer to Section 4.1 in the Draft SEA/IS/MND.

Other Special-Status Bird Species

The project would temporarily and permanently impact riparian and upland habitat, as detailed above. Based on recent surveys, vegetation removal would have the potential to impact breeding and foraging habitat for special-status bird species such as yellow warbler and osprey.

Mitigation measures for listed species as described below in Section II(e)(8) would also benefit other special-status bird species. Measures include scheduling vegetation removal activities outside of the nesting bird season, implementing biological monitoring, and requiring construction workers to take environmental training. Construction noise and increased human presence could potentially deter these species, however, open channel and adjacent open space areas upstream and downstream of the project area would allow these species to avoid these areas and utilize existing resources nearby. Therefore, the project would have a less than significant impact with mitigation incorporated on other special-status bird species.

(7) Other Wildlife

The project area has suitable habitat present for other special-status species such as San Diego desert woodrat and coast whiptail, although neither species was observed during surveys. In addition, the project area also provides suitable foraging habitat for various bat species although none were observed during surveys. Measures to minimize and avoid impacts to other special-status species would include environmental training for crewmembers, pre-construction surveys for sensitive species, biological monitoring during construction, and development and implementation of a lighting plan to reduce potential effects to residents and wildlife (refer to Section II(e)(8) below for detailed descriptions of mitigation measures [i.e., avoidance and minimization measures]). Considering the discussion above regarding the potential presence of other special-status species within the project area, the project would have a less than significant impact with mitigation incorporated on other wildlife.

(8) Actions to Minimize Impacts

Best management practices will be used for all construction. Construction will be conducted primarily in the dry. Mitigation is generally not required for temporary impacts to non-wetland waters of the U.S. However, the following mitigation measures/avoidance and minimization measures would also be implemented to minimize potential impacts to threatened and endangered species:

<u>Temporary Disturbance of Riparian/Wetland Habitat</u>

MM BIO-1: Successfully restore each acre of riparian vegetation that is temporarily disturbed during construction-related activities. Keep all temporary disturbed areas free of exotic plants until riparian vegetation is re-established. If the site(s) have not begun to recover within 5 years (i.e., 50 percent of the disturbed areas are not vegetated with young riparian vegetation), then the site(s) will be replanted with cuttings from native riparian species.

MM BIO-2: Remove 1 acre of giant reed from the upper Santa Ana River watershed and/or action area for each acre of riparian/wetland vegetation that is temporarily disturbed during construction related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage giant reed-free for the life of the project.

OR:

Remove 3 acres of giant reed for each acre of temporary impact and maintain this acreage giant reed-free for a minimum of 5 years.

MM BIO-3: Conduct brown-headed cowbird (*Molothrus ater*, "cowbird") removal trapping at a minimum of 2 sites in the Santiago Basins (or other areas along the Santa Ana River and environs where trapping would likely be more effective for vireo productivity, subject to review and approval by the Service, during all years when construction of the Project is occurring and 5 years following construction. Trapping will occur during the vireo egg-laying season (March 15 to July 30). This effort is intended to supplement on-going cowbird trapping activities elsewhere in the Santa Ana River Watershed.

Temporary Disturbance of Non-riparian (Upland) Habitat Within the Flood Plain

MM BIO-4: Successfully restore each acre of non-riparian vegetation that is temporarily disturbed during construction-related activities.[1] Non-riparian areas that are temporarily disturbed will be maintained free of exotic/invasive plants[2] for a minimum of 8 years. Container plants will be planted and irrigated in upland areas to expedite the restoration process. Restoration plantings will achieve 70 percent plant cover, including 60 percent native shrub cover, after 5 years, with understory species and less than 10 percent cover by non-native species. If 70 percent of the disturbed areas are not vegetated with woody native shrub species within 5 years, then the site will be replanted or re-seeded as needed until a minimum of 70 percent cover is attained.

MM BIO-5: Restore 1 acre of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat (i.e., both native and non-native)[3] that is temporarily disturbed during construction-related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage free of non-native/exotic plant species for the life of the project.

Permanent Loss of Riparian Habitat

MM BIO-6: Successfully restore 3 acres of riparian vegetation within the action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities.

OR

MM BIO-7: Remove 5 acres of giant reed from the upper Santa Ana River watershed and/or

[1] Restoration is defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed [Source: Society of Ecological Restoration and Policy Working Group. 2002. The SER primer on ecological restoration. Science & Policy Working Group.] Existing native vegetation within a proposed restoration area will not be counted towards the acreage restored.
[2] Plants identified by the California Invasive Plant Council as invasive plants for southern California.
[3] All upland vegetation types (BE, Table 6) are considered occupied gnatcatcher habitat.

action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities; actively monitor and manage this acreage for a period of 5 years; and then arrange for the local sponsors and/or another approved entity such as the SAWA to maintain this acreage giant reed-free for the life of the project; and conduct cowbird removal trapping in the vicinity of the restored habitat for the life of the project.

Note: A combination of these alternatives can be used to fulfill the requirements of this conservation measure.

Permanent Loss of Non-riparian (Upland) Habitat Within the Flood Plain

MM BIO-8: Successfully restore three acres of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat that is permanently destroyed or isolated from the flood plain during construction-related activities (estimated total of destroyed or isolated gnatcatcher habitat is approximately 1.82 acres, and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage free of exotic/invasive plants for the life of the project.

General Habitat Restoration Measures

MM BIO-9: Restoration activities will be initiated as soon as project activities within the restoration area are completed. Restoration activities will be initiated immediately following the completion of project activities within the restoration area. Restoration activities will occur during the non-breeding season for vireos (if adjacent to occupied vireo habitat).

MM BIO-10: Restoration of coastal sage scrub habitat will be considered successful when the following target/threshold objectives are met: 1) a minimum absolute ground cover of 70 percent native woody plant species and 10 percent native herbaceous species; 2) no more than 10 percent absolute ground cover of exotic/invasive plants, including no plants identified by the California Invasive Plant Council as invasive plants for southern California with an invasive rating of "high"[4]; 3) the shrub layer will consist of a minimum of 30 percent absolute ground cover of California sagebrush (Artemisia californica), and a minimum of 5 percent absolute ground cover of each of 4 or more of the following: California buckwheat (*Eriogonum fasciculatum*), California brittlebush (*Encelia californica*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), coast goldenbush (*Isocom menzesii*); coyote bush (*Baccharis pilularis*), and bush monkey flower (*Diplacus aurantiacus*); ; 4) the herbaceous layer will consist of a minimum of 5 percent relative cover of each of 5 or more species from the seed mix provided in the BE or the following species: ladies' tobacco (*Pseudognaphalium californicum*), clustered tarplant (*Deinandra fasciculata*), golden yarrow (*Eriophyllum confertiflorum*), purple needlegrass (*Stipa pulchra*), California poppy (*Eschscholzia californica*), small fescue (*Festuca microstachys*), California brome (*Bromus carinatus*), dwarf goldfields (*Lasthenia californica*), dove lupine (*Lupinus bicolor*), and giant wild rye (*Elymus condensatus*); 5) the recruitment of native plant seedlings must be documented to occur within the replanted areas; 6) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 7) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to suitable coastal sage scrub habitat occupied by gnatcatchers in the vicinity. Alternatively, coastal sage scrub restoration efforts can be considered successful if the habitat is occupied by a breeding pair of gnatcatchers. In addition, habitat must sustain itself for 2 consecutive years without supplemental water.

MM BIO-11: Restoration of riparian habitat will be considered successful when the following

[4] These species must be treated with lethal control methods and removed, cut down, or destroyed prior to seed production in any given year.

target/threshold objectives are met: 1) a minimum of 30 percent absolute ground cover of native plant species; 2) less than 10 percent absolute ground cover of exotic plant species (including 0 percent giant reed); 3) the absolute ground cover of native species must be represented by, at least, five dominant or co-dominant plant species; 4) the recruitment of native plant seedlings must be documented to occur within the replanted areas; 5) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 6) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to habitat occupied by vireo in the vicinity. Alternatively, riparian vegetation efforts can be considered successful if the habitat is occupied by a breeding pair of vireo, flycatcher, and/or yellow-breasted chat (*Icteria virens*). In addition, habitat must sustain itself for 2 consecutive years without supplemental water.

MM BIO-12: All acres of restored coastal sage scrub and riparian habitat for offset or permanent impacts will be protected in perpetuity through proper legal instruments for the conservation of federal and state listed species and their habitats.

MM BIO-13: The Corps will ensure that the local sponsors commit to funding a cowbird trapping program in the vicinity of the restored riparian habitat for the life of the project. Program specifics (e.g., number and locations of traps) will be determined in conjunction with permitting processes for the CDFW and USFWS.

MM BIO-14: Mitigation will be initiated as soon as practicable for impacts that occur during the first year of construction. Afterwards, mitigation will be initiated-prior to construction of individual project features. For restoration options that include management for the life of the project, the Corps will continue exotic species removal (e.g., giant reed) and cowbird control until such time as the Service receives written documentation that the local sponsors and/or another approved entity (such as SAWA) have accepted responsibility for management of the restored area(s). Written documentation will include an estimate of costs associated with management responsibilities and a description of the funding mechanism(s) that will be used to ensure management will continue for the life of the project. If SAWA or another non-public entity accepts management responsibility and then becomes unwilling or unable to continue, then responsibility for continued management will revert to the local sponsors. Any advance mitigation that exceeds the requirements of the project (i.e., if actual project impacts are less than what was anticipated when the mitigation was initiated), may be credited as compensation for the effects of future projects.

MM BIO-15: Identify and delineate on well-labeled maps the species areas in the upper Santa Ana River watershed and/or action area from which giant reed will be or has been removed, and riparian vegetation restored, as compensation for the proposed action. These areas must be approved by the local sponsors, CDFW, USFWS, and USACE. An annual report will be prepared for the Service by the approved management entity (e.g., SAWA) that address the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management; and 4) updated mapping that delineates areas in the upper Santa Ana River watershed and/or action area from which giant reed has been removed.

MM BIO-16: Identify and delineate on well-labeled maps the species areas in the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Basin that coastal sage scrub will be restored, as compensation for the proposed action. These areas must be approved by the local sponsors, and the Service prior to initiation of coastal sage scrub restoration. An annual report will be prepared for the Service by the Corps until coastal sage scrub is considered successful that addresses the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management and; 4) progress towards meeting success criteria.

MM BIO-17: Request that the administrator of the Trust Fund identify those acres within the Santa Ana watershed where giant reed was previously removed and/or habitat restored using the $1,000,000 contributed by the OCWD in lieu of restoring 133 acres of riparian habitat in the Prado Basin. This acreage will be actively monitored and managed until riparian habitat is completely restored, and then maintained giant-reed free for the life of the project.

General Conservation Measures for the Vireo, Gnatcatcher, and Flycatcher

MM BIO-18: During Project design, the Corps will consider an alternative for the proposed maintenance road in Smith Basin that allows for permanent access to Smith Basin from Villa Park Road.

MM BIO-19: A monitoring program will be developed and implemented within the Project site that entails surveys for the vireo and gnatcatcher during spring and early summer of the year prior to construction and, also, during each year of construction. Construction activities will be monitored to assure that vegetation is removed only in the designated areas. The limits of riparian/coastal sage scrub areas not to be disturbed will be flagged and not encroached upon.

MM BIO-20: Each employee, contractor, or subcontractor involved in the project construction (including temporary contractors and subcontractors) will be briefed on the following information prior to working within or near areas that may affect federally listed species and proposed species: 1) general types and locations of sensitive habitats and federally listed and proposed species that may occur in the action area; 2) measures that will be taken to avoid and minimize incidental take during construction activities; 3) location of conservation and protected areas within the action area; 4) reporting procedures for observations of federally listed and proposed species; 5) reporting procedures for incidents involving the take or potential for take of listed and proposed species; 6) information regarding whom to contact at USFWS to report non-compliance with the conservation measures in the biological opinions and terms and conditions of the incidental take statement (or other potential violations of the Act); and 7) applicable permit conditions stipulated by the CDFW and/or other regulatory agencies.

MM BIO-21: Vegetation clearing associated with project construction will take place only during periods when the vireo and gnatcatcher are not nesting (August 15 through February 15).

MM BIO-22: The construction contractor will minimize grading activities and leave root systems intact, to the extent practicable.

MM BIO-23: To the maximum extent practicable, haul routes and staging areas will be located outside of the flood plain (e.g., along bike trails, levees, and roads). All equipment maintenance, staging, and dispensing of fuel, oil, coolant, or any other toxic substance will occur in developed or designated non-sensitive upland areas. Best Management Practices (BMPs) will be implemented in these areas to prevent runoff carrying potentially toxic substances from entering the Santiago Creek and associated drainages. If a spill occurs outside of a designated area, the cleanup will be immediate and documented.

MM BIO-24: During construction, riparian vegetation adjacent to de-watering areas will be monitored. Supplemental water will be added to this vegetation as necessary to avoid water stress.

MM BIO-25: To reduce fire hazards, a water truck will always be present during construction activities. Fire suppression equipment including shovels, water, and extinguishers will also be available onsite during the fire season (as determined by Orange County Fire District) and when activities may produce sparks. Construction activities will comply with the fire prevention and protection practices set forth in the USACE's Safety and Health Requirements Manual (EM 385-1-1). The provisions of EM 385-1-1 will be incorporated into all construction specifications, and the contractor will be required to prepare a fire prevention and protection plan for the construction

project.

MM BIO-26: Dust control measures will be implemented during construction to reduce excessive dust emissions. Methods for reducing dust emissions may include wetting work areas, such as dirt access roads and sediment stockpiles, on a regular basis, as well as covering truck beds carrying material and stockpiles.

MM BIO-27: To the extent feasible, the contractor will prevent exotic weeds from establishing within the work site during construction. Construction equipment will be cleaned of mud or other debris prior to mobilizing and before leaving the site to reduce the potential spread of invasive plants and/or seeds.

MM BIO-28: Excavated materials will be backfilled over the toe stabilization structures. The contractor will replace surface material and re-grade disturbed soft-bottomed substrate areas, in particular the low-flow river channel, to replicate pre-project conditions. USACE will continue to coordinate with USFWS to develop and improve measures for re-establishing habitat values within the construction area.

General Conservation Measures to Maintain Wildlife Movement Through Action Area

MM BIO-29: Native plant species will be used to revegetate disturbed upland areas.

MM BIO-30: A monitoring protocol will be developed and implemented for raptor monitoring, including bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) potentially occurring in the proposed Project footprint during construction. If eagles are foraging or otherwise using the Project footprint, the Corps will coordinate with the Service to develop appropriate avoidance measures.

MM BIO-31: Prior to any ground-disturbing activities (e.g., mechanized clearing or rough grading) for all project related construction activities, a Corps biologist (or biological monitor) will conduct pre-construction surveys of the proposed Project area for terrestrial special-status species. During these surveys, the biologist will:

a. Inspect the proposed Project area for any sensitive wildlife species; and

b. In the event of the discovery of a non-listed, species-status ground-dwelling animal, such as burrowing owl or special-status reptile, attempts will be made to recover and relocate the animal to adjacent suitable habitat within the Proposed Project area at least 200 feet from the limits of construction activities. Burrowing owl surveys and relocations would follow the Burrowing Owl Survey Protocol and Mitigation Guidelines (California Burrowing Owl Consortium, 1993).

MM BIO-32: For construction activities within or adjacent to occupied vireo, or gnatcatcher habitat, the following measures shall be implemented to reduce or avoid noise impacts:

1. Prior to the commencement of construction activities, ambient noise levels will be measured at 50 feet and 100 feet from the proposed boundaries of the construction sites and recorded in a graphic format.

2. Sound walls shall be constructed at the boundary of the proposed construction site and/or haul route prior to February 15. Sound walls will probably consist of ½ inch-thick, 8 feet-high plywood sheets. The construction contractor may use other materials or procedures that attenuate sound to acceptable levels, defined below (MM BIO-32 #3 and #4).

3. Where ambient noise is less than 60 dBA and it is determined that construction-related

noise levels may exceed 60 dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction-related noise does not exceed 60 dBA within these areas. If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within occupied habitat areas outside the project footprint cannot be reduced below 60 dBA Leq hourly during the period of February 15 through August 15 of any year, the Corps will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat outside the project footprint[5] subject to noise levels over 60 dBA Leq hourly during the noted period, per the number of breeding seasons will result in 2 acres of restoration; 1 acre of riparian habitat affected by two separate project phases or segments in a single breeding season will result in 1 acre of restoration). The area affected will be determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps will identify restoration areas in coordination with the Service.

4. Where pre-construction ambient noise is greater than 60 dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction does not result in a significant increase over ambient conditions (i.e., noise level increases shall not exceed 5 dBA over ambient). If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within riparian/coastal sage scrub habitat areas outside the project footprint cannot be reduced to or below 5 dBA Leq hourly over ambient noise levels during the period of February 15 through August 15 of any year, the Corps will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat subject to noise levels more than 5 dBA Leq hourly over ambient during the noted period, as determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps will identify restoration areas in coordination with the Service.

As discussed in Section II(e)(5)(b) above, the Proposed Action would not directly or indirectly impact federal wetlands as no federal jurisdictional wetlands were determined to be present within the project footprint. Therefore, no mitigation measures are required for impacts to wetland waters of the U.S. The Proposed Action would also not result in the permanent loss of non-wetland waters of the U.S., but would result in temporary impacts to non-wetland waters of the U.S. It is important to note that in addition, the Proposed Action would result in the temporary loss of wetland waters of the State.

Based on the analysis of temporary impacts to non-wetland waters of the U.S. and wetland waters of the State as discussed in Section II(e)(5)(b) above, there are no mitigation measures incorporated for temporary impacts to these waters since implementation of the Proposed Action would result in no net loss of non-wetland waters of the U.S. or wetland waters of the State. However, it is important to note that temporarily disturbed areas with wetland and riparian vegetation would be replanted with native wetland and riparian vegetation once construction is

[5] Includes all riparian and upland vegetation types (BE, Table 6) outside the mapped project footprint (Figures 1 and 2). Leq hourly noise level contours for project construction activities during the vireo and gnatcatcher breeding and nesting season will be calculated and reported for the areas adjacent to the project footprint based on noise monitoring to be performed, as appropriate.

complete. In addition, under Section 7 consultation with the U.S. Fish and Wildlife Service, USACE has agreed to compensate for temporary impacts to wetland vegetation (which is habitat for the federally listed least Bell's vireo) not only by restoring native wetland/riparian vegetation onsite as described above but also restoring native wetland/riparian vegetation offsite at a 1:1 ratio (refer to MM BIO-1 and MM BIO-2 above in Section II(e)(8)).

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination

A mixing zone is not applicable because any excavated sediment would be placed upland with no direct return of untreated water.

(2) Determination of Compliance with Applicable Water Quality Standards

The Proposed Action is expected to comply with all applicable water quality standards and no violations are anticipated.

(3) Potential Effects on Human Use Characteristics

(a) Municipal and Private Water Supply

The Blue Diamond and Bond basins do not directly provide drinking water, but it does provide a supply for recharging the groundwater table which is then used for drinking water. The Proposed Action would neither decrease or increase the holding capacity of the basins; therefore, no impacts to municipal and private water supplies would occur.

(b) Recreational and Commercial Fisheries

No effects on commercial or recreational fishing would occur. The Blue Diamond and Bond basins are not open to public recreation and both the Smith Basin and lower Santiago Creek channel have intermittent flow without consistent surface water to support recreational or commercial fishing.

(c) Water Related Recreation

None of the project area allows for water related recreation, therefore, there would be no impacts to this human use characteristic.

(d) Aesthetics

The Proposed Action does not involve the construction of any structures that would obstruct existing views of residences surrounding the Santiago Recharge Basins. The Proposed Action does include the construction of floodwalls along portions of the lower Santiago Creek Channel. While the floodwalls would impact aesthetics of the area, native low growing grasses would be planted where feasible around the floodwalls. With the replanting of native vegetation once construction is complete the impacts to aesthetics due to the construction of the floodwalls is expected to be less than significant.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves.

The Proposed Action does not occur within any parks, national and historical monuments, national seashores, wilderness areas, research sites, or similar preserves; therefore, there would be no impact to this human use characteristic.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

Implementation of the Proposed Action would result in less than significant impacts to the aquatic ecosystem with the implementation of mitigation measures (refer to Section II(e)(8) below for detailed descriptions of mitigation measures). The Proposed Action combined with other projects would not contribute to cumulative aquatic ecosystem impacts within the region. The Blue Diamond, Bond, and Smith basins are currently federal mitigation sites required by the FWS as a condition of their concurrence per Section 7 Consultation for USACE's initial issuance and

renewal of RGP 90. Regional General Permit 90 allows OCWD to perform operation and maintenance activities within their groundwater recharge basins. Issuance of the 2013 Water Quality Certification by the RWQCB and the Streambed Alteration Agreement by CDFW are also contingent upon the implementation of the mitigation sites as identified in OCWD's HMP. USACE Regulatory is currently in discussions with the FWS, RWQCB, and CDFW as to whether the mitigation sites specifically in the Blue Diamond, Bond, and Smith basins can be removed as a requirement for OCWD to implement because OCWD has potentially already implemented sufficient mitigation within other basins under their purview to offset realized permanent impacts to wetland vegetation since 2013. OCWD has confirmed that only 3.19 acres of permanent impacts to wetland vegetation has occurred since the RGP 90 permit was first issued in 2014. Since discussions about removal of the Santiago Basin and Smith Basin mitigation sites from OCWD's HMP are ongoing and are expected to be resolved prior to construction of the proposed Santiago Creek project, the FWS's 2023 amendment, to the FWS's 2001 BiOp for the Santa Ana River Mainstem Project and the FWS's 2012 amendment to the 2001 BiOp for the Santa Ana River Mainstem Project, assumes that the federal requirement for OCWD mitigation has been fully satisfied in other locations. If the agencies whose permits/consultations include these existing mitigation sites do not agree to remove the Smith Basin and Santiago Basin mitigation sites from OCWD's HMP, then Section 7 consultation for the Santiago Creek project will be reinitiated at that time.

Although the Proposed Action would have temporary and permanent impacts to existing federal mitigation sites at this time, the Proposed action combined with other past, current, and reasonably foreseeable future projects is not expected to contribute to cumulative aquatic ecosystem impacts within the region. This is because the Proposed Action includes restoration of native vegetation for all temporarily disturbed areas within the project footprint as well as 1:1 compensatory mitigation offsite for all temporary impacts. In addition, all permanent impacts to native vegetation within the project footprint would be offset offsite at either a 5:1 or 3:1 mitigation ratio depending on the habitat type. Since the federally required mitigation sites under RGP 90 within Smith Basin and the Blue Diamond and Bond basins would be restored with native vegetation that would provide equivalent or better ecological functions than the habitat to be disturbed and temporal/permanent impacts to mitigation sites would be offset offsite within the action area, which includes Prado Basins, and/or within the Santa Ana River watershed downstream of Prado Dam, impacts of the Proposed Action Alternative would be reduced to less than significant levels and effects of the project would not be considered cumulatively significant with mitigation.

h. Determination of Secondary Effects on the Aquatic Ecosystem

There are no identified secondary effects on the aquatic ecosystem due to the implementation of the Proposed Action.

SECTION 3 – FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

a. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation

There were no adaptations of the Section 404(b)(1) guidelines for this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site(s) Which Would Have Less Adverse Impact on the Aquatic Ecosystem

All practicable alternatives to the Santiago Creek component of the SARMP were originally discussed in the 1980 Supplemental Environmental Impact Statement and General Design Memorandum I. The current Draft Supplemental Environmental Assessment for the Santiago Creek component also analyzes the 1988 Santiago Creek project design as well as the Proposed Action which includes design refinements to the 1988 project design. The Proposed Action reduced the acreage of permanent impacts within the Santiago Basins by eliminating the overflow

structure, outlet structure, and outlet channel that was recommended in the 1988 project design. In addition, the Proposed Action includes a “greener” design for the lower Santiago Creek channel by placing the riprap and then burying the riprap with harvested native substates from the creek channel. The Proposed Action does include the rehabilitation of an old maintenance road on the north side of Smith Basin which was not analyzed in the 1980 SEIS. Therefore, an analysis of a practicable alternative to the rehabilitation of the old maintenance road was conducted in the current SEA to minimize impacts to LBVI and CAGN habitat. The alternative considered included building a maintenance road down to the bottom of Smith Basin that would connect to the existing maintenance road located along Villa Park Road. However, this alternative was not feasible because 1) the gradient of the slope along Villa Park road is too steep to create a road that could be safely traversed down into the basin; 2) there is little to no shoulder along Villa Park Road when approaching the existing Smith Basin maintenance road which is a safety hazard for maintenance vehicles getting on and off the maintenance road; and 3) there would be a safety hazard for vehicles traveling along Villa Park Road and slow maintenance vehicles entering and exiting the roadway (i.e., not traffic light). For comparison, Villa Park Road is a four-lane highway with a speed limit of 50 miles per hour in the vicinity of Smith Basin. Conversely, Santiago Boulevard which would provide access to the rehabilitated maintenance road is a two-lane road with a speed limit of 35 miles per hour.

Therefore, the Proposed Action is the least environmentally damaging practicable alternative (LEDPA). The Proposed Action would inflict the least amount of adverse impacts on the aquatic ecosystem posed by excavation and fill activities while upholding the flood risk management objective of the project. Compared to the previously approved design (i.e., the 1988 design), the Preferred Alternative would have the least environmental impact on existing WOTUS.

c. Compliance with Applicable State Water Quality Standards

The proposed construction would comply with the California Construction General Permit Order (currently 2009-0009-DWQ but subject to update). Excess soils and excavated sediment would be placed upland for disposal with no direct return of untreated water. The Proposed Action is not anticipated to cause any considerable long-term effects on, or changes to, the water chemistry or quality. Short-term effects on water quality could occur where construction in the dry is not possible. This would potentially occur with the construction of shoreline stabilization features within Santiago Recharge Basin. Construction in the wet of the shoreline stabilization features has the potential to cause temporary increase in the concentration of suspended solids and turbidity. To minimize potential impacts, erosion control and stormwater pollution prevention practices would be implemented proactively. Overall, the Proposed Action is expected to comply with all applicable water quality standards and no violations are anticipated.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act

The Proposed Action would be in compliance with applicable Toxic Effluent Standards under Section 307 of the Clean Water Act; with the Endangered Species Act of 1973; with the National Historic Preservation Act of 1966; and with the Fish and Wildlife Coordination Act.

e. Compliance with Endangered Species Act of 1973

In accordance with Section 7(c), the USACE obtained a list of federally listed and proposed species likely to occur in the Proposed Action area. In addition, the USACE initiated formal consultation with the FWS regarding the Proposed Action and submitted a Biological Evaluation (BE) to the FWS on December 1, 2022 (Appendix 8 to the Draft SEA/IS/MND). Upon receipt of the BE, the FWS reviewed the document for completeness to initiate formal consultation. In an email response dated December 21, 2022, the FWS stated that USACE’s request and supplementary information did not include all the information necessary to initiate formal consultation and requested additional information for the initiation package to be considered complete. The USACE provided the additional information that was requested and/or a statement explaining why the information could not be made available at the time on February 24, 2023.

Following the receipt of the additional information, the FWS acknowledged on April 5, 2023, that the formal consultation was initiated upon receipt of the USACE's response letter from February. However, the FWS provided three additional comments and a fourth comment was provided on May 17, 2023. Due to the complexity of the comments, FWS requested an extension of the formal consultation period on July 7, 2023. The formal consultation period was completed on August 8, 2023, and it is anticipated that the FWS will issue the Final BiOp by September 22, 2023. With the receipt of the BiOp and the implementation of reasonable and prudent measures, the Proposed Action will be in compliance with the Endangered Species Act.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972

The proposed project does not occur within the vicinity of a designated Marine Sanctuary.

g. Evaluation of Extent of Degradation of the Waters of the United States

(1) Significant Adverse Effects on Human Health and Welfare

The proposed fill activity is not expected to have any long-term adverse impacts on human health or welfare, including;

(a) Municipal and private water supplies,
(b) Recreational and commercial fisheries,
(c) Plankton,
(d) Fish,
(e) Shellfish,
(f) Wildlife communities (including community diversity, productivity, and stability), or
(g) Special aquatic sites.

(2) Significant Adverse Effects on Life Stages of Aquatic Life and Other Wildlife Dependent on Aquatic Ecosystems

No significant adverse effects are expected.

(3) Significant Adverse Effects on Aquatic Ecosystem Diversity, Productivity, and Stability

No long-term adverse effects on aquatic ecosystem diversity, productivity, or stability are expected.

(4) Significant Adverse Effects on Recreational, Aesthetic, and Economic Values

As described earlier, the Proposed Action could have potential temporary impacts to visual aesthetics during construction of the project. No significant adverse impacts to visual aesthetics are expected. There would be no impacts to recreation or economic values.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

As discussed above, construction projects which disturb one or more acres of soil are required to obtain coverage under a General Construction Permit by the State Water Resources Control Board. Since the Proposed Action would disturb more than one acre a General Construction Permit would be obtained. The General Construction Permit would require the filing of a Notice of Intent with the State Waters Resources Control Board and the preparation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP would provide a list of BMPs to minimize/prevent uncontrolled discharges into Santiago Creek and the Santiago Recharge Basins and to control erosion and stormwater runoff. Upland work areas will be subject to erosion control and will be permanently stabilized with native vegetation once construction is complete. Excavation activities will also use best management practices to minimize solid suspension where water is present. Excess substrate not to be reused would be stockpiled onsite with no

return water unless treatment has occurred to prevent the release of anthropogenic compounds into Santiago Creek or the Santiago Recharge Basins. Excess substrate would then be hauled offsite for disposal in an approved landfill.

Since the Proposed Action would have temporary impacts to non-wetland waters of the U.S. due to cut and fill activity best management practices as detailed in Section 3.4.9.4 of the Draft SEA would be implemented during construction to minimize potential impacts to non-wetland waters of the U.S. In addition, mitigation measures required per formal consultation under Section 7 of the Endangered Species Act (as detailed in Section II(e)(8) of this Draft 404(b)(1) Analysis would help to minimize potential impacts to non-wetland waters of the U.S. as well as minimize potential adverse impacts to wildlife and aquatic organisms. It is also important to note that USACE will apply for a 401-water quality certification during the next phase of the project and anticipates no issues with obtaining certification prior to construction of the Proposed Action Alternative. All the above are the appropriate and practicable steps that USACE will take to minimize potential adverse impacts of the excavation and placement of fill material on the aquatic ecosystem.

i. On the basis of the guidelines, the proposed disposal site(s) for the discharge of the fill material is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize adverse impacts to the aquatic ecosystem.

Appendix 4 – Air Quality and General Conformity Analysis

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SANTA ANA RIVER MAINSTEM

SANTIAGO CREEK

ORANGE COUNTY, CALIFORNIA

Appendix 4 – Air Quality and General Conformity Analysis

September 2023

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 4 – AIR QUALITY AND GENERAL CONFORMITY ANALYSIS

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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 4 – AIR QUALITY AND GENERAL CONFORMITY ANALYSIS

1.0 Introduction

1.1 Project Area and Scope

The purpose of the Santiago Creek project is to reduce flood risks for the community within the lower Santiago Creek floodplain. The Santiago Creek is located entirely within Orange County, California. The full watercourse is approximately 30-miles, originating in the Santa Ana Mountains and draining at the Santa Ana River which ultimately discharges to the Pacific Ocean. This project is a component of the Santa Ana River Mainstem (SARM) megaproject managed by the USACE – Los Angeles District (CESPL). A regional map with the Santiago Creek project area is shown in Figure 1.

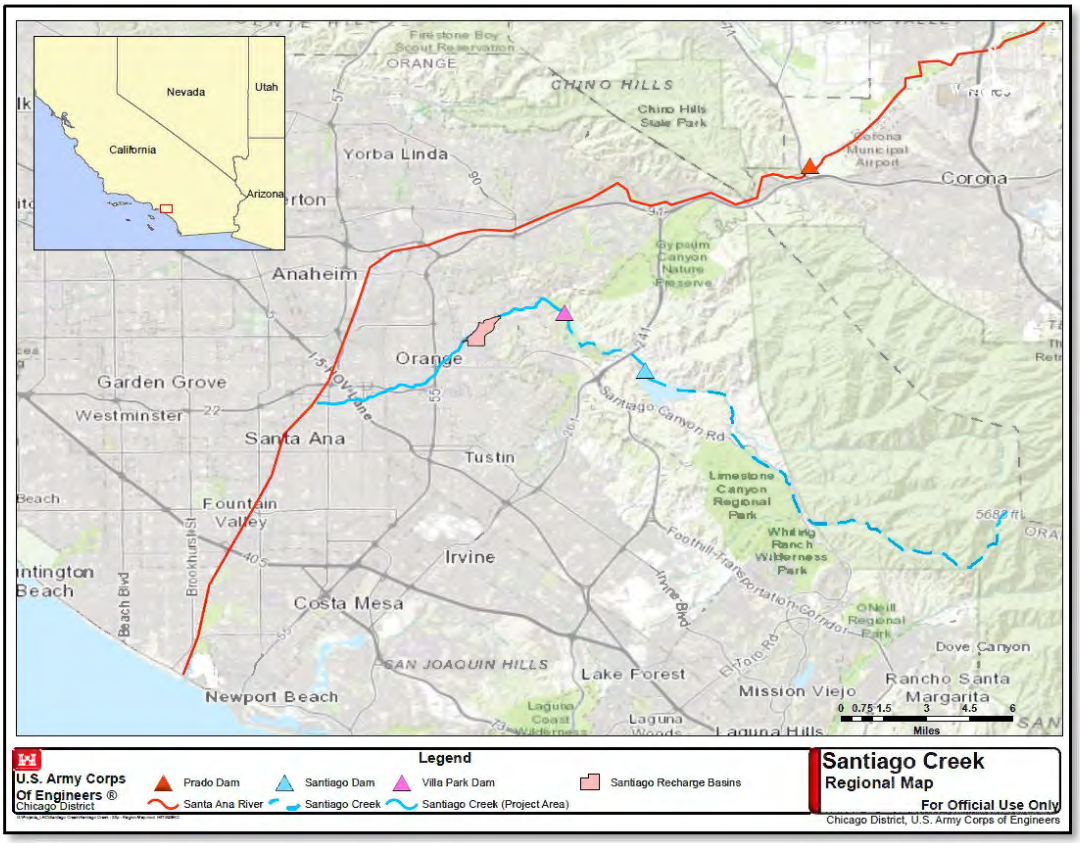


Figure 1: Regional Map

The proposed project area is contained within the lower Santiago Creek between Villa Park Dam and the creek's confluence with the Santa Ana River. Villa Park Dam is a flood-control dam located at the upstream end of the project area that is maintained and operated by the Orange County Flood Control District (OCFD). Downstream of the dam, the creek passes through two former gravel pits – the Bond and Blue Diamond Pits – that along with the Smith Basin immediately upstream were converted to water conservation basins by the Orange County Water District (OCWD) in the early 1990's. These basins – now known as Santiago Recharge Basins – are primarily gravely sand which maintain a standing pool of water throughout the year for groundwater recharge. The creek downstream of the Santiago Recharge is an approximately 9-mile long, urbanized, and channelized stream mainly earthen except in a few areas where it is armored and/or paved. The section of the creek downstream of Villa Park Dam is ephemeral and predominantly dry except during brief periods of the rainy season. Portions of the channel have other

uses during the dry periods (as a parking lot, as part of a golf course). The 1.2-mile segment of Santiago Creek between the I-5 (Santa Ana) Freeway and the confluence with the Santa Ana River is a compacted earth channel with numerous encroachments, including residential yards, retaining walls, fencing, and vegetation. The Santiago Creek project area consists of the Santiago Recharge Basins and the channel extending from the Santa Ana Freeway downstream to the creek's confluence with the Santa Ana River mainstem. A project map identifying the channel and reservoir areas is shown in Figure 2.

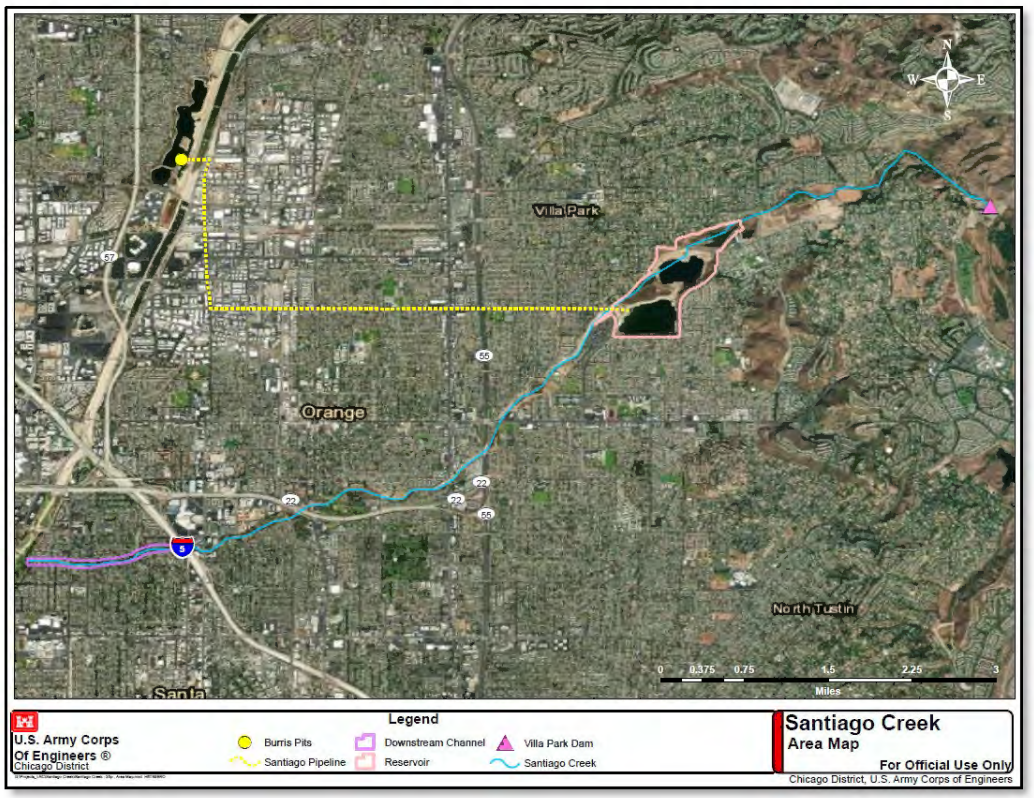


Figure 2: Project Area Map

The congressionally authorized design objective is to contain the 1% annual chance exceedance (1% ACE) flows of lower Santiago Creek within the channel and reservoir area. The 1982 Chief's Report provides the recommended plan for Santiago Creek, as described by the Phase I General Design Memorandum (GDM) feasibility-level study (USACE, 1980). The construction features necessary for control of the 1% ACE were refined in the Phase II GDM (USACE, 1988), consistent with the authorized plan. However, conditions at the project site and regulatory and community needs have changed since the original design documentation, therefore re-analysis of engineered features and environmental impacts is required as part of this DDR, which will be used for project decision making prior to future detailed design for the Plans and Specification (P&S) phase. The Proposed Action includes the following construction features for control of the 1% ACE:

- Channel Improvements (including floodwalls) – Channel improvements are necessary between Santa Ana Freeway and Santa Ana River to provide additional flow capacity and prevent erosion. The Proposed Action includes a trapezoidal rip rap channel overlain by native substrate to improve aesthetics, operations and maintenance, and ecological function along the full downstream channel extent. Low elevation steel sheet pile floodwalls with reinforced concrete cap are required between portions of Bristol Avenue and Flower Street on top of the proposed bank on the north and south sides of the channel to prevent overbank flooding.

- Reservoir Rehabilitation – Stabilization of the Santiago Recharge Basins (also referred to as the reservoir) is necessary to prevent slope failures during 1% events. The Proposed Action includes slope stabilization at select reservoir locations through installation of buttress fill, retaining walls, or armoring. The Smith Basin floor also requires rehabilitation to protect repaired slopes, and the Smith Basin historic maintenance road requires rehabilitation for access to the basin.

The Proposed Action includes updates to the Phase II GDM design, including channel improvements using natural substrate and plantings. Project areas are owned by Orange County. Most of the areas to be taken in flowage easements are owned by the Orange County Water District (i.e., the Santiago Recharge Basins). These pits were acquired in 1984 by the Water District for both water conservation and flood control use., and a draft Irrevocable Offer of Dedication was developed in 2003 for the proposed USACE project between the Orange County Water District and the Orange County Flood District and includes a perpetual flowage easement within the basins to store flood waters between elevations 274-ft NGVD29 and 298-ft NGVD29.

Construction of project features will require earth work and excavation within the channel and where slope stabilization activities are proposed at the reservoir. Reuse of material on-site has been identified as a potential cost savings measure and may require regulatory coordination with California agencies (State Water Resources Control Board (SWQCB) and Santa Ana Regional Water Quality Control Board (RWQCB) for 401 Water Quality Certification for regulating discharges of dredged or fill material to waters of the state).

1.2 Clean Air Act

The 1990 amendments to the Clean Air Act (CAA) [42 United States Code 7401 et seq.] require Federal agencies to ensure that their actions conform to the appropriate State Implementation Plan (SIP). A SIP is a plan that provides for the implementation, maintenance, and enforcement of the National Ambient Air Quality Standards (NAAQS), and includes emission limitations and control measures to attain and maintain the NAAQS. Conformity to a SIP, as defined in the CAA, means conformity to a SIP's purpose of reducing the severity and number of violations of the NAAQS to achieve attainment of such standards.

The Federal agency responsible for an action is required to determine if the action conforms to the applicable SIP. Section 176(c) of the Clean Air Act prohibits Federal entities from taking actions in nonattainment or maintenance areas which do not conform to the State implementation plan (SIP) for the attainment and maintenance of the National Ambient Air Quality Standards (NAAQS). Therefore, the purpose of conformity is to (1) ensure Federal activities do not interfere with the budgets in the SIPs; (2) ensure actions do not cause or contribute to new violations, and (3) ensure attainment and maintenance of the NAAQS.

The CAA delegates the enforcement of the federal standards to the states. In California, the California Air Resources Board (CARB) is responsible for enforcing air pollution regulations. In the air basin which includes Orange County, the South Coast Air Quality Management District (SCAQMD) is responsible for regional air quality planning efforts, including assisting lead agencies in evaluating a proposed project's potential air quality impacts and providing environmental air quality reviews according to CEQA.

1.3 General Conformity

On November 30, 1993, the United States Environmental Protection Agency (USEPA) promulgated regulations, known as the General Conformity Regulations, to ensure that other Federal actions (other than transportation projects, which are addressed separately) also conformed to the SIPs (58 FR 63214). With respect to General Conformity, all Federal Actions are covered unless otherwise exempt, e.g. actions covered by transportation conformity, actions with clearly de minimis emissions, exempt actions listed in rule, or actions covered by a Presumed to Conform demo (approved list). Conformity can be demonstrated by: (1) showing emission increases are included in SIP; (2) State agrees to include

increases in SIP; (3) areas without SIPs, no new violations of NAAQS and/or no increase in frequency/severity of violations; (4) Offsets, and (5) Mitigation. Some emissions are excluded from conformity determination, such as those already subject to new source review; those covered by CERCLA or compliance with other environmental laws, actions not reasonably foreseeable, and those for which the Agency has no continuing program responsibility.

The purpose of this analysis is to document determination of conformity of the Santiago Creek Proposed Action, which could impact Orange County in California by emitting pollutants from off-road diesel-fueled construction equipment, on-road gasoline and diesel-fueled vehicles, material handling and grading, and paved surfaces. This conformity analysis has been prepared in accordance with the final rule of the USEPA, Determining Conformity of General Federal Actions to State or Federal Implementation Plans, published in the Federal Register on November 30, 1993. The general conformity rule [40 Code of Federal Regulations (CFR) Part 93, Subpart B] was effective January 31, 1994.

In addition to General Conformity, this report will include a broader analysis to meet California Environmental Quality Act (CEQA) guidelines and determine the significance the proposed project on air quality and greenhouse gases (GHGs).

1.4 Criteria Air Pollutants

National Ambient Air Quality Standards (NAAQS) have been established for six common air pollutants considered harmful to public health and the environment (NAAQS Table, 2016). The criteria pollutants for which air quality standards have been established under the CAA are particulate matter, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. Table 1 provides a summary of the current NAAQS for each pollutant.

Table 1: National Ambient Air Quality Standards for Six Critica Pollutants (NAAQS Table, 2016)

Pollutant		Primary/Secondary Pollutant Status	Averaging Time	Level	Form
Carbon Monoxide (CO)		Primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hours	35 ppm	
Lead (Pb)		Primary & secondary	Rolling 3 month average	0.15 ug/m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)		Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary & secondary	1 year	53 ppb	Annual Mean
Ozone (O_3)		Primary & secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter (PM)	$PM_{2.5}$	Primary	1 year	12.0 ug/m^3	annual mean, averaged over 3 years
		Secondary	1 year	15.0 ug/m^3	annual mean, averaged over 3 years
		Primary & secondary	24 hours	35 ug/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary & secondary	24 hours	150 ug/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

Pollutant	Primary/Secondary Pollutant Status	Averaging Time	Level	Form
	secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

California established its own ambient air quality standards (CAAQS) for the criteria pollutants above, as well as for sulfate, hydrogen sulfide, visibility reducing particles, and vinyl chloride. Because the CAAQS are usually more stringent than the NAAQS, attainment of these standards often requires emission reductions beyond those required to show attainment of the NAAQS.

1.5 Nonattainment Areas

Areas where air pollution levels persistently exceed the NAAQS (or the CAAQS) are designated as nonattainment areas. The general conformity rule applies to Federal actions occurring in air basins designated as nonattainment for criteria pollutant NAAQSs or in attainment areas subject to maintenance plans (maintenance areas). Table 2 summarizes the attainment status of the study area in Orange County that is potentially impacted by the Proposed Action. The area is currently not attaining ozone and $PM_{2.5}$ national standards, is a maintenance area for attainment of the PM_{10} national standard, and does not meet ozone, $PM_{2.5}$, or PM_{10} state standards.

Table 2: Attainment Designations for Orange County, CA.

Pollutant	NAAQS Federal Attainment Status	CAAQS State Attainment Status*
Carbon Monoxide (CO)	Attainment/Unclassified	Attainment
Lead (Pb)	Attainment	Attainment
Nitrogen Dioxide (NO_2)	Attainment/Unclassified	Attainment
Ozone (O_3) 8-hour	Extreme Nonattainment	Nonattainment
Particulate Matter (PM) PM_{10}	Attainment - Maintenance	Nonattainment
Particulate Matter (PM) $PM_{2.5}$	Serious Nonattainment	Nonattainment
Sulfur Dioxide (SO_2)	Attainment	Attainment

*Orange County is in attainment of state sulfate AAQS and has not been classified for state hydrogen sulfide and visibly reducing particles attainment status.
Source: 2020 Designations for State Ambient Air Quality Standards, California Air Resources Board: https://ww2.arb.ca.gov/resources/documents/maps-state-and-federal-area-designations
Source: NAAQS attainment status, USEPA Greenbook: https://www3.epa.gov/airquality/greenbook/anayo_ca.html

2.0 General Conformity Determination Process

The general conformity rule consists of three major parts: applicability, analysis, and procedure. These three parts are described in the following sections.

2.1 Applicability

The general conformity rule ensures actions by federal agencies in nonattainment and maintenance areas do not interfere with a state's plan to meet national air quality standards. Construction of the

Proposed Action would increase atmospheric emissions by operating off-road diesel equipment, on-road diesel and gas vehicles, and by creating fugitive dust emissions in Orange County, CA.

2.1.1 De Minimis Emissions Levels

To focus conformity requirements on those Federal actions with the potential to have significant air quality impacts, threshold (de minimis) rates of emissions (Table 3) were established in the final rule. With the exception of lead, the de minimis levels are based on the CAA's major stationary source definitions for the criteria pollutants (and precursors of criteria pollutants) and vary by the severity of the nonattainment area. A conformity determination is required when the annual net total of direct and indirect emissions from a Federal action, occurring in a nonattainment or maintenance area, equals or exceeds the annual de minimis levels. In this report, calculated emissions estimates are compared to de minimis levels to evaluate if a conformity determination is needed. The levels circled in red in Table 3 are applicable to this determination.

Table 3: De Minimis Emission Levels (De Minimis, 2016).

Pollutant and Area Designation	Attainment Type	Tons per year[a]
Ozone (VOC and NOx)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NOx)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon Monoxide, SO_2 and NO_2	All nonattainment & maintenance	100
PM_{10}	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
$PM_{2.5}$ Direct emissions, SO2, NOx (unless determined not to be a significant precursor), VOC or ammonia (if determined to be significant precursors)	All nonattainment & maintenance	100
Lead (Pb)	All nonattainment & maintenance	25

[a] Rates circled in red are those applicable to this conformity analysis.

2.1.2 Regional Significance

A Federal action that does not exceed the threshold of rates of criteria pollutants may still be subject to a general conformity determination. The direct and indirect emissions from the action must not exceed 10% of the total emissions inventory for a particular criteria pollutant(s) in a nonattainment or maintenance area. If the emissions exceed this 10% threshold, the Federal action is considered to be a "regionally significant" activity, and thus general conformity rules apply. The concept of regionally significant is to capture those Federal actions that fall below the de minimis emission levels but have the potential to impact the air quality of a region.

2.2 Analysis

The conformity analysis for the Federal action examines the net impacts of the direct and indirect emissions from mobile and stationary sources, and emissions from any reasonably foreseeable Federal action. Indirect emissions include those emissions the Federal agency can practicably control and has continuing program responsibility to maintain control, and emissions caused by the Federal action later in time and/or farther removed in distance from the action itself, but that are still reasonably foreseeable. Reasonably foreseeable emissions are those from projected Federal actions that can be quantified at the time of the conformity requirements and are included in the analysis.

Reasonably foreseeable emissions analyzed for the Proposed Action include emissions primarily from:

a) *Off-road Construction Equipment Engines*
b) *On-road Material Hauling and Worker Vehicle Trips*
c) *Dust from Grading, Construction, and Driving*

The flood risk management project will not result in new facilities or features that have on-going direct or indirect air emissions, therefore operations and maintenance emissions will not be included and only construction-related emissions are presented.

2.3 Procedure

Procedural requirements of the conformity rule allow for public review of the Federal agency's conformity determination. Although the conformity determination is a Federal responsibility, state and local air agencies are provided notification and their expertise consulted. In Orange County, CA, the SCAQMD has review jurisdiction.

The Federal agency must provide a 30-day notice of the Federal action and draft conformity determination to the appropriate USEPA Region, and State and local air control agencies. The Federal agency must also make the draft determination available to the public to allow opportunity for review and comment. For the Santiago Creek Flood Risk Management design, the public and agency review process will occur within the National Environmental Policy Act (NEPA) and CEQA review framework.

In addition to a General Conformity, an air quality analysis must be performed for this project to meet CEQA guidelines and determine the significance the proposed project on air quality and GHGs. Therefore, the following CEQA air quality significance criteria will be addressed as part of this analysis:

a) *Conflict with or obstruct implementation of the applicable air quality plan*

The results of the General Conformity Applicability analysis; specifically, whether project-related emissions exceed General Conformity de minimis levels as established in 40 C.F.R. 93.153(b); will be used to determine if air quality impacts of the Proposed Action would conflict with the SCAQMD air quality plans, strategies, and measures to meet air quality standards.

b) *Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard*

Proposed project emissions will be compared to SCAQMD regional pollutant criteria pollutant emission thresholds (Table 4), in addition to de minimis levels, to determine if a regional air quality impact would be considered significant. The SCAQMD CEQA Handbook states that any project in the Air Basin with daily emissions that exceed any of the identified significance thresholds should be considered as having an individually and cumulatively significant air quality impact. SCAQMD emissions thresholds are developed in consideration of both existing air quality conditions in the region, as well as future attainment of air quality standards. Therefore, if emissions are below the SCAQMD thresholds, emissions are not expected

to increase the frequency or severity of existing or projected air quality violations or delay timely attainment of air quality standards.

Table 4: SCAQMD Regional Criteria Pollutant Emission Thresholds of Significance

	Pollutant Emissions (lbs/day)						
	VOC	**NOx**	**CO**	**SOx**	**PM_{10}**	**$PM_{2.5}$**	**Lead**
Construction	75	100	550	150	150	55	3
Operation	55	55	550	150	150	55	3

Source: SCAQMD CEQA Handbook

c) Expose sensitive receptors to substantial pollutant concentrations

SCAQMD developed Localized Significant Thresholds (LSTs) as guides for determining localized air quality impacts from select criteria pollutants to nearby sensitive receptors from a project area. SCAQMD Final Localized Significance Threshold Methodology (SCAQMD, 2008) found that the primary emissions of local concern are NO_2, CO, PM_{10}, and $PM_{2.5}$. Mass rate look-up tables of maximum construction or operations emissions that will not contribute to an exceedance of the most stringent applicable federal or state ambient air quality standard were developed for source areas up to 5 acres and receptor distances of 25 to 500 meters from project site. For this air quality analysis, data from the mass rate tables (Table 5) is used as a screening tool to determine if local air quality impacts could be considered significant.

Table 5: SCAQMD Localized Significant Thresholds (LSTs) for 5-acre site and 25-m receptor distance.

	North Orange County	**Central Orange County**
Pollutant	lbs/day	lbs/day
NO_2	197	183
CO	1711	1253
PM_{10}	14	13
$PM_{2.5}$	9	7

d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people.

Consideration of odors and other nuisance emissions were evaluated by assessing whether the proposed project creates an odor nuisance pursuant to SCAMD Rule 402, including discharging quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

e) Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment

GHG emission impacts were assessed by comparing the SCAQMD GHG Working Group draft annual GHG emissions threshold of 3,000 $MTCO_{2e}$ against the total construction GHG emissions for the Proposed Action amortized over 30 years. The project would be considered to create a significant cumulative GHG impact if the proposed project would exceed the annual threshold of 3,000 $MTCO_{2e.}$

f) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.

Conflicts were evaluated by assessing if approved federal, state, or district GHG thresholds for construction conflict with the proposed project. It was also assessed by comparing the SCAQMD draft annual Working Group GHG emission threshold with amortized CO_2e emissions generated by the project. The proposed project would be considered to create a significant GHG impact if it would conflict with

approved construction thresholds, exceed the annual threshold of 3,000 $MTCO_{2e,}$ or change the development pattern of local or regional plans.

2.3.1 Emissions Calculation

CalEEMod

The California Emissions Estimator Model (CalEEMod Version 2020.4.0) is a modeling software supported by SCAQMD that calculates potential emissions from construction and operation of land use projects (CAPCOA, 2017). It calculates the daily maximum and annual average for criteria pollutants as well as annual GHG emissions and combines user-defined data with default data when site-specific information is not available. It can also incorporate adjustments for mitigation. This model uses widely accepted methodologies for estimating emissions and quantifying air quality and climate change impacts as part of CEQA report preparation. In this report, CalEEMod is used to estimate annual emissions of criterial pollutants and compared to de minimis levels to evaluate if a conformity determination is required. It is also used to estimate daily maximum emissions of criteria pollutants for comparison with SCAQMD regional thresholds.

Model inputs include project size and location, construction schedule and phasing, equipment numbers and activity hours, vehicle trips, and transported soil and material amounts. This information is derived from project-specific data for the Proposed Action including Santiago Creek EDR December 2022 Cost Engineering Appendix G Estimated Construction Schedule (tasks, phasing, timeline), USACE Equipment Log 12/21/2022 (Equipment type, Hours/Day, Unit Amount), USACE EP 1110-1-8 December 2020 Hourly Equipment Ownership and Operating Expense tables - Region 7 (equipment horsepower), and calculated project areas and quantities. When data are unavailable, conservative judgements and assumptions are used to develop the modeling scenario, specifications, and inputs to obtain cautious yet realistic screening estimates.

Modeling approach. The model was run considering five defined project features that utilize project-specific data to the greatest extent possible. The Lower Santiago Creek Channel (lower channel) is the downstream reach of the project, occurring during the first year of the project, and characterized by channel reshaping and armoring with stone and rip rap. Channel floodwalls (channel floodwalls) are a portion of the lower channel work that involve steel sheet pile installation with reinforced concrete cap at specific locations. Once floodwall work is complete and remaining lower channel work is ongoing, slope stability features in the reservoirs begins. Bond Gravel Pit (Bond basin) includes regrading existing slopes and concrete retaining walls with tie-back anchors, Blue Diamond Gravel Pit (Blue Diamond Basin) involves slope earthwork and regrading, and Smith Basin includes channel regrading, slope stabilization, and access road construction.

Project location. The project resides in Orange County, CA in the cities of Santa Ana, Orange, and Lake Villa. All construction related emissions, including haul trips and worker trips are assumed to occur in Orange County. CalEEMod was run using location-specific meteorological data for climate zone 8.

Project area. Total acreage of the proposed project (42 acres) is obtained from site-specific area data of project features. City Park land is used to represent the project areas (flood control and water conservation features) in the model.

Construction schedule. Start of construction is April 23, 2026, according to the estimated construction schedule, the active construction period is just over a year and a half, to be completed November 3, 2027. The schedule assumes no weather, material delivery, T&E species, funding, design, contracting, etc. related delays. Because the schedule is likely to underestimate rather than overestimate actual construction periods, this provides assurance that calculated emissions rates are conservative since actual emissions are likely to occur later and a longer time period.

Construction phases. According to the project schedule, lower channel work is expected to start first, followed by reservoir projects. Many of the phases are concurrent, and are defined by the estimated construction schedule shown in Table 6.

Table 6: Construction phase schedule and duration for Proposed Action.

Phase Name	Phase Type	Start	End	Days/Week	Total Work Days
Lower Santiago Creek Channel	Grading	4/23/2026	4/21/2027	5	260
Channel Floodwalls	Grading	7/16/2026	1/6/2026	5	125
Bond Gravel Pit	Grading	10/29/2026	11/3/2027	5	265
Blue Diamond Gravel Pit	Grading	10/29/2026	11/3/2027	5	265
Smith Basin	Grading	10/29/2026	11/3/2027	5	265

Off-road equipment. The equipment log provides a list of equipment (model/type) and activity (hours), for all phases of the project. Horsepower of specific pieces of equipment were obtained from USACE EP 1110-1-8 December 2020 Hourly Equipment Ownership and Operating Expense tables (Region 7) and default CalEEMod engine load factors were used. Truck hauling of excavation spoils was included in the equipment log, therefore highway haul-off trips were approximated by off-road trucks. The number of pieces of equipment and hours per day of activity were calculated assuming operation every work day of a phase, up to 8 hours of operation a day, and rounding up to the nearest full hour. A summary of project equipment is given in Table 7.

Table 7: Summary of off-road equipment to for Proposed Action.

Off-road Equipment Type	Amount	Hours/Day	HorsePower	Load Factor
Air Compressors	1	8	305	0.38
Cranes	1	1	74	0.29
Cranes	2	5	285	0.29
Cranes	1	1	350	0.29
Cranes	1	1	365	0.29
Excavators	4	5	204	0.38
Excavators	2	2	262	0.38
Excavators	5	7	417	0.38
Generator Sets	1	2	11	0.74
Generator Sets	2	1	18	0.74
Generator Sets	4	1	44	0.74
Graders	2	2	259	0.41
Graders	1	2	145	0.41
Off-Highway Trucks	1	2	215	0.38
Off-Highway Trucks	1	1	230	0.38
Off-Highway Trucks	4	1	270	0.38
Off-Highway Trucks	1	1	286	0.38
Off-Highway Trucks*	15	3	385	0.38
Off-Highway Trucks	17	8	410	0.38
Off-Highway Trucks	1	5	450	0.38
Other Construction Equipment	2	2	3	0.34

Off-road Equipment Type	Amount	Hours/Day	HorsePower	Load Factor
Other Construction Equipment	2	6	14	0.34
Other Construction Equipment	1	5	580	0.34
Other Material Handling Equipment	1	1	2	0.38
Other Material Handling Equipment	1	1	3.1	0.38
Other Material Handling Equipment	1	1	8.6	0.38
Other Material Handling Equipment	1	1	49	0.38
Other Material Handling Equipment	1	3	119	0.38
Other Material Handling Equipment	3	1	147	0.38
Other Material Handling Equipment	1	1	321	0.38
Other Material Handling Equipment	1	1	750	0.38
Pavers	1	1	225	0.42
Plate Compactors	1	2	5.5	0.43
Pumps	1	7	46	0.74
Pumps	1	2	210	0.74
Rollers	5	1	74	0.38
Rollers	1	1	74.3	0.38
Rubber Tired Loaders	1	1	95	0.36
Rubber Tired Loaders	5	3	253	0.36
Skid Steer Loaders	1	1	74	0.38
Skid Steer Loaders	5	1	74.3	0.38
Tractors/Loaders/Backhoes	2	1	55	0.37
Tractors/Loaders/Backhoes	4	1	92	0.37
Tractors/Loaders/Backhoes	1	1	95	0.37
Tractors/Loaders/Backhoes	5	4	214	0.37
Tractors/Loaders/Backhoes	2	2	230	0.37
Tractors/Loaders/Backhoes	1	1	251	0.37
Tractors/Loaders/Backhoes	4	1	263	0.37
Tractors/Loaders/Backhoes	4	1	364	0.37
Tractors/Loaders/Backhoes	5	2	448	0.37
Welders	1	1	23	0.38
Welders	1	5	24.8	0.38

*Highway trucks were included in equipment log and off-road construction equipment model inputs.

Acres graded, material movement, haul trips, and worker trips. Default total acres graded data were calculated based on project areas, schedule, and equipment in the model.

All project features involve earthwork and import of construction materials such as aggregate, rip rap, concrete, and steel. Volumes of rip rap, aggregate, and soil including haul-on of suitable fill and removal of unsuitable soil for disposal were based on project-specific quantities for each feature. Import and export quantities of soil, aggregate, and rip rap were used to estimate dust from material movement and emissions from haul trips. Note export trips for soil disposal were also included in off-road construction equipment; thus, haul trips were ‘phased’ to capture import haul trips while reducing double-counting

export trips. Import of concrete and steel by concrete trucks (8 cy/trip) and steel hauling trucks (20 t/trip) were included as vendor trips and based on project-specific concrete and steel quantities in each phase.

The number of worker trips is expected to be 40 trips per day, during peak construction. Default data were used for trip lengths, speeds, and fleet mix.

Mitigation. Mitigation for construction equipment and construction dust were considered. All pieces of off-road construction equipment were changed to 'Tier 4' engines that meet more stringent USEPA emission standards than the statewide fleet mix, providing reductions in NOx, VOC, SO2 and PM emissions. The construction site would also be exposed to water (2 times a day) to minimize the release of fugitive dust.

2.3.2 Emission Results

Table 8 presents annual unmitigated criteria pollutant emissions calculated in CalEEMod and compared to de minimis rates. All emissions are highest in the final year. No pollutant emission rates exceeded their respective de minimis levels for any year. The maximum NOx emission rate is about 58 percent of the de minimis level, while VOC, CO, SO_2, PM_{10} and $PM_{2.5}$ emissions are well below their respective de minimis pollutant levels.

Table 8: Annual CalEEMod Estimated Emissions with Unmitigated Construction.

	ROG	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Year	Tons/yr	Tons/yr	Tons/yr	Tons/yr	Tons/yr	Tons/yr
2026	0.4818	3.2850	3.5494	0.0137	1.1146	0.2311
2027	0.8806	5.8488	6.6822	0.0246	1.2168	0.3217
Maximum Emissions	**0.8806**	**5.8488**	**6.6822**	**0.0246**	**1.2168**	**0.3217**
De Minimis Emission Levels	10	10	100	100	100	100
Conformity Determination Required?	No	No	NA	NA	No	No

Estimates were re-calculated in CalEEMod assuming use of Tier 4 engines for off-road construction equipment and watering of construction sites. Results (Table 9) show a significant reduction in NOx, VOC, PM_{10} and $PM_{2.5}$ emissions with mitigation. Although CO emissions increase with Tier 4 engine use, they remain well below de minimis levels.

Table 9: Annual CalEEMod Estimated Emissions with Mitigated Construction.

	ROG	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Year	Tons/yr	Tons/yr	Tons/yr	Tons/yr	Tons/yr	Tons/yr
2026	0.1746	0.9441	5.9631	0.0137	0.0681	0.0894
2027	0.3183	1.7466	11.2385	0.0246	0.5411	0.1079
Maximum Emissions	0.3183	1.7466	11.2385	0.0246	0.5411	0.1079
De Minimis Emission Levels	100	10	100	100	100	100
Conformity Determination Required?	No	No	NA	NA	No	No

The Proposed Action does not exceed General Conformity de minimis levels and project emissions would not significantly impact the air quality plan general conformity budgets. Implementation of mitigation

measures would reduce air quality impacts further. In addition, the Proposed Action follows OCPW land use plans, capital improvement program, and function of the existing flood control features, and is consistent with the growth and development patterns used in formulating air quality plans.

CalEEMod also calculates peak daily emissions for criteria pollutants, directly comparable to SCAQMD regional mass emission thresholds established to attain or maintain attainment of applicable criteria pollutants. As presented in Table 10, no emissions are expected to exceed the regional emission threshold, even with no mitigation in place. Although the project will cause a temporary decrease in air quality, the emission increase results in a less than significant 'cumulatively considerable' net increase of the pollutant in the air basin over time. The Proposed Action is not expected to have a significant regional air quality impact.

Table 10: Maximum Daily CalEEMod Emissions (Winter) and SCAQMD Regional Thresholds for Unmitigated Construction.

	ROG	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Year	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
2026	11.0402	74.5629	82.3988	0.3123	11.3059	3.6929
2027	11.0245	74.5346	82.2622	0.3118	11.3055	3.6926
Maximum Emissions	**11.0402**	**74.5629**	**82.3988**	**0.3123**	**11.3059**	**3.6929**
SCAQMD thresholds	75	100	550	150	150	55
Significant impact?	No	No	No	No	No	No

Projects analyzed for General Conformity and regionally significant impacts per CEQA guidelines are also analyzed for localized impacts. Adjacent residences and schools are considered the nearest receptor population. Residential neighborhoods border the channel and much of the reservoir system, and Oakridge Elementary School is adjacent to Smith Basin. For the purposes of this air quality impact analysis, a localized air quality impact could be considered significant if emissions exceed the SCAQMD Local Significance Thresholds (LSTs) identified in Table 5. The LST's are obtained from mass rate look-up tables of maximum construction or operations emissions that will not contribute to an exceedance of the most stringent applicable federal or state ambient air quality standard, for source areas up to 5 acres and receptor distances of 25 to 500 meters from a project. They are used in a screening tool to determine if local air quality impacts could be considered significant.

The overall project size is 42 acres and spans two Source-Receptor Areas (North Orange County and Central Orange County); both are shown. The project size for local source effects is assumed to be the maximum at 5 acres, and the receptor distance is assumed to be the minimum at 25 meters. Table 11 compares the project emissions to applicable LSTs.

Table 11: Maximum Daily Emissions and SCAQMD Localized Significance Thresholds for Unmitigated Construction.

	NOx	**CO**	**PM10**	**PM2.5**
Year	lbs/day	lbs/day	lbs/day	lbs/day
2026	74.5629	82.3988	11.3059	3.6929
2027	74.5346	82.2622	11.3055	3.6926
LTS for construction assuming 5 acre site and 25 m receptor distance	183 (central OC) 197(north OC)	1253 (central OC) 1711 (north OC)	13 (central OC) 14 (north OC)	7 (central OC) 9 (north OC)
Possibility for localized impact?	No	No	No	No

No potentially significant localized impacts were identified in the analysis. Implementation of mitigation measures would further aid in the protection of receptor population health.

Odors from construction activities are not anticipated to have a significant impact on the community. Contaminated areas should be avoided during construction and no waste or objectionable material is expected to be encountered within the channel alignment. None of the alternatives include land use or operations typically associated with odor complaints (agriculture, wastewater treatment, food or chemical processing, refineries, waste management, etc.). Therefore, less than significant odor impacts are expected from the Proposed Action.

CalEEMod calculates annual average and daily maximum rates of GHG emissions in addition to criteria pollutants for land use projects. Proposed Action GHG emission estimates indicate a maximum of 4,561 $MTCO_{2e}$/yr are emitted from fossil fuel combustion during project construction (Table 12). Construction emissions amortized assuming a 30-year project life are 203 $MTCO_{2e}$/yr, less than the CO_2e threshold of significance and therefore a less than significant GHG impact.

Table 12: Estimated GHG Emissions for Proposed Action

	Total CO2	**CH_4**	**N_2O**	**CO_2e***
Year	MTons/yr	MTons/yr	MTons/yr	MTons/yr
2026	1,220	0.3356	0.00889	1,231
2027	2,159	0.6575	0.00262	2,176
Maximum Emissions	**2,159**	**0.6575**	**0.00889**	**2,176**
Total project emissions	3,379	0.9931	0.01151	3,407
Amortized emissions (30 years)	113	0.0331	0.00038	114
SCAQMD Draft Threshold of Significance				**3,000**
Significant Impact?				No

*Emissions are essentially the same with or without Tier 4 mitigation. Construction emission for all years amortized over 30 years as recommended by SCAQMD GHG CEQA Working Group Significance Threshold Stakeholder Working Group, November 19, 2009.

Direct GHG emissions would be temporary, and permanently cease once project construction is complete. Although the project will cause a small, temporary increase in direct GHG emissions, the increase will result in a less than significant impact on the environment.

Amortized CO2e emissions generated by the project do not exceed the draft GHG thresholds. Furthermore, the Proposed Action would not change the development pattern of the surrounding area, and therefore would not be expected to obstruct implementation of GHG reduction measures of local or regional plans. Implementation of the Proposed Action does not conflict with GHG reduction plans, policies, or regulations and results in a less than significant GHG impact.

Sources of Error

Actual project emissions will vary from CalEEMod estimates due to sources of error within the model, modeling approach, and input-related uncertainties, despite best efforts to provide accurate data and valid assumptions. This analysis is based on best-available project data. To safeguard against underestimating actual emissions, assumptions were conservatively applied. The construction schedule includes no contingency, which may overestimate emissions some years. Emissions related to export of spoil material are counted by both equipment (truck usage) and material (haul trip) data, and only slightly reduced by phasing (coupling) export haul trips with aggregate import trips. Actual vehicle and equipment ages are likely to be younger than state averages since Corps of Engineers assume 3-year old equipment. Although actual emissions will vary from those predicted by CalEEMod, they are less likely to be underestimated due to conservative assumptions used. And since estimated emissions are significantly less than emission thresholds, sources of error in the analysis are unlikely to bring calculated emissions out of compliance or to reach significant, unavoidable air quality impacts.

3.0 Conclusions

This General Conformity analysis resulted in a de minimis determination for the Santiago Creek Flood Risk Mitigation Proposed Action. Construction emissions were estimated using CalEEMod version 2020 4.0 software, project-specific data, and conservative modeling assumptions. Emission estimates were found to be de minimis for all criteria air pollutants. The watering of construction sites and Tier 4 mitigation of off-road engines and highway haul trucks meeting Tier 4 standards will be used for the project considering equipment age; therefore, additional emissions reductions are also achievable. The analysis also showed that air quality and GHG impacts considered for CEQA were less than significant. Mitigation measures and environmental commitments are included in Air Quality Section 3.4.2.3 of the Draft SEA/IS/MND.

This determination is subject to review by state and local authorities, and also by the public. This will take place as part of the Design Documentation Report and Supplemental Environmental Assessment/Initial Study review, which will allow an opportunity for review and comment by interested parties.

4.0 References

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Appendix 5 – Hazardous, Toxic, and Radioactive Waste Report

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ORANGE COUNTY, CALIFORNIA

Appendix 5 – Hazardous, Toxic and Radioactive Waste (HTRW)

Phase I Environmental Site Assessment

September 2023

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 5 – HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW); PHASE I ENVIRONMENTAL SITE ASSESSMENT

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2 Historic Aerial Photographs
3 Environmental Database Reports
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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 5 – HAZARDOUS, TOXIC AND RADIOACTIVE WASTE (HTRW) PHASE I ENVIRONMENTAL SITE ASSESSMENT

1.0 INTRODUCTION

The purpose of this report is to discuss the hazardous, toxic, and radioactive waste (HTRW) assessments for the proposed project areas identified in the Santa Ana Mainstem, Santiago Creek, Engineering Documentation Report (EDR). This HTRW investigation identifies both HTRW and non-HTRW environmental issues and presents appropriate measures to resolve these issues. The methods used in performing the investigation are described in detail. Conclusions and recommendations regarding potential impacts due to HTRW and non-HTRW issues associated with project sites are provided.

2.0 AUTHORITY

The Santiago Creek project is authorized in the Water Resources Development Act (WRDA) 1986 (P.L. 99-662), Energy and Water Appropriation Act 1988 (San Timoteo), WRDA 1990 (Santa Ana Trails), WRDA 1996 (Prado Dam, SR 71), and WRDA 2007 (SARI Line). The 1982 Chief's Report provides the recommended plan for Santiago Creek, as described by the Phase I GDM. The recommended plan included improvements and flood plain management on the lower portion of Santiago Creek, including "providing a detention reservoir at existing gravel pits and 9,000 feet of trapezoidal channel along Santiago Creek, and floodplain management from Walnut Avenue to the Santa Ana Freeway", in order to provide "100-year flood protection for the residents in the Santiago Creek flood plain."

Engineer Regulation (ER) 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works projects, dated June 26, 1992, provides guidance for consideration of HTRW issues and problems within project boundaries or which may affect/be affected by Corps Civil Works projects. The ER states the Corps policy for addressing HTRW issues and outlines the timing and cost sharing requirements for HTRW encountered during the standard Civil Works project phases. Goals of the ER areto identify the level of detail for HTRW investigation for each phase of a civil works project, promote early detection and response by appropriate responsible parties, determine viable options to avoid HTRWproblems, and establish a mechanism for resolution of HTRW issues. The Corps policy provides the following:

- Civil works funds are not to be used for HTRW related activities except as specifically stated in thepolicy or provided for specifically in law (see paragraph 6a, ER 1165-2-132).
- Construction of civil works projects should be avoided in HTRW contaminated areas, where practicable. The Corps and project sponsor will cost share environmental investigations to identifyexistence of HTRW (see paragraph 6b, ER 1165-2-132).
- If not practicable to avoid HTRW for a project, the sponsor is responsible for ensuring that development and execution of HTRW response actions are accomplished at 100% sponsor providedcost. The sponsor is responsible for all costs associated with the required response of any known or unknown HTRW contamination existing at the project throughout all project phases. The sponsor isalso 100% responsible for all costs

associated with the required response plan and for ensuring that response actions are accomplished in accordance with federal, state and local environmental laws.No in-kind project cost credit will be given to the sponsor for these activities.

ER 1165-2-132 requires that a site investigation be conducted as early as possibly to identify and evaluate potential HTRW problems. According to ER 1165-2-132, non-HTRW issues that do not comply with the federal, state, and local regulations should be discussed in the HTRW investigation along with HTRW issues. This HTRW investigation is conducted during the pre-construction engineering and design (PED) phase of the Santa Ana River Mainstem Flood Risk Management Project involving Santiago Creek, during development of the Interim EDR and supplemental environmental assessment / initial study (SEA/IS). Findings of the EDR and SEA/ IS/MND will be used for project decision making and as a guide for future detailed design for the Plans and Specification (P&S) phase. In general, HTRW Phase I ESAs should rely on existing information, observations made through database research, an aerial photograph, topographic map, and historical document review, a site visit, and information provided by the local sponsor. As stated in the ER-1165-2-132 an initial assessment as appropriate for Reconnaissance Study should be conducted as a first priority for projects with no prior HTRW consideration. If the initial assessment indicated the potential for HTRW, testing, as warranted, and analysis similar to a Feasibility Study, or Phase II Environmental Site Assessment (ESA), should be conducted prior to proceeding with the project design.

3.0 DEFINITIONS

3.1 Hazardous, Toxic, and Radioactive Waste

The objective of ER 1165-2-132 is to outline procedures to facilitate early identification and appropriate consideration of HTRW. This investigation, therefore, identifies potential HTRW and discusses resolutions and/or provides recommendations regarding the HTRW identified. Except for dredged material and sediments beneath navigable waters proposed for dredging, for purposes of this guidance, HTRW includes any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA). (See 42 U.S.C. 9601(14).)Hazardous substances regulated under CERCLA include "hazardous wastes" under Sec. 3001 of the Resource Conservation and Recovery Act, 42 U.S.C. 6921 et seq; "hazardous substances" identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, "toxic pollutants" designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, "hazardous air pollutants" designated under Section 112 of the Clean Air Act, 42 U.S.C. 7412; and "imminently hazardous chemical substances or mixtures" on which EPA has taken action under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606; these do not include petroleum or natural gas unless already included in the above categories. (See 42 U.S.C.
9601(14).)

3.2 Non-Hazardous, Toxic, and Radioactive Waste

According to ER 1165-2-132, non-HTRW environmental issues that do not comply with federal, state,and local regulations should be discussed in the HTRW investigation along with HTRW. For example,solid waste is a non-HTRW issue considered. Petroleum releases from Leaking Underground Storage Tanks (LUSTs) are not considered HTRW but are regulated. These sites have the potential to impose environmental hazards. Non-HTRW issues identified during the investigation are also discussed in thisreport, along with resolutions

and/or recommendations for resolution.

3.3 Recognized Environmental Condition

For the purposes of this investigation, the term REC may be used interchangeably with HTRW to identifya potential HTRW or non-HTRW environmental issue. ASTM defines a recognized environmental condition (REC) as the presence or likely presence of any hazardous substances or petroleum products in,on, or at a property: (1) due to release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment.De minimis conditions are not recognized environmental conditions.

4.0 GUIDANCE

Supplemental guidance was provided by the Standard Practice for Environmental Assessments: Phase I Environmental Site Assessment Process (Designation: E 1527-21) prepared by the American Society forTesting of Materials (ASTM). The purpose of this guidance is to define good commercial and customarypractice in the United States of America for conducting an environmental site assessment of a parcel of commercial real estate with respect to the range of contaminants within the scope of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. §9601) and petroleum products. These standards recommend that an environmental assessment include a records review, site visit, interviews, and report preparation.

5.0 LAWS AND REGULATIONS

5.1 Federal

The definition of HTRW according to ER 1165-2-132, page 1, paragraph 4(a) is as follows: “Except fordredged material and sediments beneath navigable waters proposed for dredging, for purposes of this guidance, HTRW includes any material listed as ‘hazardous substance’ under the Comprehensives Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA). (See 42 U.S.C. 9601(14).) Hazardous substances regulated under CERCLA include ‘hazardous wastes’ under Sec.3001 of the Resource Conservation and Recovery Act, 42 U.S.C. 6921 et seq; ‘hazardous substances’ identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, ‘toxic pollutants’ designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, ‘hazardous air pollutants’ designated under Section 112 of the Clean Air Act 42 U.S.C. 7412; and ‘imminently hazardous chemical substances or mixtures’ on which EPA has taken action under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606; these do not include petroleum or natural gas unless already included in the above categories. (See 42 U.S.C. 9601(14).)”

As noted in 42 U.S.C. 9601(14), the term “hazardous substance” does not include crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance, nor doesthe term include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel.

Underground storage tanks (USTs) are federally regulated under 40 CFR Part 280, which includestechnical standards and corrective action requirements for owners and operators of USTs.

5.2 State

The California State regulations were examined to determine which regulations governed the state specific hazardous waste disposal, release, and cleanup requirements. The Department of Toxic Substances Control's (DTSC) hazardous waste regulations are located in California Code of Regulations (CCR), Title 22 Social Security, Division 4.5, Environmental Health Standards for the Management of Hazardous Waste. The State of California defines hazardous waste is a waste with properties that make it potentially dangerous or harmful to human health or the environment. In regulatory terms, a hazardous waste is a waste that appears on one of the four RCRA1 hazardous wastes lists (the F-list, K-list, P-list, orU-list) or that exhibits one of the four characteristics of a hazardous waste -ignitability, corrosivity, reactivity, or toxicity. However, materials can be hazardous wastes even if they are not specifically listedor don't exhibit any characteristic of a hazardous waste. For example, "used oil," products which contain materials on California's M-list, materials regulated pursuant to the mixture or derived-from rules, and contaminated soil generated from a "clean up" can also be hazardous wastes.

An underground storage tank (UST) is defined by law as "any one or combination of tanks, including pipes connected thereto, that is used for the storage of hazardous substances and that is substantially or totally beneath the surface of the ground." The purpose of the State of California UST Program is to protect public health and safety and the environment from releases of petroleum and other hazardous substances from tanks. There are four program elements: leak prevention, cleanup, enforcement and tanktester licensing. California regulations governing USTs are listed below:

- UST Regulations (CCR, Title 23, Division 3, Chapter 16) Amended and Effective (July 1, 2012)
- UST Cleanup Fund Regulations (CCR, Title 23, Division 3, Chapter 18)
- Tank Tester Licensing Regulations (CCR, Title 23, Division 3, Chapter 17)
- Unified Program Regulations (CCR, Title 27, Division 1, Subdivision 4, Chapter 1, Sections 15100 -15620)

6.0 PROJECT DESCRIPTION

The purpose of the Santiago Creek project is to reduce flood risks for the community within the lower Santiago Creek floodplain. The Santiago Creek is located entirely within Orange County, California. The full watercourse is approximately 30-miles, originating in the Santa Ana Mountains and draining at the Santa Ana River which ultimately discharges to the Pacific Ocean. This project is a component of the Santa Ana River Mainstem (SARM) megaproject managed by the USACE – Los Angeles District (CESPL). A regional map with the Santiago Creek project area is shown in Figure 1.

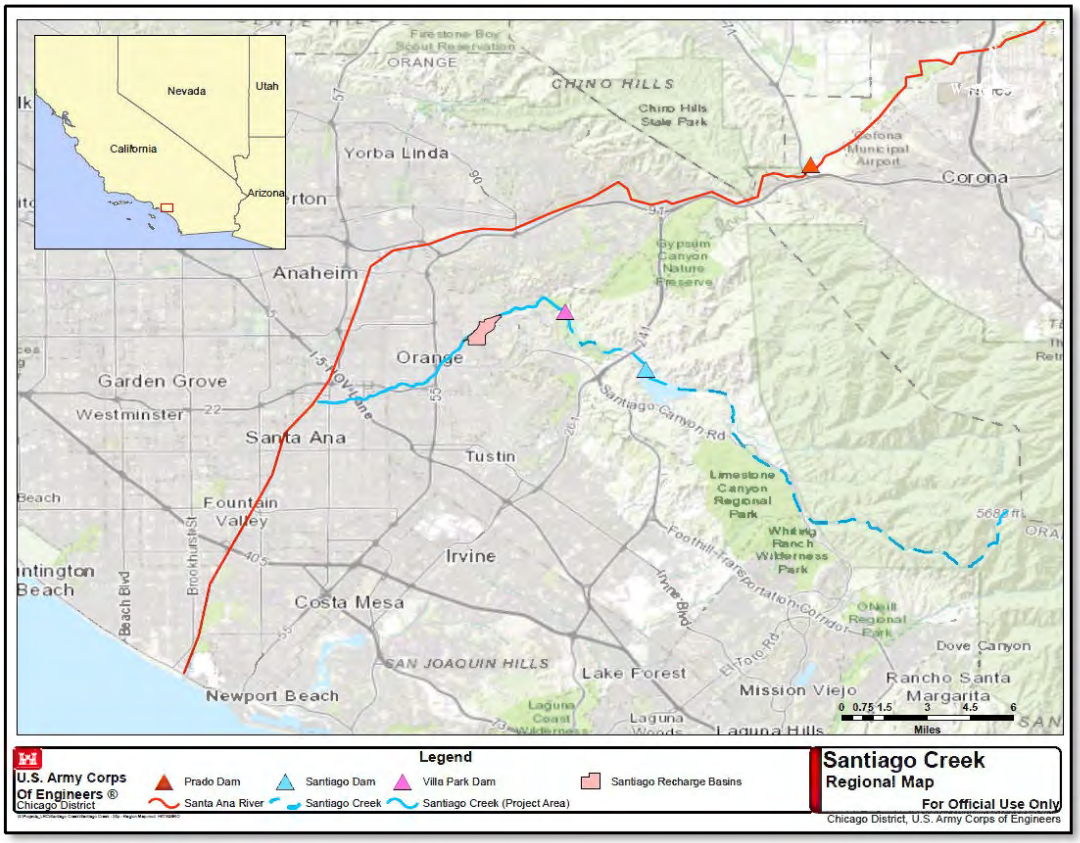


Figure 1: Regional Map

The proposed project area is contained within the lower Santiago Creek between Villa Park Dam and the creek's confluence with the Santa Ana River. Villa Park Dam is a flood-control dam located at the upstream end of the project area that is maintained and operated by the Orange County Flood Control District (OCFD). Downstream of the dam, the creek passes through two former gravel pits – the Bond and Blue Diamond Pits – that along with the Smith Basin immediately upstream were converted to environmental conservation basins by the Orange County Water District (OCWD) in the early 1990's. These basins – now known as Santiago Recharge Basins – are primarily gravely and cobbley sand which maintain a standing pool of water throughout the year for groundwater recharge. The creek downstream of the Santiago Recharge is an approximately 9-mile long, urbanized, and channelized stream mainly earthen except in a few areas where it is armored and/or paved. The section of the creek downstream of Villa Park Dam is ephemeral and predominantly dry except during brief periods of the rainy season. Portions of the channel have other uses during the dry periods (as a parking lot, as part of a golf course). The 1.2-mile segment of Santiago Creek between the I-5 (Santa Ana) Freeway and the confluence with the Santa Ana River is a compacted earth channel with numerous encroachments, including residential yards, retaining walls, fencing, and vegetation. For the purposes of this document, the Santiago Creek 'project area' consists of the reach that flows through the Santiago Recharge Basins (the reservoir) and the reach extending from the Santa Ana Freeway downstream to the creek's confluence with the Santa Ana River mainstem (the channel). A project map identifying the channel and reservoir areas is shown in Figure 2.



Figure 2. Project Area Map

The congressionally authorized design objective is to contain the 1% annual chance exceedance (1% ACE) flows of lower Santiago Creek within the channel and reservoir area. The 1982 Chief's Report provides the recommended plan for Santiago Creek, as described by the Phase I General Design Memorandum (GDM) feasibility-level study (USACE, 1980). The construction features necessary for control of the 1% ACE were refined in the Phase II GDM (USACE, 1988), consistent with the authorized plan. However, conditions at the project site and regulatory and community needs have changed since the original design documentation, therefore re-analysis of the engineered features and environmental impacts is required as part of this EDR, which will be used for project decision making prior to future detailed design for the Plans and Specification (P&S) phase. The necessary construction features for control of the 1% ACE include:

- Channel Improvements (including floodwalls) – Channel improvements are necessary between Santa Ana Freeway and Santa Ana River to provide additional flow capacity and prevent erosion. The Proposed Action includes a trapezoidal rip rap channel overlain by native substrate to improve aesthetics, operations and maintenance, and ecological function along the full downstream channel extent. Low elevation steel sheet pile floodwalls with reinforced concrete cap are required between portions of Bristol Avenue and Flower Street on top of the proposed bank on the north and south sides of the channel to prevent overbank flooding.
- Reservoir Rehabilitation – Stabilization of the Santiago Recharge Basins (also referred to as the reservoir) is necessary to prevent slope failures during 1% events. The Proposed Action includes slope stabilization at select reservoir locations through installation of buttress fill, retaining walls, or armoring. The Smith Basin floor also requires rehabilitation

to protect repaired slopes, and the Smith Basin historic maintenance road requires rehabilitation for access to the basin.

Project areas are owned by Orange County. Most of the areas to be taken in flowage easements are owned by the Orange County Water District (i.e., the Santiago Recharge Basins). These pits were acquired in 1984 by the Water District for both water conservation and flood control use., and a draft Irrevocable Offer of Dedication was developed in 2003 for the proposed USACE project between the Orange County Water District and the Orange County Flood District and includes a perpetual flowage easement within the basins to store flood waters between elevations 274-ft NGVD29 and 298-ft NGVD29.

Construction of project features will require earth work and excavation within the channel and where slope stabilization activities are proposed at the reservoir. Reuse of material on-site has been identified as a potential cost savings measure, which may require regulatory coordination with California agencies (State Water Resources Control Board (SWQCB) and Santa Ana Regional Water Quality Control Board (RWQCB) for 401 Water Quality Certification for regulating discharges of dredged or fill material to waters of the state). Due to the developed nature of the watershed, and location of existing structures adjacent to and within the project area, the ability to avoid HTRW during design and construction is assumed minimal.

7.0 GENERAL METHODS

The following sections contain information that was requested and gathered in accordance with ER 1165-2-132 for this assessment. The information was obtained from:

- Existing information review
- Historical topographic map and aerial photograph review
- Database research
- Site visit

This information was used to determine if the measures proposed for control of the 1% ACE at the Santiago Creek project area will have an impact on any environmental conditions that may exist in the surrounding areas, and if there are environmental conditions on project sites that will have an impact on implementation of the projects.

8.0 EXISTING INFORMATION REVIEW

8.1 Soils and sediment

Soils along Santiago Creek consist primarily of loose to medium dense gravelly sands, silty gravelly sands, and silty sands with cobbles and boulders up to 14 inches in diameter. Stiff to very stiff sandy clay and sandy silty layers ranging in thickness from 1 to 5 feet are also present along the channel alignment. Soils underlying the Santiago Basin consist primarily of medium dense to dense gravelly sand and sandy gravel. Frequent cobbles typically range from 9 to 12 inches. Occasional layers of sandy clay, sandy silt, and clay with a consistency ranging from very soft to stiff are present in the basin area in thickness ranging from 0.5 to 8 feet.

The dominant soil type found in the channel is Riverwash, which consists of sandy and gravelly

alluvium with high capacity to transmit water. Typical profiles are 0 to 6 inches of gravelly sand and 6 to 60 inches of stratified gravelly coarse sand and to sandy loam (websoilsurvey.sc.egov.usda.gov). Soils around the reservoir consist of gravelly coarse sand, fine sandy loam, gravelly loamy sand, and gravelly loam.

The environmental soil and sediment quality at the project site is largely unknown. No chemical testing of the soil or sediment have been done. Based on land-use, soil and sediment is likely to contain background de minimis concentrations of PAHs and metals similar to soils typically found in areas near urban development and in urban storm runoff. Soils and sediment at the project site collected during subsurface geotechnical investigation in October 2021 showed no signs of solid waste or contamination by petroleum products or hazardous substances.

8.2 Surface Water Quality

Under Section 303(d) of the CWA, states, territories, and authorized tribes are required to develop, and update every two years, lists of waters — rivers, lakes, coastal waters, and estuaries — that are impaired (or threatened) by one or more pollutants and do not (or are not expected) to meet specific water quality standards. The RWQCB is responsible for the protection of beneficial uses of water resources within its jurisdiction that are protected by appropriate water quality objectives. The Santiago Creek channel and reservoir project areas make up a portion of Santiago Creek - Reach 1, which has the following designated beneficial uses: MUN (Municipal and Domestic Supply), GWR (Groundwater Recharge), REC1 (Contact Water Recreation; note that access is prohibited), REC2 (Non-contact Water Recreation), WARM (Warm Freshwater Habitat), WILD (Wildlife Habitat). Santiago Creek - Reach 1 does not meet the criteria for Section 303(d) listing and is not listed for any pollutants.

In early 2002, the Santa Ana RWQCB issued National Pollutant Discharge Elimination System (NPDES) permits that regulate storm water discharge from municipal storm drain systems. Orange County has a NPDES permit number CAS618030 issued and approved by the Santa Ana RWQCB Order number R8-2009-0030, which includes the Santiago Creek watershed project area. NPDES number CAS618030 is incorporated as part of the countywide Drainage Area Management Plan (DAMP) for compliance with the NPDES. Regular water quality monitoring and construction requirements are part of the DAMP that include criteria for the County and City water quality ordinances as well as construction building and grading ordinances for new and redevelopment projects (Orange County 2003).

8.3 Air Quality

The project area is located in the County of Orange and is within the South Coast Air Basin. The EPA and the California Air Resources Board (ARB) designate air basins where ambient air quality standards are exceeded as “nonattainment” areas. The basin is designated as nonattainment for the state and federal ozone, PM_{10}, and $PM_{2.5}$ standards. Actions of federal agencies must conform to the appropriate State Implementation Plan (SIP), therefore, a General Conformity analysis is required to ensure federal activities do not interfere with the budgets in the SIPs, ensure actions do not cause or contribute to new violations, and ensure attainment and maintenance of the NAAQS (Appendix 4 - Air Quality Analysis). The basin is also in nonattainment for the state nitrogen dioxide annual standard, based on 2006-2008 data. Based on the more recent data (2007-2009), the basin would be in attainment for nitrogen dioxide; however, the State has not officially designated the basin as in attainment.

9.0 HISTORICAL TOPOGRAPHIC MAP AND AERIAL PHOTOGRAPH REVIEW

Indications of potential RECs can be determined by identifying the past land use and site activities at the project area and surrounding areas. Identifying industrial and residential areas, observing any evidence of topographic changes, and locating extensive areas that lack vegetation can determine indications of a potential REC.

A series of historical topographic maps and aerial photographs were reviewed for the Santiago Creek project area. The channel between the Highway 5 and Santa Ana River and the reservoir (Santiago Basins) are analyzed separately. Findings are presented in Table 1 through Table 4. Historical topographic maps and aerial photographs for the project areas are included in Attachment 1 and Attachment 2, respectively.

Table 1: Summary of Topographic Map Review for Channel.

1896 Topographic Map	Santiago Creek in the project area is a meandering, narrow stream that at times branches into two flow paths before converging again. It ultimately flows into the Santa Ana River, a meandering river with divergences. There is a slight downward slope in the direction of flow (southwest). The surrounding area is relatively flat. There is some development, roads and buildings, especially to the south of the project area. There is also a railway crossing over the creek in the project area.
1898 Topographic Map	No major changes between 1898 and 1896.
1901 Topographic Map	Only minor changes between 1901 and 1898. An increase in development in and around the project area, new roads and buildings added.
1902 Topographic Map	No major changes between 1901 and 1902.
1932 Topographic Map	Project area partially unmapped. The mapped area shows a large increase in development in the area surrounding the project area. Santiago Blvd was constructed at the eastern end of the project area.
1935 Topographic Map	A channel was created for the creek, it created a narrow flow-path with steep slopes and eliminates meanders. A channel was also created for the Santa Ana River, all meanders were eliminated. Additional development was built up around the project area.
1942 Topographic Map	No major changes to the project area between 1935 to 1942. The surrounding area had an increase of development – roads and buildings added. Santiago Blvd on the eastern end of the project area was built up into US 101.
1948, 1949 Topographic Map	No major changes to the project area. Additional development in the surrounding area.
1950, 1951 Topographic Map	No major changes.
1964, 1965 Topographic Map	The neighborhood expanded to be directly adjacent to the Santiago Creek channel. There is now a road with residences directly adjacent to the project area. There is a park directly north of the channel and adjacent to the Santa Ana River. There were no major changes within the project area or Santa Ana River channel. Large roads and highways were built to the north of the project area.

1972 Topographic Map	No major changes to the project area and Santa Ana River channel. There is now urban development on both sides of the project area, completely surrounding it.
1981 Topographic Map	No major changes to the project area. New large roads and highways were added north of the project area.
2012 Topographic Map	No major changes to the project area. A golf course was added just west of the project area near the Santa Ana River channel.

Table 2: Summary of Historical Aerial Photograph Review for Channel.

1938 Aerial Photo	Santiago Creek is a narrow waterway lined with vegetation on both sides. It is a meandering creek with bifurcation. To the east of the project area is a minor roadway. A majority of the project area is surrounded by farmland, though there are residential neighborhoods to the south of the project area. The Santa Ana River is a wide, braided, meandering river just west of the project area.
1947 Aerial Photo	Santiago Creek in the project area had no major changes. The neighborhood to the south of the project area was expanded. Santa Ana River was narrowed and has fewer and more narrow meanders, though the river is still braided. There are banks on either side of the River.
1952 Aerial Photo	The creek in the project area has no major changes. The surrounding area is still primarily farmland, but there are residential neighborhoods to the north and south of the project area, directly adjacent to the project area. The creek is still lined with vegetation.
1963 Aerial Photo	The area to the south is entirely developed, mainly residential neighborhoods. There is still farmland to the north of the project area, though the residential area to the north was expanded along the channel. Large roads were built to the north of the project area. Both Santiago Creek and Santa Ana River appear to be dried up in this photo.
1972 Aerial Photo	The neighborhoods are completely developed on both sides of the project area. The pictured area is completely developed. There is no longer vegetation along the creek. The banks of the creek have been built up into steep slopes and a man-made channel. The creek is dry in this photo as is the Santa Ana River.
1977 Aerial Photo	There aren't major changes since 1977. The creek and river remain dry in this photo. There is a cleared area south of the project area, east of Bristol St. There is a large, warehouse-like building and clearing, though it is not clear what the purpose of it is.
1985 Aerial Photo	Only part of the project area is pictured. There are not major changes to the project area. There is additional development, including larger roads to the north of the project area.
1989 Aerial Photo	No major changes to the project area and surrounding area.
1990 Aerial Photo	No major changes.
1995 Aerial Photo	No major changes. A building was built in the previously cleared area to the south of the project area east of Bristol St. The Santa Ana River channel was narrowed. And straightened.
2005 Aerial Photo	No major changes. There was vegetation added, lining the Santiago Creek channel. A golf course was added west of the project area, in the Santa Ana River channel. Both the river and creek are dry in this photo.
2009 Aerial Photo	No major changes.
2012 Aerial Photo	No major changes. Vegetation added to the Santa Ana River channel. Both creek and river are dry in this photo.

2016 Aerial Photo	No major changes.

Table 3: Summary of Topographic Map Review for Reservoir.

1896, 1898 Topographic Map	The study area and surrounding area were developed. Roads and buildings were mapped. Santiago Creek flows uninterrupted through the study area, with several meanders and braids. Topography of the study area is relatively flat, with a slight slope following southwesterly flow of the creek. To the north and east of the study area the topography increases steeply into the Santa Ana mountain range.
1901, 1902 Topographic Map	Only minor changes between 1898 and 1901. Minor changes to the roads in the surrounding area and some additional buildings mapped. No changes to the study area, creek, or topography.
1932, 1935 Topographic Map	Slight increase in buildings in the area surrounding the project area. Topography more detailed than previous maps. Map roughly shows creek banks – relatively steep banks (compared to surrounding area). Creek's footprint widens, then narrows again in the middle of the project area. New railway, partially within project area.
1942 Topographic Map	Minor changes from the 1935 map. This map shows a tributary from the east joining with Santiago Creek in the middle of the project area. Another tributary from the north joins with Santiago Creek in the southwest corner of the project area.
1949, 1950 Topographic Map	Three gravel pits mapped in and around project area. First is in the project area, southeast of the creek and just east of Hewes St. The second pit is mapped just outside of the south west corner of the project area, north of Bond Ave. Third is northeast of the project area, north of Santiago Blvd. A reservoir is also mapped northeast of the project area, just south of Serrano Ave. Banks of the creek within the project area appear to be less steep than in previous topo maps. Tributaries mapped in the 1942 map no longer appear within the project area. Slight increase of development in the mapped area.
1964 Topographic Map	Previously mapped gravel pits in and around project area expanded, deepened, and (partially) filled with water. Topography of project area considerably changed since 1950 map. Channel banks and gravel pit banks steepened, and rest of project area flattened out. New pits dug on north side of the project area (location of current Smith Basin) and south of Villa Park Road, north of the creek (location of part of the current Diamond Basin). Santiago Creek is no longer mapped as flowing continuously through the project area. Large increase in development in the mapped area. New roads and buildings created in the project area.
1972 Topographic Map	Continued increase in development of the mapped area. Footprint of current Bond Pit mapped (which is an edit added later on based on aerial photos), but topography does not indicate that the pit has been excavated in its entirety. Topography of the project area largely unchanged since the 1964 map. Existing gravel pits in the project area filled with water.
1981 Topographic Map	This topographic map is almost completely overlain by edits indicating urban expansion from 1978 to 1981 based on aerial images. Almost the entire mapped area is urbanized. The entire project area is edited to indicate a large quarry/ man-made topographic changes. However, how the landscape has been changed in the project area is unclear in this topographic map.

2012 Topographic Map	The mapped area is nearly completely developed and urbanized. Several former gravel pits in the project area were combined and filled with water to create the Santiago Creek Recharge Basin (Bond and Diamond Basins). Other pits were filled and topography built up to create a saddle between Diamond and Bond Basins. The saddle has steep slopes, with the peak elevation roughly 100 feet above the lowest points in the basins. The Bond basin appears to have an additional (very deep) pit not filled with water, west of the existing recharge basin. Santiago Creek is shown flowing into the north side of the Recharge Basin (Smith Basin) and flowing out of the southwest corner of the Diamond Basin. The Bond and Diamond Basins are not shown to be connected, and there is a slight increase in topography between the two keeping them separated.

Table 4: Summary of Historical Aerial Photograph Review for Reservoir.

1938 Aerial Photo	This photo shows the area surrounding the project area is farmland. Santiago Creek is a wide, shallow creek with no clear flow paths, just large flood plain. In this photo, the creek appears to be largely dried up. The project area is the stream and floodplain of Santiago Creek. There does not appear to be significant farmland in the project area, any area not covered by Santiago Creek is an empty field with sparse vegetation. There does not appear to be human intervention in the area immediately surrounding the creek.
1946 Aerial Photo	In this photo, the flow paths of Santiago Creek appear to have deepened, creating a braided river effect and contrast between flow paths and floodplain. The west side of the creek was expanded outwards. This is unclear if it was due to flooding or man-made clearings. There also appears to be human intervention on the southeast side of the creek, mainly vegetation clearing and minor regrading. The surrounding area remains farmlands.
1952 Aerial Photo	Santiago Creek's flow paths converged into only a couple pronounced streams. A couple basins have been formed in the project area and are filled with water, mainly north of Bond St. and south/ east of the main portion of Santiago Creek. There is an additional large basin filled with water just northeast of the project area. The surrounding area remains farmland, but the area directly adjacent to Santiago Creek appears to have undergone additional grading and vegetation clearing.
1963 Aerial Photo	The channels of Santiago Creek have become more pronounced, and the floodplain revegetated. Additional pits have been dug and are filled with water, creating what appears to be five, water-filled basins in total within the project area. The northern section of the project area was completely cleared of vegetation and regraded. This includes a basin filled with water. An additional, very large, gravel pit has been dug on the southern section of the project area, it is empty of water and appears to be actively excavated/ mined. Santiago Creek flows bypasses all dug pits and flows uninterrupted through the project area. North of Villa Park Rd, vegetation has been cleared and land regraded into a flat area. There appears to be evidence of construction or a gravel mining operation on the east side of the project area. The middle/ northwest of the project area has been extensively regraded, cleared and built up for what appears to be a gravel mining operation with small roads going around each of the dug pits and some small buildings. Much of the pictured area is farmland, though residential neighborhoods have been created to the south, west, and east of the project area.
1966 Aerial Photo	Significant excavation and grading occurred since 1963. The dug pits in the middle section of the project area were expanded and combined, creating

	three large, main pits. There were also small pits in the surrounding area, some filled with water. The pit on the northern side of the project area appears to be deepened and temporary roads built around it. The large, southern gravel pit was expanded out eastward. The pit north of Villa Park Rd (roughly the footprint and location of the existing Smith Basin) was deepened and filled with water in this photo. New buildings were built on the site, some appearing to be warehouses. The residential neighborhoods to the south of the project area were expanded.
1972 Aerial Photo	The southern pit was expanded into a very large pit, taking up roughly the footprint of the existing Bond Pit. The pit has a flat bottom and steep sides. There appears to be a raised saddle between this pit and the northern half of the project area. Three pits of varying sizes are shown in the northern half of the project area, two of them are not being mined and are filled with water. The pit north of Villa Park was expanded into the current footprint of Smith Basin. The pit was deepened and has steep sides. The gravel mining operation appears to still be active. Very little of the surrounding land is farmland, a majority of it has become residential neighborhood and other urban developments.
1977 Aerial Photo	The pits in the project area were expanded further – Bond Basin is deepened in some sections and takes up the entirety of the southern half of the project area. There appears to be only one pit on the northern side of the project area (south of Villa Park Rd). This is a deep pit with steep sides and a road around the perimeter. The northern and southern pits were separated by a raised section of land. The basin north of Villa Park Rd now has some vegetation in the bottom, with a road running through the basin. In the surrounding area, residential neighborhoods were expanded and nearly all of the pictured area was developed.
1985 Aerial Photo	The changes in this aerial photo mainly consists of slight changes in grading within the pits and expansion of the residential neighborhoods into the remaining farmlands.
1989 Aerial Photo	Minimal changes from 1985, some minor changes in grade within the pits, with some new vegetation in Bond Pit. Both pits were expanded, and the raised saddle between them was reduced.
1994 Aerial Photo	In this photo, all pits were completely filled with water. The Bond (southern) and Diamond (northern) pits are combined into one large reservoir. There is a raised peninsula in the center of the project area (the saddle), extending out from Prospect St. The pit above Villa Park Rd (Smith Basin) is also filled with water.
2002 Aerial Photo	The water levels in the pits were decreased from 1994, and saddle expanded. The Bond and Diamond pits were separate due to low water levels. No farmland remains in the surrounding area, it has been completely developed into neighborhoods.
2005 Aerial Photo	Minimal changes, the only difference is the differing water levels in the pits from previous aerial photos.
2009 Aerial Photo	No changes.
2012 Aerial Photo	No changes.
2016 Aerial Photo	No changes, other than lower-than-usual water levels.

Review of historical topographic maps and aerial photographs indicate the region was primarily used for agriculture since the early 20th century. Suburban development has grown to border most of the

project area, Santiago Creek channel has existed largely in its current formation, while Santiago Basin reservoirs were defined in the 1940s through 1970s by sand and gravel mining, then filled and operated for groundwater recharge purposes starting in the early 1990s.

10.0 DATABASE SEARCH

A search of available environmental records was conducted utilizing Environmental Database Resources, Inc. (EDR). EDR searched federal and state databases using the minimum search distances issued in the ASTM E 1527-13 guidelines (Table 5).

Table 5: Minimum Search Distance for Federal and State Databases

Database	Approximate MinimumSearch Distance (mi)
Federal NPL Site List	1.0
Federal CERCLIS List	0.5
Federal CERCLIS NFRAP site list	Property and Adjoining Properties
Federal RCRA CORRACTS Facilities List	1.0
Federal RCRA non-CORRACTS TSD Facilities List	0.5
Federal RCRA Generators List	Property and Adjoining Properties
Federal ERNS List	Property Only
State Equivalent NPL	1.0
State Equivalent CERCLIS	0.5
State Landfill/Solid Waste Disposal Site Lists	0.5
State LUST Lists	0.5
State registered UST List	Property and Adjoining Properties

Asummary of database returns within the recommended search distance is provided in Table 6 and 7 for the channel and reservoir sites, respectively.

Table 6: Summary of EDR Database Returns within Recommended Search Distance for Channel

Database	Search Distance (Miles)	Target Property	< 1/8 mi	1/8 - ¼mi	¼ - ½mi	½ – 1mi	> 1 mi	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
State- and tribal - equivalent CERCLIS								
ENVIROSTOR	1.00		0	1	1	4	NR	6
State and tribal landfill and/orsolid waste disposal site lists								
SWF/LF	0.5		0	0	1	NR	NR	1
State and tribal leaking storage tank lists								
LUST	0.5		0	5	10	NR	NR	15
State and tribal registered storage tank lists								
UST	0.25		0	1	NR	NR	NR	1
ADDITIONAL ENVIRONMENTAL RECORDS								

Database	Search Distance (Miles)	Target Property	< 1/8 mi	1/8 - ¼mi	¼ - ½mi	½ – 1mi	> 1 mi	Total Plotted
State and tribal voluntary cleanup sites								
VCP	0.5		0	0	1	NR	NR	1
Local Lists of Hazardous waste /Contaminated Sites								
SCH	0.25		0	1	NR	NR	NR	1
CERS HAZ WASTE	0.25		0	1	NR	NR	NR	1
Local Lists of Registered Storage Tanks								
SWEEPS UST	0.25		1	2	NR	NR	NR	3
HIST UST	0.25		0	4	NR	NR	NR	4
FID UST	0.25		0	3	NR	NR	NR	3
CERS TANKS	0.25		0	1	NR	NR	NR	1
Other Ascertainable Records								
RCRA NonGen / NLR	0.25		10	27	NR	NR	NR	37
FUDS	1.00		0	0	0	1	NR	1
FINDS	1.00	1	NR	NR	NR	NR	NR	1
ECHO	1.00	1	NR	NR	NR	NR	NR	1
Cortese	0.5		0	4	5	NR	NR	9
DRYCLEANERS	0.25		0	1	NR	NR	NR	1
HAZNET	.001		1	NR	NR	NR	NR	1
HIST CORTESE	0.5		0	1	2	NR	NR	3
PROC	0.5		0	0	1	NR	NR	1
Notify 65	1.00		0	0	1	1	NR	2
CIWQS	.001		3	NR	NR	NR	NR	3
CERS	.001		3	NR	NR	NR	NR	3

Table 7: Summary of EDR Database Returns within Recommended Search Distance for Reservoir.

Database	Search Distance (Miles)	Target Property	< 1/8 mi	1/8 - ¼mi	¼ - ½mi	½ – 1mi	> 1 mi	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
State- and tribal - equivalent CERCLIS								
ENVIROSTOR	1.00		0	0	0	1	NR	1
State and tribal landfill and/orsolid waste disposal site lists								
SWF/LF	0.5		2	1	0	NR	NR	3
State and tribal leaking storage tank lists								
LUST	0.5		1	1	3	NR	NR	5
CPS-SLIC	0.5		0	0	1	NR	NR	1

Database	Search Distance (Miles)	Target Property	< 1/8 mi	1/8 - ¼mi	¼ - ½mi	½ – 1mi	> 1 mi	Total Plotted
State and tribal registered storage tank lists								
UST	0.25		1	0	NR	NR	NR	1
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.5		0	0	1	NR	NR	1
Local Lists of Landfill / Solid Waste Disposal Sites								
WMUDS/SWAT	0.5		3	0	0	NR	NR	3
Local Lists of Registered Storage Tanks								
SWEEPS UST	0.25		2	0	NR	NR	NR	2
HIST UST	0.25		1	1	NR	NR	NR	2
CA FID UST	0.25		1	0	NR	NR	NR	1
Other Ascertainable Records								
RCRA NonGen / NLR	0.25		23	31	NR	NR	NR	54
Cortese	0.5		1	1	1	NR	NR	3
HIST CORTESE	0.5		1	0	1	NR	NR	2
CIWQS	.001		2	NR	NR	NR	NR	2
CERS	.001		2	NR	NR	NR	NR	2
MINES MRDS	.001		3	NR	NR	NR	NR	3
EDR HIGH RISK HISTORICAL RECORDS								
EDR Hist Cleaner	.125		1	NR	NR	NR	NR	1

10.1 Federal Databases

No environmental records were found in the Federal Databases search using standard search distances from the project area.

10.2 State Databases

10.2.1 CA RESPONSE

State equivalent NPL database: Identifies confirmed release sites where the Department of Toxic Substances Control's (DTSC) is involved in remediation, either in a lead or oversight capacity. Theseconfirmed release sites are generally high-priority and high potential risk. There are two (2) CA RESPONSE sites within the recommended search distance.

10.2.2 CA ENVIROSTAR

State equivalent CERCLIS: The DTSC's Site Mitigation and Brownfields Reuse Program's (SMBRP's) EnviroStor database identifies sites that have known contamination or sites for which there may be reasons to investigate further. The database includes the following site types: Federal Superfund sites (National Priorities List (NPL)); State Response, including Military Facilities and State Superfund; Voluntary Cleanup; and School sites. EnviroStor provides similar information to the information that wasavailable in CalSites, and provides

additional site information, including, but not limited to, identificationof formerly-contaminated properties that have been released for reuse, properties where environmental deed restrictions have been recorded to prevent inappropriate land uses, and risk characterization information that is used to assess potential impacts to public health and the environment at contaminated sites. There are 6 and 1 CA ENVIROSTAR sites within the recommended search distance.

10.2.3 CA SWF/LF

Active, Closed and Inactive Landfills: SWF/LF records typically contain an inventory of solid waste disposal facilities or landfills. These may be active or inactive facilities or open dumps that failed to meet RCRA Section 4004 criteria for solid waste landfills or disposal sites. There are 1 and 3 CA SWF/LF siteswithin the recommended search distance.

10.2.4 CA LUST and INDIAN UST

CA LUST: Leaking Underground Storage Tank (LUST) Sites included in GeoTracker. GeoTracker is the Water Boards data management system for sites that impact, or have the potential to impact, water qualityin California, with emphasis on groundwater. INDIAN LUST: LUST sit located on Indian land. There are15 and 5 CA LUST sites within the recommended search distance.

10.2.5 CA CPS-SLIC

Cleanup Program Sites (CPS; also known as Site Cleanups [SC] and formerly known as Spills, Leaks, Investigations, and Cleanups [SLIC] sites) included in GeoTracker. GeoTracker is the Water Boards data management system for sites that impact, or have the potential to impact, water quality in California, withemphasis on groundwater. There is 1 CA CPS-SLIC site within the recommended search distance.

10.2.6 CA UST, FEMA USTs, CA MILITARY UST SITES

Active underground storage tank (UST) sites owned by military organizations, FEMA, or informationgathered from local regulatory agencies. There are 1 and 1 CA USTs within the recommended search distance.

10.2.7 CA VCP and INDIAN VCP

Voluntary cleanup program (VCP) properties contain a low threat level with either confirmed or unconfirmed releases and the project proponents have request that DTSC oversee investigation and/or cleanup activities and have agreed to provide coverage for DTSC's costs. INDIAN VCP are a listing ofVCP sites on Indian land. There is 1 CA VCP sites within the recommended search distance.

10.2.8 CA BROWNFIELDS and US BROWNFIELDS

Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated bythe presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up andreinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which

information is reported back to EPA, as well as areas served by Brownfields grant programs. CA BROWNFIELDS are a listing of sites the SWRCB considers to be Brownfields since these are sites havecome to them through the MOA Process. There is 1 brownfield site within the recommended search distance.

10.3 Local List of Landfill/Solid Waste Disposal Sites, Hazardous waste/Contaminated Sites, and Registered Storage Tanks

10.3.1 CA WMUDS/SWAT

Waste Management Unit Database System (WMUDS) is used by the State Water Resources Control Board staff and the Regional Water Quality Control Boards for program tracking and inventory of wastemanagement units. WMUDS is composed of the following databases: Facility Information, Scheduled Inspections Information, Waste Management Unit Information, SWAT Program Information, SWAT Report Summary Information, SWAT Report Summary Data, Chapter 15 (formerly Subchapter 15) Information, Chapter 15 Monitoring Parameters, TPCA Program Information, RCRA Program Information, Closure Information, and Interested Parties Information. There are four (4) CA MWUDS/SWAT sites within the recommended search distance.

10.3.2 CA CERS HAZ WASTE

This database contains a list of sites in the California Environmental Protection Agency (CalEPA) Regulated Site Portal which fall under the Hazardous Chemical Management, Hazardous Waste Onsite Treatment, Household Hazardous Waste Collection, Hazardous Waste Generator, and RCRA LQ HW Generator programs. There is 1 CERS HAZ WASTE site within the recommended search distance.

10.3.3 CA SCH

School Property Evaluation Program: this category contains proposed and existing school sites that are being evaluated by DTSC for possible hazardous materials contamination. In some cases, these propertiesmay be listed in the CalSites category depending on the level of threat to public health and safety or the environment they pose. There is 1 CA SCH sites within the recommended search distance.

10.3.4 CA SWEEPS UST

Statewide Environmental Evaluation and Planning System (SWEEPS): this underground storage tank listing was updated and maintained by a company contacted by the SWRCB in the early 1990's. The listing is no longer updated or maintained. The local agency is the contact for more information on a siteon the SWEEPS list. There are 3 and 2 SWEEPS sites within the recommended search distance.

10.3.5 CA HIST UST

The Hazardous Substance Storage Container Database is a historical listing of UST sites. Refer to local/county source for current data. There are 4 and 2 CA HIST USTs within the recommendedsearch distance.

10.3.6 CA FID UST

The Facility Inventory Database (FID) contains a historical listing of active and inactive

undergroundstorage tank locations from the State Water Resource Control Board. Refer to local/county source forcurrent data. There are 3 and 1 CA FID USTs within the recommended search distance.

10.3.7 CA CERS TANKS

California Environmental Reporting System Tanks contains a list of sites in the California Environmental Protection Agency (CalEPA) Regulated Site Portal which fall under the Aboveground Petroleum Storage and Underground Storage Tank regulatory programs. There is one (1) CERS TANKS site within the recommended search distance.

10.4 Other Databases

A variety of other databases are searched as part of the environmental records search. Activities conducted at these sites, such as the RCRA-non generator, FUDS, DOD, ABANDONED MINES, unexploded ordinance, historical auto service, historical drycleaners, and other California state databases,etc. may indicate a potential for a REC to be present at a site. A description of the information included ineach of these databases is included in the EDR report.

10.5 Project Site

EDR sites returned for the channel and the reservoir areas were assessed. Site status, description, and summary of potential projects impacts are presented in Tables 8 and 9. 'Orphan' sites that could not be mapped due to poor or inadequate address information were also evaluated here. The EDR database reports are provided in Attachment 3.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
BRIAN & MICHELLE BOUSLEY	A1 A2 A4	RCRA NonGen/ NLR FINDS, ECHO HAZNET, HWTS	Adjacent to target property	Manifest documents 0.46000 tons asbestos-containing waste generated and disposed of in a landfill or surface impoundment that will be closed as landfill. File created Dec 5 2018 and dated as last active March 7 2019. Not currently generating hazardous waste. No violations.	Site is homeowner adjacent to project site although listed in report as on target property. No potential impacts since all evidence suggests asbsestos-containing waste was properly managed and disposed of in a landfill.
FLOWER STREET BRIDGE REPAIR	B3 B9	CERS CIWQS	Target property	Wetlands – Fill and Dredge Material Dredge/ Fill Site, Historical 401 Certification, No violations. Adoption date: 4/10/2007	Site was permitted for fill in wetlands (channel) related to bridge repair. No potential impacts as there were no violations or release of hazardous substances.
MONITORING WELL NUMBER 5	C5 C6	CIWQS CERS	Target property	Dredge/ Fill Site, 401 Certification No violations. Adoption Date: 8/1/2008. Expiration/ Review Date: 8/1/2013 Wetlands – Fill and Dredge Material Operated by Orange County Water District	Site was permitted for fill in wetlands (channel) for a monitoring well. No potential impacts as there were no violations or release of hazardous substances.
SANTIAGO CREEK BRIDGE WIDENING	D7 D8	CIWQS CERS	Target property	Dredge/ Fill Site, 401 Certification, No violations. Adoption Date: 2/28/2001. Expiration/ Review Date: 2/28/2006 Wetlands – Fill and Dredge Material	Site was permitted for fill in wetlands (channel) related to bridge widening. No potential impacts as there were no violations or release of hazardous substances.
CITY OF SANTA ANA	13	SWEEPS UST, EMI	217ft, 0.041mi, WSW	City Water Pump. Active. Created: 7/21/1993 Tank Status: A Capacity: 5000 gal Content: Diesel As of 1990 emits: Organic Hydrocarbon Gases, Reactive Organic	No evidence of spills, leaks, or releases to soil or groundwater from the UST. No violations related to air emissions. No potential impacts to project site identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				Gases, Carbon Monoxide, NOX, Particulate Matter	
LORIN GRISET NEW ELEMENTARY SCHOOL	F24	ENVIROSTOR, SCH	824ft, 0.156mi, NE	School Cleanup COC: Arsenic in soil Past use that caused contamination: Agricultural – Row Crops (1947-1962) Preliminary Endangerment Assessment Report dated 2/8/2002. Removal Action Completion Report dated 5/21/2003. Certification dated 5/23/2003. Brownfields outreach program	Cleanup of contamination on school property has been certified complete and there are no restrictions on use. No potential for impact to project site.
FARMERS INSURANCE BUILDING (FORMER)	F25	LUST, Cortese, CERS	824ft, 0.156 NE	LUST Cleanup site Completed – Case Closed 7/5/2005 COC: Diesel Media: Soil Leak Discovered/ Reported: 3/21/1988 Remediation: Excavation 3/21/1988	LUST cleanup site status is Completed - Case Closed. No impacts identified.
PATHKARE LABORATORY	I30	RCRA NonGen/NLR	920ft, 0.174mi ENE	Biopsy and Pathology Lab Services. No violations. Verified non-generator. Universal Waste Indicator & Destination Facility.	Currently not generating hazardous waste. No evidence of past release. No impacts identified.
PENSKE TRUCK LEASING HERTZ-PENSKE TRUCK LEASING	38 L51 L52	LUST, Cortese, CERS SEEPS UST, HIST UST, CA FID UST, RCRA NonGen/ NLR HIST UST	1197ft, 0.227mi, East	Completed – Case Closed 8/20/1992 Leak Began/ Discovered 4/8/1992 COC and media not specified. Received UST cleanup fund reimbursement (LOC issued 3/17/2015). UST tanks installed in 1971: 3000 gal UST, M.V. Fuel, Reg Unleaded	Cleanup completed / case closed status. No additional details readily available from the online case file. Based on closed regulatory status, site is not likely to impact project.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				7000 gal UST, M.V. Fuel, Diesel 550 gal UST, Waste oil UST tank, Waste	
SHELL OIL STATION SAM'S SHELL SHELL SERVICE STATION SHELL #2641	K41 K42 K43 K44 K45 K46 K47	LUST, Cortese, CERS CERS, HAZ WASTE, SWEEPS UST, CERS TANKS, CERS RCRA NonGen/ NLR LUST, HIST CORTESE RCRA NonGen/ NLR UST LUST, CA FID UST, Cortese, CERS	1119ft, 0.212mi, NW	Status: Completed – Case Closed dated 9/30/2009 for Gasoline Leak Discovered/Reported during UST system upgrades 5/31/1998. Site Assessment 2/26/2001. TPH-G, BTEX, MTBE and TBA detected in soil and vapor. MTBE and TBA detected in groundwater. Remediation action: Soil Vapor Extraction in operation Dec 2006 - Jan 2008. Quarterly monitoring 2005-2007. Closure/ no further action letter: 9/30/2009 Unleaded gasoline release into soil during tank test. Discovered/ stopped: 12/3/1987 Close date / NFA issued by Santa Ana Fire Dept 8/31/1989. Created: 1992 UST: M.V. Fuel (4 Tanks) Capacity: 12000 gal Content: Reg Unleaded UST: M.V. Fuel Capacity: 12000 gal Content: Leaded	Cleanup completed / case closed status. Review of NFR dated September 30 2009 indicates that leaching of gasoline constituents to groundwater appears to be no longer occurring and not likely to impact future groundwater quality, residual impacted soil is limited to silts and clays which limit mobility of gasoline constituents, and detection of MTBE and TBA has been below the maximum contaminant level or not detected in the groundwater since October 2005. Site not likely to impact project.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				UST: Waste Oil Capacity: 550 gal Numerous UST system violations from 2014 through 2020 involving failure to maintain leak detection system, staff training, and reporting / records. Each violation was returned to compliance.	
BENKINS RECORDS MANAGEMENT	L49 L50	HIST UST HIST UST, CA FID UST	1191ft, 0.226mi, East	Warehouse 3 UST All: Product, 06 Fuel Motor vehicle fuel/ waste oil, slurry.	No evidence of a release. No impacts identified.
KELLEE PRESTON	L53	RCRA NonGen/ NLR	1199ft, 0.227mi, East	Museums. Verified non-generator. No violations	No evidence of a release. No impacts identified.
BROADWAY INVESTMENT GROUP, LLC		RCRA NonGen/ NLR	1232ft, 0.233mi, East	Commercial and institutional building construction. Verified non-generator. No violations.	No evidence of a release. No impacts identified.
SANTIAGO ELEMENTARY	56	RCRA NonGen/ NLR	1259ft, 0.238mi, SSW	Not a generator, verified Elementary and secondary schools. Verified non-generator. No violations found	No evidence of a release. No impacts identified.
MEMORY LANE CLEANERS	K57	DRYCLEANERS	1269ft, 0.240mi, NW	Open/ operational. Permit status inactive. BCAT description: Dry cleaning equip. Perchloroethyene CCAT Description: vapor recovery unit compress & condense Application date: 1/18/1982 PO Issue date: 8/5/1983 Dry cleaning eqip. Perchloroethylene App: 10/12/1992 PO Issues: 12/31/1999	No evidence of a release. A quarter mile away from project site. No impacts identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
CHEVRON #9-8787	M59 M60	LUST, HIST CORTESE LUST, Cortese, CERS	1341ft, 0.254mi, NW	Completed - Case Closed 10/4/2001. Gasoline Leak Discovered/ Stopped: 1/28/1999 Type of release: leaks from tank, clarifier, sump, and degreaser Leak Reported: 4/23/1999 MTBE detected in soil and groundwater. 2 Tanks closed removed: 1999 (10000 gal for gas and used oil) 4 monitoring wells installed 1999 (abandoned after 2001) Remediation began 8/21/2001. Closure/ no further action letter: 10/22/2001.	Closure letter issued. Source of contamination removed during tank removal and soil excavation. Determined groundwater was not affected and residual gasoline constituents no longer a threat. No impacts identified.
UNOCAL #5492 UNOCAL	L61 L62 65	LUST LUST, SWEEPS UST, HIST UST, Cortese, CERS Notify 65	1345ft, 0.255mi, East 1406ft, 0.266mi, East	Completed - Case Closed 12/3/1992. Unleaded gasoline impacted soil. Discovered: 10/21/1991. Subsurface monitoring Pollution characterization began 6/22/1988 Method: vapor extraction. No further action letter issued 12/3/1992. 3 UST 9,950 gal capacity each M.V. Fuel Reg. Unleaded (2) & waste oil (1)	Closure letter issued and no impacts identified.
EXXON SERVICE STATION #3843	K63 K64	LUST LUST, CA FID UST, Cortese, CERS	1374ft, 0.260mi, NW	Completed – Case Closed 4/29/2009. Aquifer affected by Gasoline. Discovery: tank closure Discovered: 4/21/1995 Pollution characterization: 12/31/2004 MTBE Detected	Closure letter issued and source of contamination removed in 1990s. Monitoring wells had three years of non-detect hydrocarbon concentrations. No impacts identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				Regional data suggests GW is 70-90' Contamination is mainly 10-40' Remedial action began: 5/3/2004 Remediation: Soil Vapor Extraction (1998, 2004, 2005). Estimated 10,477 lbs removed from all three events 5 tanks containing gasoline and waste oil removed in 1993 & 1995 Monitoring until 2009 No further action letter issued.	
ORANGE CITY SQUARE	66	ENVIROSTOR, VCP, Orange Co. Industrial Site	1815ft, 0.344mi, WNW	Former Cecilia's Cleaners operating from 1991-2000. 1.1 Acres. Past use dry cleaner Voluntary Cleanup. Project active as of 11/1/2017. COC: PCE, TCE in soil. Voluntary Agreement signed 11/29/2017 No further action letter 11/9/2020. Currently: fitness center. GW is likely 44-50' deep, generally southwesterly flow Land use restriction due 6/26/2022. Orange Co, Industrial Site: Closed 12/17/2014 Closure type: invalidated	Cleanup site is closed and located 0.35 miles from project site. No impacts identified.
CAL TRANS SANTA ANA DECANTING SITE LVTO	67	SWF/LF, CERS	1847ft, 0.350mi, East	Limited Volume Transfer Operation Transfer/ Processing Solid Waste Operation 25 cubic yards/ day Capacity: 2640 cy/year Active Non-Disposal Only Started on 4/11/2011	No violations or evidence of releases. Soil removed from decanted water is tested and not hazardous. No impacts identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				Waste: Draining Cleaning Waste from traveling public vacuum trucks that remove material from drainage system (Green Materials, Mixed Municipal) No violations.	
NEXUS CITY SQUARE	N68 N69	LUST, Cortese, HIST CORTESE, CERS LUST	2308ft, 0.437mi, WNW	Completed - Case closed 10/17/1991. COC: Diesel Fuel Soil only Discovered: tank test 3/6/1991 Piping leak – estimate 15 gal spill Action: excavate and dispose Post remedial action monitoring: 4/9/1991 Closure/ no further action letter issued	Closure letter issued. Small spill would not have migrated to project site. No impact identified.
NEWPORT CH INTERNATIONAL	70	PROC	2546ft, 0.482mi, ENE	Operation begin date: 3/28/2012 Aluminum, Glass, Plastic, Bimetal Recycling Plant	No evidence of releases. No impacts identified.
PARK CITY CENTER	O71 O72	LUST, HIST UST, Cortese, CERS LUST	2637ft, 0.499mi, NW	Completed- Case Closed 4/24/1998 Closure/ no further action letter Media: Soil Gasoline – Automotive leaded & unleaded Leak discovered: Tank closure 10/27/1997 3 tanks removed in 97 (4000 gal each) Contaminated soil (125.2 tons) excavated & removed (remaining soil tested)	Closure letter issued and source of contamination (USTs, soil) removed. No impacts identified.
MISSION CAR WASH	73	Notify 65	3193ft, 0.605mi, South	Prop 65: state keeps updated list of chemicals known to state to cause cancer/ reproductive toxicity LUST site Completed – case closed 10/21/1990. Closure/ no further action letter issued. COC: Diesel. Media: Soil	Remedial actions complete and closure letter issued. No impacts identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				Leak Discovered 7/11/1989 Leak resolved with tank replacement. Another LUST incident Completed – case closed 4/10/2003 Closure/ no further action letter COC: Gasoline. Media: soil Remedial action: soil excavation 2003 Leak discovered 2/26/2003	
TOWN AND COUNTRY MANOR OF THE CHRISTIAN AND MISSIONARY ALLIANCE	74	ENVIROSTOR	3381ft, 0.640mi, ENE	Senior Living Community Status: Refer Other Agency 8/4/2020 Site type: Calmortgage Phase 1 assessment: 8/1/2020 Status: refer other agency as of 8/4/2020 Agency: DTSC – site cleanup program No specified COC/ media Not on National Priorities List	Limited information on status of cleanup. Site is over a half mile from project. No impacts identified.
ORANGE COUNTY ARMY AIRFIELD	P75 P76	FUDS ENVIROSTOR	4163FT, 0.788mi, SSE	Property without projects Eligible No project required Status: Inactive – Needs Eval 8/14/2018 Site Type: Military Evaluation Past use: Firing range – artillery Site screening 9/29/2017 USACE FUDS Report (2019): There has been no activity for cleanup, no funding Category: PA/INPR Status: complete	Limited information on status of site. Site is located over three quarters mile from the project. No impacts identified.
SOUTHERN CALIFORNIA EDISON BRISTOL SUBSTATION	77	ENVIROSTOR, VCP, HAZNET, HWTS	4994ft, 0.946mi, SSW	Status: Active 2/6/2020 Voluntary Cleanup Past use: Utility – Electric	Cleanup underway about one mile from project site. Contamination not likely to migrate to project site. No

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				COC: Arsenic, Lead, TPH-Motor Oil Media: soil Technical workplan submitted 5/18/2020 Site is currently vacant, enclosed with concrete wall Recommended: Excavation and removal of contaminated soils VOCs found below screening level Should be no restrictions on future use of property after cleanup is complete GW is 40-60' below surface, south-southeast flow direction Waste: polychlorinated biphenyls and material containing PCBs; storage, bulking and/or transfer off-site – no treatment/ recovery. 5.82132 tons United Pumping Services Inc Shipment date: 9/11/2015 Waste Code Description: 261 – NR Meth Code: storage, bulking, and/or transfer off-site – no treatment/ recovery 5.82132 tons	impacts identified.
B&D METAL FINISHING	78	ENVIROSTOR	5042ft, 0.955mi, WSW	Status: Refer Other Agency 9/1/1984 Past Hazardous Waste Disposal Inventory Site (RCRA 3012) COC: Hydrocarbon solvents; oxygenated solvents. Discovery: 10/11/1983. Prelim Assessment Report: 9/1/1984. Site Screening: 1/18/1995. Database	NFA letter issued and distance to project site is just under one mile. No impacts identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				validation confirms NFA for DTSC.	
Various Homeowner Sites		RCRA NonGen/ NLR	Within 0.25 mi	Private residences All other waste management services (sewer cleaning and rodding, portable toilet renting/servicing) No violations. Verified non-generator	Homeowner sites receiving service within a quarter mile of project site. No violations or release of hazardous material. No impacts identified.
BOLSA CHICA CHANNEL CONSTRUCTION	Not mapped	SPILLS 90	~8.5 mi West	Regional flood control facility Case status: open	Orphan area over 8 miles from project site. Limited spill information. No impacts identified.
RUDY'S AUTO REPAIR	Not mapped	LUST, HIST CORTESE	~1.45 mi South	Completed – case closed 5/28/1996 Closure/ no further action letter issued. Released substance: waste oil/ motor/ hydraulic/ lubricating in soil.	Orphan area over one mile from project site. Closure letter issued. No impacts identified.
ALPER FINANCIAL INC	Not mapped	DRYCLEANERS	~0.66 mi South	Former drycleaner Dry Cleaning Equipment Perchloroethylene Remedial action: vapor recovery unit compress & condense Permit status: expired PO Issue date: 3/5/1992	Orphan area is more than half mile from project site. Remediation of PCE contaminated soil. No impacts identified
HOLLY W. DAVIDSON DUMP #1 and #2	Not mapped	SWF/LF	~5.4 mi NNE	Closed – Category D Pre-Regulation Disposal Only Started on: 8/16/1994 Archived Operator: Holly Davidson	No further action needed. Orphan area over file miles from project site. No impacts identified.
ANAHEIM CITY DUMP #7	Not mapped	SWF/LF	~4.3 mi North	Closed – Category D Pre-Regulation Disposal Only Started on: 8/16/1994 Archived	No further action needed. Orphan area over four miles to project site. No impacts identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				Operator: City of Anaheim	
ORANGE #4/ CANAL ST/ NEWKIRK LF	Not mapped	SWF/LF	~5.4 mi NNE (may be same location as Holly Davidson)	Closed – Category B1 Pre-Regulation Disposal Only Archived	Orphan area over 5 miles to project site. No impacts identified.
ORANGE CITY DUMP #4	Not mapped	SWF/LF	~1.1 mi NE	Closed – Category C1 Pre-Regulation Disposal Only Archived	Orphan area over 1 mile to project site. No impacts identified.
FOSTER SAND & GRAVEL	Not mapped	SWF/LF	~2.45 mi North	Clean Closed – Category D Pre-Regulation Disposal Only Started: 2/26/1998 Operator: Syufy Enterprises	No further action needed. Orphan area over two miles to project site. No impacts identified
ORANGE CITY DUMP #10	Not mapped	SWF/LF	~3.3 mi NE	Closed – C1 Archived Pre-regulation	Orphan area is over 3 mile to project site. No impacts identified
ORANGE CITY DUMP #2 SANTA ANA RIVER	Not mapped	SWF/LF	~2.5 mi North	Closed – C1 Archived Pre-regulation	Orphan area is over 2 mile to project site. No impacts identified
SHELL #510 FORMER	Not mapped	LUST	~1.4 mi South	Status: Open – Pollution Characterization began 10/27/2004. GW affected by TPH (incl Benzene), BTES, DIPE, MTBE Shell gasoline and diesel fuel service station from 1958-1978 (5 USTs) Now: commercial retail center. Remedial action: groundwater extraction, soil vapor extraction. Size and stability of plume unknown. As of April 2020, LNAPL detected in	Based on proximity of orphan area to project site, groundwater plume not likely to impact project. No impacts identified.

Table 8: Summary of EDR Search Results for Channel

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				GW (shallow, intermediate and deep aquifers)	
INTERSTATE ENVIRONMENTAL SERVICES	Not mapped	LUST	~1.9 mi SSE	Completed – case closed 5/5/1999 Closure/ no further action letter Leak reported 5/4/1999 COC: Gasoline Media: soil	No further action needed. Orphan area distance to project site over one mile. No impacts identified.
CAPITOL BANK PARCEL, GGRV CTY	Not mapped	CPS-SLIC	~2.8mi West	Former auto repair shop Completed – case closed 9/18/1996 Closure/ no further action letter issued Leak reported 1/2/1965 COC: petroleum/ fuels/ oils Affected media: other groundwater (uses other than drinking water), soil In 1996: was part of parking lot for Costco	No further action needed. Orphan area distance to project site over two miles. No impacts identified.
BRISTOL PLAZA CALIF CLEANERS	Not mapped	CPS-SLIC	~.68 mi North	Completed – case closed 6/1/2005 Closure/ no further action letter issued Leak reported 1/2/1965 COC: PCE, TCE Media: other groundwater (uses other than drinking water), soil Remedial action: soil vapor extraction. Plume traveled <150’ from spill location	No further action needed. Orphan area distance to project site over half mile and plume did not travel to site. No impacts identified.

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
SANTIAGO CREEK NORTH	A1 A2	CERS CIWQS	Target property	Bike Trail North Segment Wetlands - Fill and Dredge Material Dredge/Fill Site 401 Certification Effective 01/25/2010 Termination 01/01/2015 No enforcement actions or violations	Permitting action. No evidence of release of hazardous substances. No impacts identified.
SANTIAGO BASINS FLOATING PUMP STATION	B3 B4	CIWQS CIWQS	Target property	Dredge/Fill Site 401 Certification Effective 09/28/2015 Termination 09/27/2015 No enforcement actions or violations Wetlands – Fill and Dredge Material	Permitting action. No evidence of release of hazardous substances. No impacts identified.
GRAVEL PIT	5	MINES MRDS	Target property	Sand and Gravel, Construction Surface Operations	Site was formerly a sand and gravel pit. No evidence of release of hazardous substances related to past use. No impacts identified.
BLUE DIAMOND PIT	C6	MINES MRDS	Target property	Sand and Gravel, Construction Surface Operations	Site was formerly a sand and gravel pit. No evidence of release of hazardous substances related to past use. No impacts identified.
GRAVEL PIT	C7	MINES MRDS	Target property	Sand and Gravel, Construction Surface Operations	Site was formerly a sand and gravel pit. No evidence of release of hazardous substances related to past use. No impacts identified.
REEVE'S PIT	F24 F25	WMUDS/SWAT SWF/LF, CERS	413 ft, 0.078 mi, ENE 422 ft, 0.080 mi, ENE	Solid Waste Disposal Site / Solid Municipal Waste Class III - No Hazardous Materials Status: Pre-title 27, closed/ no monitoring as of 7/5/2015 (although restarted monitoring) Landfill operated by OC Waste &	This site is upgradient and adjacent to Smith Basin. It is monitored for background groundwater quality and downgradient groundwater quality. In 1991 SWAT report results found no hazardous materials known to exist above established regulatory

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				Recycling 1958-1961 The 9-acre site was closed in 1961 with an estimated refuse volume of 440000 cy. Cover over landfill (capped) Oakridge Private School built on top of closed landfill in late 1990s. Landfill gas extraction system (activated carbon barrels) on campus (ongoing and maintained). Gas Monitoring and Air Injection System (ongoing at adjacent Fire Station property to the south to prevent gas migration). Groundwater flows in SW direction Pre-title 27 solid waste disposal site had monitoring programs developed and implemented to characterize the any leachate generated by the site operations and the sites impact on nearby ground and surface water. GW monitoring is conducted regularly according to water district approved monitoring plan.	levels in native soil or groundwater at the site. Background groundwater at the site contained trace levels of VOCs and exceeded some secondary drinking water standards. Groundwater monitoring in 2021 detected TCE, PCE, toluene at trace levels (below MCLs) that were not found to be associated with a release from the disposal site. Historic and current well data in the site vicinity indicate the organics appear to be contributed from an upgradient source and that leachate or contamination has not emanated from the waste of the landfill site. Monitoring will continue to detect if landfill gas or any leachate may impact groundwater in the future. The property is also monitored for drainage to minimize infiltration of runoff into underlying refuse, maintenance of cover, and minimal fertilizers and pesticide use. There is no evidence of a release from the site, or of recent groundwater contamination or methane gas migration, and the site will be continued to be monitored. There have been no previous significant adverse impacts to the project site or operation of adjacent water recharge basins from the adjacent site. The project will not encroach on landfill or adjacent monitoring wells, avoids

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
					any excavation over refuse, and no adverse impacts would be expected from repair and continued operation of the recharge basins. Although this site is a REC, there appears to be low risk of impacts at the project site or to Reeve's Pit from project implementation.
K & H LAUNDRY & CLEANERS	26	EDR Hist Cleaner	434 ft, 0.082 mi, SE	Drycleaning Plants, Except Rugs, NEC (2002-2005)	No indication of hazardous substance release. No impacts identified.
SULLY MILLER CONSTR. CO#2/ BLUE DIAMOND	H30	SWF/LF	490 ft, 0.093 mi, NNE	Disposal Only (Waste not specified) Closed Category D No further action needed. Pre-Regulation Started on 8/16/1994 Limited information regarding this listing, as not listed in other EDR-searched databases and not found in SWIS database. However online GeoTracker search revealed Sully Miller and Blue Diamond Material LUST cleanup sites on Santiago Canyon Blvd. Both sites had cleanup status of complete and were closed in 2001. The same GeoTracker search identified open case Milan RIE X. LLC Inert Waste Disposal Facility land disposal site in open and operational	Based on EDR information, the closed/complete/NFA status of site as well as the LUST sites would not be expected to affect the project. Compliance issues with the site as described in the Milan RIE X LLC IWDF land disposal files were confirmed by correspondence with the Coalition of County of Orange Residents (see interview below with further detail). The filling operations was planned as part of a development called Trails at Santiago Creek. A Phase II ESA (2011) of the Trail Creek Project evaluated potential exposure to hazardous substances from the past land use activities including a maintenance shop, maintenance building, former USTs and ASTs, former asphalt plant, former materials recycling area, and former

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				status associated with this address. Documents show the facility is in violation for illegal disposal of solid waste, did not obtain a permit to store stockpiled inert debris Type A solid waste or remove the stockpiles, does not have a current Operations Plan for the Inert Debris Engineered Fill Operation (IDEFO), did not provide/keep adequate records, and that stockpiled material is not eligible/acceptable for use in an IDEFO such as shingles and pool plaster. Cleanup of this material and noncompliance issues are being negotiated between the owner and the Orange County Department of Health Local Enforcement Agency (LEA). A 128-home development planned for the larger site (Trails at Santiago Creek) was recently overturned by voters through a referendum. In April 2022, Milan was issued a notice of violation by the Santa Ana Water Board for failure to comply with NPDES Permit No. CAS000001 for stormwater discharges associated with industrial activities.	agriculture on the former Sundy Miller property. Results indicated there was the potential for vapor intrusion of TCE and methane into future dwelling units and elevated levels of Total Petroleum Hydrocarbons in soil. The RECs are limited to the site, which is about a half mile away from the recharge basins and are not expected to impact the project. Low risk of potential impacts. .
ORANGE COUNTY FIRE STATION #23	H29 H31 I32	HIST UST SWEEPS UST, CA FID UST, HIST CORTSESE	468 ft, 0.089mi, NNE 502 ft, 0.095 mi, NNE	Fire Department. Two UST. Premium unleaded fuel storage (1000gal) Diesel Fuel Storage (1000 gal) Leak Detection: Visual, Stock Inventory in both USTs	A closure letter/ other formal decision document has been issued for this site stating that the cleanup is complete. The site is listed as priority D (no longer a concern). Landfill gas monitoring at the station

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
	I33	UST LUST, SWEEPS UST, Cortese, CERS, HWTS	504 ft, 0.095 mi, ENE 504 ft, 0.095 mi, ENE	Released substance: Diesel fuel oil and additives, Nos. 1-D, 2-D, 2-4 in Soil Leak discovered 06/23/1998 Cleanup Completed & Tank Closed Remediation measures not specified Priority D (no longer a concern) Tracked in HWTS from 03/13/1998 to 10/25/2000 Case Completely Closed 10/4/2002	related to Reeve's Pit is discussed in other sections.
BLUE DIAMOND	J34	WMUDS/ SWAT	508 ft, 0.096 mi, NE	No detail/information reported	Limited information on this listing. Database tracks waste management units. No SWIS or water board documentation could be found related to Blue Diamond waste management near the project site, except related to Sully Miller/Blue Diamond listing above. No other databases listed this site. No evidence of release of hazardous substances related to this listing that would affect project site. No impacts identified.
CHANDLER AGGREGATES	F35	RCRA NonGen/ NLR	528 ft, 0.100 mi, ENE	Not a waste generator NAICS Description: Commercial and Institutional Building Construction No violations No evaluations The company has several inert debris facilities & recycling yards. Site is adjacent to the Blue Ribbon Nursery landscaping supply store known as the Chandler Pit. Per letter	State water resources control board files for the OC Reclamation, LLC - Inert Debris Engineered Fill Operation Project were obtained through the agency online GeoTracker for the site and reviewed. A Notice of Intent / application package dated 21 November 2019 and report dated 6 January 2021 were submitted for

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				from City of Orange dated 28 October 2021, the owner of the site intended to grade and backfill the pit left behind from long-ago terminated sand and gravel mining activities. On 02 December 2022 a tentative WDRs order and draft IS/MND were released for public review. A 2020 approved JD for the project indicates no impact to federal Waters of the US.	waste discharge requirements for fill of waters of the state from the water control board. The project was denied issuance in a letter dated 11 March 2021 pending further application information. The site is currently in the permit process for WDRs with no site activity or violations. Proposed inert waste disposal unit is outside waters of US and no impacts identified for project site.
CONSOLIDATED ROCK PRODUCTS	F38	WMUDS/ SWAT	588 ft, 0.111 mi, ENE	1 WMUDS Facility No details reported	Limited information on this listing. Database tracks waste management units. Company no longer exists but at one point (1930) owned and operated 23 sand, gravel, and rock producing plants in southern California. No SWIS or water board documentation could be found related to Consolidated Rock Products waste management near the project. No other databases listed this site. No evidence of release of hazardous substances related to this listing that would affect project site. No impacts identified.
RELIANCE AUTO	42	RCRA NonGen/ NLR	703 ft, 0.133 mi, WSW	NAICS Description: General Automotive Repair Verified non-generator of federal waste Universal Waste Indicator No violations	There is no indication of a substance release or waste disposal at this site. No impacts identified.

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				No evaluations	
IRVINE LAKE BOAT AND TACKLE	J45	LUST, HIST UST, Cortese, CERS	725 ft, 0.137 mi, ENE	Released substance: Gasoline – Automotive (motor gasoline and additives), leaded & unleaded Media: Soil Leak Discovery & Report 08/25/1986 Case Closed 07/08/1987 Cleanup Completed & Tank Closed Action type: Excavation. Removed soil was aerated. Samples came back clean in 1987. 3 Hist Tanks: 1000 gal Premium, 500 gal Unleaded, 500 gal Regular	A No Further action letter was issued for this site. Cleanup is completed and fulfills local regulatory requirements. No impacts identified.
VILLA PARK (LOMA STREET) LANDFILL	48	SWF/LF, CERS	798 ft, 0.151 mi, NE	Status: closed landfill with monitoring. Closed 12/31/1966 (C1 Category) Operated by Orange County as refuse disposal station 1962-1966 (was previously excavated gravel pit). Types of waste: mixed municipal, industrial, construction/ demo, agricultural, leaves/ clippings (Class III: nonhazardous, chemically inert and insoluble substances) Enforcement action opened 8/2/1995, closed 5/17/1996 Currently case is open – landfill is closed with monitoring as of 1/1/2014 – remediation phases are complete, all current risks to receptors are mitigated, and risk management measures are in place. Monitoring and inspection program are ongoing.	No liquid or hazardous wastes are known at this site. OC Waste & Recycling operates landfill gas collection and flaring system and conducts groundwater monitoring, vadose zone perimeter gas probe monitoring, and site maintenance of perimeter surface water collection system and topsoil landfill cover to minimize adverse impacts to groundwater quality recharge efforts. There has been no indication of released substances to groundwater or landfill gas migration in recent years. Post-closure systems, environmental controls, and monitoring are in place and ongoing to minimize risk of impacts to human health or the environment.

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				No recent violations/ areas of concern. The 18-acre site was originally a sand and gravel mine. is enclosed with a fence, and contains an active gas collection system to control, collect, and flare landfill gas generated in the buried refuse. It also contains groundwater monitoring wells, vadose zone perimeter gas probe monitoring, and site maintenance of perimeter surface water collection channels and top soil landfill cover to prevent ponding, erosion, and settlement conducted by OC Waste & Recycling. The site was operated by OC Waste & Recycling as a Class III municipal solid waste disposal site from 1962 to 1966. The landfill was closed in 1966 in accordance with closure regulation in effect at the time (pre-regulation), so is not equipped with an engineered artificial liner or with a leachate collection and removal system. OC Waste & Recycling has since been implementing post-closure monitoring and maintenance of the Villa Park Landfill.	There is a quarter mile distance between Villa Park Landfill and the project site that minimizes potential impacts from landfill gas or leachate. Although this site is a REC, there appears to be low risk of adverse impacts at the project site or to the landfill from project implementation.
VILLA PARK ELEMENTARY SCHOOL	65	RCRA NonGen/ NLR	1065 ft, 0.202 mi, WNW	Universal Waste Indicator Does not generate federal waste NAICS Code: All other waste management services No violations	No indication of a substance release or waste disposal at this site. No impacts identified.

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				No evaluations	
CAL-MAT FACILITY/ COMPANY	S74 S75 S76	LUST, Cortese, CERS HIST CORTESE LUST, EMI	1902 ft, 0.360 mi, SW 1926 ft, 0.365 mi, SW 1928 ft, 0.365 mi, SW	Released Substance: Diesel, Waste Oil/ Motor/ Hydraulic/ Lubricating Leak Discovery & Report 01/08/1985 Case Closed 02/15/1990 Cleanup Completed & Tank Closed Spill did not impact water, all contamination in water Remediation: removal of contaminated soils. Exposed surfaces of excavation inspected. Backfilled with clean soil. Removed soils aerated until hydrocarbon concentrations decreased to trace levels Four USTs removed – content of USTs unknown. Depth to groundwater: >200’	Cleanup was completed and confirmed with site investigation. A closure letter was issued. Additionally, the initial spill did not impact groundwater, just soil, which did not migrate and was removed & remediated. No impacts identified.
OWL ROCK PRODUCTS CO	S77	LUST, EMI, CERS	1928 ft, 0.365 mi, SW	Production of construction aggregates. Also: end dumps and hauling. Released Substance: Diesel fuel oil and additives, Nos. 1-D, 2-D, 2-4; waste oil/ used oil. Case Closed 02/15/1990.	Limited information available. Based on closed case and distance from project site, no impacts are identified.
GRIJALVA EXTENSION	T78 T79	US BROWNFIELDS, FINDS CPS-SLIC	2432 ft, 0.461 mi, SW 2432 ft, 0.461 mi, SW	Previously owned by Union Pacific Railroad. Former land use: orange grove, landfill (early 1950s through 1969), surface mine, materials processing plant. Main contaminant: Lead (detected	Site is capped to prevent infiltration of water into waste that may leach lead into soils and unlikely that contamination will spread. Site is nearly half mile from project site. No impacts identified.

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
				within landfill soils, not native soils). Low levels of total petroleum hydrocarbon contamination. Phase I Assessment Completed 1/1/2001 Phase II Completed 7/13/2005 Soil monocover cap installed 2006 over landfill to contain contamination and prevent leaching into Santiago Creek. Redevelopment (aquatic center, parking lot, community center, playground, outdoor amphitheater, picnic shelter, skatepark) started 7/1/2006 No methane discovered regular testing over several years.	
DANNY'S CLEANERS 2	80	ENVIROSTOR, VCP, DRYCLEANERS, HAZNET, HWTS	4005 ft, 0.759 mi, SSW	Active Drycleaning and Laundry Services Voluntary Cleanup by Responsible Party DTSC – Site Cleanup Program Active since 3/26/2020 Released substances: Dry cleaning equipment petroleum solvent (PCE, TCE, VOCs) Affected media: soil vapor Dry cleaning operating on site since 1985 Status: Site Characterization report due 2022 Southwest groundwater gradient.	The extent of the contaminant plume has not yet been defined, but site is over three quarters of a mile from project and unlikely to reach project site. No impacts identified.

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
Numerous Sites		RCRA NonGen/ NLR	Within 0.25 mi	Private residences verified to not be generators of federal waste. NAICS Description: All other waste management services (sewer cleaning and rodding, portable toilet renting/servicing) No violations	Homeowner sites serviced within a quarter mile of project site. No violations or release of hazardous material. No impacts identified.
ANAHEIM CITY DUMP #7	Santa Ana River & Lincoln Ave Anaheim		~3.5 mi	Archived, Closed. Category D. Pre-regulation Disposal only. Operator: City of Anaheim	No further action needed. Orphan area distance to project site over three miles. No impacts identified.
JEFFERY ROAD ROCK PLANT	Jeffery Road and Santiago Canyon Rd, Irvine, CA		~ 7 mi	Archived, Closed. Category D Pre-regulation	No further action needed. Orphan area distance to project site over several miles. No impacts identified.
ORANGE CITY DUMP #4	Hart Park, 600 Glassell St, Orange		~ 2.5 mi	Archived, Closed. Category C1 Pre-regulation	Orphan area distance to project site over one mile. No impacts identified.
ORANGE CITY DUMP #10	S of Walnut Ave near Santiago Creek, Orange		~ 0.5 mi	Archived, Closed. Category C1. Pre-regulation.	Orphan area distance to project site about half a mile. No impacts identified.
CALMET/ CONROCK QUARRY	Prospect and Spring, Orange, CA		~ 0.55 mi	Archived, Closed. Category C1 Pre-regulation	Located at Old Grijalva Park. Orphan area distance to project site over half mile. No impacts identified.
DIAMOND LAUNDRY & CLEANERS, J.GRFIFFITT	1001 Santiago Blvd,	Dryclean South Coast	Santa Ana, ~ 4 miles	Dry Cleaning Equipment Petroleum Solvent, Application Date: 12/31/1999, PO Issue date: 8/18/1982, Status O	No evidence of spill or release. Orphan area distance to project site over one mile. No impacts identified.

Table 9: Summary of EDR Search Results for Reservoir

Site Name	Map ID - EDR Report	Database	Proximity to Site/work limits	Status	Potential Impact
	Santa Ana, CA				

11.0 SITE RECONNAISANCE

Site visits were conducted at the Santiago Creek project area October 18 and 19 of 2021 with the PDT and VE team on guided tours by OCPW (Ariel Corpus) and OCWD (Ryan Bouley). Weather on both days was mostly sunny, with temperatures around 70° F. Photo documentation of the site visit is provided in Attachment 4. All portions of the project site and nearby properties were limited to areas made accessible by property owners/operators or visible from public roads. Due to the large size of the study site, not every area could be visually observed during the site visits. All site photos, including a map and index, are provided in Attachment 4. No signs of HTRW or hazardous substances were visible that would affect construction or implementation of the project.

18 October 2021: Site Visit of Channel led by OCPW and Site Visit of Bond and Diamond Pits lead by OCWD

The channel was accessed from gates near Bristol Street and west of the highway. The entire channel invert was walked. Most of the channel was lined with rip rap and gravel. Erosion and undercutting were noted along banks. Site drains were observed that appeared to be municipal stormwater outfalls (no individual NPDES discharges were identified in the area). Residences abutted the top of channel banks. Some buildup of debris occurred near bridge structures. No HTRW was discovered, however small amounts of old and new refuse were observed along the channel reach (yard waste, a small rusted out empty tank, an empty household sealant container). No hazardous substances were observed. An on-site interview with OCPW revealed they have no knowledge of storage, use, disposal, or release of hazardous or petroleum materials in the project area. Historically, materials including entire cars were used as emergency bank protection and erosion control following the flood of 1969.

Bond Pit was viewed from parking area off Prospect Street and Bond and Blue Diamond Pits were viewed from the Saddle in between the pits. Water was drawn down 100 feet lower than normal water levels for culvert and saddle repair/construction. The outlet works, a staging area, floating pump station, an outfall with significant erosion, and some old gravel mining infrastructure was observed at Bond Pit. Construction staging area and saddle repair was observed between Bond and Blue Diamond Pits. No HTRW were observed at the Pits, though construction equipment had unearthed large chunks of concrete, old metal culverts, large tire, and other debris buried in saddle. An onsite interview with OCWD revealed they have no knowledge of storage, use, disposal, or release of hazardous or petroleum materials in the project area or issues with adjacent properties. They monitor no water quality data for the recharge basin surface water or shallow aquifers, only at drinking water supply wells. PFAS are currently contaminants of concern and being treated at supply locations.

19 October 2021: Site Visit of Smith Basin lead by OCWD and Site Visit of surrounding properties

Smith Basin was observed from the top of the walls and inside. Mostly vegetated and dry, Santiago Creek flows through the basin in a winding path at very low (not clearly visible) water levels. Steep slopes are visible on the east wall adjacent to Oakridge School / Reeve's Pit caused by erosion but stable that this time. Concrete block and rebar, spoil piles were observed in the basin, OCWD

indicated the result of bridge washout debris from a historic flood around 1982 or 1983. No signs of HTRW or petroleum releases were noted on the site.

East of and adjacent to Smith Basin, the Oakridge Private School/Reeve's Pit site appeared to be in good condition. Along the adjacent property line, three protected groundwater monitoring wells were observed. Within a fenced area, part of the surface water drainage system, landfill gas probes, and athletic fields of the school were observed. East of the school, a landscape nursery operated near the Chandler Pit historic gravel mine. In subsequent discussions with concerned citizens and representatives of the Friends of the Santiago Creek, a resident stated the owner of the Chandler Pit site is seeking Santa Anna Water Board approval to backfill the pit with inert waste to adjacent grade. On the east side of Cannon Street, Villa Park Landfill was observed from the road as a sparsely vegetated field with landfill gas collection and monitoring equipment, surrounded by a chain link fence. East of the Villa Park Landfill, the site owned by Milan Capital where Sully Miller gravel pits were operated was viewed from Santiago Canyon Boulevard. The site was fenced and locked with no current activity. Large stockpiles were present on the site. In a subsequent discussion with concerned citizens and representatives of the Friends of the Santiago Creek, the resident stated that the stockpiles may contain hazardous materials (shingles and pool plaster) not eligible for use in an inert debris filling operation, and the facility does not have a current Operations Plan for the fill operation. The owners received an order to cease and desist operations by the LEA and are currently in the process of negotiating cleanup and resolution of noncompliance issues.

12.0 FINDINGS AND CONCLUSIONS

This HTRW investigation was performed to determine if HTRW and non-HTRW environmental issues at the Santiago Creek FRM EDR project area have impacted the project site or will impact implementation of the proposed project. According to ER 1165-2-132, non-HTRW environmental issues that do not comply with federal, state, and local regulations should be discussed in the HTRW evaluation along with HTRW issues. The investigation is based on an existing information review, database research, historical aerial photograph and topographic map review, and site reconnaissance. Summary of findings from this investigation are outlined below.

The project is in an urbanized area of Orange County, CA. The Santiago River project reach was channelized for agricultural irrigation and flood control since the early 1900s. Sand and gravel mines began operating around the upstream project area in the 1940s, and the Santiago Basins began operating for purposes of groundwater recharge in the early 1990s.

No RECs, or HTRW issues, were identified in the project area. The site is not listed in a database for the storage, use, disposal, or release of hazardous substances or petroleum products, no HTRW was observed during the site visit, and owners/operators had no knowledge of the presence or threat of contamination on site. Potential non-HTRW issues were identified at the channel and reservoirs however, such as the potential for buried channel bank debris following emergency back stabilization measures (cars provided bank stabilization post-1969 flood event) and construction, demolition, or washout debris (broken concrete, metal rebar and culverts, and spoil piles observed in Smith Basin and buried in Bond and Blue Diamond Basin from bridge washout following 1982 or 1983 flood). Unsuitable demolition debris, solid waste, and excess material excavated during construction would require proper disposal in coordination with regulatory agencies (Orange County Health Care Agency as the Solid Waste Local Enforcement Agency (LEA) and the Santa Ana RWQCB). Boring logs from a geotechnical investigation conducted in October 2021 did not indicate the presence of solid waste, petroleum, or other HTRW issues (see Appendix 6 - Geotechnical Investigation Report).

Off-site RECs were identified in the database search and observed during the site visit. Reeves Pit (adjacent to Smith Basin) and Villa Park Landfill (0.25 miles from the Smith Basin) are solid waste facilities closed prior to current solid waste regulations and continuously monitored and maintained for groundwater and vapor impacts. Groundwater monitoring in 2021 at Reeve's Pit near Smith Basin detected TCE, PCE, toluene at trace, background levels not associated with a release from the disposal site. The off-site RECs do not represent a significant risk for the project because they will be avoided and not encroached upon during construction, groundwater monitoring indicates only trace concentrations near the project site, no impacts on groundwater recharge or the project site have occurred since monitoring and groundwater recharge operations began in the early 1990s, and no HTRW response actions are expected or required prior to project implementation. The potential that construction and continued operation of the site may release or expose persons to HTRW is low.

Soils and sediments, surface water, and groundwater likely contain *de minimis* concentrations of organic compounds and metals due to urban stormwater runoff and proximity to developed areas and historic solid waste sites in the area. Suitable soil would be managed on-site during construction, pending regulatory approval, to the maximum extent possible. If wastewater is generated on the site, it would require proper treatment and disposal as regulated by the Santa Ana RWQCB. Background or *de minimis* concentrations of anthropogenic contaminants do not represent a REC.

No HTRW investigation can wholly eliminate uncertainty regarding the potential for HTRW associated with a project area. Performance of the HTRW investigation is intended to reduce, but not eliminate, uncertainty regarding the potential for HTRW in connection with a project area.

13.0 REFERENCES

American Society for Testing of Materials. Publication E 1527-21. Standard Practice for Environmental Assessments: Phase I Environmental Site Assessment Process.

Department of the Army. U.S. Army Corps of Engineers. ER 1165-2-132. Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects. June 1992.

Hazardous, Toxic and Radioactive Waste (HTRW)Phase I Environmental Site Assessment

Attachments
(Available digitally upon request)

1 Historic Topographic Maps

2 Historic Aerial Photographs

3 Environmental Database Reports

4 Site Visit Photographs

Appendix 6 – Geotechnical Investigation Report

US Army Corps of Engineers®
CHICAGO DISTRICT
LEADERS IN CUSTOMER CARE

SANTA ANA RIVER MAINSTEM
SANTIAGO CREEK
ORANGE COUNTY, CALIFORNIA

Appendix 6 – Geotechnical Investigation Report

September 2023

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 6 - GEOTECHNICAL INVESTIGATION REPORT

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GEOTECHNICAL ENGINEERNG ANALYSIS
APPENDIX 6

1 Bottom Line Up Front

The existing plan identified in the Phase II General Design Memorandum No. 1, Volume 6 (DM 1) and further detailed in Design Memorandum 14 (DM 14) and Design Memorandum (DM 18) contained some gaps that needed to be addressed. Downstream data on the sides of the channel as well as targeted geotechnical data such as deep stratigraphy and consolidation properties were missing. Connections to bridges needed to be developed. In the gravel pit area, the rational for slides was not understood due to lack of short and long-term strength properties of the clayey gravel and gravelly clay. Though there are many geotechnical borings in the gravel pit area, most of them did not have engineering descriptions of the soils and there is a shortage of engineering parameters. Finally, there are new areas of instability, namely a slope failure in the Smith Basin that occurred long after completion of the past studies that should be addressed.

As a result of this study the following have been determined:

1. Many sections can be designed as 2H:1V cutting into existing slopes, resulting in construction cost savings. The exception is line F, which is limited by the available real estate.
2. The existing slopes are very steep in some areas. This is likely due to water capillarity that produces negative water pressures. Once water is introduced either from the pool or from groundwater infiltration, these steep slopes become unstable.
3. Seismic forces were considered both for the channel and reservoir. The channel is marginally stable for liquefaction. Proposed lines F and G slopes (see Figure 44 for reservoir locations) were not stable for seismic loads based on a pseudo-static analysis and may require additional study.
4. Past areas of surface erosion in the Smith Street Basin and in the Bond Street Pit (Hewes and Bond) were evaluated using Google Earth imagery. The Smith Basin erosion has been stable since 2003. The Bond Street erosion has been exacerbated by a broken drainage pipe. These erosional features should be addressed as part of this project.
5. The slide along Villa Park was evaluated using Google Earth imagery. The slide initiated between Apr 2003 and Aug 2005 and increased in size between Oct 2007 and Mar 2011. The slide was likely initiated due to high water levels. Stability analyses of the Villa Park slide shows that without water the slope is stable, but with high water or surface infiltration the slope is unstable and should be mitigated similarly to Line A.
6. Numerous slopes were considered throughout the reservoir for analysis. The slopes are generally 2H:1V and estimated to be stable. However, shallow surface sloughing due to water is possible.
7. Soil parameters within the reservoir area were developed for long-term and rapid drawdown based on the USACE geotechnical investigation (Sep-Oct 2021).
8. Boring logs from the geotechnical investigation (Sep-Oct 2021) were added to Attachment C-2.

9. Preliminary anchor design has been performed for Line F (see Figure 44).
10. Design for filter under foundation of outlet structure completed.
11. A soil strength envelop was developed for sands and gravels based on the laboratory testing to address concerns with sloughing. The influence of wave action should be coordinated with hydraulics.
12. Construction considerations for slope stability and compaction were developed.
13. Grain size data was collected at the surface and sides of the channel. Additional analyses need to be performed to evaluate the potential to re-use of existing materials in the proposed design.
14. Soils were screened for corrosivity in the field based on ORP measurements and analyzed in the laboratory. The soils were found to have a low corrosion potential.
15. Lessons learned from the Irwindale pit studies (Baird, et al, 2005, Coduto, et al, 2004; Coduto, et al., 2003) were reviewed.
16. Stability for Lines D and B (as shown in Figure XX) are not considered to pose significant stability risks either presently or with proposed designs. Additional analysis can be performed during the next design phase if necessary.
17. More detailed analysis of the channel section was added to consider the potential for surface sloughing, slope instability, and constructability.
18. Additional documentation regarding the influence of soil suction on slope stability was added to include selection of soil moisture parameters, requirement for additional shear resistance for slope stability of existing slopes, and evaluation of suction resistance from slope stability analyses.
19. Additional stability analyses considered the following:
    a. Vehicle surcharge was not included in these analyses but can be added during more detailed design.
    b. Seepage forces were not considered for global slope stability. However, they may result in some surface sloughing.
    c. Weak layers were generally not present near the area of slope failure and wedge analyses were not considered.
    d. Because the top of the slopes are frictional tension cracks are not expected to occur.

A design change from an active reservoir to a passive reservoir resulted in several changes:

1. The slope stability required factors of safety were reviewed, and it was determined that the rapid drawdown factor of safety could be lowered to 1.1, given the change in reservoir pool type being analyzed.
2. Rapid drawdown conditions were determined to significantly change when the passive reservoir design was selected. New design parameters, from 295.5 ft NAVD88 to 271.5 ft NAVD88, were input into existing models and compared against required factors of safety. Tables 13 and Table 14 were updated as necessary.

3. All the proposed slopes meet guidance for slope stability, considering the new rapid drawdown parameters. Line A's (as shown in Figure XX) required slope has changed from 3.5H:1V to 2.5H:1V.

2 Introduction

The authorized flood control plan was described in the Phase I General Design Memorandum on the Santa Ana River Main Stem including Santiago Creek, September 1980 (GDM). The authorized plan consisted of (1) detention flood control storage at the existing gravel pits between Villa Park Road and Prospect Street, (2) an outlet structure at Prospect Street, and (3) a riprap trapezoidal channel between the Santa Ana Freeway and the Santa Ana River. The Santa Ana River Design Memorandum No. 1 Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, August 1998 (DM 1) recommended proceeding with the 1980 plan for the channel except that maintenance roads would not be included to reduce the risk of vandalism and crime.

The Channel Improvements in the DM 1 were for a 6,400-foot-long riprap lined trapezoidal channel from the Santa Ana Freeway (US 5) (approx. Station 75+30) to the Santa Ana River. The existing earth-bottomed channel would be enlarged and lined with 18 to 36-inch riprap to provide protection for a 100-year flood. To provide additional conveyance, the cross sections were generally enlarged in the downstream channel area as shown in Figure 1.

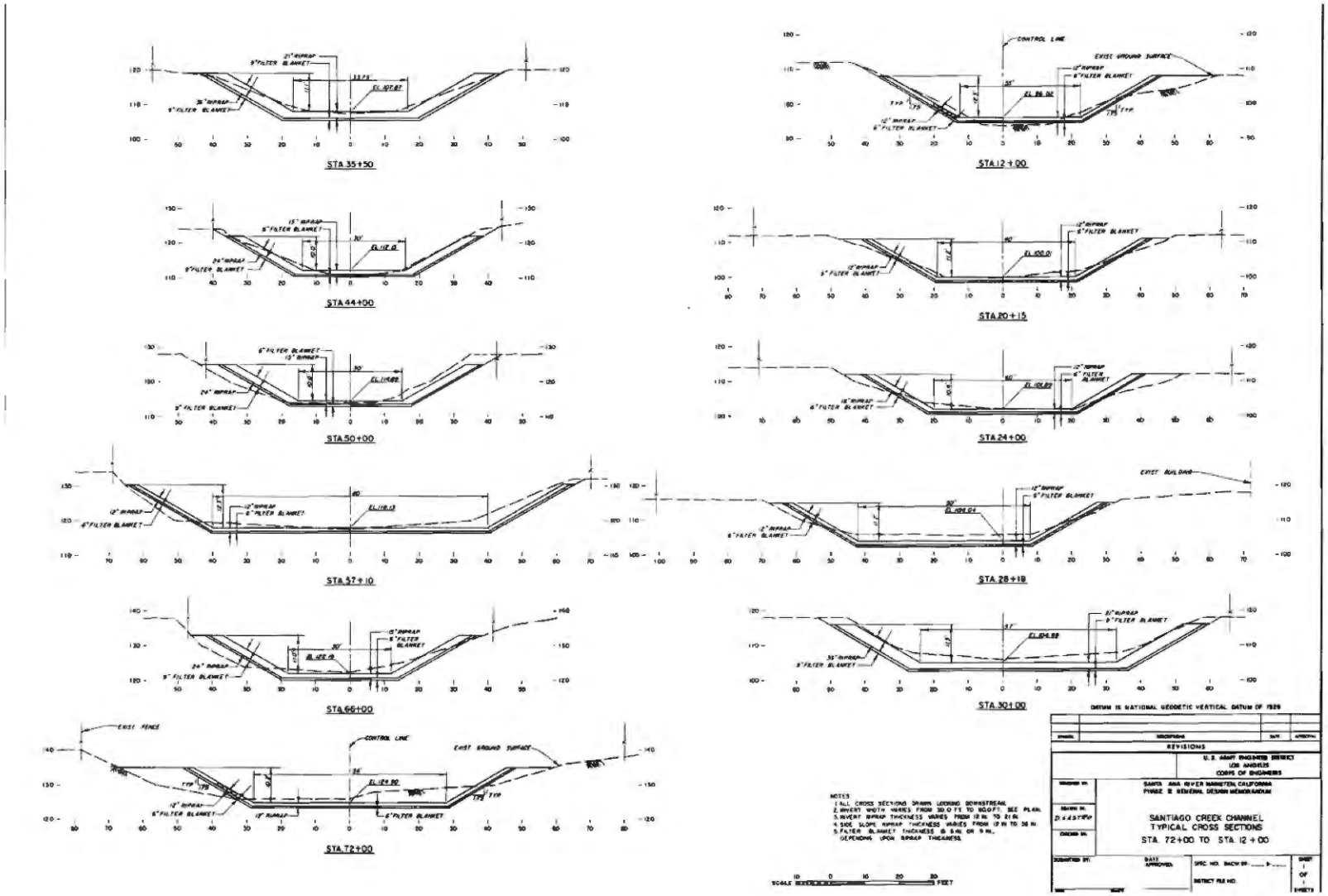


Figure 1. Downstream cross sections showing general enlargement to increase conveyance (DM 1)

The Reservoir Area was described in more detail in Technical Design Memorandum No. 18 Feature Design – Santiago Creek Santiago Creek Reservoir, January 1998 (DM 18). DM 18 included the latest physical changes to the project, results of detailed design studies, environmental concerns of various agencies, and the criteria established by the local sponsor. Based on DM 18, the outflow from the pits would be controlled to not exceed 3,500 ft^3/s for a 100-year design flood and the Blue Diamond and Bond pits would be used for floodwater storage between elevations of 274 and 298 ft. The Orange County Water District (OCWD) would use the pits for water conservation below elevation 274. Existing steep banks between elevations would be stabilized with compacted buttress fill placed on a 2H to 1 V slope against the exiting slope. The proposed plans of OCWD and based on the recommendations of DM 1, modification to the existing slopes from elevation 230 to 260 for water conservation are anticipated.

The proposed channel improvements were further modified in Design Memorandum No. 14 Feature Design – Santiago Creek Alternate Channel – Station 10+15 to Station 74+75, July 1992 (DM 14) to address concerns of the local public that the flood control project proposed in the GDM would eliminate the aesthetics of the natural creek setting. The intent of DM 14 was to perform preliminary design and cost estimating for a textured concrete wall and cobble stream bed to replicate the look of the old hand-placed rock walls along various upstream reaches of the existing creek. This locally preferred option exists east of the Santa Ana Freeway (US 5) and is shown in Figure 2. Note that the additional cost for the textured concrete wall above that of a riprap lined channel was described as a betterment in DM 14.



Figure 2. Locally preferred channel wall as described in DM 14 (1992)

Plan view and typical sections from DM 14 are shown in Figure 3. Cross sections from DM 14 are shown in Figure 4.

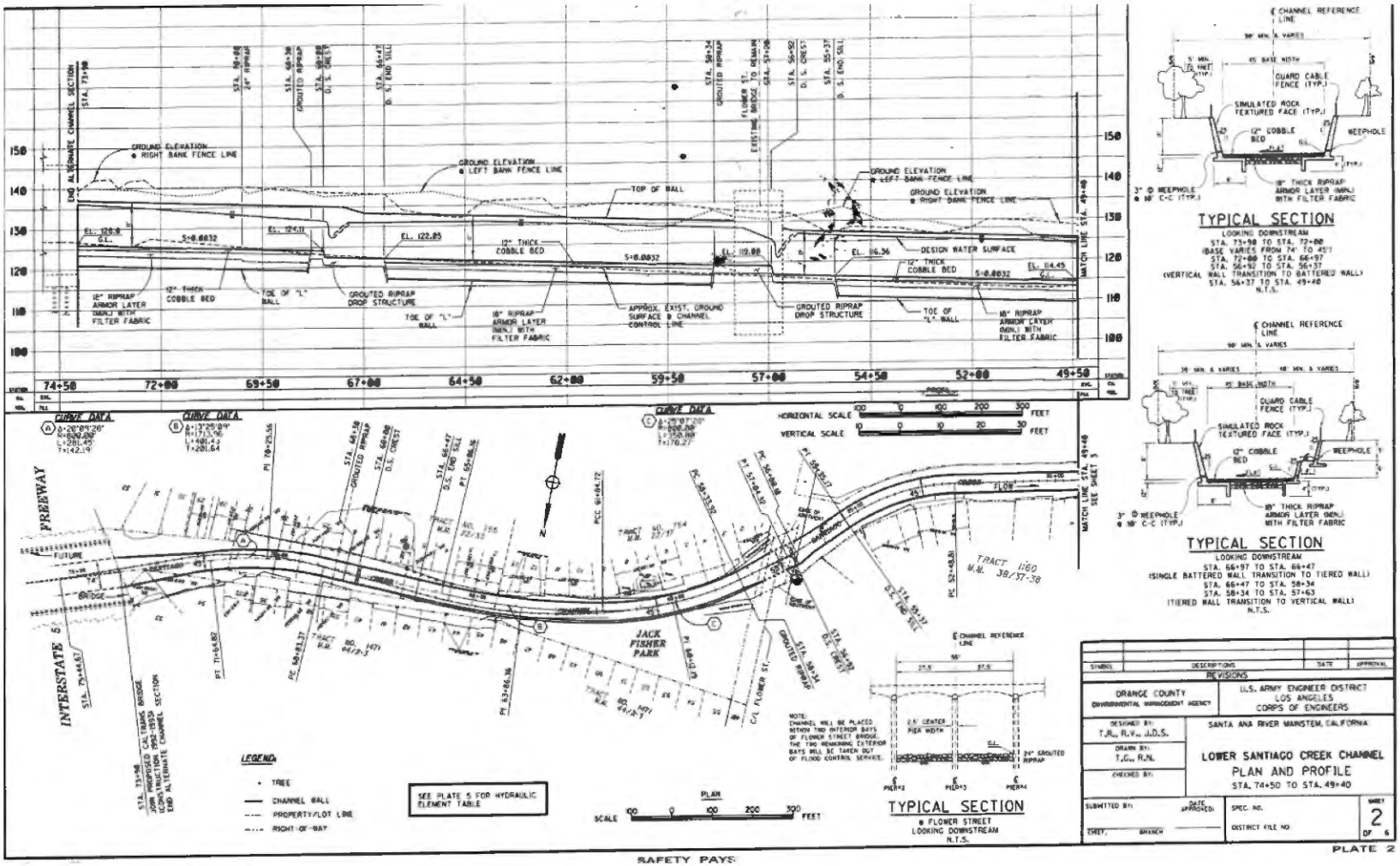


Figure 3. Plan and typical sections for locally preferred downstream channel (DM 14)

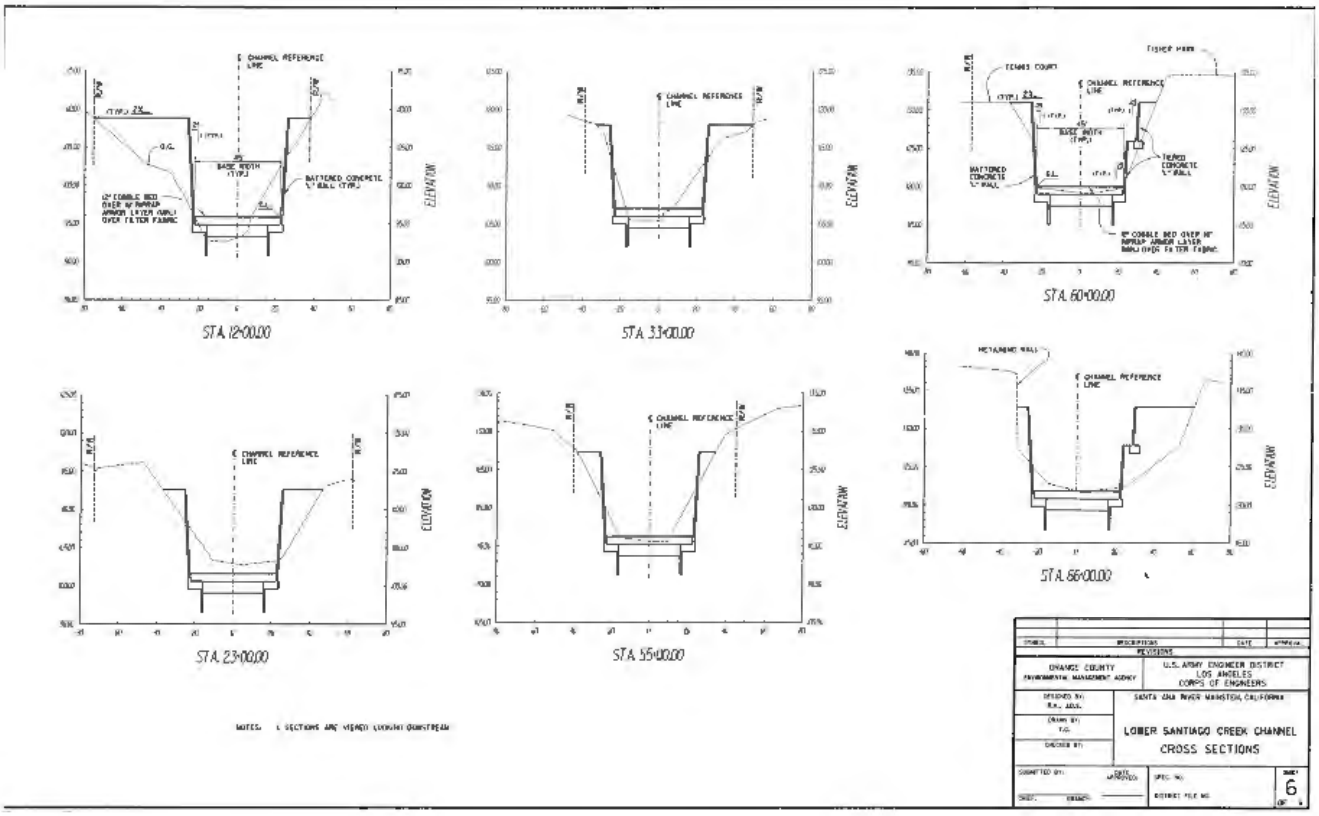


Figure 4. Cross sections for locally preferred downstream channel (DM 14)

DM 18 included details of the reservoir work. It included a plan view of improvements as shown in Figure 5.

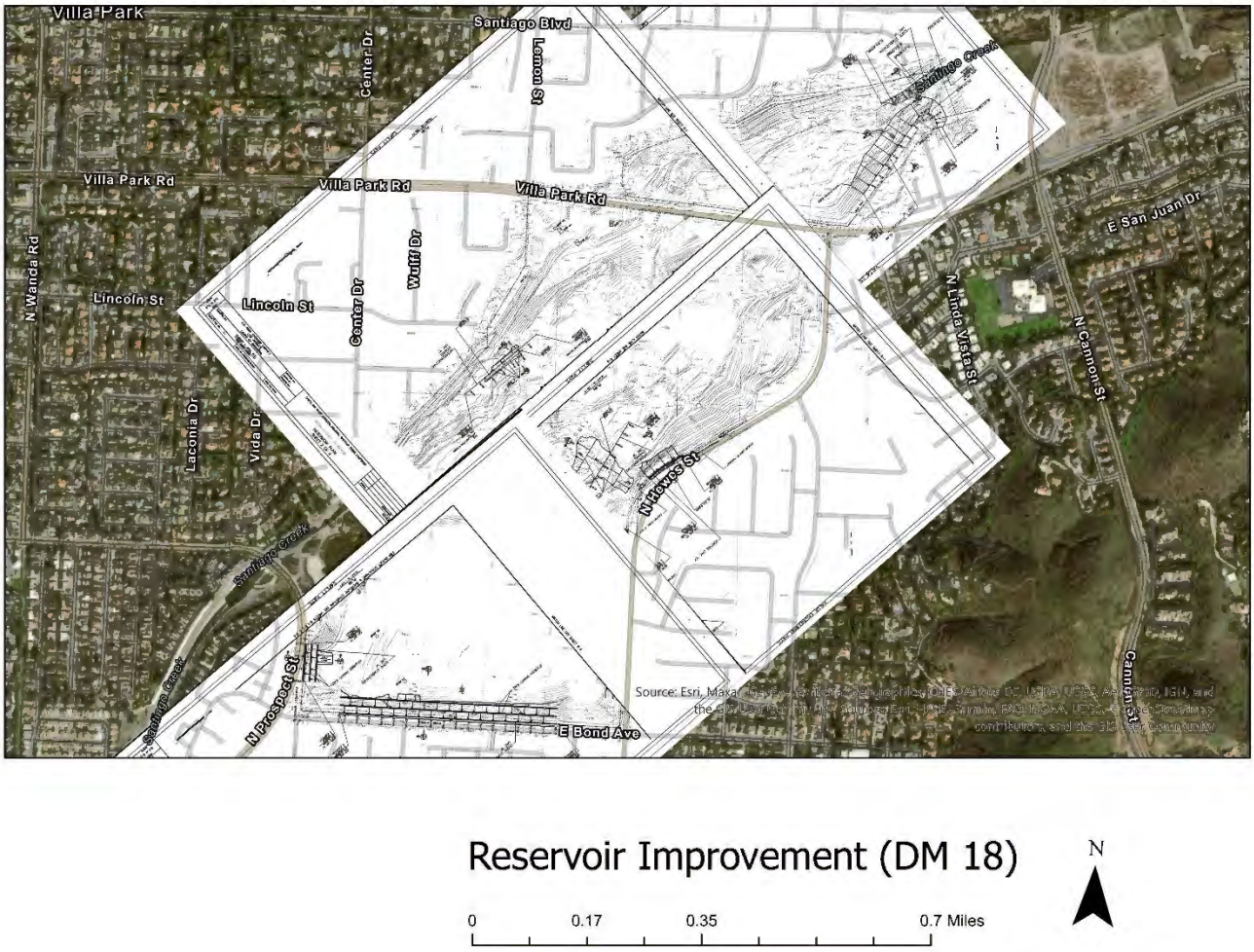


Figure 5. Proposed reservoir improvements (DM 18)

3 Datums

Table 1. Project Datums

Datum	Elevation (ft)
NAVD 88	2.507
NGVD 29	0
Note: computed with Corpscon 6.0.1.	

4 Geotechnical Design Risks

4.1 Channel

4.1.1 Seismic failure

The area is known to be seismically active and there may be loose sands and gravels subject to liquefaction. However, based on the analyses in this report, because of the low water table (elevation ranging from 211 to 313 feet at the reservoir area, and 57 to 65 feet at the downstream channel area) , liquefaction is less likely.

4.1.2 Excessive settlement

There are some areas of fill and some layers of compressible clays. There may be settlement that extends into backyards (approximately 3-4 inches) and potential settlement that could affect the I-5 bridge. This may be mitigated by placing fill further from the bridge to reduce the impact of settlement.

4.1.3 Wall failure

The proposed design does not consider walls in the proposed channel area.

4.1.4 Slope failure

All slopes were evaluated to meet USACE criteria for slope stability.

4.1.5 Corrosive Soils

Corrosive soils were not encountered within the proposed channel area.

4.1.6 Structural connections to bridges

The I-5 bridge as-built drawings were evaluated. There may be some impact due to adjacent filling which can be mitigated by moving the fill farther away from the bridge.

4.2 Reservoir

4.2.1 Slope Failure

Rapid Drawdown: The Group Delta (1997) report estimated the factor of safety for rapid drawdown to be 1.05, where the minimum acceptable value is 1.1. No data were provided for their analysis. Based on the site-specific data collection and analysis a factor of safety of 1.3 was chosen because of the frequency of reservoir changes. The water level may change as much as 20 ft within a day and there are fines in the coarse-grained soils that may make them subject to rapid drawdown. Based on the analyses in this report Line H (see Figure 44) had a factor of safety of 1.2 against rapid drawdown, which is slightly less than the recommended 1.3 chosen for this study. See Table 17 for summary of stability results.

Steady State Seepage is not likely to be an issue due to the low water table and dry environment. There may be some surface erosion as seen at Hewes and Bond as well as in the northwest corner of Smith Basin. However, those areas of surface erosion are limited and can be mitigated with proper riprap or routing of surface runoff.

Anchor Pull-out: The proposed design of 65-foot-long anchors is considered robust. However, the anchor design can be further refined during the next design phase.

4.2.2 Slope Erosion

The slopes chosen for design match existing stable slopes below the typical water line. Therefore, slope erosion is not expected within the basins.

4.2.3 Outlet Structural Foundation

The main concern with the outlet structure is uplift, which can be mitigated by installing a drain under the structure. The net loading for the outlet structure will be mainly unloading. Therefore, the structure is not expected to have issues with settlement.

4.2.4 Settlement

There may be some settlement in areas where fill is added. This may likely increase the quantities of fill.

4.2.5 Seismic Failure

The soils in the reservoir area were found to be very dense and not likely subject to liquefaction. However, pseudo-static analyses show factors of safety of less than one for lines F and G (see Table 17 for summary of stability results). A site- specific hazard analysis should be performed during next design phase.

5 Regional and Site Geology

The project geology is described in DM 1, volume 6 as follows:

The proposed channel improvements along the lower reaches of Santiago Creek are located in the southeastern portion of the Los Angeles basin. This basin, which forms the northern portion of the Peninsular Ranges geomorphic province, is a deep structural depression that has subsided over time and accumulated upwards of approximately 30,000 feet of predominantly marine Cretaceous to Holocene (Recent) age sediments. Santiago Creek, a major tributary to the Santa Ana River, originates on the western slopes of the Santa Ana Mountains and flows in a generally westerly direction for about 25 miles to the confluence with the Santa Ana River in the city of Orange. Streamflow is now partially regulated by the Santiago and Villa Park Dams several miles upstream from the project area. In the upper reaches of Santiago Creek the depth to the channel floor is shallow and very irregular, ranging from 15 to 40 feet Downstream of Villa Park Dam, where the channel leave the relatively narrow confines of the highlands and turns southwestward onto the floodplain, the relatively coarse alluvial fan deposits of Quaternary age thicken considerably, to perhaps an average thickness of as much as 540 feet (Miller and Corbaley, 1981). At the upstream end of the project area, deep gravel pits have been excavated in cobbley gravelly sands. Progressively finer sediments have been encountered in borings downstream. Just upstream from the project area the active creek channel is bounded by Quaternary age terrace deposits resulting from older stream activity. Flanking these older terrace deposits are complex association of folded and faulted Tertiary sediments and volcanics.

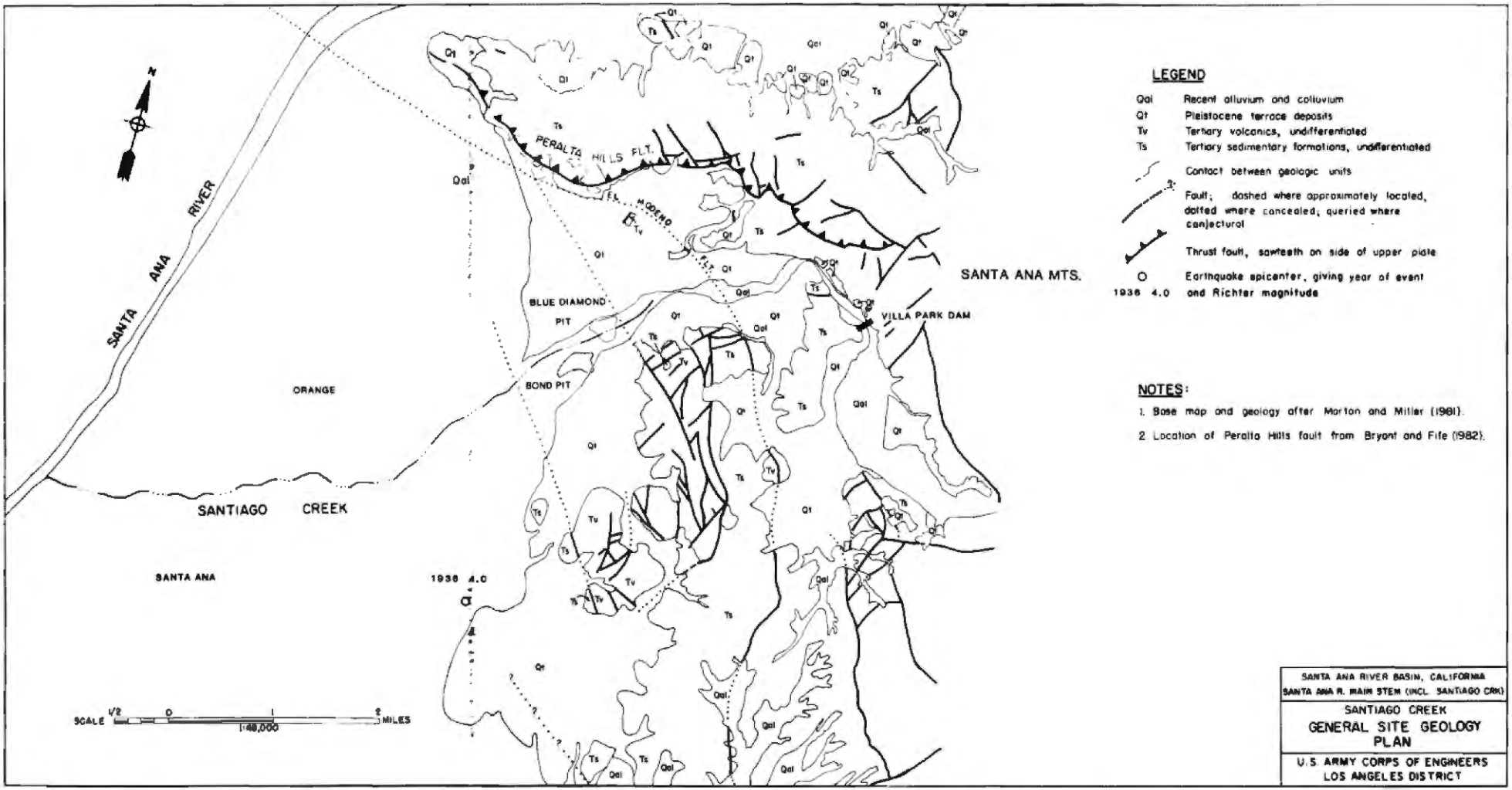


Figure 6. Geologic map of the site (DM 1)

6 Past Investigations

6.1. Reservoir

There have been numerous soil investigations in the gravel pit areas by USACE, Woodward Clyde, and OCWD as shown in Figure 7. However, the critical limitation in all those borings is the lack of specific geotechnical data. For example, only a limited number of borings have engineering data such as SPT blows per foot, grain size, or Atterberg limits. The OCWD borings, though plentiful, lack in engineering descriptions of the soil types, grain size data, Atterberg limits, and strength data. A summary of geotechnical data available in the gravel pit area is shown in Attachment C-2.

There was one boring performed by Wilden along Hewes Street near the saddle area. However, though the material consisted of significant fines, only direct shear tests were performed. Therefore, short-term strengths were not evaluated, which are necessary for rapid drawdown analyses discussed later.

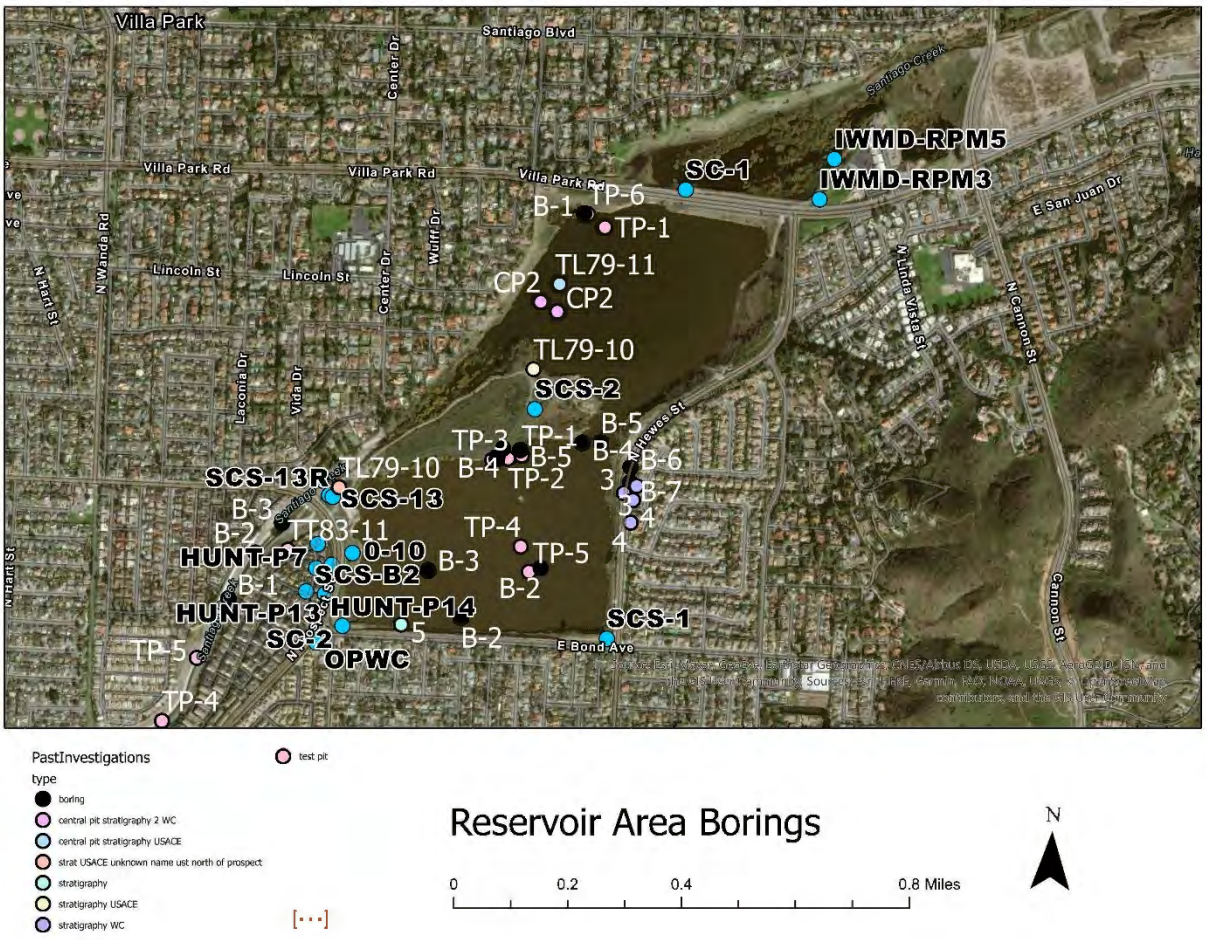


Figure 7. Historical borings around the reservoir

6.1 Channel

There were a few historical borings and test pits data available in the channel area as shown in Figure 8. A table of geotechnical data and tests is shown in Attachment C-2. Additionally, the borings were often drilled from the bottom of the channel. Only in two locations were the borings performed from the top of the channel. Additional borings from the top of the channel were performed in Sep-Oct 2021 as shown in Figure 9.



Figure 8. Historical borings around channel



Figure 9. Soil borings drilled Sep-Oct 2021

6.2 Groundwater Elevation at the outlet to Santa Ana River Area

Water levels in the Santa Ana River area were provided by Orange County and are plotted in Figure 48 11 and 12. The long-term groundwater elevation hydrograph at production well SA-21 was selected as reference at the outlet area, shown in Figure 10. In addition to the OCWD information, borings (TH20-01 to TH20-13) at the downstream channel were also referenced and had estimated water level elevations that ranged 59 to 64 feet, which may be encountered in the shallower aquifer. Based on Figures 11 and 12 and groundwater information from the downstream channel borings, it is shown that the water levels in these areas are generally deep and may have decreased over the years. Increased fluctuations at water levels in SA-21 were due to water demand and increased pumping per OCWD report; however, these fluctuation does not pose potential risk of instability to the outlet area (where it has a levee condition) due to these deep aquifers. For stability analysis of the channel/outlet at the critical areas, refer to 11.2 of this report.

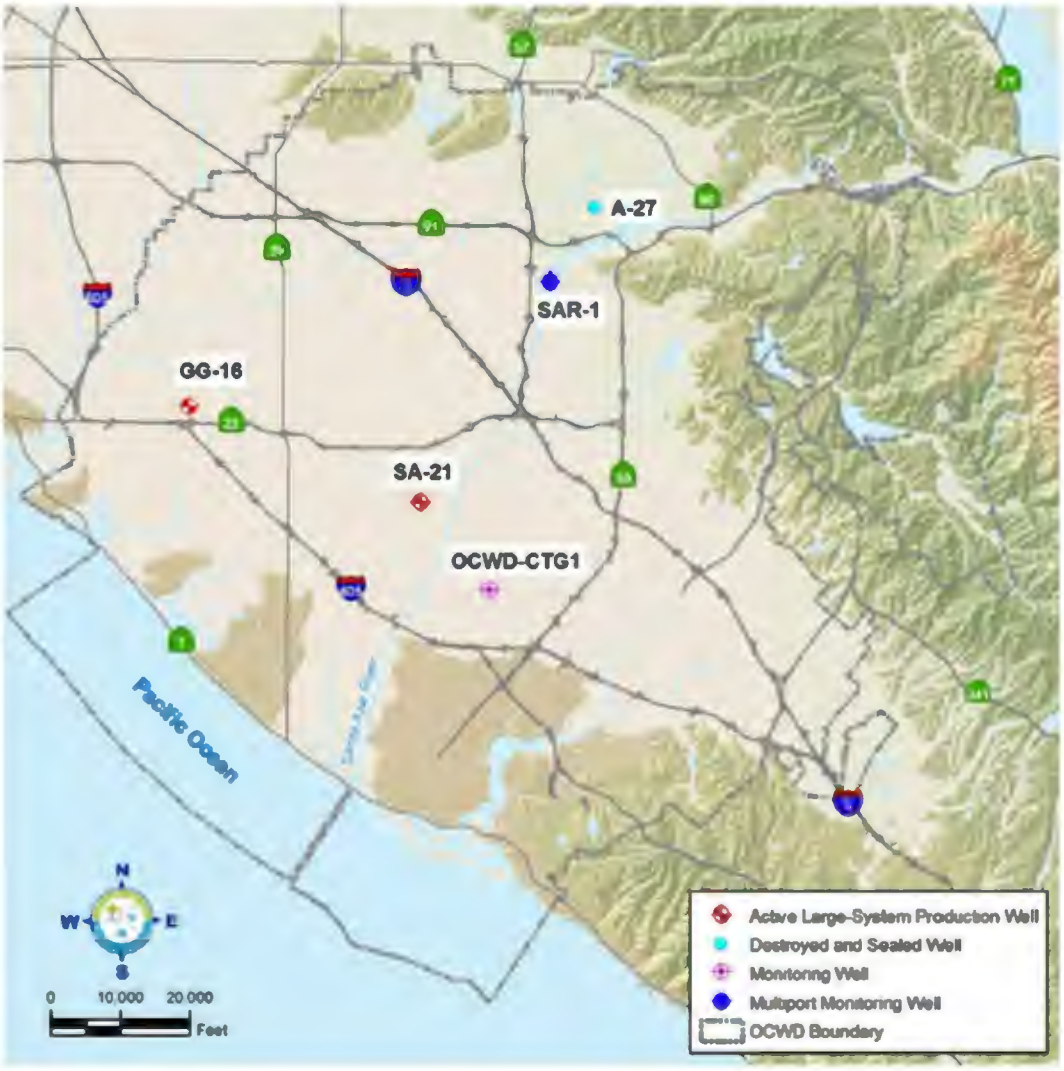


Figure 10. Location of Long-Term Groundwater Elevation Hydrograph

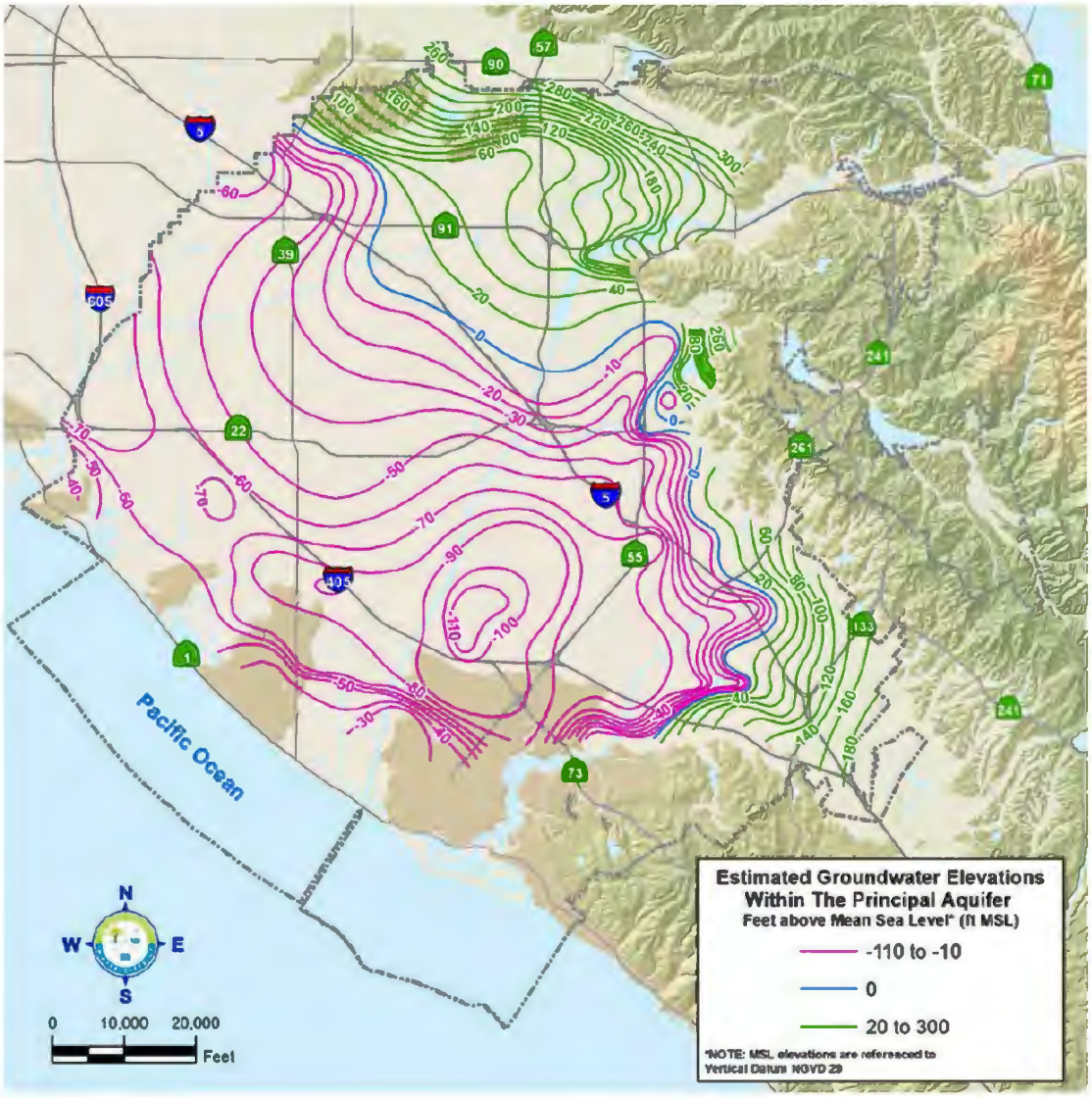


Figure 11. Groundwater Level Contour Map in June 2014

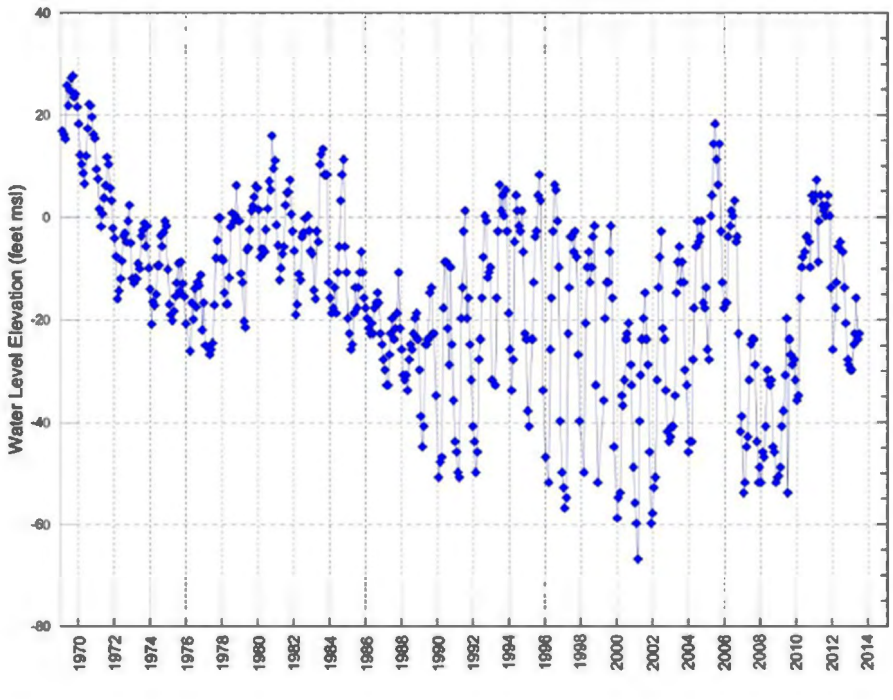


Figure 12. Water levels at SA-21

7 Dam and Levee Safety Considerations

If the Passive Reservoir Alternative is pursued, the reservoir may not function as a dam. However, should the proposed overflow and outlet structures be pursed, the reservoir will likely hold back water and therefore, it meets the criteria as a dam.

The channel is incised and is not subject to the typical levee safety concerns, such as maintaining a vegetative free area within 15 feet of the levee toe. However, some of the floodwall will be constructed along the channel, which these floodwalls would be considered levees if they are the feature that is excluding water from leaving the channel. Technical requirements (i.e. seepage and global stability) have been checked per EM 110-2-2502; these are included in the geotechnical analyses sections (Section 11) of this Appendix.

Since the reservoir act as a dam and the floodwall along the channel is considered as a levee, the Interim Approach for Risk-Informed Designs for Dams and Levee Projects under Engineering Construction Bulletin (ECB) needs to be followed as guidance. In addition to ECB guidance, the following guidance below is required for this consideration:

1) Coordination with the State of California would be required to see if the State believe that the proposed reservoir would serve as a dam and proposed floodwalls are considered levee, and that State regulations are being followed.

2) A USACE Safety Assurance Review (SAR) would need to be completed. The intent is to add the SAR to the detailed design phase. The Review Management Organization (RMO) for the Review Plan would be the Risk Management Center (RMC). Because there is no Safety Assurance Review (SAR) the South Pacific Division (SPD) would be the Risk Management Organization (RMO).

4) Risk Assessment (RA) and/or Levee Screening workshop to be facilitated by USACE would be required consistent with Engineering Construction Bulletin (ECB) 2019-5. Consequence modeling for different potential failure modes, which is a combined Geotechnical and Hydrology and Hydraulics (HH) task would be required.

8 Soil Parameters

8.1 Reservoir Area

The soil parameters for the reservoir were provided in the GDM as shown in Table 2 and revised in DM 18 (1997) as shown in Table 2. These values were revised in 1997 for DM 18 as shown in Table 3. Similar strength values were obtained in the Sep-Oct 2021 geotechnical investigation as described below.

Table 2. GDM design values for the reservoir area

	In Situ Older Alluvium	Compacted Buttress Fill
Dry Unit Weight (pcf)	120	120
Moist Unit Weight (pcf)	130	130
Saturated Unit Weight (pcf)	140	140
Drained, Angle of Internal Friction (deg)	45	40
Permeability (fpd)	10	0.1

Table 3. Design values for reservoir area (DM 18)

1997 Design Values

2-03 In order to account for the change in saturated shear strengths the design values have been modified and are shown in Table 2. The concrete wall was modeled using a unit weight of 150 lb/ft^3, a cohesion of 10,000 lb/ft^2, and a shear strength (phi angle) of 45 degrees. The gabion wall was modeled using a unit weight of 130 lb/ft^3, a shear strength (phi angle) of 30 degrees, and no cohesion.

Table 2. 1997 Design Values.

Material	γ_m ($^{lb}/_{ft^3}$)	γ_s ($^{lb}/_{ft^3}$)	ϕ_m°	ϕ_s°	c ($^{lb}/_{ft^2}$)
Alluvium	130	140	45	42	0
Buttress Fill	130	140	N/A	40	0

γ_m = moist unit weight, γ_s = saturated unit weight, ϕ_m = drained shear strength,

ϕ_s = undrained shear strength, c = cohesion.

8.2 Channel Area

Values for the channel area were provided in Volume 6 of the Phase II GDM Appendix A (Geotechnical Appendix) (Aug 1998) as shown in Table 4.

Table 4. Channel geotechnical properties (Vol 6 of Phase II GDM, Appendix A; Aug 1998)

	In situ Material	Compacted Fill
Dry Unit Weight, (pcf)	120	115
Moist Unit Weight, (pcf)	130	125
Saturated Unit Weight, (pcf)	138	133
Drained Angle of Internal Friction, (deg)	35	35
Permeability, (fpd)	10	0.1
Coefficient of Active Earth Pressure,	0.3	0.3
Equivalent Earth Fluid, (pcf)	39	37

The unit weights chosen in the geotechnical analyses are summarized in the slope stability analysis (see Attachment C-7).

8.3 Sep-Oct 2021 Geotechnical Investigation

Based on the Sep-Oct 2021 geotechnical investigation, sixty-three (63) soil samples were tested using the direct shear method (ASTM D3080). Soil tests were broken into two groups: sands (SP, SW, SP-SC, SP-SM, SC, and SM) and gravels (GP, GW, GP-GC, GP-GM, GC, and GM). Based on these two groups the values for shear strength were relatively consistent as shown in Figure 13 and Figure 14. See summaries of these tests in Attachments C-2 (for the prior tests), C-9 (for the recent borings by Savannah District in 2021, and C-7 (shown in the slope stability analysis models).

For the sand shear strength, the values decrease as normal stress increases beyond 40 psi. Above 40 psi, the values appear to follow a non-linear pattern. Therefore, two functions were used to describe the shear strength of sand. Below 40 psi a linear fit was used and above 40 psi a non-linear fit was used. For gravel shear strength, the values of the normal versus shear strength appear to follow a linear pattern. The fit for both the linear and non-linear relationships for both sand and gravels were chosen such at 2/3 of the laboratory tests values exceeded the fit, or design curve. Data for direct shear can be found in Attachment C-2.

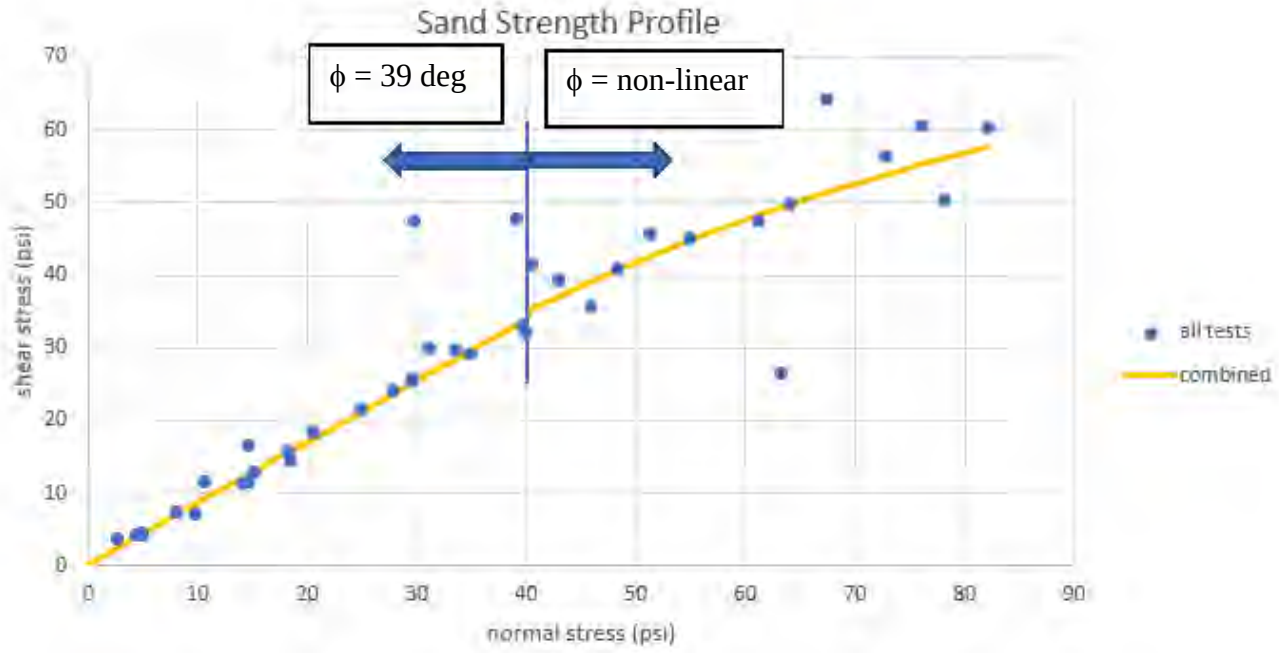


Figure 13. Sand strength profile based on direct shear tests

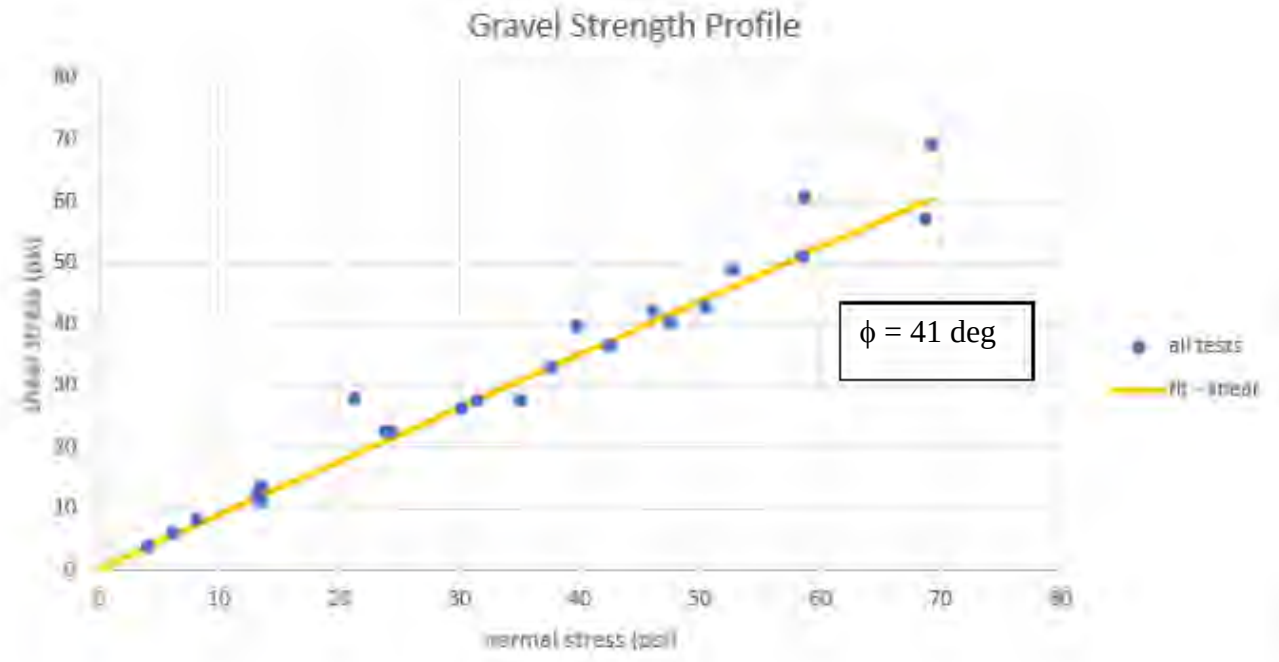


Figure 14. Gravel strength profile based on direct shear tests

8.4 Consolidation

The terms required to compute settlement are existing stresses, induced load and final stress, maximum past pressure, compression index (Cc), recompression index (Cr), and initial void ratio. To model the clay deformation numerically, the modified Cam Clay model was using, which is the same as the standard consolidation equation except that consolidation parameters are shown on a natural log scale. The input parameters are shown in Table 5.

Table 5. Required input parameters for the Modified Cam Clay model ("Stress-Strain Modeling with GeoStudio," Seequent Limited, 2021)

Parameter	Symbol	Unit
Effective angle of shear resistance	ϕ'	°
Slope of normal compression line	λ	
Slope of the unloading-reloading line	κ	
Poisson's ratio	ν'_{ur}	
Isotropic over-consolidation ratio	$OCR = p'_{0,max}/p'_{0,i}$	
Coefficient of earth pressure for the overconsolidated state*	K_0^{oc}	
Initial void ratio	e	

*The coefficient of earth pressure for the over-consolidated state K_0^{oc} is an optional parameter for establishing the initial stresses by means of a Gravity Activation analysis in combination with the K_0 -procedure (Section 4.1.2).

The parameters λ and κ can be computed as shown in Figure 15.

$$M = \frac{6\sin\phi'}{3-\sin\phi'}$$

By definition, the specific volume, v, is related to the void ratio, e, through the following expression:

$$v = 1 + e$$

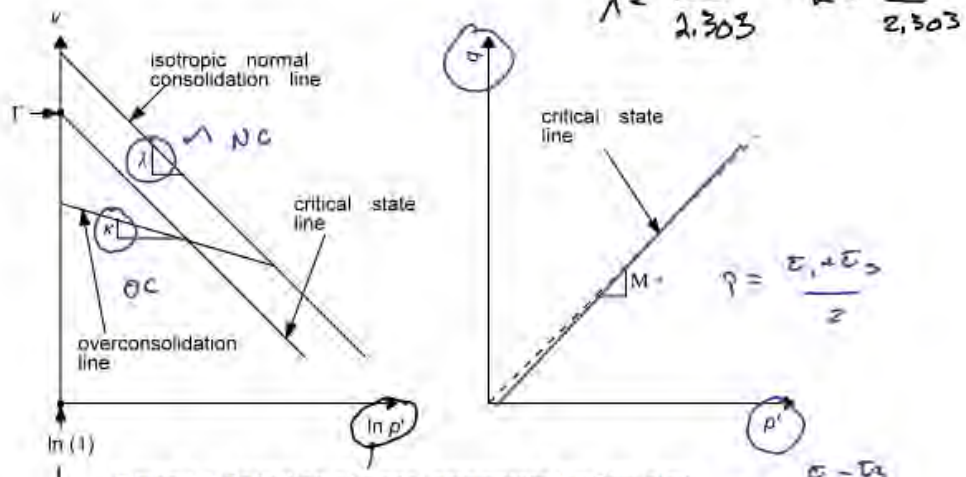


Figure 5-8 Definition of model parameters for Cam-clay

Yield function

Figure 15. Converting consolidation parameters to Cam Clay parameters

Data from consolidation tests are shown in Table 6. The coefficient of volume compressibility (m_v) is computed from the consolidation curve between the expected initial (σ_i') and final (σ_f') stresses shown in Table 6. The soil permeability is computed from the unit weight of water (g_w), coefficient of volume compressibility (m_v), and the coefficient of consolidation (c_v). The terms λ and κ are equivalent to the slope of compression (Cc) and recompression (Cr) on a natural log scale. The friction angle (ϕ) is taken to be 30 degrees. For fine grained material the Poisson's ratio is taken to be 0.4. For coarse grained material Poisson's ratio is taken to be 0.3. The OCR is conservatively assumed to be one. For coarse grained material the friction angle is assumed to be 38 degrees and the elastic modulus is assumed to be 500,000 psf and the compressibility is 1e-6 1/psf.

Table 6. Settlement Input Parameters

	depth (ft)	LL	PI	Pc (tsf)	Cc	Cr	e0	cv (ft²/day)	λ	κ	θw	σi' (tsf)	σf' (tsf)	Δσ (lb)	Δe	mv (1/psf)	k (ft/s)
TH20-07	10.5-12.5	50	29	0.9	0.09	0.04	0.559	0.018	0.039	0.017	0.359	0.25	1	1500	0.0235	1.00E-05	1.13E-05
TH20-07	12.5-14.5	41	21	1.5	0.11	0.03	0.552	0.024	0.048	0.013	0.356	0.25	1	1500	0.0165	7.09E-06	1.06E-05
TH20-12	10.0-12.0	33	15	1.3	0.2	0.02	0.601	0.023	0.087	0.009	0.375	0.25	1	1500	0.025	1.04E-05	1.49E-05
average					0.133333	0.03	0.571		0.058	0.013	0.363					9.1E-06	1.2E-05

$$m_v = \frac{\Delta e}{\Delta\sigma(1 + e_o)}$$

$$k_v = \gamma_w m_v c_v$$

$$\lambda = \frac{C_c}{2.303}$$

$$\kappa = \frac{C_r}{2.303}$$

The locations boring samples where consolidation tests were performed are shown in Figure 16.



Figure 16. Location of borings with consolidation tests

The maximum past pressure is conservatively assumed based on the test from 10-12 ft for TH20-12. The compressible fine-grained material at TH20-12 is located from an elevation of 129 – 119 ft. The OCR is computed until the depth where the OCR equals one. Then the OCR is taken to be one. This will likely lead to some over-estimation of settlement. Additional consolidation tests might show some additional overconsolidation with depth. However, since consolidation tests are not available at other depths, this method is chosen. Based on this analysis, the average OCR for the fine-grained material is 1.4 The results of these analyses are shown in Table 7.

Table 7. Estimation of Overconsolidation Ratio (TH20-12)

depth to water 50 ft

Max past pressure (Pc) 2600 psf

depth (ft)	elevation (ft)	u (psf)	σ (psf)	σ' (psf)	OCR
1	139	0	120	120	21.7
2	138	0	240	240	10.8
3	137	0	360	360	7.2
4	136	0	480	480	5.4
5	135	0	600	600	4.3
6	134	0	720	720	3.6
7	133	0	840	840	3.1
8	132	0	960	960	2.7
9	131	0	1080	1080	2.4
10	130	0	1200	1200	2.2
11	129	0	1320	1320	2.0
12	128	0	1440	1440	1.8
13	127	0	1560	1560	1.7
14	126	0	1680	1680	1.5
15	125	0	1800	1800	1.4
16	124	0	1920	1920	1.4
17	123	0	2040	2040	1.3
18	122	0	2160	2160	1.2
19	121	0	2280	2280	1.1
20	120	0	2400	2400	1.1
21	119	0	2520	2520	1.0

9 Seismic Parameters

Based on Woodward Clyde (1984) Group Delta (1996) provided annual return period versus peak ground acceleration as shown in Table 1. These data were plotted on a plot of ground motion versus annual frequency of exceedance as shown in Figure 17. From a comparison of these data is clear that the Group Delta data are nearly identical to the USGS data.

Table 8. Peak horizontal ground acceleration, annual return period and probability of exceedance in 50 years as presented by Group Delta (1996)

Peak Horizontal Ground Acceleration	Average Return Period (years)	Probability of Exceedance (P_e) in 50 Years (%)
0.16	72	50
0.18	100	39
0.23	200	22
0.31	475	10
0.38	1000	5

Plot of ground motion (g) versus annual frequency of exceedance showing that the ground acceleration used by Group Delta (1996) is nearly identical to that provided by the Unified Hazard Tool (USGS). The return period for the values provided by Group Delta is labeled as shown in Figure 17.

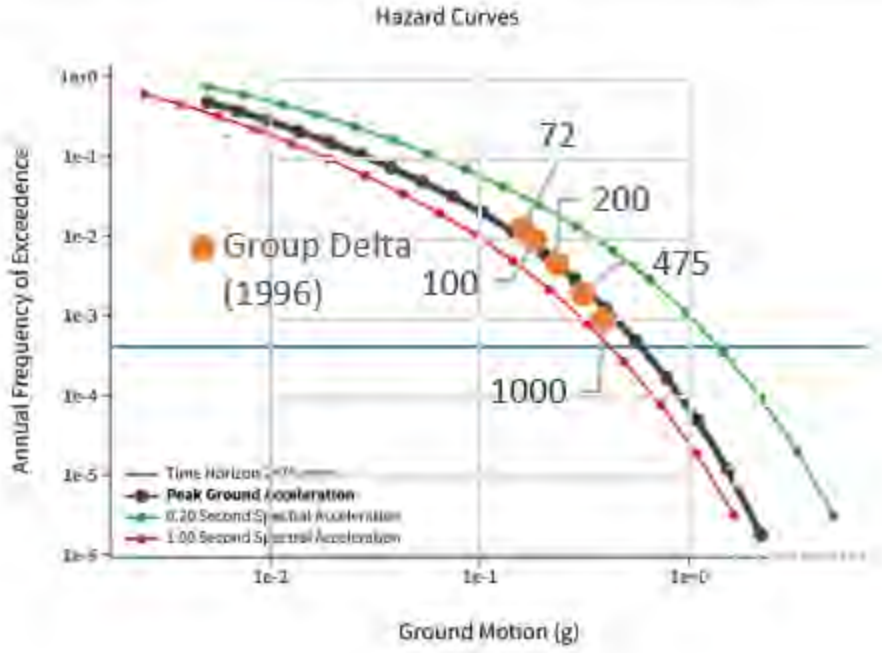


Figure 17. Hazard Curves Plot by Group Delta (1996)

To screen slopes for seismic issues, (USACE, MP GL-84-13) recommends:

1. Use pseudostatic with coefficients equal to 50% peak bedrock acceleration. Consistent with Group Delta (1996), this analysis will use the 475-year return period peak ground acceleration and multiply this by 50% resulting a design pseudostatic acceleration of 0.15 g.
2. Use composite slow-rapid (S-R) strength envelope for pervious and the rapid (R, undrained) strength for clays, multiplying the shear strength in either case by 0.8. S-R test results are used for pervious soils and R test results are used for clays. In both cases the strengths are multiplied by 0.8.
3. Use a minimum factor of safety of 1.0.

The strength envelopes used for sand and gravel are based on the direct shear tests shown above. The values chosen for seismic strengths are as shown in Figure 18 and Figure 19, which are the same as the direct shear fit values except that the shear strength for each point is multiplied by 0.8. For cohesive soils, the shear strength was based on field pocket penetrometer values multiplied by 0.8.

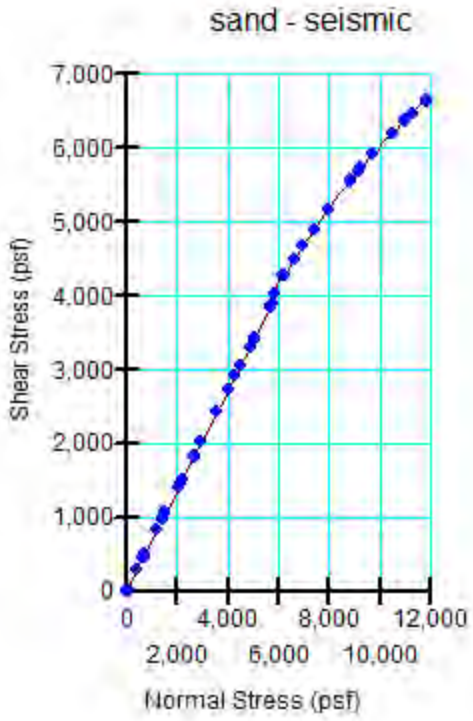


Figure 18. Seismic shear strength envelope for sands at Santiago Creek Reservoir and Channel

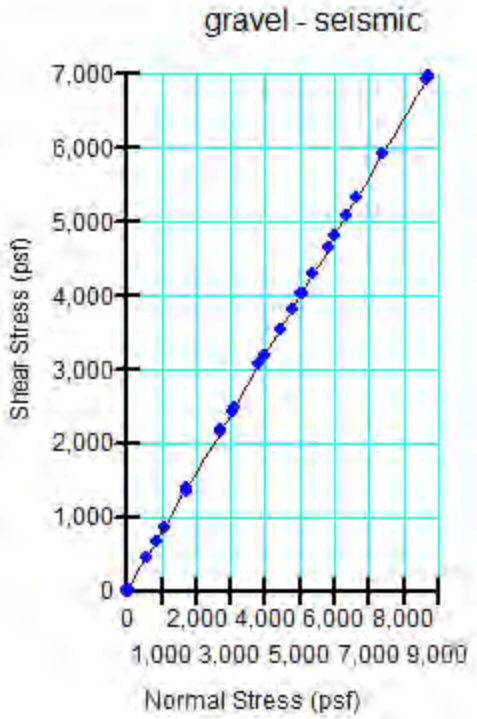


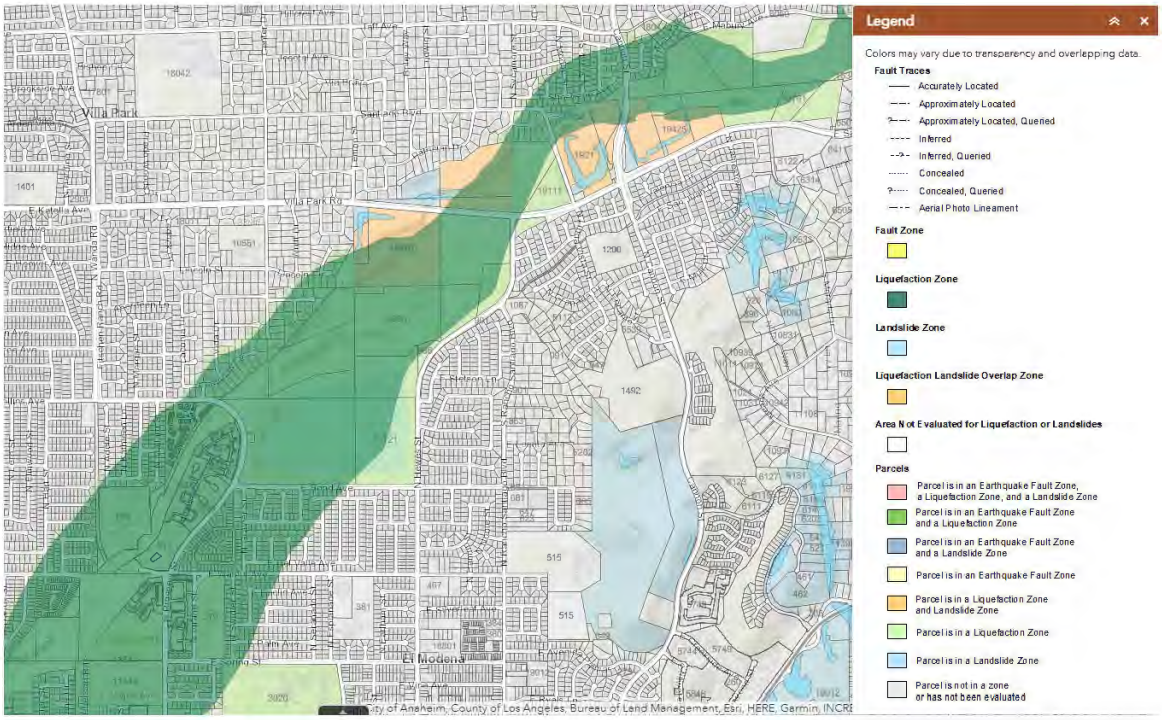
Figure 19. Seismic shear strength envelope for gravels at Santiago Creek Reservoir and Channel

Although couple slopes at Lines F and G were the most unstable and did not meet the seismic criteria when psuedostatic analysis and screening were conducted, seismic analysis will potentially need a site-specific or time history seismic study to further buy down the risk. Site-specific Response Spectrum Analysis or Time History analysis should be performed during the Pre-construction, Engineering and Design phase (PED) phase.

10 Liquefaction Analysis

ER 1110-2-1806 “Earthquake Design and Evaluation for Civil Works Projects” requires that all foundation materials that support or affect project features are to be analyzed for liquefaction. An assessment for liquefaction potential by quadrangle was developed by the California Department of Conservation, Division of Mines and Geology. The assessment for the Orange quadrangle is documented in Seismic Hazard Zone Report 011.

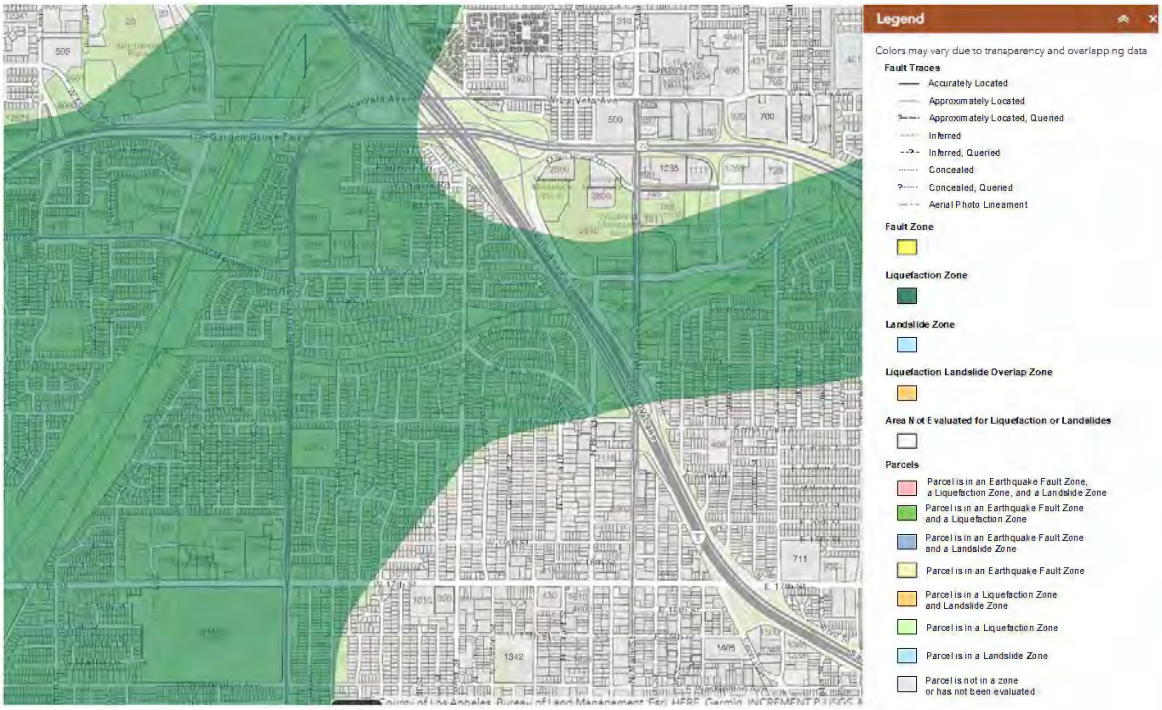
Based on the California Geologic Survey (CGS) EQZ App, most of the reservoir area is in a liquefaction zone as shown in Figure 20.



https://maps.conservation.ca.gov/cgs/EQZApp/app/

Figure 20. Most of the reservoir is located within a liquefaction zone

All the channel portion of the project is located within a liquefaction zone as shown in Figure 21.



https://maps.conservation.ca.gov/cgs/EQZApp/app/

Figure 21. The channel area is shown as being in a liquefaction zone

A site-specific analysis was performed as documented in Attachment C-3. Based on the site-specific analysis the soils, summarized in Figure 22, and the available blow count data, in the reservoir area are not likely to liquefy. The soils in the channel area have some possibility of liquefaction for an earthquake with a moment magnitude of 6.8. There are soft layers of clay in the reservoir area that will likely soften due to shaking and may lead to slope instability. This will be evaluated in the pseudo-static analysis.

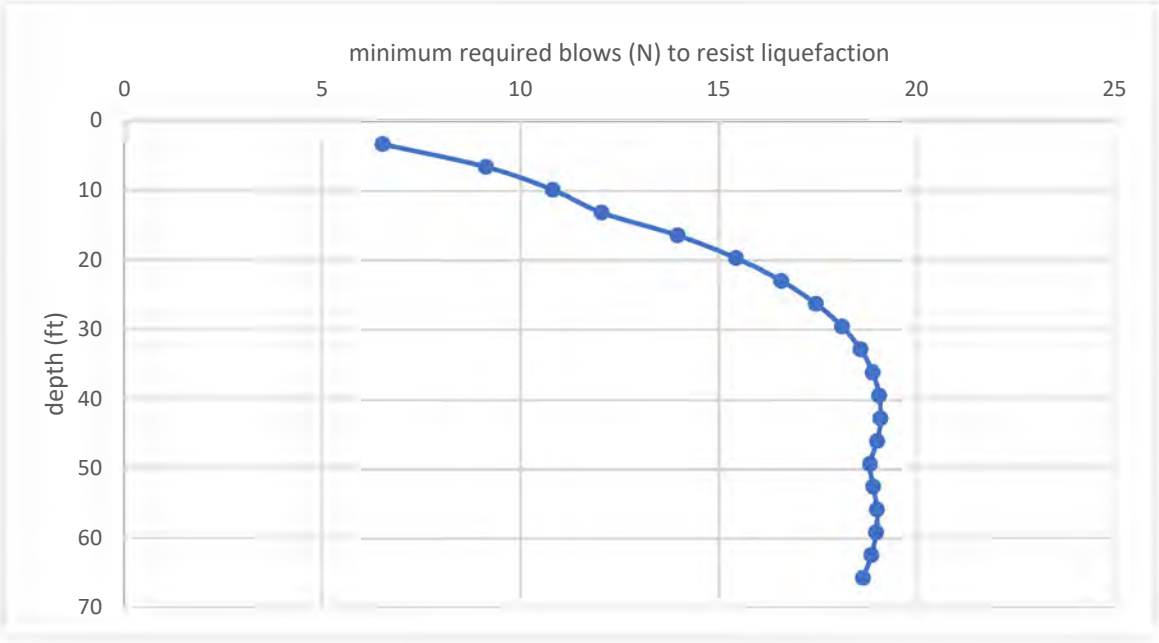


Figure 22. Minimum required blow counts to resist liquefaction

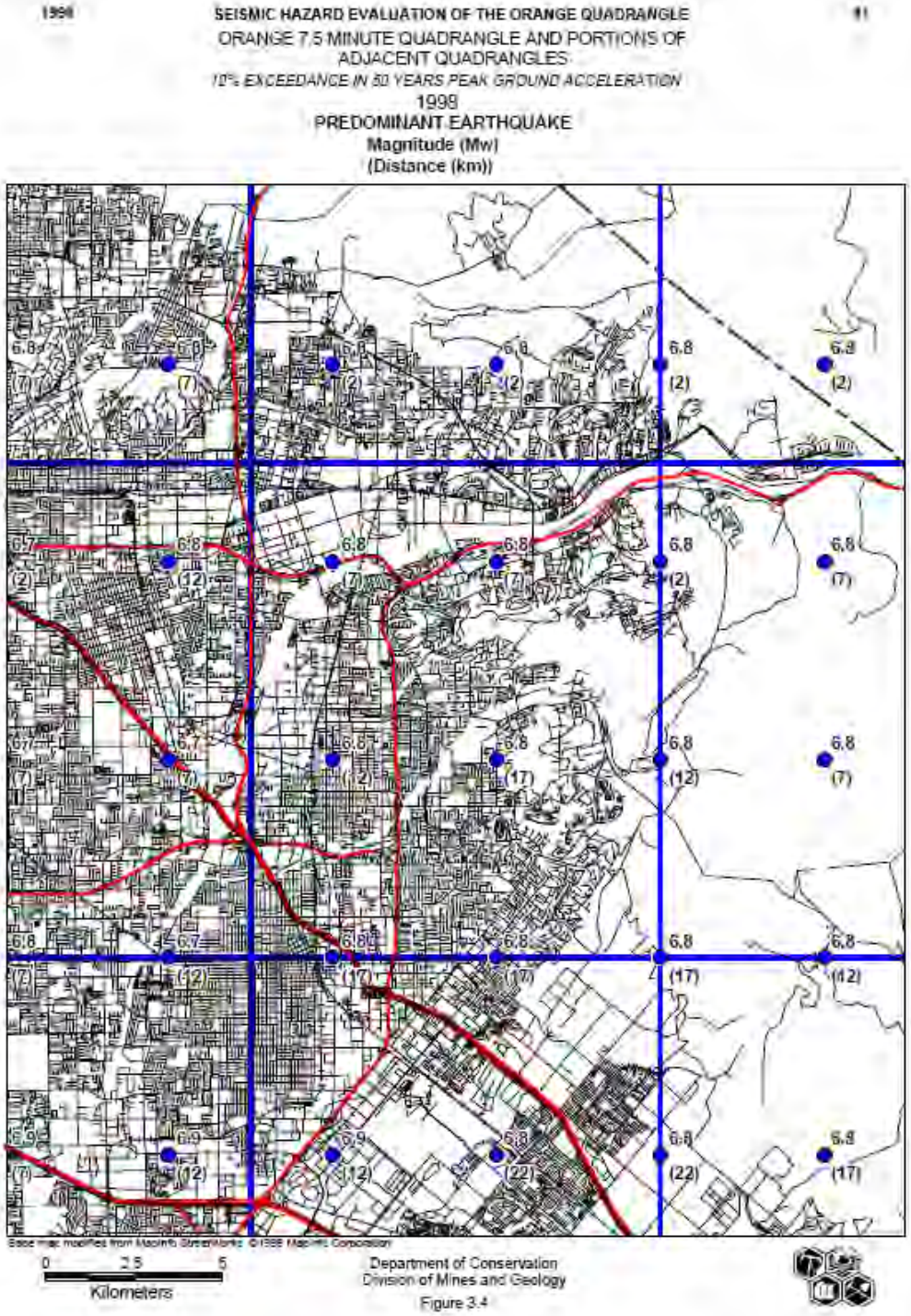


Figure 23. Earthquake Moment Magnitudes (Mw) in Orange quadrangle (California Department of Conservation)

11 Geotechnical Analysis

11.1 Corrosivity

The soils were evaluated for pH, (ASTM D4972), sulphates, chlorides, and electrical resistivity (ASTM G187) during the geotechnical investigation. Field measurements of pH and oxidation reduction potential (ORP) were obtained from all samples (see Attachment C-9 for depths and test results).Mainly fine-grained soils were selected for corrosion index tests because the lower resistivity would increase the likelihood of corrosion. The soils were evaluated based on the indices shown in Table 9. Where data were not available, the average of the data from other points were used. All corrosivity data analyses can be found in Attachment C-2.

Table 9. 10-Point Soil Test Evaluation for Iron Pipe

TABLE 2 10-point soil test evaluation for iron pipe

Soil Characteristics	Points*
Resistivity—Ωcm†	
<1,500	10
≥1,500–1,800	8
>1,800–2,100	5
>2,100–2,500	2
>2,500–3,000	1
>3,000	0
pH	
0–2	5
2–4	3
4–6.5	0
6.5–7.5	0‡
7.5–8.5	0
>8.5	3
Redox potential—mV	
>+100	0
+50 – +100	3.5
0 – +50	4
Negative	5
Sulfides	
Positive	3.5
Trace	2
Negative	0
Moisture	
Poor drainage, continuously wet	2
Fair drainage, generally moist	1
Good drainage, generally dry	0

*10 points: corrosive to iron pipe; protection is indicated.
†Based on water-saturated soil box. This method is designed to obtain the lowest and most accurate resistivity reading.
‡If sulfides are present and low (<100 mV) or negative redox-potential results are obtained, three points should be given for this range.

The results of these analyses, as shown in Figure 24, indicate that even in the case of soil inundation, the likelihood of corrosion is low throughout the site. Based on the index evaluated, no soils tested exceeded 10 indicating that corrosion protection is not required. Figure 24 shows an evaluation of corrosion potential that the soils have low indices and do not require additional corrosion protection.



Figure 24. Evaluating Corrosion Potential for Santiago Creek Soils

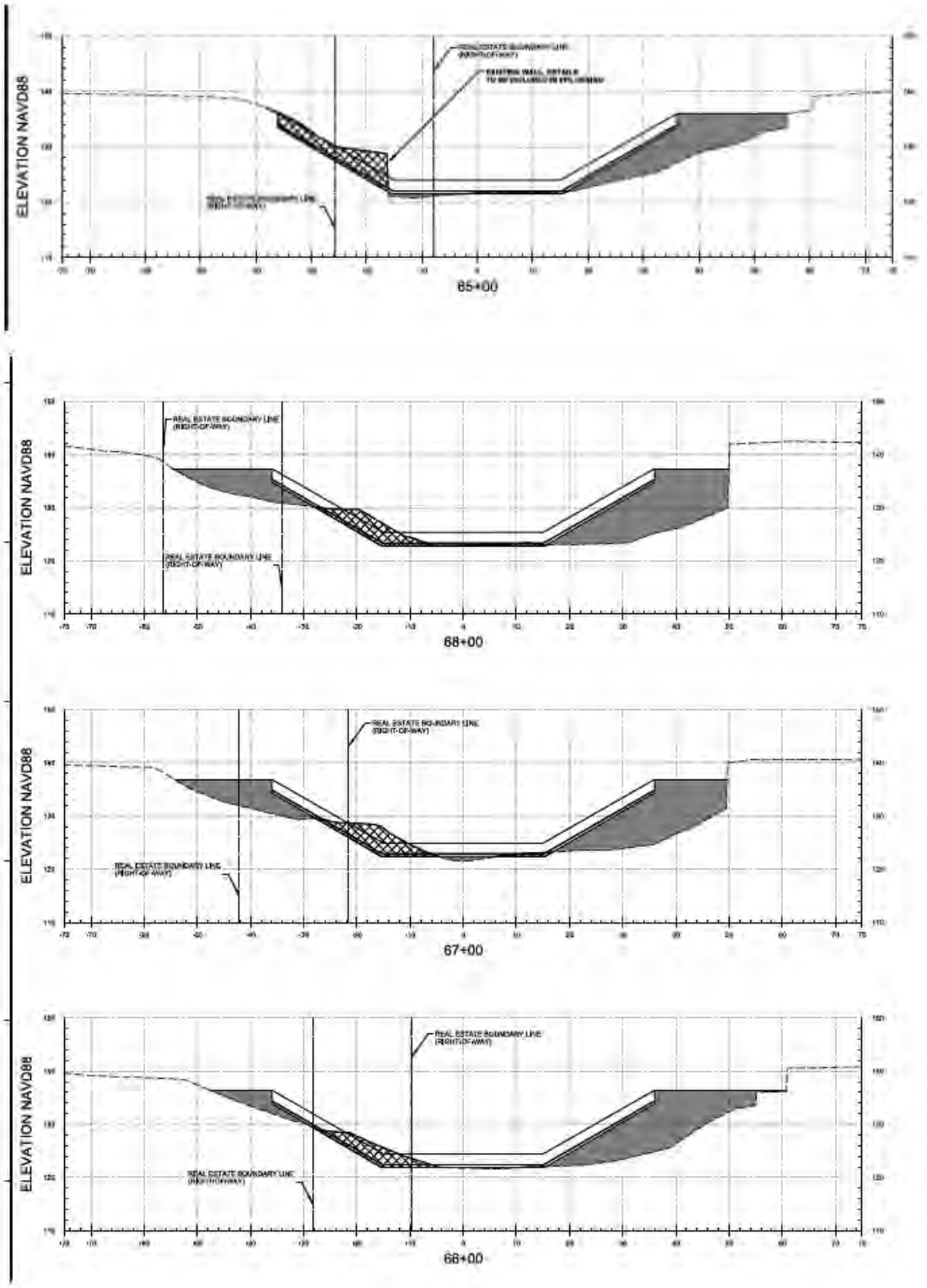
11.2 Channel

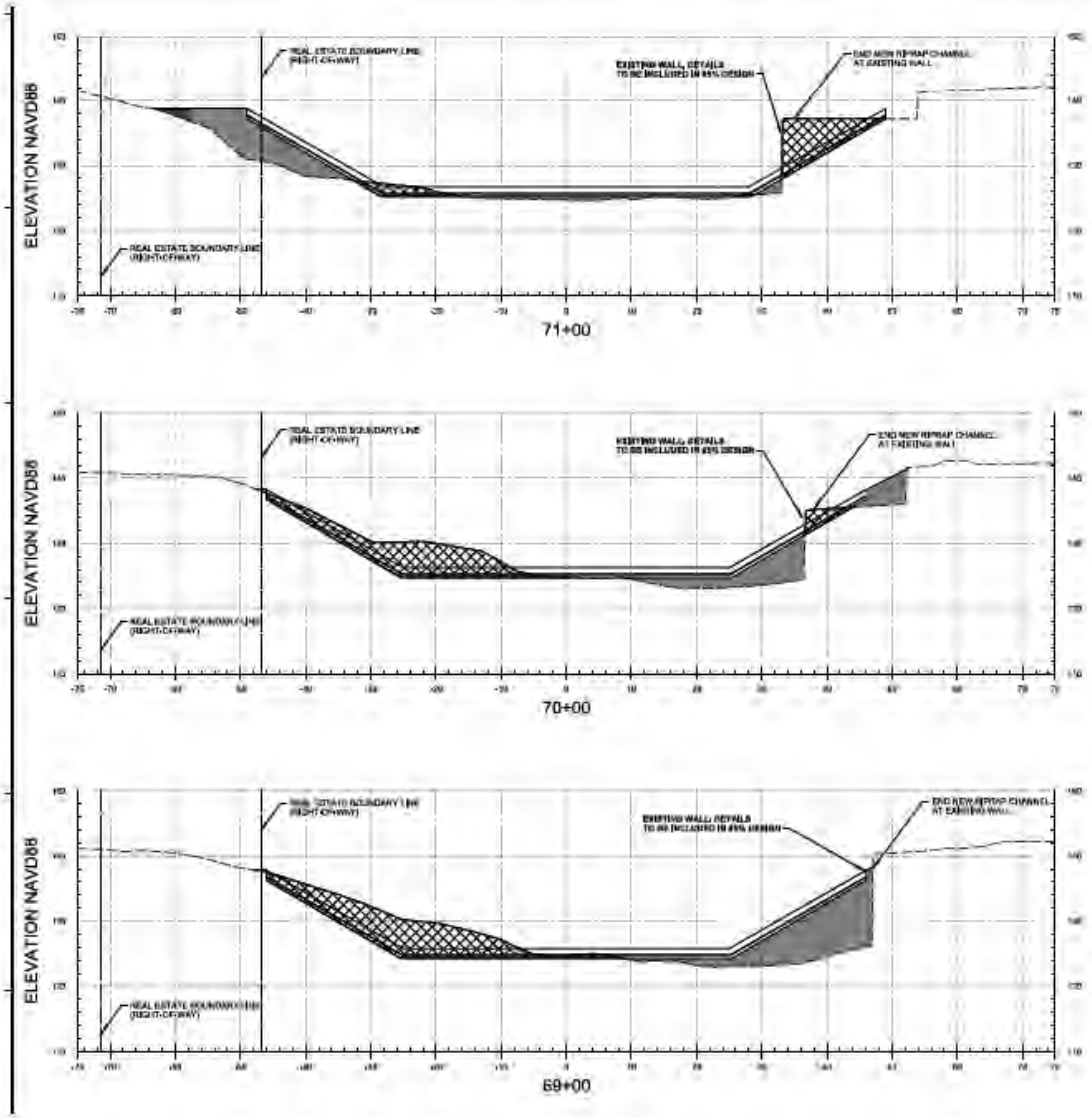
11.2.1 Settlement

11.2.1.1 Rationale

Settlement is computed because of the presence of layers of clay and because there are some areas of proposed fill. The fill areas are mainly in the downstream channel area as shown in Figure 4 should the locally preferred plan be chosen.

The proposed cross sections also have some areas of fill in the channel area as shown in Figure 25.


ELEVATION NAVD88
REAL ESTATE BOUNDARY LINE (RIGHT-OF-WAY)
65+00
ELEVATION NAVD88
REAL ESTATE BOUNDARY LINE (RIGHT-OF-WAY)
REAL ESTATE BOUNDARY LINE (RIGHT-OF-WAY)
68+00
ELEVATION NAVD88
REAL ESTATE BOUNDARY LINE (RIGHT-OF-WAY)
REAL ESTATE BOUNDARY LINE (RIGHT-OF-WAY)
67+00
ELEVATION NAVD88
REAL ESTATE BOUNDARY LINE (RIGHT-OF-WAY)
REAL ESTATE BOUNDARY LINE (RIGHT-OF-WAY)
66+00


ELEVATION NAVD88
71+00
ELEVATION NAVD88
70+00
ELEVATION NAVD88
69+00

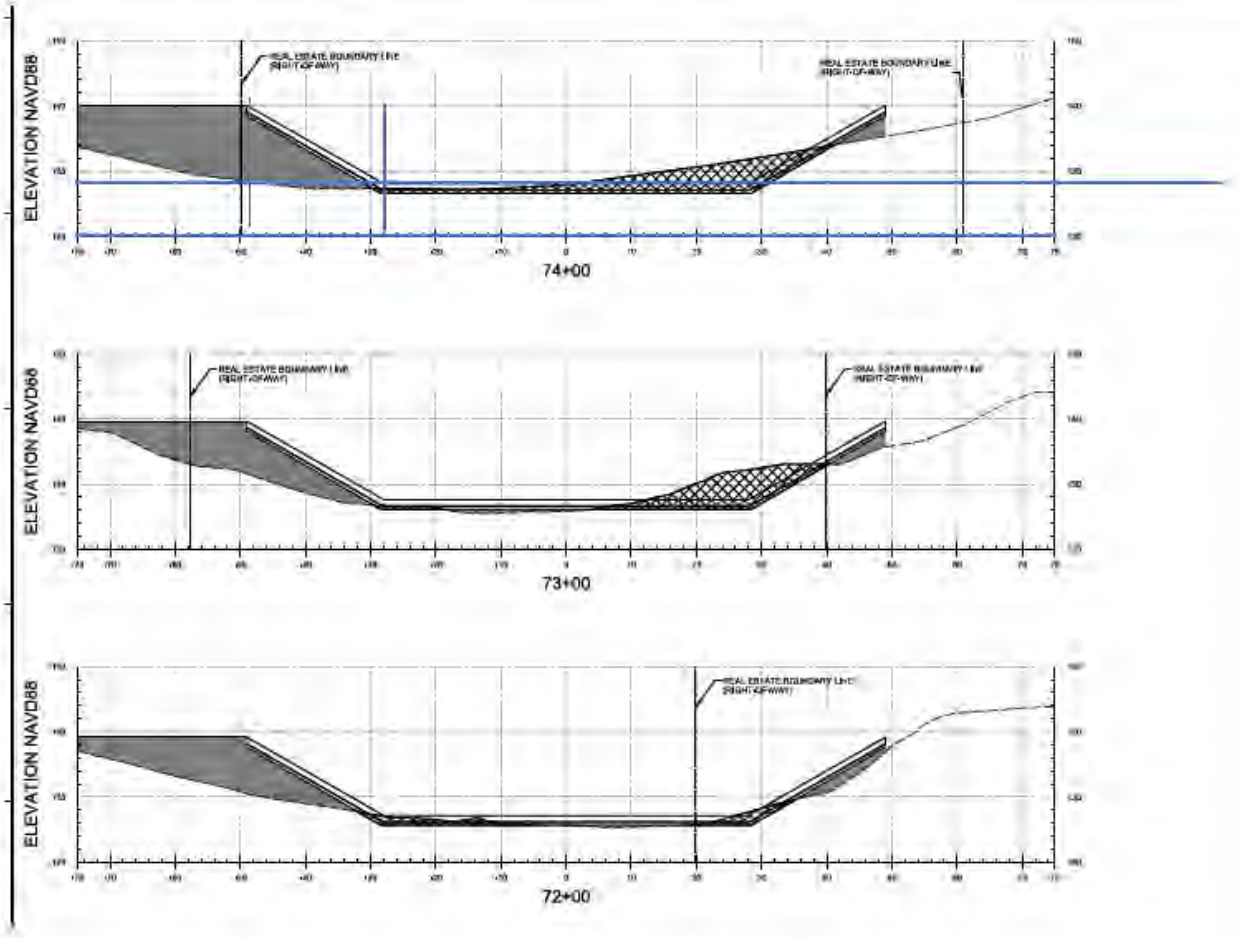


Figure 25. Downstream sections showing fill. Note that the slopes are 1.7H:1V

11.2.1.2 Results

The location of the analysis is shown in Figure 26. The stress distribution is shown in Figure 27. The settlement at the centerline (Figure 28), max load (Figure 29), 175 ft to the right of the centerline facing downstream (Figure 30), and 175 ft to the left of the centerline facing downstream (Figure 31) is 0.45, 0.82, 0.29, and 0.27 ft (5, 10, 4, and 3 inches). The settlement is expected to occur very quickly due to the high permeability of the fine-grained materials, as determined from consolidation testing. The consequences of this settlement may be to increase quantities, down drag on the adjacent freeway bridge foundation piers, and some settlement in the backyards of adjacent residences (approximately 3-4 inches).



Figure 26. Location of settlement analysis

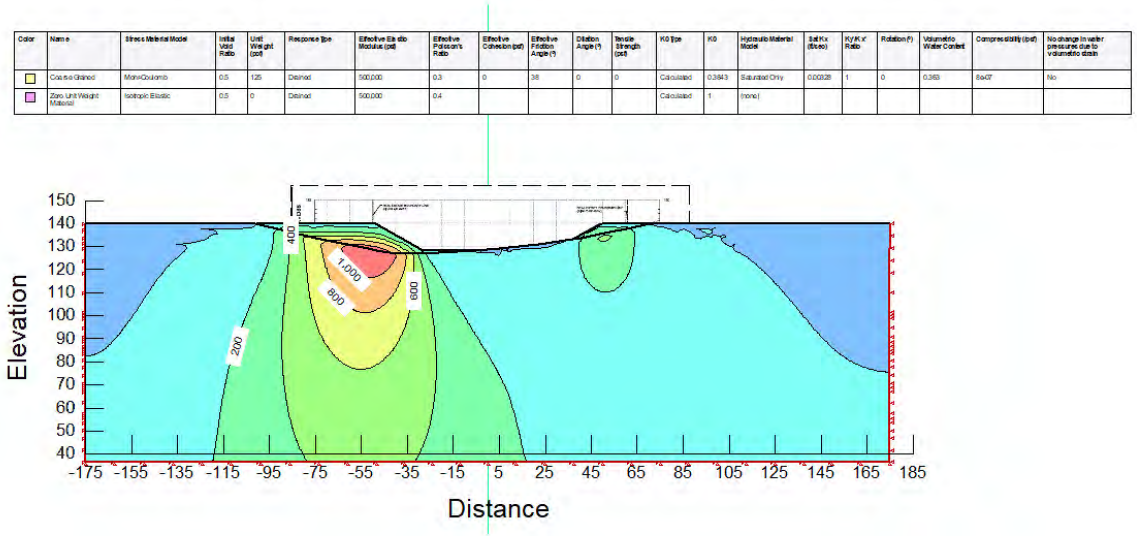


Figure 27. Stress distribution due to fill at Station 74+00

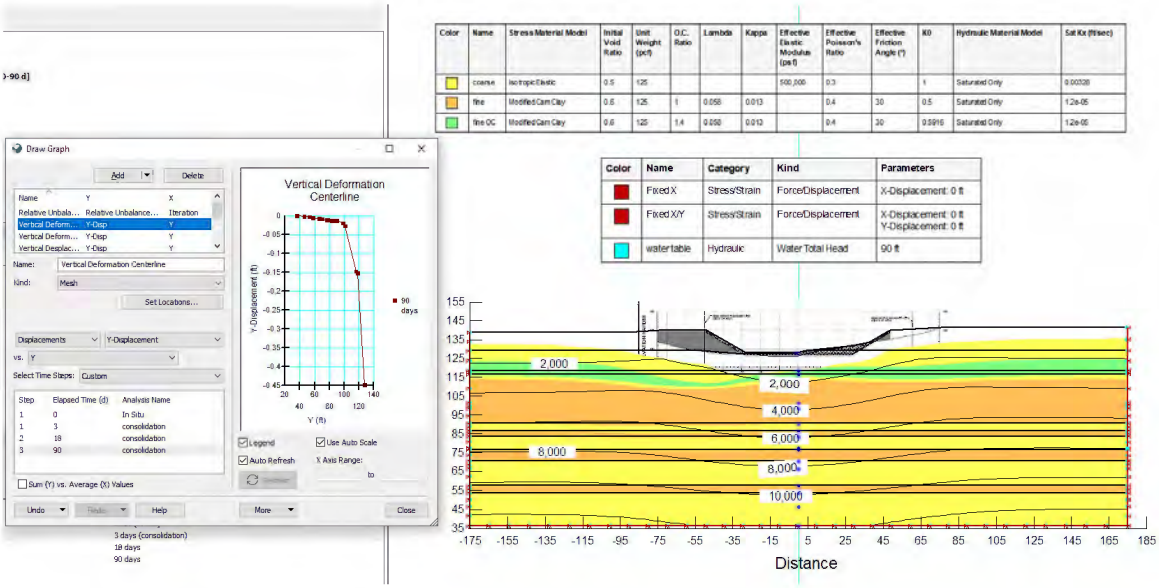


Figure 28. Stress distribution and settlement at Station 74+00 after 3 days (centerline)

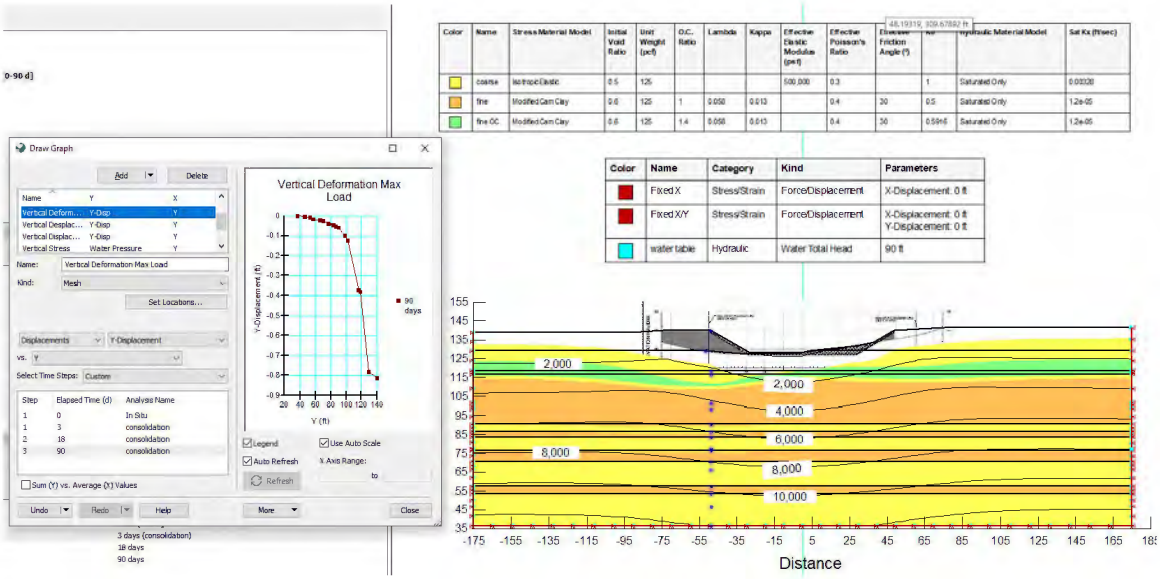


Figure 29. Stress distribution and settlement at Station 74+00 after 3 days (max stress)

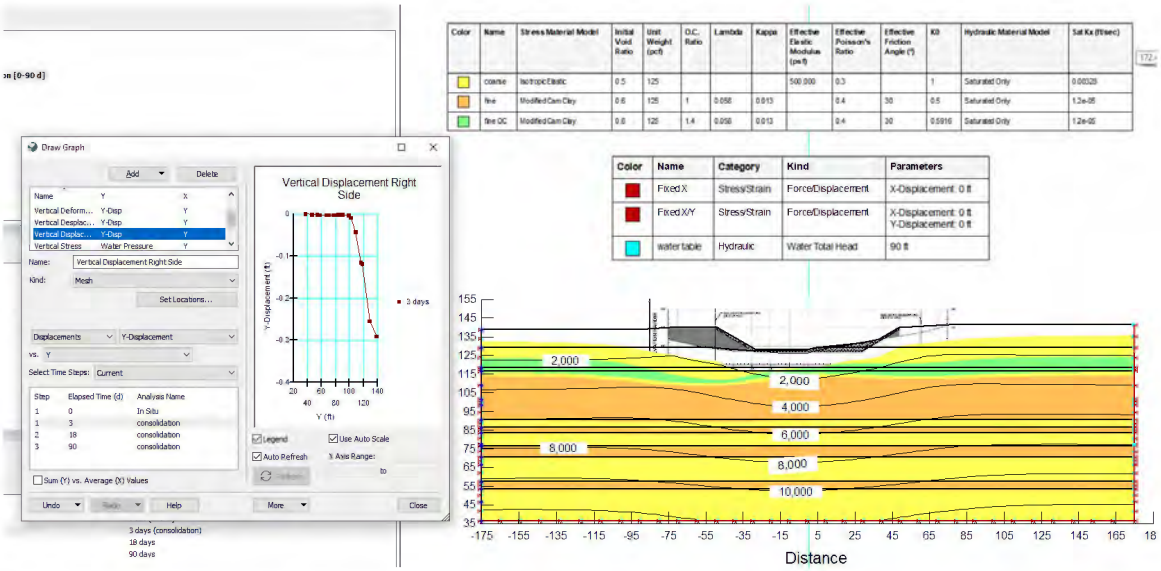


Figure 30. Stress distribution and settlement at Station 74+00 after 3 days (175 ft to the right of the centerline, facing downstream)

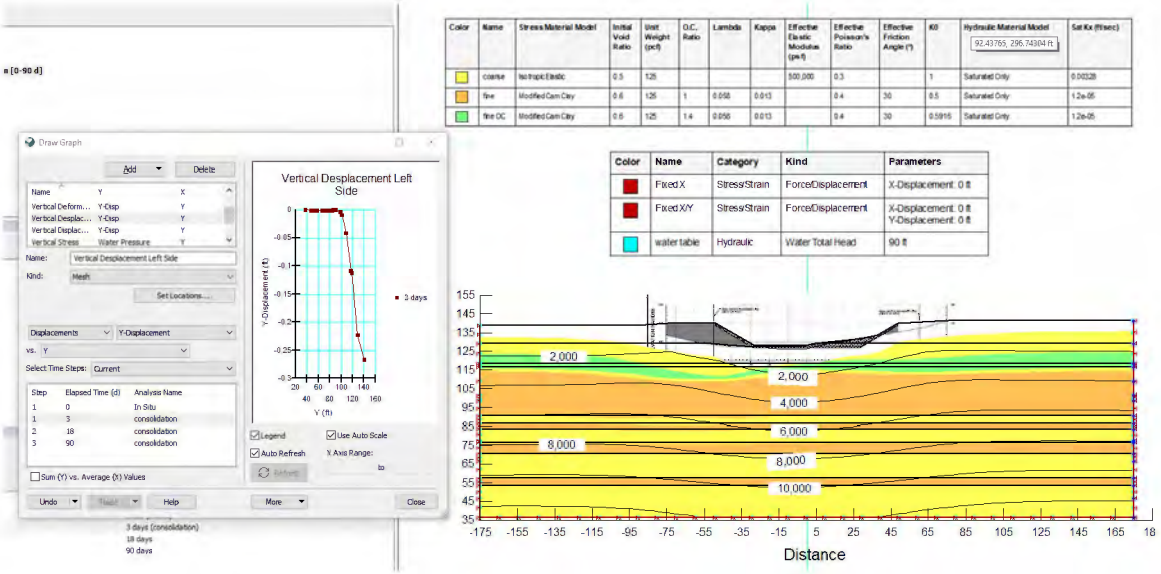


Figure 31. Stress distribution and settlement at Station 74+00 after 3 days (175 ft to the left of the centerline, facing downstream)

11.2.2 Slope failure

A summary of slope stability analyses performed at Station 74+00 is shown in

Table 10. Analyses are shown in Figure 32, Figure 33, Figure 34, and Figure 35.

Table 10. Slope stability analyses performed for Sta 74+00 (Critical channel area)

Analysis	Factor of Safety	Required Factor of Safety	Comments
1a. Short-term, high water	2.299	1.3	
1b. Short-term, low water	1.844	1.3	Reflects construction condition
3a. Rapid drawdown	1.515	1.4	
4b. Pseudostatic Low Water	0.976	1.0	Borderline stable.

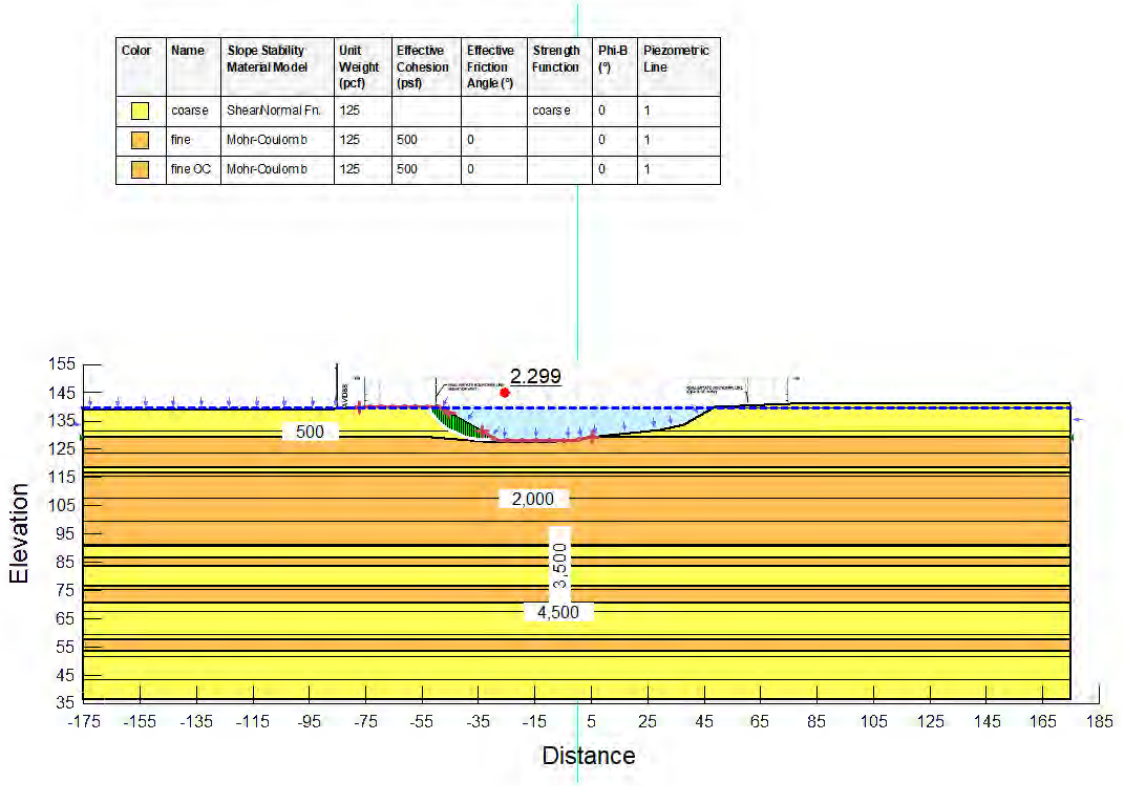


Figure 32. Channel Station 74+00 Analysis 1a. Short-term High Water

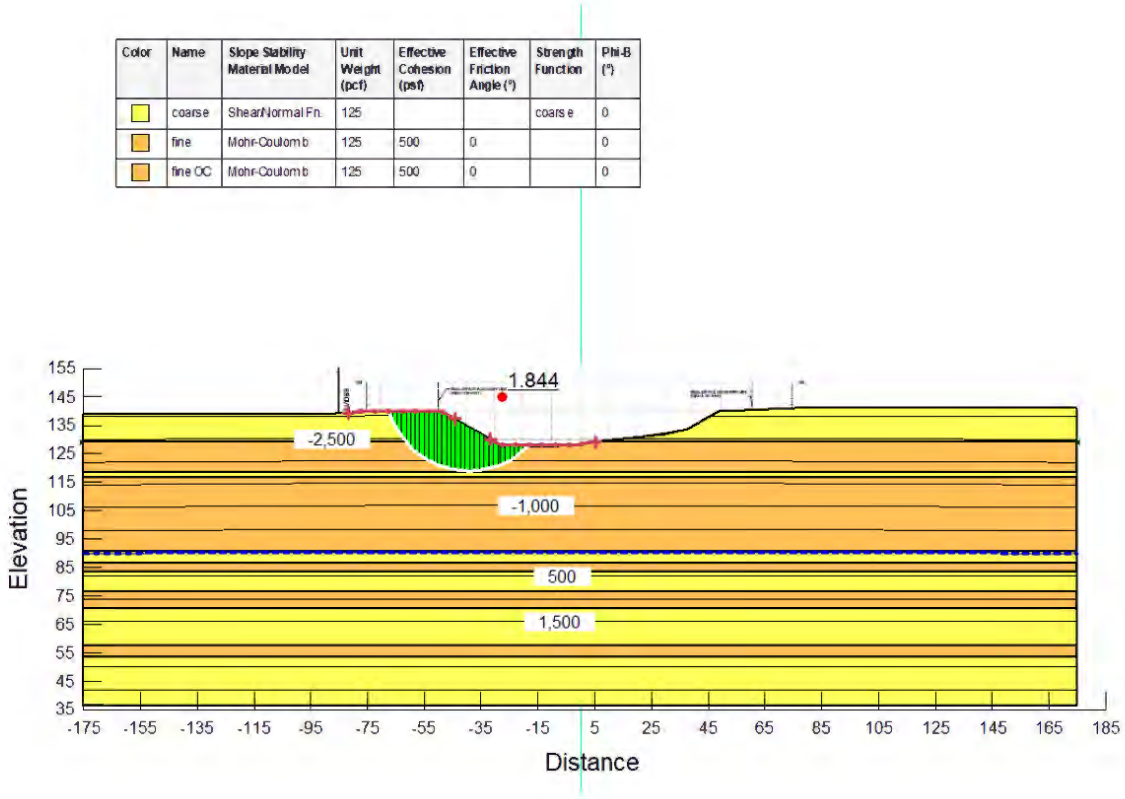


Figure 33. Channel Station 74+00 Analysis 1b. Short-term Low Water

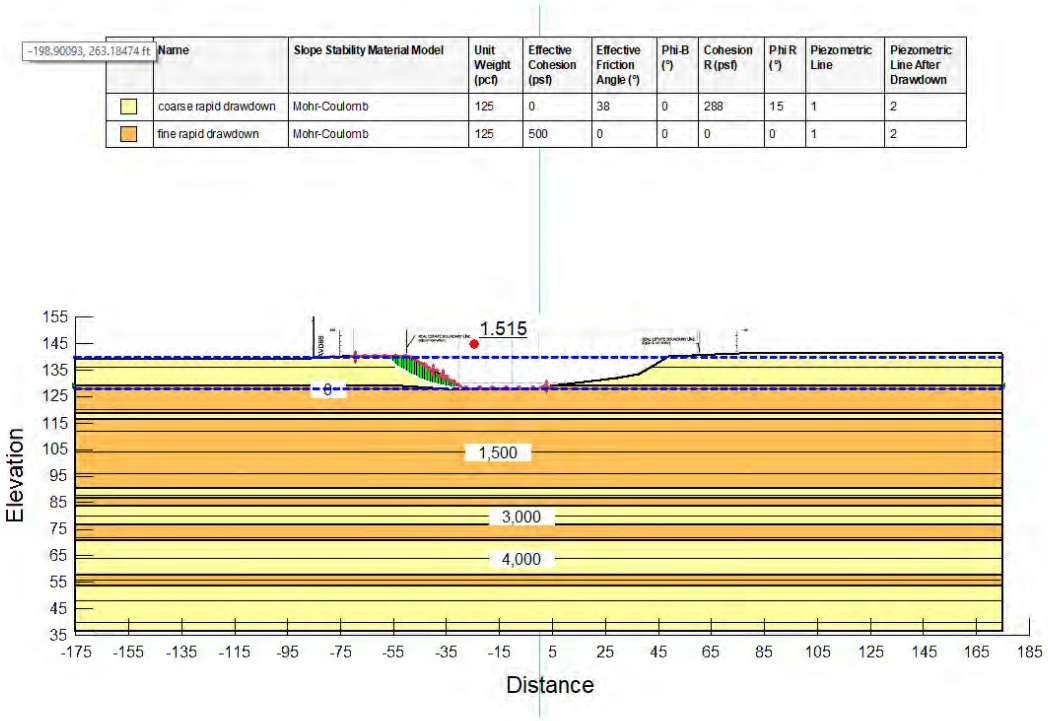


Figure 34. Channel Station 74+00 Analysis 3a. Rapid Drawdown

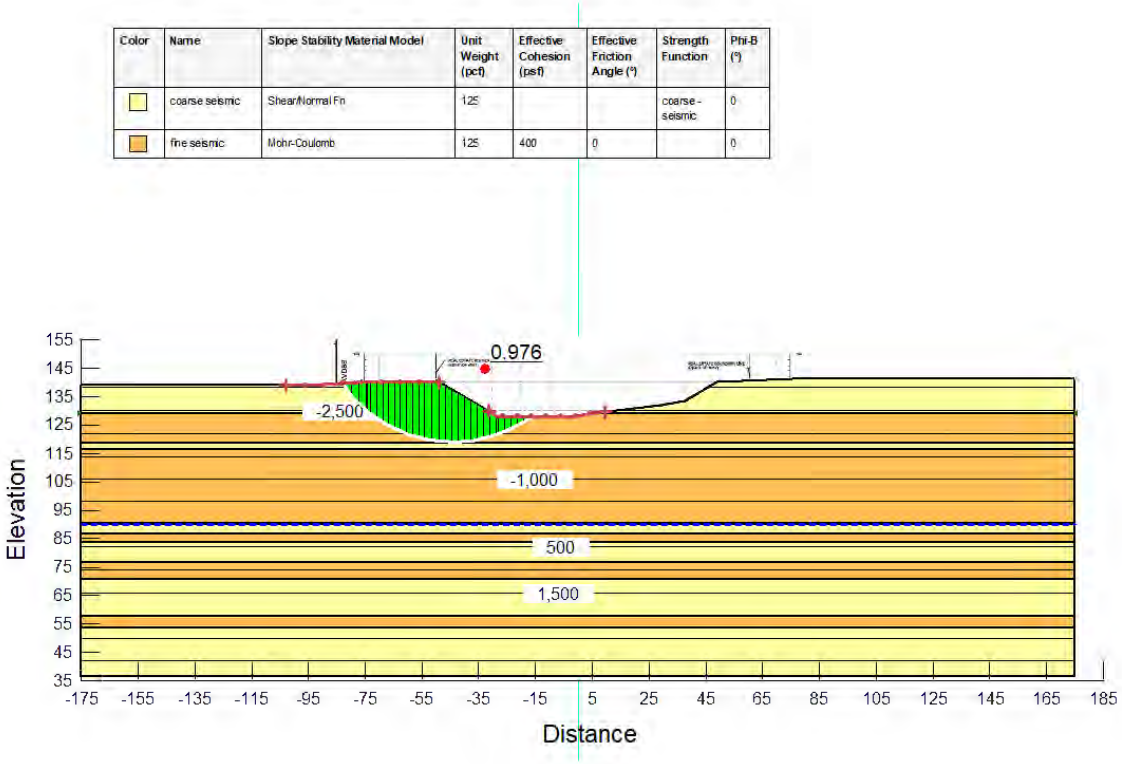


Figure 35. Channel Station 74+00 Analysis 4b. Pseudostatic Low Water

11.2.3 SSP Seepage Cutoff at Downstream Channel

It has been discussed with the project design team that the design of the outlet structures that controls the basin levels may no longer necessary since it was hugely expensive and introduces significant risk to the area. Instead, a “passive reservoir management” approach has been developed that does not include active flow control and will use flood walls at the downstream channel to prevent flooding. Steel sheet piles with concrete cap will be modeled as the seepage cutoff to be built with double and triple contact joints to reduce seam leakage. An initial typical cross-section of the proposed flood wall provided by the civil/structural engineer is shown in Figure 36.

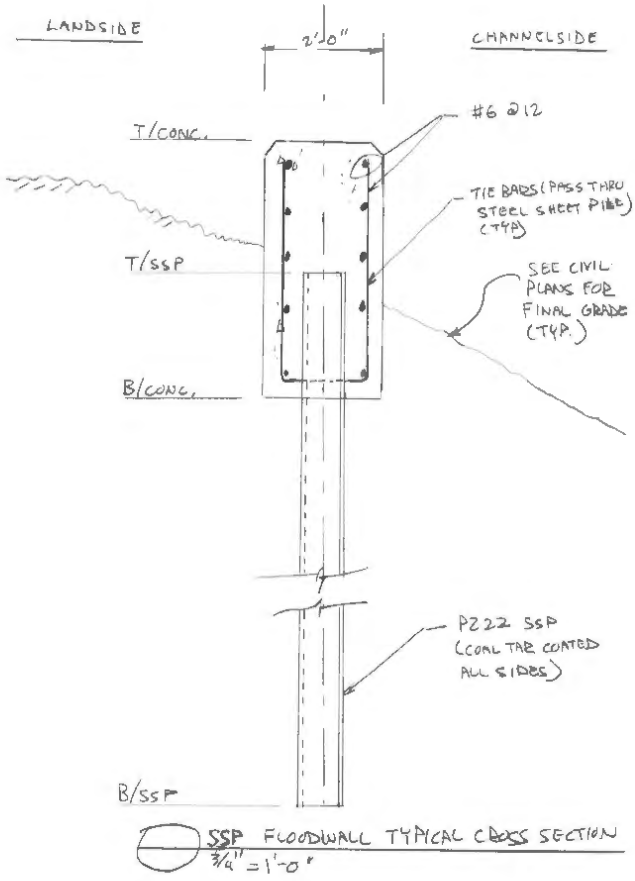


Figure 36. SSP Flood wall Typical Cross-Section

The height of the floodwall will be constructed about 3 feet above ground from the top of channel embankment. For the purposes of the seepage check, a minimum embedment depth of the SSP cutoff is assumed at 6 feet below ground. Based on the downstream channel borings at Bristol, existing site conditions at the channel embankment consists of sand to sandy gravel in the surface level at approximate elevation 119 to 137 feet, then sporadic stratums of sandy to silty clays from approximate elevation 136.5 to 100.0 feet. The following table shows the materials and its corresponding hydraulic conductivity used in the seepage check modeling in SEEP/W program.

Stratigraphic Unit	Hydraulic Conductivity (ft/s)	Ky'/Kx' Ratio
Clay Gravel with Sand (SC)	1.13e-05	1.0
Silty Clay (CL-ML) to Sandy Clay (CL)	1e-07	0.1
Riprap	6.45	1.0
SSP with Concrete Cap	Assumed Impermeable	

Table 11. Generalized Hydraulic Conductivity of Materials at Downstream Channel area

Hydraulic conductivity parameters of the in-situ soils assigned are based on the "k" results (see Table 6 of this Appendix) from nearby borings (TH-20-07 at depths 10.5 to 12.5 feet for clayey sand and 12.5 to 14.5 feet for silty clays). Riprap "k" value was estimated from Hazen equation based on some of D_{10} for an 18-inch rock gradation ($k = C(D_{10})^2$; where C = 0.01, estimated D_{10} = 25.4 mm). Although permeability at the channel area was recommended in Table 4 of this Appendix, it was considered appropriate to use the "k" value to model existing site conditions (at boring TH-20-07) where the floodwalls are proposed.

A steady-state seepage analysis was calculated in SEEP/W to evaluate the pore pressure conditions and under-seepage exit gradients beneath the floodwall for a selected cross-section east of Bristol at approximate Sta. 45+00. Hydraulic boundary condition is only applied to the wet side soils or at the slope of the channel, and not to the wet side of the floodwall. To prevent SEEP/W from applying the water load to the wall, the concrete cap or the top portion of the wall is excluded from the model runs. Table 12 below summarizes the method of calculating the Factor of Safety with the equation shown.

Column 1 (C1): Total Water Head (ft)	**Column 2 (C2):** Bottom of Surface Clay Elevation (ft)	**Column 3 (C3):** Landside Toe / Water Head at Exit (ft)	**Column 4 (C4):** Y Gradient	**Column 5:** FS_{vg} based on y gradient
SEEP/W node at the base of the silty clay (CL-ML) about 1-ft from the tip of SSP	Elevation of the point where "Total Water Head" or C1 was taken	Elevation of the ground at the exit gradient	=(C1-C3) /(C2-C3)	= i_{cr}*/C4, (where $i_{cr} = \gamma'/\gamma w$= (125 pcf – 62.4 pcf) / 62.4 pcf = 1.003)

Table 12. Description of Gradient Analysis Table

The analysis plots from SEEP/W are presented below in Figure 34. The SSP tip is assumed at 6 feet below the base of the concrete cap and loading elevation at elevation 120 feet as shown in the plot. Table 12 below summarizes the piping analysis and factor of safety using Sta. 45+00 as a typical cross-section at the downstream channel.

Color	Name	Hydraulic Material Model	Sat Kx (ft/sec)	Ky'/Kx' Ratio
	Clayey Sand (SC)	Saturated Only	1.13e-05	1
	Riprap	Saturated Only	6.45	1
	Silty Clay (CL-ML)	Saturated Only	1e-05	0.1

Color	Name	Category	Kind	Parameters
	Overtop Flood	Hydraulic	Water Total Head	120 ft
	Protected Area	Hydraulic	Water Flux	0 ft/sec

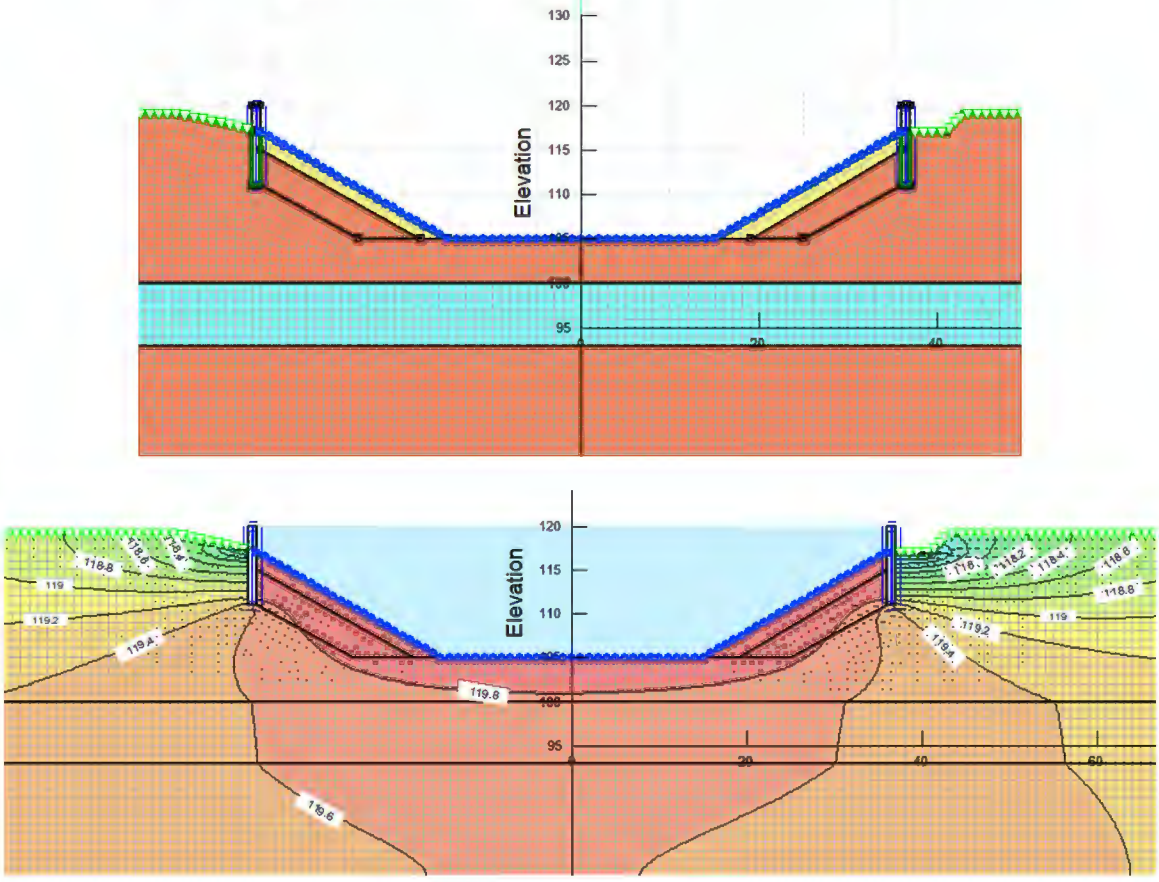


Figure 37. Seepage Set-up

Geometry	Total Water Head (ft) [1]	Bottom of Surface Material Elev. (ft) [2]	Landside Toe at Water Head Exit (ft) [3]	Y-Gradient [4]	Calculated Piping Factor of Safety (FS) [5]	Recommended FS per EM 1110-2-1901
Left side	119.5	110.2	117.4	0.29	3.5	1.5
Right side	119.4	110.2	117.0	0.35	2.9	

Table 13. Summary of Piping Factors of Safety using 6 feet of SSP embedment

Based on a generalized soil conditions at the downstream channel embankments, assumed SSP cutoff depth of 6 feet, and with steady-state loading, the model exceeds the recommended minimum factor of safety per EM 1110-2-1901 and is considered feasible for limitation of seepage flow.

As for pile driving, limits of the floodwall (where the SSP will be driven) will be from approximate Sta. 19+00 to 56+00, which will reference borings to the east and west of Bristol. Overall existing soil conditions consist of some sands, gravel and miscellaneous fills consisting of cobbles, concrete and other debris of about 1 to 3 feet depth that were encountered at the surficial layer, and sporadic stratums of sandy gravel, clayey sand and gravel, and silty clays at the upper strata (approximate elevation 67 to 137 feet) which had N values that ranged between 5 to 22. Hard driving is not anticipated based on the blow counts encountered in the upper strata at the downstream channel (from approximate elevation 67 to 137 feet). However, if new loading is introduced on top of the channel embankment (i.e., adding of new fill and/or SSP on top), the SSP will need to account for downdrag due to potential settlement of variable fill at the surficial layer and some capacity loss at the base of the concrete cap due to scour potential at the buried ripraps. In addition, downstream channel arear may encounter some possibility of temporary liquefaction of the sandy and gravelly soils during the SSP driving process. Refer to Figures 21 and 22 regarding the liquefaction zone and minimum blow counts required to resist liquefaction.

Material	Approx. Elevation (feet)	Unit Wt. (pcf)	Undrained Condition		Drained Condition	
			Cohesion (psf)	Phi (deg)	Cohesion (psf)	Phi (deg)
Sand (SP)	137.0 to 129.0	126	0	37	0	37
Sandy Gravel (GW)	129.0 to 119.0	146	0	44	0	44
Silty Clay (CL-ML)	119.0 to 100.0	121	1250	0	0	30
Clayey Gravel with Sand (GC)	100.0 to 93.0	144	0	38	0	38
Silty Clay (CL)	93.0 to 67.0	121	1500	0	0	30
Clayey to Silty Sand (SC to SP-SM)	67.0 to 32.0	126	0	37	0	37
Sandy Clay (CL)	32.0 to 24.0	113	1500	0	0	30
Clayey Sand (SC)	24.0 to 13.0	139	0	38	0	38

Table 14. Generalized Soil Parameters to be used for floodwall design

11.2.4 Structural connections to bridges

Drawings for CalTrans bridges can be found here: https://geodog.dot.ca.gov/search_projects_map.php. A bridge section for the I-5 bridge over Santiago Creek (No. 55-114) is shown in Figure 38. It appears that the original bridge was founded on shallow footings. This is supported by the Foundation Report (16 Mar 1960) which recommends "spread footings of up to 3 tsf design load recommended for all bents at or below elevation 116.5. Abutment 1 may be supported by spread footings up to 3.0 tsf at or below elevation 136.0, and Abutment 2 may be supported by spread footings up to 1.5 tsf at or below elevation 139.0" (2015-02-19-1524311512_50900071). The Foundation Review (31 Jan 1961) confirms "Piers as per foundation report dated 3-16-60" and "Abutments to be at Elevation 127.0-2 T.S.F.."

Boring logs from bridge construction (1976) are shown in Figure 39. Logs for bridge widening (logs taken in 1989) are shown in Figure 40. The 1989 borings show dense materials (blows greater than 70 ft) in the vicinity of elevation 90-100 ft.

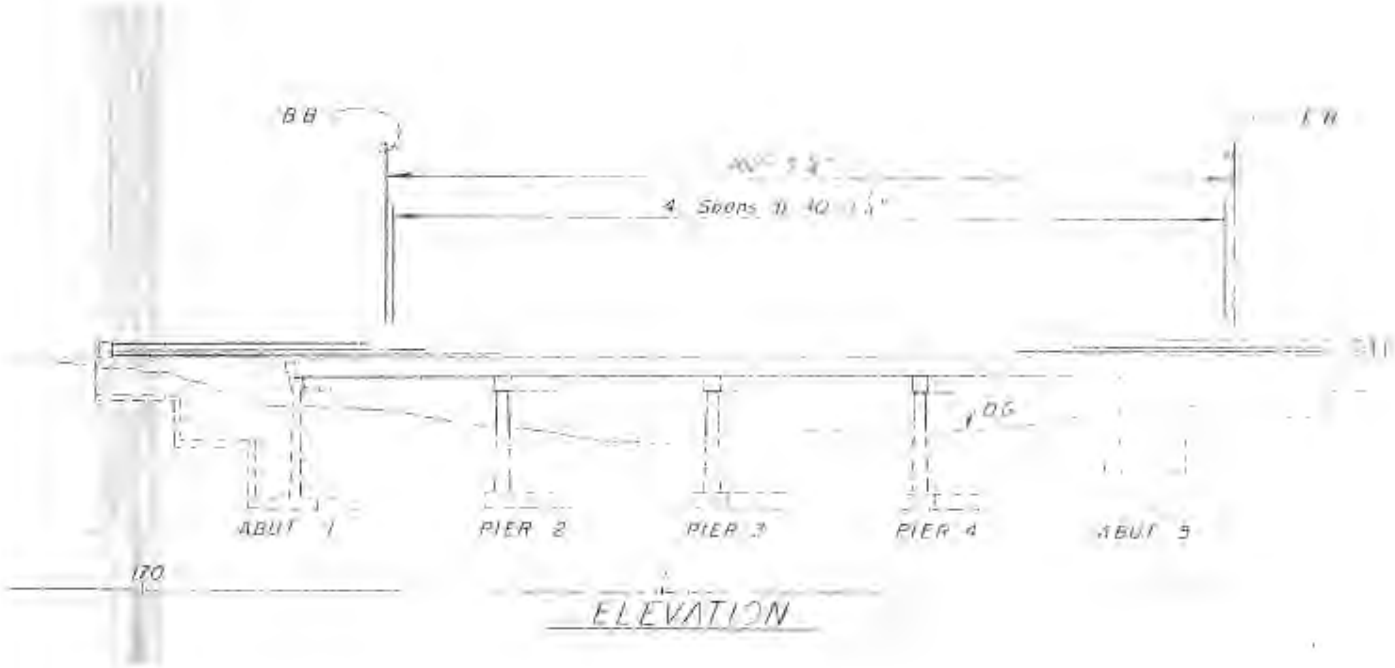


Figure 38. I-5 Bridge across Santiago Creek section (05300472)

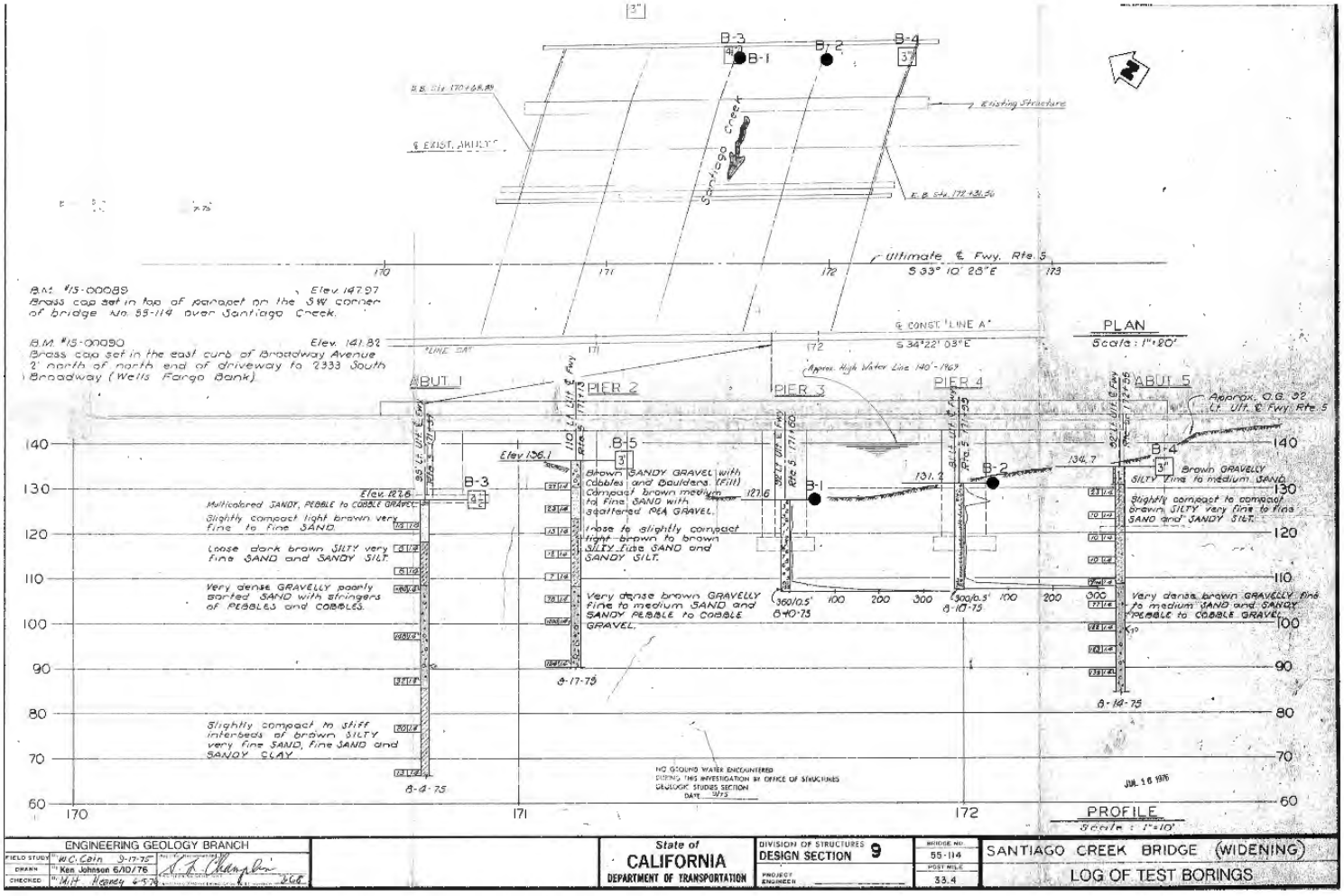


Figure 39. Boring logs for the I-5 bridge over Santiago Creek at the piers

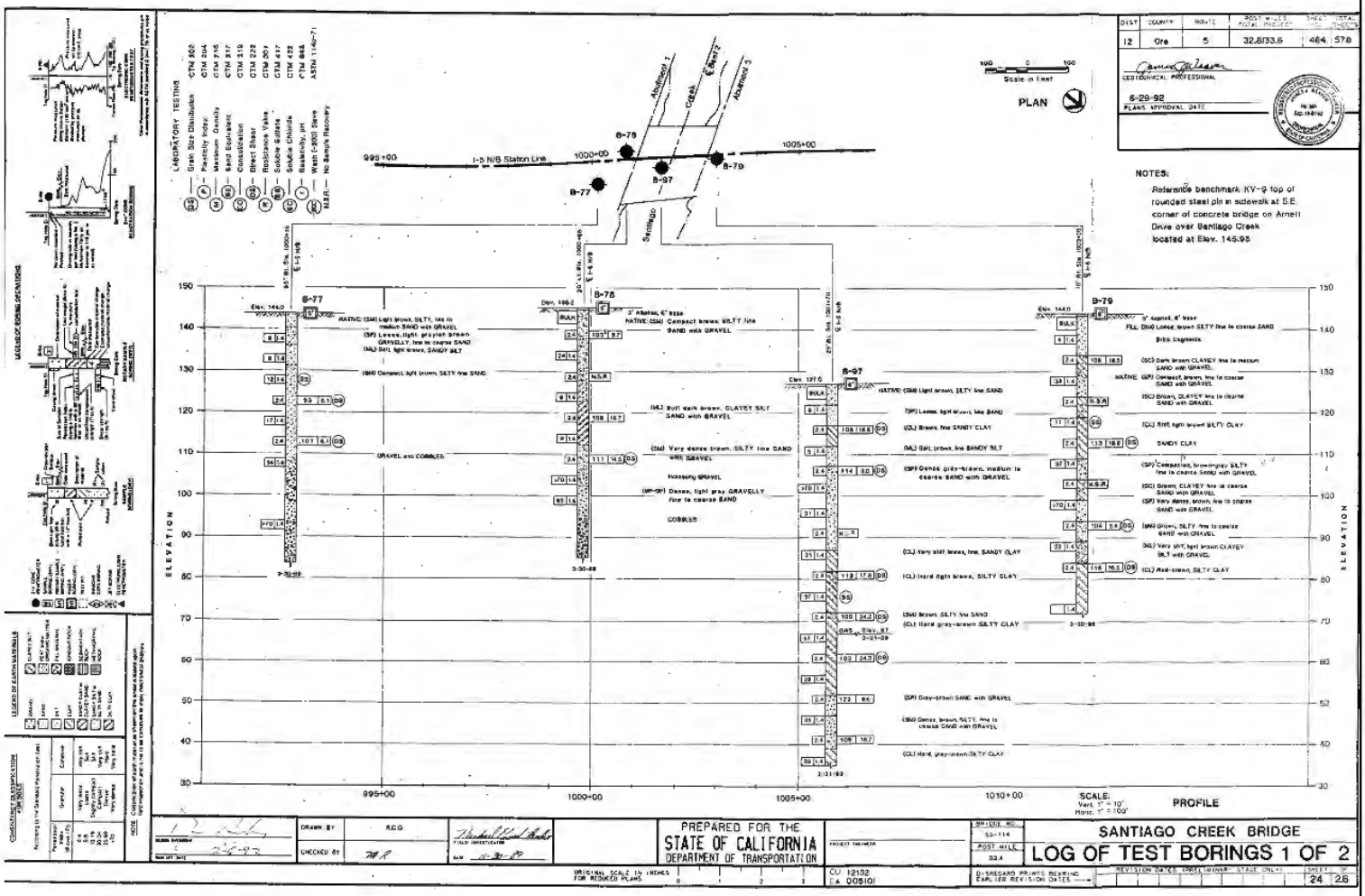


Figure 40. Logs of test borings, sheet 1 (1989)

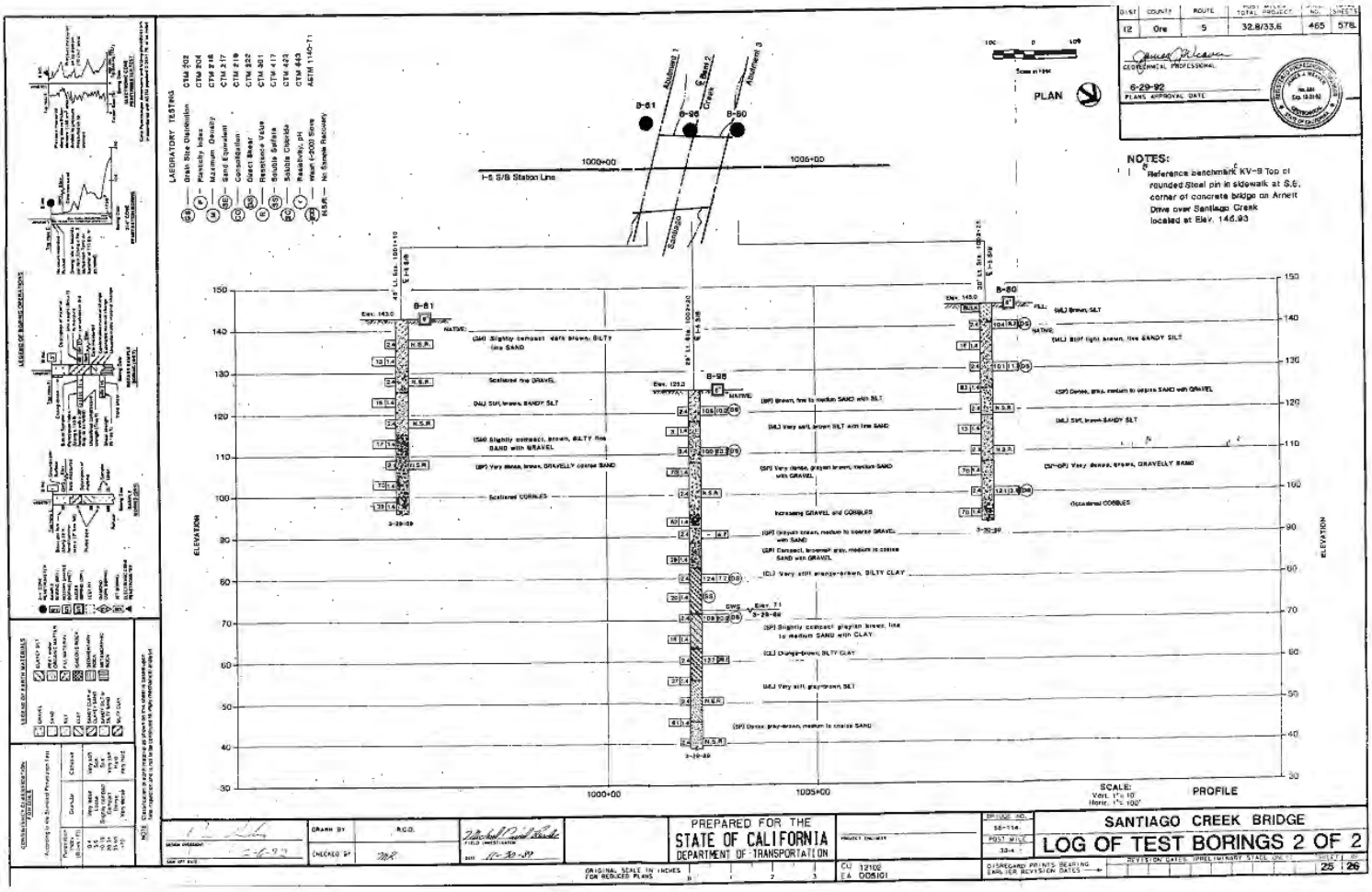


Figure 41. Logs of test borings, sheet 2 (1989)

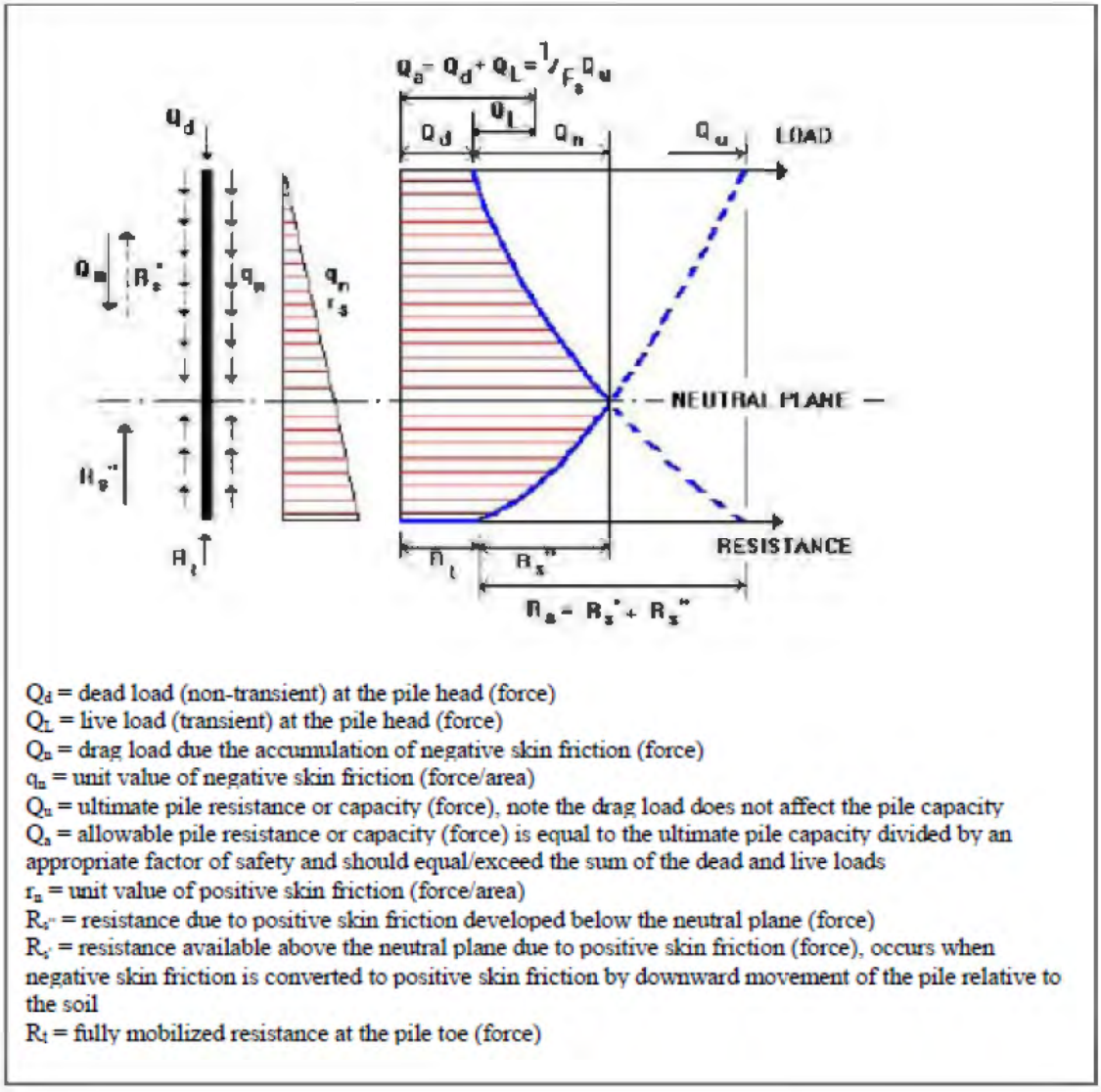
A foundation investigation was performed in 1989 for the I-5 Widening and Transitway Development Orange County, California (2015-02-18-1510534744_50900059). In 1989 there were three bridges at the proposed Santiago Creek Bridge area: Arnett Street Bridge, I-5 Bridge No. 55-114, and the Southern Pacific Railway Bridge. The I-5 bridge at that time was a two-span structure with one open and one closed abutment. It was 125 wide and 165 ft long. Since widening, the bridge is now approximately 310 feet wide. The railway bridge is no longer visible.

The investigation included design recommendations for scour, driven pile foundations, resistance to lateral loads, pile spacing and clearance, seismic criteria, liquefaction, and corrosion. Seven (7) borings were drilled in March 1989 to depths ranging between 47 and91.5 ft. The foundation report recommended that driven piles be installed to support 45-70 tons/pile in accordance with CALTRANS Standard Plans. The design concluded the coincidence of high water with an earthquake was low and therefore the probability of liquefaction was low. The design indicates that there are deep piles adjacent to the proposed shallow piles that could lose frictional resistance due to pile driving. Also, because the soluble sulfate concentrations were less than 2,000 ppm, corrosivity was not expected to be of concern and no special cement was recommended.

Based on a review of pile quantity and driving records for Santiago Creek Bridge No. 55-114 (Stage III, year 1992) showing the piles driven to nominally 20, 25, 27, 28, 30 ft, 34, . 25 blows per foot were required using a 6 ft stroke and a Delmag D30-32 E = 39,690 ft-lb hammer. Notes were provided such as “72 blows/in” for Pile number 17 at 27.5 ft. (2015-02-18-1510534744_50900060). Additionally, a Delmag model 16-32 hammer was used with an energy of 40,200 ft-lbs with a required blow/ft at required bearing of 26.

Records were included that show the count of the blows and the piles meeting the required 26 blows per foot. Some piles hit “hard” driving such as #83 which records 45-56 blows per foot from 25-34 feet. #62 records 70-90 blows per foot from 29-33 ft.

The concern for the I-5 bridge is the potential of downdrag due to settlement of fill placed adjacent to the structure. The method recommended to analyze downdrag is provided in the Hurricane And Storm Damage Risk Reduction System Design Guidelines (HSDRRS Interim, June 2012).



Q_d = dead load (non-transient) at the pile head (force)
Q_L = live load (transient) at the pile head (force)
Q_n = drag load due the accumulation of negative skin friction (force)
q_n = unit value of negative skin friction (force/area)
Q_u = ultimate pile resistance or capacity (force), note the drag load does not affect the pile capacity
Q_a = allowable pile resistance or capacity (force) is equal to the ultimate pile capacity divided by an appropriate factor of safety and should equal/exceed the sum of the dead and live loads
r_s = unit value of positive skin friction (force/area)
R_s^- = resistance due to positive skin friction developed below the neutral plane (force)
R_s^+ = resistance available above the neutral plane due to positive skin friction (force), occurs when negative skin friction is converted to positive skin friction by downward movement of the pile relative to the soil
R_t = fully mobilized resistance at the pile toe (force)

Figure 42. Downdrag analysis method (HSDRRS, 2012)

11.3 Reservoir

11.3.1 Settlement

There is some fill proposed in the Smith Basin as shown in Figure 43. Settlement was not evaluated as part of this analysis but should be evaluated during detailed design. Settlement is expected to be in the range of that was evaluated in the Channel area at Station 74+00.

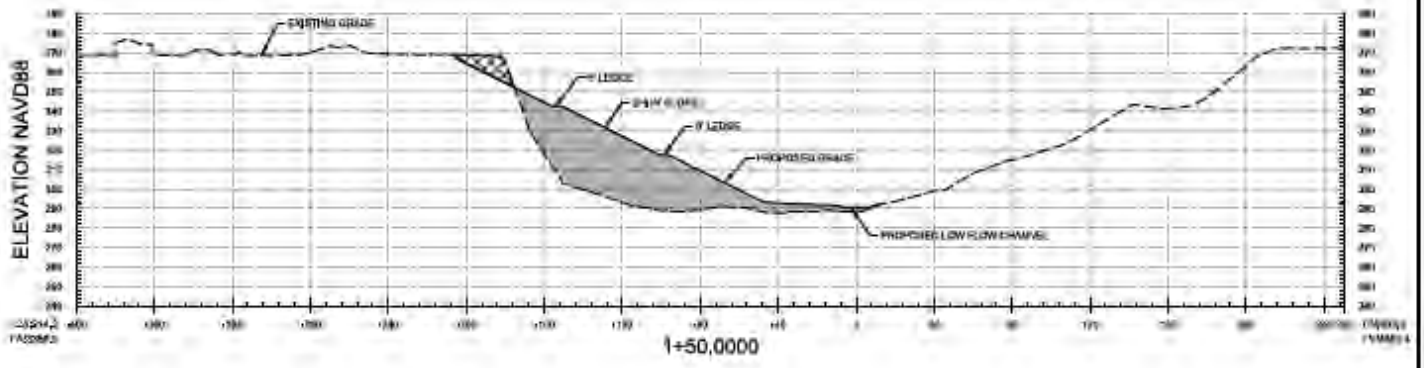


Figure 43. Smith Basin area fill

11.3.2 Cut/Fill Analysis

See Cut/Fill Analysis located in Attachment C-6 and summarized in Figure 44. For all but line F (as shown in Figure XX) there is a cost savings using fill rather than walls. Though there may be some cost savings by cutting into the existing access road in the Smith Basin, this will require re-installing wells in that area, which may offset the benefits and may also entail coordination with other agencies. There is generally cost savings when filling as opposed to pursuing the DM18 option as shown in Figure 44.

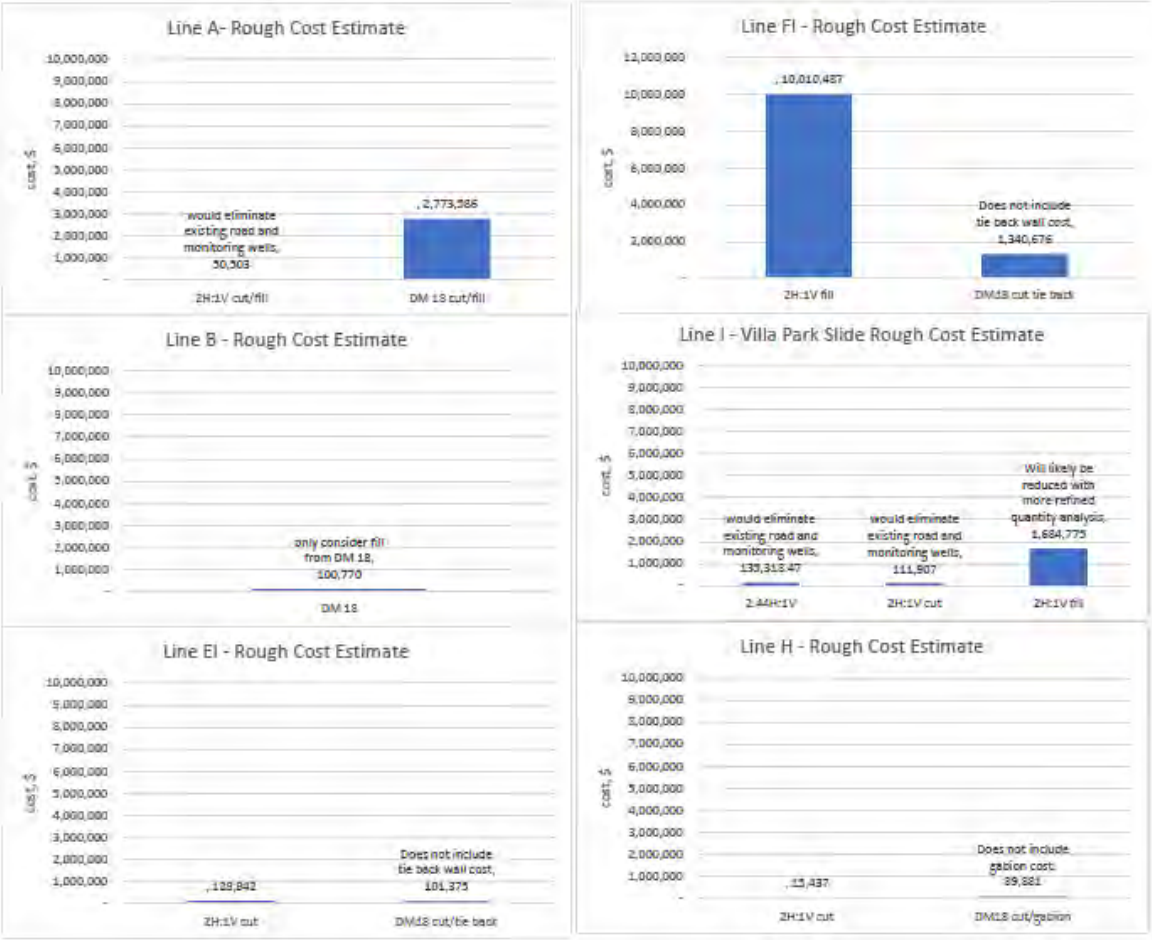


Figure 44. Cost Savings when filling as opposed to pursuing the DM18 option

11.3.3 Slope Failure

11.3.3.1 Rationale for present slope stability

The slopes in Santiago Creek reservoir vary between very flat (4H:1V) at the bottom of some of the slopes to very steep (0.8H:1V) near the top of some of the slopes. One possible reason for this is negative pore water pressure. This was studied extensively in the 65% DDR. The purpose of those analyses was not to say that these slopes were stable but to answer the question, how are they presently standing.

In Irwindale tests were performed (Coduto et al, 24 Dec 2003) showing that 50-degree slopes can be stable. This may be the case on a dry day. For the slopes to be stable, soil friction angles should exceed 50 degrees and cohesion must be added. Neither of these parameters are supported by the soil investigations or the laboratory testing. However, if one considers the effect of capillarity and negative pore water pressure factors of safety exceeding unity (one) can be computed for all the slopes.

Using negative pore pressures is not recommended for design. There is nothing in USACE guidance that permits use of negative pore water pressure to justify slope stability analyses. Negative pore water pressure is discussed in EM 1110-2-1902. However, it is acknowledged that this extra stress, which increases the effective confining stress on the soil, cannot be relied upon once water is introduced. And though southern California is known to be very dry, it is not always the case. Water is part of the design. The reservoir is designed to hold more water than at present to assist with groundwater infiltration. Water is expected to be held longer and higher than presently.

Additionally, though this is less likely, there may be water infiltration from the surface. This has been demonstrated most notably by two large washout areas where surface water was allowed to drain into the basin. One location is at the corner of Bond and Hewes where a water pipe broke. The other location in the southwest corner of the Smith Basin. However, it may be possible that perched groundwater may flow through the soil and down the slopes during particularly wet periods. This can be modeled using unsaturated functions such as a soil-moisture retention curve, expected precipitation patterns, and unsaturated permeability relationship. However, the values for these functions are highly uncertain. And the soils at the reservoir are highly variable.

11.3.3.2 Global stability

For global stability, parameters for granular materials were chosen based on the Sep-Oct 2021 geotechnical investigation as described above. Short-term cohesive soil strengths are assigned specific to each section and were chosen based on field pocket penetrometer tests. Long-term clay strengths were chosen to be 30 degrees.

11.3.3.3 Rapid Drawdown

Consolidated undrained tests were performed for selected samples at TH20-15 (20'-30'), TH20-19 (40'-43'), TH20-22 (30'-40'), amd TH20-24 (60'-70') obtained from the reservoir area. Parameters used for clayey gravels and silty gravels are shown in Figure 45. Parameters used for silty sands and clayey sands are shown in Figure 46. For both the silty sand and the clayey sand there were some anomalous results. For the silty and clayey gravel encountered within boring TH20-15 at 20-30 ft had both total and effective stresses that were significantly lower than the other two tests. For the silty and clayey sand encountered within boring TH20-19 at 40-43 ft had two tests with significantly lower total and effective strengths. Because of the method of constructing the samples via Proctor tests there is some possibility of sample disturbance which could account for these lower strengths. The other tests are more in line with expected strengths. Therefore, the lower tests are treated as anomalous. Data for these analyses can be found in Attachment C-2

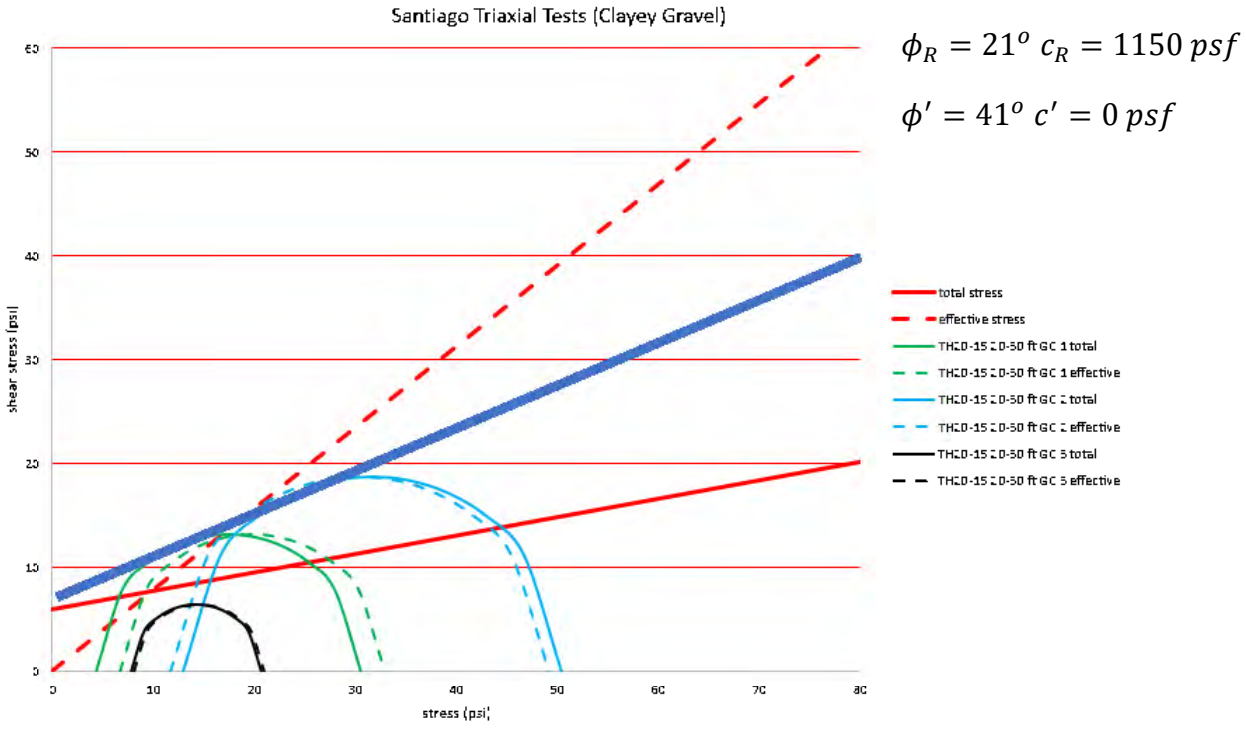


Figure 45. Parameters used for silty and clayey gravel in the reservoir area

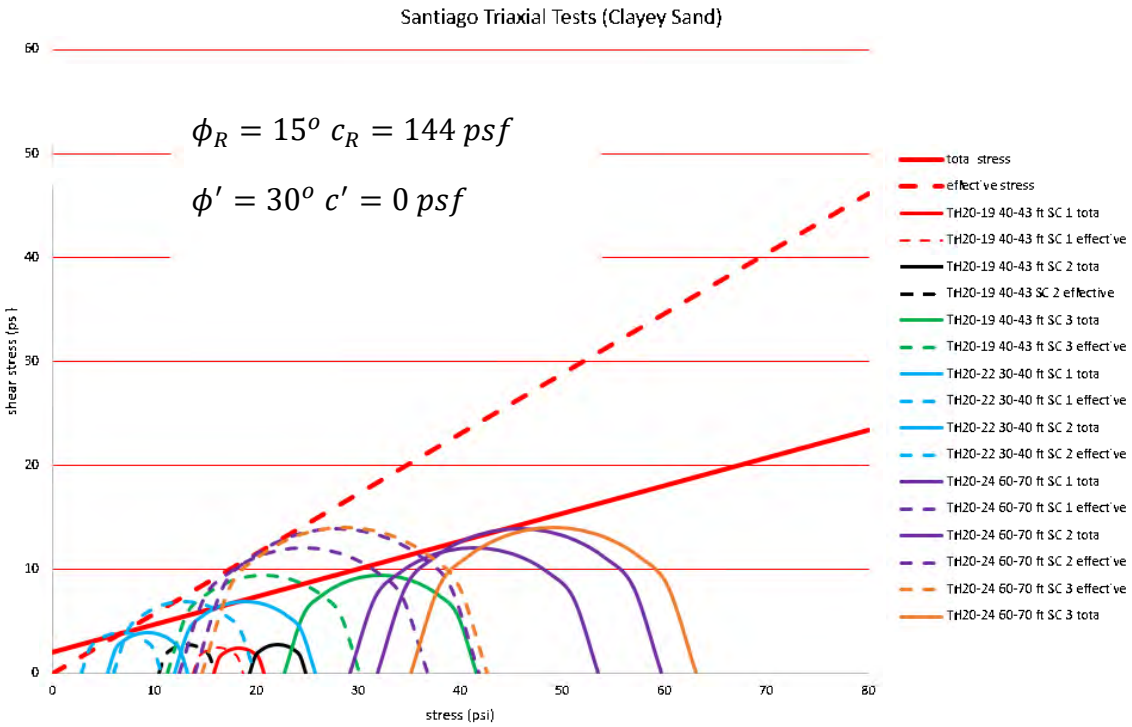


Figure 46. Parameters used for silty and clayey sand in the reservoir

11.4 Global Slope Stability Analyses

Soils were analyzed for global stability for short, long-term, seismic (pseudo-static), and rapid drawdown. The input parameters and loadings are described above. The locations of these stability analyses are shown in Figure 47.



Figure 47. Lines analyzed for global stability

11.4.1 Acceptable Factors of Safety – USACE Guidance

USACE does not have guidance for minimum required factors of safety for reservoirs. Therefore, the most applicable guidance is taken to be that developed for earth and rock-fill dams as shown in

Table 15. The rationale for using this guidance is that that slope failure could lead to life loss for those on top of the slope should a slope failure occur.

Table 15. Minimum required factors of safety for new earth and rock-fill dams (EM 1110-2-1902)

Table 3-1
Minimum Required Factors of Safety: New Earth and Rock-Fill Dams

Analysis Condition[1]	Required Minimum Factor of Safety	Slope
End-of-Construction (including staged construction)[2]	1.3	Upstream and Downstream
Long-term (Steady seepage, maximum storage pool, spillway crest or top of gates)	1.5	Downstream
Maximum surcharge pool[3]	1.4	Downstream
Rapid drawdown	1.1-1.3[4,5]	Upstream

[1] For earthquake loading, see ER 1110-2-1806 for guidance. An Engineer Circular, "Dynamic Analysis of Embankment Dams," is still in preparation.

[2] For embankments over 50 feet high on soft foundations and for embankments that will be subjected to pool loading during construction, a higher minimum end-of-construction factor of safety may be appropriate.

[3] Pool thrust from maximum surcharge level. Pore pressures are usually taken as those developed under steady-state seepage at maximum storage pool. However, for pervious foundations with no positive cutoff steady-state seepage may develop under maximum surcharge pool.

[4] Factor of safety (FS) to be used with improved method of analysis described in Appendix G.

[5] FS = 1.1 applies to drawdown from maximum surcharge pool; FS = 1.3 applies to drawdown from maximum storage pool.

For dams used in pump storage schemes or similar applications where rapid drawdown is a routine operating condition, higher factors of safety, e.g., 1.4-1.5, are appropriate. If consequences of an upstream failure are great, such as blockage of the outlet works resulting in a potential catastrophic failure, higher factors of safety should be considered.

11.4.2 Water Level Analyses

Water levels in the Bond and Diamond pits were provided by Orange County and are plotted in Figure 48. From this figure typical high and low water levels can be determined for global stability analyses based on present operations. Additionally, the potential for rapid drawdown failure can be evaluated by examining the typical rates of water change in the reservoir. As shown in, the change in water elevation is generally -0.8 to +1.4 ft/day. Rates of -3 to +0.8 ft/day can be seen. Decreases of more than 3 ft per day are very rare but possible. However, drawdown rates are expected to be 20 ft/day when the outlet structure is installed.

Given that the drawdown rates analyzed were for existing conditions, it was decided that a rapid drawdown rate of 24 feet per day was still applicable, given its existence in the recording period at the Bond and Diamond Pits.

For Rapid Drawdown Conditions, an initial height of 295.5 was chosen, corresponding to the High Pool during the dry season (as referenced in section 2.3.1 of Appendix D – Hydraulics)

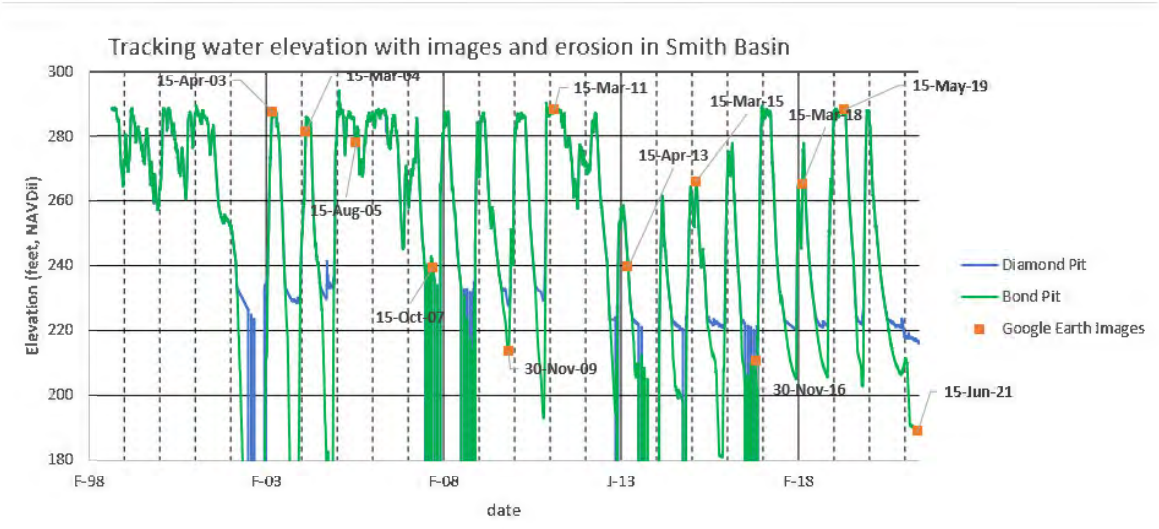


Figure 48. Water levels in the Bond and Diamond pits (Orange County)

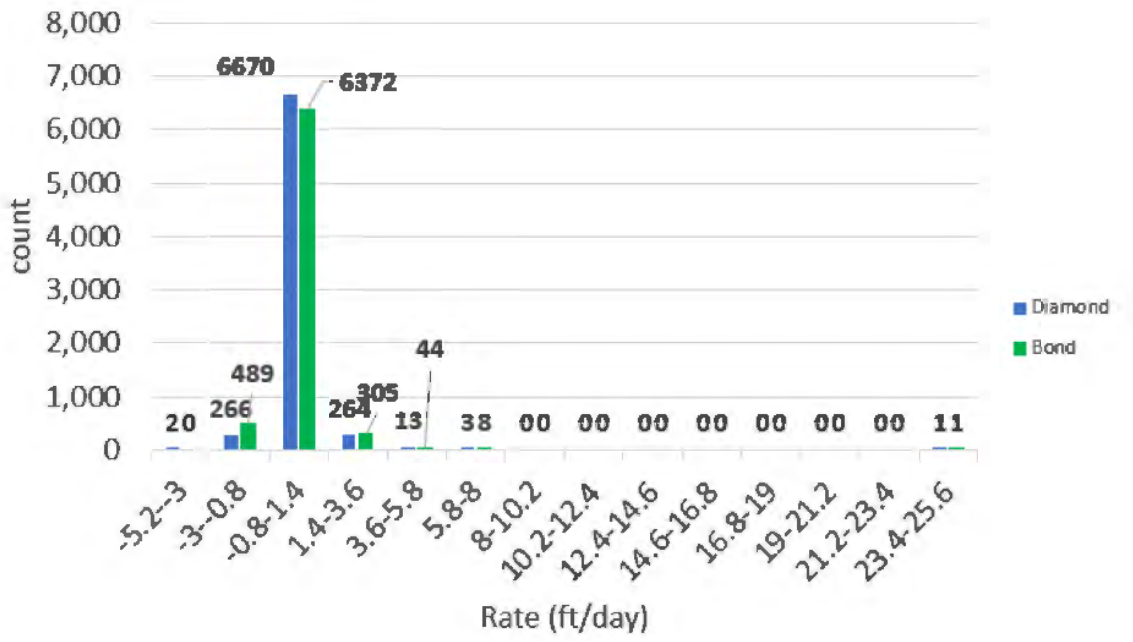


Figure 49. Analysis of water level changes in the Bond and Diamond pits showing high rates of water drawdown

The 100 YR (0.01 ACE) design water levels in NAVD 88 are as follows:

Existing

- Smith 304.0’
- Blue Diamond 300.7’
- Bond 300.7’

With Reservoir Improvements

- Smith 300.6’
- Blue Diamond 298.3’
- Bond 298.3’

11.4.3 History of Consideration of Rapid Drawdown in the Reservoir Area

The previous USACE analyses (DM18) did not consider long and short-term properties of the soil, but rather only long-term drained properties. However, some of the gravels contain large amounts of clays that will make them have both short and long-term strength and make them susceptible to rapid drawdown as seen during the Sep-Oct 2021 geotechnical investigation. Rapid drawdown was identified as a critical issue by the Group Delta (1996) report. They report a factor of safety of 1.05 for rapid drawdown. However, the Group Delta report does not provide the analysis and input parameters. Slopes analyzed in this analysis for rapid drawdown are shown in Figure 47. Details regarding these analyses are provided in Attachment C-7.

11.4.4 Applicability of Soils in Reservoir Area to Rapid Drawdown

The rate of drawdown from past operations varies and is generally slow (on the order of 1 ft per day) and may be as much as 3-5 ft per day at times. However, during the proposed operations, the drawdown may be up to 20 ft/day. The response of the soil to such an event is unknown. There are layers of clean gravel but also many layers containing fines. How these fines drain is unknown. In addition to the low factor of safety against rapid drawdown computed by Group Delta, there have been two large slope failures in the Smith Basin. The failures in the Smith Basin may be due to erosion of the toe of the slope by streamflow. Or these failures may be due to rapid drawdown. If filling to flatten the slope is performed, it is assumed that the worst case, sands with appreciable fines (SM, SC, SP-SM, SP-SC) will be used based on the prevalence of these soils found during the Sep-Oct 2021 geotechnical investigation. Soils with appreciable fines are most susceptible to rapid drawdown. The soil parameters for rapid drawdown are shown above. As a result of these considerations, the conservative approach is to assume rapid drawdown is applicable.

11.4.5 Applicable Factor of Safety for Rapid Drawdown

Though USACE guidance accepts a factor of safety for rapid drawdown of 1.1 for maximum surcharge pool, which varies in the reservoir from 298 – 304 NAVD88 depending on the reservoir and the pool. The storage pool could also be at similar levels. Therefore, a factor of safety of 1.3 could be applicable, which applies to water at the storage pool based on EM 1110-2-1902. However, since the pool is now being designed as a passive reservoir, it is reasonable to keep the applicable factor of safety to 1.1, the guidance for the maximum pool surcharge.

Table 16. Summary of analyses performed for each line (section) and corresponding required factor of safety

Analysis number	Period	Water	Required Factor of Safety
1a	Short	High	1.4
1b	Short	Low	1.3
2a	Long	High	RA
2b	Long	Low	1.5
3a	Rapid	Drawdown	1.1
4a	Pseudostatic	High	RA
4b	Pseudostatic	Low	1

11.5 Reservoir Global Slope Stability Results

A summary of the global slope stability results for the proposed slopes are shown in

Table 17. The individual analyses are in Attachment C-7. Though the analyses generally show slopes meeting the required criteria, lines F and G fall below a factor of safety of one (1) for pseudo-static condition. Therefore, a site-specific analysis may be necessary. Failure of lines F or G would possibly result in failure of the adjacent roadways of Hewes and Bond, respectively into the Bond Reservoir.

Line H does not meet the long-term slope stability factor of safety of 1.5 for high or low water. However, given the relatively low consequences of the modeled slides in for line H, the additional cost of flattening this slope may not be justified and may be better addressed through long-term maintenance should this be required.

Table 17. Summary of Global Slope Stability Analyses for the Proposed Design

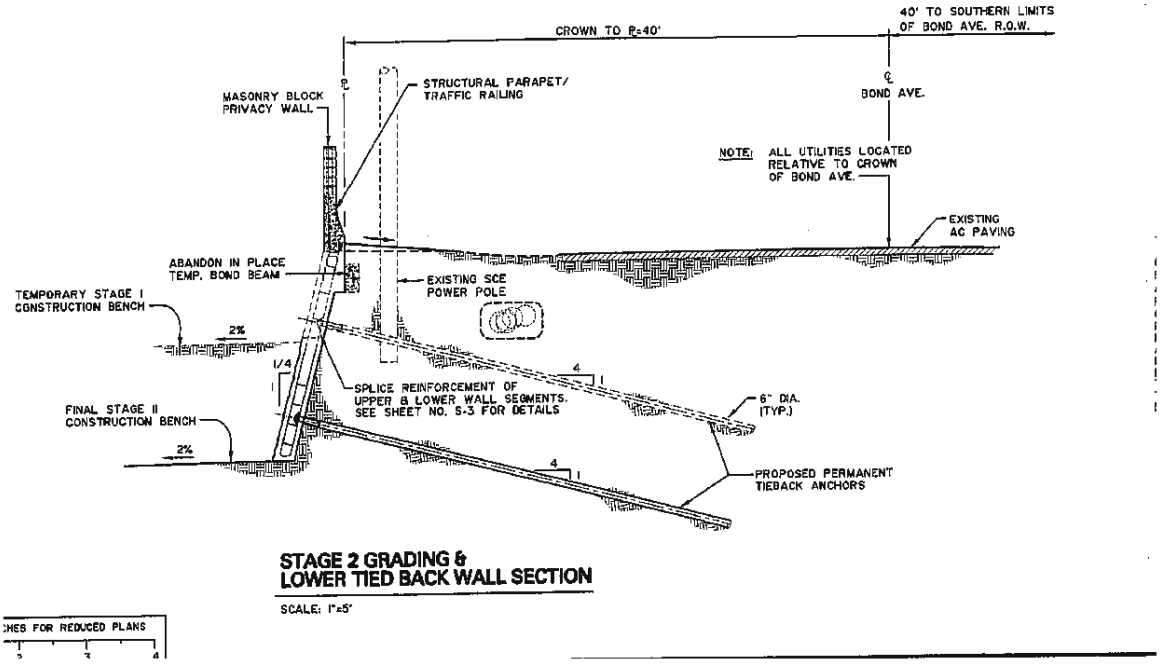
Line	Short-term		Long-term		Rapid Drawdown		Pseudo Static	
	High Water	Low Water	High Water	Low Water	High Water	Low Water	High Water	Low Water
	1a	1b	2a	2b	3a	3b	4a	4b
A	2.046	2.305	2.066	2.311	1.102	1.199	1.023	1.057
B	Grade – slope very similar to present							
C	Incidental to project – slope for erosion protection							
D	Completed by OCWD							
E	2.110	2.122	1.892	1.727	1.546		1.105	1.140
F	2.070	2.011	1.999	2.022	1.381	1.471	0.876	0.773
G	1.665	1.521	1.651	1.513	1.30		0.791	0.810
H	1.647	1.446	1.492	1.369	1.205		0.964	1.134
I	1.983	1.872	2.013	2.133	1.300		0.950	1.146

A summary of proposed slope modifications is shown in Table 18 below.

Table 18. Summary of Santiago Creek Slope Modifications

Line	Required slope	Basin	Type of Adjustment	Notes
A	2.5H:1V	Smith	Fill from existing road	Sandy/silty clays at the bottom of the reservoir require flatter slope
B	2H:1V	Smith	Small amount of grading/fill	No past slope stability issues noted. No investigation at this location.
I	2H:1V	Smith	Fill from existing road	More gravels at the base of the slope allows for a flatter slope than Line A.
E	2H:1V	Diamond near saddle area	Cut existing slope	
F	2H:1V + tie back wall	Bond	Use DM18 plan as the basis for tie back and grading	
G	2H:1V + tie back wall	Bond	No change – keep existing design	Completed by OCWD
H	2H:1V	Bond	Small amount of cut at the top of the slope	Minor grading

11.6 Anchor Design



Anchorage is proposed for line F. The anchor design follows guidance of Sabatini et al, 1999 and PTI (2006). An average ultimate bond stress of 0.795 MPa (795 kPa or about 15,900 psf) was used for sandy gravel, medium dense to dense as shown in Table 19. Based on the Group Delta analysis, this analysis assumes an anchor spacing both vertically and horizontally of 1.5 m (5 ft) and a bonded length of 65 ft and an unbonded length of 15 ft, respectively. For the purpose of this analysis the anchor bar was assumed to have a yield strength of 150 ksi steel and a 2-1/2 in diameter bar was assumed (

Table 20). For the slope stability analysis, the factored tensile capacity of the anchor bar is input as 0.8 fpu*Aps of 622.4 kips. For shearing resistance, it is assumed that the 2-1/2 in diameter bars with 150 ksi steel and a reduction factor of 0.8 have a corresponding shear resistance of 4,090 lbs.

For slope stability the "factor of safety dependent" mode is chosen. Therefore, the resistance is reduced by dividing by the global factor of safety. In addition, as a measure of conservativism given the various unknown in the installation and grouting process, the pullout, tensile, and shear force are all reduced by a factor of 1.5.

Table 19. Presumptive average ultimate bond stress for ground/grout interface along anchor bond zone (Sabatini et al., 1999 after PTI, 1996)

Table 7. Presumptive average ultimate bond stress for ground/grout interface along anchor bond zone (after PTI, 1996).

Rock		Cohesive Soil		Cohesionless Soil	
Rock type	Average ultimate bond stress (MPa)	Anchor type	Average ultimate bond stress (MPa)	Anchor type	Average ultimate bond stress (MPa)
Granite and basalt	1.7 - 3.1	Gravity-grouted anchors (straight shaft)	0.03 - 0.07	Gravity-grouted anchors (straight shaft)	0.07 - 0.14
Dolomitic limestone	1.4 - 2.1	Pressure-grouted anchors (straight shaft)		Pressure-grouted anchors (straight shaft)	
Soft limestone	1.0 - 1.4	• Soft silty clay	0.03 - 0.07	• Fine-med. sand, med. dense – dense	0.08 - 0.38
Slates and hard shales	0.8 - 1.4	• Silty clay	0.03 - 0.07	• Med.–coarse sand (w/gravel), med. dense	0.11 - 0.66
Soft shales	0.2 - 0.8	• Stiff clay, med. to high plasticity	0.03 - 0.10	• Med.–coarse sand (w/gravel), dense - very dense	0.25 - 0.97
Sandstones	0.8 - 1.7	• Very stiff clay, med. to high plasticity	0.07 - 0.17	• Silty sands	0.17 - 0.41
Weathered Sandstones	0.7 - 0.8	• Stiff clay, med. plasticity	0.10 - 0.25	• Dense glacial till	0.30 - 0.52
Chalk	0.2 - 1.1	• Very stiff clay, med. plasticity	0.14 - 0.35	• Sandy gravel, med. dense-dense	0.21 - 1.38
Weathered Marl	0.15 - 0.25	• Very stiff sandy silt, med. plasticity	0.28 - 0.38	• Sandy gravel, dense-very dense	0.28 - 1.38
Concrete	1.4 - 2.8				

Note: Actual values for pressure-grouted anchors depend on the ability to develop pressures in each soil type.

Table 20. Properties of prestressing steel bars (Sabatini et al., 1999 after ASTM A722)

Steel grade	Nominal diameter	Ultimate stress f_{pu}	Nominal cross section area A_{ps}	Ultimate strength $f_{pu} A_{ps}$	Prestressing force		
					0.8 $f_{pu} A_{ps}$	0.7 $f_{pu} A_{ps}$	0.6 $f_{pu} A_{ps}$
(ksi)	(in.)	(ksi)	($in.^2$)	(kips)	(kips)	(kips)	(kips)
150	1	150	0.85	127.5	102.0	89.3	76.5
	1-1/4	150	1.25	187.5	150.0	131.3	112.5
	1-3/8	150	1.58	237.0	189.6	165.9	142.2
	1-3/4	150	2.66	400.0	320.0	280.0	240.0
	2-1/2	150	5.19	778.0	622.4	435.7	466.8
160	1	160	0.85	136.0	108.8	95.2	81.6
	1-1/4	160	1.25	200.0	160.0	140.0	120.0
	1-3/8	160	1.58	252.8	202.3	177.0	151.7
(ksi)	(mm)	(N/mm^2)	(mm^2)	(kN)	(kN)	(kN)	(kN)
150	26	1035	548	568	454	398	341
	32	1035	806	835	668	585	501
	36	1035	1019	1055	844	739	633
	45	1035	1716	1779	1423	1246	1068
	64	1035	3348	3461	2769	2423	2077
160	26	1104	548	605	484	424	363
	32	1104	806	890	712	623	534
	36	1104	1019	1125	900	788	675

11.7 Bike Trail Tunnel Regrading

The PDT has discussed re-grading bike path slope approximately 100-ft adjacent to the tunnel due to a low-point that was discovered by the H&H team. The low point may create some flooding concerns under existing and current and proposed conditions. Temporary flood fighting measures (i.e. sandbagging) was also explored to minimize the flooding issues that the low-point elevation could cause.

For the purposes of the stability check at the re-graded portion of the bike trail path, crest and slope design were assumed to be 5-ft and 2.5H:1V, respectively. Soil stratigraphy at the bike trail tunnel area consists of sandy clay with gravel and cobbles to sandy gravel from elevations 302.5 feet to 295.0 feet. Regrading location, and nearby borings taken from the as-builts are shown in the following Figures next page.

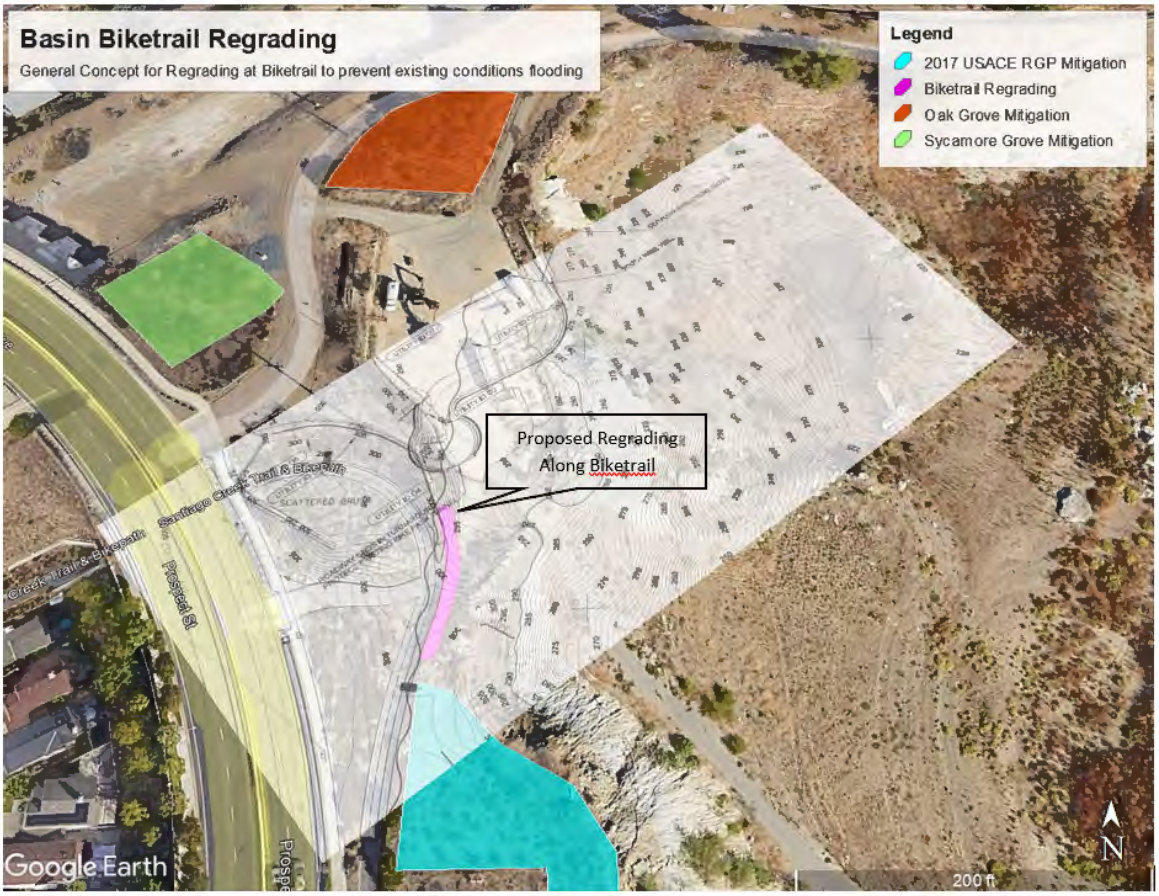
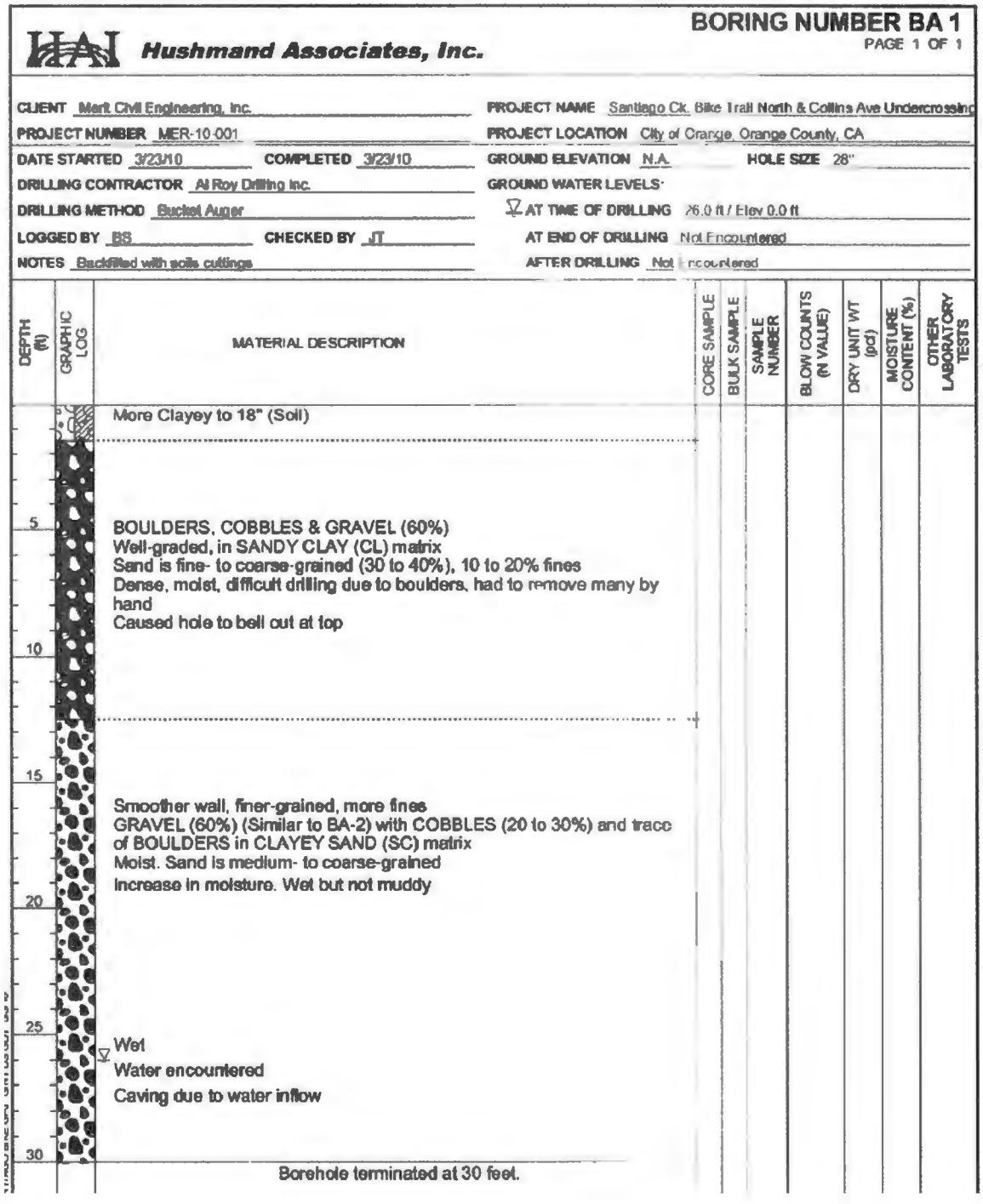


Figure 50. Proposed Re-grading Along Bike Trail



Figure 51. Locations of Existing Borings (2010, as-builts)



HAI Hushmand Associates, Inc.

BORING NUMBER BA 1
PAGE 1 OF 1

CLIENT Merit Civil Engineering, Inc.
PROJECT NAME Santiago Ck. Bike Trail North & Collins Ave Undercrossing
PROJECT NUMBER MER-10-001
PROJECT LOCATION City of Orange, Orange County, CA
DATE STARTED 3/23/10 COMPLETED 3/23/10
GROUND ELEVATION N.A. HOLE SIZE 28"
DRILLING CONTRACTOR Al Roy Drilling Inc.
GROUND WATER LEVELS:
DRILLING METHOD Bucket Auger
AT TIME OF DRILLING 26.0 ft / Elev 0.0 ft
LOGGED BY BS CHECKED BY JT
AT END OF DRILLING Not Encountered
NOTES Backfilled with soils cuttings
AFTER DRILLING Not Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	CORE SAMPLE	BULK SAMPLE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT (pcf)	MOISTURE CONTENT (%)	OTHER LABORATORY TESTS
		More Clayey to 18" (Soil)							
5		BOULDERS, COBBLES & GRAVEL (60%) Well-graded, in SANDY CLAY (CL) matrix Sand is fine- to coarse-grained (30 to 40%), 10 to 20% fines Dense, moist, difficult drilling due to boulders, had to remove many by hand Caused hole to bell out at top							
10									
15		Smoother wall, finer-grained, more fines GRAVEL (60%) (Similar to BA-2) with COBBLES (20 to 30%) and trace of BOULDERS in CLAYEY SAND (SC) matrix Moist. Sand is medium- to coarse-grained Increase in moisture. Wet but not muddy							
20									
25		Wet Water encountered Caving due to water inflow							
30		Borehole terminated at 30 feet.							

Figure 52. Closest existing boring to Bike Trail Regrading area (from as-builts)

The slope stability analysis was performed using the soil parameters from the closest boring (see Figure 51) and using the slope stability procedures outlined in EM 1110-2-1902. The stability analyses were evaluated using an assumed surcharging of 250 psf at the bike path crest and based on overtopping elevation (approximately 302.5 feet) for rapid drawdown and using long-term conditions with estimated groundwater elevation below 295 feet.

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Concrete Path	Mohr-Coulomb	130	0	34
	Sandy Clay, Cobbles and Gravel	Mohr-Coulomb	118	0	32
	Sandy Gravel (GW)	Mohr-Coulomb	140	0	40

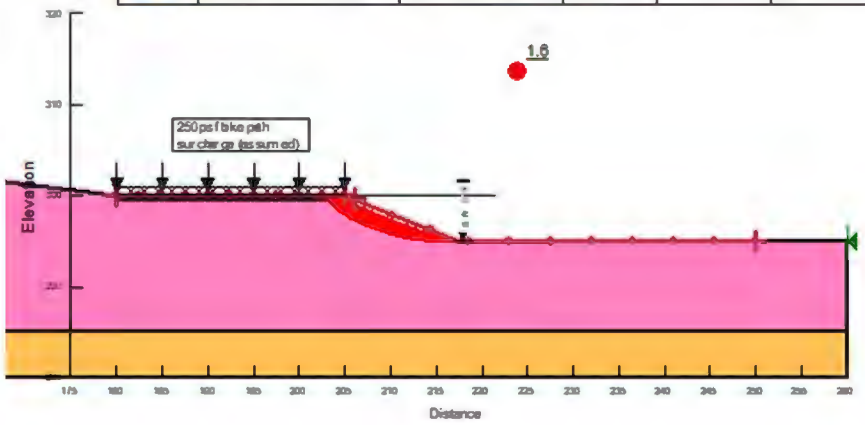


Figure 533. Long-term conditions (estimated groundwater below 295 feet)

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line	Piezometric Line After Drawdown
	Concrete Pab	Mohr Coulomb	130	0	34	0	0	1	2
	Sandy Clay,Cobbles and Gravel	Mohr Coulomb	118	0	32	25	30	1	2
	Sandy Gravel (GW)	Mohr Coulomb	140	0	40	100	37	1	2

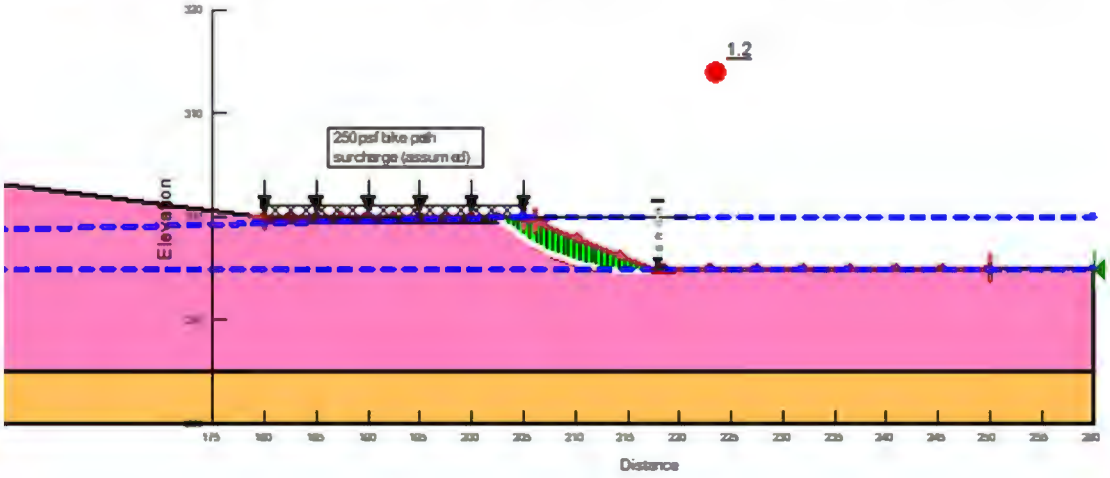


Figure 54. Rapid drawdown (assuming overtopping elevation at 302.5 feet)

Table 21. Summary of Stability Check at the Bike Trail Regrading

Bike Trail Boring Location	Long-term case; 2.5H:1V, 5-ft crest (FS min = 1.5)	Rapid Drawdown (FS min = 1.1)
BA-1	1.6	1.2

Based on Table 21, the factors of safety for the proposed geometry and soil conditions reach are all above the minimum safety factors required per EM 1110-2-1902.

11.8 Soil Nails

Soil nails were considered in place of anchors. Soil nails create a reinforced soil mass. Design guidance for soil nails can be found in Geotechnical Engineering Circular No. 7 (FHWA 2015). The process of soil nail walls is to excavate 3-5 ft, drill the nail hole, install the grout nail, place initial facing (shotcrete, reinforcement, bearing plate, washer, and hex nut), then proceed with subsequent levels. The process works well where the soil can sustain a cut of 3-5 ft without unraveling. Soil nail and anchors have similar costs although soil nails can be installed in some cases at a lower cost than anchors (FHWA, 2017). However, installation of soils nails may not be possible for Line F (see Figure 47), which is the only section were reinforcement is being considered. Line F contains well graded sands for the top 30 ft. The other sections evaluated to develop a stratigraphic pattern similarly have sands (SP, SW) near the tops of the slopes. Therefore, the boring used to construct Line F is typical. Based on review of the cross sections developed in the reservoir, deeper into the reservoir, the soils have larger amounts of fines that may be able to sustain open cuts. However, because the soil nails would be required near the top of the excavation where the clean sandy soils may not be able to stand up for 3-5 ft cuts. Therefore, soil nails are not recommended for this project.

11.9 Prospect Road Crossing

The recommended method to install culverts under Prospect Road is a cut and cover tunnel. A pedestrian tunnel constructed by the City of Orange required that the road be open to traffic by the end of the day (City of Orange, Trail, Title Sheet, General Note 18; 18 Aug 2010). However, the photos in Figures 58 through 60 indicate that the cut and cover tunnel was constructed approximately from 13 – 21 Sep 2011. It should be noted that the proposed culvert has an invert elevation of approximately 266 ft NAVD88. The pedestrian tunnel had an invert of 290.1 feet. Therefore, the excavation will be approximately 24 feet deeper than the pedestrian tunnel excavation. This excavation will likely prolong the road closure beyond the time of the pedestrian bridge construction. Therefore, there will likely be several weeks of road closure to permit construction of the prefabricated concrete culvert.



Figure 55. Construction of cut and cover of prefabricated culvert for pedestrian tunnel at Prospect (looking towards reservoir with joints sealed)



Figure 56. Construction of cut and cover of prefabricated culvert for pedestrian tunnel at Prospect (looking west with moisture wrap)



Figure 57. Construction of cut and cover of prefabricated culvert for pedestrian tunnel at Prospect (looking west with moisture barrier)



Figure 58. Construction of cut and cover of prefabricated culvert for pedestrian tunnel at Prospect (looking west)



Figure 59. Construction of cut and cover of prefabricated culvert for pedestrian tunnel at Prospect (looking west, backfilling)



Figure 60. Construction of cut and cover of prefabricated culvert for pedestrian tunnel at Prospect (looking towards reservoir and backfilled on sides)

Another method besides a pre-cast concrete tunnel would be a bolted plate, metal culvert. The traffic disruption will likely be less than a prefabricated concrete culvert because all the components could be brought in one mobilization. Should no traffic disruption be necessary, the liner plate method is a way to excavate, grout and install a tunnel under Prospect without closing the road. One vendor that provides this technology is Contec. At the Contec site it is possible to bring in an air photo, soil type, loading and required dimensions and they automatically generate drawings. However, as mentioned, the cut and cover prefabricated concrete culvert option will likely be most suited for this area.

There are several soil borings near the Prospect crossing as shown in Figure 61 and Figure 62. The soils in the culvert area are generally gravels and sands with some layers of clay.



Figure 61. Borings near Prospect (Collins) crossing

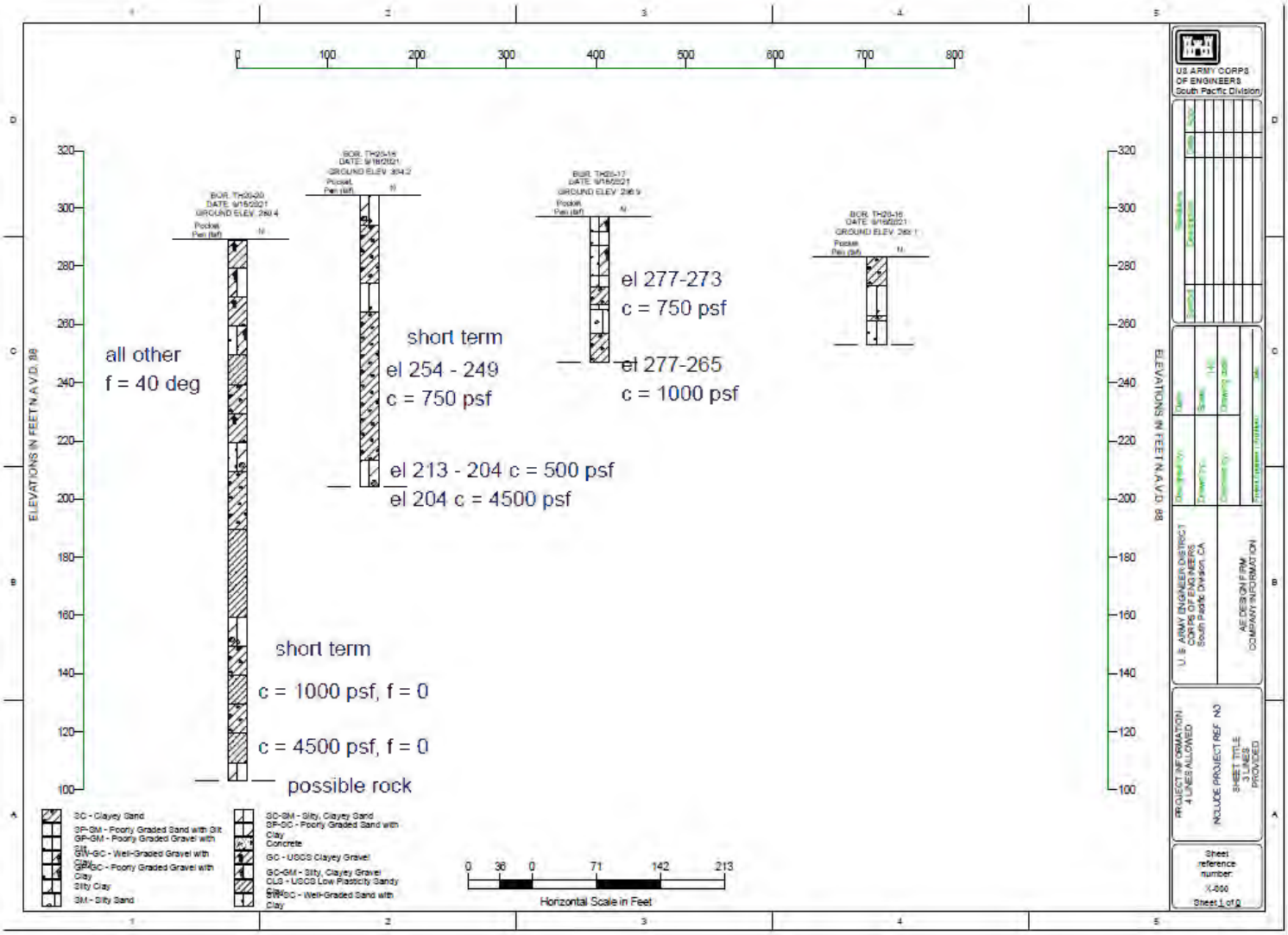


Figure 62. Borings in the vicinity of the Prospect (Collins) crossing (borings are from west (left) to east (right))

EM 385-1-1 provides guidance for temporary excavations. Base on soil types shown in Table 22 the soil at Prospect, which consists of dense sands and gravels with layers of clay may be classified as Soil type B. For soil type B a maximum slope for a temporary excavation is 1H:1V. However, the maximum height of this excavation is 20 ft. Therefore, a slope stability analysis is required. Assuming a friction angle (ϕ) of 38 degrees and a factor of safety of 1.3, a slope angle (α) which corresponds to a 1.7H:1V slope is possible. An infinite slope analysis as shown in the following:

$$\alpha = atan\left(\frac{tan\phi}{FS}\right) = atan\left(\frac{tan(38)}{1.3}\right) = 31^o$$

Table 22. Soil classification for temporary excavation (EM 385-1-1, 30 Nov 20140

EM 385-1-1
30 Nov 14

TABLE 25-1

Soil Classification

Soil Type	Criteria	Other Considerations
Stable Rock	Natural solid mineral that can be excavated with vertical sides and remain intact while exposed.	
Type A	Cohesive soil with an unconfined compressive strength of 1.5 tons per square foot (tsf) (144 kPa) or greater.	Can not be Type A if soil is: 1) fissured; 2) subject to vibration from heavy traffic, pile driving, etc.; 3) previously disturbed; 4) part of sloped, layered system where layers dip into excavation on a slope of 4H:1V or greater; or 5) subject to other factors requiring it to be classified as less stable material.
Type B	Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa).	Type B soil can also be: 1) granular cohesionless soils such as angular gravel, silt, silt loam, sandy loam, and in some cases, silty clay loam and sandy clay loam; 2) previously disturbed soils except those which would otherwise be classed as Type C soil; 3) soil that meets the requirements of Type A, but is fissured or subject to vibration; 4) dry rock that is not stable; or 5) part of sloped, layered system where layers dip into excavation on a slope of 4H:1V , but only if the soil would otherwise be classed as Type A.
Type C	Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less.	Type C soil can also be: 1) granular soils including gravel, sand, and loamy sand; 2) submerged soil or soil from which water is freely seeping; 3) submerged rock that is not stable; or 4) part of sloped, layered system where layers dip into excavation on a slope of 4H:1V or steeper. Can NOT be benched!

NOTE: Soil classification must be determined by a Competent Person, per Section 25.A.02

The south side of the excavation contains a pedestrian tunnel with an invert of 290 ft. Sloping back at 1.7H:1V as shown in Figure 63 results in a factor of safety of 1.563, which exceeds the minimum required for short-term of 1.3. However, steepening the slope to 1.4H:1V to remove sheetpile results in an unstable slope (FS<1.3) as shown in Figure 64. The slopes could be steepened to 1.5H:1V and would remain stable (FS>1.3) for both the slope and globally with sheetpile as shown in Figure 65 and Figure 66, provided sheetpile were added.

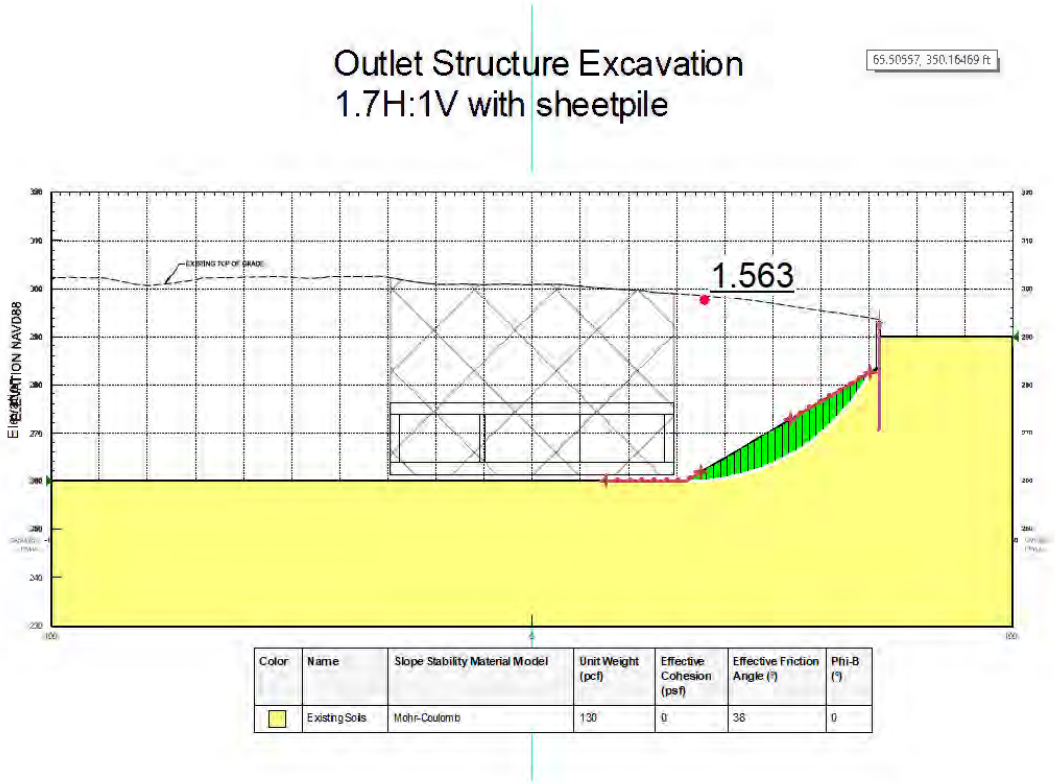


Figure 63. Temporary excavation with sheetpile and 1.7H:1V slope (FS>1.3)

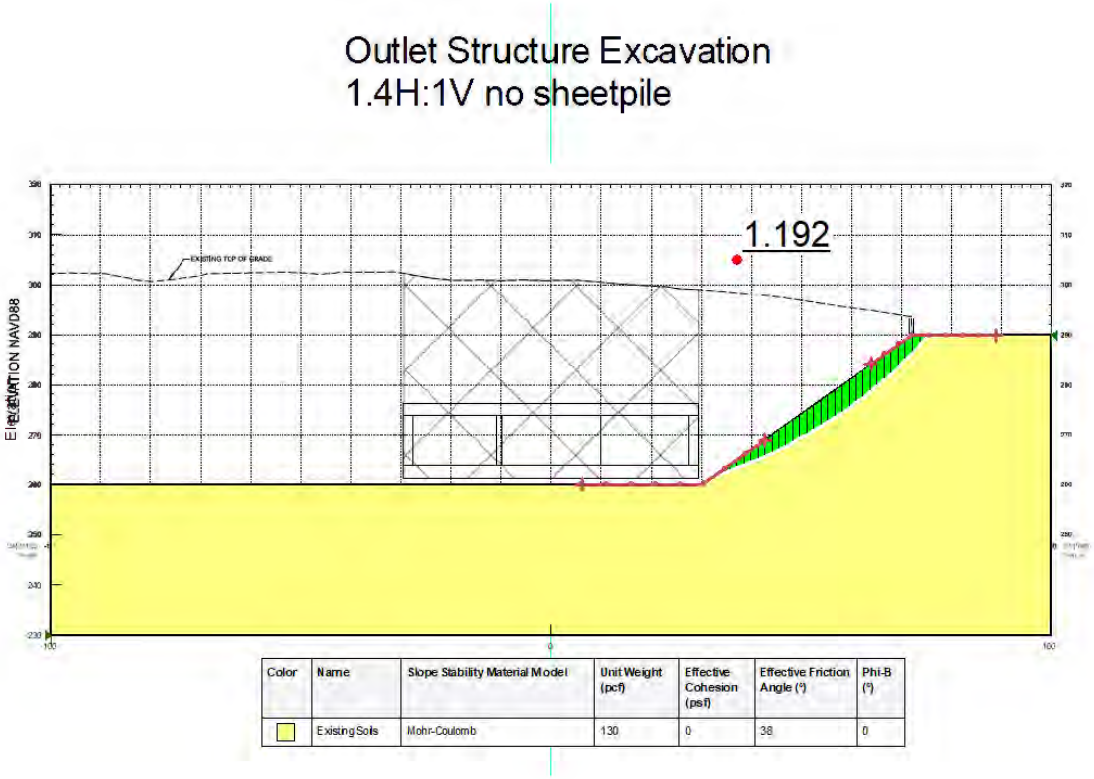


Figure 64. Temporary excavation without sheetpile and 1.4H:1V slope (FS<1.3)

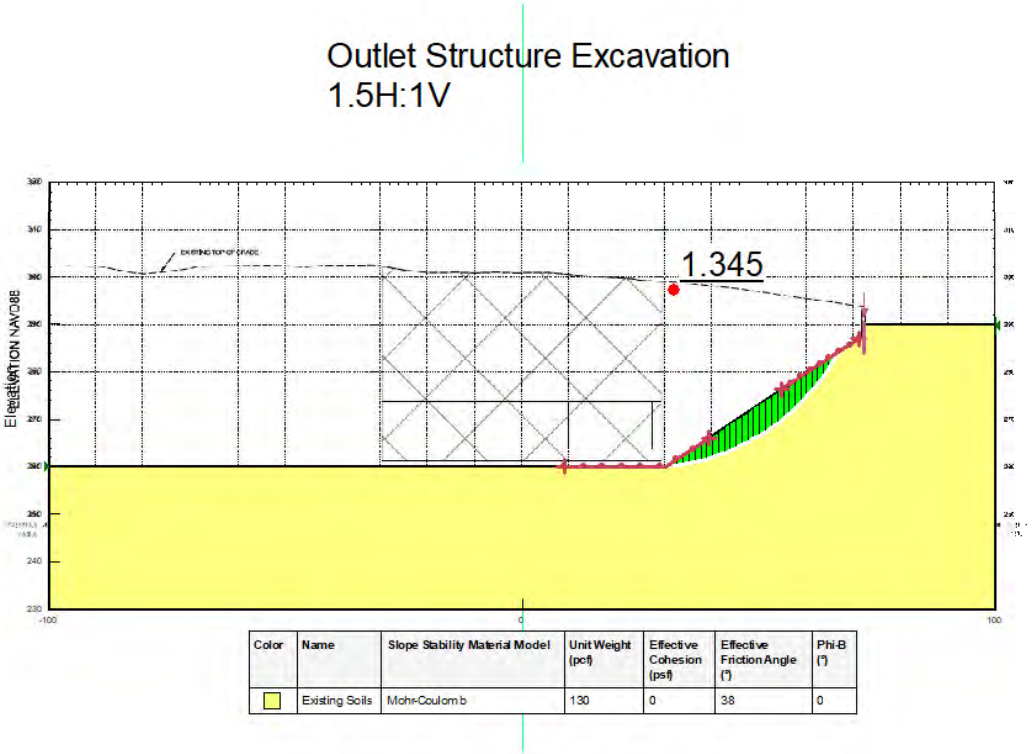


Figure 65. Temporary excavation with sheetpile and 1.5H:1V slope beneath the sheetpile (FS>1.3)

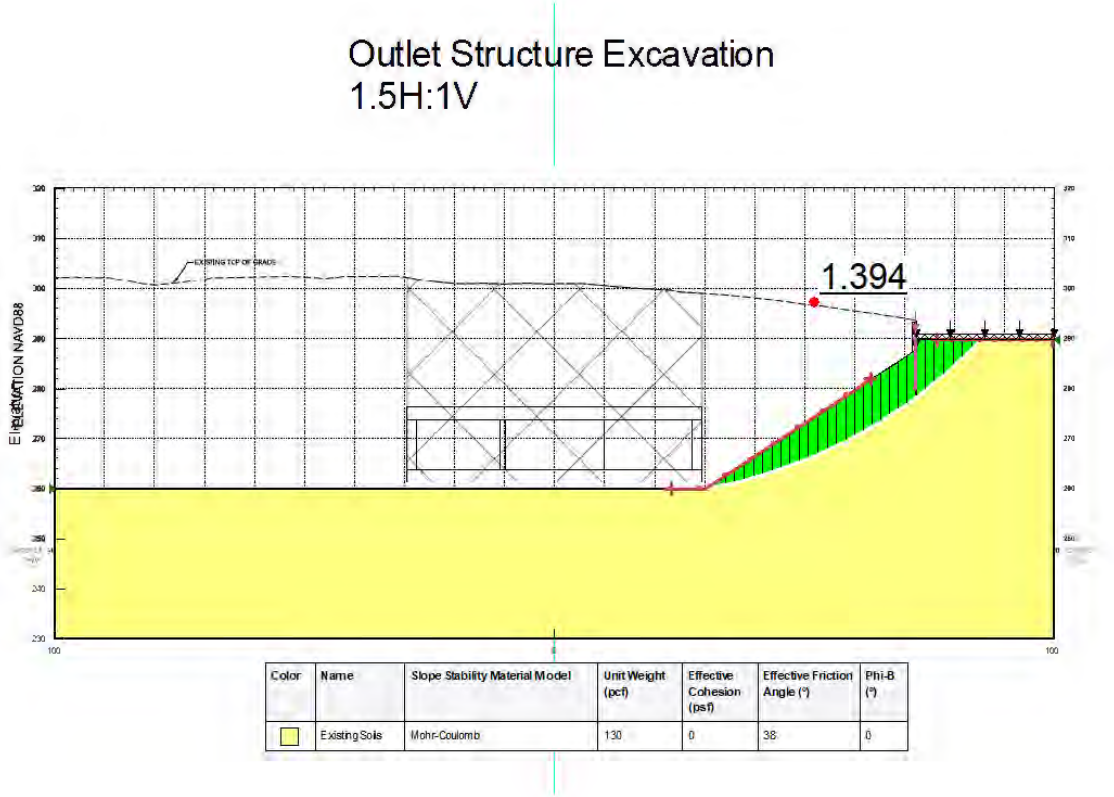


Figure 66. Temporary excavation with (10 ft deep) sheetpile and 1.5H:1V slope beneath the sheetpile (FS>1.3) – 200 psf surcharge assumed

11.10 Construction Considerations

The 21 ft diameter conduit from Smith Basin to the Diamond Reservoir shown in Figure 67 should be investigated should it be necessary to move materials from the Bond/Diamond to the Smith Basin to minimize traffic and safety impacts of moving material from one side of Villa Park Road to the other. A tandem axle dump truck with a height of 9 ft 4 inches and width of 9.5 feet could easily pass through the 21 ft diameter tunnel based on the geometry of the truck. The tire pressure for a dump truck is expected to be between 85-105 psi with an expected value of 95 psi. Additionally, because of the large amount of earthwork envisioned, a plan should be developed to construct these slopes with minimal impact to reservoir operations. This will likely mean construction of access roads within the reservoir so that earth may be moved from one portion of the reservoir to another.

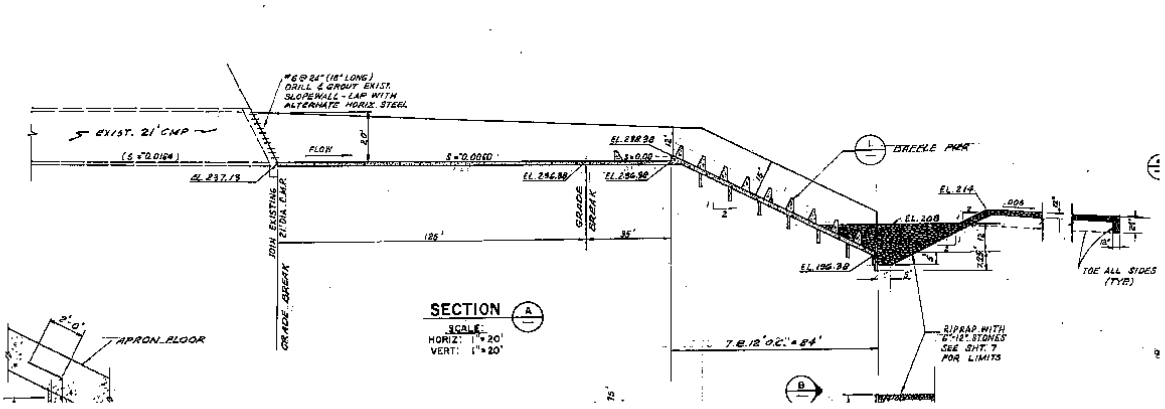


Figure 67. Twenty-one (21) Foot Diameter Conduit between Smith and Diamond Reservoirs

Another significant impact will be wildlife. Drilling borings in the reservoir area required extensive environmental surveying and coordination. The work could only take place during the period from September to February due to bird nesting during the March-September timeframe. The amount of earthwork will inevitably impact animal and plant habitat. And, even if there were not plant or animal impacts, the requirement to construct in the wettest part of the year will be problematic. The wettest part of the year which is the November - February time frame.

11.11 Water infiltration considerations

The concern with adding fill to flatten the slopes would be that it might reduce infiltration. To address this the construction specifications would require that the fill place be either sands or gravels. Therefore, it is not expected that sands and gravels, even with fines, would be appreciably less permeable than the existing soils. Additionally, the existing soils are a hodgepodge of fine layers (clays) and clayey or silty gravels and clayey or silty sands. Provided the specifications require the placed material to be sands or gravels, infiltration should not be negatively affected.

11.12 Expanded scope

Since the GDM (1980) there was a slope failure on the south side of the Smith Basin as shown in Figure 68. Progress of this failure is shown in Figure 69. This failure initiated between April 2003 and Aug 2005. A second large movement occurred between Oct 2007 and March 2011. It is likely that the second movement occurred between Aug 2010 and Feb 2011, as this is the interval identified in Google Earth that the second movement occurred. This area should be shorn up as part of reservoir slope stabilization. A more detailed analysis of the slope failure in the Smith Basin along Villa Park located in Attachment C-8

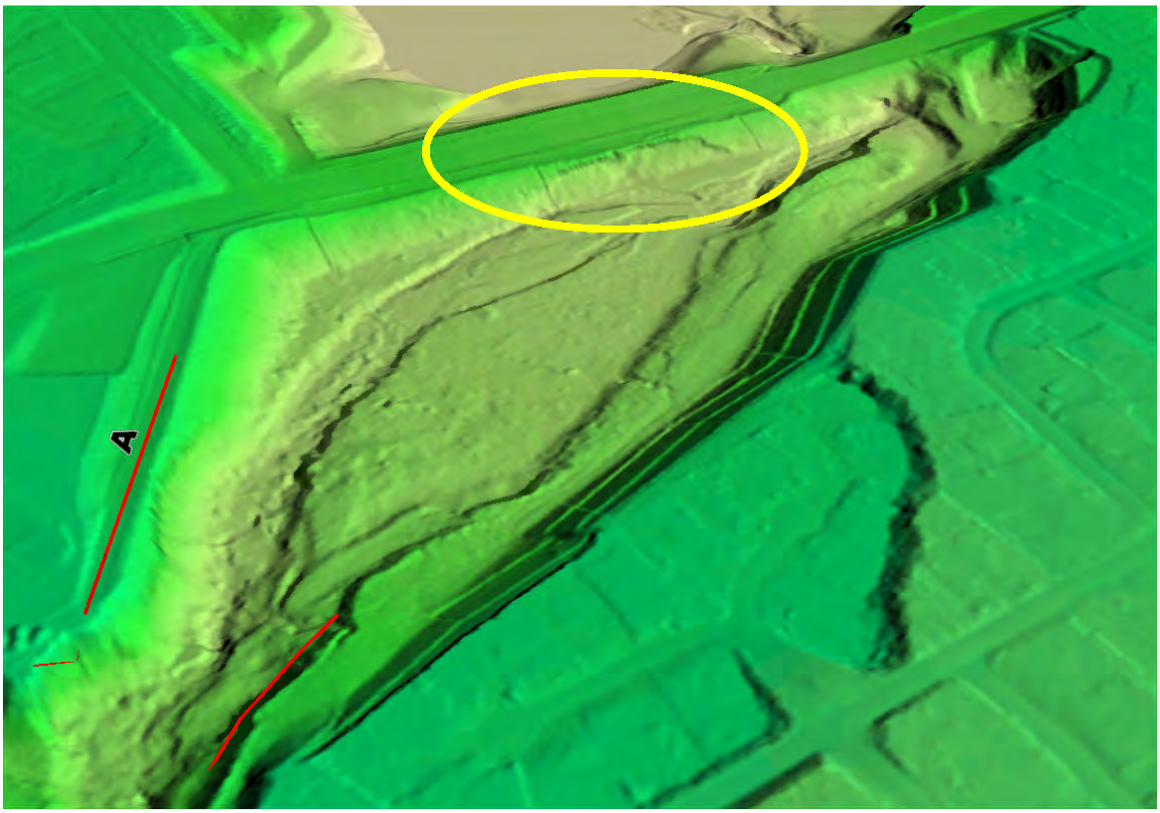


Figure 68. Slope failure in the Smith Basin that occurred between Oct 2010 and Feb 2011.

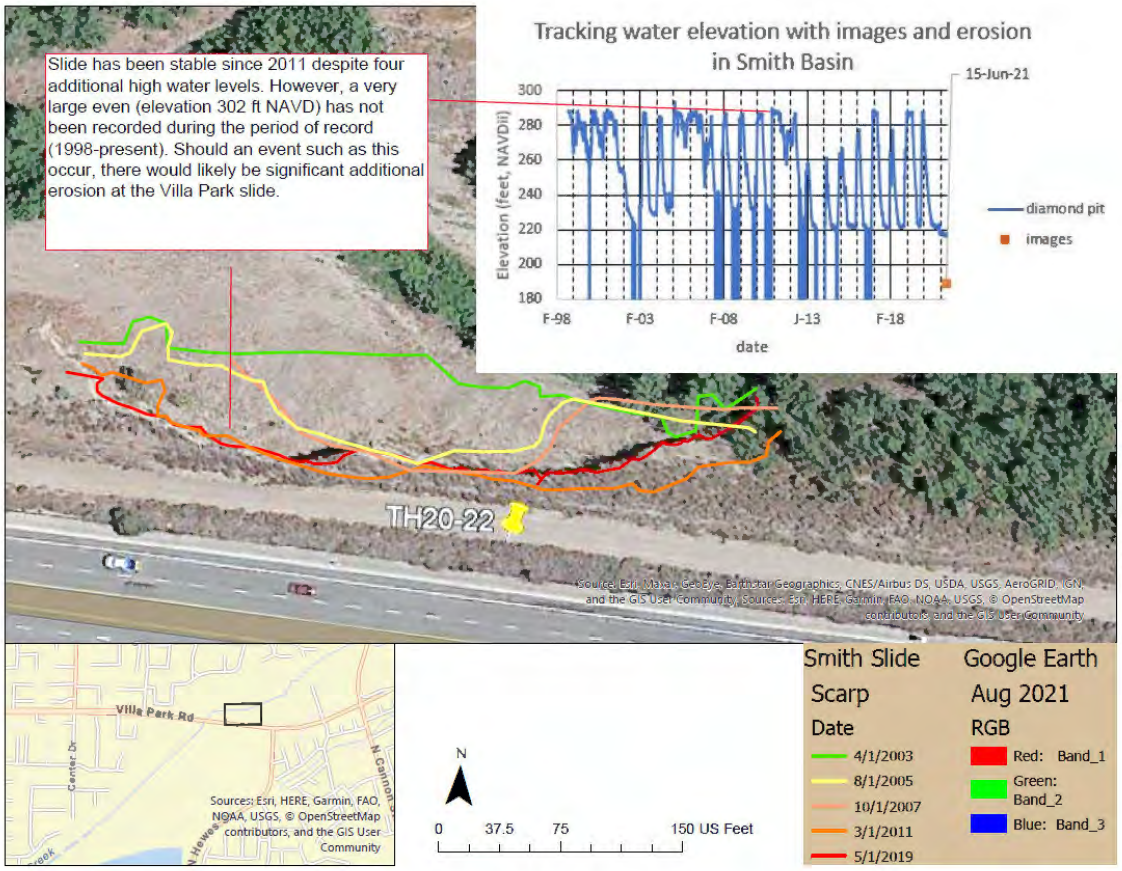


Figure 69. Evaluating progression of Smith Basin slide adjacent to Villa Park Road

Other areas around the Reservoir were evaluated in sections shown in Figure 70. The purpose of this analysis is to evaluate other sections not evaluated in the DM18 report. Sections were chosen and compared with a baseline 2H:1V slope to see if slope stability issues might arise. Based on this analysis, though several sections had portions that were steeper than 2H:1V, over the entire slope all sections were determined to have stable slopes at or near 2H:1V. An exception is Section T (1.7H:1V), which is an area of erosion on the southwest corner of the Smith Basin. Section M has a steep portion but on average the slope is 2H:1V and there is a wide bench before reaching Villa Park.

road. Any sloughing at Section M should have low consequences. The analysis is provided in Attachment C-5.

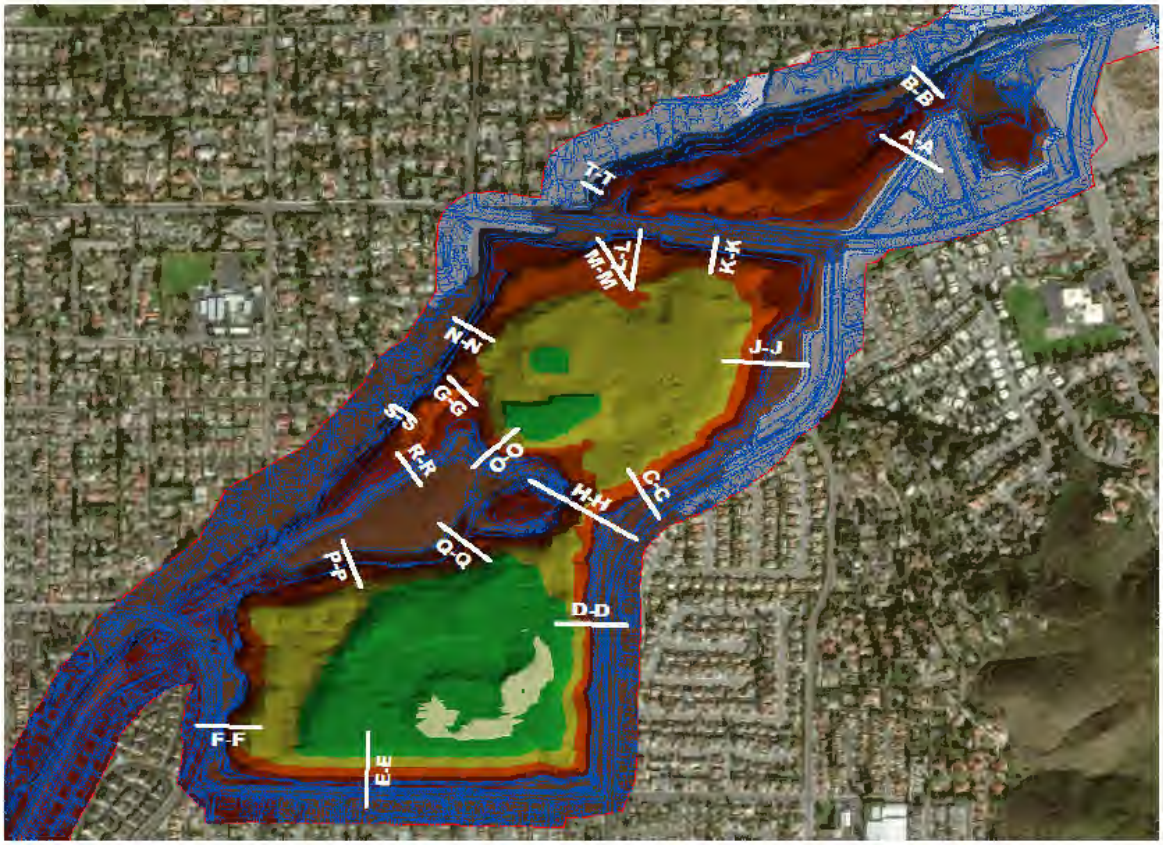


Figure 70. Cross sections (DM18) and additional slopes screened for stability

11.13 Steady State Seepage

Steady state seepage is not expected to be an issue. The main source of slope stability is expected to be due to rise and fall of the reservoir levels.

11.14 Slope Erosion

As shown in Figure 71 and Figure 72 erosion from discharge of surface water is noted in several locations in the reservoir and should be addressed as part of the reservoir stabilization project.

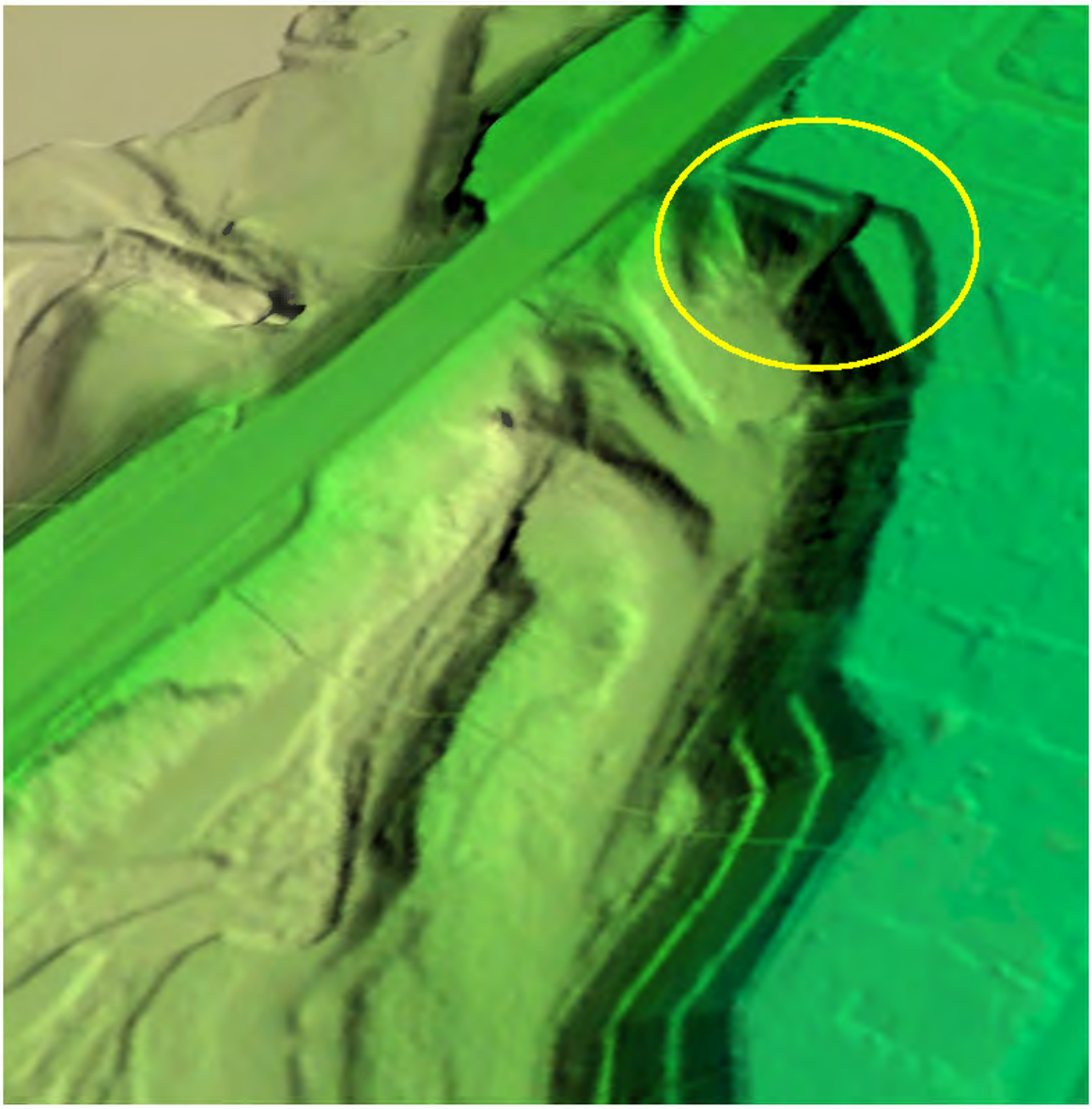


Figure 71. Example of erosion from surface water in the Smith Basin



Figure 72. Surface erosion at intersection of Bond and Hewes

The Bond and Smith Basin erosion is evaluated in Attachment C-4. Progression of erosion in the Smith Basin is shown in Figure 74. For the Smith Basin, if surface water cannot be directed away from the location of the existing erosion, to address this feature the slope should be stripped, graded and a layer of riprap should be installed to address future erosion. If surface water can be directed away from the erosion, which may be true given the lack of progression of the erosion from 2003-2021, then the slope should be stripped and graded. Figure 73 shows significant erosion in Smith Basin, but has not increased in size since 2003.



Figure 73. Erosion in Smith Basin since 2003

Progression of erosion in the Bond Basin is shown in Figure 74. For the Bond Basin, structurally the slope requires some reconstruction. A well-constructed drainage pipe can be added on top of the reconstructed slope. The erosion at the toe of the Hewes slope will be addressed during the slope stabilization along Line FI (Section D-D).

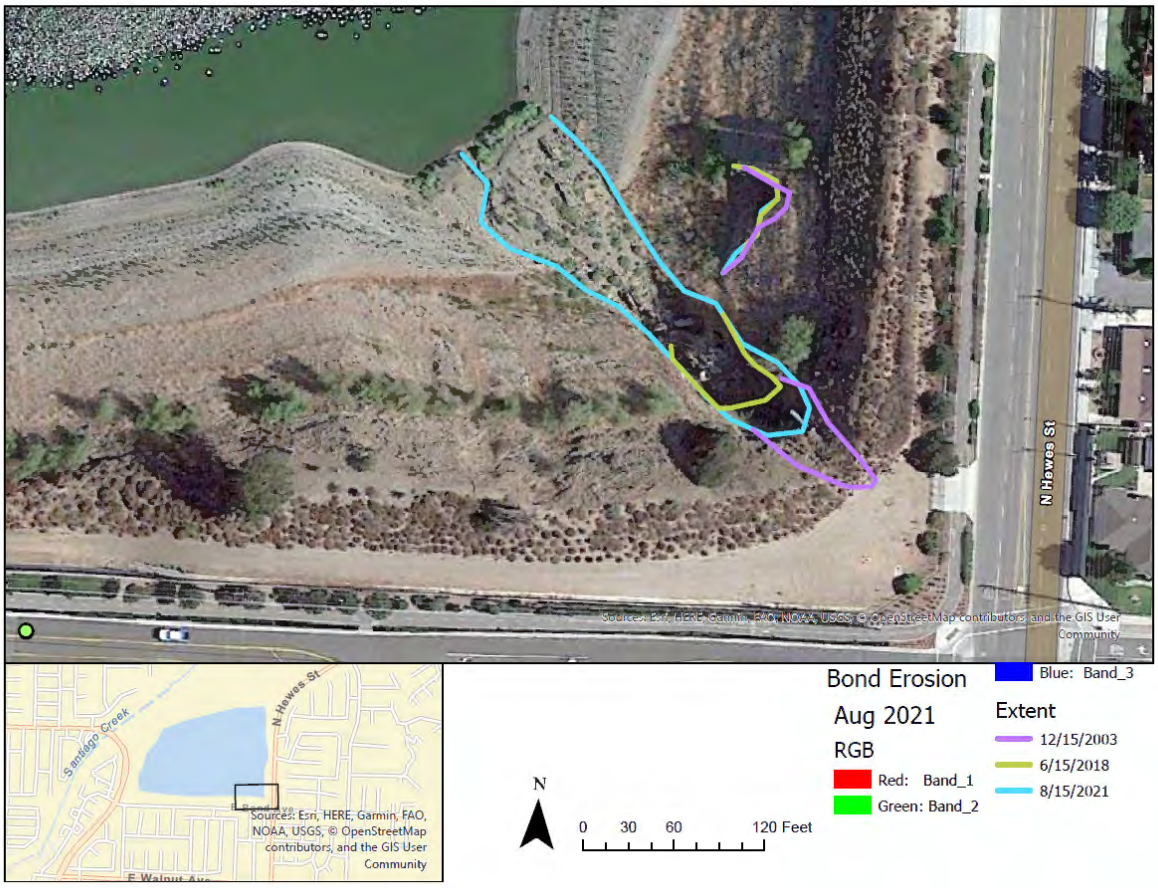


Figure 74. Progression of erosion at the corner of Bond and Hewes due to pipe break

11.15 Outlet Structural Foundation

The outlet structure will be incised into the existing ground. The critical loading will be uplift from the reservoir prior to opening the gates. A seepage analysis was performed. Several approaches were considered. The first was a two-dimensional seepage analysis along the centerline of the outlet structure. The results of this seepage analysis are shown in **Figure 75**.

Color	Name	Hydraulic Material Model	Sat Kx (ft/sec)
	clayey sand	Saturated Only	3.28e-07
	concrete	Saturated Only	3.28e-11
	sandy clay	Saturated Only	3.28e-08

Color	Name	Parameters
	HighReservoir	298 ft
	Zero Pressure	0 ft

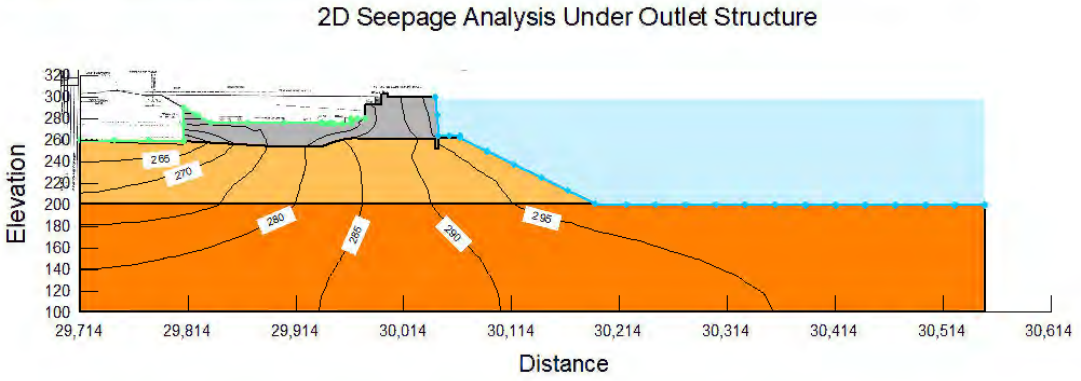


Figure 75. 2D seepage analysis along the centerline of the outlet structure – no drain (Elevations in NGVD29)

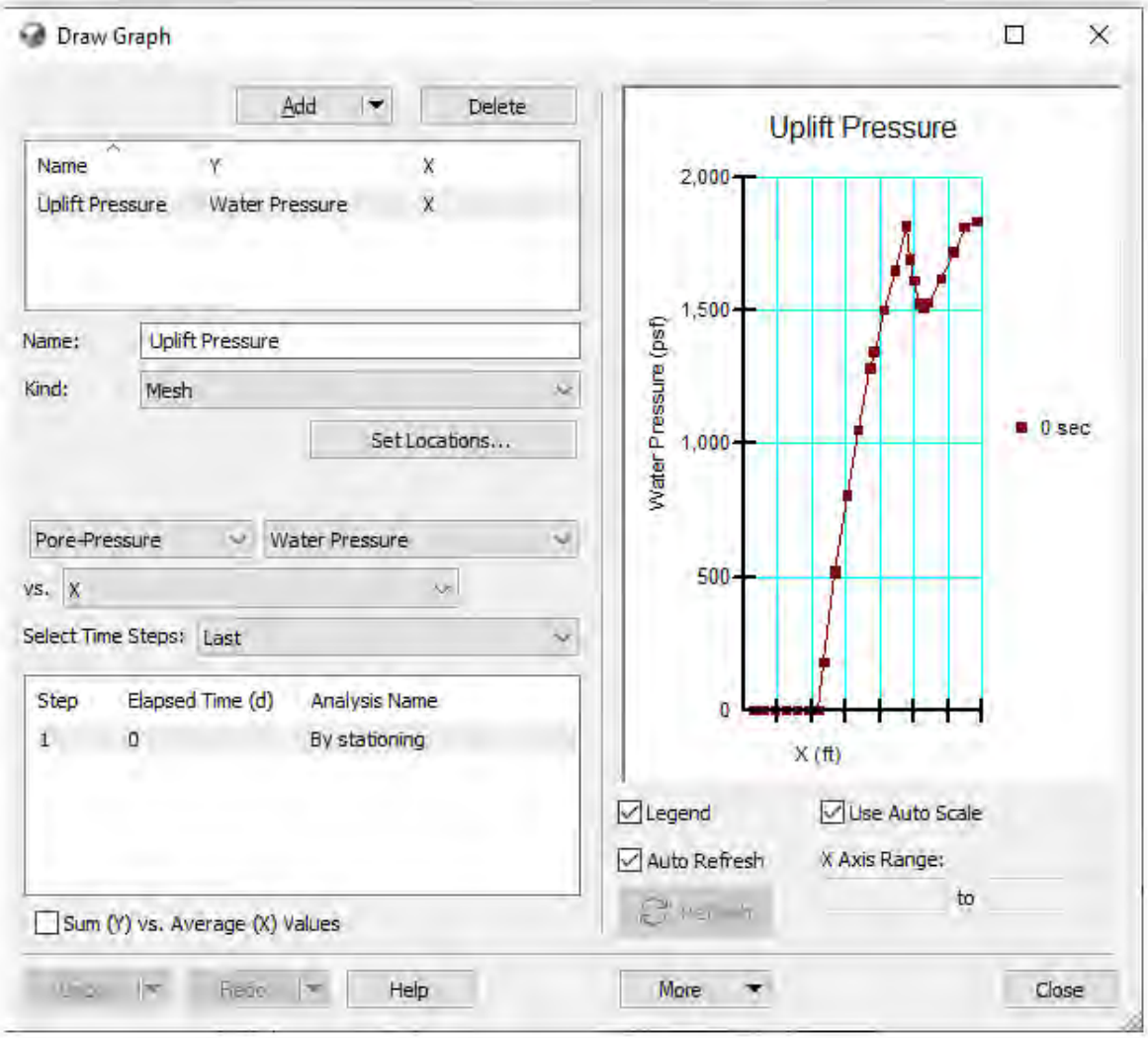


Figure 76. Uplift Pressures (1,500-2,000 psf) under the outlet structure (without underdrains)

Large pore pressures (1,500-2,000 psf) can build up under the outlet structure (if the structure does not include an underdrain) as shown in Figure 76.

Because the seepage problem is three dimensional, a second seepage analysis was performed perpendicular to the centerline of the outlet channel as shown in **Figure 77**. The results of these analyses show pore water pressure build up similar to the 2D analysis along the centerline of the outlet structure (Figure 78).

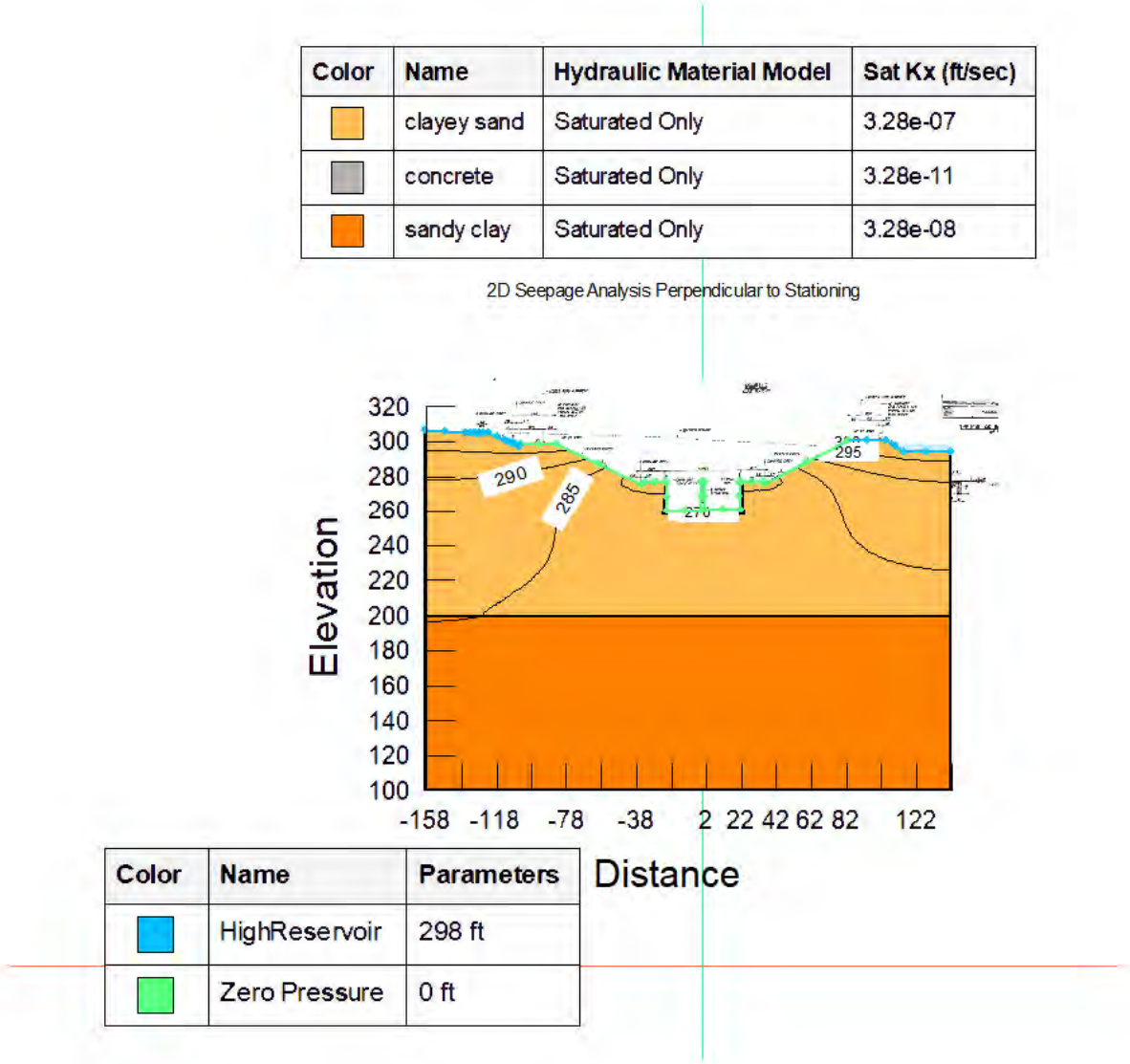


Figure 77. 2D Seepage analysis perpendicular to the centerline of the outlet structure (Elevations in NGVD29)

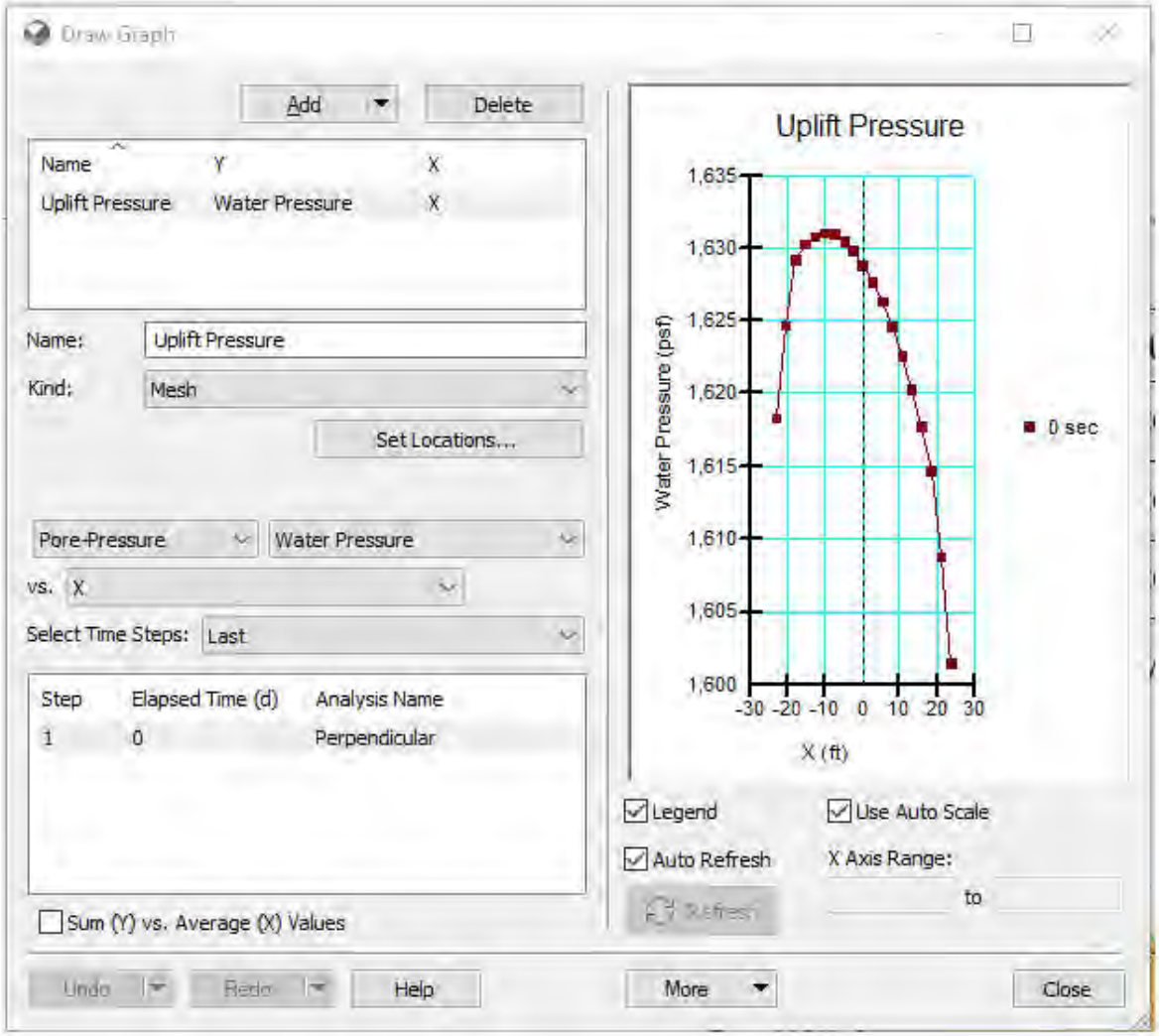


Figure 78. Uplift pressures in 2D Analysis perpendicular to the outlet channel (without underdrain)

A 2D analysis of the uplift pressures that is perpendicular to the outlet channel shows similarly high values of potential water pressure under the outlet structure without a drain as shown in Figure 78.

Finally, a plan view seepage analysis was performed as shown in Figure 79. This analysis shows a large potential for uplift beneath the bottom of the outlet structure.

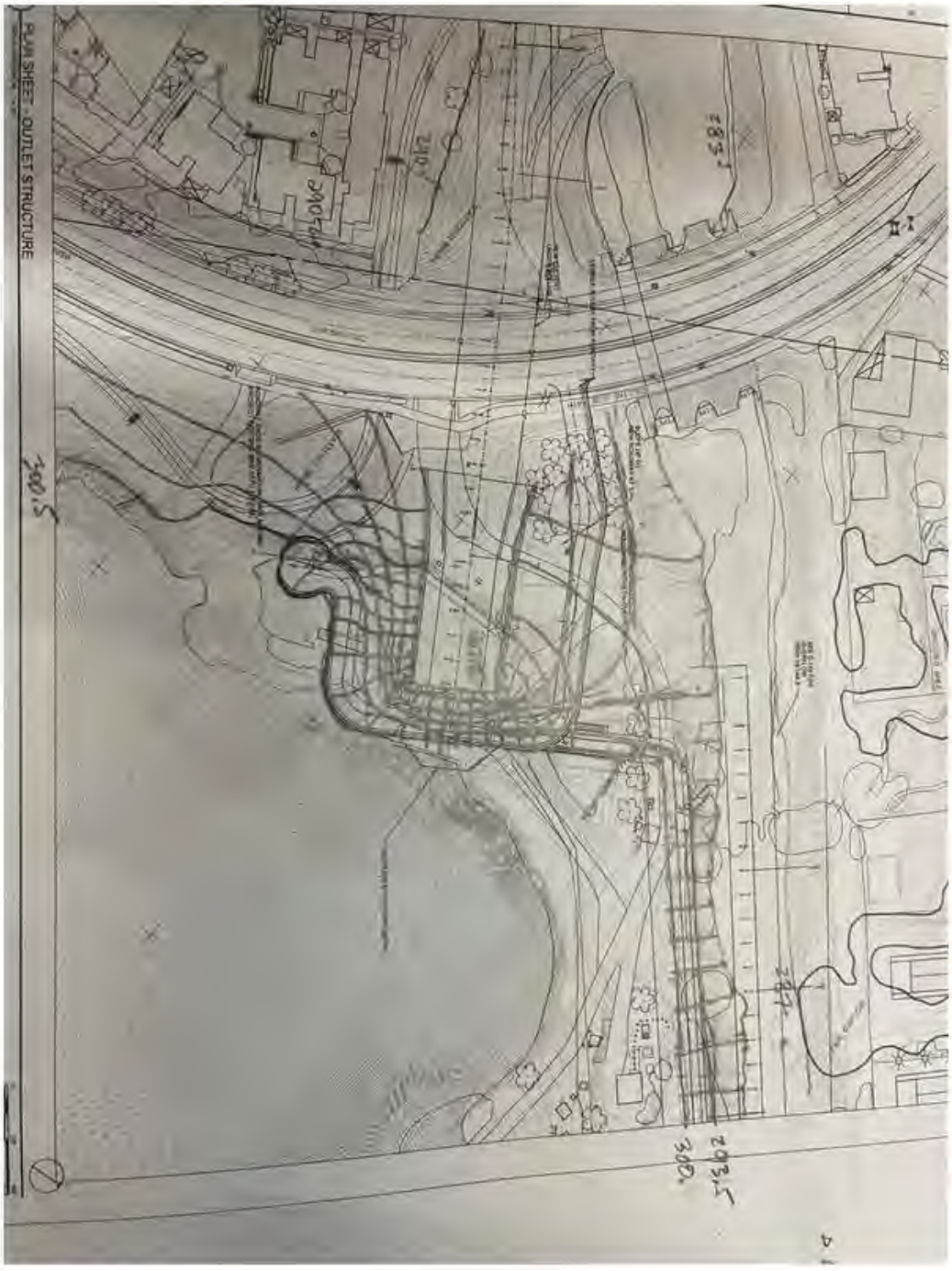


Figure 79. Plan View Seepage Analysis at the outlet structure

A plan view seepage analysis in Figure 79 shows the likelihood of flow to the bottom of the outlet structure showing the potential for water build-up under the outlet structure.

11.15.1 How to reduce the uplift pressures

One method to reduce uplift pressures would be to line the bottom of the outlet channel with riprap rather than concrete. However, given the velocities through the outlet channel just as the gates are opened, a more robust design would be to line the bottom of the channel with concrete. To allow water to drain and relieve potential pressure under the outlet structure floor, a drainage layer is proposed as shown in Figure 80.

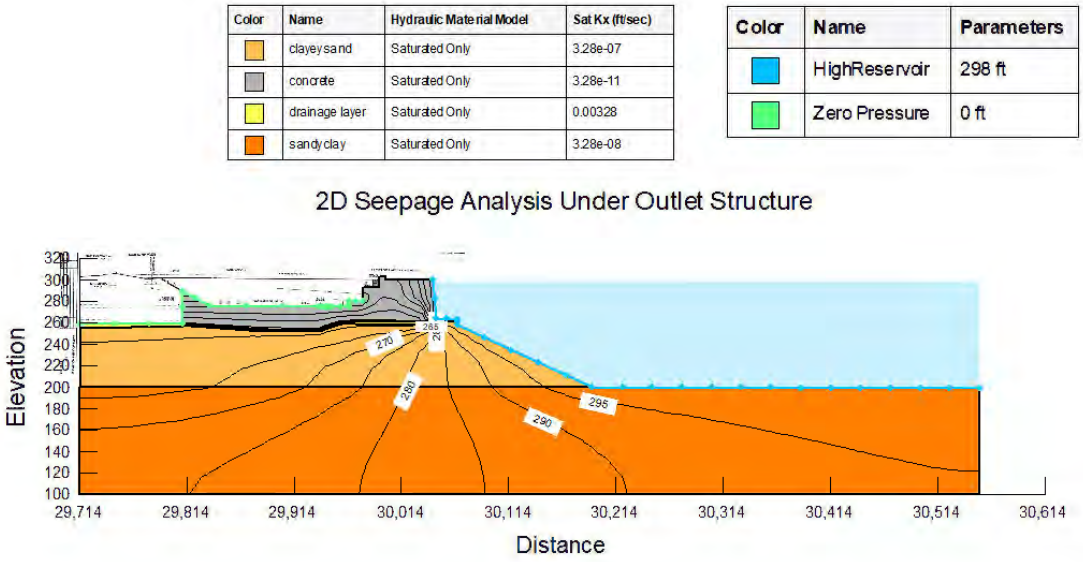


Figure 80. 2D seepage analysis along the centerline of the outlet structure – drainage layer present (elevations in NGVD29)

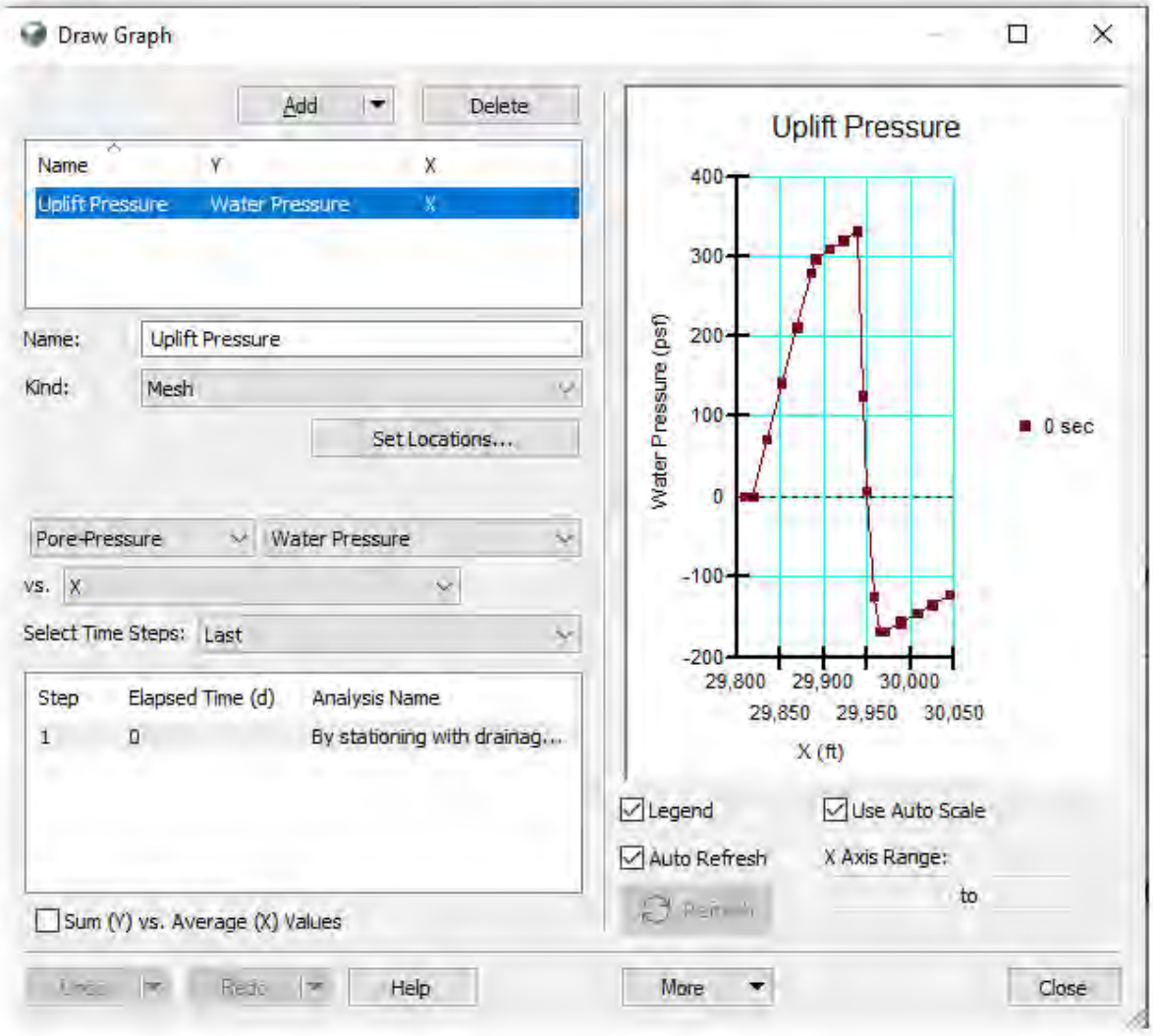


Figure 81. Uplift Pressures when adding underdrains at the outlet structure

Figure 81 shows that by adding an underdrain under the outlet structure, the water pressure is significantly reduced.

A graded filter is designed based on the range of grain sizes found during the geotechnical investigation. The grain sizes found are shown in Figure 82. The graded filter design is shown in Figure 83. Based on this analysis ASTM 33 Size #9 (or AASHTO M43 Size #9) meet the filter requirements. Availability of this sand is discussed in Attachment C-1.

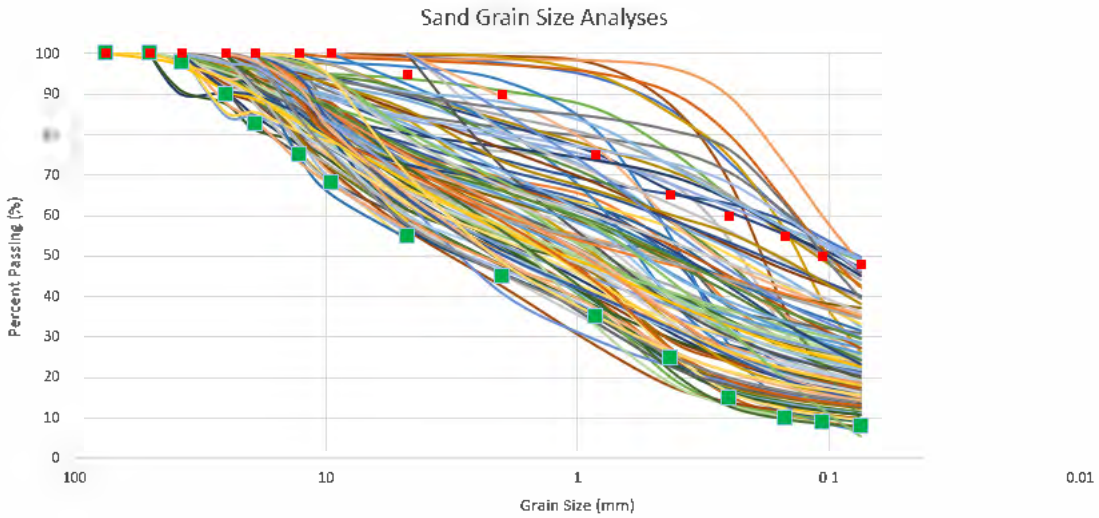


Figure 82. Plot of all grain size analyses performed (63 total) for filter analysis

Table 23 below shows that the filter analysis (showing ASTM 33 Size #9 or AASHTO M43 Size #9) meets the USACE filter criteria.

Table 23. Filter analysis showing ASTM 33 Size #9 (or AASHTO M43 Size #9)

Candidate filter soil gradation. Values shown in red in the left column, and all values in the two right columns, can be changed.

Particle size mm	Sieve #	% Passing (upper bound)	% Passing (lower bound)
150.0	-		
100.0	-		
90.0	-		
75.0	-		
63.0	-		
50.0	-		
37.5	-		
25.0	-		
19.0	-		
12.5	-		
9.5	-	100.0%	
4.75	4	85.0%	100.0%
3.35	6		
2.36	8	10.0%	40.0%
2.00	10		
1.70	12		
1.40	14		
1.18	16	0.0%	10.0%
0.850	20		
0.600	30		
0.425	40		
0.300	50	0.0%	5.0%
0.250	60		
0.212	70		
0.180	80		
0.150	100		
0.125	120		
0.106	140		
0.090	170		
0.075	200	(0.0%)	(0.0%)
0.053	270		
0.037	-		
0.019	-		
0.009	-		
0.0001	-	0.0%	0.0%

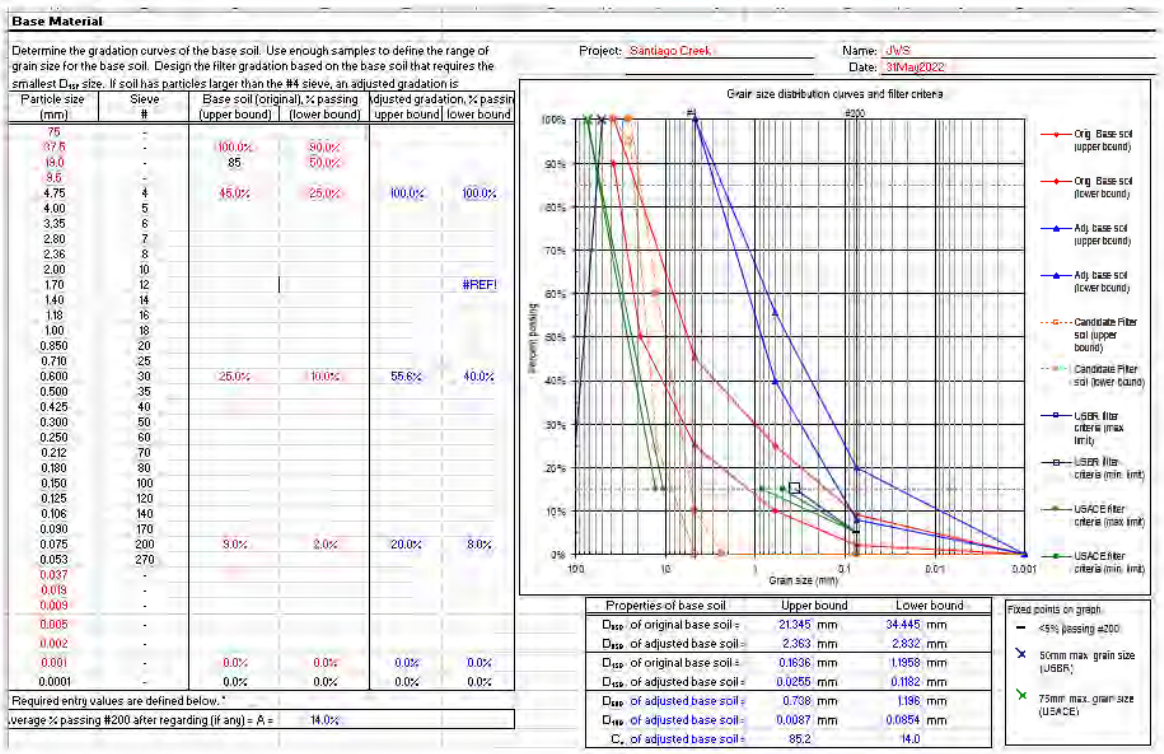
Acceptibility of candidate filter (CF) soil:

USBR criteria	Upper bound	Lower bound
Max % passing #200:	OK	OK
Max particle size (mm):	OK	OK
Maximum D_{15CF}:	OK	OK
Minimum D_{15CF}:	OK	OK
To minimize segregation (from Table 2)***		
Max allowable D_{90CF} =	30	OK
Max D_{90CF} =	5.98	

USACE criteria	Upper bound	Lower bound
Max % passing #200:	OK	OK
Max particle size (mm):	OK	OK
Maximum D_{15CF}:	OK	OK
Minimum D_{15CF} ($3\times D_{15B}$):	OK	OK
Minimum D_{15CF} ($5\times D_{15B}$):	OK	OK
To minimize segregation (from Table B-3)***		
Max allowable D_{90CF} =	30	OK
Max D_{90CF} =	5.98	

Filters should be relatively uniform (see the C_U value of the candidate filter soil.). Also, filters should not be gap-graded.

*** Generally, this requirement is only necessary for coarse filters and gravel zones that serve as both filters and drains. For sand filters with D_{90} < ~20mm, these limitations are usually not necessary.



Base Material

Determine the gradation curves of the base soil. Use enough samples to define the range of grain size for the base soil. Design the filter gradation based on the base soil that requires the smallest D_{15f} size. If soil has particles larger than the #4 sieve, an adjusted gradation is

Project: Santiago Creek Name: JWS Date: 31May2022

Particle size (mm)	Sieve #	Base soil (original), % passing (upper bound)	(lower bound)	Adjusted gradation, % passin upper bound	lower bound
75	-				
37.5	-	100.0%	90.0%		
19.0	-	85	50.0%		
9.5	-				
4.75	4	45.0%	25.0%	100.0%	100.0%
4.00	5				
3.35	6				
2.80	7				
2.36	8				
2.00	10				
1.70	12				#REF!
1.40	14				
1.18	16				
1.00	18				
0.850	20				
0.710	25				
0.600	30	25.0%	10.0%	55.6%	40.0%
0.500	35				
0.425	40				
0.300	50				
0.250	60				
0.212	70				
0.180	80				
0.150	100				
0.125	120				
0.106	140				
0.090	170				
0.075	200	9.0%	2.0%	20.0%	8.0%
0.053	270				
0.037	-				
0.019	-				
0.009	-				
0.005	-				
0.002	-				
0.001	-	0.0%	0.0%	0.0%	0.0%
0.0001	-	0.0%	0.0%	0.0%	0.0%

Required entry values are defined below.*

Average % passing #200 after regarding (if any) = A = 14.0%

Properties of base soil	Upper bound	Lower bound
D_{85b} of original base soil =	21.345 mm	34.445 mm
D_{85b} of adjusted base soil =	2.363 mm	2.832 mm
D_{15b} of original base soil =	0.1636 mm	1.1958 mm
D_{15b} of adjusted base soil =	0.0255 mm	0.1182 mm
D_{85b} of adjusted base soil =	0.738 mm	1.196 mm
D_{15b} of adjusted base soil =	0.0087 mm	0.0854 mm
C_u of adjusted base soil =	85.2	14.0

Fixed points on graph
- <5% passing #200
- 50mm max. grain size (USBR)
- 75mm max. grain size (USACE)

Figure 83. Filter criteria analysis for ASTM 33 Size #9 (or AASHTO Size #9)

12 Borrow Materials and Construction Considerations

12.1 Borrow Materials

Past evaluations of borrow sources have been performed in DM 18. It is the intent of this design to utilize the existing reservoir for borrow to address areas of cut and fill within the reservoir. Borrow material will likely be needed for the outlet structure drain as well as for riprap armoring in the channel. Additional information regarding aggregate sources can be found in Attachment C-1.

12.2 Construction Considerations

During construction, considerable effort will be required for control of compaction within the fill areas of the reservoir.

Specification will need to be developed for anchor testing following FHWA-IF-99-015.

Grain size quality assurance will be required to correctly identify material for compaction tests as well as for filter material both in outlet structure drain and the filter in the downstream channel.

12.3 Surveillance and Monitoring Needs

12.4 Slope Stability

As part of the Contractor's installation plan, methods to assure slope stability during construction will need to be presented for approval by the government. Because of the steep and very high slopes in the reservoir area, a great deal of attention will need to be paid to safely constructing the proposed slopes.

12.5 Compaction.

Compaction should be monitored at intervals of 1 test for every 2000 cubic yards (Fang, 1991) using the standard Proctor method (ASTM D698). The percentage fines range between 10-50% for coarse grained soils. A sheepsfoot roller may be appropriate to compact soils with greater than 20% fines. Since the materials tend to be finer near the bottom of the reservoir and coarser near the top, a mixture of sheepsfoot for the bottom and vibratory compaction equipment near the top may be effective. Problem materials such as expansive clays are not expected to be an issue. However, the presence of large gravel will require modifications to the samples for Proctor testing. A summary of compaction and grain size data collected on site can be found in Attachment D-2.

13 References

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Fang, H. 1991. Foundation Engineering Handbook. Van Nostrand Reinhold, New York.

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USACE, 1984. MP GL-84-13. “Rationalizing Seismic Coefficient Method.”

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ATTACHMENT C-1 - Certified Aggregate Producers

Attachment C-1 Aggregate Sources

Rip Rap Gradations (SPL, 1988)

Rip rap gradations provided by SPL (1988) are shown below. These were likely sized based on the D30 size to prevent scour and closely follow those provide in EM 1110-2-1601.

Table A-4. Riprap and Filter Stone Gradations.

RIPRAP

Riprap Layer Thickness	Weight Individual Pieces (Pounds)	Approximate Average Dimension (Inches)	Percent Smaller by Weight
12-inch	125	12	100
	50	9	50-90
	25	7	20-50
	10	5	0-20
15-inch	250	15	100
	100	11	50-90
	50	9	20-50
	20	7	0-20
21-inch	675	21	100
	270	15	50-90
	135	13	20-50
	50	9	0-20
24-inch	1000	24	100
	400	18	50-90
	200	14	20-50
	80	10	0-20
36-inch	3400	36	100
	1400	26	50-90
	680	21	20-50
	250	15	0-20

Caltrans Standard Rock Gradations

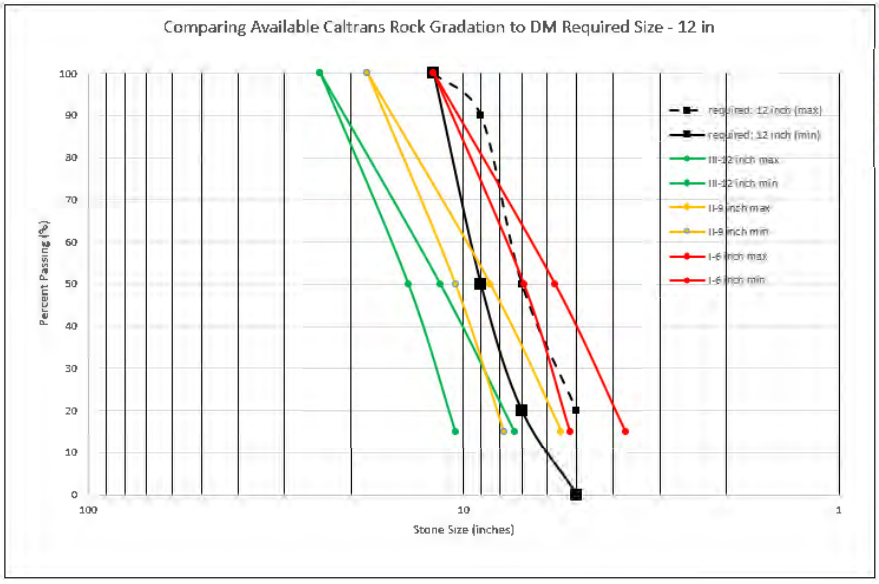
To reduce project expense, it may be useful to follow standard Caltrans riprap sizing. Rock gradation from Caltrans Standard Plans and Standard Specifications (2018) is shown below.

Rock Gradation

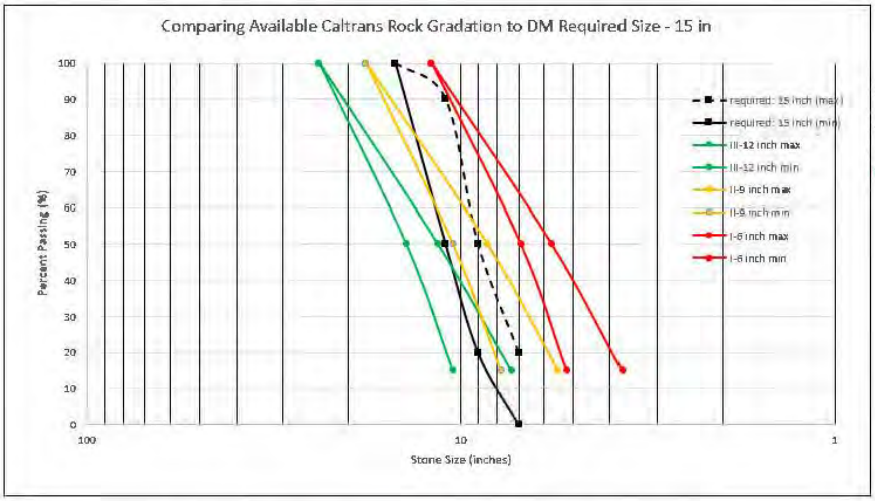
Nominal RSP class by median particle diameter[b]		Nominal median particle weight W_{50}[c,d]	d_{15}[c] (inches)		d_{50}[c] (inches)		d_{100}[c] (inches)	Placement
Class[a]	Diameter (inches)		Min	Max	Min	Max	Max	Method
I	6	20 lb	3.7	5.2	5.7	6.9	12.0	B
II	9	60 lb	5.5	7.8	8.5	10.5	18.0	B
III	12	150 lb	7.3	10.5	11.5	14.0	24.0	B
IV	15	300 lb	9.2	13.0	14.5	17.5	30.0	B
V	18	1/4 ton	11.0	15.5	17.0	20.5	36.0	B
VI	21	3/8 ton	13.0	18.5	20.0	24.0	42.0	A or B
VII	24	1/2 ton	14.5	21.0	23.0	27.5	48.0	A or B
VIII	30	1 ton	18.5	26.0	28.5	34.5	48.0	A or B
IX	36	2 ton	22.0	31.5	34.0	41.5	52.8	A
X	42	3 ton	25.5	36.5	40.0	48.5	60.5	A
XI	46	4 ton	28.0	39.4	43.7	53.1	66.6	A

[a]For RSP Classes I–VIII, use Class 8 RSP fabric. For RSP Classes IX–XI, use Class 10 RSP fabric.
[b]Intermediate or B dimension (i.e., width) where A dimension is length and C dimension is thickness.
[c]d%, where % denotes the percentage of the total weight of the graded material.
[d]Values shown are based on the minimum and maximum particle diameters shown and an average specific gravity of 2.65. Weight will vary based on specific gravity of rock available for the project.

The Caltrans gradations are plotted versus the DM design recommendations. Then recommended riprap sizing is provided as follows.

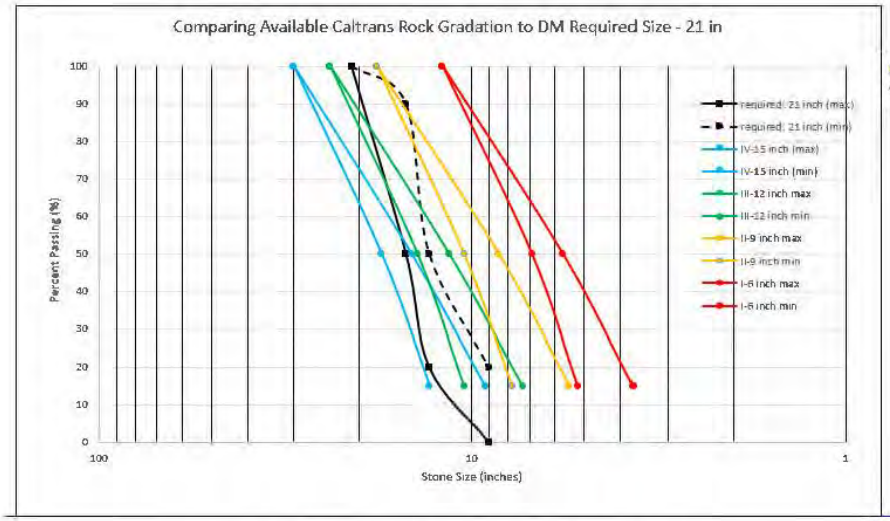


Recommend using II-9. Though there may be many stones larger than the required size, stones can be distributed to better match the 12 inch thickness. Additionally, there may be some degredation over time. The D30 meets the required.

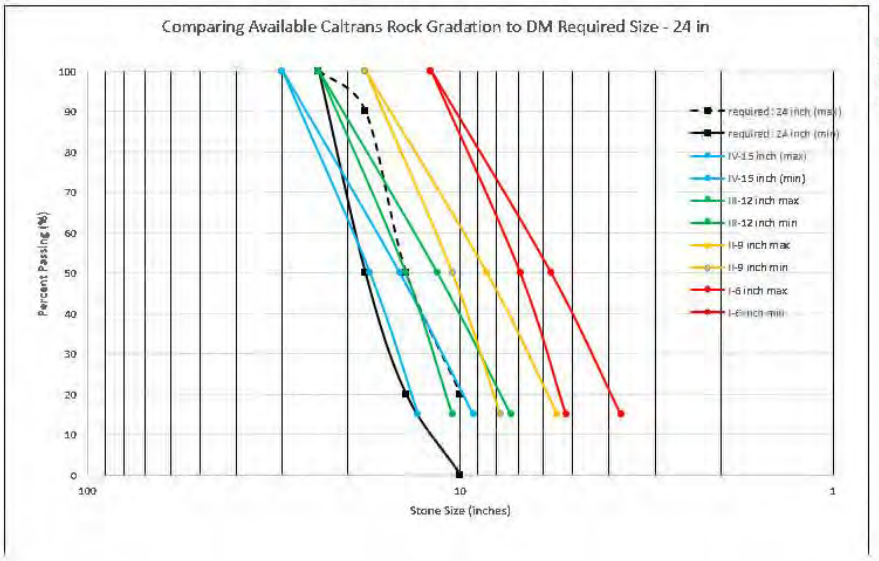


Recommend II-12 inch.

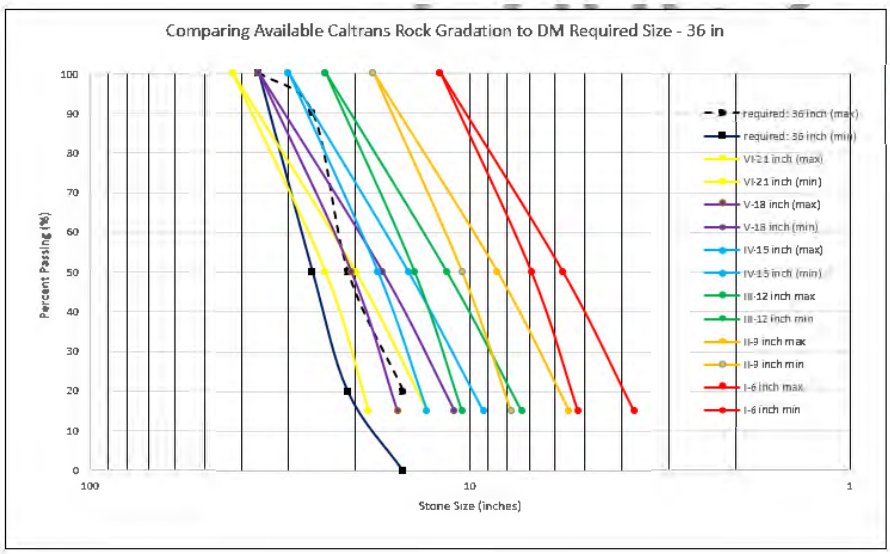
There may be some stones as large as 24 inches, which is 9 inches more than the required layer thickness. But the D30 exceeds the requirements.



Recommend IV-15 inch. Exceeds D100 by 9 inch. But D30 is very similar to required.



Recommend IV-15 inch. Though there may be some stones as much as 6 inches larger than the required 24 inch thick layer, most of the gradation agrees with the required stone sizes.



Recommend VI-21 inch. Though some stones may be 6 inches larger than required, the majority of the gradation matches the required gradation.

Materials suppliers

Materials suppliers were provided by the LA District (SPL) as well as internet searches with correspondence from the vendor as shown below.

FST Sand and Gravel
P.O. BOX 2798
Corona CA, 92878
1-800-585-SAND (7263)
Orange Co. (949) 768-8440
Riverside Co. (951) 277-8440
Fax (951) 277-8904
Source: Peter Gauer (SPL)

Vulcan Materials
Manolito Limos Jr. (limosm@vmcmail.com)
Nancy VonMuegge (vonmueggen@vmcmail.com)
(internet search/correspondence)

Lynx Cat Mountain Quarry Operations, LLC.
Quality Rock Products
Annie Fox
Sales Manager
(760) 702-6324 Cell
annief@lcmquarry.com
(internet search/correspondence)

ATTACHMENT C-2 - Laboratory Test Summary

SOILS PROPERTIES - SANTIAGO CREEK

Date	Source	ID	Gr. Elev., ft	Elev., ft	Depth, ft	Soil	Coarse / Fine	LL	PI	#4	#200	N	UC, ksf	Other
1983	USACE	TT83-1	100	99.25	0.75	GP	Coarse			47	1			
1983	USACE	TT83-1	100	98.5	1.5	CL	Fine	38	16	100	86			
1983	USACE	TT83-1	100	95.5	4.5	SP	Coarse		NP	71	1			
1983	USACE	TT83-1	100	92.5	7.5	CL	Fine	33	14	100	72			
1983	USACE	TT83-1	100	91	9	SM	Coarse	19	2	100	29			
1983	USACE	TT83-1	100	89	11	SP	Coarse		NP	100	14			
1983	USACE	TT83-2	110	109	1	GW	Coarse		NP	28	0			
1983	USACE	TT83-2	110	108.25	1.75	SP	Coarse		NP	67	1			
1983	USACE	TT83-2	110	106.5	3.5	SC/SM	Coarse	27	6	62	13			
1983	USACE	TT83-2	110	103.5	6.5	GW	Coarse		NP	28	1			
1983	USACE	TT83-2	110	100.5	9.5	GW	Coarse		NP	36	2			
1983	USACE	TT83-2	110	98.75	11.25	CL	Fine	30	10	100	63			
1983	USACE	TT83-2	110	98.25	11.75	SC	Fine	24	9	100	47			
1983	USACE	TT83-3	110	108.25	1.75	GW	Coarse		NP	40	1			
1983	USACE	TT83-3	110	106.5	3.5	CL	Fine	46	23	100	78			
1983	USACE	TT83-3	110	105	5	SP/SM	Coarse		NP	96	7			
1983	USACE	TT83-3	110	100	10	CL	Fine	35	13	100	89			
1983	USACE	TT83-3	110	99.5	10.5	CL	Fine	30	12	100	54			
1983	USACE	TT83-3	110	94.75	15.25	SP	Coarse		NP	82	1			
1983	USACE	TT83-4	120	119.25	0.75	GP	Coarse		NP	38	0			
1983	USACE	TT83-4	120	118.25	1.75	GC	Coarse	38	20	41	14			
1983	USACE	TT83-4	120	117.25	2.75	GW	Coarse		NP	24	0			
1983	USACE	TT83-4	120	115.25	4.75	SP	Coarse		NP	73	1			
1983	USACE	TT83-4	120	113	7	CL	Fine	37	14	100	85			
1983	USACE	TT83-4	120	110.25	9.75	SM	Coarse		NP	83	15			
1983	USACE	TT83-4	120	106.75	13.25	CL	Fine	33	13	100	73			
1983	USACE	TT83-4	120	104.5	15.5	SP/SM	Coarse		NP	94	8			
1983	USACE	TT83-5	130	128.5	1.5	GP	Coarse		NP	32	0			
1983	USACE	TT83-5	130	126.75	3.25	SP	Coarse		NP	51	1			
1983	USACE	TT83-5	130	125.25	4.75	SC/SM	Coarse	23	6	98	50			
1983	USACE	TT83-5	130	122.75	7.25	SP/SM	Coarse		NP	96	6			
1983	USACE	TT83-5	130	120	10	ML	Fine	22	3	100	80			
1983	USACE	TT83-5	130	118	12	CL	Fine	28	10	100	65			
1983	USACE	TT83-5	130	115.75	14.25	SP	Coarse		NP	84	3			
1983	USACE	TT83-5	130	113.25	16.75	CL	Fine	26	8	91	56			
1983	USACE	TT83-6	130	129.25	0.75	GW	Coarse		NP	35	1			

SOILS PROPERTIES - SANTIAGO CREEK

Date	Source	ID	Gr. Elev., ft	Elev., ft	Depth, ft	Soil	Coarse / Fine	LL	PI	#4	#200	N	UC, ksf	Other
1983	USACE	TT83-6	130	128.25	1.75	GP	Coarse		NP	18	2			
1983	USACE	TT83-6	130	126.75	3.25	SM	Coarse	23	4	100	50			
1983	USACE	TT83-6	130	125.5	4.5	CL	Fine	29	9	100	73			
1983	USACE	TT83-6	130	124.5	5.5	SP	Coarse		NP	100	2			
1983	USACE	TT83-6	130	123.25	6.75	SP/SM	Coarse		NP	99	11			
1983	USACE	TT83-6	130	120.25	9.75	CL	Fine	27	9	98	54			
1983	USACE	TT83-6	130	116.5	13.5	CL/ML	Fine	24	6	99	62			
1983	USACE	TT83-7	260	258.87	1.13	GW	Coarse		NP	14	1			
1983	USACE	TT83-7	260	256.37	3.63	GP/GC	Coarse	27	11	50	5			
1983	USACE	TT83-7	261	253.5	7.5	GW	Coarse	36	17	24	4			
1983	USACE	TT83-7	262	251.5	10.5	GP/GC	Coarse	41	24	25	6			
1983	USACE	TT83-7	263	251.75	11.25	SC/SM	Coarse	25	6	79	30			
1983	USACE	TT83-7	264	250.75	13.25	GP/GC	Coarse	28	8	35	5			
1983	USACE	TT83-8	270	269	1	GW	Coarse		NP	23	1			
1983	USACE	TT83-8	270	266	4	GW	Coarse		NP	35	3			
1983	USACE	TT83-8	270	261.5	8.5	GP	Coarse		NP	31	1			
1983	USACE	TT83-8	270	257.25	12.75	GP	Coarse		NP	51	3			
1983	USACE	TT83-8	270	255.75	14.25	GW/GM	Coarse		NP	36	5			
1983	USACE	TT83-9	270	269	1	GC/GM	Coarse	26	7	50	21			
1983	USACE	TT83-9	270	267	3	GP/GC	Coarse	33	15	28	7			
1983	USACE	TT83-9	270	262.5	7.5	GP/GM	Coarse		NP	42	6			
1983	USACE	TT83-9	270	257.5	12.5	GP	Coarse		NP	34	2			
1983	USACE	TT83-9	270	255.5	14.5	SP	Coarse		NP	88	3			
1983	USACE	TT83-10	280	279.5	0.5	SC	Coarse	28	13	70	34			
1983	USACE	TT83-10	280	276.5	3.5	GW	Coarse		NP	30	4			
1983	USACE	TT83-10	280	272	8	GP	Coarse	33	15	40	4			
1983	USACE	TT83-10	280	269	11	SP	Coarse		NP	59	1			
1983	USACE	TT83-10	280	267.25	12.75	GW	Coarse		NP	27	2			
1983	USACE	TT83-10	280	266	14	GP	Coarse		NP	38	3			
1983	USACE	TT83-10	280	265	15	GW	Coarse		NP	30	2			

SOILS PROPERTIES - SANTIAGO CREEK

Date	Source	ID	Gr. Elev., ft	Elev., ft	Depth, ft	Soil	Coarse / Fine	Sample #	Sample Type	w, %	γd, pcf	γ, pcf	PL	LL	PI	#4	#200	N	UC, ksf	Other
1979	USACE	TH79-1	111	104.25	6.75	SM	Coarse			12					NP	92	30	7		
1979	USACE	TH79-1	111	99.75	11.25	SP-SM	Coarse			6					NP	94	7	14		
1979	USACE	TH79-1	111	96	15	CL	Fine			21				39	21	100	79	27		
1979	USACE	TH79-1	111	92.25	18.75	SM	Coarse			17					NP	100	49	18		
1979	USACE	TH79-1	111	87.75	23.25	CL	Fine			21				32	14	100	82	9		
1979	USACE	TH79-1	111	84	27	CL-ML	Fine			22				26	5	100	50	17		
1979	USACE	TH79-1	111	81.75	29.25	SM	Coarse			23					NP	100	36			
1979	USACE	TH79-2	110	108.5	1.5	SP-SM	Coarse			2					NP	72	11	R		
1979	USACE	TH79-2	110	105.5	4.5	SW-SM	Coarse			1					NP	77	11	R		
1979	USACE	TH79-2	110	101.75	8.25	SC	Coarse			22				34	17	96	49	18		
1979	USACE	TH79-2	110	97.25	12.75	CL	Fine			18				35	18	99	75	14		
1979	USACE	TH79-2	110	92.75	17.25	SM	Coarse			11					NP	100	50	17		
1979	USACE	TH79-2	110	89	21	ML	Coarse			14					NP	100	63	18		
1979	USACE	TH79-2	110	86.75	23.25	ML	Coarse			21					NP	100	67	5		
1979	USACE	TH79-2	110	83	27	SM	Coarse			24					NP	99	22	10		
1979	USACE	TH79-2	110	80.75	29.25	SM	Coarse			24					NP	99	36	25		
1979	USACE	TH79-3	140	138.5	1.5	SM	Coarse			1					NP	82	28	17		
1979	USACE	TH79-3	140	134	6	GM	Coarse			2					NP	56	15	R		
1979	USACE	TH79-3	140	130.25	9.75	SW/SM	Coarse			2					NP	60	17			
1979	USACE	TH79-3	140	127.25	12.75	SM	Coarse			10					NP	94	38	14.5		
1979	USACE	TH79-3	140	122.75	17.25	SM	Coarse			9					NP	87	41	16		
1979	USACE	TH79-3	140	118.25	21.75	CL/ML	Fine			11				23	6	99	62	13.5		
1979	USACE	TH79-3	140	113.75	26.25	CL	Fine			11				24	9	98	54	12		
1979	USACE	TH79-3	140	110.75	29.25	CL/ML	Fine			10				23	7	96	52	12		
1979	USACE	TH79-4	150	147.75	2.25	SC	Coarse			4				24	7	77	28	R		
1979	USACE	TH79-4	150	144	6	SP-SM	Coarse			2					NP	75	8	R		
1979	USACE	TH79-4	150	140.5	9.5	SM	Coarse			3					NP	85	25	9		
1979	USACE	TH79-4	150	135.75	14.25	CL-ML	Fine			13				26	5	100	65	10		
1979	USACE	TH79-4	150	131.25	18.75	CL-ML	Fine			14				23	5	99	56			
1979	USACE	TH79-4	150	127.5	22.5	SM	Coarse			8				22	7	74	26			
1979	USACE	TH79-4	150	124.5	25.5	SP-SM	Coarse			3					NP	66	9			
1979	USACE	TH79-4	150	122.25	27.75	SP-SM	Coarse			3					NP	51	8			
1979	USACE	TH79-5	192	189.75	2.25	SC	Coarse			5				23	6	76	26	R		
1979	USACE	TH79-5	192	185.25	6.75	SM	Coarse			16					NP	100	33	R		
1979	USACE	TH79-5	192	180.75	11.25	SC	Coarse			10				22	5	72	27	R		
1979	USACE	TH79-5	192	177	15	SM	Coarse			6					NP	62	17	R		
1979	USACE	TH79-5	192	174	18	GW-GM	Coarse			4					NP	52	10	R		
1979	USACE	TH79-5	192	172.25	19.75	GW	Coarse			2					NP	13	3			
1979	USACE	TH79-6	225	222.75	2.25	SP	Coarse			2					NP	60	4	R		
1979	USACE	TH79-6	225	218.25	6.75	SM	Coarse			2					NP	69	14	R		
1979	USACE	TH79-6	225	213.75	11.25	GP-GM	Coarse			3					NP	44	6	R		
1979	USACE	TH79-6	225	210.75	14.25	SW-SM	Coarse			4					NP	50	7	R		
1979	USACE	TH79-7	241	238.75	2.25	SM	Coarse			5					NP	62	21	R		
1979	USACE	TH79-7	241	234.25	6.75	GW-GM	Coarse			5					NP	49	10	R		
1979	USACE	TH79-7	241	229.75	11.25	GW-GM	Coarse			6				23	7	42	7	R		
1979	USACE	TH79-7	241	225.25	15.75	SW-SM	Coarse								NP	57	5	R		

SOILS PROPERTIES - SANTIAGO CREEK

Date	Source	ID	Gr. Elev., ft	Elev., ft	Depth, ft	Soil	Coarse / Fine	Sample #	Sample Type	w, %	γd, pcf	γ, pcf	PL	LL	PI	#4	#200	N	UC, ksf	Other
1979	USACE	TL79-8	310.1	300.1	10	GM	Coarse								NP	49	13			
1979	USACE	TL79-8	310.1	290.1	20	GP	Coarse								NP	43	2			
1979	USACE	TL79-9	310	300	10	SM	Coarse								NP	68	31			
1979	USACE	TL79-9	310	280	30	SM	Coarse								NP	92	44			
1979	USACE	TL79-9	310	265	45	GP	Coarse								NP	38	4			
1979	USACE	TL79-9	310	250	60	GM	Coarse								NP	61	23			
1979	USACE	TL79-9	310	230	80	GW-GM	Coarse								NP	46	10			
1979	USACE	TL79-9	310	205	105	GP-GM	Coarse								NP	37	11			
1979	USACE	TL79-10	320	310	10	GP-GM	Coarse								NP	55	12			
1979	USACE	TL79-10	320	280	40	GP-GM	Coarse								NP	36	7			
1979	USACE	TL79-11	320	315	5	SP	Coarse								NP	62	2			
1979	USACE	TL79-11	320	295	25	GW-GM	Coarse								NP	34	2			
1979	USACE	TL79-11	320	270	50	SP	Coarse								NP	70	4			
1979	USACE	TL79-11	320	250	70	CL	Fine							49	23	81	54			
1979	USACE	TL79-11	320	230	90	SW-SM	Coarse								NP	60	7			
1979	USACE	TL79-12	315	312.5	2.5	CL	Fine							26	8	99	62			
1979	USACE	TL79-12	315	300	15	GP-GM	Coarse								NP	49	8			

SOILS PROPERTIES - SANTIAGO CREEK

GRAVEL PIT EXPLORATIONS - WCC, Wildan

Date	Source	ID	Depth, ft	Soil	Coarse / Fine	Sample #	Sample Type	w, %	γd, pcf	γ, pcf	PL	LL	PI	#4	#200	N	N-SPT	N-MC	UC, ksf	Other
4/10/1985	WCC	B-1	3.5	ML	Fine	1	MC	14	107	122.0						23		23	9	CORR
4/10/1985	WCC	B-1	3.5	ML	Fine	1	MC												3.2	CORR
4/10/1985	WCC	B-1	6	ML	Fine	2	MC									20		20		
4/10/1985	WCC	B-1	11	ML	Fine	3	SH	21	107	129.5										
4/10/1985	WCC	B-1	12.5	ML	Fine	4	MC									28		28	7.3	
4/10/1985	WCC	B-1	15	SP	Coarse	5	MC									208		208		
4/10/1985	WCC	B-1	18	SP	Coarse	6	MC									78		78		
4/10/1985	WCC	B-2	4	SM	Coarse	1	MC					24	1		20	5		5	2	MA
4/10/1985	WCC	B-2	9	CL	Fine	2	MC	18	89	105.0						1		1		
4/10/1985	WCC	B-2	14	CL-CH	Fine	3	SH	74	84	146.2										
4/10/1985	WCC	B-2	15.5	CL-CH	Fine	4	MC									2		2		
4/10/1985	WCC	B-2	21	SC	Coarse	5	MC	31	89	116.6					39	10		10		WA
4/10/1985	WCC	B-2	25	SC	Coarse	6	MC									133.3333		133.3333		
4/10/1985	WCC	B-2	30	SC	Coarse	7	MC	12	121	135.5						300		300		
4/10/1985	WCC	B-3	3.5	SM	Coarse	1	MC	17	86	100.6						8		8		
4/10/1985	WCC	B-3	9	SM	Coarse	2	MC									2		2		
4/10/1985	WCC	B-3	14	SM	Coarse	3	SH								87	10				MA
4/10/1985	WCC	B-3	16	SM	Coarse	4	MC	33	86	114.4										
4/10/1985	WCC	B-3	21	CL	Fine	5	MC					48	25							
4/10/1985	WCC	B-3	27.5	CL	Fine	7	MC									3		3		
4/10/1985	WCC	B-3	31	CL	Fine	8	MC	32	80	105.6						2		2		
4/10/1985	WCC	B-3	36	CL	Fine	9	MC	50	72	108.0						7		7		
4/10/1985	WCC	B-3	42.5	CL	Fine	11	MC	68	86	144.5						8		8	1	
4/10/1985	WCC	B-4	6	CL	Fine	1	MC	31	92	120.52						15		15	7.2	
4/10/1985	WCC	B-4	11	CL	Fine	2	SPT								88	18	18			MA
4/10/1985	WCC	B-4	16	CL	Fine	3	SH	38	81	111.8									2.7	
4/10/1985	WCC	B-4	17	CL	Fine	4	SPT									7	7			
4/10/1985	WCC	B-4	21	CL	Fine	5	MC	48	74	109.5						6		6	1	
4/10/1985	WCC	B-4	26	SM	Coarse	6	MC	18	104	122.7						11		11		
4/10/1985	WCC	B-4	31	SM	Coarse	7	SH													
4/10/1985	WCC	B-4	32.5	SM	Coarse	8	SPT												1	
4/10/1985	WCC	B-4	36	CL	Fine	9	MC	30	82	106.6										
4/10/1985	WCC	B-4	41	CL	Fine	10	MC												1.5	
4/10/1985	WCC	B-4	52	CL	Fine	11	SH	33	86	114.4									0.3	
4/10/1985	WCC	B-4	53	CL	Fine	12	SPT													
4/10/1985	WCC	B-4	66	GP	Coarse	13	MC	24	100	124.0									4	
4/10/1985	WCC	B-5	6	CH	Fine	1	SH												5	
4/10/1985	WCC	B-5	7.5	CH	Fine	2	SPT	31	82	107.4		81	35			4	4		4.5	
4/10/1985	WCC	B-5	12	SM	Coarse	3	MC	20	94	112.8						27		27		
4/10/1985	WCC	B-5	19	SM	Coarse	4	SPT									8	8			
4/10/1985	WCC	B-5	24	SC	Coarse	5	MC	30	93	120.9						30		30	3	
4/10/1985	WCC	B-5	29	SC	Coarse	6	SH													
4/10/1985	WCC	B-5	30.5	CH	Fine	7	SPT									8	8			
4/10/1985	WCC	B-5	34	CH	Fine	8	MC									4		4		
4/10/1985	WCC	B-5	39	CH	Fine	9	MC	35	94	126.9						8		8		
4/10/1985	WCC	B-5	43	CH	Fine	10	SH													
4/10/1985	WCC	B-5	44	CH	Fine	11	SPT	43				58	33			8	8			CORR
4/10/1985	WCC	B-5	53	CL	Fine	12	MC	27	88	111.8						12		12	0.5	
4/10/1985	WCC	B-5	63	CL	Fine	13	SH													
4/10/1985	WCC	B-5	64	CL	Fine	14	SPT	20	100	120.0										
4/10/1985	WCC	B-6	7	CH	Fine	1	MC	27	90	114.3						9		9	7	
4/10/1985	WCC	B-6	14.5	CH	Fine	2	SH													
4/10/1985	WCC	B-6	16	CH	Fine	3	SPT	32				80	35			7	7			CORR
4/10/1985	WCC	B-6	22	CH	Fine	4	MC									9		9	8	
4/10/1985	WCC	B-6	31	CH	Fine	5	MC	36	86	116.96						11		11	1.2	
4/10/1985	WCC	B-6	41	GP	Coarse	6	SPT									120	120			
4/10/1985	WCC	B-7	9.5	GW	Coarse															
4/10/1985	WCC	B-8	13	CL-CH	Fine	1	SH	46	73	106.58										
4/10/1985	WCC	B-8	14.5	CL-CH	Fine	2	SPT									2	2			
4/10/1985	WCC	B-8	24.5	CL-CH	Fine	3	MC	55	70	108.5						7		7		
4/10/1985	WCC	B-8	29	CL-CH	Fine	4	MC									3		3		
4/10/1985	WCC	B-8	42.5	CL-CH	Fine	5	SH													

SOILS PROPERTIES - SANTIAGO CREEK

GRAVEL PIT EXPLORATIONS - WCC, Wildan

Date	Source	ID	Depth, ft	Soil	Coarse / Fine	Sample #	Sample Type	w, %	γd, pcf	γ, pcf	PL	LL	PI	#4	#200	N	N-SPT	N-MC	UC, ksf	Other
4/10/1985	WCC	B-8	44	CL-CH	Fine	6	SPT	46								4	4			
4/10/1985	WCC	B-8	49	CL-CH	Fine	7	MC	30	81	105.3		56	28			5		5		
1979	USACE	TL79-8	10	GM	Coarse									49	13					
1979	USACE	TL79-8	20	GP	Coarse									43	2					
1979	USACE	TL79-9	10	SM	Coarse									68	31					
1979	USACE	TL79-9	30	SM	Coarse									92	44					
1979	USACE	TL79-9	45	GP	Coarse									38	4					
1979	USACE	TL79-9	60	GM	Coarse									61	23					
1979	USACE	TL79-9	80	GW-GM	Coarse									46	10					
1979	USACE	TL79-9	105	GP-GM	Coarse									37	11					
1979	USACE	TL79-10	10	GP-GM	Coarse									55	12					
1979	USACE	TL79-10	40	GP-GM	Coarse									36	7					
1979	USACE	TL79-11	5	SP	Coarse									62	2					
1979	USACE	TL79-11	25	GW-GM	Coarse									34	2					
1979	USACE	TL79-11	50	SP	Coarse									70	4					
1979	USACE	TL79-11	70	CL	Fine							49	23	81	54					
1979	USACE	TL79-11	90	SW-SM	Coarse									60	7					
1979	USACE	TL79-12	2.5	CL	Fine							26	8	99	62					
1979	USACE	TL79-12	15	GP-GM	Coarse									49	8					
11/25/2008	Willdan	B-1	7.5	SC	Coarse	B-1								74	38					
11/25/2008	Willdan	B-1	8	SC	Coarse	B-1		5.6												
11/25/2008	Willdan	B-1	10.5	GC	Coarse	R-1		8.7	108.4	117.8308										
11/25/2008	Willdan	B-1	32.5	GC	Coarse	B-2								43	13					
11/25/2008	Willdan	B-1	35.5	GC	Coarse	R-4		4.2	91.3	95.1346										
11/25/2008	Willdan	B-1	41	GC	Coarse	R-5		13.5	84	95.34										
11/25/2008	Willdan	B-1	50.5	GC	Coarse	R-6		3.6	110.7	114.6852										
11/25/2008	Willdan	B-1	60.5	GC	Coarse	R-7		3.8	95.8	99.4404										
11/25/2008	Willdan	B-1	70.5	GC	Coarse	R-8		6.3	58.1	61.7603										
11/25/2008	Willdan	B-1	80.5	SC	Coarse	R-9		20	111.2	133.44										
11/25/2008	Willdan	B-1	87.5	SC	Coarse	B-1								85	48					
11/25/2008	Willdan	B-1	100.5	GC	Coarse	R-12		6.3	81.7	86.8471										
11/25/2008	Willdan	B-1	110.5	GC	Coarse	R-13		7.7	89.7	96.6069										
11/25/2008	Willdan	B-1	112.5	SC	Coarse	B-1								73	49					
11/25/2008	Willdan	B-1	121.5	ML	Fine	R-14		22.1	105.3	128.5713										
11/25/2008	Willdan	B-1	135.5	GP-GM	Coarse	R-16		5.6	91.9	97.0464										

SOILS PROPERTIES - SANTIAGO CREEK

Date	Source	ID	Gr. Elev., ft	Elev., ft	Depth, ft	Soil	Coarse / Fine	Sample #	Sample Type	w, %	γd, pcf	γ, pcf	PL	LL	PI	#4	#200	N	UC, ksf	Other
9/17/1990	OCEMA	B-1	279	276	3	SW	Coarse													
9/17/1990	OCEMA	B-1	279	273	6	SC	Coarse													
9/17/1990	OCEMA	B-1	279	269	10	SM	Coarse													
9/17/1990	OCEMA	B-1	279	253	26	GP-GM	Coarse			5	120									85% RC
9/17/1990	OCEMA	B-2	280	257	23	GP-GM	Coarse													
9/17/1990	OCEMA	B-2	280	262.5	17.5	GP-GM	Coarse			2.9	118							44		84% RC
9/17/1990	OCEMA	B-2	280	256.5	23.5	SC	Coarse			16.9	125							50		88% RC
9/17/1990	OCEMA	B-2	280	254.5	25.5	SC	Coarse			9.4	125							50		89% RC
9/17/1990	OCEMA	B-2	280	254	26	SC	Coarse													
9/17/1990	OCEMA	B-3	281	266	15	SW-SM	Coarse													
9/17/1990	OCEMA	B-3	281	262.5	18.5	GM	Coarse			3.9	125							50		89% RC
9/17/1990	OCEMA	B-3	281	250.5	30.5	GM	Coarse			3.2	126							50		89% RC

SOILS PROPERTIES - SANTIAGO CREEK

Date	Source	ID	Gr. Elev., ft	Elev., ft	Depth, ft	Soil	Coarse / Fine	Sample #	Sample Type	w, %	γd, pcf	γ, pcf	PL	LL	PI	#4	#200	N	UC, ksf	Other
10/2/1990	OCEMA	TP-1	260	247	13	GW-GM	Coarse													
10/2/1990	OCEMA	TP-2	267	264	3	GW-GM	Coarse													
10/2/1990	OCEMA	TP-2	267	252	15	GW-GM	Coarse													
10/2/1990	OCEMA	TP-3	264.5	260.5	4	GW-GM	Coarse													
10/2/1990	OCEMA	TP-3	264.5	247.5	17	SW-SM	Coarse													
10/2/1990	OCEMA	TP-4	267	261	6	GW-GM	Coarse													
10/2/1990	OCEMA	TP-4	267	254	13	GW-GC	Coarse													
10/2/1990	OCEMA	TP-4	267	251	16	SP-SM	Coarse													
10/2/1990	OCEMA	TP-5	270.5	267.5	3	GW-GM	Coarse													
10/2/1990	OCEMA	TP-5	270.5	262.5	8	SC	Coarse													
10/2/1990	OCEMA	TP-5	270.5	252.5	18	GP	Coarse													

ASTM D422, D1140 & D6913 - Particle Size Analysis - Percent Passing

Number LAB	Number Hole	Number Sample	(ft) Depth	% 3 in	% 2 in	% 1-1/2 in	% 1 in	% 3/4 in	% 1/2 in	% 3/8 in	% No.4	% No.10	% No.20	% No.40	% No.60	% No.100	% No.140	% No 200	LL D4318	PL Atterberg	PI Limits	MC% D2216	SpG D854	Color	Class.	D2487 Unified Soil Classification System	Cobbles %	Gravel %	Sand %	Fines %
L1/16779	TH20-05		0.0 to 5.0							100	99	97.4	95.7	94.1	90.6	84.9	73.1	61.6	50.4				20.12		Brown	CL	(Visual) Sandy Lean Clay (CL), with a trace of gravel.	0	2.6	47	50.4
L1/16780	TH20-05		5.0 to 10.0																				13.18		Brown			0	0	0	0
L1/16783	TH20-05		15.0 to 20.0								100	99.3	97.7	94.2	86.2	73.4	60.6	54.6	49.9				15.5		Brown	SC	(Visual) Clayey Sand (SC).	0	0.7	49.4	49.9
L1/16785	TH20-05		20.0 to 25.0																				17.11		Dark Yellowish Brown						
L1/16786	TH20-05		25.0 to 30.0																				18.68		Brown						
L1/16787	TH20-05		30.0 to 35.0																				21.31		Brown						
L1/16788	TH20-05		35.0 to 40.0				100	97	89.2	83.8	75.8	69.4	64.1	52.4	38.2	28.7	24.8	21.6				5.82		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	24.2	54.2	21.6
L1/16789	TH20-05		40.0 to 45.0																			8.97		Dark Brown						
L1/16791	TH20-05		45.0 to 50.0					100	90.2	84	69.9	56	48.7	42.6	35.8	29.3	25.9	22.9				2.49		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	30.1	47	22.9
L1/16793	TH20-05		55.0 to 60.0					100	93.5	87.4	74.4	60.2	43.3	27.1	17.6	12.8	11.1	9.9				8.39		Dark Grayish Brown	SP-SM	Poorly Graded Silty Sand (SP-SM), with some gravel.	0	25.6	64.5	9.9
L1/16864	TH20-05		75.0 to 80.0																			8.24		Brown						
L1/16865	TH20-05		80.0 to 85.0																			11.8		Brown						
L1/16866	TH20-05		85.0 to 90.0																			8.81		Brown						
L1/16897	TH20-07		0.0 to 5.0					100	90.7	82.1	72.8	62.2	51.2	39.2	30.9	24.4	21.2	18.6	26	15	11	2.24		Grayish Brown	SC	Clayey Sand (SC), with some gravel.	0	27.2	54.2	18.6
L1/16899	TH20-07		10.0 to 11.5					100	95.8	95	93.8	90.9	86.5	75.9	64.9	57	52.7	48.8				10.41		Grayish Brown	SC	(Visual) Clayey Sand (SC), with a trace of gravel.	0	6.2	45	48.8
L1/16900	TH20-07		10.0 to 15.0																46	20	26	22.16		Grayish Brown	CL	(Visual) Lean Clay (CL), with sand.				
L1/17277C	TH20-07		10.5 to 12.5								100	98.8	98.1	97.3	95.7	93.5	91.8	89.6	50	21	29	19.93		Dark Brown & Very Pale Brown	CH	Fat Clay (CH), with a little sand.	0	0	10.4	89.6
L1/17278C	TH20-07		12.5 to 14.5								100	98	97	94.9	91.1	86.4	84.1	82.3	41	20	21	18.31		Dark Brown & Very Pale Brown	CL	Lean Clay (CL), with a little sand.	0	0	17.7	82.3
L1/16901	TH20-07		15.0 to 20.0							100	97.4	93.4	91.5	88.9	84.1	78.8	76	73.9	29	16	13	14.13		Dark Yellowish Brown	CL	Lean Clay (CL), with some sand and a trace of gravel.	0	2.6	23.5	73.9
L1/16903	TH20-07		20.0 to 25.0																34	19	15	22.37		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16905	TH20-07		30.0 to 35.0							100	99.6	99.4	97.5	87.3	68.6	37	21.6	13.5	21	17	4	22.14		Brown	SC-SM	Clayey Silty Sand (SC-SM).	0	0.4	86.1	13.5
L1/16906	TH20-07		35.0 to 40.0																37	22	15	27.02		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16909	TH20-07		50.0 to 55.0																23	15	8	14.48		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16910	TH20-07		55.0 to 60.0					100	93.9	86.7	75.5	67.7	62.1	53.9	44.2	35.3	31.4	28.2				10.16		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	24.5	47.3	28.2
L1/16912	TH20-07		65.0 to 70.0				100	95	76.5	65.6	46.2	36.1	27.5	14.6	8.1	5.7	4.9	4.4				4.56		Brown	GP	Sandy Poorly Graded Gravel (GP).	0	53.8	41.8	4.4
L1/16914	TH20-07		80.0 to 85.0																			16.59		Brown						
L1/16915	TH20-07		85.0 to 90.0																31	19	12	21.41		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16916	TH20-07		90.0 to 95.0																29	20	9	23.09		Brown	SC	(Visual) Clayey Sand (SC).				
L1/17279	TH20-07		95.0 to 100.0							100	98.7	98.6	98.3	96.5	89.6	73	59.9	48.3	24	18	6	19.97		Brown	SC-SM	Clayey Silty Sand (SC-SM), with a trace of gravel.	0	1.3	50.4	48.3
L1/16924	TH20-12		5.0 to 8.0				100	94.6	93.4	79.5	77.6	75.9	73.6	67.9	54.2	31.4	21.4	15.8				4.88		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	22.4	61.8	15.8
L1/17279C	TH20-12		10.0 to 12.0							100	99	97.9	96.4	93.8	88.6	80.2	75	69.9	33	18	15	18.47		Yellowish Brown	CL	Lean Clay (CL), with some sand and a trace of gravel.	0	1	29.1	69.9
L1/16927	TH20-12		12.0 to 13.5																27	18	9	24.22		Brown	CL	(Visual) Lean Clay (CL), with sand.				
L1/16928	TH20-12		15.0 to 19.0								100	99.5	98	93.1	85.9	77.3	71.7	65.1	24	17	7	11.74		Brown	CL-ML	Silty Lean Clay (CL-ML), with some sand.	0	0	34.9	65.1
L1/16930	TH20-12		20.0 to 25.0																27	17	10	10.58		Brown	CL	(Visual) Lean Clay (CL), with sand.				
L1/16934	TH20-12		35.0 to 40.0																26	16	10	17.55		Brown	CL	(Visual) Lean Clay (CL), with sand.				
L1/16935	TH20-12		38.0 to 40.0																			19.77		Brown						
L1/16936	TH20-12		40.0 to 45.0																			18.97		Dark Yellowish Brown						
L1/16937	TH20-12		45.0 to 50.0			100	92.4	83.5	71.6	66.9	54.5	43.6	34.4	24.5	18.5	15.1	13.6	12.3				2.97		Brown	GM	Sandy Silty Gravel (GM).	0	45.5	42.2	12.3
L1/16938	TH20-12		50.0 to 55.0																27	15	12	12.08		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16939	TH20-12		55.0 to 60.0					100	93.5	92.1	88.5	80.4	70.7	58.6	52	44.6	38.8	32.6	23	16	7	8.48		Brown	SC-SM	Clayey Silty Sand (SC-SM), with a little gravel.	0	11.5	55.9	32.6
L1/16940	TH20-12		60.0 to 65.0																27	18	9	19.67		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16941	TH20-12		65.0 to 70.0					100	90.6	87.3	76.8	68.9	62.4	49.6	33	22.3	18.4	15.4				6.41		Dark Yellowish Brown	SM	Silty Sand (SM), with some gravel.	0	23.2	61.4	15.4
L1/16942	TH20-12		70.0 to 75.0																			13.36		Brown						
L1/16943	TH20-12		75.0 to 80.0				100	94.4	87.7	82.2	67.5	52.6	39.4	25	15.3	10.5	8.9	7.7				4.01		Dark Yellowish Brown	SP-SM	Poorly Graded Silty Sand (SP-SM), with some gravel.	0	32.5	59.8	7.7
L1/16944	TH20-12		80.0 to 85.0																29	15	14	12.91		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC).				
L1/16945	TH20-12		85.0 to 90.0								100	99.2	95	85.2	74.7	56.5	38.8	26.2				17.54		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC).	0	0	73.8	26.2
L1/16947	TH20-12		95.0 to 100.0						100	97.9	96.8	93.4	81.3	54.7	27.9	13.3	9.1	6.9				15.5		Brown	SP-SM	Poorly Graded Silty Sand (SP-SM), with a trace of gravel.	0	3.2	89.9	6.9
L1/16948	TH20-13		0.0 to 5.0																			4.2		Brown						
L1/16949	TH20-13		5.0 to 10.0																33	16	17	10.33		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16950	TH20-13		10.0 to 12.0																31	16	15	9.19		Brown	SC	(Visual) Clayey Sand (SC).				
L1/16798	TH20-14		0.0 to 10.0			100	91.9	91.9	79.3	70.3	57.2	45.5	36.2	26	19.2	15.3	14.1	12.2				4.2		Brown	SM	Gravelly Silty Sand (SM).	0	42.8	45	12.2
L1/16959	TH20-14		10.0 to 20.0			100	92.3	89.4	79.4	73.5	58.6	45.6	33.2	23.9	18.2	14.1	12.2	10.8				3.82		Brown	SP-SM	Gravelly Poorly Graded Silty Sand (SP-SM).	0	41.4	47.8	10.8
L1/16963	TH20-14		20.0 to 30.0			100	87.3	78.5	69.1	62.6	48.4	37.4	27.1	19	14.9	12.1	10.9	9.9				3.51		Brown	GP-GM	Sandy Poorly Graded Silty Gravel (GP-GM).	0	51.6	38.5	9.9
L1/16965	TH20-14	S-7	30.0 to 35.0				100	87.5	75.6	68.7	53.6											6.38		Brown	SM	(Visual) Gravelly Silty Sand (SM).	0	46.4	0	0
L1/16799	TH20-14		38.0 to 40.0				100	88.9	77.4	66.4	40	30.7	24.8	18.4	13.5	10.3	9.1	8.1	20	13	7	2.79		Brown	GW-GC	Well Graded Clayey Gravel (GW-GC), with some sand.	0	60	31.9	8.1
L1/16800	TH20-14		40.0 to 42.0				100	90.9	78.6	67.7	53.9	42.9	34.1	25.5	19.6	15.7	14	12.5	20	14	6	5.58		Brown	GC-GM	Sandy Clayey Silty Gravel (GC-GM).	0	46.1	41.4	12.5
L1/16969	TH20-14		40.0 to 50.0				100	95.8	85	76.7	64.5											2.14		Brown	SM	(Visual) Gravelly Silty Sand (SM).	0	35.5	0	0
L1/16973	TH20-14	S-11	50.0 to 55.0			100	93.2	90.1	80.5	73	50.9	29.2	17.2	13.1	11.3	10	9.3	8.5	26	17	9	11.33		Brown	GP-GC	Sandy Poorly Graded Clayey Gravel (GP-GC).	0	49.1	42.4	8.5
L1/16975	TH20-14		50.0 to 60.0				100	97.3	92.9	86.4	76	64.5	51.9	38.5	31.3	26.6	24.1	22.1				6.95		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	24	53.9	22.1
L1/16978	TH20-14		60.0 to 70.0				100	96.4	83.7	75.2	57	49.6	40.1	30.3	24.7	20.8	18.7	16.9				3.41		Brown	GM	(Visual) Sandy Silty Gravel (GM).	0	43	40.1	16.9
L1/16981	TH20-14		70.0 to 80.0		100	90	90	84.6	77.5	74.3	63.5	54	42.2	31.1	24.3	19.7	17.6	15.8	27	15	12	8.4		Brown & Pale Brown	SC	Gravelly Clayey Sand (SC).	0	36.5	47.7	15.8
L1/17282	TH20-14		80.0 to 90.0			100	90.8	87.7	79.1	74.3	62.7	51.1	39.9	29.6	24.3	20.5	18.6	16.8	27	15	12	5.59		Brown & Pale Brown	SC	Gravelly Clayey Sand (SC).	0	37.3	45.9	16.8
L1/17283	TH20-14		90.0 to 100.0		100	88.8	81.1	72.9	66.1	57.8	48.4	37.5	27.7	19.6	15.6	13.6	11.8	10.7	28	18	10	5.87		Brown	GP-GC	Sandy Clayey Poorly Graded Gravel (GP-GC).	0	51.6	37.7	10.7
L1/17287	TH20-14		100.0 to 110.0				100	90.8	82.4	75	68.4	59.2	47.7	35.1	24.1	19.3	16.3	14.8	13.6	31	18	13	6.57		Brown	SC	Gravelly Clayey Sand (SC).	0	40.8	45.6	13.6
L1/17289	TH20-14		110.0 to 120.0				100	98	94.1	85.5	81.1	72.5	60.2	49.7	39.2	33.1	28.7	26.5	24.4	26	13	13	4.97		Brown	SC	Clayey Sand (SC), with some gravel.	0	27.5	48.1	24.4
L1/17292	TH20-14	S-25	120.0 to 125.0				100	94.4	88.9	81.5	76.4	65.3	51.6	40.5	32.2	28	24.8	23	21.3	29	16	13	8.93		Brown	SC	Clayey Sand (SC), with some gravel.	0	34.7	44	21.3
L1/17293	TH20-14	S-26	125.0 to 130.0				100	95.9	87	78.6	71.1	60.8	48.2	40.9	34.8	30.3	26.2	23.9	21.8	23	16	7	2.53		Brown	GC-GM	Sandy Clayey Silty Gravel (GC-GM).	0	39.2	39	21.8
L1/17295	TH20-14		130.0 to 140.0		100	90.9	87.7	81.2	78.4	73.5	60.1	47.9	37.8	29.7	25	21.5	19.5	17.8	27	16	11	2.98		Very Pale Brown	SC	Gravelly Clayey Sand (SC).	0	39.9	42.3	17.8
L1/17300A	TH20-14		140.0 to 150.0			100	84.7	84.7	79.4	74.4	66	55.8	45.6	35.7	29.7	25.5	23.2	21.2	29	14	15	5.31		Brown & Pale Brown	SC	Clayey Sand (SC), with some gravel.	0	34	44.8	21.2
L1/16801	TH20-15		0.0 to 10.0				100	92.9	87.4	80	69.7	60.3	54.3	49.4	43.7	35.4	31.1	25.1				2.58		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	30.3	44.6	25.1
L1/16984	TH20-15		5.0 to 10.0			100	84.6	70.9	58.1	51	39.3											3.29		Brown	GM	(Visual) Sandy Silty Gravel (GM).	0	60.7	0	0
L1/16985	TH20-15		10.0 to 20.0			100	95.5	87.4	75.2	68	55.8											1		Brown	SM	(Visual) Gravelly Silty Sand (SM).	0	44.2	0	0
L1/16802	TH20-15		20.0 to 30.0	100	97.8	93.7	84.7	78.6	68.5	62.2	48	32	21.6	16.1	13.3	11.2	10	8.9	30	16	14	5.72		Brown	GP-GC	Sandy Poorly Graded Clayey Gravel (GP-GC).	0	52	39.1	8.9
L1/16991	TH20-15		30.0 to 40.0			100	93.8	75.5	64.4	59.5	48.9	38.4	29	20.4	14.6	11.2	9.9	9	21	16	5	7.48		Brown	GP-GC	Sandy Poorly Graded Clayey Gravel (GP-GC).	0	51.1	39.9	9
L1/16803	TH20-15		40.0 to 42.0					100	84.7	81	73.9	67.3	62.5	57.1	50.5	42.7	37.8	33.3	27	15	12	15.23		Dark Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	26.1	40.6	33.3
L1/16994	TH20-15	S-9	40.0 to 45.0																			27	15	12	11.15	Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/16995	TH20-15	S-10	45.0 to 50.0				100	97.2	95.6	85.6	78.4	69	56.7	48.2	40.9	35.5	31	28.3	25.6	22	14	8	2.62		Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	31	43.4	25.6
L1/16997	TH20-15		50.0 to 60.0				100	94	92.3	89.1	81.6	73.9	68.5	65.3	63	58.7	53.2	46.2	29	17	12	14.96		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	18.4	35.4	46.2
L1/16999	TH20-15	S-12	55.0 to 60.0					100	91.5	87.8	71.8	61.7	43.9	28.9	23.8	20.6	18.9	17.3	29	15	14	5.24		Brown	SC	Clayey Sand (SC), with some gravel.	0	28.2	54.5	17.3
L1/16805	TH20-15		60.0 to 62.0					100	94.2	90.6	85.2	81.8	79.3	76.2	70.8	60.9	53.3	45.9	27	15	12	12.16		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	14.8	39.3	45.9
L1/17001	TH20-15	S-13	60.0 to 65.0					100	97.3	97.3	90.6	83.5	76.9	71	64.5	55.4	49.1	42.9	28	15	13	18.16		Yellowish Brown	SC	Clayey Sand (SC), with a trace of gravel.	0	9.4	47.7	42.9
L1/17002	TH20-15	S-14	65.0 to 75.0			100	94.3	92.5	74.3	65.2	54.4											8.85		Yellowish Brown	SP-SM	(Visual) Gravelly Poorly Graded Silty Sand (SP-SM).	0	45.6	0	0
L1/17003	TH20-15	S-15	70.0 to 75.0			100	96.5	89.2	79.4	71.8	59.4	47.8	35.7	23.3	17.2	14.1	12.7	11.5				5.2		Yellowish Brown	SP-SM	Gravelly Poorly Graded Silty Sand (SP-SM).	0	40.6	47.9	11.5
L1/17005	TH20-15		70.0 to 80.0			100	95.2	90.8	78.4	68.9	56	46.8	36.1	23.1	16.4	13.3	11.9	10.7				5.2		Yellowish Brown	SP-SM	Gravelly Poorly Graded Silty Sand (SP-SM).	0	44	45.3	10.7
L1/17004	TH20-15	S-16	75.0 to 80.0																			5.2		Yellowish Brown						
L1/17008	TH20-15		80.0 to 90.0			100	98.1	94.3	80.7	74.4	62.8											1.4		Yellowish Brown	SP-SM	(Visual) Gravelly Poorly Graded Silty Sand (SP-SM).	0	37.2	0	0
L1/17011	TH20-15		90.0 to 100.0																26	18	8	16.68		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/17014	TH20-15		100.0 to 110.0					100	89.3	80.9	64.7	52.7	44.4	37.1	32.7	29.2	27.2	25.2	29	16	13	5.74		Yellowish Brown	SC	Gravelly Clayey Sand (SC).	0	35.3	39.5	25.2
L1/17017	TH20-15		110.0 to 120.0					100	94.4	87.4	69.1	55.7	46.4	37.5	32.6	28.9	26.8	24.9	29	15	14	6.49		Brown	SC	Clayey Sand (SC), with some gravel.	0	30.9	44.2	24.9
L1/17016	TH20-15	S-24	115.0 to 120.0					100	86.4	80.5	67.9	57.5	48.4	39.3	34	29.9	27.6	25.6				7.83		Olive Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	32.1	42.3	25.6
L1/17018	TH20-15		120.0 to 130.0																28	16	12	12.08		Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/17021	TH20-15	S-27	130.0 to 135.0																31	16	15	18.36		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/17022	TH20-15	S-28	135.0 to 140.0					100	98	97.4	90.2	84.8	79.7	72.6	65.2	56.2	50.1	44.3				9.12		Brown	SC	(Visual) Clayey Sand (SC), with a trace of gravel.	0	9.8	45.9	44.3
L1/17025	TH20-15	S-29	140.0 to 145.0							100	99.7	99.2	97.8	93.4	87.5	80.6	75	68.2				19.12		Dark Yellowish Brown	CL	(Visual) Lean Clay (CL), with some sand.	0	0.3	31.5	68.2
L1/17026	TH20-15	S-30	145.0 to 150.0				100	95.9	92.1	89.5	83.6											7.68		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with a little gravel.	0	16.4	0	0
L1/17027	TH20-16	S-1	0.0 to 5.0					100	87.2	82.9	69.7	59.3	49	40.2	35.5	31.7	29.5	27.4				0.81		Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	30.3	42.3	27.4
L1/17028	TH20-16	S-2	5.0 to 10.0			100	89.3	85.4	74.3	66.9	54.9											6.22		Pale Brown	GM	(Visual) Sandy Silty Gravel (GM).	0	45.1	0	0
L1/17029	TH20-16	S-3	10.0 to 15.0					100	92.6	86.4	68	53.4	37.4	20.1	13.8	11.2	10.1	9.3				4.35		Yellowish Brown & Olive Brown	SP-SM	Poorly Graded Silty Sand (SP-SM), with some gravel.	0	32	58.7	9.3
L1/17030	TH20-16	S-4	15.0 to 20.0				100	84	69.6	60.8	48											4.63		Yellowish Brown	GM	(Visual) Sandy Silty Gravel (GM).	0	52	0	0
L1/17031	TH20-16		20.0 to 22.0					100	98.1	94.4	89.4	82.7	75.4	66.1	60.9	55.3	51.6	47.1	30	16	14	9.34		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	10.6	42.3	47.1
L1/17033	TH20-16	S-6	25.0 to 30.0			100	82.2	77.1	66.4	59.8	45.9	36.6	28.2	17.1	11.1	8.5	7.3	6.5				5.62		Dark Yellowish Brown	GP-GM	(Visual) Sandy Silty Poorly Graded Gravel (GP-GM).	0	54.1	39.4	6.5

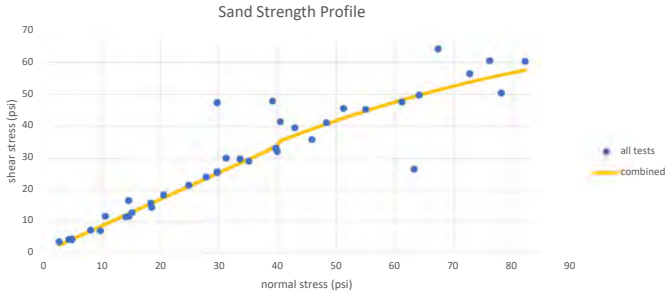
Number LAB	Number Hole	Number Sample	(ft) Depth	% 3 in	% 2 in	% 1-1/2 in	% 1 in	% 3/4 in	% 1/2 in	% 3/8 in	% No.4	% No.10	% No.20	% No.40	% No.60	% No.100	% No.140	% No 200	LL D4318 Atterberg Limits	PL	PI	MC% D2216	SpG D854	Color	Class.	D2487 Unified Soil Classification System	Cobbles %	Gravel %	Sand %	Fines %
L1/17034	TH20-17	S-1	0.0 to 5.0			100	92.6	80.3	72.8	66.8	55.8	43.5	34.4	25.1	18.8	14.9	13.1	11.6	24	15	9	1.84		Yellowish Brown	GW-GC	Sandy Well Graded Clayey Gravel (GW-GC).	0	44.2	44.2	11.6
L1/17035	TH20-17	S-2	5.0 to 10.0			100	84.3	68.5	55.1	48.7	40.3	32.9	25.8	18.4	14.5	11.8	10.5	9.3				2.89		Brown	GP-GM	(Visual) Silty Poorly Graded Gravel (GP-GM), with some sand.	0	59.7	31	9.3
L1/17036	TH20-17	S-3	10.0 to 15.0			100	92.6	90.1	79.5	71.1	56.5	42.6	28	17.8	13.9	11.8	10.8	9.8				5.37		Brown	SP-SM	(Visual) Gravelly Poorly Graded Silty Sand (SP-SM).	0	43.5	46.7	9.8
L1/16806	TH20-17		10.0 to 20.0	97.2	94.5	91.6	81.8	74.8	64.2	58.6	46.6	35.9	26.7	19.9	16.3	13.8	12.5	11.4	26	13	13	4.09		Olive Brown	GP-GC	Sandy Clayey Poorly Graded Gravel (GP-GC), with a trace of cobble.	2.8	50.6	35.2	11.4
L1/17037	TH20-17	S-4	15.0 to 20.0			100	89.8	84.5	69.9	61.1	47.1	34.6	22.9	14.7	11.3	9.2	8.1	7.3	28	16	12	6.48		Dark Yellowish Brown	GW-GC	Sandy Well Graded Clayey Gravel (GW-GC).	0	52.9	39.8	7.3
L1/17039	TH20-17	S-6	25.0 to 30.0			100	98.1	88.6	80.1	76.6	69.9	61.5	53.3	51	37.6	34.1	32.5	31.1				7.65		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	30.1	38.8	31.1
L1/17040	TH20-17	S-7	30.0 to 35.0																			12.58		Dark Yellowish Brown						
L1/17041	TH20-17	S-8	35.0 to 40.0				100	93.5	79.1	71.9	61.5	55.2	45.6	27.2	18.1	15	13.6	12.5				8.3		Brown	SM	(Visual) Gravelly Silty Sand (SM).	0	38.5	49	12.5
L1/17042	TH20-17	S-9	40.0 to 45.0			100	96.5	91.6	83.5	75.1	61.7								25	14	11	8.6		Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	38.3	0	0
L1/17044	TH20-18	S-1	0.0 to 5.0			100	95	90	81.6	75.1	61.4	53.5	47.5	40.9	34.2	27.2	23.2	19.7	21	16	5	1.89		Yellowish Brown	SC-SM	Gravelly Clayey Silty Sand (SC-SM).	0	38.6	41.7	19.7
L1/17045	TH20-18		5.0 to 10.0																			1.9		Dark Yellowish Brown						
L1/16807	TH20-18		10.0 to 20.0					100	89.6	84.8	63.4	41	29.5	22.9	18.9	16	14.6	13.3	26	14	12	1.1		Pale Brown	SC	Gravelly Clayey Sand (SC).	0	36.6	50.1	13.3
L1/17047	TH20-18	S-4	15.0 to 20.0			100	97.9	88.1	75.4	66.4	52.2													Brown	GC	(Visual) Sandy Clayey Gravel (GC).	0	47.8	0	0
L1/16808	TH20-18		20.0 to 30.0				100	96.6	89.3	80.4	59.6	47.8	40.3	32.7	27.7	23.1	20.6	18.6	29	17	12	1.76		Pale Brown	SC	Gravelly Clayey Sand (SC).	0	40.4	41	18.6
L1/17049	TH20-18	S-5	20.0 to 25.0				100	96	87.4	78.7	63.2											1.8		Pale Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	36.8	0	0
L1/17051	TH20-18	S-6	25.0 to 30.0																			7.37		Yellowish Brown						
L1/17052	TH20-18	S-7	30.0 to 35.0				100	97.2	85.3	74.6	58.8											6.19		Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	41.2	0	0
L1/17054	TH20-18		30.0 to 40.0					100	84.3	77.4	63.1	50.3	38.5	23.9	16.6	13.5	12.1	11				2.82		Brown	SP-SM	(Visual) Gravelly Poorly Graded Silty Sand (SP-SM).	0	36.9	52.1	11
L1/17056	TH20-18		40.0 to 50.0					100	96.9	93.8	79.8	64.8	50.3	38.1	31.4	26.8	24.5	22.4				4.54		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	20.2	57.4	22.4
L1/17058	TH20-18	S-11	50.0 to 55.0																31	16	15	19.56		Brown	SC	(Visual) Clayey Sand (SC).				
L1/17059	TH20-18	S-12	55.0 to 60.0						100	99.2	98.4	97.3	95.3	90.4	80	63.5	51.9	42.2	25	17	8	13.47		Dark Yellowish Brown	SC	Clayey Sand (SC), with a trace of gravel.	0	1.6	56.2	42.2
L1/17063	TH20-18		60.0 to 70.0					100	96.5	85.9	69.7	60.4	49.6	35.1	26.4	21.2	18.7	16.6				1.05		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	30.3	53.1	16.6
L1/17066	TH20-18		70.0 to 80.0					100	99	93.6	83.9	66.9	50.4	33.7	23.8	18.7	16.6	14.9				1.81		Pale Brown	SC	(Visual) Clayey Sand (SC), with a little gravel.	0	16.1	69	14.9
L1/17067	TH20-18		80.0 to 90.0							100	92.5	81.8	63.7	39.3	27.2	21	18.5	16.5	26	15	11	1.27		Very Pale Brown	SC	Clayey Sand (SC), with a trace of gravel.	0	7.5	76	16.5
L1/17070	TH20-18		90.0 to 100.0		100	98.8	97.6	97	95.7	94.5	90.9	78.7	69.3	58.5	48.2	34.6	22.8	9.4	28	16	12	2.56		Yellowish Brown	SP-SC	Poorly Graded Clayey Sand (SP-SC), with a trace of gravel.	0	9.1	81.5	9.4
L1/17073	TH20-19		0.0 to 10.0				100	96.9	91.7	89.7	83.8	79.4	74.4	67.9	62.3	57	53.6	49.6				4.92		Brown	SC	(Visual) Clayey Sand (SC), with a little gravel.	0	16.2	34.2	49.6
L1/16812	TH20-19		30.0 to 40.0	100	67.7	55.9	51.5	45.7	42.3	36.7	26.5	19.5	15.6	12.9	11.2	9.8	9.1	8.4	24	15	9	0.82		Brown	GP-GC	Poorly Graded Clayey Gravel (GP-GC), with a little sand.	0	73.5	18.1	8.4
L1/16813	TH20-19		40.0 to 43.0					100	99.7	99.5	99.3	96.9	94.9	91.9	88.7	83.8	78.9	72.1	34	14	20	21.73		Brown	CL	Lean Clay (CL), with some sand.	0	0.7	27.2	72.1
L1/17089	TH20-19	S-10	45.0 to 50.0				100	88.9	74.6	65.3	44.3	38.8	33.8	28.9	25.3	22.1	20.2	18.4				2.16		Brown	GC	(Visual) Clayey Gravel (GC), with some sand.	0	55.7	25.9	18.4
L1/17095	TH20-19		60.0 to 70.0			100	81.9	56.6	45.6	39.5	23.3	20	16.2	12.6	10.5	8.7	7.8	7				4.2		Pale Brown	GP-GM	(Visual) Poorly Graded Silty Gravel (GP-GM), with a little sand.	0	76.7	16.3	7
L1/17300B	TH20-19		70.0 to 80.0			100	92.8	86.8	76.1	69.4	56.8	44.8	35	26.1	20.8	17.3	15.7	14.3	26	14	12	1.09		Brown	GC	Sandy Clayey Gravel (GC).	0	43.2	42.5	14.3
L1/17302	TH20-19	S-16	75.0 to 80.0			100	85.4	73.9	69.9	65.4	55.8	45.4	34.9	25.3	19.8	16.4	14.8	13.4	28	15	13	5.62		Yellowish Brown	GC	Sandy Clayey Gravel (GC).	0	44.2	42.4	13.4
L1/17304	TH20-19		80.0 to 90.0			100	94.9	81.9	73.1	63.5	48.2	37.3	30.7	25.3	21.5	18.5	16.9	15.3	27	17	10	4.97		Dark Yellowish Brown	GC	Clayey Gravel (GC), with some sand.	0	51.8	32.9	15.3
L1/17306	TH20-19	S-19	90.0 to 95.0																					Dark Yellowish Brown						
L1/17308	TH20-19		90.0 to 100.0								100	89.3	76.9	58.7	48.1	41.8	38.5	35.5				4.38		Yellowish Brown	SC	(Visual) Clayey Sand (SC).	0	0	64.5	35.5
L1/17311	TH20-19		100.0 to 110.0			100	92.1	87.3	78	71	60	53	45	37	30.9	26.4	24.1	22	29	15	14	1.64		Light Gray	GC	Sandy Clayey Gravel (GC).	0	40	38	22
L1/17310	TH20-19	S-22	105.0 to 110.0				100	96.4	88.5	83.2	72.7	64	54	39.7	30.1	24.2	21.7	19.5	27	15	12	8.61		Pale Brown	SC	Clayey Sand (SC), with some gravel.	0	27.3	53.2	19.5
L1/17312	TH20-19	S-23	110.0 to 115.0				100	90	85.8	79	63	50.8	41.2	34.3	30.3	27.4	25.6	24	30	16	14	10.59		Dark Yellowish Brown	SC	Gravelly Clayey Sand (SC).	0	37	39	24
L1/17314	TH20-19		110.0 to 120.0				100	98.7	95.7	91.4	80.8	69.9	57	40.7	32	26.8	24.4	22.2	32	17	15	6.07		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	19.2	58.6	22.2
L1/17313	TH20-19	S-24	115.0 to 120.0			100	96.8	90.3	82.3	77.6	70.2	60.8	51.3	40.3	33.8	29.2	26.7	24.4				5.85		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	29.8	45.8	24.4
L1/17318	TH20-19	S-26	125.0 to 130.0			100	95.7	91.5	86.9	84.3	80.3	77	73.8	69.8	64.1	56.3	51	45.3	30	17	13	13.37		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	19.7	35	45.3
L1/17320	TH20-19		130.0 to 140.0				100	97.6	95.3	92.1	85.5	76.7	68.1	59.3	52.7	46.7	43.2	39.9	29	16	13	6.41		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	14.5	45.6	39.9
L1/16814	TH20-20		0.0 to 10.0	97.7	95.7	92.9	83.8	77.2	67.3	61.4	50	39.2	31.1	24.9	21.4	18.7	17.1	15.6	34	15	19	1.59		Pale Brown	GC	Clayey Gravel (GC), with some sand, and a trace of cobble.	2.3	47.7	34.4	15.6
L1/16815	TH20-20		10.0 to 20.0	96	85.5	80.8	74.5	70.3	63.3	59.2	49.7	37.9	29.8	24.3	20.6	17.7	16.2	14.7	24	18	6	2.63		Pale Brown	GC-GM	Clayey Silty Gravel (GC-GM), with some sand, and a trace of cobble.	4	46.3	35	14.7
L1/16816	TH20-20		20.0 to 30.0								100	72.1	52.5	38.1	30.2	25.1	22.5	20.3	24	15	9	3.51		Pale Brown	SC	Clayey Sand (SC).	0	0	79.7	20.3
L1/17099	TH20-20		20.0 to 30.0			100	90.3	81.8	68.7	62.6	50.5											5.8		Pale Brown	GC	(Visual) Clayey Gravel (GC), with sand.	0	49.5	0	0
L1/16817	TH20-20		30.0 to 40.0	88.7	87.4	81.5	73.2	66.9	59.1	53.4	42.9	31.7	23.2	17.2	14.2	12	10.9	9.9	29	15	14	7.03		Brown	GW-GC	Well Graded Clayey Gravel (GW-GC), with some sand and a little cobble.	11.3	45.8	33	9.9
L1/17102	TH20-20	S-6	40.0 to 45.0					100	96.8	96.8	96.8	95.8	93.2	87.3	79.7	68.8	59.7	50.1	26	15	11	18.13		Dark Yellowish Brown	CL	Sandy Lean Clay (CL), with a trace of gravel.	0	3.2	46.7	50.1
L1/17104	TH20-20	S-8	50.0 to 55.0				100	94.3	86.9	78.8	71.5	64.2	57.5	49.8	44.6	40.5	38.6	37.4	35	19	16	11.71		Yellowish Brown & Olive Brown	SC	Clayey Sand (SC), with some gravel.	0	28.5	34.1	37.4
L1/17105	TH20-20	S-9	55.0 to 60.0				100	89.3	79	67.4	55.3											4.3		Yellowish Brown & Olive Brown	GC	(Visual) Clayey Gravel (GC), with sand.	0	44.7	0	0
L1/17106	TH20-20	S-10	60.0 to 65.0					100	89.5	79.1	57.2	45.9	35.9	24	16.6	12	10.5	9.3	25	15	10	4.93		Yellowish Brown & Olive Brown	SP-SC	Gravelly Poorly Graded Clayey Sand (SP-SC).	0	42.8	47.9	9.3
L1/17107	TH20-20	S-11	65.0 to 70.0				100	92.6	79.2	70.1	58.1											5.33		Yellowish Brown & Olive Brown	GC	(Visual) Clayey Gravel (GC), with sand.	0	41.9	0	0
L1/17108	TH20-20	S-12	70.0 to 75.0					100	93	80.9	67.7	52.5	38.8	23.6	16.5	13.2	11.8	10.8	26	17	9	7.84		Yellowish Brown & Olive Brown	SW-SC	Well Graded Clayey Sand (SW-SC), with some gravel.	0	32.3	56.9	10.8
L1/17109	TH20-20	S-13	75.0 to 80.0			100	88	82.2	67.6	62.5	48.5											7.8		Yellowish Brown & Olive Brown	GC	(Visual) Clayey Gravel (GC), with sand.	0	51.5	0	0
L1/17110	TH20-20	S-14	80.0 to 85.0				100	95.9	86.9	81	64.3	52.7	44.2	37.7	33.1	29.1	26.7	24.3	26	18	8	7.28		Brown	SC	Gravelly Clayey Sand (SC).	0	35.7	40	24.3
L1/17111	TH20-20	S-15	85.0 to 90.0			100	87.9	83.3	73.1	67.6	56.6											6.8		Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	43.4	0	0
L1/16819	TH20-20		90.0 to 100.0							100	99.8	81.1	70.7	62.9	56.3	48.8	44.1	39.6	29	14	15	8.75		Brown	SC	Clayey Sand (SC).	0	0.2	60.2	39.6
L1/17114	TH20-20	S-18	100.0 to 105.0						100	99.1	97.8	96.6	94.2	90.7	85.9	79.2	74.1	67.8	23	14	9	12.85		Brown	CL	Lean Clay (CL), with some sand and a trace of gravel.	0	2.2	30	67.8
L1/17116	TH20-20	S-20	110.0 to 115.0							100	99.2	98.6	97.4	94.9	90.8	83.3	77.2	69.8	31	16	15	19.78		Brown	CL	Lean Clay (CL), with some sand.	0	0.8	29.4	69.8
L1/17118	TH20-20	S-22	120.0 to 125.0			100	99	98.9	98.7	98.5	98.2	96.8	95.7	92.8	89.3	82.5	76	68.5	28	18	10	4.07		Dark Yellowish Brown	CL	Lean Clay (CL), with some sand and a trace of gravel.	0	1.8	29.7	68.5
L1/17119	TH20-20		120.0 to 130.0																					Brown						
L1/17120	TH20-20	S-23	125.0 to 130.0			100	85.5	85.5	80.6	78.1	73.5											12.66		Pale Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	26.5	0	0
L1/17121	TH20-20	S-24	130.0 to 135.0				100	96.6	95.8	93.6	90.6	88.1	82.3	72.3	64.3	57	52.9	49.2	21	15	6	5.23		Pale Brown	SC-SM	Clayey Silty Sand (SC-SM), with a trace of gravel.	0	9.4	41.4	49.2
L1/17123	TH20-20	S-26	140.0 to 145.0				100	90.9	83.8	79.7	66.2	55	47.5	41.1	36.7	32.7	30.4	28.3	23	14	9	2.46		Pale Brown	SC	Clayey Sand (SC), with some gravel.	0	33.8	37.9	28.3
L1/17124	TH20-20	S-27	145.0 to 150.0					100	97.2	92	85.1											12.92		Pale Brown	CL	(Visual) Lean Clay (CL), with a little gravel and sand.	0	14.9	0	0
L1/17125	TH20-20	S-28	150.0 to 155.0					100	96.6	93.2	88.8	85.4	81	75.6	71.4	67.3	64.1	59.4	28	15	13	11.44		Yellowish Brown	CL	Lean Clay (CL), with some sand and a little gravel.	0	11.2	29.4	59.4
L1/17127	TH20-20	S-30	160.0 to 165.0				100	91.9	85.8	83.7	77.9	71.4	65.6	59	53.4	47.7	43.9	40.2	24	16	8	8.36		Brown	SC	Clayey Sand (SC), with some gravel.	0	22.1	37.7	40.2
L1/17130	TH20-20	S-32	170.0 to 175.0							100	99.6	99	98	96.3	93.3	86.4	80	72.4	32	17	15	19.15		Brown	CL	Lean Clay (CL), with some sand.	0	0.4	27.2	72.4
L1/17134	TH20-21	S-1	0.0 to 5.0			100	95.8	94	91.1	87.6	75.3	67.9	60.8	52.7	45.2	37.1	32	27.4				3.79		Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	24.7	47.9	27.4
L1/17135	TH20-21	S-2	5.0 to 10.0					100	94.1	93.6	89.9	86.6	84.4	81.1	76.4	62.9	50.4	39.7				5.86		Yellowish Brown	SC	(Visual) Clayey Sand (SC), with a little gravel.	0	10.1	50.2	39.7
L1/17137	TH20-21	S-3	10.0 to 15.0			100	93.7	90.9	78.7	71	58.3	46.5	39.6	33.6	29.2	25.8	24	22.3	29	15	14	3.98		Yellowish Brown	GC	Sandy Clayey Gravel (GC).	0	41.7	36	22.3
L1/16820	TH20-21		20.0 to 30.0			100	96.9	96.2	94.5	92.4	86.2	73.5	66.4	60.3	55.8	49.3	43.8	38.4	29	15	14	6.52		Brown	SC	Clayey Sand (SC), with a little gravel.	0	13.8	47.8	38.4
L1/17144	TH20-21		30.0 to 40.0		100	92.3	89	84.7	66.9	58.6	46.8	38.6	30.6	23.2	18.4	14.8	12.9	11.5				4.13		Pale Brown	GC-GM	(Visual) Sandy Clayey Silty Gravel (GC-GM).	0	53.2	35.3	11.5
L1/17148	TH20-21		40.0 to 50.0				100	97.5	90	84.8	74.7	67.3	59.4	50.6	44	38.2	34.7	31.5				1.35		Light Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	25.3	43.2	31.5
L1/17151	TH20-21		50.0 to 60.0					100	80.9	72.2	52.9	46.3	38.6	28.7	22.4	18.9	17.3	16	23	14	9	2.32		Brown	GC	Sandy Clayey Gravel (GC).	0	47.1	36.9	16
L1/17152	TH20-21		60.0 to 70.0			100	95.8	88.6	82.3	79.7	72.7	66.2	57.6	48.6	41	33.3	28.6	24.4	26	16	10	9.4		Brown	SC	Clayey Sand (SC), with some gravel.	0	27.3	48.3	24.4
L1/16821	TH20-21		60.0 to 70.0							100	99.7	99.2	98.4	97.5	95.8	88.3	77.7	65.4	29	18	11	16.02		Dark Yellowish Brown	CL	Lean Clay (CL), with some sand.	0	0.3	34.3	65.4
L1/17154	TH20-21	S-14	65.0 to 70.0				100	97.8	91	88.6	84.4	80.3	76.3	72.9	68.1	59.7	53	46.4	28	17	11	15.53		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	15.6	38	46.4
L1/17155	TH20-21		70.0 to 80.0			100	93.9	93.9	86.5	80.8	70	60.5	49.3	35.6	26	19.9	17.4	15.5				3.93		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	30	54.5	15.5
L1/17160	TH20-21		80.0 to 90.0			100	93.3	89.3	82.4	76.7	65.8	55.6	46.1	33.6	25.5	20.6	18.3	16.4	24	14	10	4.04		Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	34.2	49.4	16.4
L1/17161	TH20-21	S-19	90.0 to 95.0																					Yellowish Brown						
L1/17168	TH20-22		10.0 to 20.0			100	97.7	91	81.1	75.2	63.6	54.1	43	26	16.4	12.2	10.7	9.5				4.26		Pale Brown	SP-SC	(Visual) Gravelly Poorly Graded Clayey Sand (SP-SC).	0	36.4	54.1	9.5
L1/17174	TH20-22	S-6	25.0 to 30.0					100	81.1	75.6	60	50.8	40.3	31.9	27.2	23.4	21.2	19.2	25	17	8	4.68		Brown	SC	Gravelly Clayey Sand (SC).	0	40	40.8	19.2
L1/16822	TH20-22		30.0 to 40.0	100	99.9	98.5	95.3	92.3	86.4	80.9	68.3	56.9	32.9	18.5	13.2	10.2	8.8	7.5	26	16	10	12.7		Brown	SW-SC	Well Graded Clayey Sand (SW-SC), with some gravel.	0	31.7	60.8	7.5
L1/17181	TH20-22		40.0 to 50.0			100	97.3	95.8	82.8	76	56.8	43.8	34.3	26.7	21.9	18.3	16.5	14.9				4.47		Pale Brown	GC	(Visual) Sandy Clayey Gravel (GC).	0	43.2	41.9	14.9
L1/16823	TH20-22		50.0 to 53.0				100	93.8	76.8	66.9	56.2	50.3	44.6	39.1	34.9	30.3	27.2	24.2	26	15	11	6.59		Dark Yellowish Brown	GC	Clayey Gravel (GC), with some sand.	0	43.8	32	24.2
L1/17188	TH20-22		60.0 to 65.0				100	97.1	90.9	85.6	73											5.38		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	27	0	0
L1/16825	TH20-22	S-13	66.0 to 70.0					100	92.8	85.4	72.6	60.2	52.8	47.9	44.7	40.8	38	35	41	23	18	19.09		Dark Gray	SC	Clayey Sand (SC), with some gravel.	0	27.4	37.6	35
L1/17190	TH20-22	S-15	70.0 to 75.0				100	92.1	79.4	75.1	60.5	51.6	47.1	42.9	39.8	36.4	31.6	31.5	44	23	21	18.34		Grayish Brown & Dark Gray	GC	Clayey Gravel (GC), with some sand.	0	39.5	29	31.5
L1/17191	TH20-22	S-16	75.0 to 80.0					100	90.7	83.9	69.2	59.3	53.8	48.5	44.2	40	37.3	34.7	40	21	19	14.89		Grayish Brown & Dark Gray	SC	Clayey Sand (SC), with some gravel.	0	30.8	34.5	34.7
L1/16826	TH20-23		0.0 to 10.0	100	98.8	97	90.9	88.7	83	79.1	68.6	56.2	47.3	38.7	32.8	28	25.3	22.8	30	14	16	5.42		Brown	SC	Clayey Sand (SC), with some gravel.	0	31.4	45.8	22.8
L1/17195	TH20-23	S-3	10.0 to 15.0					100	85.7	83	73	65.1	56.4	45.9	37.9	31.9	28.7	26.1				7.25		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	27	46.9	26.1
L1/17196	TH20-23	S-4	15.0 to 20.0			100	96.2	96.2	90.7	86.9	80.8											8.97		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with a little gravel.	0	19.2	0	0
L1/17197	TH20-23	S-5	20.0 to 25.0			100	91.4	89.7	85.1	79	72.6	68.4	61	51.7	42.6	33.5	28.3	23.5	26	15	11	6.27		Dark Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	27.4	49.1	23.5
L1/16828	TH20-23		30.0 to 40.0		100	96.2	91.7	89.3	85.9	84	79.4	74.5	68.5	63.4	60.7	58.9	57.8	56.7	52	15	37	18.51		Dark Yellowish Brown	CH	Fat Clay (CH), with some sand and some gravel.	0	20.6	22.7	56.7
L1/17199	TH20-23		30.0 to 35.0																											
L1/17200	TH20-23	S-8	35.0 to 40.0				100	96.7	88.9	80	64.5											5.3		Light Olive Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	35.5	0	0
L1/17201	TH20-23		40.0 to 50.0																					Brown						
L1/17204	TH20-23		50.0 to 60.0			100	91.1	82	71.3	64.7	50	37.3	20.8	20.4	17	14.9	13.8	12.8	31	16	15	6.14		Brown	GC	Sandy Clayey Gravel (GC).	0	50	37.2	12.8
L1/17206	TH20-23	S-12	55.0 to 60.0			100	87.7	80.4	64.4	58.5	47.4											5.4		Pale Brown	GC	(Visual) Sandy Clayey Gravel (GC).	0	52.6	0	0
L1/17207	TH20-23		60.0 to 70.0					100	87.4	79.5	56.3	43.3	34.2	25.2	19.6	16.1	14.6	13.4	29	16	13	5.32		Brown	GC	Sandy Clayey Gravel (GC).	0	43.7	42.9	13.4
L1/17208	TH20-23	S-13	60.0 to 65.0			100	94.8	92.7	84.1	74.3	58.7											8.31		Brown	GC	(Visual) Sandy Clayey Gravel (GC).	0	41.3	0	0

Number LAB	Number Hole	Number Sample	(ft) Depth	% 3 in	% 2 in	% 1-1/2 in	% 1 in	% 3/4 in	% 1/2 in	% 3/8 in	% No.4	% No.10	% No.20	% No.40	% No.60	% No.100	% No.140	% No 200	LL	PL	PI	MC% D2216	SpG D854	Color	Class.	D2487 Unified Soil Classification System	Cobbles %	Gravel %	Sand %	Fines %
L1/17209	TH20-23	S-14	65.0 to 70.0																			8.3		Brown						
L1/17210	TH20-23		70.0 to 80.0					100	91.2	78.5	56	43.9	35.3	26.9	21.7	18.4	16.8	15.4	26	15	11	5.09		Pale Brown	GC	Sandy Clayey Gravel (GC).	0	44	40.6	15.4
L1/17213	TH20-23		80.0 to 90.0				100	91.9	86.4	79.9	64.1	48.8	33.8	22.8	18.1	15.3	14	12.8	31	17	14	8.43		Dark Yellowish Brown	SC	Gravelly Clayey Sand (SC).	0	35.9	51.3	12.8
L1/17217	TH20-23	S-19	90.0 to 95.0			100	90.7	82.6	78.4	71.5	60.1	50.4	41.2	34.6	30.8	27.8	26.1	24.5	30	16	14	11.63		Dark Yellowish Brown	GC	Sandy Clayey Gravel (GC).	0	39.9	35.6	24.5
L1/17218	TH20-23	S-20	95.0 to 100.0																27	15	12	5.75		Dark Yellowish Brown	GC	(Visual) Clayey Gravel (GC), with sand.				
L1/16830	TH20-24		0.0 to 10.0	100	94.6	90.6	84.3	78.4	70.2	65.5	54.6	46.4	35.6	25.1	19.6	16.3	14.8	13.5	29	15	14	5.99		Yellowish Brown	GC	Sandy Clayey Gravel (GC).	0	45.4	41.1	13.5
L1/17221	TH20-24	S-2	5.0 to 10.0																35	18	17	8.41		Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/17225	TH20-24	S-4	15.0 to 20.0																35	18	17	9.43		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/17228	TH20-24	S-5	20.0 to 25.0				100	93.8	88.9	86.6	72	56.4	39.6	21.8	13.1	9.9	8.8	8				5.54		Yellowish Brown	SP-SM	Poorly Graded Silty Sand (SP-SM), with some gravel.	0	28	64	8
L1/17229	TH20-24	S-6	25.0 to 30.0				100	93.1	78.6	68.9	52.6											6.69		Yellowish Brown	GC	(Visual) Sandy Clayey Gravel (GC).	0	47.4	0	0
L1/16831	TH20-24		25.0 to 35.0								100	85.8	71.2	56.7	46.8	38.5	34.1	30.1				5.46		Yellowish Brown	SC	(Visual) Clayey Sand (SC).	0	0	69.9	30.1
L1/17235	TH20-24	S-9	40.0 to 45.0					100	92.1	85.8	74.7	62.2	48.2	35.3	26.7	22.2	20.3	18.9	30	16	14	7.13		Brown	SC	Clayey Sand (SC), with some gravel.	0	25.3	55.8	18.9
L1/17241	TH20-24		50.0 to 60.0			100	97.8	90.9	77.7	72.3	60.8											2.16		Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	39.2	0	0
L1/16831	TH20-24		60.0 to 70.0	100	99.9	97.5	93.8	89.8	83.1	78.7	66.8	57.2	43.8	32.4	26.4	22.2	19.9	18	23	15	8	5.9		Dark Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	33.2	48.8	18
L1/17243	TH20-24		60.0 to 65.0			100	76.5	76.5	66.1	59.4	48.3											7.21		Dark Yellowish Brown	GC	(Visual) Clayey Gravel (GC), with sand.	0	51.7	0	0
L1/17245	TH20-24	S-15	70.0 to 75.0					100	91.5	89.3	82.5	71	59.1	45.3	38.7	33.7	30.9	28.5	32	17	15	8.12		Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	17.5	54	28.5
L1/17248	TH20-25	S-1	0.0 to 5.0					100	97.8	94.4	81	68.5	57.3	43.9	31.8	19.7	12.2	5.7				3.86		Brown	SP-SM	Poorly Graded Silty Sand (SP-SM), with a little gravel.	0	19	75.3	5.7
L1/17252	TH20-25	S-3	10.0 to 15.0					100	94	82.6	64.3	50.4	40.4	32.2	25.5	19.6	16.8	14.5				3.55		Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	35.7	49.8	14.5
L1/17254	TH20-25	S-4	15.0 to 20.0					100	87.9	79.5	70.6	58.5	43.6	27	19.2	15.4	14	13				6.47		Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	29.4	57.6	13
L1/16833	TH20-25		20.0 to 30.0		100	91	82.8	76.6	68.7	63.9	50.6	40.3	32.9	23.5	17.7	14.1	12.5	11.3	29	15	14	3.01		Brown	GW-GC	Sandy Well Graded Clayey Gravel (GW-GC).	0	49.4	39.3	11.3
L1/17261	TH20-25	S-7	30.0 to 35.0				100	97.7	84	75.2	57.8	45.7	35.3	25.3	20	16.7	15.2	14.1				5.21		Brown	SC	(Visual) Gravelly Clayey Sand (SC).	0	42.2	43.7	14.1
L1/16834	TH20-25		39.0 to 40.0																31	17	14	15.83		Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/17265	TH20-25		40.0 to 50.0			100	93	84.4	75.1	68.9	56	47.9	39.5	31.5	26.8	23.2	21.2	19.3				3.65		Yellowish Brown	GC	(Visual) Sandy Clayey Gravel (GC).	0	44	36.7	19.3
L1/17267	TH20-25	SPT-5	50.0 to 51.5																28	15	13	7.76		Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.				
L1/17269	TH20-25		50.0 to 60.0					100	91.1	86.1	76.4	66.2	58.4	50	43	36.6	33	29.7				3.98		Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	23.6	46.7	29.7
L1/17289	TH20-25		52.0 to 60.0			100	97.6	96.6	89.4	82.6	69.5											3.98		Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	30.5	0	0
L1/17272	TH20-25		60.0 to 70.0			100	97.9	85.3	70.6	62.7	49.3	40.5	31.9	24.5	20.1	16.9	15.4	14				3.82		Yellowish Brown	GC	(Visual) Sandy Clayey Gravel (GC).	0	50.7	35.3	14
L1/17274	TH20-25	S-15	70.0 to 75.0				100	98.1	91.5	81.1	65.4	49.3	37.2	26.7	21.2	17.6	15.7	14.3	30	16	14	8.16		Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	34.6	51.1	14.3
L1/16836	TH20-25		77.0 to 79.0					100	96.5	93.4	78.9	67.2	59.8	53.4	48.1	43	39.7	36.1	26	14	12	8.12		Reddish Brown	SC	Clayey Sand (SC), with some gravel.	0	21.1	42.8	36.1
L1/16837	TH20-25		80.0 to 85.0					100	98.8	93.9	70.1	48.6	35.4	26.3	21.5	18.5	17	15.7	26	16	10	2.97		Pale Brown	SC	Clayey Sand (SC), with some gravel.	0	29.9	54.4	15.7
L1/16839-4	TH20-25		80.0 to 90.0		100	92	83.4	75.6	66	61.1	51.5											3		Pale Brown	GC	(Visual) Clayey Gravel (GC), with sand.	0	48.5	0	0
L1/16838	TH20-25		90.0 to 100.0																			5.5		Brown						

	γm	γsat
sand	134.5	134.7
gravel	129.5	132.1
average	132.0	133.4

linear		nonlinear	
c	0.3	a1	-0.00417
phi	40	a2	1.045296
		a3	-0.13283

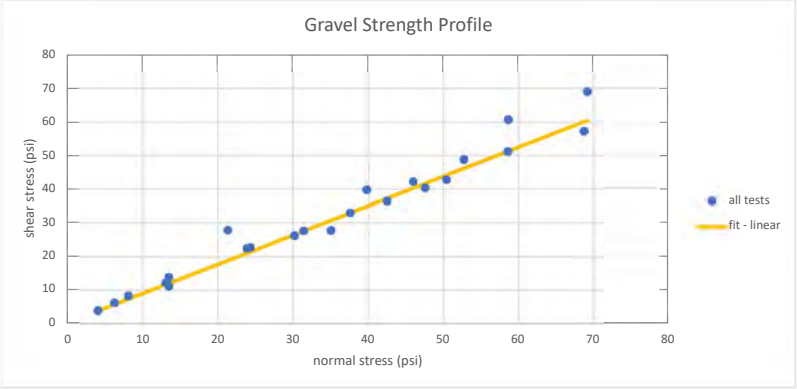
	Lab No.	Hole	Depth (ft)			Elevation (ft)		σ	u	σ'	σ'											Fitting	linear			non-linear			
			average	low	high	ground	sample	psf	psf	psf	psi	Kg	gms	Shear	MC	strain	e	gmoist	gat	Other	deformation	estimate	least squares	test	estimate	test	least squares	combined
linear	17028	TH20-16	5	0	10	283.1	278.1	1785.76	1397.76	388	2.694444	6.026387	602.6387	3.65	20.3	7.4	0.5386	131.7	131.3	SC	0.00096	2.56	1.19	1				2.56
	17045	TH20-18	5	0	10	304.223	299.223	700	79.6848	620.3152	4.307744	9.634689	963.4689	4.36	21.5	7.4	0.5928	128.5	129.0	SC-SM		3.91	0.20	1				3.91
	17073	TH20-19	5	0	10	329.488	324.488	700	0	700	4.861111	10.87235	1087.235	4.26	22.9	8.1	0.6308	127.0	127.4	SC		4.38	0.01	0				4.38
	17134	TH20-21	5	0	10	312.053	307.053	700	0	700	4.861111	10.87235	1087.235	4.46	20.5	4.4	0.5642	129.8	130.2	SC		4.38	0.01	1				4.38
	17030		15	10	20	283.1	268.1	3185.76	2021.76	1164	8.083333	18.07916	1807.916	7.3	16.6	5.6	0.4559	134.9	135.3	SP-SM	0.006	7.08	0.05	1				7.08
	16959	TH20-14	15	10	20	293	278	2568	1404	1164	8.083333	18.07916	1807.916	7.3	17.6	4.6	0.4675	135.0	134.7	SP-SM	0.013	7.08	0.05	1				7.08
	16807		15	10	20	304.223	289.223	2100	703.6848	1396.315	9.696633	21.68746	2168.746	7.06	19.3	2.7	0.5306	131.3	131.7	SC		8.44	1.89	0				8.44
	16985		15	10	20	306.2	291.2	2100	580.32	1519.68	10.55333	23.60356	2360.356	11.68	15.1	12.4	0.4547	133.3	135.3	SM	0.0105	9.16	6.37	1				9.16
	17168	TH20-22	15	10	20	314.226	299.226	2100	79.4976	2020.502	14.03127	31.38229	3138.229	11.44	24.9	10.2	0.6857	124.8	125.3	SP-SC	TH20-21 62	12.07	0.40	0				12.07
	17039		27	24	30	296.938	269.938	4002.269	1907.069	2095.2	14.55	32.54249	3254.249	16.59	12.7	4.1	0.3498	140.7	141.0	SC		12.51	16.66	1				12.51
	17195	TH20-23	15	10	20	325.791	310.791	2100	0	2100	14.58333	32.61704	3261.704	11.62	20.6	13.5	0.5672	129.6	130.1	SC		12.54	0.84	0				12.54
	16808		25	20	30	304.223	279.223	3500	1327.685	2172.315	15.08552	33.74024	3374.024	12.82	21.1	8.8	0.5814	129.0	129.5	SC		12.96	0.02	0				12.96
	16965		34	30	38	293	259	5228	2589.6	2638.4	18.32222	40.97943	4097.943	15.9	15.6	1.8	0.4129	137.8	137.5	SM	-0.0066	15.67	0.05	1				15.67
	16820		25	20	30	312.053	287.053	3500	839.0928	2660.907	18.47852	41.32901	4132.901	14.52	19.5	9.1	0.517	132.7	132.3	SC		15.81	1.65	0				15.81
	17054		35	30	40	304.223	269.223	4900	1951.685	2948.315	20.47441	45.79301	4579.301	18.41	19.1	9.1	0.526	131.5	131.9	SP-SM		17.48	0.86	1				17.48
	16969		46	42	50	293	247	6908	3338.4	3569.6	24.78889	55.44276	5544.276	21.48	12.7	8	0.3364	142.1	141.8	SM	0.0138	21.10	0.14	1				21.10
	16995		47	44	50	306.2	259.2	6580	2577.12	4002.88	27.79778	62.17243	6217.243	24.07	13	10.3	0.3453	141.5	141.3	SC	0.0104	23.63	0.20	1				23.63
	16975		55	50	60	293	238	8168	3900	4268	29.63889	66.29026	6629.026	25.78	16.7	11.6	0.4422	136.3	136.0	SC	0.0324	25.17	0.37	1				25.17
	17105		55	50	60	289.409	234.409	8392.078	4124.078	4268	29.63889	66.29026	6629.026	25.45	20.1	5.5	0.5522	130.4	130.7	SC	osivity tests	25.17	0.08	1				25.17
	16831	TH20-24	30.5	26	35	354.801	324.301	4270	0	4270	29.65278	66.32132	6632.132	47.35	16.5	7.1	0.4528	135.1	135.4	SC		25.18	491.44	1				25.18
	17200		37.5	35	40	325.791	288.291	5250	761.8416	4488.158	31.16777	69.70974	6970.974	30.02	16.8	11.9	0.4629	134.5	134.9	SC		26.45	12.72	1				26.45
	17261		34.5	30	39	335.989	301.489	4830	0	4830	33.54167	75.0192	7501.92	29.77	19.1	10.9	0.5267	131.4	131.9	SC		28.44	1.76	1				28.44
	17106		65	60	70	289.409	224.409	9792.078	4748.078	5044	35.02778	78.34303	7834.303	29.08	19.8	3.6	0.5461	130.5	131.0	SP-SC		29.69	0.37	0				29.69
	17002		68	66	70	306.2	238.2	9520	3887.52	5632.48	39.11444	87.48326	8748.326	47.8	9.3	3	0.2465	147.7	147.5	SP-SM	-0.023	33.12	215.48	1				33.12
	17265		45	40	50	335.989	290.989	6300	593.4864	5706.514	39.62857	88.63314	8863.314	33.06	14.7	13.6	0.4041	137.6	138.0	SC		33.55	0.24	0				33.55
	17188		63	60	66	314.226	251.226	8820	3074.698	5745.302	39.89793	89.23561	8923.561	32.14	17.1	6.2	0.4696	134.2	134.6	SC		33.78	2.68	0				33.78
nonlinear	17108		75	70	80	289.409	214.409	11192.08	5372.078	5820	40.41667	90.3958	9039.58	41.39	15.8	2.9	0.434	136.1	136.4	SW-SC					35.30	1	37.06	35.30
	17005		75	70	80	306.2	231.2	10500	4324.32	6175.68	42.88667	95.9202	9592.02	39.45	16.3	8.7	0.4327	136.8	136.4	SP-SM	0.02				37.03	1	5.88	37.03
	17111		85	80	90	289.409	204.409	12592.08	5996.078	6596	45.80556	102.4486	10244.86	35.65	18.1	8.8	0.4987	132.8	133.2	SC					39.00	0	11.21	39.00
	17008		85	80	90	306.2	221.2	11900	4948.32	6951.68	48.27556	107.973	10797.3	41.01	14	8	0.3708	140.1	139.8	SP-SM	0				40.61	1	0.16	40.61
	16819		95	90	100	289.409	194.409	13992.08	6620.078	7372	51.19444	114.5014	11450.14	45.53	17.3	11	0.4598	135.4	135.1	SC					42.45	1	9.48	42.45
	17274		73.5	70	77	335.989	262.489	10290	2371.886	7918.114	54.9869	122.9835	12298.35	45.18	15.7	8.8	0.4311	136.2	136.5	SC					44.74	1	0.20	44.74
	16837		85	80	90	335.989	250.989	11900	3089.486	8810.514	61.18412	136.8442	13684.42	47.58	15.5	9.3	0.411	137.9	137.6	SC					48.21	0	0.40	48.21
	17217-8		97	94	100	325.791	228.791	13580	4474.642	9105.358	63.23166	141.4237	14142.37	26.55	20.1	9.3	0.5528	130.3	130.7	SC					49.29	0	517.06	49.29
	17289		119	118	120	293	174	17128	7893.6	9234.4	64.12778	143.428	14342.8	49.75	16.6	10.8	0.4554	135.0	135.3	SC	0.03				49.75	1	0.00	49.75
	17119		125	120	130	289.409	164.409	18192.08	8492.078	9700	67.36111	150.6597	15065.97	64.29	12.7	3.7	0.3479	140.9	141.1	SC-SM					51.36	1	167.28	51.36
	17121		135	130	140	289.409	154.409	19592.08	9116.078	10476	72.75	162.7124	16271.24	56.46	15.7	12.3	0.4314	136.2	136.5	SC-SM					53.84	1	6.86	53.84
	17313		118	116	120	329.488	211.488	16520	5554.349	10965.65	76.15036	170.3177	17031.77	60.56	19.2	8.8	0.5278	131.4	131.8	SC					55.28	1	27.84	55.28
	17123		145	140	150	289.409	144.409	20992.08	9740.078	11252	78.13889	174.7652	17476.52	50.42	16.6	9.3	0.4579	134.7	135.2	SC					56.08	0	32.07	56.08
	17026		148	146	150	306.2	158.2	20720	8879.52	11840.48	82.22556	183.9054	18390.54	60.42	16.1	11.3	0.4261	137.2	136.8	SC	0.024				57.62	1	7.83	57.62
																						26	755.7388	17	14	10	823.3157	

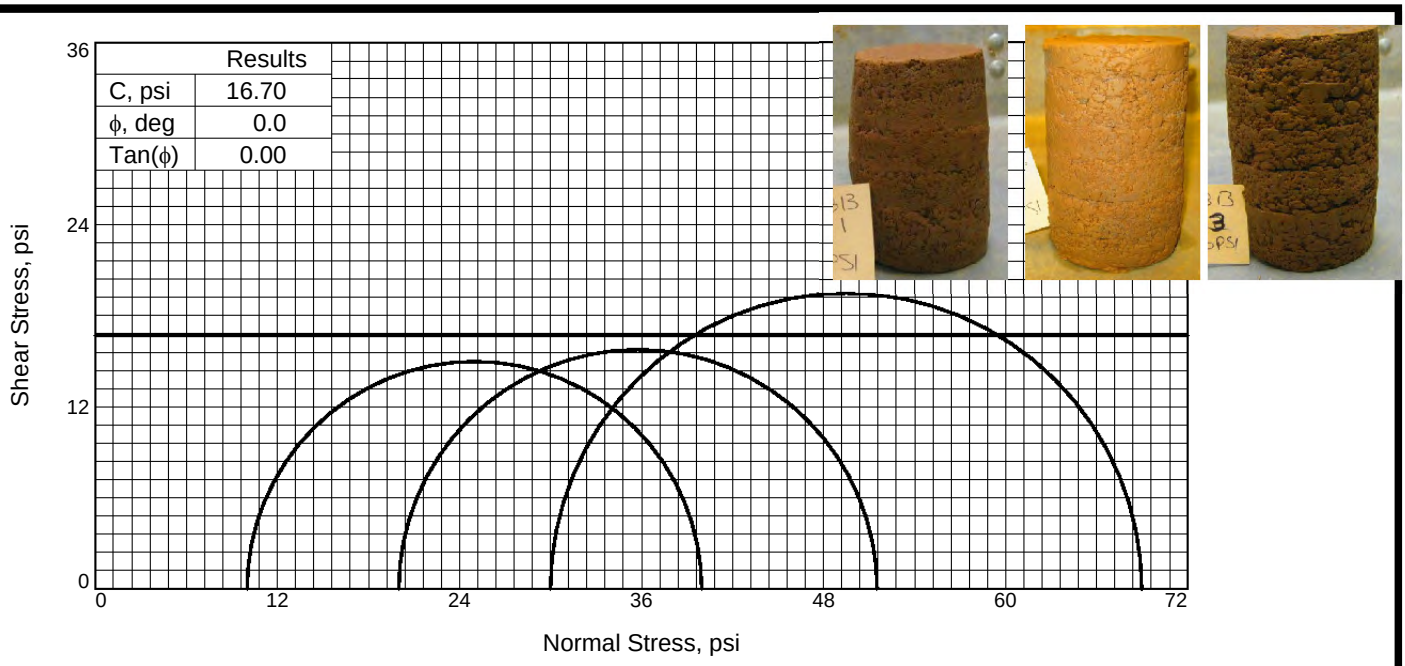


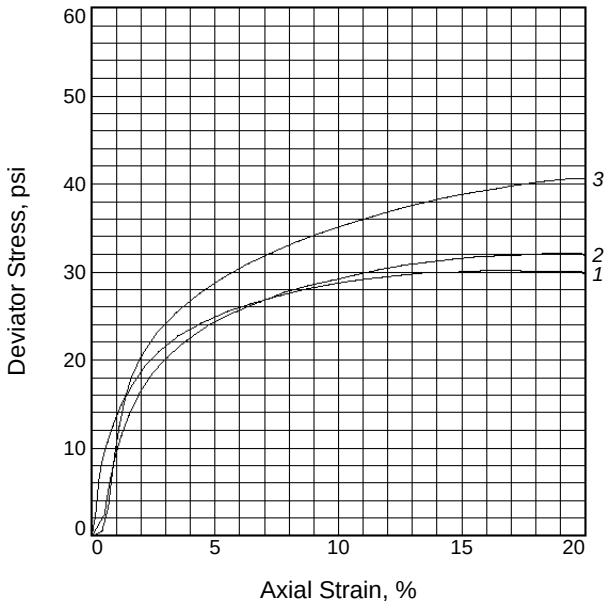
	moist	sat
average unit weight (pcf)	129.5	132.1

c	0.3	psi
	43.2	psf
phi	41.0	

		Depth (ft)			Elevation (ft)		σ	u	σ'	σ'													
Lab No.	Hole	average	low	high	ground	sample	psf	psf	psf	psi	Kg	gms	Shear	MC	strain	e	gmoist	gat	Other	deformatio	linear estin	least squar	test
16963		25	20	30	293	268	1272.269	690.2688	582	4.041667	9.03958	903.958	3.91	16.8	5.7	0.4635	134.5	134.9	GP-GM		3.82	0.01	1
16978		65	60	70	293	228	980	81.12	898.88	6.242222	13.96134	1396.134	6.21	15.6	5.3	0.4133	137.8	137.5	GM	-0.008	5.73	0.23	1
17293		127.5	125	130	293	165.5	2322.269	1158.269	1164	8.083333	18.07916	1807.916	8.29	19	5.4	0.5217	131.8	132.1	GP-GM		7.33	0.92	1
16984	TH20-15	7	4	10	306.2	299.2	2100	215.0928	1884.907	13.08963	29.27624	2927.624	12.15	19.5	7.9	0.5362	131.1	131.5	GC		11.69	0.21	1
16991		35	30	40	306.2	271.2	3968	2028	1940	13.47222	30.13193	3013.193	11.19	19.3	10.8	0.5111	133.0	132.6	GP-GM	0.012	12.02	0.69	0
17035	TH20-17	7.5	5	10	296.938	289.438	4192.078	2252.078	1940	13.47222	30.13193	3013.193	13.83	18.1	1	0.4978	132.8	133.2	GC		12.02	3.27	1
16806		15	10	20	296.938	281.938	4900	1828.32	3071.68	21.33111	47.7091	4770.91	27.91	15	2	0.4322	135.3	136.5	GP-GC	-0.0315	18.86	81.91	1
16812		35	30	40	329.488	294.488	4900	1463.093	3436.907	23.86741	53.38179	5338.179	22.49	18.4	9.6	0.505	132.5	132.9	GC-GM		21.07	2.03	1
17089		46.5	43	50	329.488	282.988	3500	0	3500	24.30556	54.36174	5436.174	22.73	16.9	10.9	0.4493	135.9	135.6	GW-GC		21.45	1.64	1
17095		65	60	70	329.488	264.488	6300	1951.498	4348.502	30.19793	67.54061	6754.061	26.28	17.9	9.4	0.4934	133.0	133.4	GC		26.57	0.09	0
17300B		74.5	70	79	329.488	254.988	4900	375.1488	4524.851	31.42258	70.27965	7027.965	27.68	18.4	7.4	0.4882	134.0	133.7	GP-GC		27.64	0.00	1
17304		85.5	81	90	329.488	243.988	9568	4524	5044	35.02778	78.34303	7834.303	27.8	14	10.7	0.3722	140.0	139.7	GM	0.022	30.78	8.86	0
17311		105	100	110	329.488	224.488	6510	1092.749	5417.251	37.6198	84.14034	8414.034	33.04	14.3	13.8	0.392	138.3	138.6	GC		33.03	0.00	1
17099	TH20-20	25	20	30	289.409	264.409	7490	1760.242	5729.758	39.78999	88.99418	8899.418	39.8	20.6	10.8	0.568	129.6	130.1	GC		34.92	23.81	1
17137		15	10	20	312.053	297.053	8190	2072.242	6117.758	42.48443	95.02057	9502.057	36.46	21	10.9	0.577	129.3	129.7	GC		37.26	0.65	0
17144		35	30	40	312.053	277.053	9100	2477.842	6622.158	45.98721	102.8549	10285.49	42.2	16.5	11.8	0.4548	134.9	135.3	GC		40.31	3.56	1
17181		45	40	50	314.226	269.226	9100	2247.149	6852.851	47.58924	106.438	10643.8	40.36	17.5	9.9	0.4805	133.7	134.1	GP-GM		41.71	1.81	0
17204		53.5	50	57	325.791	272.291	9100	1841.486	7258.514	50.40634	112.7387	11273.87	42.87	16.7	10.7	10.7	16.8	71.5	GC		44.16	1.66	0
17206		58.5	57	60	325.791	267.291	10430	2839.949	7590.051	52.70869	117.8881	11788.81	48.86	14.6	8.6	0.4021	137.7	138.1	GC		46.16	7.29	1
17208-9		65	60	70	325.791	260.791	9100	667.6176	8432.382	58.55821	130.9711	13097.11	51.25	14.6	8.7	0.4006	137.9	138.1	GC		51.25	0.00	1
17243		65	60	70	354.801	289.801	11970	3526.349	8443.651	58.63647	131.1462	13114.62	60.72	16.7	11.7	0.458	134.9	135.2	GC		51.32	88.40	1
16833	TH20-25	25	20	30	335.989	310.989	18318	8424	9894	68.70833	153.6729	15367.29	57.27	14.4	9.2	0.3948	138.2	138.5	GC-GM	0.024	60.08	7.90	0
17272		65	60	70	335.989	270.989	14700	4743.149	9956.851	69.1448	154.6491	15464.91	69.1	16.1	12.2	0.4431	135.5	135.9	GC		60.46	74.63	1
																						309.565	16







Sample No.		1	2	3
Initial	Water Content, %	14.2	14.2	14.2
	Dry Density, pcf	104.9	105.4	104.9
	Saturation, %	65.1	66.0	65.2
	Void Ratio	0.5777	0.5699	0.5766
	Diameter, in.	2.80	2.79	2.80
	Height, in.	5.59	5.59	5.59
At Test	Water Content, %	14.9	15.5	14.9
	Dry Density, pcf	104.9	105.4	104.9
	Saturation, %	68.2	72.3	68.6
	Void Ratio	0.5777	0.5699	0.5766
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.59	5.59	5.59
Strain rate, in./min.		1.000	1.000	1.000
Back Pressure, psi		0.0	0.0	0.0
Cell Pressure, psi		10.0	20.0	30.0
Fail. Stress, psi		30.0	31.5	39.0
Ult. Stress, psi		30.0	31.5	39.0
σ_1 Failure, psi		40.0	51.5	69.0
σ_3 Failure, psi		10.0	20.0	30.0

Type of Test:
Unconsolidated Undrained

Sample Type: Remolded

Description: Brown, Lean Clay (CL), with some sand. Triaxial specimens 2.8 x 5.6 remolded to 105.0 pcf at

LL= 34 **PL=** 14 **PI=** 20

Assumed Specific Gravity= 2.65

Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D2850 & D4318.

Figure _____

Client: Chicago District

Project: Santiago Creek

Location: TH20-19, 40.0 - 43.0', L1/16813 UUT

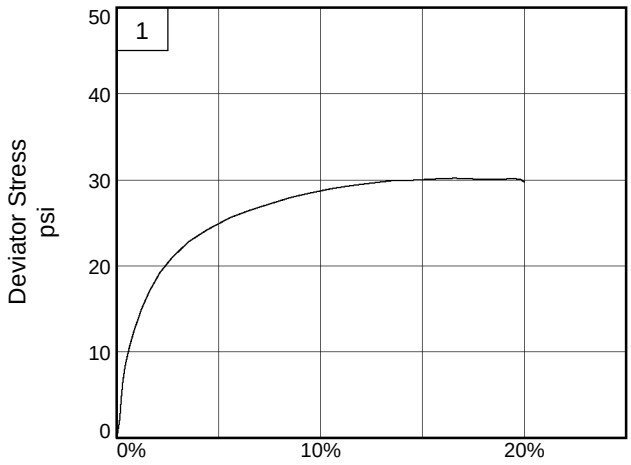
Depth: 40.0 - 43.0'

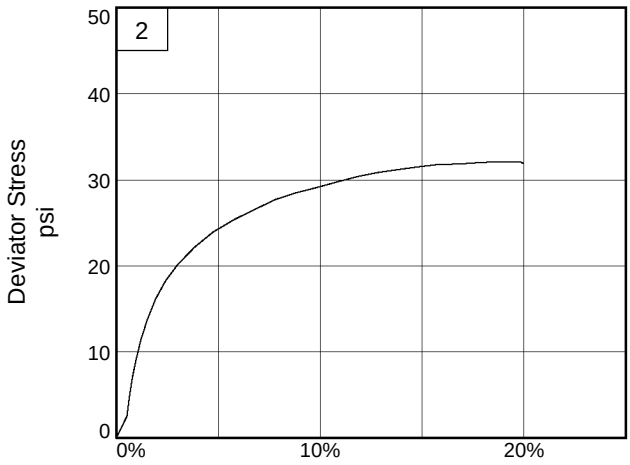
Proj. No.: W81EYN12437800, CCRC# 1575KB **Date Sampled:**

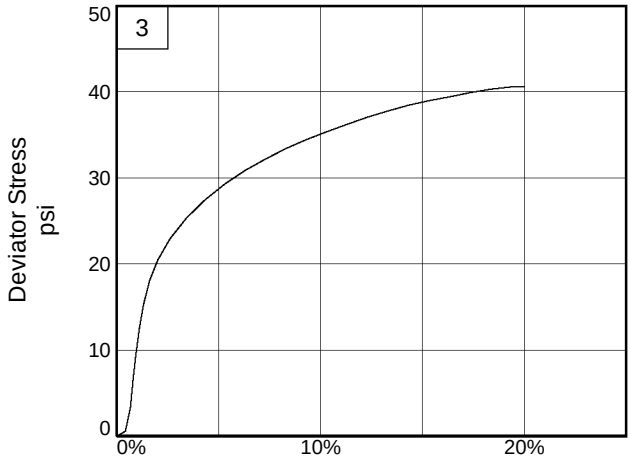
TRIAXIAL SHEAR TEST REPORT

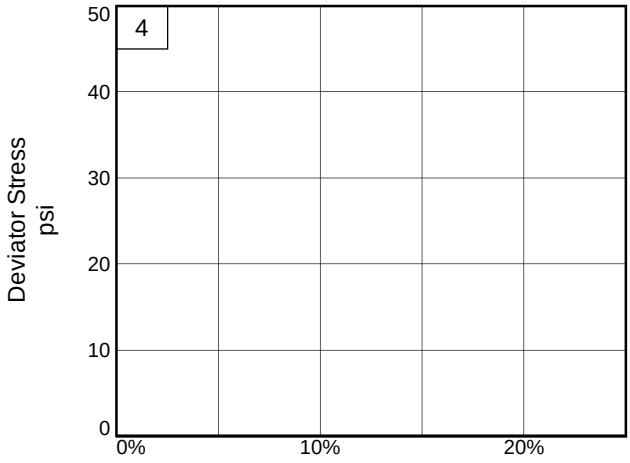
U.S. Army Corp of Engineers

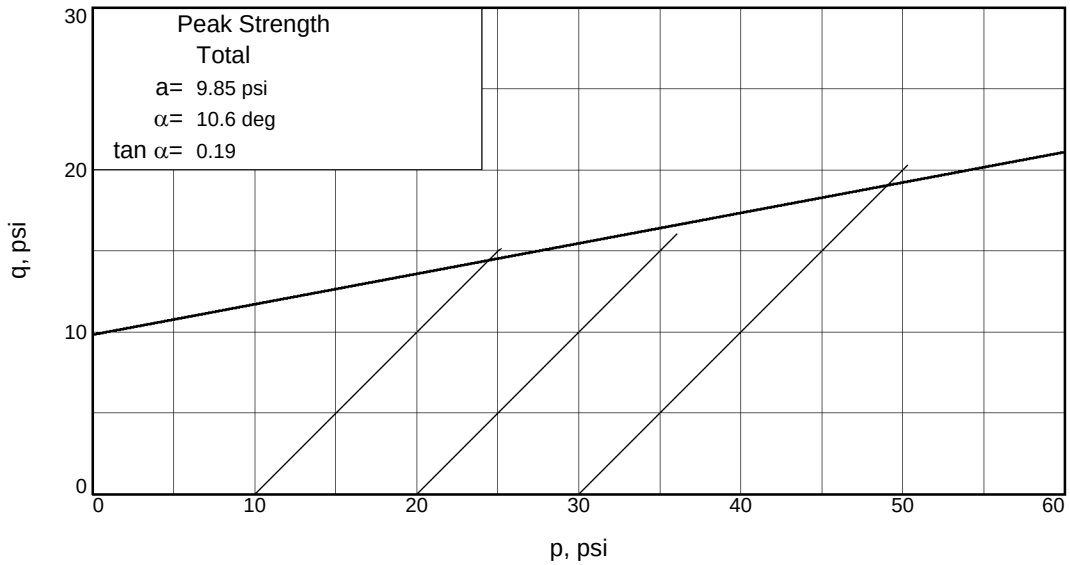
Tested By: JC **Checked By:** MW







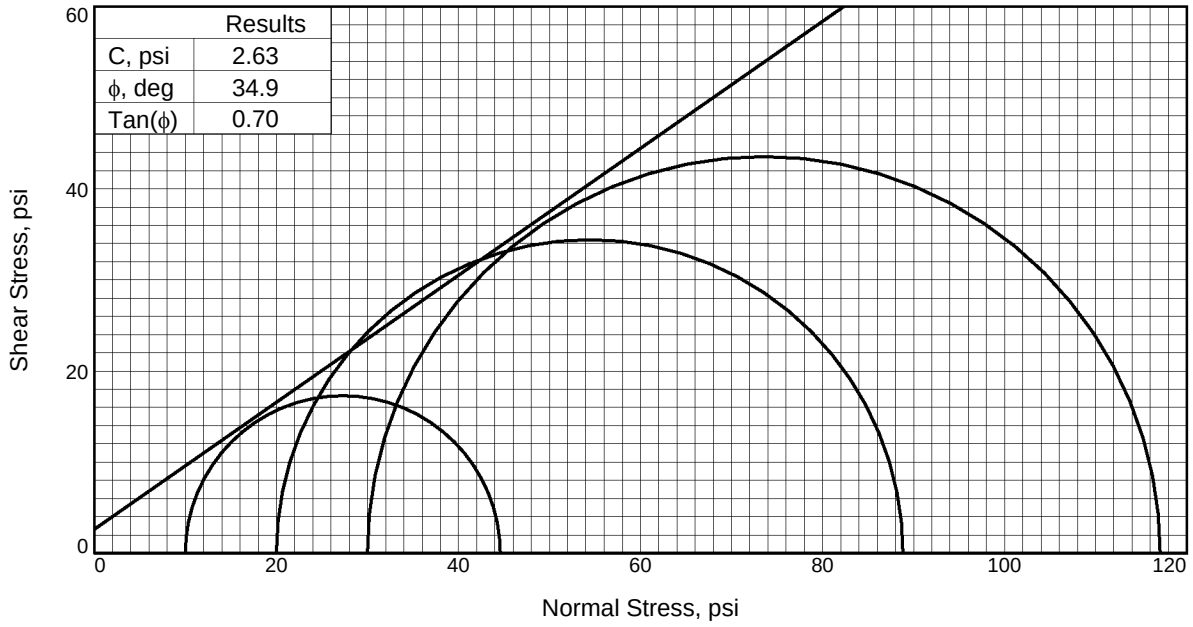


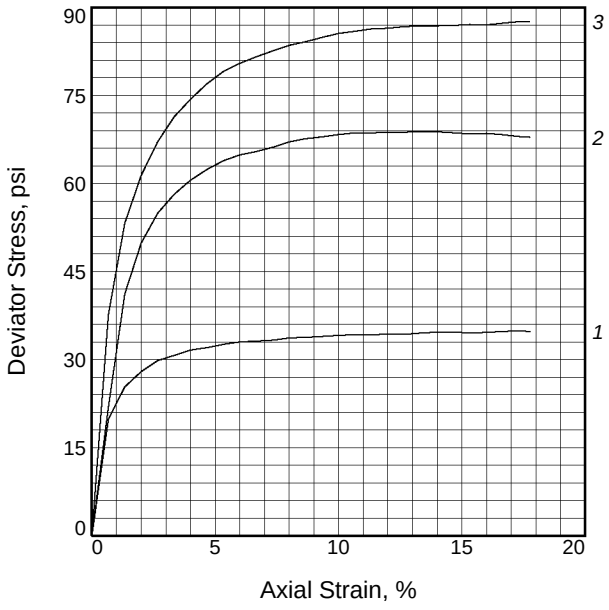


Client: Chicago District
Project: Santiago Creek
Location: TH20-19, 40.0 - 43.0', L1/16813 UUT **Depth:** 40.0 - 43.0'
Project No.: W81EYN12437800, CCRC# 1575KB **Figure** _____

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW





Sample No.		1	2	3
Initial	Water Content, %	7.3	6.7	6.6
	Dry Density, pcf	110.3	110.8	110.4
	Saturation, %	38.5	35.8	35.0
	Void Ratio	0.5002	0.4930	0.4980
	Diameter, in.	6.01	6.01	6.02
	Height, in.	11.98	12.00	12.01
At Test	Water Content, %	6.9	6.3	6.0
	Dry Density, pcf	110.3	110.8	110.4
	Saturation, %	36.4	34.0	32.1
	Void Ratio	0.5002	0.4930	0.4980
	Diameter, in.	6.01	6.01	6.02
	Height, in.	11.98	12.00	12.01
Strain rate, in./min.		1.000	1.000	1.000
Back Pressure, psi		0	0	0
Cell Pressure, psi		10	20	30
Fail. Stress, psi		35	69	87
Ult. Stress, psi		35	68	87
σ_1 Failure, psi		45	89	117
σ_3 Failure, psi		10	20	30

Type of Test:
Unconsolidated Undrained

Sample Type: Remolded

Description: Brown, Sandy Poorly Graded Clayey Gravel (GP-GC). Triaxial specimens 6 x 12 remolded

LL= 30 **PL=** 16 **PI=** 14

Assumed Specific Gravity= 2.65

Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D2850 & D4318.

Figure _____

Client: Chicago District

Project: Santiago Creek

Location: TH20-15, 20.0 - 30.0', L1/16802 UUT

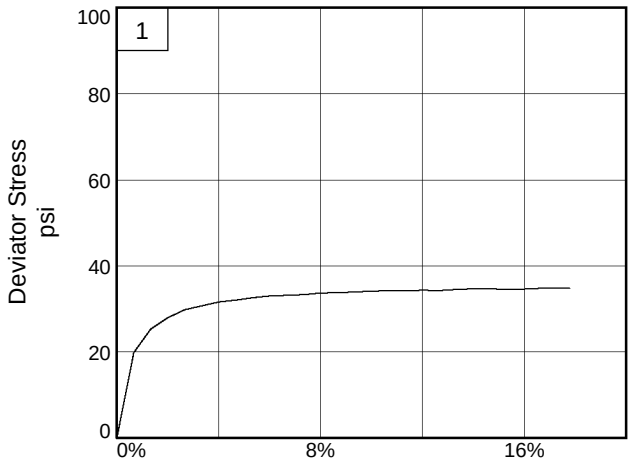
Depth: 20.0 - 30.0'

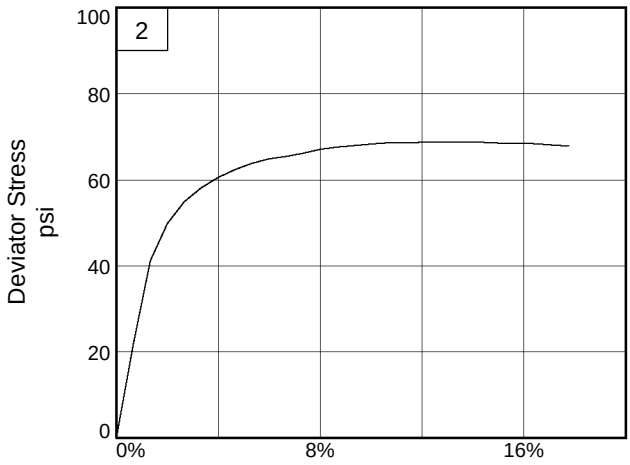
Proj. No.: W81EYN12437800, CCRC# 1575KB **Date Sampled:**

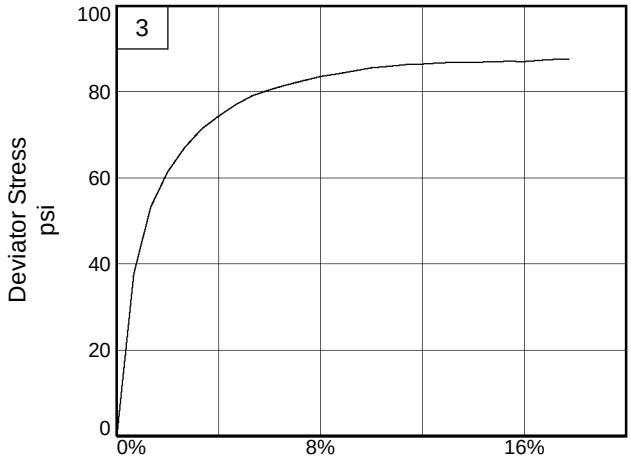
TRIAXIAL SHEAR TEST REPORT

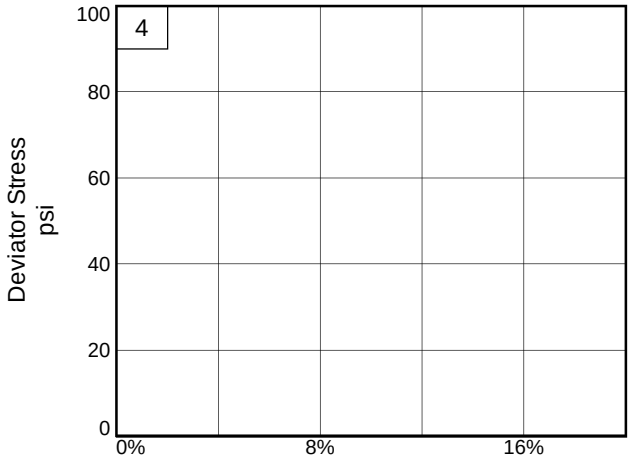
U.S. Army Corp of Engineers

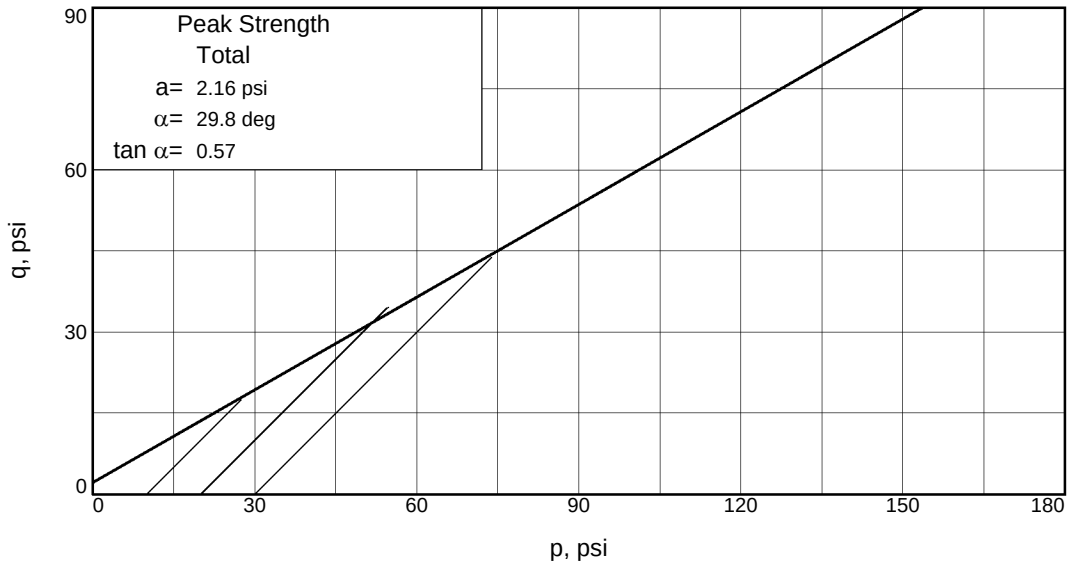
Tested By: JC **Checked By:** MW







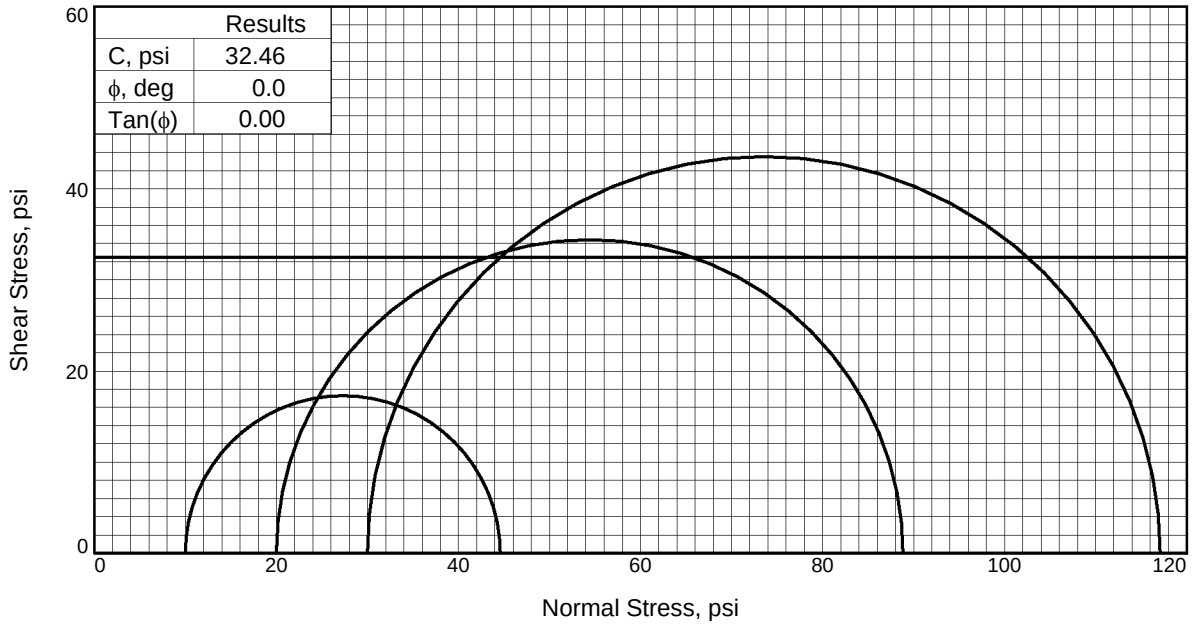


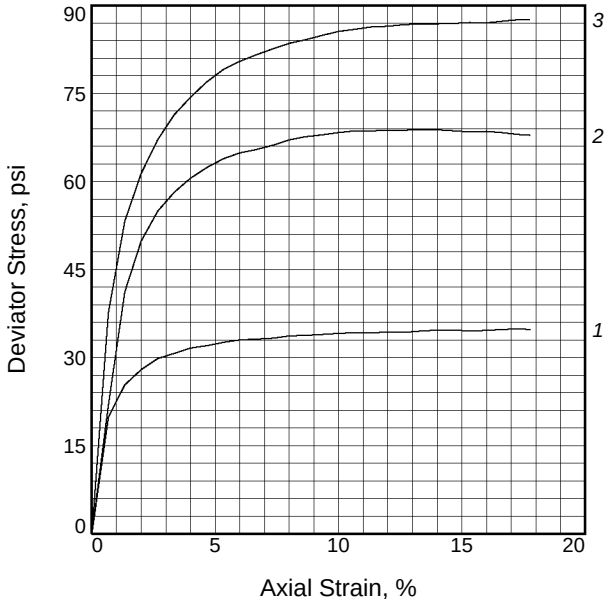


Client: Chicago District
Project: Santiago Creek
Location: TH20-15, 20.0 - 30.0', L1/16802 UUT **Depth:** 20.0 - 30.0'
Project No.: W81EYN12437800, CCRC# 1575KB **Figure** _____

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW





Sample No.		1	2	3
Initial	Water Content, %	7.3	6.7	6.6
	Dry Density, pcf	110.3	110.8	110.4
	Saturation, %	38.5	35.8	35.0
	Void Ratio	0.5002	0.4930	0.4980
	Diameter, in.	6.01	6.01	6.02
	Height, in.	11.98	12.00	12.01
At Test	Water Content, %	6.9	6.3	6.0
	Dry Density, pcf	110.3	110.8	110.4
	Saturation, %	36.4	34.0	32.1
	Void Ratio	0.5002	0.4930	0.4980
	Diameter, in.	6.01	6.01	6.02
	Height, in.	11.98	12.00	12.01
Strain rate, in./min.		1.000	1.000	1.000
Back Pressure, psi		0	0	0
Cell Pressure, psi		10	20	30
Fail. Stress, psi		35	69	87
Ult. Stress, psi		35	68	87
σ_1 Failure, psi		45	89	117
σ_3 Failure, psi		10	20	30

Type of Test:
Unconsolidated Undrained

Sample Type: Remolded

Description: Brown, Sandy Poorly Graded Clayey Gravel (GP-GC). Triaxial specimens 6 x 12 remolded

LL= 30 **PL=** 16 **PI=** 14

Assumed Specific Gravity= 2.65

Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D2850 & D4318.

Figure _____

Client: Chicago District

Project: Santiago Creek

Location: TH20-15, 20.0 - 30.0', L1/16802 UUT

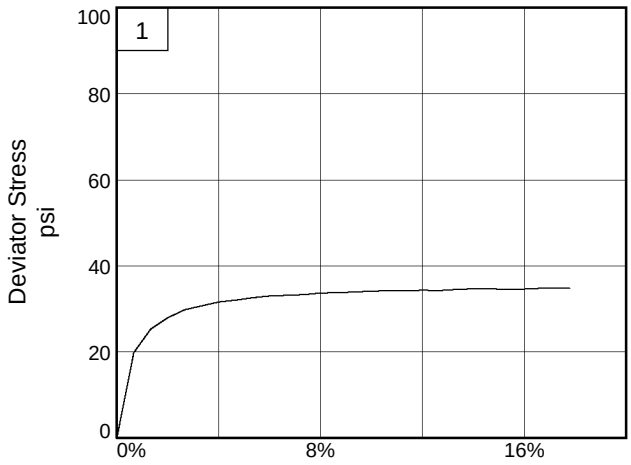
Depth: 20.0 - 30.0'

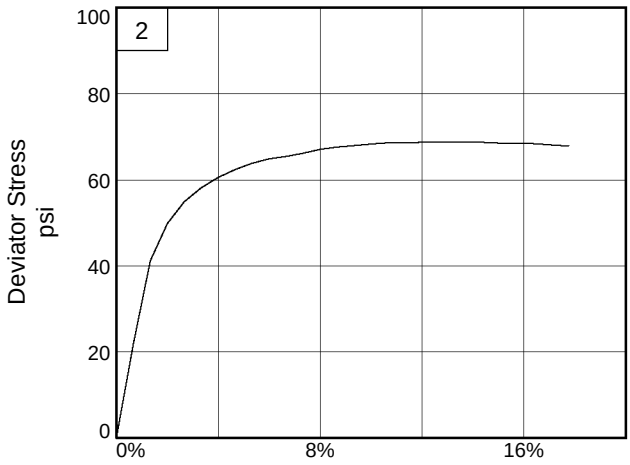
Proj. No.: W81EYN12437800, CCRC# 1575KB **Date Sampled:**

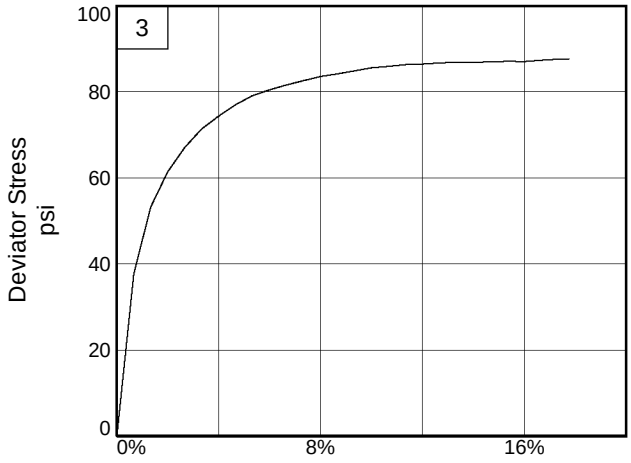
TRIAXIAL SHEAR TEST REPORT

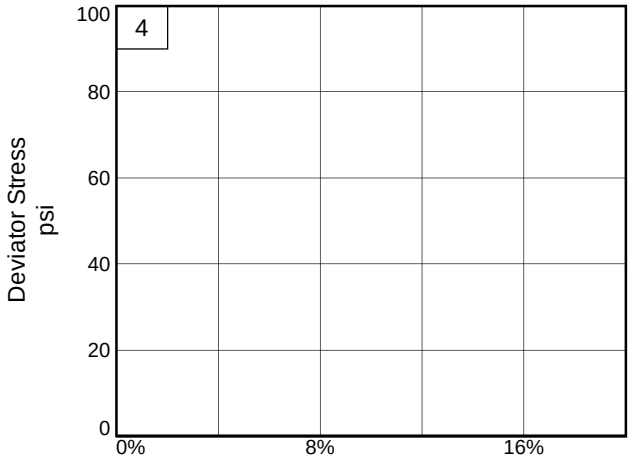
U.S. Army Corp of Engineers

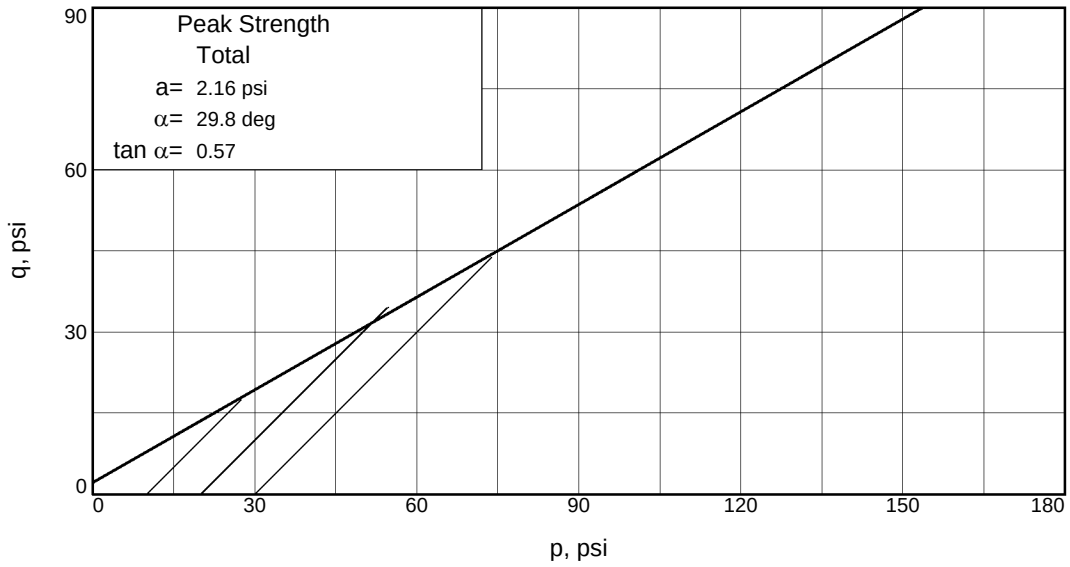
Tested By: JC **Checked By:** MW









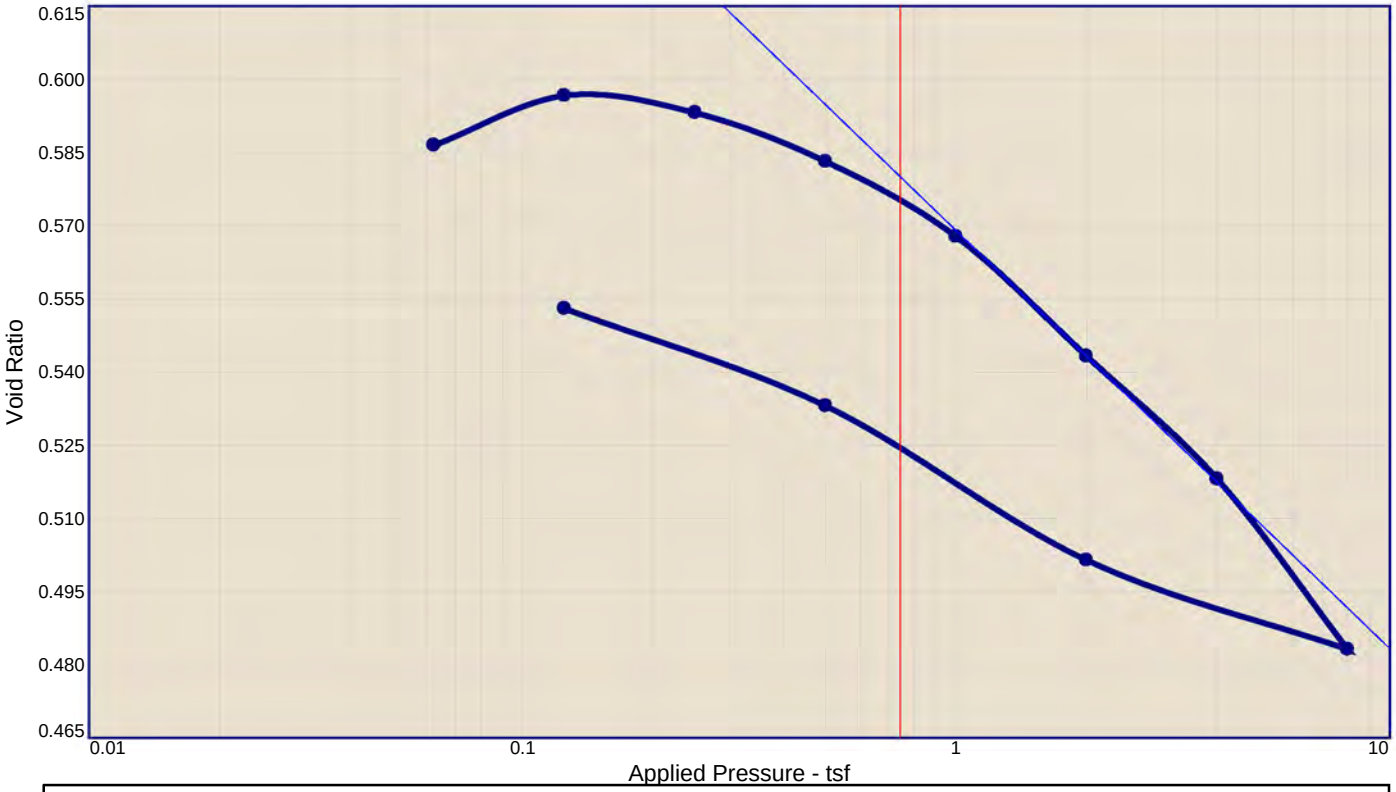


Client: Chicago District
Project: Santiago Creek
Location: TH20-15, 20.0 - 30.0', L1/16802 UUT **Depth:** 20.0 - 30.0'
Project No.: W81EYN12437800, CCRC# 1575KB **Figure** _____

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW

CONSOLIDATION TEST REPORT ASTM D2435



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
3	0.25	0.013	0.001								
4	0.50	0.008	0.003								
5	1.00	0.040	0.002								
6	2.00	0.047	0.002								
7	4.00	0.067	0.003								
8	8.00	0.046	0.004								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
94.4 %	19.9 %		50	29	2.65	0	0.9	0.09	0.04			0.559

MATERIAL DESCRIPTION	USCS	AASHTO
Dark Brown & Very Pale Brown, Fat Clay (CH), with a little sand.	CH	

Project No. W81EYN12437800,**Client:** Chicago District

Project: Santiago Creek

Location: TH20-07, 10.5 - 12.5', L1/17277C Consol **Depth:** 10.5 - 12.5'

Remarks:

Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.

U.S. Army Corp of Engineers

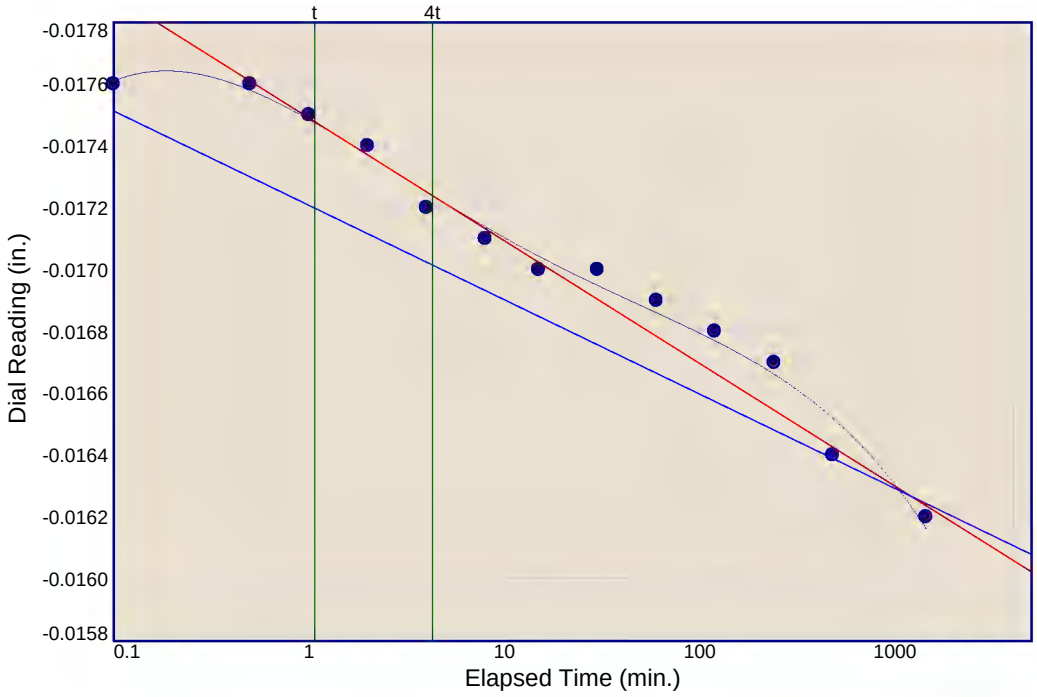
Figure

Tested By: ML **Checked By:** MW

Dial Reading vs. Time

Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

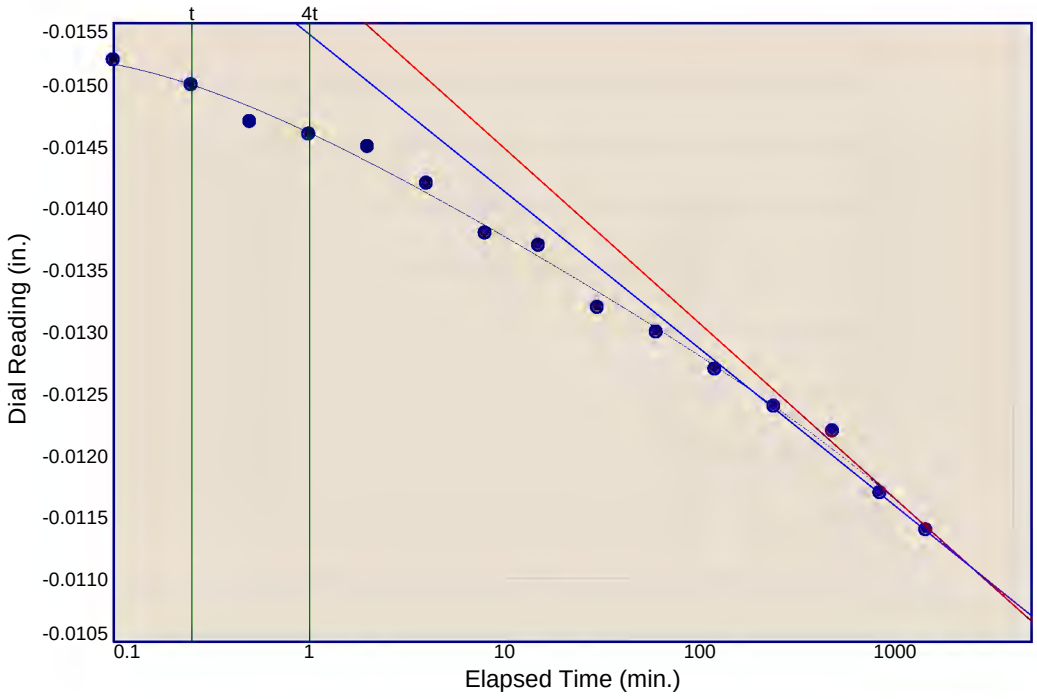
Location: TH20-07, 10.5 - 12.5', L1/17277C Consol Depth: 10.5 - 12.5'



Load No.= 3
Load= 0.25 tsf
D_0 = -0.0177
D_{50} = -0.0170
D_{100} = -0.0163
T_{50} = 22.30 min.

C_v @ T_{50}
0.013 $ft.^2/day$

C_α = 0.001



Load No.= 4
Load= 0.50 tsf
D_0 = -0.0154
D_{50} = -0.0132
D_{100} = -0.0111
T_{50} = 36.96 min.

C_v @ T_{50}
0.008 $ft.^2/day$

C_α = 0.003

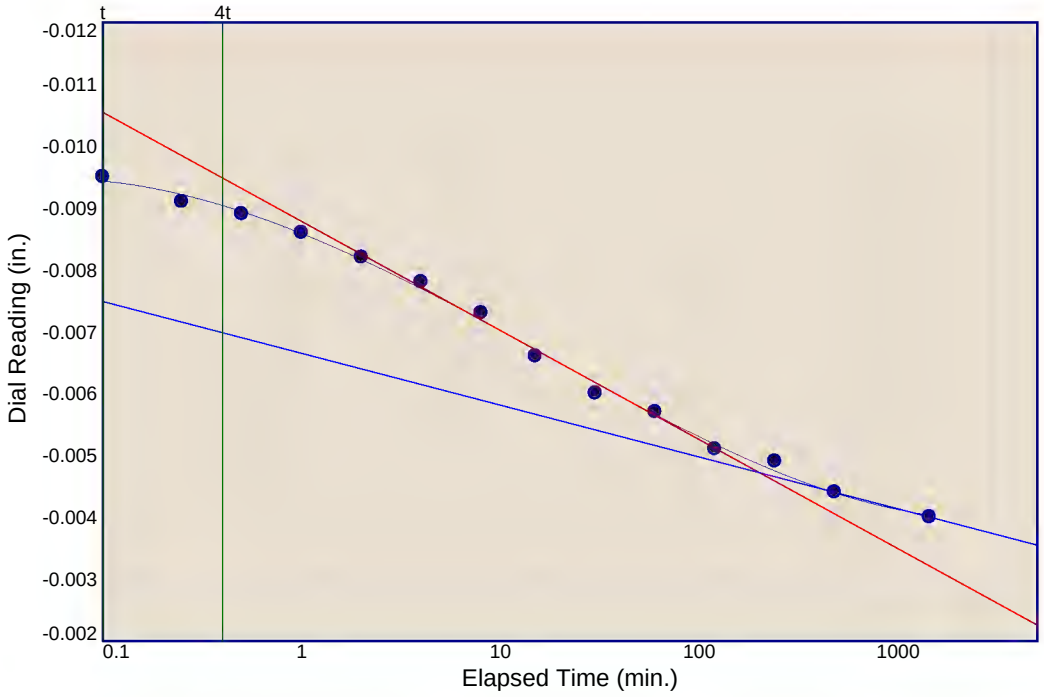
Figure

U.S. Army Corp of Engineers

Dial Reading vs. Time

Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

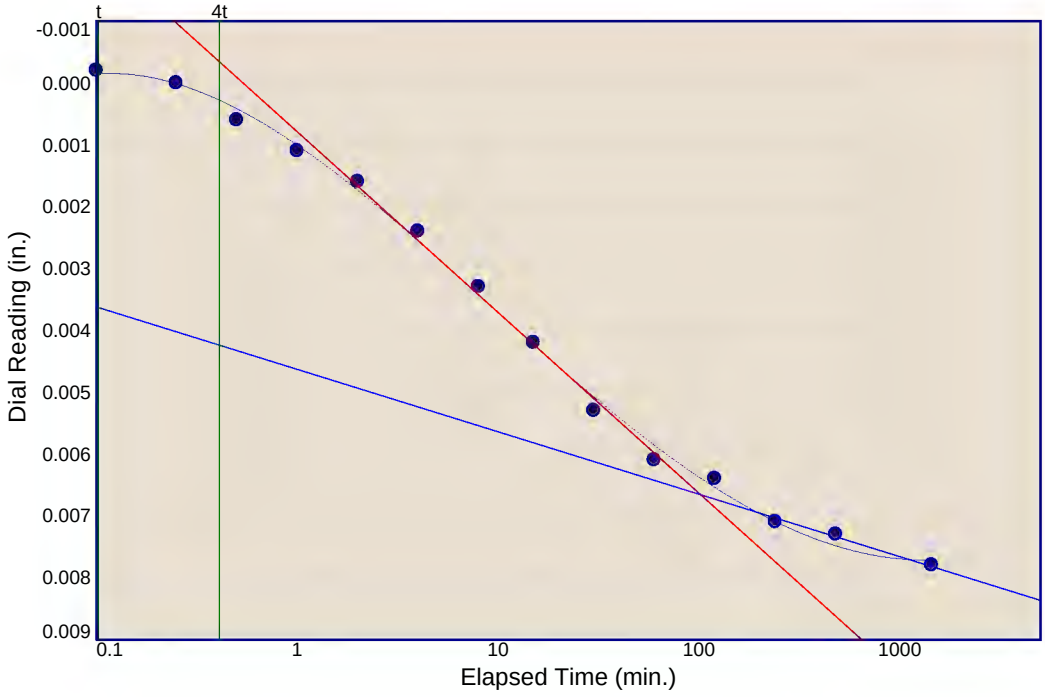
Location: TH20-07, 10.5 - 12.5', L1/17277C Consol Depth: 10.5 - 12.5'



Load No.= 5
Load= 1.00 tsf
D_0 = -0.0098
D_{50} = -0.0073
D_{100} = -0.0047
T_{50} = 7.07 min.

C_v @ T_{50}
0.040 ft.^{2}/day

C_α = 0.002



Load No.= 6
Load= 2.00 tsf
D_0 = -0.0006
D_{50} = 0.0030
D_{100} = 0.0067
T_{50} = 5.88 min.

C_v @ T_{50}
0.047 ft.^{2}/day

C_α = 0.002

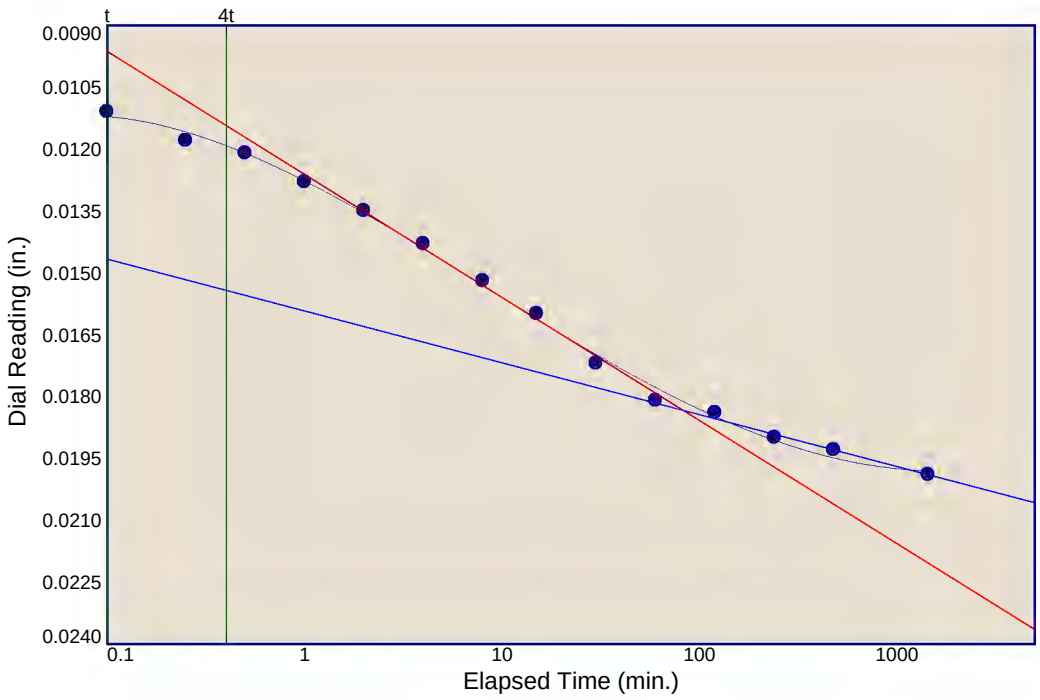
Figure

U.S. Army Corp of Engineers

Dial Reading vs. Time

Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

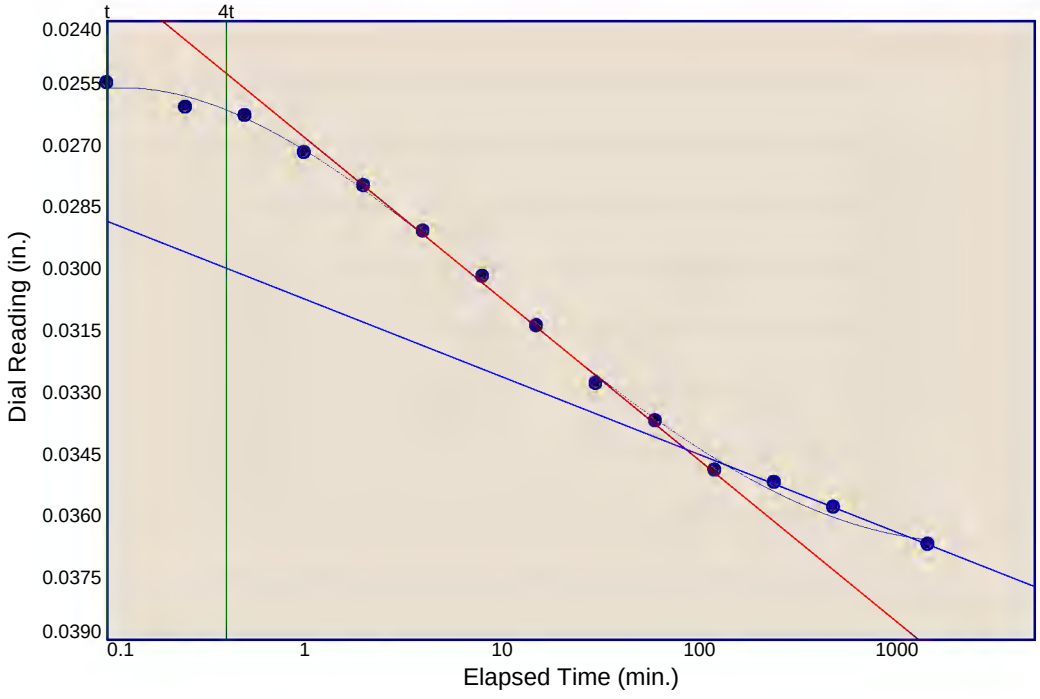
Location: TH20-07, 10.5 - 12.5', L1/17277C Consol Depth: 10.5 - 12.5'



Load No.= 7
Load= 4.00 tsf
D_0 = 0.0105
D_{50} = 0.0144
D_{100} = 0.0183
T_{50} = 4.01 min.

C_v @ T_{50}
0.067 ft.^{2}/day

C_α = 0.003



Load No.= 8
Load= 8.00 tsf
D_0 = 0.0251
D_{50} = 0.0297
D_{100} = 0.0344
T_{50} = 5.56 min.

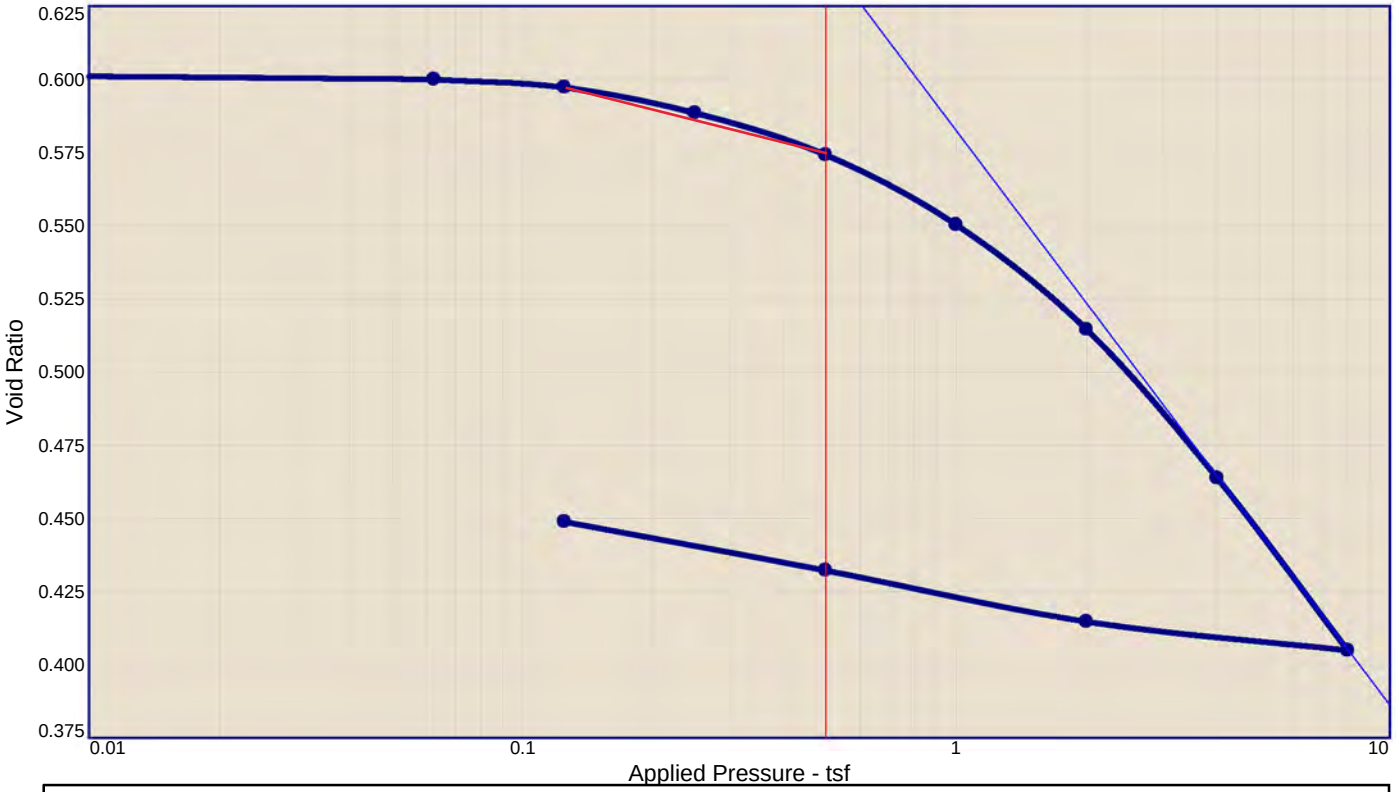
C_v @ T_{50}
0.046 ft.^{2}/day

C_α = 0.004

Figure

U.S. Army Corp of Engineers

CONSOLIDATION TEST REPORT ASTM D2435



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
2	0.13	0.016	0.000								
3	0.25	0.044	0.001								
4	0.50	0.013									
5	1.00	0.012									
6	2.00	0.011									
7	4.00	0.011									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
81.4 %	18.5 %		33	15	2.65	0	1.3	0.20	0.02			0.601

MATERIAL DESCRIPTION	USCS	AASHTO
Yellowish Brown, Lean Clay (CL), with some sand and a trace of gravel.	CL	

Project No. W81EYN12437800,**Client:** Chicago District

Project: Santiago Creek

Location: TH20-12, 10.0 - 12.0', L1/17279C Consol **Depth:** 10.0 - 12.0'

Remarks:

Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.

U.S. Army Corp of Engineers

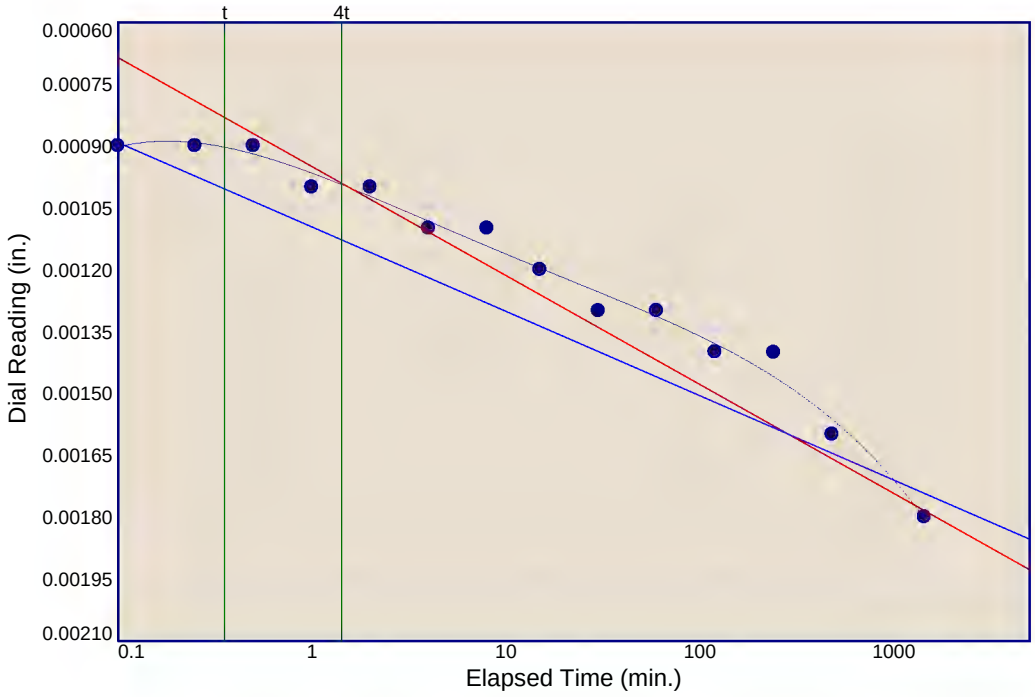
Figure

Tested By: ML **Checked By:** MW

Dial Reading vs. Time

Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

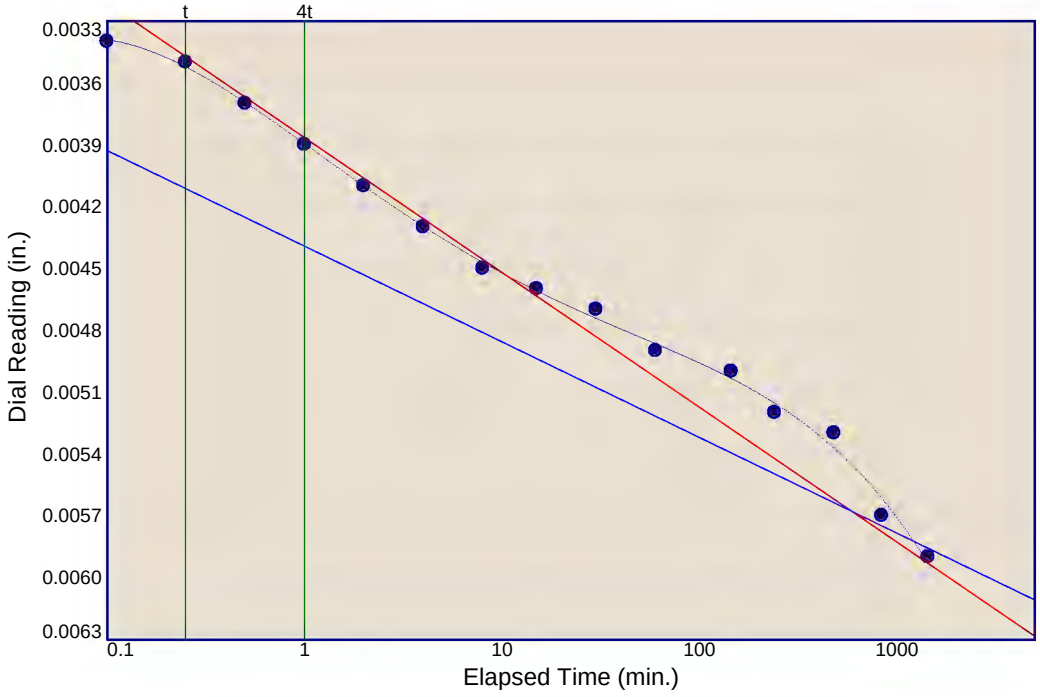
Location: TH20-12, 10.0 - 12.0', L1/17279C Consol Depth: 10.0 - 12.0'



Load No.= 2
Load= 0.13 tsf
D_0 = 0.0008
D_{50} = 0.0012
D_{100} = 0.0016
T_{50} = 16.81 min.

C_v @ T_{50}
0.016 ft.^{2}/day

C_α = 0.000



Load No.= 3
Load= 0.25 tsf
D_0 = 0.0031
D_{50} = 0.0044
D_{100} = 0.0057
T_{50} = 6.30 min.

C_v @ T_{50}
0.044 ft.^{2}/day

C_α = 0.001

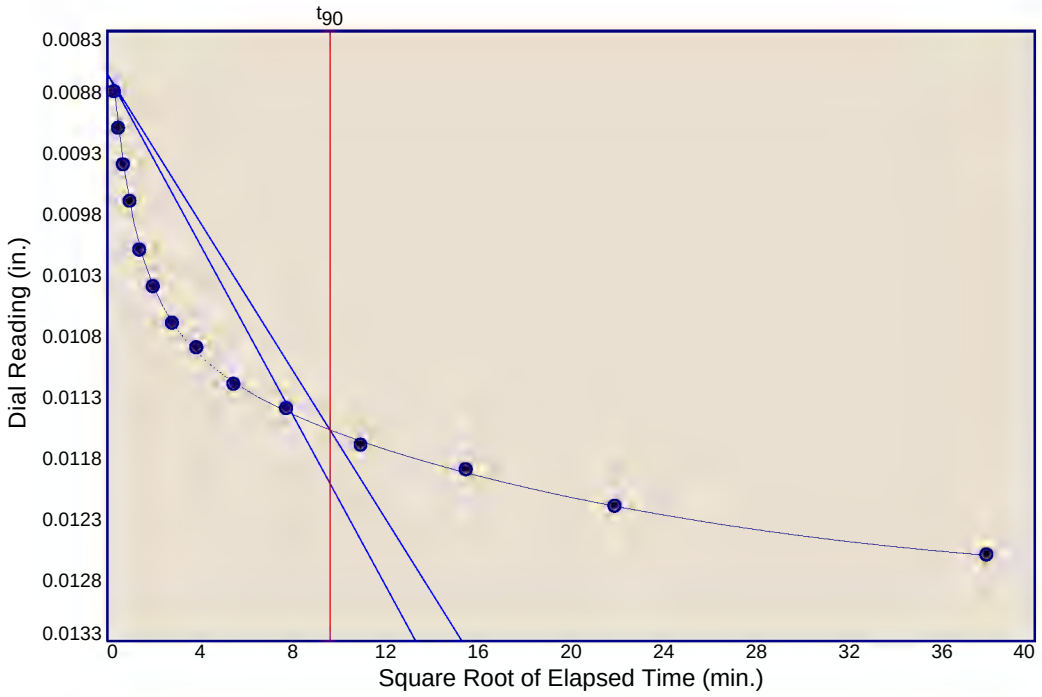
Figure

U.S. Army Corp of Engineers

Dial Reading vs. Time

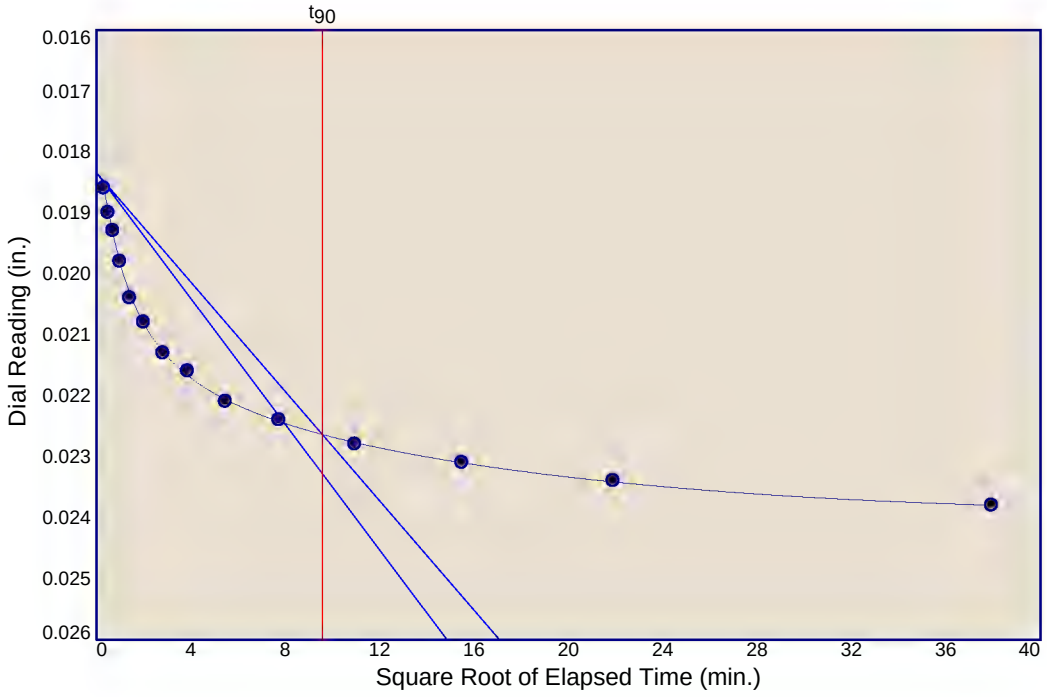
Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

Location: TH20-12, 10.0 - 12.0', L1/17279C Consol Depth: 10.0 - 12.0'



Load No.= 4
Load= 0.50 tsf
D_0 = 0.0087
D_{90} = 0.0116
D_{100} = 0.0119
T_{90} = 92.07 min.

C_v @ T_{90}
0.013 ft.^{2}/day



Load No.= 5
Load= 1.00 tsf
D_0 = 0.0183
D_{90} = 0.0226
D_{100} = 0.0231
T_{90} = 91.63 min.

C_v @ T_{90}
0.012 ft.^{2}/day

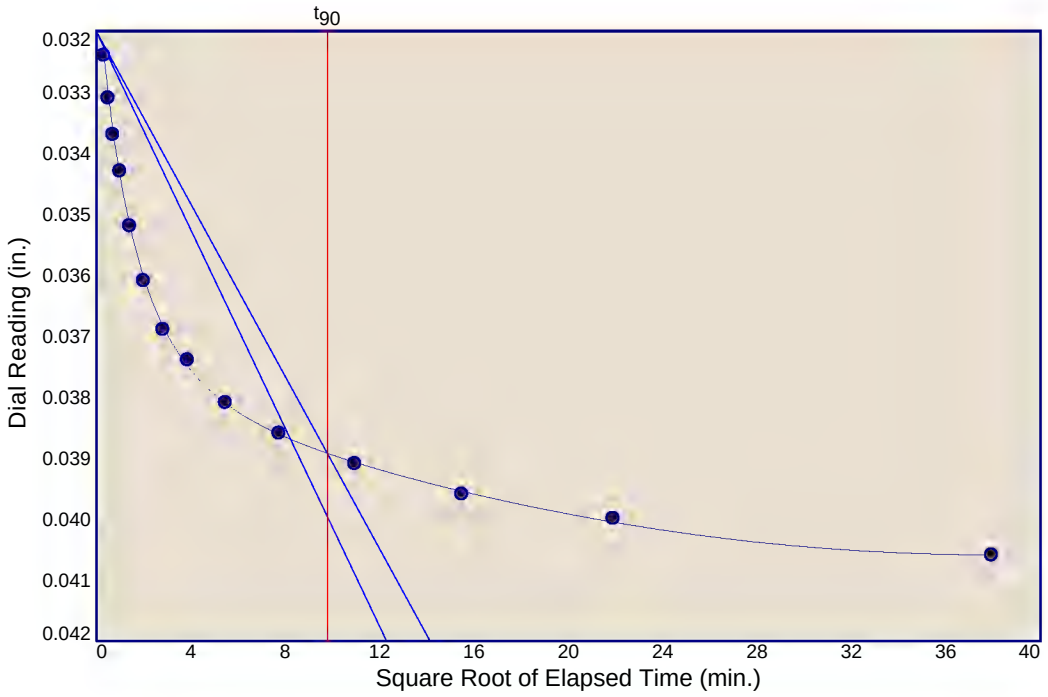
Figure

U.S. Army Corp of Engineers

Dial Reading vs. Time

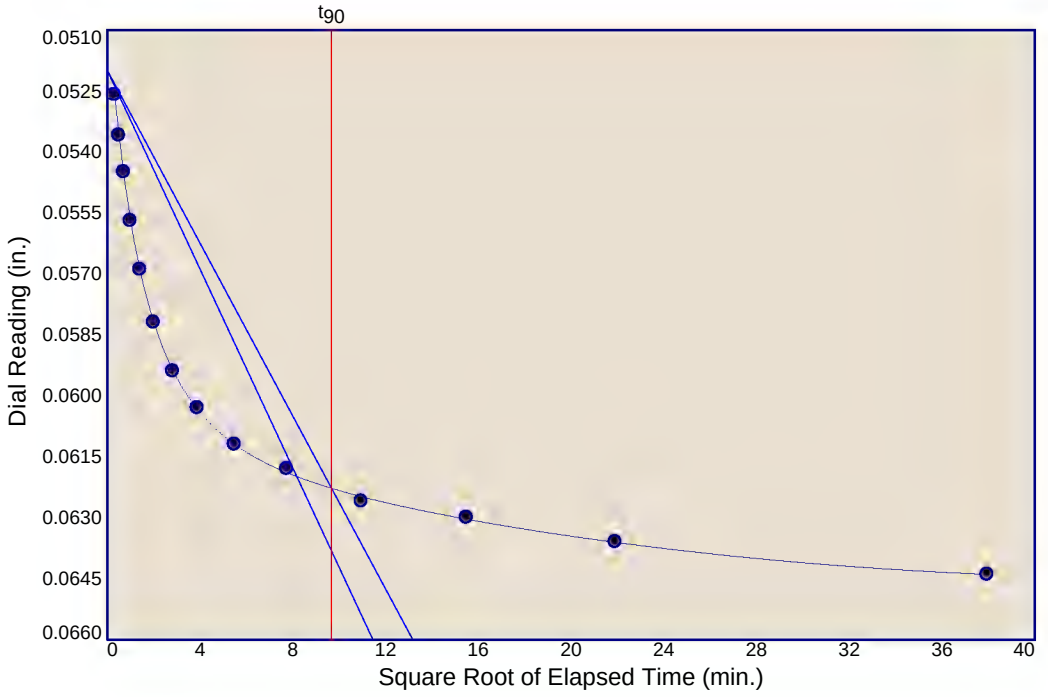
Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

Location: TH20-12, 10.0 - 12.0', L1/17279C Consol Depth: 10.0 - 12.0'



Load No.= 6
Load= 2.00 tsf
D_0 = 0.0320
D_{90} = 0.0389
D_{100} = 0.0397
T_{90} = 95.63 min.

C_v @ T_{90}
0.011 ft.^{2}/day



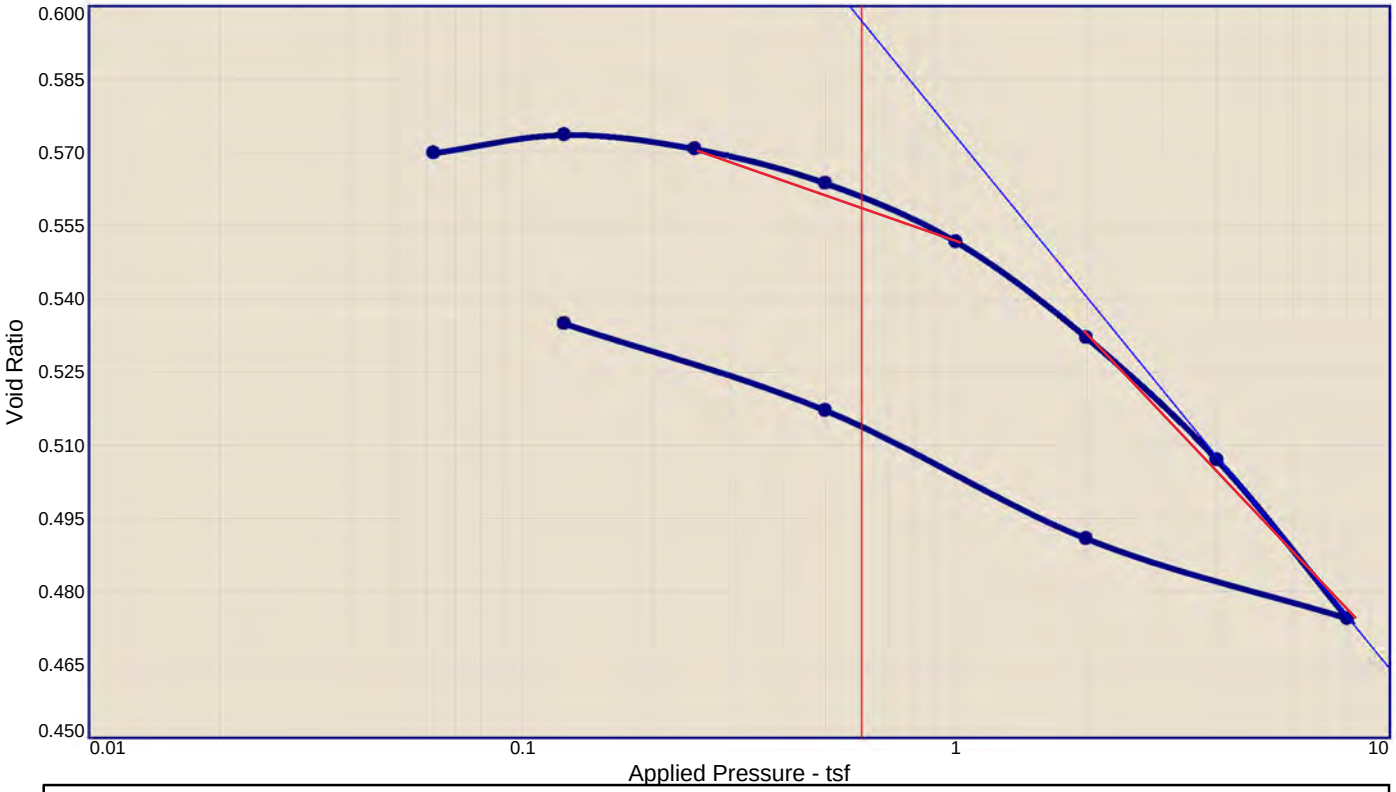
Load No.= 7
Load= 4.00 tsf
D_0 = 0.0520
D_{90} = 0.0623
D_{100} = 0.0634
T_{90} = 93.49 min.

C_v @ T_{90}
0.011 ft.^{2}/day

Figure

U.S. Army Corp of Engineers

CONSOLIDATION TEST REPORT ASTM D2435



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.06	0.038		8	8.00	0.161	0.003				
2	0.13	0.007									
3	0.25	0.002	0.000								
4	0.50	0.008	0.002								
5	1.00	0.074	0.001								
6	2.00	0.139	0.002								
7	4.00	1.935	0.002								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
87.9 %	18.3 %		41	21	2.65	0	1.5	0.11	0.03			0.552

MATERIAL DESCRIPTION	USCS	AASHTO
Dark Brown & Very Pale Brown, Lean Clay (CL), with a little sand.	CL	

Project No. W81EYN12437800,**Client:** Chicago District

Project: Santiago Creek

Location: TH20-07, 12.5 - 14.5', L1/17278C Consol **Depth:** 12.5 - 14.5'

U.S. Army Corp of Engineers

Remarks:

Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.

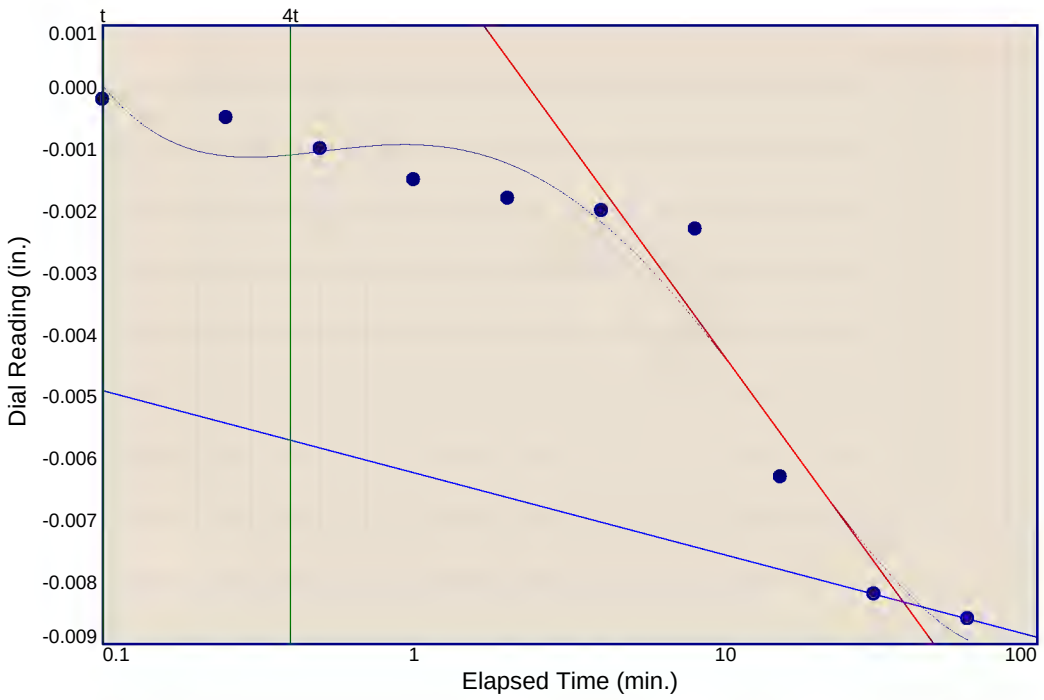
Figure

Tested By: ML **Checked By:** MW

Dial Reading vs. Time

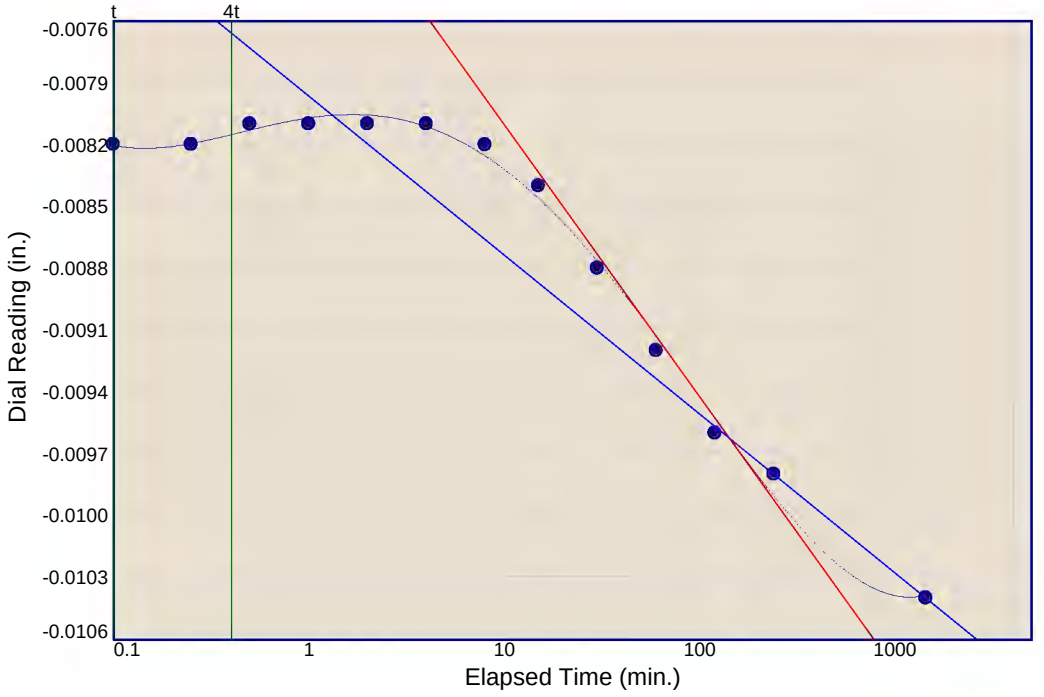
Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

Location: TH20-07, 12.5 - 14.5', L1/17278C Consol Depth: 12.5 - 14.5'



Load No.= 1
Load= 0.06 tsf
D_0 = 0.0011
D_{50} = -0.0036
D_{100} = -0.0083
T_{50} = 7.44 min.

C_v @ T_{50}
0.038 $ft.^2$/day



Load No.= 2
Load= 0.13 tsf
D_0 = -0.0083
D_{50} = -0.0089
D_{100} = -0.0096
T_{50} = 42.04 min.

C_v @ T_{50}
0.007 $ft.^2$/day

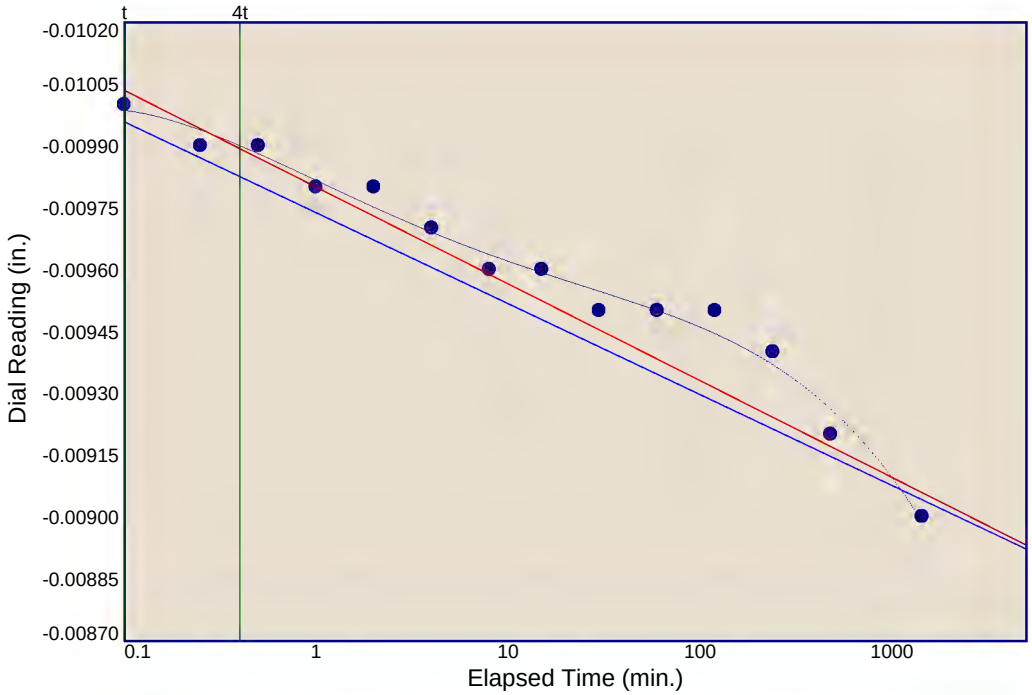
Figure

U.S. Army Corp of Engineers

Dial Reading vs. Time

Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

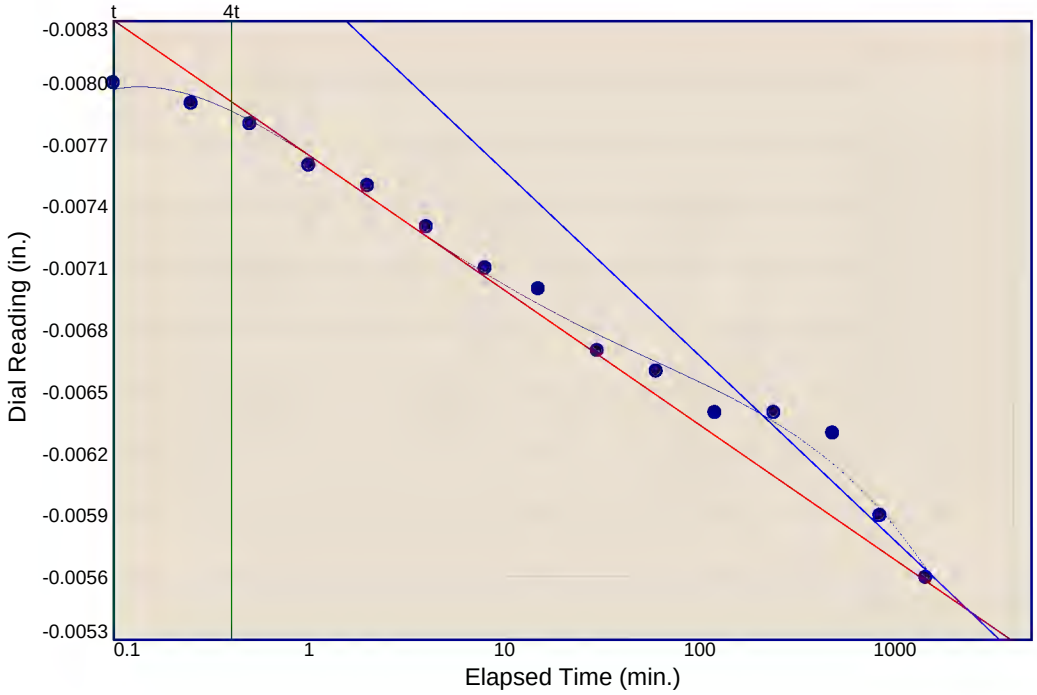
Location: TH20-07, 12.5 - 14.5', L1/17278C Consol Depth: 12.5 - 14.5'



Load No.= 3
Load= 0.25 tsf
D_0 = -0.0101
D_{50} = -0.0094
D_{100} = -0.0088
T_{50} = 149.64 min.

C_v @ T_{50}
0.002 $ft.^2/day$

C_α = 0.000



Load No.= 4
Load= 0.50 tsf
D_0 = -0.0081
D_{50} = -0.0068
D_{100} = -0.0054
T_{50} = 33.79 min.

C_v @ T_{50}
0.008 $ft.^2/day$

C_α = 0.002

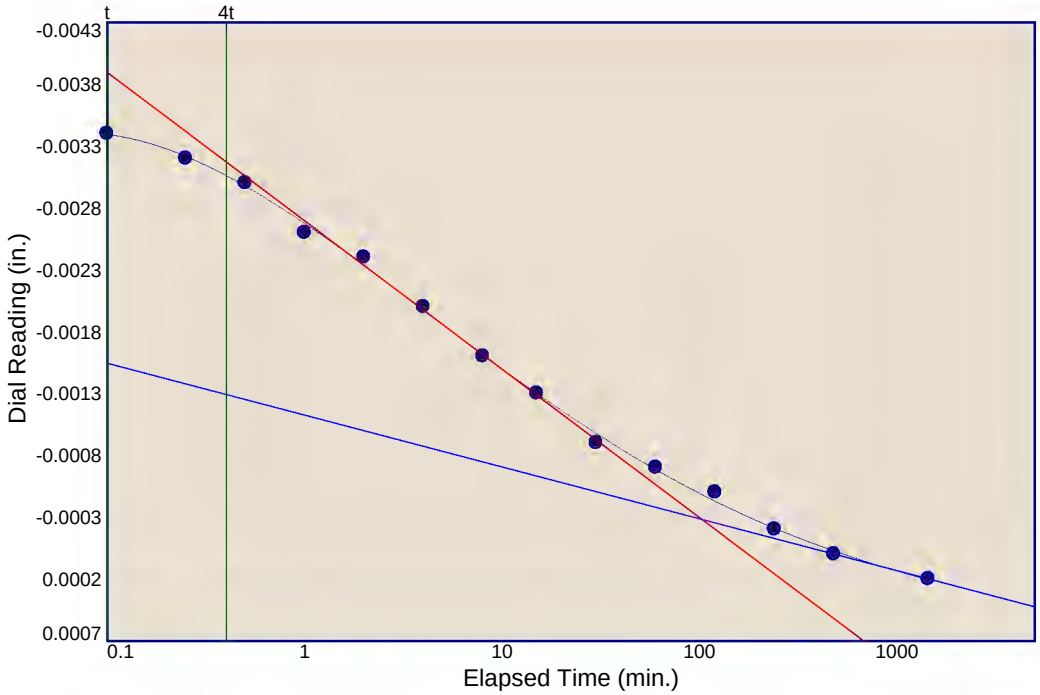
Figure

U.S. Army Corp of Engineers

Dial Reading vs. Time

Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

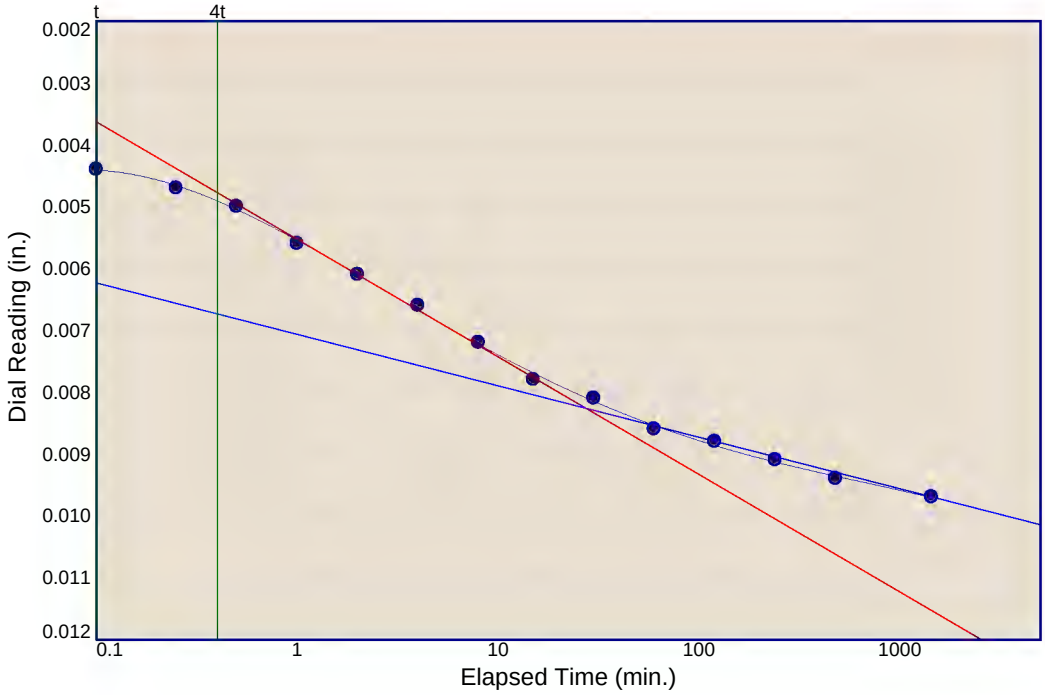
Location: TH20-07, 12.5 - 14.5', L1/17278C Consol Depth: 12.5 - 14.5'



Load No.= 5
Load= 1.00 tsf
D_0 = -0.0037
D_{50} = -0.0020
D_{100} = -0.0003
T_{50} = 3.78 min.

C_v @ T_{50}
0.074 ft.^{2}/day

C_α = 0.001



Load No.= 6
Load= 2.00 tsf
D_0 = 0.0039
D_{50} = 0.0061
D_{100} = 0.0083
T_{50} = 1.96 min.

C_v @ T_{50}
0.139 ft.^{2}/day

C_α = 0.002

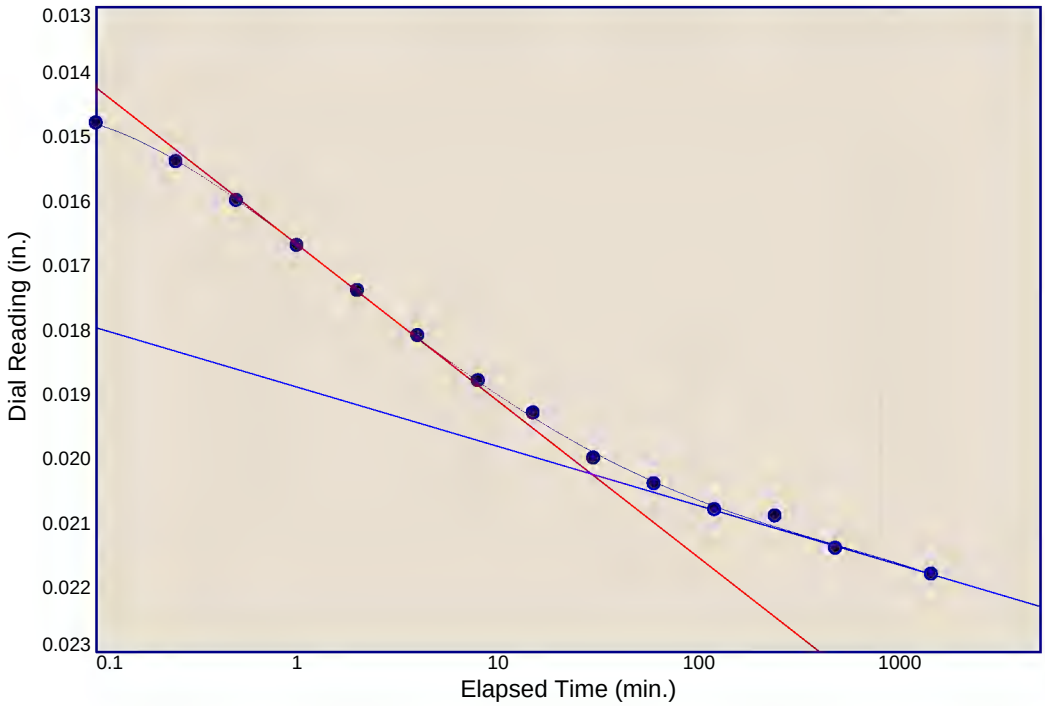
Figure

U.S. Army Corp of Engineers

Dial Reading vs. Time

Project No.: W81EYN12437800, CCRC# 1575KB
Project: Santiago Creek

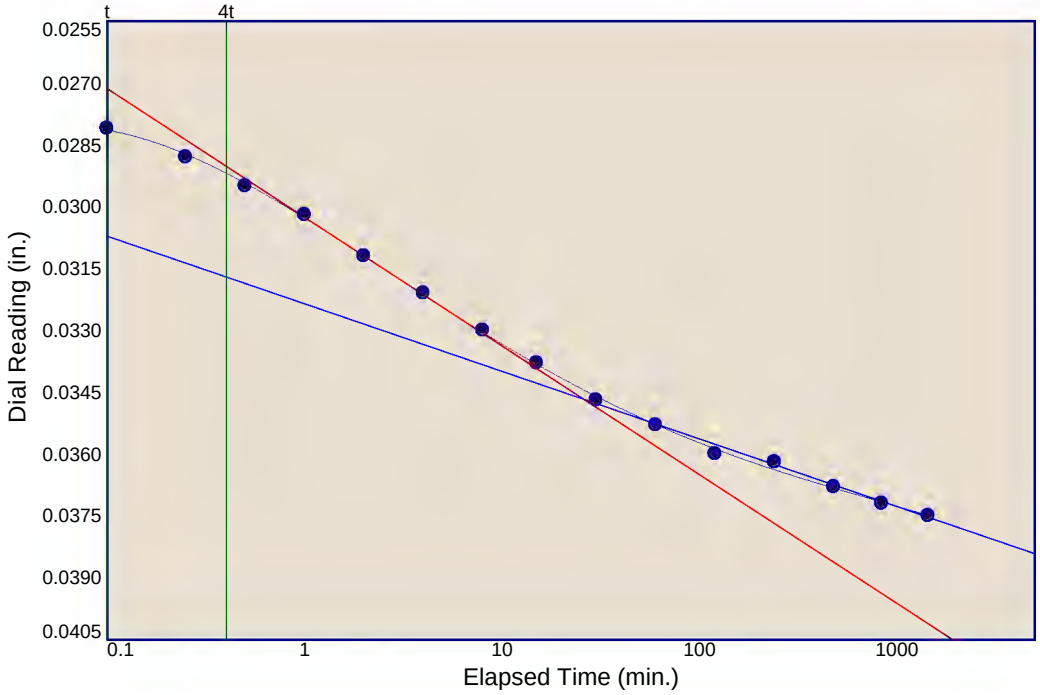
Location: TH20-07, 12.5 - 14.5', L1/17278C Consol Depth: 12.5 - 14.5'



Load No.= 7
Load= 4.00 tsf
D_0 = 0.0097
D_{50} = 0.0150
D_{100} = 0.0202
T_{50} = 0.14 min.

C_v @ T_{50}
1.935 ft.^{2}/day

C_α = 0.002



Load No.= 8
Load= 8.00 tsf
D_0 = 0.0271
D_{50} = 0.0309
D_{100} = 0.0347
T_{50} = 1.59 min.

C_v @ T_{50}
0.161 ft.^{2}/day

C_α = 0.003

Figure

U.S. Army Corp of Engineers

CORROSIVITY SUMMARY OF MATERIAL PROPERTIES

PROJECT: Santiago Creek Testing Project LOCATION: **4-Apr-22**

REQUISITION NO: W81EYN12437800 **WORK ORDER:** CCRC# 1575KB

							G187 Resistance								Index							
															Resistivity						total	
LAB Number	Hole Number	Sample Number	Depth (ft)	D2216 MC%	Moisture	D4972 pH	Natural Ohms.cm	Inundated Ohms.cm	Sulfates mg/Kg	Chlorides mg/Kg	Redox	Color	Class.	D2487 Unified Soil Classification System	natural	inundated	pH	Redox	Sulfate	Moisture	natural	Inundated
L1/16780	TH20-05		5.0 to 10.0	13.18	dry	8.02	4.50E+04	6598.6881	16	9.2	220	Brown			0	0	0	0	0	0	0	0
L1/16899	TH20-07		10.0 to 11.5	10.41	dry	8.058043	8.70E+04	2.20E+03	63.45238	15.22619	210	Grayish Brown	SC	(Visual) Clayey Sand (SC), with a trace of gravel.	0	2	0	0	0	0	0	2
L1/16900	TH20-07		10.0 to 15.0	22.16	dry	7.88	6.80E+03	8.70E+05	580	170	210	Grayish Brown	CL	(Visual) Lean Clay (CL), with sand.	0	0	0	0	1	0	1	1
L1/16924	TH20-12		5.0 to 8.0	4.88	dry	8.058043	2.10E+04	2.40E+03	63.45238	15.22619	220	Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	2	0	0	0	0	0	2
L1/16934	TH20-12		35.0 to 40.0	17.55	moist	8	1.80E+04	5.40E+03	21	8.1	200	Brown	CL	(Visual) Lean Clay (CL), with sand.	0	0	0	0	0	1	1	1
L1/16948	TH20-13		0.0 to 5.0	4.2	dry	8.058043	3.30E+05	1.10E+04	63.45238	15.22619	232.5111	Brown			0	0	0	0	0	0	0	0
L1/16949	TH20-13		5.0 to 10.0	10.33	dry	7.5	1.60E+04	6.80E+03	10	8.1	232.5111	Brown	SC	(Visual) Clayey Sand (SC).	0	0	0	0	0	0	0	0
L1/16798	TH20-14		0.0 to 10.0	4.2	dry	8.69	4.40E+04	7.20E+03	35	6	220	Brown	SM	Gravelly Silty Sand (SM).	0	0	3	0	0	0	3	3
L1/16981	TH20-14		70.0 to 80.0	8.4	moist	8.69	4.40E+04	7.20E+03	35	6	170	Brown & Pale Brown	SC	Gravelly Clayey Sand (SC).	0	0	3	0	0	0	3	3
L1/16802	TH20-15		20.0 to 30.0	5.72	dry	7.29	5.40E+04	3.50E+03	73	13	240	Brown	GP-GC	Sandy Poorly Graded Clayey Gravel (GP-GC).	0	0	0	0	0	0	0	0
L1/16803	TH20-15		40.0 to 42.0	15.23	dry	8.25	4.50E+04	6.60E+03	30	18	580	Dark Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/16805	TH20-15		60.0 to 62.0	12.16	moist	8.13	4.50E+04	6.60E+03	33	13	180	Dark Yellowish Brown	SC	Clayey Sand (SC), with a little gravel.	0	0	0	0	0	0	0	0
L1/17017	TH20-15		110.0 to 120.0	6.49	wet	8.41	4.50E+04	6.60E+03	35	8.3	140	Brown	SC	Clayey Sand (SC), with some gravel.	0	0	0	0	0	2	2	2
L1/17021	TH20-15	S-27	130.0 to 135.0	18.36	wet	8.12	4.50E+04	6.60E+03	24	13	-10	Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.	0	0	0	5	0	2	7	7
L1/17025	TH20-15	S-29	140.0 to 145.0	19.12	wet	8	4.50E+04	6.60E+03	28	15	160	Dark Yellowish Brown	CL	(Visual) Lean Clay (CL), with some sand.	0	0	0	0	0	2	2	2
L1/17027	TH20-16	S-1	0.0 to 5.0	0.81	dry	8.21	4.50E+04	6.60E+03	63.45238	15.22619	220	Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/17029	TH20-16	S-3	10.0 to 15.0	4.35	dry	8.058043	9.00E+04	1.80E+04	63.45238	15.22619	280	Yellowish Brown & Olive Brown	SP-SM	Poorly Graded Silty Sand (SP-SM), with some gravel.	0	0	0	0	0	0	0	0
L1/17034	TH20-17	S-1	0.0 to 5.0	1.84	dry	8.35	4.50E+04	6.60E+03	12	8.1	230	Yellowish Brown	GW-GC	Sandy Well Graded Clayey Gravel (GW-GC).	0	0	0	0	0	0	0	0
L1/16806	TH20-17		10.0 to 20.0	4.09	dry	7.7	3.80E+05	9.00E+03	72	8	270	Olive Brown	GP-GC	Sandy Clayey Poorly Graded Gravel (GP-GC), with a trace of cobble.	0	0	0	0	0	0	0	0
L1/17044	TH20-18	S-1	0.0 to 5.0	1.89	dry	8.17	4.50E+04	6.60E+03	63.45238	15.22619	240	Yellowish Brown	SC-SM	Gravelly Clayey Silty Sand (SC-SM).	0	0	0	0	0	0	0	0
L1/16812	TH20-19		30.0 to 40.0	0.82	dry	8.38	4.50E+04	6.60E+03	51	6	240	Brown	GP-GC	Poorly Graded Clayey Gravel (GP-GC), with a little sand.	0	0	0	0	0	0	0	0
L1/16813	TH20-19		40.0 to 43.0	21.73	moist	6.58	4.10E+04	3.00E+03	73	25	230	Brown	CL	Lean Clay (CL), with some sand.	0	0	0	0	0	0	0	0
L1/17312	TH20-19	S-23	110.0 to 115.0	10.59	moist	8.45	4.50E+04	6.60E+03	47	15	110	Dark Yellowish Brown	SC	Gravelly Clayey Sand (SC).	0	0	0	0	0	0	0	0

CORROSIVITY SUMMARY OF MATERIAL PROPERTIES

PROJECT: Santiago Creek Testing Project LOCATION: **4-Apr-22**

REQUISITION NO: W81EYN12437800 **WORK ORDER:** CCRC# 1575KB

							G187 Resistance								Index								
															Resistivity						total		
LAB Number	Hole Number	Sample Number	Depth (ft)	D2216 MC%	Moisture	D4972 pH	Natural Ohms.cm	Inundated Ohms.cm	Sulfates mg/Kg	Chlorides mg/Kg	Redox	Color	Class.	D2487 Unified Soil Classification System	natural	inundated	pH	Redox	Sulfate	Moisture	natural	Inundated
L1/17104	TH20-20	S-8	50.0 to 55.0	11.71	moist	8.2	4.50E+04	6.60E+03	63.45238	15.22619	224	Yellowish Brown & Olive Brown	SC	Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/17110	TH20-20	S-14	80.0 to 85.0	7.28	moist	7.99	4.50E+04	6.60E+03	63.45238	15.22619	203	Brown	SC	Gravelly Clayey Sand (SC).	0	0	0	0	0	0	0	0
L1/16819	TH20-20		90.0 to 100.0	8.75	wet	8.19	3.70E+04	6.00E+03	33	14	623	Brown	SC	Clayey Sand (SC).	0	0	0	0	0	2	2	2
L1/17118	TH20-20	S-22	120.0 to 125.0	4.07	wet	7.92	2.00E+04	5.50E+03	35	20	308	Dark Yellowish Brown	CL	Lean Clay (CL), with some sand and a trace of gravel.	0	0	0	0	0	2	2	2
L1/17134	TH20-21	S-1	0.0 to 5.0	3.79	dry	8.14	4.50E+04	6.60E+03	170	44	210	Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	0	0	0	1	0	1	1
L1/17137	TH20-21	S-3	10.0 to 15.0	3.98	dry	6.94	4.50E+04	6.60E+03	90	9.4	230	Yellowish Brown	GC	Sandy Clayey Gravel (GC).	0	0	0	0	0	0	0	0
L1/16820	TH20-21		20.0 to 30.0	6.52	dry	7.99	4.50E+04	6.60E+03	37	6.1	230	Brown	SC	Clayey Sand (SC), with a little gravel.	0	0	0	0	0	0	0	0
L1/17144	TH20-21		30.0 to 40.0	4.13	dry	7.25	1.40E+05	1.50E+04	48	5.6	240	Pale Brown	GC-GM	(Visual) Sandy Clayey Silty Gravel (GC-GM).	0	0	0	0	0	0	0	0
L1/17148	TH20-21		40.0 to 50.0	1.35	dry	8.43	4.50E+04	6.60E+03	87	5.3	150	Light Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/17151	TH20-21		50.0 to 60.0	2.32	dry	8.26	4.50E+04	6.60E+03	44	5.3	240	Brown	GC	Sandy Clayey Gravel (GC).	0	0	0	0	0	0	0	0
L1/17152	TH20-21		60.0 to 70.0	9.4	moist	8.51	4.50E+04	6.60E+03	23	13	240	Brown	SC	Clayey Sand (SC), with some gravel.	0	0	3	0	0	0	3	3
L1/16821	TH20-21		60.0 to 70.0	16.02	moist	8.34	4.50E+04	6.60E+03	45	22	240	Dark Yellowish Brown	CL	Lean Clay (CL), with some sand.	0	0	0	0	0	0	0	0
L1/17155	TH20-21		70.0 to 80.0	3.93	moist	8.23	4.50E+04	6.60E+03	26	5	170	Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/17160	TH20-21		80.0 to 90.0	4.04	moist	8.24	4.50E+04	6.60E+03	41	9.7	210	Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/17161	TH20-21	S-19	90.0 to 95.0		wet	8.24	4.50E+04	6.60E+03	25	9.7	270	Yellowish Brown			0	0	0	0	0	2	2	2
L1/17174	TH20-22	S-6	25.0 to 30.0	4.68	dry	8.55	4.50E+04	6.60E+03	13	4.2	232.5111	Brown	SC	Gravelly Clayey Sand (SC).	0	0	3	0	0	0	3	3
L1/16822	TH20-22		30.0 to 40.0	12.7	dry	8.16	4.50E+04	1.00E+04	17	8.2	232.5111	Brown	SW-SC	Well Graded Clayey Sand (SW-SC), with some gravel.	0	0	0	0	0	0	0	0
L1/16823	TH20-22		50.0 to 53.0	6.59	dry	8.11	4.50E+04	6.60E+03	78	17	232.5111	Dark Yellowish Brown	GC	Clayey Gravel (GC), with some sand.	0	0	0	0	0	0	0	0
L1/16826	TH20-23		0.0 to 10.0	5.42	dry	8.05	4.50E+04	6.60E+03	16	8.1	230	Brown	SC	Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/17195	TH20-23	S-3	10.0 to 15.0	7.25	moist	8.05	4.50E+04	6.60E+03	19	5.2	270	Dark Yellowish Brown	SC	(Visual) Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/17197	TH20-23	S-5	20.0 to 25.0	6.27	moist	8.04	4.50E+04	6.60E+03	36	8.1	240	Dark Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	0	0	0	0	0	0	0
L1/16828	TH20-23		30.0 to 40.0	18.51	moist	7.63	2.90E+03	1.70E+03	470	30	250	Dark Yellowish Brown	CH	Fat Clay (CH), with some sand and some gravel.	1	8	0	0	1	0	2	9
L1/17201	TH20-23		40.0 to 50.0		moist	8.15	4.50E+04	6.60E+03	37	7.6	245	Brown			0	0	0	0	0	0	0	0

CORROSIVITY SUMMARY OF MATERIAL PROPERTIES

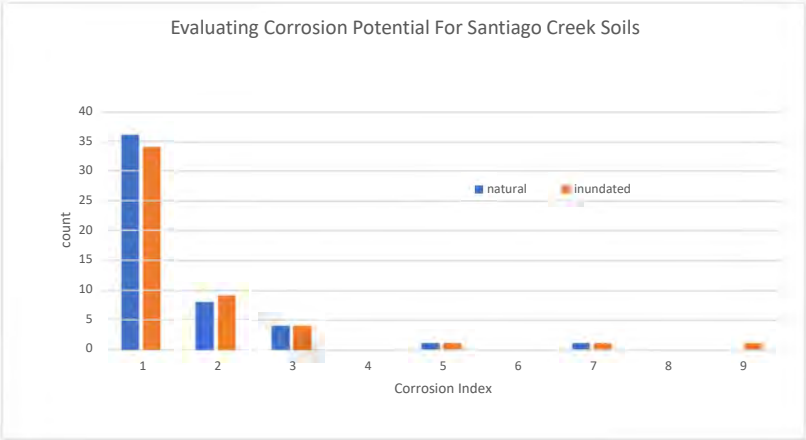
PROJECT: Santiago Creek Testing Project LOCATION: **4-Apr-22**

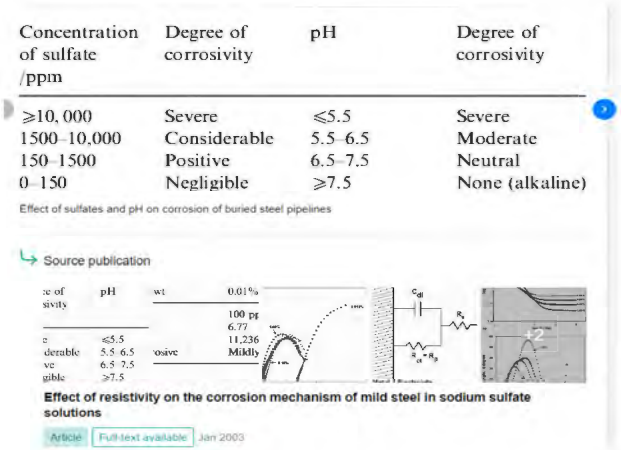
REQUISITION NO: W81EYN12437800 **WORK ORDER:** CCRC# 1575KB

LAB Number	Hole Number	Sample Number	Depth (ft)	D2216 MC%	Moisture	D4972 pH	G187 Resistance Natural Ohms.cm	G187 Resistance Inundated Ohms.cm	Sulfates mg/Kg	Chlorides mg/Kg	Redox	Color	Class.	D2487 Unified Soil Classification System	Index: Resistivity natural	Index: Resistivity inundated	Index: pH	Index: Redox	Index: Sulfate	Index: Moisture	Index: total natural	Index: total Inundated
L1/17207	TH20-23		60.0 to 70.0	5.32	wet	8.44	4.50E+04	6.60E+03	22	7.3	210	Brown	GC	Sandy Clayey Gravel (GC).	0	0	0	0	0	2	2	2
L1/17213	TH20-23		80.0 to 90.0	8.43	wet	8.52	4.50E+04	6.60E+03	13	6.9	230	Dark Yellowish Brown	SC	Gravelly Clayey Sand (SC).	0	0	3	0	0	2	5	5
L1/17221	TH20-24	S-2	5.0 to 10.0	8.41	dry	7.22	4.50E+04	6.60E+03	16	8	210	Yellowish Brown	SC	(Visual) Clayey Sand (SC), with gravel.	0	0	0	0	0	0	0	0
L1/16831	TH20-24		60.0 to 70.0	5.9	wet	8.06	4.00E+04	5.80E+03	49	10	230	Dark Yellowish Brown	SC	Clayey Sand (SC), with some gravel.	0	0	0	0	0	2	2	2
						8.058043			63.45238	15.22619	232.5111											

Where other data values were not available, average of the other soils was taken to evaluate the index.

USACE, Savannah District Materials Testing RTCX - Marietta, GA 30062





Concentration of sulfate /ppm	Degree of corrosivity	pH	Degree of corrosivity
⩾10, 000	Severe	⩽5.5	Severe
1500–10,000	Considerable	5.5–6.5	Moderate
150–1500	Positive	6.5–7.5	Neutral
0–150	Negligible	⩾7.5	None (alkaline)

Effect of sulfates and pH on corrosion of buried steel pipelines

Source publication

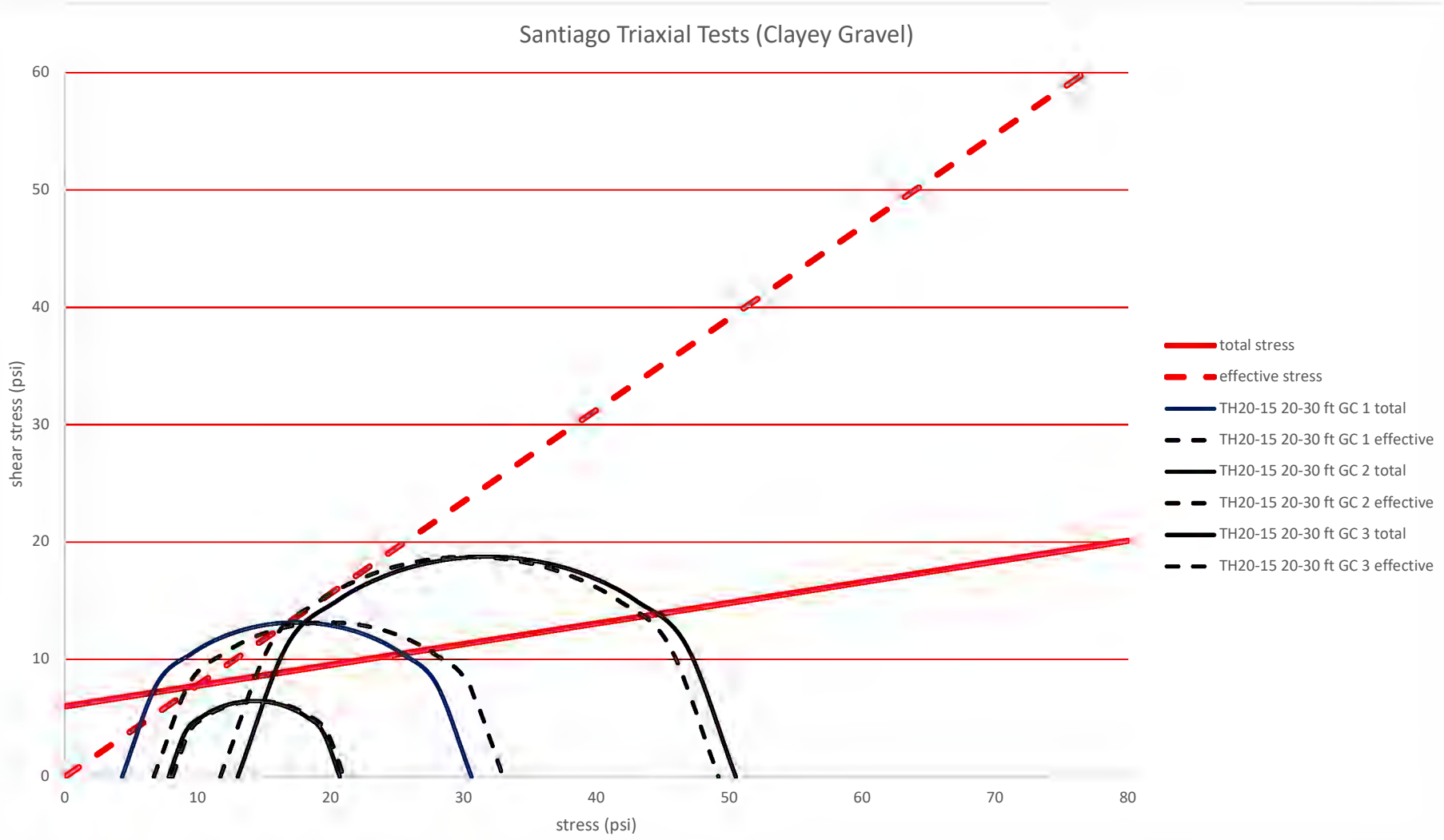
Effect of resistivity on the corrosion mechanism of mild steel in sodium sulfate solutions

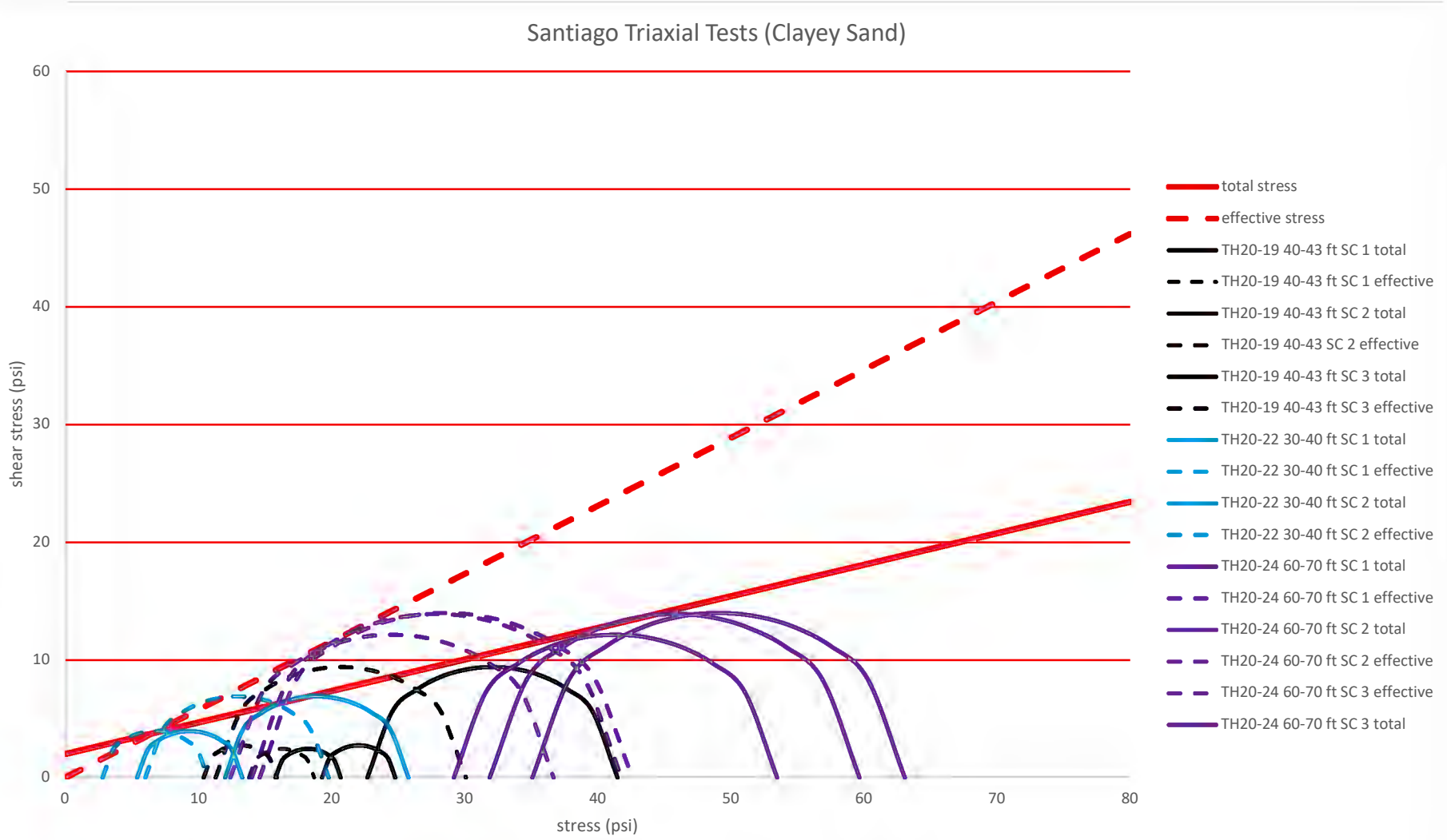
Article Full-text available Jan 2003

TABLE 2 10-point soil test evaluation for iron pipe

Soil Characteristics	Points*
Resistivity—Ω·cm†	
<1,500	10
≥1,500–1,800	8
>1,800–2,100	5
>2,100–2,500	2
>2,500–3,000	1
>3,000	0
pH	
0–2	5
2–4	3
4–6.5	0
6.5–7.5	0‡
7.5–8.5	0
>8.5	3
Redox potential—mV	
>+100	0
+50 – +100	3.5
0 – +50	4
Negative	5
Sulfides	
Positive	3.5
Trace	2
Negative	0
Moisture	
Poor drainage, continuously wet	2
Fair drainage, generally moist	1
Good drainage, generally dry	0

*10 points: corrosive to iron pipe; protection is indicated.
†Based on water-saturated soil box. This method is designed to obtain the lowest and most accurate resistivity reading.
‡If sulfides are present and low (<100 mV) or negative redox-potential results are obtained, three points should be given for this range.


Santiago Triaxial Tests (Clayey Gravel)
shear stress (psi)
stress (psi)
0
10
20
30
40
50
60
70
80
total stress
effective stress
TH20-15 20-30 ft GC 1 total
TH20-15 20-30 ft GC 1 effective
TH20-15 20-30 ft GC 2 total
TH20-15 20-30 ft GC 2 effective
TH20-15 20-30 ft GC 3 total
TH20-15 20-30 ft GC 3 effective


Santiago Triaxial Tests (Clayey Sand)
shear stress (psi)
stress (psi)
0
10
20
30
40
50
60
70
80
total stress
effective stress
TH20-19 40-43 ft SC 1 total
TH20-19 40-43 ft SC 1 effective
TH20-19 40-43 ft SC 2 total
TH20-19 40-43 SC 2 effective
TH20-19 40-43 ft SC 3 total
TH20-19 40-43 ft SC 3 effective
TH20-22 30-40 ft SC 1 total
TH20-22 30-40 ft SC 1 effective
TH20-22 30-40 ft SC 2 total
TH20-22 30-40 ft SC 2 effective
TH20-24 60-70 ft SC 1 total
TH20-24 60-70 ft SC 1 effective
TH20-24 60-70 ft SC 2 total
TH20-24 60-70 ft SC 2 effective
TH20-24 60-70 ft SC 3 effective
TH20-24 60-70 ft SC 3 total

TRIAXIAL COMPRESSION TEST

12/12/2021

CU with Pore Pressures

8:09 PM

Date:
Client: Chicago District
Project: Santiago Creek
Project No.: W81EYN12437800, CCRC# 1575KB
Location: TH20-15, 20.0 - 30.0', L1/16802
Depth: 20.0 - 30.0'
Description: (Visual) Sandy Clayey Gravel (GC). Triaxial specimens 6x12 remolded to 123.1 pcf at 6.5%.
Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.
Type of Sample: Remolded
Assumed Specific Gravity=2.65 **LL=** **PL=** **PI=**
Test Method: ASTM D 4767 Method B

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	106.500			13794.600
Moisture content: Dry soil+tare, gms.	100.000			12683.000
Moisture content: Tare, gms.	0.000			1718.300
Moisture, %	6.5	10.5	10.1	10.1
Moist specimen weight, gms.	11678.3			
Diameter, in.	5.99	5.89	5.87	
Area, in.²	28.14	27.21	27.03	
Height, in.	11.86	11.86	11.85	
Net decrease in height, in.		0.00	0.00	
Net decrease in water volume, cc.			37.80	
Wet density, pcf	133.3	143.0	143.6	
Dry density, pcf	125.2	129.5	130.4	
Void ratio	0.3216	0.2778	0.2687	
Saturation, %	53.6	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 74.60 psi
Consolidation back pressure = 70.30 psi
Consolidation effective confining stress = 4.30 psi
Strain rate, in./min. = 0.007
Fail. Stress = 26.28 psi **at reading no.** 11
Ult. Stress = 21.10 psi **at reading no.** 41

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.9997	-2.549	0.0	0.0	0.00	4.30	4.30	1.00	70.30	4.30	0.00
1	-2.9901	139.892	142.4	0.1	5.27	3.97	9.24	2.33	70.63	6.60	2.63
2	-2.9834	243.114	245.7	0.1	9.08	3.97	13.05	3.29	70.63	8.51	4.54
3	-2.9761	335.355	337.9	0.2	12.48	3.97	16.45	4.14	70.63	10.21	6.24
4	-2.9684	413.792	416.3	0.3	15.36	4.27	19.63	4.60	70.33	11.95	7.68
5	-2.9606	479.678	482.2	0.3	17.78	4.55	22.33	4.91	70.05	13.44	8.89
6	-2.9523	529.877	532.4	0.4	19.62	4.84	24.46	5.05	69.76	14.65	9.81
7	-2.9437	570.664	573.2	0.5	21.11	5.17	26.28	5.08	69.43	15.72	10.55
8	-2.9266	627.139	629.7	0.6	23.15	5.77	28.92	5.01	68.83	17.34	11.58
9	-2.9089	664.788	667.3	0.8	24.50	6.07	30.57	5.04	68.53	18.32	12.25
10	-2.8642	705.575	708.1	1.1	25.90	6.67	32.57	4.89	67.93	19.62	12.95
11	-2.8285	718.125	720.7	1.4	26.28	6.67	32.94	4.94	67.93	19.80	13.14
12	-2.7750	719.016	721.6	1.9	26.19	6.67	32.86	4.93	67.93	19.76	13.10
13	-2.7224	714.987	717.5	2.3	25.93	6.67	32.59	4.89	67.93	19.63	12.96
14	-2.6680	708.712	711.3	2.8	25.58	6.37	31.95	5.02	68.23	19.16	12.79
15	-2.6152	708.712	711.3	3.2	25.46	6.37	31.83	5.00	68.23	19.10	12.73
16	-2.5619	705.575	708.1	3.7	25.23	6.07	31.30	5.16	68.53	18.68	12.62
17	-2.5083	702.437	705.0	4.1	25.00	6.07	31.07	5.12	68.53	18.57	12.50
18	-2.4550	689.888	692.4	4.6	24.44	6.07	30.51	5.03	68.53	18.29	12.22
19	-2.4022	683.613	686.2	5.0	24.11	5.77	29.87	5.18	68.83	17.82	12.05
20	-2.3491	683.613	686.2	5.5	23.99	5.77	29.76	5.16	68.83	17.76	12.00
21	-2.2943	677.338	679.9	6.0	23.66	5.77	29.43	5.10	68.83	17.60	11.83
22	-2.2415	680.475	683.0	6.4	23.65	5.66	29.32	5.18	68.94	17.49	11.83
23	-2.1868	680.475	683.0	6.9	23.54	5.47	29.01	5.30	69.13	17.24	11.77
24	-2.1335	680.475	683.0	7.3	23.42	5.47	28.89	5.28	69.13	17.18	11.71
25	-2.0804	677.338	679.9	7.8	23.20	5.47	28.67	5.24	69.13	17.07	11.60
26	-2.0269	680.475	683.0	8.2	23.20	5.47	28.67	5.24	69.13	17.07	11.60
27	-1.9743	680.475	683.0	8.7	23.09	5.47	28.55	5.22	69.13	17.01	11.54
28	-1.9197	677.338	679.9	9.1	22.86	5.47	28.33	5.18	69.13	16.90	11.43
29	-1.8664	677.338	679.9	9.6	22.75	5.17	27.92	5.40	69.43	16.54	11.38
30	-1.8132	667.925	670.5	10.0	22.32	5.17	27.49	5.32	69.43	16.33	11.16
31	-1.7605	667.925	670.5	10.5	22.21	5.17	27.38	5.30	69.43	16.28	11.11
32	-1.7081	667.925	670.5	10.9	22.10	5.17	27.27	5.28	69.43	16.22	11.05
33	-1.6544	664.788	667.3	11.3	21.89	5.17	27.06	5.23	69.43	16.11	10.94
34	-1.6012	667.925	670.5	11.8	21.88	5.17	27.05	5.23	69.43	16.11	10.94
35	-1.5480	671.063	673.6	12.2	21.87	5.17	27.04	5.23	69.43	16.10	10.94
36	-1.4949	667.925	670.5	12.7	21.66	4.87	26.53	5.45	69.73	15.70	10.83
37	-1.4425	671.063	673.6	13.1	21.65	4.87	26.52	5.45	69.73	15.69	10.82
38	-1.3896	671.063	673.6	13.6	21.54	4.87	26.41	5.42	69.73	15.64	10.77
39	-1.3365	674.200	676.7	14.0	21.53	4.87	26.40	5.42	69.73	15.63	10.76
40	-1.2835	667.925	670.5	14.5	21.22	4.87	26.08	5.36	69.73	15.48	10.61
41	-1.2304	667.925	670.5	14.9	21.10	4.87	25.97	5.33	69.73	15.42	10.55
42	-1.1775	671.063	673.6	15.4	21.09	4.87	25.96	5.33	69.73	15.42	10.55
43	-1.1249	667.925	670.5	15.8	20.88	4.87	25.75	5.29	69.73	15.31	10.44
44	-1.0720	664.788	667.3	16.3	20.68	4.87	25.54	5.25	69.73	15.21	10.34
45	-1.0184	664.788	667.3	16.7	20.56	4.87	25.43	5.22	69.73	15.15	10.28
46	-0.9667	661.651	664.2	17.2	20.36	4.87	25.23	5.18	69.73	15.05	10.18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
47	-0.9137	661.651	664.2	17.6	20.25	4.87	25.12	5.16	69.73	14.99	10.13
48	-0.8595	664.788	667.3	18.1	20.23	4.57	24.80	5.43	70.03	14.69	10.12
49	-0.8061	658.513	661.1	18.5	19.93	4.57	24.50	5.36	70.03	14.54	9.97
50	-0.7525	664.788	667.3	19.0	20.01	4.57	24.58	5.38	70.03	14.58	10.00
51	-0.7007	667.925	670.5	19.4	20.00	4.57	24.57	5.38	70.03	14.57	10.00
52	-0.6470	671.063	673.6	19.8	19.98	4.57	24.55	5.37	70.03	14.56	9.99

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	106.500			14206.100
Moisture content: Dry soil+tare, gms.	100.000			12893.600
Moisture content: Tare, gms.	0.000			1966.700
Moisture, %	6.5	12.6	12.0	12.0
Moist specimen weight, gms.	11678.0			
Diameter, in.	6.00	5.97	5.94	
Area, in.²	28.29	28.04	27.75	
Height, in.	12.01	12.00	11.99	
Net decrease in height, in.		0.00	0.01	
Net decrease in water volume, cc.			59.80	
Wet density, pcf	131.0	139.7	140.6	
Dry density, pcf	123.0	124.1	125.5	
Void ratio	0.3452	0.3328	0.3183	
Saturation, %	49.9	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 68.00 psi
Consolidation back pressure = 55.00 psi
Consolidation effective confining stress = 13.00 psi
Strain rate, in./min. = 0.007
Fail. Stress = 37.45 psi **at reading no.** 10
Ult. Stress = 29.91 psi **at reading no.** 42

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.8964	0.000	0.0	0.0	0.00	13.00	13.00	1.00	55.00	13.00	0.00
1	-2.8892	226.946	226.9	0.1	8.17	12.60	20.77	1.65	55.40	16.68	4.09
2	-2.8818	370.955	371.0	0.1	13.35	12.60	25.95	2.06	55.40	19.27	6.68
3	-2.8745	505.865	505.9	0.2	18.19	12.60	30.79	2.44	55.40	21.70	9.10
4	-2.8671	640.776	640.8	0.2	23.03	12.60	35.63	2.83	55.40	24.11	11.52
5	-2.8595	766.274	766.3	0.3	27.53	12.60	40.12	3.18	55.40	26.36	13.76
6	-2.8513	866.673	866.7	0.4	31.11	12.60	43.71	3.47	55.40	28.15	15.56
7	-2.8434	935.697	935.7	0.4	33.57	12.60	46.16	3.66	55.40	29.38	16.78
8	-2.8266	1004.721	1004.7	0.6	35.99	12.60	48.59	3.86	55.40	30.59	18.00
9	-2.7738	1048.645	1048.6	1.0	37.40	12.00	49.40	4.12	56.00	30.70	18.70
10	-2.7558	1051.783	1051.8	1.2	37.45	11.70	49.15	4.20	56.30	30.43	18.73
11	-2.7472	1051.783	1051.8	1.2	37.43	11.70	49.13	4.20	56.30	30.41	18.71
12	-2.6936	1045.508	1045.5	1.7	37.04	11.10	48.14	4.34	56.90	29.62	18.52

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
13	-2.6406	1039.233	1039.2	2.1	36.65	10.80	47.45	4.39	57.20	29.13	18.32
14	-2.5874	1029.820	1029.8	2.6	36.15	10.50	46.65	4.44	57.50	28.58	18.08
15	-2.5347	1026.683	1026.7	3.0	35.88	10.20	46.08	4.52	57.80	28.14	17.94
16	-2.4812	1023.545	1023.5	3.5	35.60	9.91	45.51	4.59	58.09	27.71	17.80
17	-2.4272	1014.133	1014.1	3.9	35.11	9.61	44.72	4.66	58.39	27.16	17.56
18	-2.3740	1007.858	1007.9	4.4	34.73	9.61	44.34	4.62	58.39	26.97	17.37
19	-2.3214	1004.721	1004.7	4.8	34.47	9.31	43.77	4.70	58.69	26.54	17.23
20	-2.2682	1004.721	1004.7	5.2	34.31	9.31	43.61	4.69	58.69	26.46	17.15
21	-2.2149	1001.583	1001.6	5.7	34.04	9.01	43.05	4.78	58.99	26.03	17.02
22	-2.1614	1001.583	1001.6	6.1	33.88	9.01	42.89	4.76	58.99	25.95	16.94
23	-2.1088	998.446	998.4	6.6	33.61	8.71	42.32	4.86	59.29	25.52	16.81
24	-2.0555	992.171	992.2	7.0	33.24	8.71	41.95	4.82	59.29	25.33	16.62
25	-2.0023	989.033	989.0	7.5	32.98	8.71	41.69	4.79	59.29	25.20	16.49
26	-1.9493	989.033	989.0	7.9	32.82	8.60	41.42	4.82	59.40	25.01	16.41
27	-1.8959	989.033	989.0	8.3	32.66	8.41	41.07	4.88	59.59	24.74	16.33
28	-1.8429	989.033	989.0	8.8	32.51	8.44	40.94	4.85	59.56	24.69	16.25
29	-1.7891	985.896	985.9	9.2	32.24	8.41	40.65	4.83	59.59	24.53	16.12
30	-1.7362	985.896	985.9	9.7	32.09	8.41	40.50	4.82	59.59	24.45	16.04
31	-1.6832	985.896	985.9	10.1	31.93	8.11	40.04	4.94	59.89	24.07	15.97
32	-1.6294	979.621	979.6	10.6	31.57	8.11	39.68	4.89	59.89	23.89	15.78
33	-1.5766	982.759	982.8	11.0	31.51	8.11	39.62	4.89	59.89	23.87	15.76
34	-1.5235	985.896	985.9	11.4	31.46	8.11	39.57	4.88	59.89	23.84	15.73
35	-1.4704	973.346	973.3	11.9	30.90	8.11	39.01	4.81	59.89	23.56	15.45
36	-1.4165	976.484	976.5	12.3	30.84	8.11	38.95	4.80	59.89	23.53	15.42
37	-1.3631	960.796	960.8	12.8	30.19	7.81	38.00	4.87	60.19	22.91	15.10
38	-1.3110	976.484	976.5	13.2	30.53	7.81	38.34	4.91	60.19	23.08	15.27
39	-1.2573	976.484	976.5	13.7	30.38	7.81	38.19	4.89	60.19	23.00	15.19
40	-1.2044	967.071	967.1	14.1	29.93	7.81	37.74	4.83	60.19	22.78	14.97
41	-1.1503	973.346	973.3	14.6	29.97	7.81	37.78	4.84	60.19	22.79	14.98
42	-1.0966	976.484	976.5	15.0	29.91	7.81	37.72	4.83	60.19	22.76	14.95
43	-1.0434	979.621	979.6	15.4	29.84	7.81	37.66	4.82	60.19	22.73	14.92
44	-0.9905	979.621	979.6	15.9	29.69	7.81	37.50	4.80	60.19	22.65	14.84
45	-0.9373	976.484	976.5	16.3	29.44	7.51	36.95	4.92	60.49	22.23	14.72
46	-0.8832	979.621	979.6	16.8	29.37	7.51	36.88	4.91	60.49	22.20	14.69
47	-0.8301	985.896	985.9	17.2	29.40	7.51	36.92	4.91	60.49	22.21	14.70
48	-0.7773	989.033	989.0	17.7	29.34	7.51	36.85	4.91	60.49	22.18	14.67
49	-0.7236	992.171	992.2	18.1	29.27	7.51	36.78	4.90	60.49	22.15	14.64
50	-0.6704	989.033	989.0	18.6	29.02	7.51	36.53	4.86	60.49	22.02	14.51
51	-0.6160	989.033	989.0	19.0	28.86	7.51	36.37	4.84	60.49	21.94	14.43
52	-0.5637	992.171	992.2	19.4	28.80	7.51	36.31	4.83	60.49	21.91	14.40
53	-0.5110	985.896	985.9	19.9	28.46	7.51	35.97	4.79	60.49	21.74	14.23

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	106.500			14206.100
Moisture content: Dry soil+tare, gms.	100.000			12893.600
Moisture content: Tare, gms.	0.000			1966.700
Moisture, %	6.5	12.1	12.0	12.0
Moist specimen weight, gms.	11678.0			
Diameter, in.	6.01	5.94	5.94	
Area, in.²	28.36	27.76	27.72	
Height, in.	12.01	12.01	12.01	
Net decrease in height, in.		0.00	0.00	
Net decrease in water volume, cc.			8.80	
Wet density, pcf	130.6	140.4	140.6	
Dry density, pcf	122.6	125.3	125.5	
Void ratio	0.3491	0.3204	0.3183	
Saturation, %	49.3	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 66.80 psi
Consolidation back pressure = 59.00 psi
Consolidation effective confining stress = 7.80 psi
Strain rate, in./min. = 0.007
Fail. Stress = 12.92 psi **at reading no.** 8
Ult. Stress = 7.47 psi **at reading no.** 41

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.9634	0.000	0.0	0.0	0.00	7.80	7.80	1.00	59.00	7.80	0.00
1	-2.9402	80.689	80.7	0.2	2.91	7.51	10.41	1.39	59.29	8.96	1.45
2	-2.9324	185.166	185.2	0.3	6.66	7.51	14.17	1.89	59.29	10.84	3.33
3	-2.9243	245.719	245.7	0.3	8.83	7.81	16.64	2.13	58.99	12.22	4.42
4	-2.9159	283.369	283.4	0.4	10.18	7.81	17.99	2.30	58.99	12.90	5.09
5	-2.9072	311.606	311.6	0.5	11.19	8.11	19.29	2.38	58.69	13.70	5.59
6	-2.8898	339.843	339.8	0.6	12.18	8.11	20.29	2.50	58.69	14.20	6.09
7	-2.8637	358.668	358.7	0.8	12.83	8.11	20.94	2.58	58.69	14.52	6.42
8	-2.8456	361.805	361.8	1.0	12.92	8.11	21.03	2.59	58.69	14.57	6.46
9	-2.8368	361.805	361.8	1.1	12.91	8.11	21.02	2.59	58.69	14.56	6.46
10	-2.7842	352.393	352.4	1.5	12.52	7.81	20.33	2.60	58.99	14.07	6.26
11	-2.7306	349.255	349.3	1.9	12.35	7.81	20.16	2.58	58.99	13.98	6.18
12	-2.6770	346.118	346.1	2.4	12.19	7.59	19.77	2.61	59.21	13.68	6.09
13	-2.6236	339.843	339.8	2.8	11.91	7.51	19.42	2.59	59.29	13.46	5.96
14	-2.5711	333.568	333.6	3.3	11.64	7.51	19.15	2.55	59.29	13.33	5.82
15	-2.5183	327.293	327.3	3.7	11.37	7.34	18.71	2.55	59.46	13.03	5.68
16	-2.4644	324.156	324.2	4.2	11.21	7.21	18.42	2.55	59.59	12.81	5.60
17	-2.4114	317.881	317.9	4.6	10.94	7.21	18.15	2.52	59.59	12.68	5.47
18	-2.3582	317.881	317.9	5.0	10.89	7.21	18.10	2.51	59.59	12.65	5.44
19	-2.3052	311.606	311.6	5.5	10.62	7.21	17.83	2.47	59.59	12.52	5.31
20	-2.2521	308.468	308.5	5.9	10.47	7.21	17.68	2.45	59.59	12.44	5.23
21	-2.1994	302.193	302.2	6.4	10.21	6.91	17.12	2.48	59.89	12.01	5.10
22	-2.1468	299.056	299.1	6.8	10.05	6.91	16.96	2.46	59.89	11.94	5.03

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
23	-2.0933	295.919	295.9	7.2	9.90	6.91	16.81	2.43	59.89	11.86	4.95
24	-2.0413	292.781	292.8	7.7	9.75	6.91	16.66	2.41	59.89	11.78	4.88
25	-1.9885	292.781	292.8	8.1	9.70	6.91	16.61	2.40	59.89	11.76	4.85
26	-1.9366	292.781	292.8	8.6	9.66	6.91	16.57	2.40	59.89	11.74	4.83
27	-1.8839	289.644	289.6	9.0	9.51	6.91	16.42	2.38	59.89	11.66	4.75
28	-1.8304	286.506	286.5	9.4	9.36	6.91	16.27	2.35	59.89	11.59	4.68
29	-1.7783	283.369	283.4	9.9	9.21	6.91	16.12	2.33	59.89	11.52	4.61
30	-1.7240	277.094	277.1	10.3	8.96	6.91	15.87	2.30	59.89	11.39	4.48
31	-1.6712	273.956	274.0	10.8	8.82	6.91	15.73	2.28	59.89	11.32	4.41
32	-1.6175	270.819	270.8	11.2	8.67	6.91	15.58	2.26	59.89	11.25	4.34
33	-1.5638	267.681	267.7	11.7	8.53	6.91	15.44	2.23	59.89	11.17	4.27
34	-1.5110	265.172	265.2	12.1	8.41	6.91	15.32	2.22	59.89	11.11	4.20
35	-1.4575	262.034	262.0	12.5	8.27	6.91	15.18	2.20	59.89	11.04	4.13
36	-1.4047	255.132	255.1	13.0	8.01	6.91	14.92	2.16	59.89	10.91	4.00
37	-1.3511	255.759	255.8	13.4	7.99	6.91	14.90	2.16	59.89	10.90	3.99
38	-1.2980	251.053	251.1	13.9	7.80	6.91	14.71	2.13	59.89	10.81	3.90
39	-1.2453	244.151	244.2	14.3	7.55	6.91	14.46	2.09	59.89	10.68	3.77
40	-1.1918	245.719	245.7	14.8	7.56	6.91	14.47	2.09	59.89	10.69	3.78
41	-1.1387	244.151	244.2	15.2	7.47	7.02	14.49	2.06	59.78	10.76	3.73
42	-1.0856	243.837	243.8	15.6	7.42	6.91	14.33	2.07	59.89	10.62	3.71
43	-1.0327	242.896	242.9	16.1	7.35	7.21	14.56	2.02	59.59	10.89	3.68
44	-0.9796	238.189	238.2	16.5	7.17	7.21	14.38	1.99	59.59	10.80	3.59
45	-0.9260	237.876	237.9	17.0	7.12	7.21	14.33	1.99	59.59	10.77	3.56
46	-0.8734	233.797	233.8	17.4	6.97	7.21	14.17	1.97	59.59	10.69	3.48
47	-0.8200	234.738	234.7	17.8	6.96	7.21	14.16	1.96	59.59	10.69	3.48
48	-0.7671	233.797	233.8	18.3	6.89	7.21	14.10	1.96	59.59	10.65	3.45
49	-0.7138	233.169	233.2	18.7	6.84	7.18	14.02	1.95	59.62	10.60	3.42
50	-0.6609	232.228	232.2	19.2	6.77	7.21	13.98	1.94	59.59	10.59	3.39
51	-0.6070	228.150	228.1	19.6	6.61	7.21	13.82	1.92	59.59	10.52	3.31

TRIAXIAL COMPRESSION TEST

12/12/2021

CU with Pore Pressures

8:31 PM

Date:
Client: Chicago District
Project: Santiago Creek
Project No.: W81EYN12437800, CCRC# 1575KB
Location: TH20-19, 40.0 - 43.0', L1/16813
Depth: 40.0 - 43.0'
Description: (Visual) Clayey Sand (SC). Triaxial specimens 2.8x5.6 remolded to 105.0 pcf at 14.0%.
Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.
Type of Sample: Remolded
Assumed Specific Gravity=2.65 **LL=** **PL=** **PI=**
Test Method: ASTM D 4767 Method B

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	114.000			121.000
Moisture content: Dry soil+tare, gms.	100.000			100.000
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	14.0	21.5	21.0	21.0
Moist specimen weight, gms.	1161.2			
Diameter, in.	2.81	2.89	2.88	
Area, in.²	6.18	6.56	6.51	
Height, in.	5.61	5.61	5.60	
Net decrease in height, in.		0.00	0.01	
Net decrease in water volume, cc.			5.00	
Wet density, pcf	127.5	128.1	128.6	
Dry density, pcf	111.9	105.4	106.3	
Void ratio	0.4790	0.5695	0.5565	
Saturation, %	77.4	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 87.80 psi
Consolidation back pressure = 72.00 psi
Consolidation effective confining stress = 15.80 psi
Strain rate, in./min. = 0.007
Fail. Stress = 4.90 psi **at reading no.** 10
Ult. Stress = 1.90 psi **at reading no.** 23

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	0.0001	0.000	0.0	0.0	0.00	15.80	15.80	1.00	72.00	15.80	0.00
1	0.0016	12.777	12.8	0.0	1.96	15.75	17.71	1.12	72.05	16.73	0.98
2	0.0052	13.109	13.1	0.1	2.01	14.52	16.53	1.14	73.28	15.52	1.01
3	0.0067	17.524	17.5	0.1	2.69	13.96	16.64	1.19	73.84	15.30	1.34
4	0.0081	20.378	20.4	0.1	3.12	14.00	17.12	1.22	73.80	15.56	1.56
5	0.0096	22.505	22.5	0.2	3.45	14.45	17.90	1.24	73.35	16.17	1.72
6	0.0102	24.446	24.4	0.2	3.75	13.69	17.44	1.27	74.11	15.56	1.87
7	0.0142	27.026	27.0	0.3	4.14	14.16	18.30	1.29	73.64	16.23	2.07
8	0.0179	28.833	28.8	0.3	4.41	13.85	18.26	1.32	73.95	16.05	2.21
9	0.0236	30.684	30.7	0.4	4.69	13.89	18.58	1.34	73.91	16.24	2.35
10	0.0435	32.141	32.1	0.8	4.90	13.75	18.65	1.36	74.05	16.20	2.45
11	0.0444	32.042	32.0	0.8	4.88	14.14	19.02	1.35	73.66	16.58	2.44
12	0.0750	30.056	30.1	1.3	4.55	13.92	18.47	1.33	73.88	16.19	2.28
13	0.1050	28.297	28.3	1.9	4.26	14.29	18.55	1.30	73.51	16.42	2.13
14	0.1359	26.531	26.5	2.4	3.97	14.61	18.58	1.27	73.19	16.60	1.99
15	0.1741	24.849	24.8	3.1	3.70	14.40	18.09	1.26	73.40	16.25	1.85
16	0.2047	23.237	23.2	3.7	3.44	14.40	17.84	1.24	73.40	16.12	1.72
17	0.2483	21.550	21.6	4.4	3.16	14.64	17.80	1.22	73.16	16.22	1.58
18	0.2983	19.816	19.8	5.3	2.72	14.56	17.29	1.19	73.24	15.93	1.36
19	0.3561	19.056	19.1	6.4	2.55	14.64	17.19	1.17	73.16	15.91	1.28
20	0.4186	18.537	18.5	7.5	2.41	14.25	16.66	1.17	73.55	15.45	1.21
21	0.4808	17.283	17.3	8.6	2.17	13.98	16.15	1.16	73.82	15.06	1.09
22	0.5429	16.461	16.5	9.7	2.00	13.93	15.92	1.14	73.87	14.93	1.00
23	0.6058	16.231	16.2	10.8	1.90	13.45	15.35	1.14	74.35	14.40	0.95

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	114.000			121.000
Moisture content: Dry soil+tare, gms.	100.000			100.000
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	14.0	22.5	21.0	21.0
Moist specimen weight, gms.	1161.2			
Diameter, in.	2.81	2.91	2.88	
Area, in.²	6.20	6.67	6.52	
Height, in.	5.61	5.61	5.60	
Net decrease in height, in.		0.00	0.01	
Net decrease in water volume, cc.			15.00	
Wet density, pcf	127.2	127.0	128.6	
Dry density, pcf	111.5	103.7	106.3	
Void ratio	0.4832	0.5955	0.5565	
Saturation, %	76.8	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 90.60 psi
Consolidation back pressure = 71.30 psi
Consolidation effective confining stress = 19.30 psi
Strain rate, in./min. = 0.007
Fail. Stress = 5.49 psi **at reading no.** 12
Ult. Stress = 5.85 psi **at reading no.** 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	0.0124	8.331	0.0	0.0	0.00	19.30	19.30	1.00	71.30	19.30	0.00
1	0.0131	13.683	5.4	0.0	0.82	18.29	19.11	1.04	72.31	18.70	0.41
2	0.0141	17.474	9.1	0.0	1.40	17.68	19.08	1.08	72.92	18.38	0.70
3	0.0259	20.247	11.9	0.2	1.82	17.37	19.19	1.10	73.23	18.28	0.91
4	0.0194	24.124	15.8	0.1	2.42	16.78	19.20	1.14	73.82	17.99	1.21
5	0.0208	26.796	18.5	0.1	2.83	16.24	19.07	1.17	74.36	17.65	1.41
6	0.0268	30.102	21.8	0.3	3.33	15.53	18.86	1.21	75.07	17.20	1.67
7	0.0319	32.621	24.3	0.3	3.71	14.99	18.71	1.25	75.61	16.85	1.86
8	0.0387	35.634	27.3	0.5	4.17	14.16	18.33	1.29	76.44	16.25	2.08
9	0.0484	38.301	30.0	0.6	4.57	13.51	18.08	1.34	77.09	15.79	2.28
10	0.0632	40.818	32.5	0.9	4.94	13.00	17.93	1.38	77.60	15.47	2.47
11	0.0925	43.525	35.2	1.4	5.32	11.94	17.26	1.45	78.66	14.60	2.66
12	0.1489	45.025	36.7	2.4	5.49	10.41	15.90	1.53	80.19	13.15	2.75
13	0.2046	44.956	36.6	3.4	5.42	9.74	15.17	1.56	80.86	12.45	2.71
14	0.2593	45.867	37.5	4.4	5.50	9.01	14.51	1.61	81.59	11.76	2.75
15	0.3099	46.957	38.6	5.3	5.61	8.39	14.00	1.67	82.21	11.20	2.80
16	0.3691	47.894	39.6	6.4	5.68	7.87	13.55	1.72	82.73	10.71	2.84
17	0.4303	48.963	40.6	7.5	5.77	7.21	12.98	1.80	83.39	10.09	2.88
18	0.4469	48.902	40.6	7.8	5.74	7.02	12.76	1.82	83.58	9.89	2.87
19	0.4977	50.055	41.7	8.7	5.85	7.26	13.11	1.80	83.34	10.19	2.92

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	114.000			121.000
Moisture content: Dry soil+tare, gms.	100.000			100.000
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	14.0	23.5	21.0	21.0
Moist specimen weight, gms.	1161.2			
Diameter, in.	2.80	2.94	2.88	
Area, in.²	6.17	6.80	6.54	
Height, in.	5.60	5.60	5.59	
Net decrease in height, in.		0.00	0.01	
Net decrease in water volume, cc.			25.00	
Wet density, pcf	128.1	126.0	128.6	
Dry density, pcf	112.4	102.0	106.3	
Void ratio	0.4722	0.6215	0.5565	
Saturation, %	78.6	100.0	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 78.70 psi
Consolidation back pressure = 56.00 psi
Consolidation effective confining stress = 22.70 psi
Strain rate, in./min. = 0.007
Fail. Stress = 18.85 psi **at reading no.** 21
Ult. Stress = 18.85 psi **at reading no.** 21

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	0.2452	3.798	0.0	0.0	0.00	22.70	22.70	1.00	56.00	22.70	0.00
1	0.2463	15.086	11.3	0.0	1.73	21.95	23.68	1.08	56.75	22.82	0.86
2	0.2484	25.524	21.7	0.1	3.32	21.84	25.17	1.15	56.86	23.51	1.66
3	0.2515	37.891	34.1	0.1	5.21	21.04	26.25	1.25	57.66	23.64	2.61
4	0.2557	47.039	43.2	0.2	6.60	19.66	26.26	1.34	59.04	22.96	3.30
5	0.2627	55.040	51.2	0.3	7.82	18.26	26.07	1.43	60.44	22.16	3.91
6	0.2758	63.691	59.9	0.5	9.11	16.80	25.91	1.54	61.90	21.36	4.56
7	0.2922	71.724	67.9	0.8	10.31	15.05	25.36	1.68	63.65	20.20	5.15
8	0.3191	79.817	76.0	1.3	11.48	13.51	24.98	1.85	65.19	19.24	5.74
9	0.3687	88.345	84.5	2.2	12.65	11.60	24.25	2.09	67.10	17.92	6.32
10	0.4230	95.056	91.3	3.2	13.52	10.37	23.89	2.30	68.33	17.13	6.76
11	0.4735	99.555	95.8	4.1	14.05	9.62	23.67	2.46	69.08	16.65	7.03
12	0.5287	104.337	100.5	5.1	14.60	9.48	24.08	2.54	69.22	16.78	7.30
13	0.5856	109.163	105.4	6.1	15.14	8.69	23.82	2.74	70.01	16.26	7.57
14	0.6463	114.266	110.5	7.2	15.69	8.29	23.98	2.89	70.41	16.13	7.84
15	0.7089	118.855	115.1	8.3	16.14	8.51	24.65	2.90	70.19	16.58	8.07
16	0.7715	123.336	119.5	9.4	16.57	8.61	25.18	2.92	70.09	16.89	8.28
17	0.8341	127.965	124.2	10.5	16.99	9.39	26.39	2.81	69.31	17.89	8.50
18	0.8955	133.931	130.1	11.6	17.59	9.84	27.43	2.79	68.86	18.63	8.80
19	0.9561	138.754	135.0	12.7	18.02	10.64	28.66	2.69	68.06	19.65	9.01
20	1.0182	142.986	139.2	13.8	18.35	10.64	28.99	2.73	68.06	19.81	9.17
21	1.0812	148.656	144.9	15.0	18.85	11.29	30.14	2.67	67.41	20.72	9.42
22	1.1419	153.173	149.4	16.1	19.19	10.89	30.07	2.76	67.81	20.48	9.59

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
23	1.1733	155.179	151.4	16.6	19.31	11.25	30.56	2.72	67.45	20.90	9.66
24	1.1734	155.082	151.3	16.6	19.30	11.15	30.45	2.73	67.55	20.80	9.65

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

12/12/2021
8:07 PM

Date:
Client: Chicago District
Project: Santiago Creek
Project No.: W81EYN12437800, CCRC# 1575KB
Location: TH20-22, 30.0 - 40.0', L1/16822
Depth: 30.0 - 40.0'
Description: (Visual) Clayey Sand (SC), with some gravel. Triaxial specimens 6x12 remolded to 122.7 pcf at 7.5%.
Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.
Type of Sample: Remolded
Assumed Specific Gravity=2.65 **LL=** **PL=** **PI=**
Test Method: ASTM D 4767 Method B

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.500			114.000
Moisture content: Dry soil+tare, gms.	100.000			100.000
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	7.5	14.1	14.0	14.0
Moist specimen weight, gms.	11744.9			
Diameter, in.	6.00	6.06	6.05	
Area, in.²	28.27	28.82	28.78	
Height, in.	12.00	12.00	11.99	
Net decrease in height, in.		0.00	0.01	
Net decrease in water volume, cc.			14.40	
Wet density, pcf	131.9	137.4	137.6	
Dry density, pcf	122.7	120.4	120.7	
Void ratio	0.3486	0.3745	0.3710	
Saturation, %	57.0	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 46.80 psi
Consolidation back pressure = 41.40 psi
Consolidation effective confining stress = 5.40 psi
Strain rate, in./min. = 0.007
Fail. Stress = 7.94 psi **at reading no.** 7
Ult. Stress = 5.94 psi **at reading no.** 40

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.9415	0.000	0.0	0.0	0.00	5.40	5.40	1.00	41.40	5.40	0.00
1	-2.9370	83.919	83.9	0.0	2.91	4.87	7.78	1.60	41.93	6.32	1.46
2	-2.9286	146.354	146.4	0.1	5.08	4.64	9.72	2.09	42.16	7.18	2.54
3	-2.9202	173.023	173.0	0.2	6.00	4.27	10.27	2.41	42.53	7.27	3.00
4	-2.9108	187.455	187.5	0.3	6.50	3.97	10.46	2.64	42.83	7.22	3.25
5	-2.8932	206.594	206.6	0.4	7.15	3.67	10.82	2.95	43.13	7.24	3.57
6	-2.8757	219.143	219.1	0.5	7.57	3.07	10.64	3.47	43.73	6.86	3.79
7	-2.8317	230.752	230.8	0.9	7.94	2.77	10.72	3.87	44.03	6.74	3.97
8	-2.8132	230.124	230.1	1.1	7.91	2.47	10.38	4.20	44.33	6.43	3.96
9	-2.7605	221.967	222.0	1.5	7.60	2.17	9.77	4.50	44.63	5.97	3.80
10	-2.7073	214.123	214.1	2.0	7.29	1.87	9.17	4.89	44.93	5.52	3.65
11	-2.6546	210.045	210.0	2.4	7.12	1.57	8.70	5.53	45.23	5.14	3.56
12	-2.6015	204.084	204.1	2.8	6.89	1.57	8.46	5.38	45.23	5.02	3.44
13	-2.5489	198.122	198.1	3.3	6.66	1.27	7.93	6.22	45.53	4.60	3.33
14	-2.4950	193.416	193.4	3.7	6.47	1.27	7.74	6.08	45.53	4.51	3.24
15	-2.4427	193.103	193.1	4.2	6.43	1.27	7.70	6.04	45.53	4.49	3.22
16	-2.3900	190.593	190.6	4.6	6.32	0.98	7.29	7.48	45.82	4.13	3.16
17	-2.3366	189.651	189.7	5.0	6.26	0.98	7.23	7.42	45.82	4.10	3.13
18	-2.2833	189.024	189.0	5.5	6.21	0.68	6.88	10.18	46.12	3.78	3.10
19	-2.2305	189.338	189.3	5.9	6.19	0.68	6.86	10.15	46.12	3.77	3.09
20	-2.1771	189.024	189.0	6.4	6.15	0.68	6.83	10.10	46.12	3.75	3.07
21	-2.1237	189.024	189.0	6.8	6.12	0.68	6.80	10.05	46.12	3.74	3.06
22	-2.0704	188.396	188.4	7.3	6.07	0.68	6.75	9.98	46.12	3.71	3.04
23	-2.0173	189.024	189.0	7.7	6.06	0.68	6.74	9.97	46.12	3.71	3.03
24	-1.9638	190.279	190.3	8.2	6.07	0.38	6.45	17.11	46.42	3.41	3.04
25	-1.9108	189.651	189.7	8.6	6.02	0.38	6.40	16.98	46.42	3.39	3.01
26	-1.8577	189.965	190.0	9.0	6.00	0.38	6.38	16.93	46.42	3.38	3.00
27	-1.8047	191.534	191.5	9.5	6.02	0.41	6.43	15.81	46.39	3.42	3.01
28	-1.7515	191.848	191.8	9.9	6.00	0.38	6.38	16.93	46.42	3.38	3.00
29	-1.6985	193.103	193.1	10.4	6.01	0.38	6.39	16.96	46.42	3.38	3.01
30	-1.6454	193.103	193.1	10.8	5.98	0.38	6.36	16.88	46.42	3.37	2.99
31	-1.5916	194.357	194.4	11.3	5.99	0.38	6.37	16.90	46.42	3.37	3.00
32	-1.5386	195.926	195.9	11.7	6.01	0.38	6.39	16.95	46.42	3.38	3.01
33	-1.4852	196.240	196.2	12.2	5.99	0.08	6.07	78.26	46.72	3.07	3.00
34	-1.4326	197.809	197.8	12.6	6.01	0.08	6.09	78.48	46.72	3.08	3.00
35	-1.3797	198.436	198.4	13.0	6.00	0.08	6.07	78.34	46.72	3.08	3.00
36	-1.3261	198.436	198.4	13.5	5.97	0.08	6.04	77.94	46.72	3.06	2.98
37	-1.2736	200.005	200.0	13.9	5.98	0.19	6.17	32.85	46.61	3.18	2.99
38	-1.2202	201.574	201.6	14.4	6.00	0.17	6.17	36.11	46.63	3.17	3.00
39	-1.1683	201.887	201.9	14.8	5.98	0.08	6.05	78.09	46.72	3.07	2.99
40	-1.1140	201.574	201.6	15.2	5.94	0.08	6.01	77.56	46.72	3.05	2.97
41	-1.0607	201.574	201.6	15.7	5.90	0.08	5.98	77.16	46.72	3.03	2.95
42	-1.0087	202.515	202.5	16.1	5.90	0.38	6.28	16.66	46.42	3.33	2.95
43	-0.9549	202.515	202.5	16.6	5.87	0.38	6.25	16.58	46.42	3.31	2.94
44	-0.9026	202.829	202.8	17.0	5.85	0.38	6.23	16.52	46.42	3.30	2.92
45	-0.8487	203.456	203.5	17.5	5.83	0.38	6.21	16.49	46.42	3.29	2.92
46	-0.7956	203.142	203.1	17.9	5.79	0.38	6.17	16.38	46.42	3.27	2.90

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
47	-0.7425	203.456	203.5	18.3	5.77	0.38	6.15	16.32	46.42	3.26	2.89
48	-0.6887	204.711	204.7	18.8	5.78	0.38	6.15	16.33	46.42	3.26	2.89
49	-0.6356	205.025	205.0	19.2	5.75	0.38	6.13	16.27	46.42	3.25	2.88
50	-0.5829	204.711	204.7	19.7	5.71	0.38	6.09	16.16	46.42	3.23	2.86

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.500			114.000
Moisture content: Dry soil+tare, gms.	100.000			100.000
Moisture content: Tare, gms.	0.000			0.000
Moisture, %	7.5	14.3	14.0	14.0
Moist specimen weight, gms.	11744.9			
Diameter, in.	6.00	6.06	6.05	
Area, in.²	28.27	28.89	28.78	
Height, in.	12.00	12.00	11.98	
Net decrease in height, in.		0.00	0.01	
Net decrease in water volume, cc.			28.00	
Wet density, pcf	131.9	137.2	137.6	
Dry density, pcf	122.7	120.1	120.7	
Void ratio	0.3486	0.3778	0.3710	
Saturation, %	57.0	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 53.00 psi
Consolidation back pressure = 41.00 psi
Consolidation effective confining stress = 12.00 psi
Strain rate, in./min. = 0.007
Fail. Stress = 13.82 psi **at reading no.** 10
Ult. Stress = 7.07 psi **at reading no.** 43

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.9499	0.000	0.0	0.0	0.00	12.00	12.00	1.00	41.00	12.00	0.00
1	-2.9416	47.211	47.2	0.1	1.64	11.66	13.30	1.14	41.34	12.48	0.82
2	-2.9318	144.472	144.5	0.2	5.01	10.77	15.78	1.47	42.23	13.27	2.51
3	-2.9236	208.790	208.8	0.2	7.24	9.98	17.22	1.73	43.02	13.60	3.62
4	-2.9154	256.479	256.5	0.3	8.89	9.27	18.16	1.96	43.73	13.71	4.44
5	-2.9067	294.756	294.8	0.4	10.20	8.67	18.88	2.18	44.33	13.77	5.10
6	-2.8979	319.856	319.9	0.4	11.06	8.07	19.14	2.37	44.93	13.61	5.53
7	-2.8896	344.955	345.0	0.5	11.92	7.77	19.70	2.53	45.23	13.74	5.96
8	-2.8721	376.330	376.3	0.6	12.99	6.94	19.93	2.87	46.06	13.44	6.50
9	-2.8457	398.292	398.3	0.9	13.72	5.98	19.70	3.29	47.02	12.84	6.86
10	-2.8372	401.429	401.4	0.9	13.82	5.98	19.79	3.31	47.02	12.89	6.91
11	-2.8283	401.429	401.4	1.0	13.81	5.68	19.48	3.43	47.32	12.58	6.90
12	-2.7752	398.292	398.3	1.5	13.64	4.75	18.38	3.87	48.25	11.57	6.82
13	-2.7230	382.605	382.6	1.9	13.04	4.18	17.22	4.12	48.82	10.70	6.52
14	-2.6693	366.917	366.9	2.3	12.45	3.58	16.03	4.47	49.42	9.81	6.22

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
15	-2.6171	354.368	354.4	2.8	11.97	3.28	15.25	4.64	49.72	9.27	5.98
16	-2.5636	341.818	341.8	3.2	11.49	2.99	14.48	4.85	50.01	8.73	5.75
17	-2.5109	332.405	332.4	3.7	11.13	2.69	13.81	5.14	50.31	8.25	5.56
18	-2.4579	319.856	319.9	4.1	10.66	2.69	13.34	4.97	50.31	8.01	5.33
19	-2.4042	316.718	316.7	4.6	10.50	2.39	12.89	5.40	50.61	7.64	5.25
20	-2.3520	307.306	307.3	5.0	10.14	2.39	12.53	5.25	50.61	7.46	5.07
21	-2.2985	301.031	301.0	5.4	9.89	2.09	11.98	5.74	50.91	7.03	4.95
22	-2.2462	294.457	294.5	5.9	9.63	2.09	11.72	5.61	50.91	6.90	4.81
23	-2.1927	288.481	288.5	6.3	9.39	2.09	11.48	5.50	50.91	6.78	4.69
24	-2.1399	282.206	282.2	6.8	9.14	1.79	10.93	6.11	51.21	6.36	4.57
25	-2.0863	279.069	279.1	7.2	9.00	1.79	10.79	6.03	51.21	6.29	4.50
26	-2.0332	275.931	275.9	7.6	8.85	1.79	10.64	5.95	51.21	6.22	4.43
27	-1.9809	272.794	272.8	8.1	8.71	1.67	10.39	6.20	51.33	6.03	4.36
28	-1.9274	269.656	269.7	8.5	8.57	1.49	10.06	6.75	51.51	5.77	4.28
29	-1.8741	266.519	266.5	9.0	8.43	1.49	9.92	6.66	51.51	5.70	4.21
30	-1.8206	263.381	263.4	9.4	8.29	1.49	9.78	6.57	51.51	5.63	4.14
31	-1.7677	262.127	262.1	9.9	8.21	1.49	9.70	6.51	51.51	5.59	4.10
32	-1.7154	258.362	258.4	10.3	8.05	1.49	9.54	6.41	51.51	5.52	4.03
33	-1.6618	257.107	257.1	10.7	7.97	1.49	9.46	6.35	51.51	5.48	3.99
34	-1.6089	253.969	254.0	11.2	7.84	1.49	9.33	6.26	51.51	5.41	3.92
35	-1.5556	250.832	250.8	11.6	7.70	1.39	9.09	6.53	51.61	5.24	3.85
36	-1.5024	250.204	250.2	12.1	7.64	1.19	8.83	7.42	51.81	5.01	3.82
37	-1.4498	249.263	249.3	12.5	7.58	1.19	8.77	7.37	51.81	4.98	3.79
38	-1.3962	247.694	247.7	13.0	7.49	1.19	8.68	7.29	51.81	4.93	3.75
39	-1.3437	245.812	245.8	13.4	7.40	1.19	8.59	7.22	51.81	4.89	3.70
40	-1.2899	242.047	242.0	13.9	7.24	1.19	8.43	7.09	51.81	4.81	3.62
41	-1.2373	241.419	241.4	14.3	7.19	1.19	8.38	7.04	51.81	4.78	3.59
42	-1.1843	242.047	242.0	14.7	7.17	1.19	8.36	7.03	51.81	4.78	3.59
43	-1.1312	239.851	239.9	15.2	7.07	0.89	7.96	8.94	52.11	4.42	3.53
44	-1.0774	239.223	239.2	15.6	7.01	0.89	7.90	8.87	52.11	4.40	3.51
45	-1.0233	238.909	238.9	16.1	6.97	0.89	7.86	8.82	52.11	4.37	3.48
46	-0.9718	238.282	238.3	16.5	6.91	0.89	7.80	8.76	52.11	4.35	3.46
47	-0.9187	237.654	237.7	16.9	6.86	0.89	7.75	8.70	52.11	4.32	3.43
48	-0.8655	237.968	238.0	17.4	6.83	0.89	7.72	8.67	52.11	4.31	3.41
49	-0.8125	237.341	237.3	17.8	6.78	0.89	7.67	8.61	52.11	4.28	3.39
50	-0.7588	236.399	236.4	18.3	6.71	0.89	7.60	8.54	52.11	4.25	3.36
51	-0.7069	237.968	238.0	18.7	6.72	0.89	7.61	8.55	52.11	4.25	3.36
52	-0.6533	234.831	234.8	19.2	6.60	0.89	7.49	8.41	52.11	4.19	3.30
53	-0.6005	235.144	235.1	19.6	6.57	0.89	7.46	8.37	52.11	4.17	3.28

TRIAXIAL COMPRESSION TEST 12/12/2021

CU with Pore Pressures 8:06 PM

Date:
Client: Chicago District
Project: Santiago Creek
Project No.: W81EYN12437800, CCRC# 1575KB
Location: TH20-24, 60.0 - 70.0', L1/16831
Depth: 60.0 - 70.0'
Description: Clayey Sand (SC), with some gravel. Triaxial specimens 6x12 remolded to 122.2 pcf at 7.0%.
Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.
Type of Sample: Remolded
Assumed Specific Gravity=2.65 **LL=**23 **PL=**15 **PI=**8
Test Method: ASTM D 4767 Method B

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.000			28.835
Moisture content: Dry soil+tare, gms.	100.000			26.781
Moisture content: Tare, gms.	0.000			8.990
Moisture, %	7.0	11.6	11.5	11.5
Moist specimen weight, gms.	11647.4			
Diameter, in.	5.98	5.93	5.93	
Area, in.²	28.10	27.59	27.58	
Height, in.	11.89	11.89	11.87	
Net decrease in height, in.		0.00	0.02	
Net decrease in water volume, cc.			9.70	
Wet density, pcf	132.8	141.2	141.3	
Dry density, pcf	124.1	126.4	126.7	
Void ratio	0.3327	0.3083	0.3059	
Saturation, %	55.8	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 84.00 psi
Consolidation back pressure = 54.80 psi
Consolidation effective confining stress = 29.20 psi
Strain rate, in./min. = 0.007
Fail. Stress = 24.28 psi **at reading no.** 17
Ult. Stress = 12.06 psi **at reading no.** 47

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.9975	11.910	0.0	0.0	0.00	29.20	29.20	1.00	54.80	29.20	0.00
1	-2.9845	65.874	54.0	0.1	1.95	29.04	30.99	1.07	54.96	30.02	0.98
2	-2.9840	119.838	107.9	0.1	3.91	28.90	32.81	1.14	55.10	30.85	1.95
3	-2.9823	168.469	156.6	0.1	5.67	28.90	34.57	1.20	55.10	31.73	2.83
4	-2.9812	209.570	197.7	0.1	7.16	28.90	36.06	1.25	55.10	32.48	3.58
5	-2.9795	244.709	232.8	0.2	8.43	28.90	37.33	1.29	55.10	33.11	4.21
6	-2.9767	289.261	277.4	0.2	10.04	28.64	38.68	1.35	55.36	33.66	5.02
7	-2.9740	330.048	318.1	0.2	11.51	28.60	40.11	1.40	55.40	34.36	5.76
8	-2.9702	367.697	355.8	0.2	12.87	28.30	41.17	1.45	55.70	34.74	6.44
9	-2.9646	408.484	396.6	0.3	14.34	28.00	42.34	1.51	56.00	35.17	7.17
10	-2.9567	449.271	437.4	0.3	15.80	27.40	43.21	1.58	56.60	35.30	7.90
11	-2.9476	486.921	475.0	0.4	17.15	26.80	43.96	1.64	57.20	35.38	8.58
12	-2.9377	508.883	497.0	0.5	17.93	25.91	43.84	1.69	58.09	34.87	8.97
13	-2.9317	546.532	534.6	0.6	19.28	25.81	45.09	1.75	58.19	35.45	9.64
14	-2.9033	587.319	575.4	0.8	20.70	24.11	44.81	1.86	59.89	34.46	10.35
15	-2.8754	624.969	613.1	1.0	22.00	15.73	37.73	2.40	68.27	26.73	11.00
16	-2.8644	668.893	657.0	1.1	23.56	14.53	38.09	2.62	69.47	26.31	11.78
17	-2.8343	690.855	678.9	1.4	24.28	12.44	36.72	2.95	71.56	24.58	12.14
18	-2.7812	675.168	663.3	1.8	23.61	10.64	34.25	3.22	73.36	22.45	11.81
19	-2.7267	646.931	635.0	2.3	22.50	9.45	31.95	3.38	74.55	20.70	11.25
20	-2.6732	612.419	600.5	2.7	21.18	8.55	29.73	3.48	75.45	19.14	10.59
21	-2.6202	584.182	572.3	3.2	20.09	7.95	28.04	3.53	76.05	17.99	10.05
22	-2.5665	555.945	544.0	3.6	19.01	7.65	26.66	3.49	76.35	17.16	9.51
23	-2.5134	537.120	525.2	4.1	18.27	7.05	25.32	3.59	76.95	16.19	9.13
24	-2.4601	521.433	509.5	4.5	17.64	6.75	24.39	3.61	77.25	15.57	8.82
25	-2.4067	508.883	497.0	5.0	17.12	6.63	23.76	3.58	77.37	15.20	8.56
26	-2.3535	496.333	484.4	5.4	16.61	6.45	23.07	3.57	77.55	14.76	8.31
27	-2.3000	486.921	475.0	5.9	16.21	6.45	22.66	3.51	77.55	14.56	8.11
28	-2.2474	471.233	459.3	6.3	15.60	7.05	22.65	3.21	76.95	14.85	7.80
29	-2.1942	461.821	449.9	6.8	15.21	7.65	22.86	2.99	76.35	15.25	7.61
30	-2.1411	468.096	456.2	7.2	15.35	5.85	21.20	3.62	78.15	13.53	7.67
31	-2.0877	461.821	449.9	7.7	15.06	5.85	20.92	3.57	78.15	13.39	7.53
32	-2.0343	455.546	443.6	8.1	14.78	5.55	20.34	3.66	78.45	12.95	7.39
33	-1.9818	449.271	437.4	8.6	14.50	5.64	20.15	3.57	78.36	12.89	7.25
34	-1.9286	446.134	434.2	9.0	14.33	5.55	19.88	3.58	78.45	12.72	7.16
35	-1.8754	442.996	431.1	9.5	14.15	5.55	19.71	3.55	78.45	12.63	7.08
36	-1.8224	436.721	424.8	9.9	13.88	5.55	19.43	3.50	78.45	12.49	6.94
37	-1.7694	436.721	424.8	10.3	13.81	5.26	19.07	3.63	78.74	12.16	6.91
38	-1.7163	430.446	418.5	10.8	13.54	5.26	18.79	3.58	78.74	12.02	6.77
39	-1.6626	427.309	415.4	11.2	13.37	5.26	18.62	3.54	78.74	11.94	6.68
40	-1.6097	421.034	409.1	11.7	13.10	5.26	18.36	3.49	78.74	11.81	6.55
41	-1.5568	417.897	406.0	12.1	12.93	5.26	18.19	3.46	78.74	11.72	6.47
42	-1.5038	414.759	402.8	12.6	12.77	5.26	18.03	3.43	78.74	11.64	6.38
43	-1.4512	411.622	399.7	13.0	12.61	5.26	17.86	3.40	78.74	11.56	6.30
44	-1.3980	411.622	399.7	13.5	12.54	5.26	17.80	3.39	78.74	11.53	6.27
45	-1.3447	411.622	399.7	13.9	12.48	5.26	17.73	3.37	78.74	11.49	6.24
46	-1.2917	405.347	393.4	14.4	12.22	5.26	17.47	3.32	78.74	11.36	6.11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
47	-1.2388	402.209	390.3	14.8	12.06	5.26	17.31	3.29	78.74	11.28	6.03
48	-1.1852	399.072	387.2	15.3	11.90	5.26	17.15	3.26	78.74	11.20	5.95
49	-1.1321	399.072	387.2	15.7	11.83	5.26	17.09	3.25	78.74	11.17	5.92
50	-1.0789	399.072	387.2	16.2	11.77	5.26	17.03	3.24	78.74	11.14	5.88
51	-1.0263	399.072	387.2	16.6	11.71	5.55	17.26	3.11	78.45	11.41	5.85
52	-0.9730	395.934	384.0	17.1	11.55	5.55	17.10	3.08	78.45	11.33	5.78
53	-0.8823	394.000	382.1	17.8	11.39	5.55	16.94	3.05	78.45	11.25	5.69
54	-0.8701	392.000	380.1	17.9	11.31	5.54	16.85	3.04	78.46	11.20	5.66

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.000			35.344
Moisture content: Dry soil+tare, gms.	100.000			32.825
Moisture content: Tare, gms.	0.000			8.851
Moisture, %	7.0	10.8	10.5	10.5
Moist specimen weight, gms.	11647.4			
Diameter, in.	5.98	5.87	5.86	
Area, in.²	28.10	27.07	26.93	
Height, in.	11.94	11.91	11.90	
Net decrease in height, in.		0.03	0.01	
Net decrease in water volume, cc.			32.60	
Wet density, pcf	132.3	142.5	143.0	
Dry density, pcf	123.6	128.6	129.4	
Void ratio	0.3383	0.2864	0.2784	
Saturation, %	54.8	100.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 92.70 psi
Consolidation back pressure = 60.80 psi
Consolidation effective confining stress = 31.90 psi
Strain rate, in./min. = 0.007
Fail. Stress = 27.76 psi **at reading no.** 13
Ult. Stress = 17.63 psi **at reading no.** 44

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.9984	0.000	0.0	0.0	0.00	31.90	31.90	1.00	60.80	31.90	0.00
1	-2.9399	2.258	2.3	0.5	0.08	31.90	31.98	1.00	60.80	31.94	0.04
2	-2.9217	91.990	92.0	0.6	3.39	31.90	35.29	1.11	60.80	33.60	1.70
3	-2.9202	143.444	143.4	0.7	5.29	31.61	36.90	1.17	61.09	34.26	2.65
4	-2.9193	205.565	205.6	0.7	7.58	31.36	38.94	1.24	61.34	35.15	3.79
5	-2.9144	320.710	320.7	0.7	11.83	30.42	42.24	1.39	62.28	36.33	5.91
6	-2.9063	417.971	418.0	0.8	15.40	28.32	43.72	1.54	64.38	36.02	7.70
7	-2.8984	496.407	496.4	0.8	18.28	26.52	44.81	1.69	66.18	35.67	9.14
8	-2.8903	556.019	556.0	0.9	20.46	24.73	45.19	1.83	67.97	34.96	10.23
9	-2.8816	606.218	606.2	1.0	22.29	22.93	45.23	1.97	69.77	34.08	11.15
10	-2.8731	647.005	647.0	1.1	23.78	21.44	45.21	2.11	71.26	33.33	11.89

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
11	-2.8565	703.479	703.5	1.2	25.82	18.74	44.56	2.38	73.96	31.65	12.91
12	-2.8296	744.266	744.3	1.4	27.25	16.05	43.30	2.70	76.65	29.68	13.62
13	-2.8036	759.954	760.0	1.6	27.76	13.96	41.72	2.99	78.74	27.84	13.88
14	-2.7944	759.954	760.0	1.7	27.74	13.36	41.10	3.08	79.34	27.23	13.87
15	-2.7409	741.129	741.1	2.2	26.93	11.26	38.19	3.39	81.44	24.73	13.46
16	-2.6882	719.167	719.2	2.6	26.01	9.77	35.78	3.66	82.93	22.77	13.01
17	-2.6342	697.205	697.2	3.1	25.10	8.87	33.97	3.83	83.83	21.42	12.55
18	-2.5823	681.517	681.5	3.5	24.43	8.27	32.70	3.95	84.43	20.48	12.21
19	-2.5283	668.967	669.0	3.9	23.86	7.67	31.53	4.11	85.03	19.60	11.93
20	-2.4751	653.280	653.3	4.4	23.20	7.37	30.57	4.15	85.33	18.97	11.60
21	-2.4220	647.005	647.0	4.8	22.87	7.37	30.24	4.10	85.33	18.80	11.43
22	-2.3689	640.730	640.7	5.3	22.54	7.07	29.61	4.19	85.63	18.34	11.27
23	-2.3161	637.593	637.6	5.7	22.32	7.07	29.39	4.16	85.63	18.23	11.16
24	-2.2620	631.318	631.3	6.2	22.00	7.07	29.07	4.11	85.63	18.07	11.00
25	-2.2094	625.043	625.0	6.6	21.67	6.77	28.45	4.20	85.93	17.61	10.84
26	-2.1562	618.768	618.8	7.1	21.35	6.77	28.13	4.15	85.93	17.45	10.68
27	-2.1027	612.493	612.5	7.5	21.04	6.47	27.51	4.25	86.23	16.99	10.52
28	-2.0495	609.356	609.4	8.0	20.83	6.47	27.30	4.22	86.23	16.89	10.41
29	-1.9962	603.081	603.1	8.4	20.51	6.47	26.99	4.17	86.23	16.73	10.26
30	-1.9431	596.806	596.8	8.9	20.20	6.17	26.37	4.27	86.53	16.27	10.10
31	-1.8895	593.669	593.7	9.3	19.99	6.17	26.17	4.24	86.53	16.17	10.00
32	-1.8369	590.531	590.5	9.8	19.79	6.17	25.97	4.21	86.53	16.07	9.90
33	-1.7836	587.394	587.4	10.2	19.59	5.87	25.46	4.33	86.83	15.67	9.79
34	-1.7301	581.119	581.1	10.7	19.28	5.94	25.22	4.25	86.76	15.58	9.64
35	-1.6775	577.981	578.0	11.1	19.08	5.87	24.96	4.25	86.83	15.42	9.54
36	-1.6241	574.844	574.8	11.5	18.88	5.79	24.67	4.26	86.91	15.23	9.44
37	-1.5713	574.844	574.8	12.0	18.79	5.87	24.66	4.20	86.83	15.27	9.39
38	-1.5179	571.706	571.7	12.4	18.59	5.58	24.17	4.33	87.12	14.87	9.30
39	-1.4649	568.569	568.6	12.9	18.40	5.58	23.97	4.30	87.12	14.77	9.20
40	-1.4120	565.431	565.4	13.3	18.20	5.58	23.78	4.26	87.12	14.68	9.10
41	-1.3588	565.431	565.4	13.8	18.11	5.58	23.68	4.25	87.12	14.63	9.05
42	-1.3067	562.294	562.3	14.2	17.92	5.58	23.49	4.21	87.12	14.53	8.96
43	-1.2529	562.294	562.3	14.7	17.82	5.28	23.10	4.38	87.42	14.19	8.91
44	-1.2000	559.157	559.2	15.1	17.63	5.28	22.91	4.34	87.42	14.09	8.81
45	-1.1467	562.294	562.3	15.6	17.63	5.28	22.91	4.34	87.42	14.09	8.82
46	-1.0937	562.294	562.3	16.0	17.54	5.28	22.82	4.32	87.42	14.05	8.77
47	-1.0402	562.294	562.3	16.5	17.45	5.28	22.72	4.31	87.42	14.00	8.72
48	-0.9871	565.431	565.4	16.9	17.45	5.28	22.73	4.31	87.42	14.00	8.73
49	-0.9339	562.294	562.3	17.3	17.26	5.19	22.45	4.32	87.51	13.82	8.63
50	-0.8808	562.294	562.3	17.8	17.17	5.28	22.44	4.25	87.42	13.86	8.58
51	-0.8276	562.294	562.3	18.2	17.07	5.28	22.35	4.24	87.42	13.81	8.54
52	-0.7745	565.431	565.4	18.7	17.08	4.98	22.05	4.43	87.72	13.52	8.54
53	-0.7210	559.157	559.2	19.1	16.79	5.06	21.85	4.32	87.64	13.46	8.40
54	-0.6690	559.157	559.2	19.6	16.70	4.98	21.68	4.36	87.72	13.33	8.35
55	-0.6200	559.157	559.2	20.0	16.62	4.98	21.59	4.34	87.72	13.29	8.31

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.000			13800.000
Moisture content: Dry soil+tare, gms.	100.000			12646.100
Moisture content: Tare, gms.	0.000			1718.300
Moisture, %	7.0	10.8	10.6	10.6
Moist specimen weight, gms.	11647.4			
Diameter, in.	6.00	5.87	5.85	
Area, in.²	28.25	27.05	26.90	
Height, in.	11.93	11.93	11.92	
Net decrease in height, in.		0.00	0.00	
Net decrease in water volume, cc.			29.90	
Wet density, pcf	131.7	142.5	142.9	
Dry density, pcf	123.1	128.5	129.3	
Void ratio	0.3443	0.2871	0.2798	
Saturation, %	53.9	100.0	100.0	

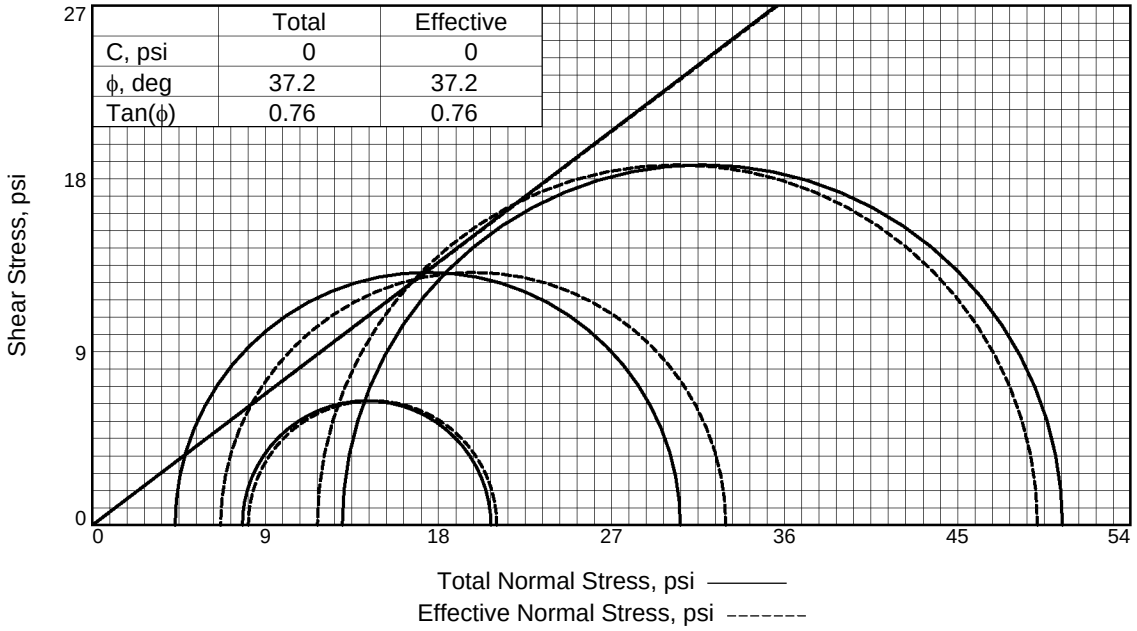
Test Readings for Specimen No. 3

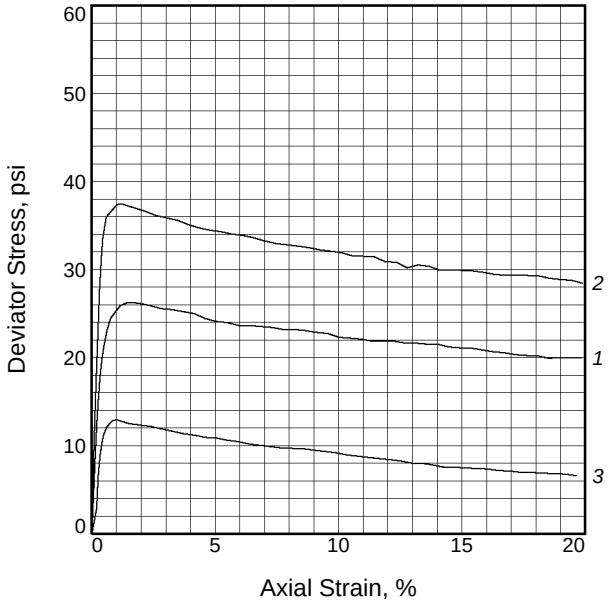
Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.03 cm
Consolidation cell pressure = 90.10 psi
Consolidation back pressure = 55.00 psi
Consolidation effective confining stress = 35.10 psi
Strain rate, in./min. = 0.007
Fail. Stress = 28.03 psi **at reading no.** 12
Ult. Stress = 17.18 psi **at reading no.** 43

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
0	-2.9892	2.250	0.0	0.0	0.00	35.10	35.10	1.00	55.00	35.10	0.00
1	-2.9368	13.231	11.0	0.4	0.41	35.00	35.40	1.01	55.10	35.20	0.20
2	-2.9087	219.989	217.7	0.7	8.04	34.10	42.14	1.24	56.00	38.12	4.02
3	-2.8994	318.505	316.3	0.8	11.67	32.60	44.27	1.36	57.50	38.44	5.83
4	-2.8916	393.804	391.6	0.8	14.44	30.81	45.24	1.47	59.29	38.03	7.22
5	-2.8834	459.691	457.4	0.9	16.85	29.01	45.87	1.58	61.09	37.44	8.43
6	-2.8749	516.165	513.9	1.0	18.92	27.52	46.44	1.69	62.58	36.98	9.46
7	-2.8658	566.364	564.1	1.0	20.75	26.02	46.77	1.80	64.08	36.40	10.38
8	-2.8578	610.289	608.0	1.1	22.35	24.52	46.88	1.91	65.58	35.70	11.18
9	-2.8402	676.175	673.9	1.2	24.74	22.13	46.87	2.12	67.97	34.50	12.37
10	-2.8229	723.237	721.0	1.4	26.43	19.73	46.16	2.34	70.37	32.95	13.21
11	-2.7885	764.024	761.8	1.7	27.84	16.14	43.98	2.72	73.96	30.06	13.92
12	-2.7707	770.299	768.0	1.8	28.03	14.65	42.67	2.91	75.45	28.66	14.01
13	-2.7614	770.299	768.0	1.9	28.00	14.35	42.35	2.95	75.75	28.35	14.00
14	-2.7089	754.612	752.4	2.4	27.31	11.65	38.96	3.34	78.45	25.31	13.65
15	-2.6560	729.512	727.3	2.8	26.28	9.86	36.14	3.67	80.24	23.00	13.14
16	-2.6021	704.412	702.2	3.2	25.25	8.96	34.21	3.82	81.14	21.59	12.63
17	-2.5494	682.450	680.2	3.7	24.35	8.06	32.41	4.02	82.04	20.24	12.18
18	-2.4955	663.625	661.4	4.1	23.57	7.76	31.33	4.04	82.34	19.55	11.78
19	-2.4437	651.076	648.8	4.6	23.01	7.17	30.18	4.21	82.93	18.67	11.51
20	-2.3902	638.526	636.3	5.0	22.46	6.87	29.33	4.27	83.23	18.10	11.23
21	-2.3373	622.839	620.6	5.5	21.81	6.64	28.45	4.28	83.46	17.54	10.90
22	-2.2835	613.426	611.2	5.9	21.37	6.27	27.64	4.41	83.83	16.95	10.69

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psi	Minor Eff. Stress psi	Major Eff. Stress psi	1:3 Ratio	Pore Press. psi	P psi	Q psi
23	-2.2310	604.014	601.8	6.4	20.95	6.27	27.21	4.34	83.83	16.74	10.47
24	-2.1781	597.739	595.5	6.8	20.63	5.97	26.60	4.46	84.13	16.28	10.31
25	-2.1247	591.464	589.2	7.2	20.31	5.97	26.28	4.40	84.13	16.13	10.16
26	-2.0714	588.327	586.1	7.7	20.11	5.67	25.78	4.55	84.43	15.72	10.05
27	-2.0181	585.189	582.9	8.1	19.90	5.67	25.57	4.51	84.43	15.62	9.95
28	-1.9651	578.914	576.7	8.6	19.59	5.67	25.26	4.46	84.43	15.47	9.80
29	-1.9128	575.777	573.5	9.0	19.39	5.37	24.76	4.61	84.73	15.07	9.70
30	-1.8597	569.502	567.3	9.5	19.09	5.37	24.46	4.55	84.73	14.91	9.54
31	-1.8070	566.364	564.1	9.9	18.89	5.37	24.26	4.52	84.73	14.81	9.44
32	-1.7538	563.227	561.0	10.4	18.69	5.07	23.76	4.69	85.03	14.42	9.35
33	-1.7006	560.089	557.8	10.8	18.49	5.07	23.57	4.65	85.03	14.32	9.25
34	-1.6481	556.952	554.7	11.2	18.30	5.07	23.37	4.61	85.03	14.22	9.15
35	-1.5951	553.815	551.6	11.7	18.11	5.07	23.18	4.57	85.03	14.12	9.05
36	-1.5424	553.815	551.6	12.1	18.01	5.07	23.09	4.55	85.03	14.08	9.01
37	-1.4891	553.815	551.6	12.6	17.92	4.77	22.69	4.76	85.33	13.73	8.96
38	-1.4362	552.162	549.9	13.0	17.78	4.77	22.55	4.73	85.33	13.66	8.89
39	-1.3844	550.677	548.4	13.5	17.64	4.77	22.41	4.70	85.33	13.59	8.82
40	-1.3312	550.677	548.4	13.9	17.55	4.77	22.32	4.68	85.33	13.55	8.78
41	-1.2782	547.540	545.3	14.3	17.36	4.77	22.13	4.64	85.33	13.45	8.68
42	-1.2248	547.540	545.3	14.8	17.27	4.71	21.98	4.67	85.39	13.34	8.63
43	-1.1739	547.540	545.3	15.2	17.18	4.68	21.87	4.67	85.42	13.28	8.59
44	-1.1204	547.540	545.3	15.7	17.09	4.77	21.86	4.58	85.33	13.32	8.55
45	-1.0674	547.540	545.3	16.1	17.00	4.47	21.47	4.80	85.63	12.97	8.50
46	-1.0141	547.540	545.3	16.6	16.91	4.47	21.38	4.78	85.63	12.93	8.46
47	-0.9613	550.677	548.4	17.0	16.92	4.47	21.39	4.78	85.63	12.93	8.46
48	-0.9090	547.540	545.3	17.4	16.73	4.47	21.21	4.74	85.63	12.84	8.37
49	-0.8553	547.540	545.3	17.9	16.64	4.47	21.11	4.72	85.63	12.79	8.32
50	-0.8026	547.540	545.3	18.3	16.55	4.47	21.02	4.70	85.63	12.75	8.28
51	-0.7494	547.540	545.3	18.8	16.46	4.47	20.93	4.68	85.63	12.70	8.23
52	-0.6964	550.677	548.4	19.2	16.47	4.47	20.94	4.68	85.63	12.71	8.23
53	-0.6430	550.677	548.4	19.7	16.37	4.47	20.85	4.66	85.63	12.66	8.19





Sample No.		1	2	3
Initial	Water Content, %	6.5	6.5	6.5
	Dry Density, pcf	125.2	123.0	122.6
	Saturation, %	53.6	49.9	49.3
	Void Ratio	0.3216	0.3452	0.3491
	Diameter, in.	5.99	6.00	6.01
	Height, in.	11.86	12.01	12.01
At Test	Water Content, %	10.1	12.0	12.0
	Dry Density, pcf	130.4	125.5	125.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.2687	0.3183	0.3183
	Diameter, in.	5.87	5.94	5.94
	Height, in.	11.85	11.99	12.01
Strain rate, in./min.		0.007	0.007	0.007
Back Pressure, psi		70.3	55.0	59.0
Cell Pressure, psi		74.6	68.0	66.8
Fail. Stress, psi		26.3	37.5	12.9
Total Pore Pr., psi		67.9	56.3	58.7
Ult. Stress, psi		21.1	29.9	7.5
Total Pore Pr., psi		69.7	60.2	59.8
$\bar{\sigma}_1$ Failure, psi		32.9	49.2	21.0
$\bar{\sigma}_3$ Failure, psi		6.7	11.7	8.1

Type of Test:
CU with Pore Pressures

Sample Type: Remolded

Description: (Visual) Sandy Clayey Gravel (GC). Triaxial specimens 6x12 remolded to 123.1 pcf at 6.5%.

Assumed Specific Gravity= 2.65

Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.

Figure _____

Client: Chicago District

Project: Santiago Creek

Location: TH20-15, 20.0 - 30.0', L1/16802

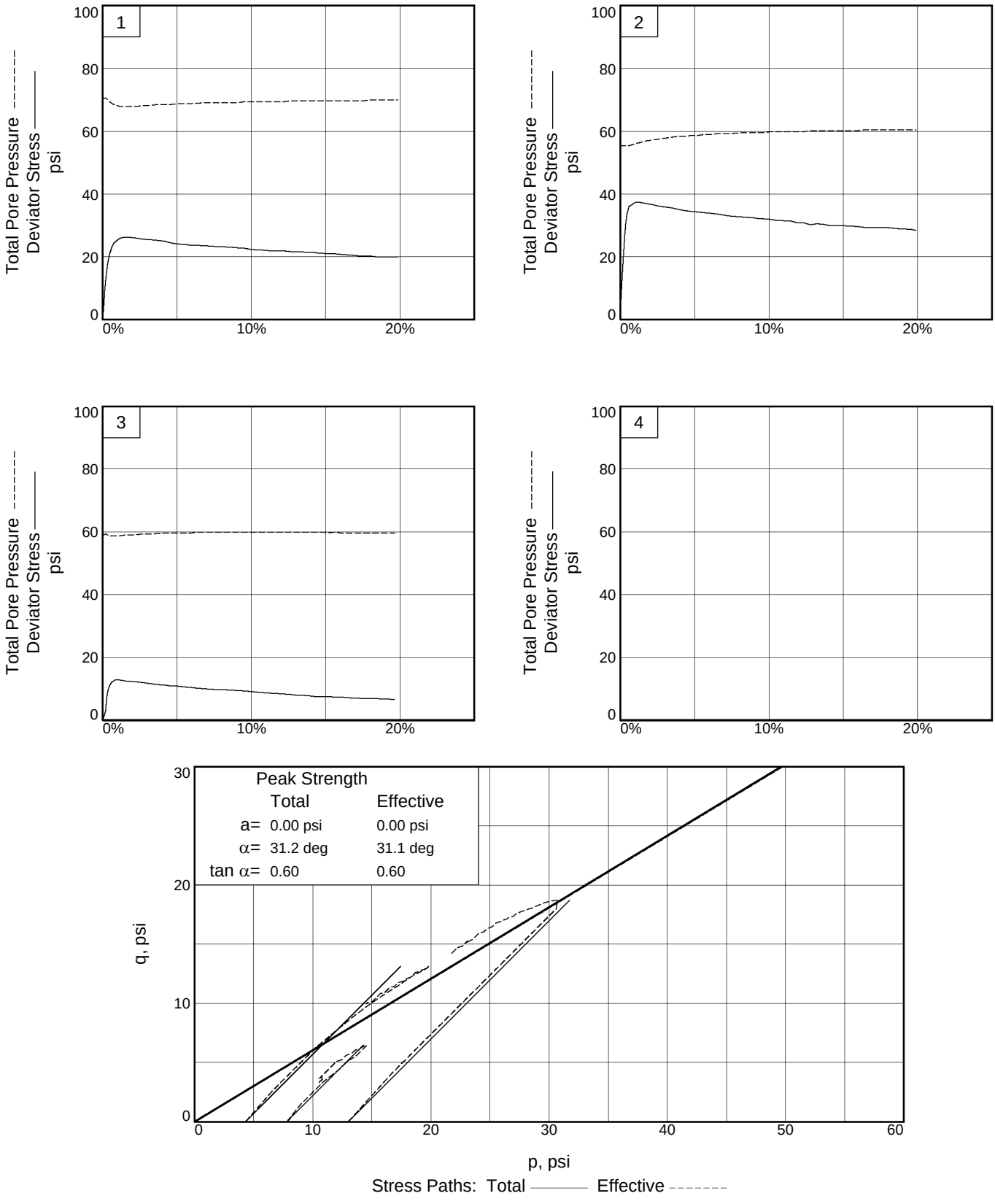
Depth: 20.0 - 30.0'

Proj. No.: W81EYN12437800, CCRC# 1575KB **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT

U.S. Army Corp of Engineers

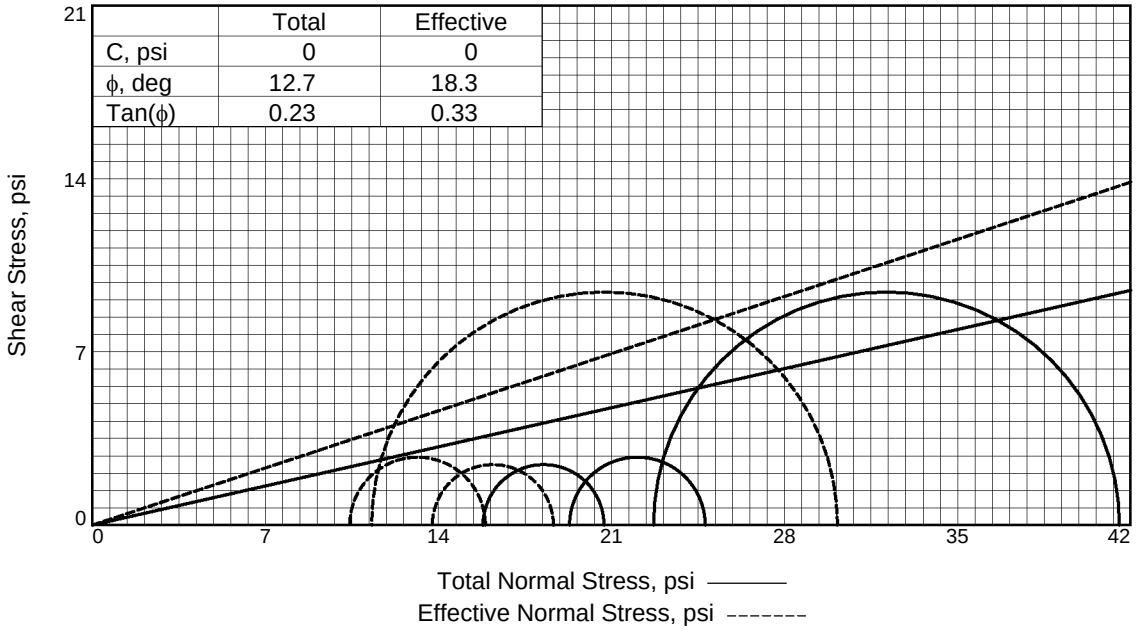
Tested By: JC **Checked By:** MW

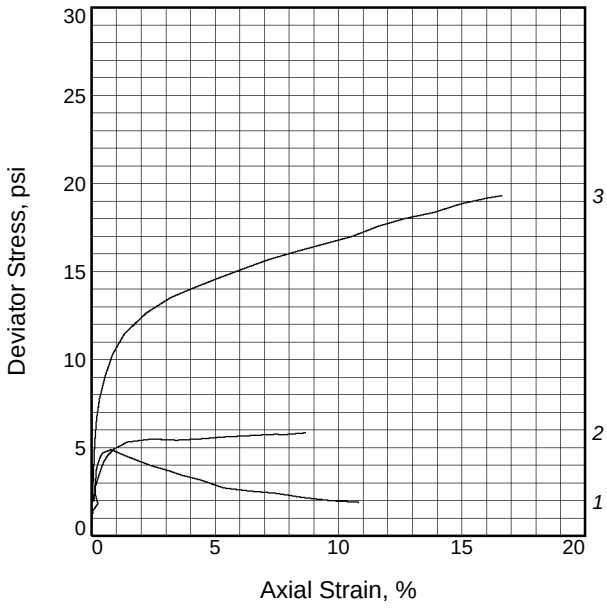


Client: Chicago District
Project: Santiago Creek
Location: TH20-15, 20.0 - 30.0', L1/16802 **Depth:** 20.0 - 30.0'
Project No.: W81EYN12437800, CCRC# 1575KB **Figure** _____

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW





Sample No.		1	2	3
Initial	Water Content, %	14.0	14.0	14.0
	Dry Density, pcf	111.9	111.5	112.4
	Saturation, %	77.4	76.8	78.6
	Void Ratio	0.4790	0.4832	0.4722
	Diameter, in.	2.81	2.81	2.80
	Height, in.	5.61	5.61	5.60
At Test	Water Content, %	21.0	21.0	21.0
	Dry Density, pcf	106.3	106.3	106.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5565	0.5565	0.5565
	Diameter, in.	2.88	2.88	2.88
	Height, in.	5.60	5.60	5.59
Strain rate, in./min.		0.007	0.007	0.007
Back Pressure, psi		72.0	71.3	56.0
Cell Pressure, psi		87.8	90.6	78.7
Fail. Stress, psi		4.9	5.5	18.8
Total Pore Pr., psi		74.0	80.2	67.4
Ult. Stress, psi		1.9	5.8	18.8
Total Pore Pr., psi		74.3	83.3	67.4
$\bar{\sigma}_1$ Failure, psi		18.6	15.9	30.1
$\bar{\sigma}_3$ Failure, psi		13.8	10.4	11.3

Type of Test:
CU with Pore Pressures

Sample Type: Remolded

Description: (Visual) Clayey Sand (SC). Triaxial specimens 2.8x5.6 remolded to 105.0 pcf at 14.0%.

Assumed Specific Gravity= 2.65

Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.

Figure _____

Client: Chicago District

Project: Santiago Creek

Location: TH20-19, 40.0 - 43.0', L1/16813

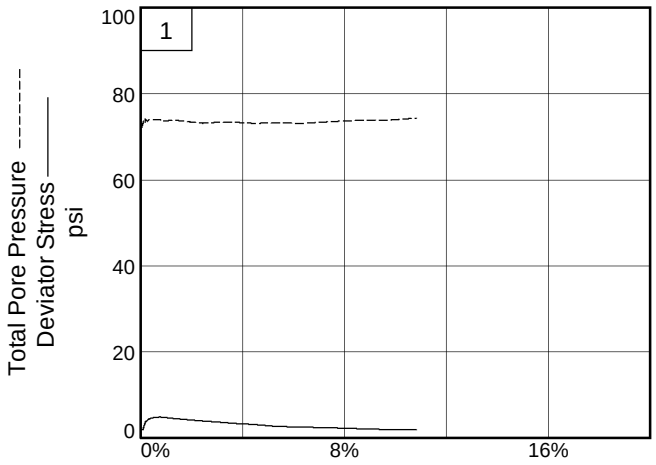
Depth: 40.0 - 43.0'

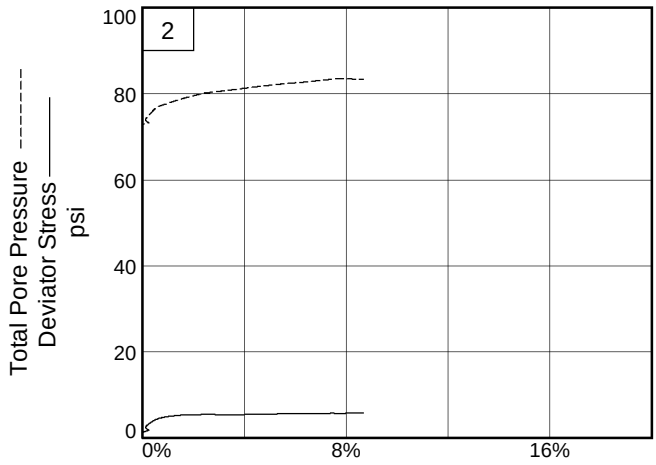
Proj. No.: W81EYN12437800, CCRC# 1575KB **Date Sampled:**

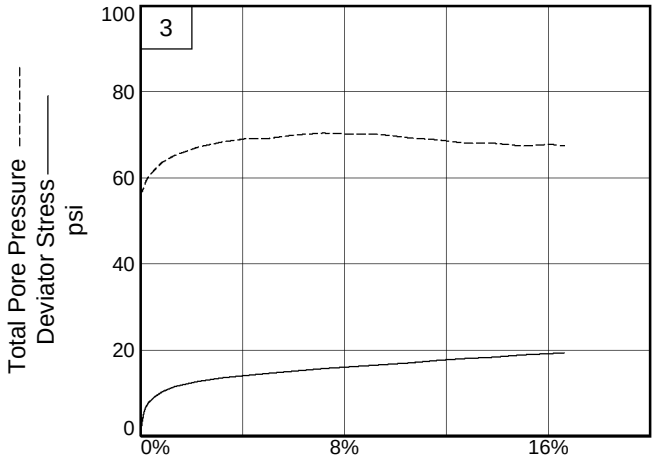
TRIAXIAL SHEAR TEST REPORT

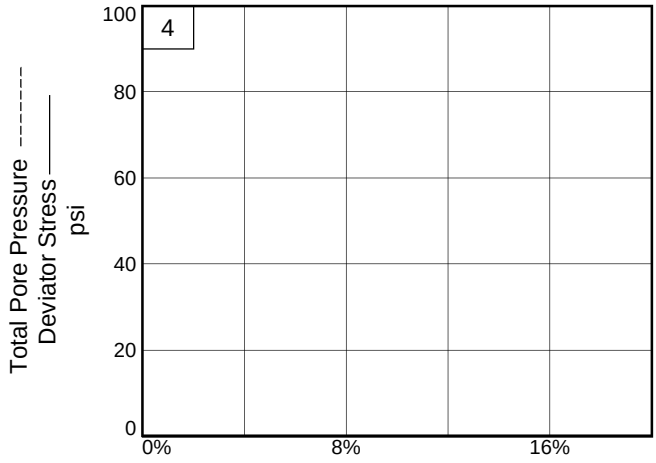
U.S. Army Corp of Engineers

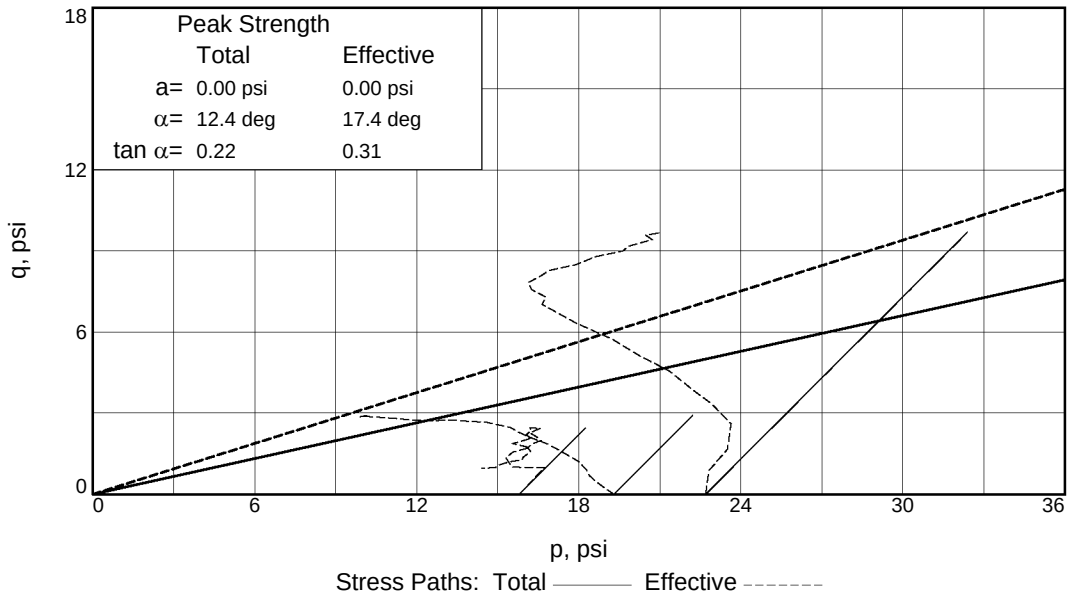
Tested By: JC **Checked By:** MW







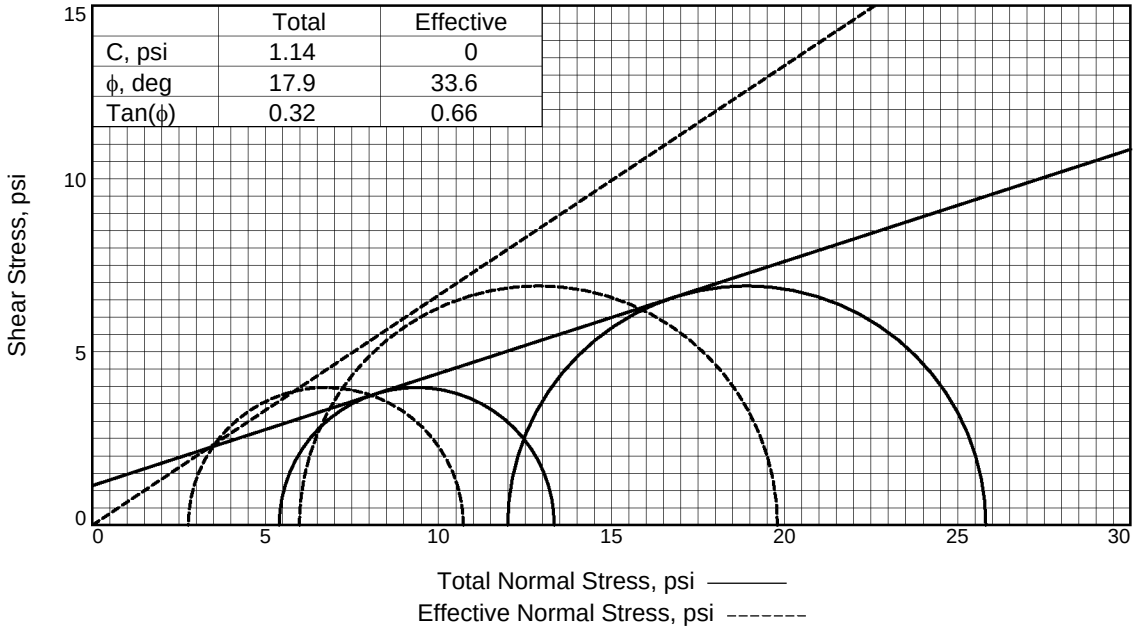


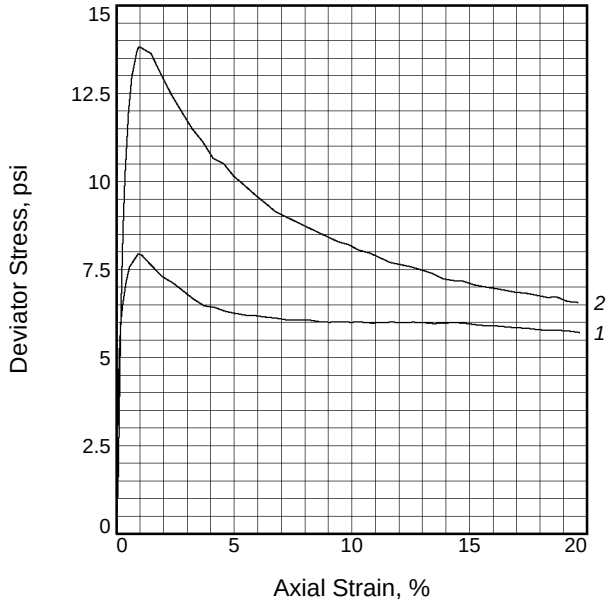


Client: Chicago District
Project: Santiago Creek
Location: TH20-19, 40.0 - 43.0', L1/16813 **Depth:** 40.0 - 43.0'
Project No.: W81EYN12437800, CCRC# 1575KB **Figure** _____

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW





Sample No.		1	2
Initial	Water Content, %	7.5	7.5
	Dry Density, pcf	122.7	122.7
	Saturation, %	57.0	57.0
	Void Ratio	0.3486	0.3486
	Diameter, in.	6.00	6.00
	Height, in.	12.00	12.00
At Test	Water Content, %	14.0	14.0
	Dry Density, pcf	120.7	120.7
	Saturation, %	100.0	100.0
	Void Ratio	0.3710	0.3710
	Diameter, in.	6.05	6.05
	Height, in.	11.99	11.98
Strain rate, in./min.		0.007	0.007
Back Pressure, psi		41.4	41.0
Cell Pressure, psi		46.8	53.0
Fail. Stress, psi		7.9	13.8
Total Pore Pr., psi		44.0	47.0
Ult. Stress, psi		5.9	7.1
Total Pore Pr., psi		46.7	52.1
$\bar{\sigma}_1$ Failure, psi		10.7	19.8
$\bar{\sigma}_3$ Failure, psi		2.8	6.0

Type of Test:
CU with Pore Pressures

Sample Type: Remolded

Description: (Visual) Clayey Sand (SC), with some gravel. Triaxial specimens 6x12 remolded to 122.7 pcf at 7.5%.

Assumed Specific Gravity= 2.65

Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.

Figure _____

Client: Chicago District

Project: Santiago Creek

Location: TH20-22, 30.0 - 40.0', L1/16822

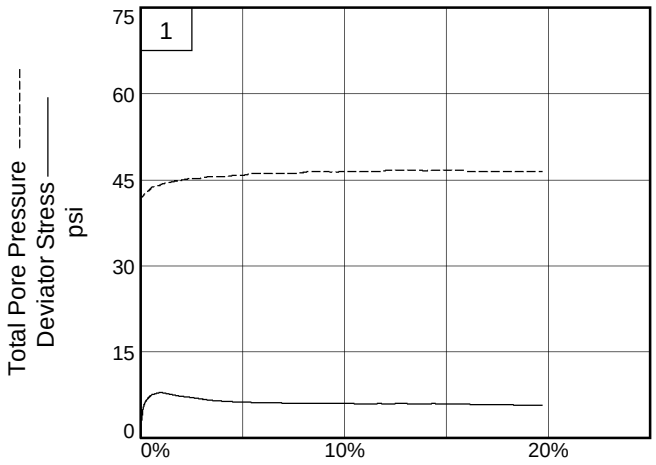
Depth: 30.0 - 40.0'

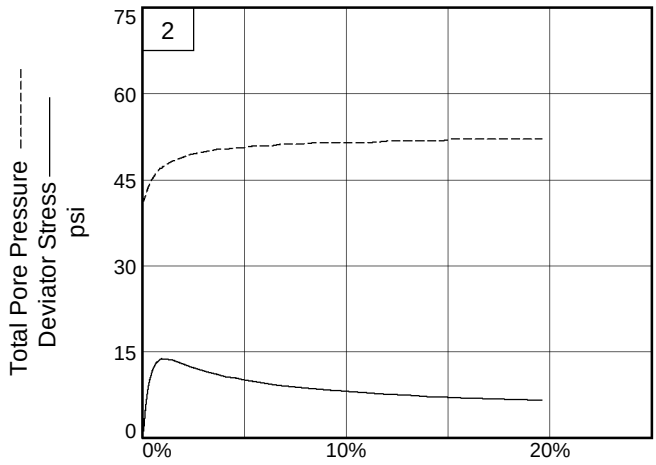
Proj. No.: W81EYN12437800, CCRC# 1575KB **Date Sampled:**

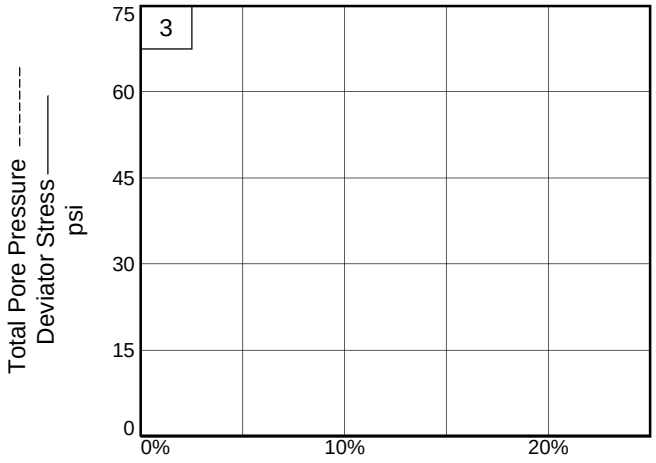
TRIAXIAL SHEAR TEST REPORT

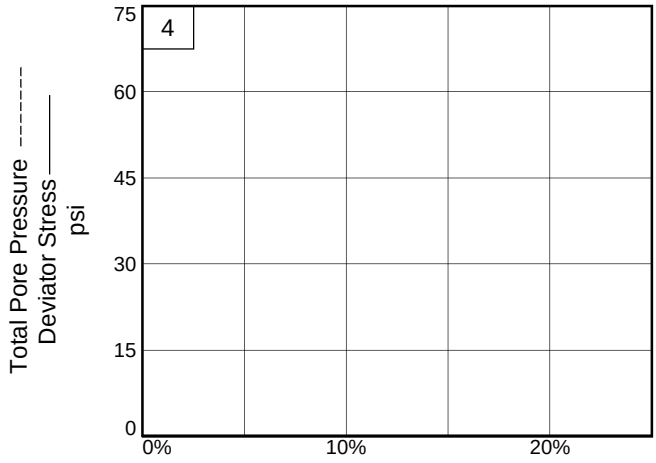
U.S. Army Corp of Engineers

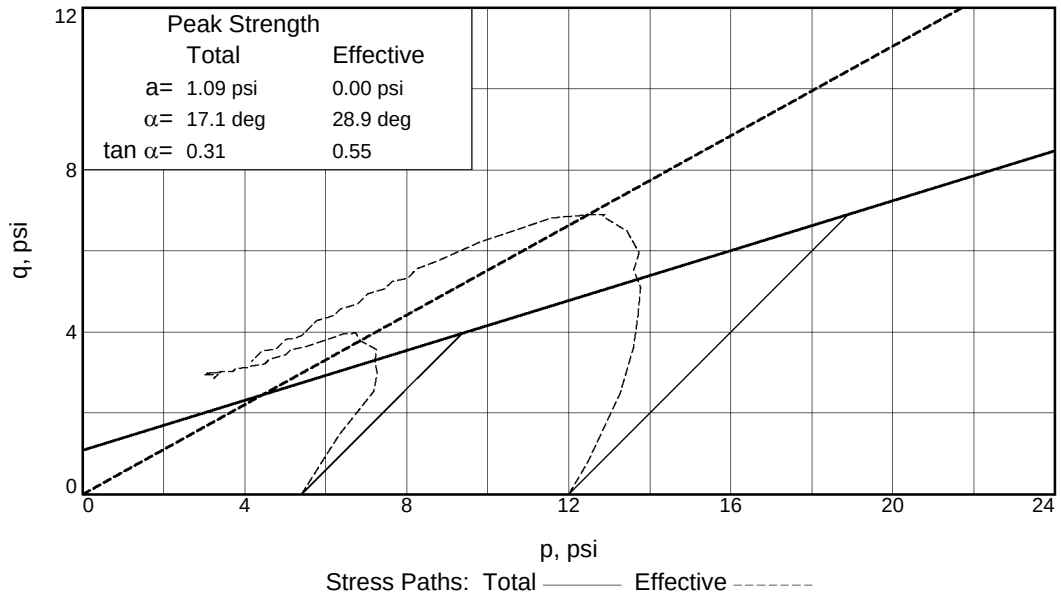
Tested By: JC **Checked By:** MW







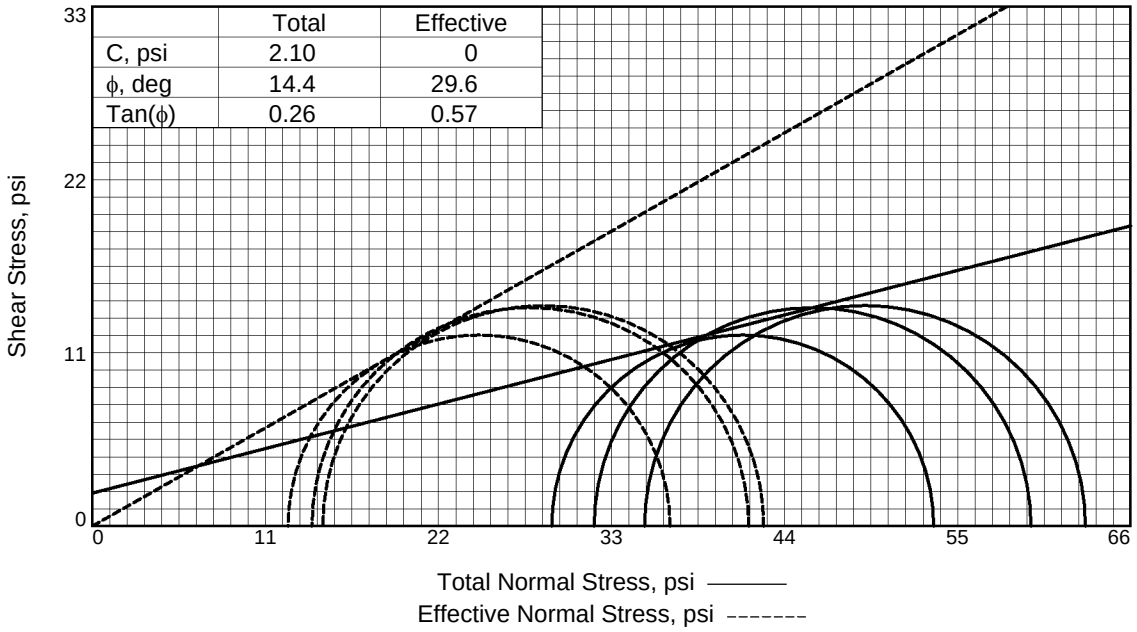


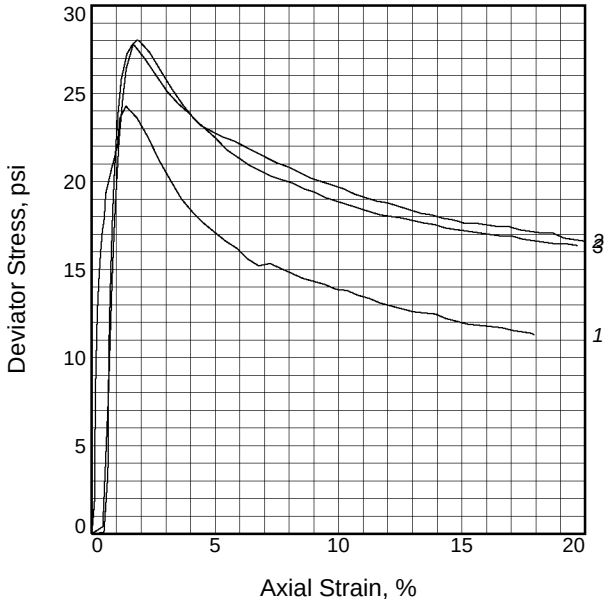


Client: Chicago District
Project: Santiago Creek
Location: TH20-22, 30.0 - 40.0', L1/16822 **Depth:** 30.0 - 40.0'
Project No.: W81EYN12437800, CCRC# 1575KB **Figure** _____

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW





Sample No.		1	2	3
Initial	Water Content, %	7.0	7.0	7.0
	Dry Density, pcf	124.1	123.6	123.1
	Saturation, %	55.8	54.8	53.9
	Void Ratio	0.3327	0.3383	0.3443
	Diameter, in.	5.98	5.98	6.00
	Height, in.	11.89	11.94	11.93
At Test	Water Content, %	11.5	10.5	10.6
	Dry Density, pcf	126.7	129.4	129.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.3059	0.2784	0.2798
	Diameter, in.	5.93	5.86	5.85
	Height, in.	11.87	11.90	11.92
Strain rate, in./min.		0.007	0.007	0.007
Back Pressure, psi		54.8	60.8	55.0
Cell Pressure, psi		84.0	92.7	90.1
Fail. Stress, psi		24.3	27.8	28.0
Total Pore Pr., psi		71.6	78.7	75.5
Ult. Stress, psi		12.1	17.6	17.2
Total Pore Pr., psi		78.7	87.4	85.4
$\bar{\sigma}_1$ Failure, psi		36.7	41.7	42.7
$\bar{\sigma}_3$ Failure, psi		12.4	14.0	14.6

Type of Test:
CU with Pore Pressures

Sample Type: Remolded

Description: Clayey Sand (SC), with some gravel. Triaxial specimens 6x12 remolded to 122.2 pcf at

LL= 23 **PL=** 15 **PI=** 8

Assumed Specific Gravity= 2.65

Remarks: Other testing was done in general accordance with ASTM's: D422, D698, D854, D2216, D2487, D4318 & D4767.

Figure _____

Client: Chicago District

Project: Santiago Creek

Location: TH20-24, 60.0 - 70.0', L1/16831

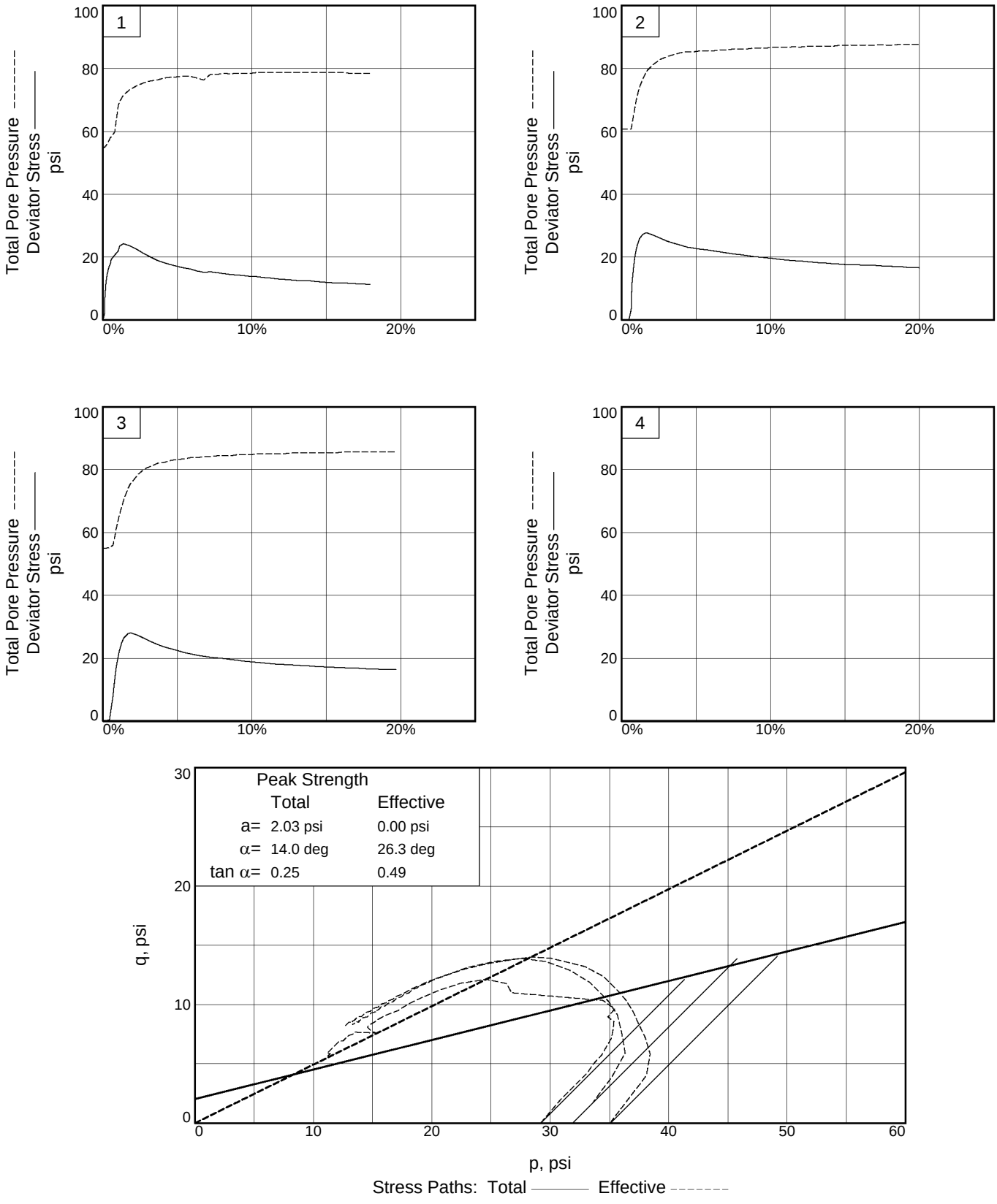
Depth: 60.0 - 70.0'

Proj. No.: W81EYN12437800, CCRC# 1575KB **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW



Client: Chicago District
Project: Santiago Creek
Location: TH20-24, 60.0 - 70.0', L1/16831 **Depth:** 60.0 - 70.0'
Project No.: W81EYN12437800, CCRC# 1575KB **Figure** _____

U.S. Army Corp of Engineers

Tested By: JC **Checked By:** MW

DRAFT SUMMARY OF MATERIAL PROPERTIES

12-Dec-21

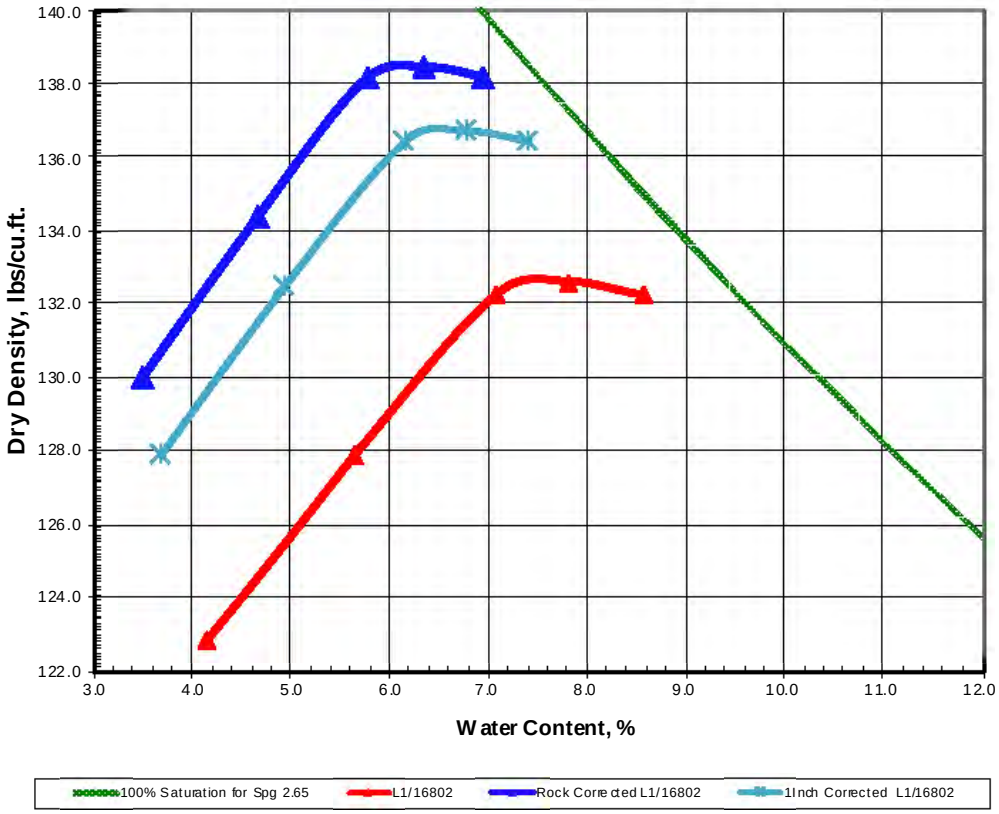
PROJECT: Santiago Creek Testing Project **LOCATION:**
REQUISITION NO:W81EYN12437800 **WORK ORDER:** CCRC# 1575KB

				ASTM D422 Grain Size Analysis - Percent Passing												D4318 Atterberg Limits			D2216					
LAB Number	Hole Number	Sample Number	Depth (ft)	1 in %	3/4 in %	1/2 in %	3/8 in %	No.4 %	No.10 %	No.20 %	No.40 %	No.60 %	No.100 %	No.140 %	No 200 %	LL	PL	PI	MC%	SpG	Color	Class.	D2487 Soil Classification System	
L1/17277C	TH20-07		10.5 to 12.5																					
L1/17278C	TH20-07		12.5 to 14.5																					
L1/17279C	TH20-12		10.0 to 12.0																					
L1/16981	TH20-14	Line G	70.0 to 80.0	90	84.6	77.5	74.3	63.5											8.4				Gravelly Clayey Sand (SC).	
L1/16802	TH20-15	Line H	20.0 to 30.0	84.7	78.6	68.5	62.2	48											5.72				(Visual) Sandy Clayey Gravel (GC).	
L1/17070	TH20-18		90.0 to 100.0	97.6	97	95.7	94.5	90.9											2.56				(Visual) Clayey Sand (SC), with a trace of gravel.	
L1/16813	TH20-19	Line FI	40.0 to 43.0		100	99.7	99.5	99.3											21.73				(Visual) Clayey Sand (SC).	no hydrometer? Field said this was clay
L1/17118	TH20-20		120.0 to 125.0	99	98.9	98.7	98.5	98.2											4.07				(Visual) Clayey Sand (SC), with a trace of gravel.	
L1/16822	TH20-22	Villa Park Slide	30.0 to 40.0	95.3	92.3	86.4	80.9	68.3											12.7				(Visual) Clayey Sand (SC), with some gravel.	field said gravel
L1/16828	TH20-23	Line D	30.0 to 35.0	91.7	89.3	85.9	84	79.4											18.51				(Visual) Clayey Sand (SC), with a little gravel.	Field said CL-ML
L1/16830	TH20-24	Line A	0.0 to 10.0	84.3	78.4	70.2	65.5	54.6	46.4	35.6	25.1	19.6	16.3	14.8	13.5	29	15	14	5.99			GC	Sandy Clayey Gravel (GC).	
L1/16831	TH20-24	Line A	60.0 to 70.0	93.8	89.8	83.1	78.7	66.8	57.2	43.8	32.4	26.4	22.2	19.9	18	23	15	8	5.9			SC	Clayey Sand (SC), with some gravel.	field said gravel
L1/17289	TH20-25	Line EI	52.0 to 60.0																3.98				(Visual) Clayey Sand (SC), with some gravel.	field said gravel

U.S. Army Corps of Engineers, Savannah District

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Moisture Density Relationship



Standard Compaction Test **ASTM D 698** **Procedure C**

56 Blows per each of 3 Layers, with a 5.5 pound rammer and a 12 inch drop, using a 6 inch diameter mold.

Sample No.	Elev. or Depth	Classification	Spg	LL	PL	%Pass No. 4	%Pass 3/4 in.
	20 - 30	(Visual) Sandy Clayey Gravel (GC).	2.654			48.0	78.6

Sample No.					
Laboratory No.	L1/16802	Rock Corrected L1/16802	1Inch Corrected L1/16802		
Natural water content, percent					
Optimum water content, percent	7.4	6.1	6.5		
Max. Dry Density, lb/ft^3	132.7	138.6	136.8		

Remarks:

Other tests conducted in General accordance with ASTM's D422, D4318, D2216, D854, and D2487. Results shown and plotted with corrected and uncorrected values for moisture and dry density following ASTM D4718 where applicable.

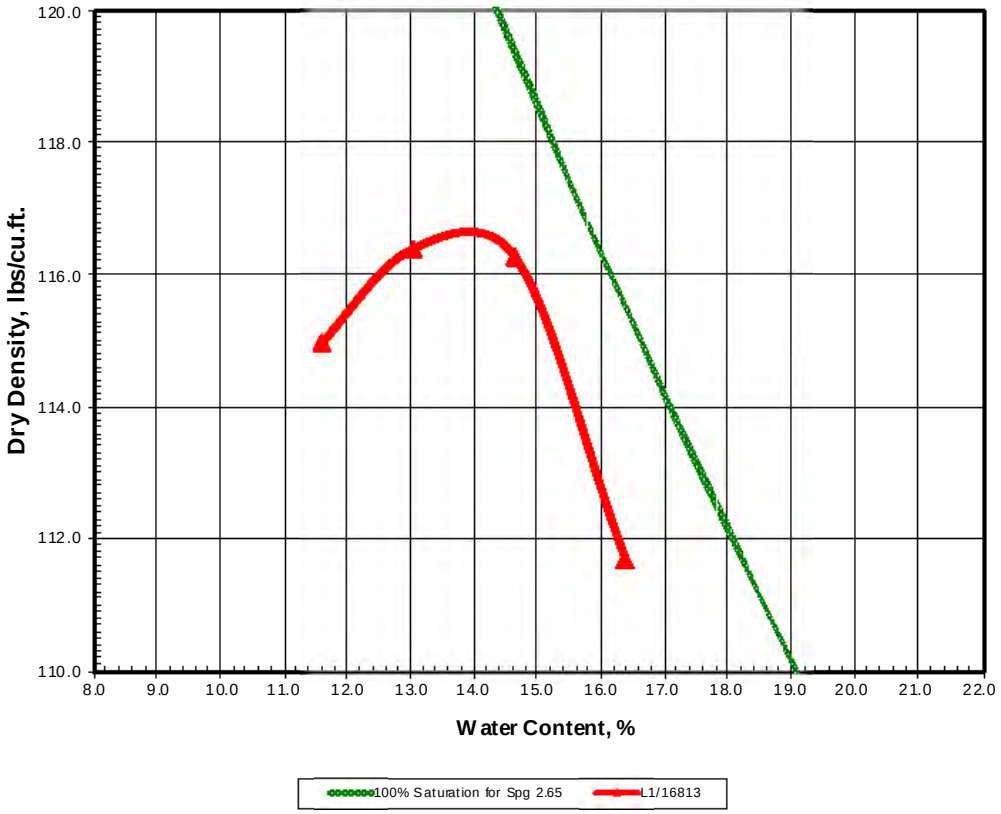
Project	Santiago Creek Testing Project		
Area			
Requisition No.	W81EYN12437800	**Work Order No.**	
Hole No.	TH20-15	**Lab No.**	L1/16802

Compaction Test Report

U.S. Army Corps of Engineers, Savannah District

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Moisture Density Relationship



Standard Compaction Test **ASTM D 698** **Procedure A**

25 Blows per each of 3 Layers, with a 5.5 pound rammer and a 12 inch drop, using a 4 inch diameter mold.

Sample No.	Elev. or Depth	Classification	Spg	LL	PL	%Pass No. 4	%Pass 3/4 in.
	40 - 43	(Visual) Clayey Sand (SC).	2.654			99.3	100.0

Sample No.					
Laboratory No.	L1/16813				
Natural water content, percent					
Optimum water content, percent	14.0				
Max. Dry Density, lb/ft^3	116.7				

Remarks:

Other tests conducted in General accordance with ASTM's D422, D4318, D2216, D854, and D2487. Results shown and plotted with corrected and uncorrected values for moisture and dry density following ASTM D4718 where applicable.

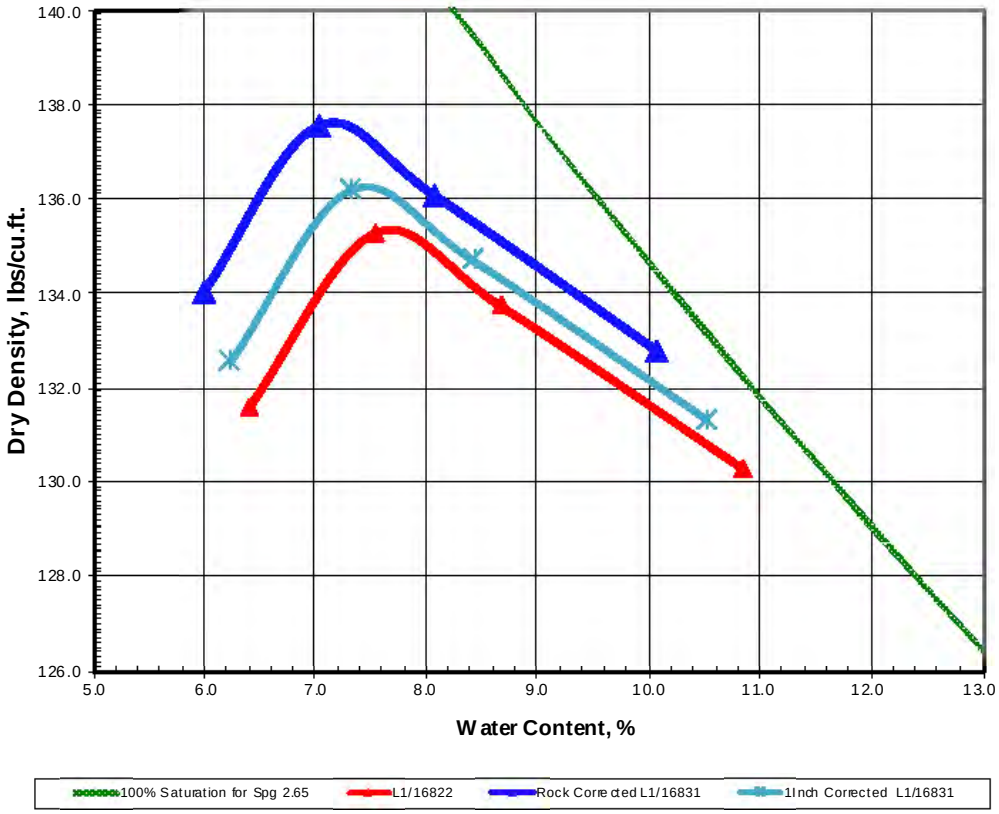
Project	Santiago Creek Testing Project		
Area			
Requisition No.	W81EYN12437800	**Work Order No.**	
Hole No.	TH20-19	**Lab No.**	L1/16813

Compaction Test Report

U.S. Army Corps of Engineers, Savannah District

Materials Testing Regional Technical Center of Expertise

Moisture Density Relationship



Standard Compaction Test **ASTM D 698** **Procedure C**

56 Blows per each of 3 Layers, with a 5.5 pound rammer and a 12 inch drop, using a 6 inch diameter mold.

Sample No.	Elev. or Depth	Classification	Spg	LL	PL	%Pass No. 4	%Pass 3/4 in.
	30 - 40	(Visual) Clayey Sand (SC), with some gravel.	2.750			68.3	92.3

Sample No.					
Laboratory No.	L1/16822	Rock Corrected L1/16831	1Inch Corrected L1/16831		
Natural water content, percent					
Optimum water content, percent	7.7	7.2	7.5		
Max. Dry Density, lb/ft^3	135.3	137.6	136.3		

Remarks:

Other tests conducted in General accordance with ASTM's D422, D4318, D2216, D854, and D2487. Results shown and plotted with corrected and uncorrected values for moisture and dry density following ASTM D4718 where applicable.

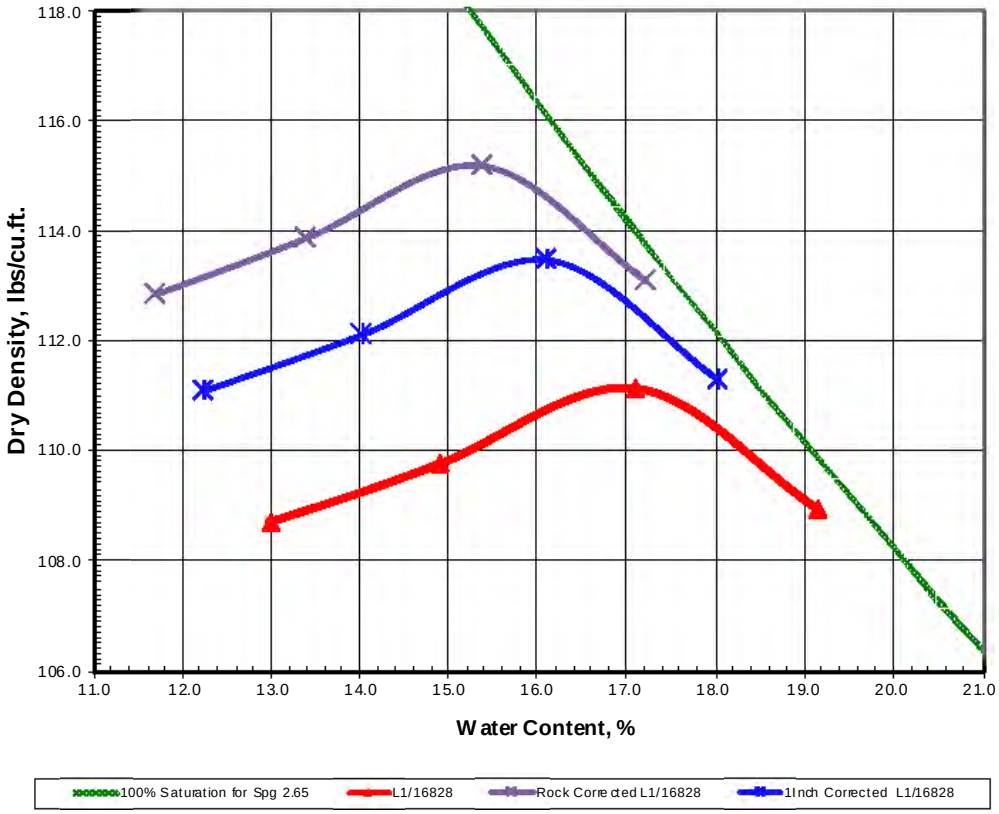
Project	Santiago Creek Testing Project		
Area			
Requisition No.	W81EYN12437800	**Work Order No.**	
Hole No.	TH20-22	**Lab No.**	L1/16822

Compaction Test Report

U.S. Army Corps of Engineers, Savannah District

Materials Testing Regional Technical Center of Expertise

Moisture Density Relationship



Standard Compaction Test **ASTM D 698** **Procedure C**

56 Blows per each of 3 Layers, with a 5.5 pound rammer and a 12 inch drop, using a 6 inch diameter mold.

Sample No.	Elev. or Depth	Classification	Spg	LL	PL	%Pass No. 4	%Pass 3/4 in.
	30 - 35	(Visual) Clayey Sand (SC), with a little gravel.	2.654			79.4	89.3

Sample No.					
Laboratory No.	L1/16828	Rock Corrected L1/16828	1Inch Corrected L1/16828		
Natural water content, percent					
Optimum water content, percent	17.0	15.4	16.1		
Max. Dry Density, lb/ft^3	111.3	115.3	113.5		

Remarks:

Other tests conducted in General accordance with ASTM's D422, D4318, D2216, D854, and D2487. Results shown and plotted with corrected and uncorrected values for moisture and dry density following ASTM D4718 where applicable.

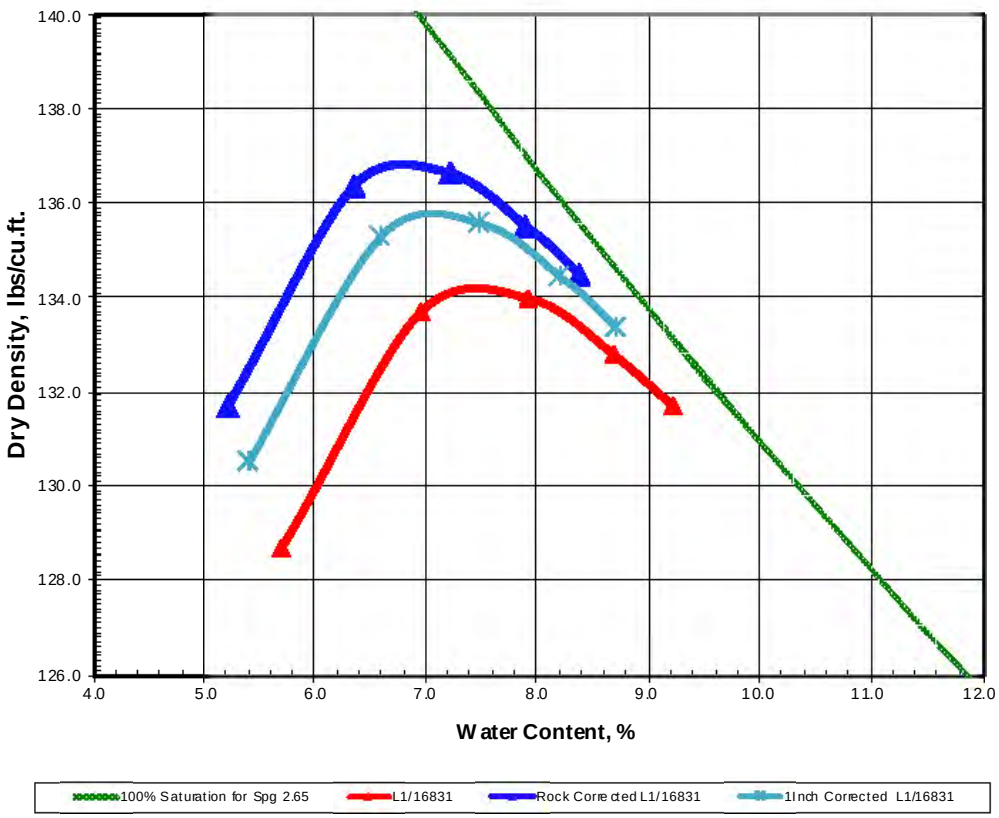
Project	Santiago Creek Testing Project		
Area			
Requisition No.	W81EYN12437800	**Work Order No.**	
Hole No.	TH20-23	**Lab No.**	L1/16828

Compaction Test Report

U.S. Army Corps of Engineers, Savannah District

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Moisture Density Relationship



Standard Compaction Test **ASTM D 698** **Procedure C**

56 Blows per each of 3 Layers, with a 5.5 pound rammer and a 12 inch drop, using a 6 inch diameter mold.

Sample No.	Elev. or Depth	Classification	Spg	LL	PL	%Pass No. 4	%Pass 3/4 in.
	60 - 70	(Visual) Clayey Sand (SC), with some gravel.	2.654			66.8	89.8

Sample No.					
Laboratory No.	L1/16831	Rock Corrected L1/16831	1Inch Corrected L1/16831		
Natural water content, percent					
Optimum water content, percent	7.4	6.7	7.0		
Max. Dry Density, lb/ft^3	134.3	136.9	135.8		

Remarks:

Other tests conducted in General accordance with ASTM's D422, D4318, D2216, D854, and D2487. Results shown and plotted with corrected and uncorrected values for moisture and dry density following ASTM D4718 where applicable.

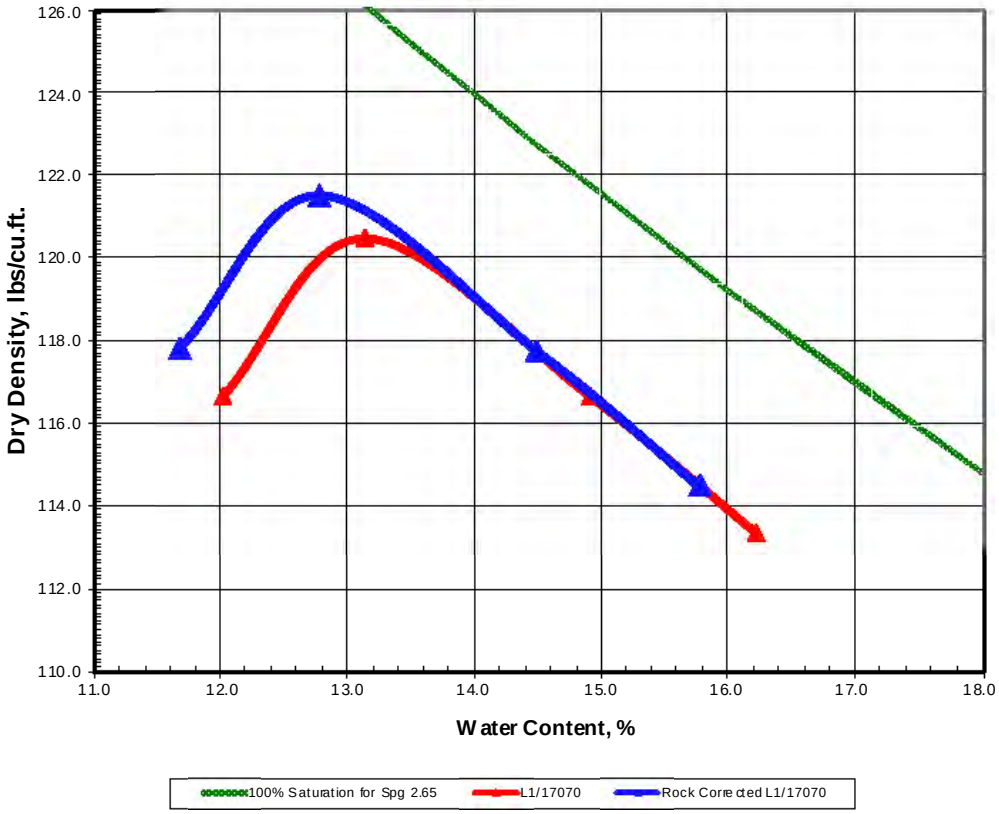
Project	Santiago Creek Testing Project		
Area			
Requisition No.	W81EYN12437800	**Work Order No.**	
Hole No.	TH20-24	**Lab No.**	L1/16831

Compaction Test Report

U.S. Army Corps of Engineers, Savannah District

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Moisture Density Relationship



Standard Compaction Test **ASTM D 698** **Procedure B**

25 Blows per each of 3 Layers, with a 5.5 pound rammer and a 12 inch drop, using a 4 inch diameter mold.

Sample No.	Elev. or Depth	Classification	Spg	LL	PL	%Pass No. 4	%Pass 3/4 in.
	90 - 100	(Visual) Clayey Sand (SC), with a trace of gravel.	2.750			90.9	97.0

Sample No.					
Laboratory No.	L1/17070	Rock Corrected L1/17070			
Natural water content, percent					
Optimum water content, percent	13.2	12.7			
Max. Dry Density, lb/ft^3	120.4	121.6			

Remarks:

Other tests conducted in General accordance with ASTM's D422, D4318, D2216, D854, and D2487. Results shown and plotted with corrected and uncorrected values for moisture and dry density following ASTM D4718 where applicable.

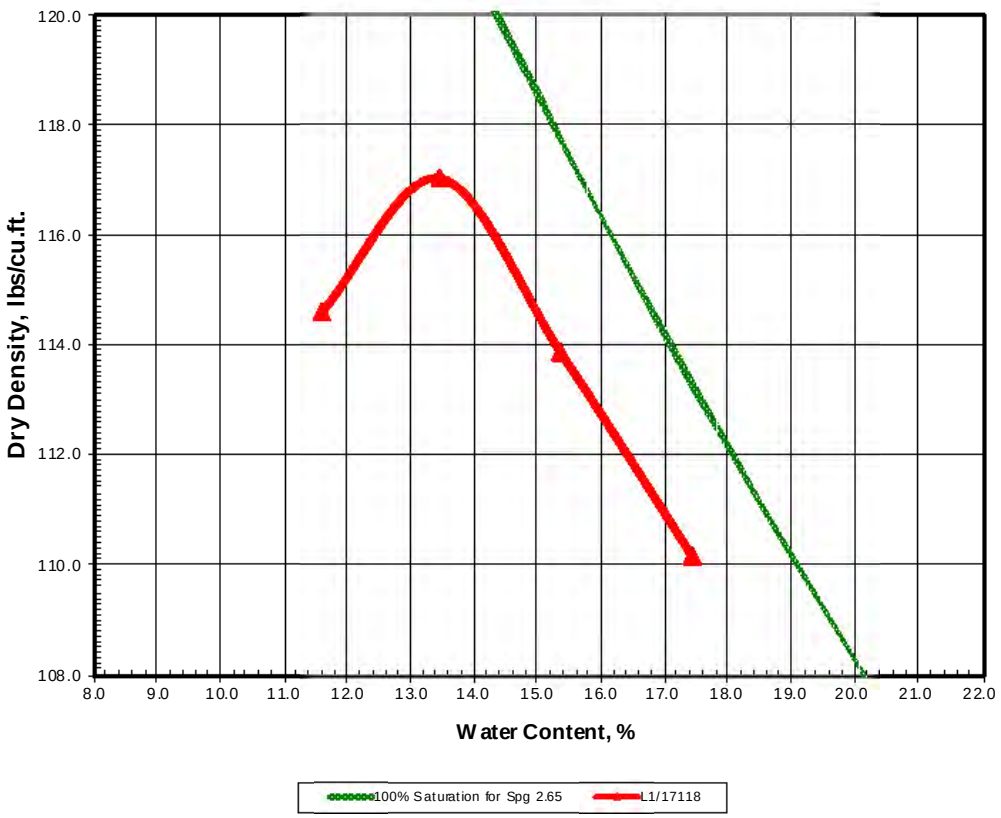
Project	Santiago Creek Testing Project		
Area			
Requisition No.	W81EYN12437800	**Work Order No.**	
Hole No.	TH20-18	**Lab No.**	L1/17070

Compaction Test Report

U.S. Army Corps of Engineers, Savannah District

Materials Testing Regional Technical Center of Expertise

Moisture Density Relationship



Standard Compaction Test **ASTM D 698** **Procedure A**

25 Blows per each of 3 Layers, with a 5.5 pound rammer and a 12 inch drop, using a 4 inch diameter mold.

Sample No.	Elev. or Depth	Classification	Spg	LL	PL	%Pass No. 4	%Pass 3/4 in.
	120 - 125	(Visual) Clayey Sand (SC), with a trace of gravel.	2.654			98.2	98.9

Sample No.					
Laboratory No.	L1/17118				
Natural water content, percent					
Optimum water content, percent	13.4				
Max. Dry Density, lb/ft^3	117.0				

Remarks:

Other tests conducted in General accordance with ASTM's D422, D4318, D2216, D854, and D2487. Results shown and plotted with corrected and uncorrected values for moisture and dry density following ASTM D4718 where applicable.

Project	Santiago Creek Testing Project		
Area			
Requisition No.	W81EYN12437800	**Work Order No.**	
Hole No.	TH20-20	**Lab No.**	L1/17118

Compaction Test Report

ATTACHMENT C-3 - Site-specific liquefaction analysis

Determine the required blow counts

Steps

1. Compute the CSR

Considering the effective overburden stress effect, a cyclic stress ratio (CSR) is defined as follows:

$$\text{CSR} = \frac{\tau_{\text{cyc}}}{\sigma'_{z0}} = 0.65 r_d \left(\frac{\sigma_{z0}}{\sigma'_{z0}}\right)\left(\frac{a_{\max}}{g}\right) \qquad (2.120)$$

where σ'_{z0} = effective overburden stress at a depth of z
$a_{\max}$ = maximum ground acceleration
r_d = stress reduction factor

The maximum acceleration is given as **0.3** g for a 475 year event

Asume water table (Dw) is at **50** ft 15.2439 m

Solve for stress at 1 m intervals to a depth of 20 m

The unit weight of soils is assumed to be **120** pcf 18.86538 kN/m3

The reduction factor is given by

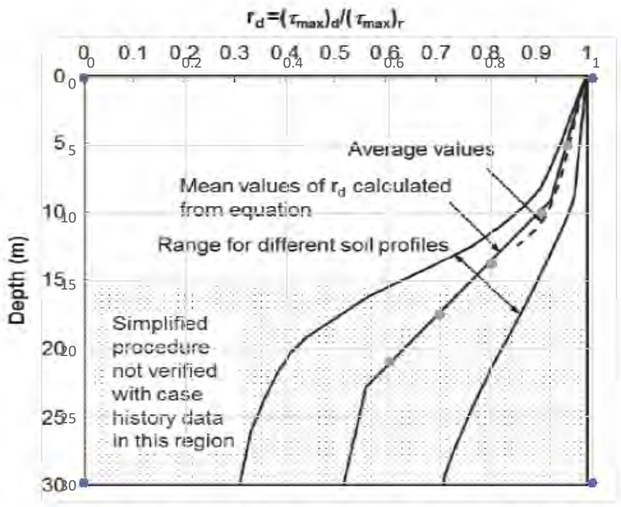


Figure 2.82 Shear stress reduction factor, r_d, versus depth curves developed by Seed and Idriss (1971) with added mean value line (after Youd and Idriss, 1997).

2. Assuming a factor of safety of **1**

compute the required CRR

Correct the CRR value
Magnitude **6.8**
MSF 1.200516

3. Then using the CRR compute the required corrected blow counts from Youd and Idriss, 1997 for clean sand

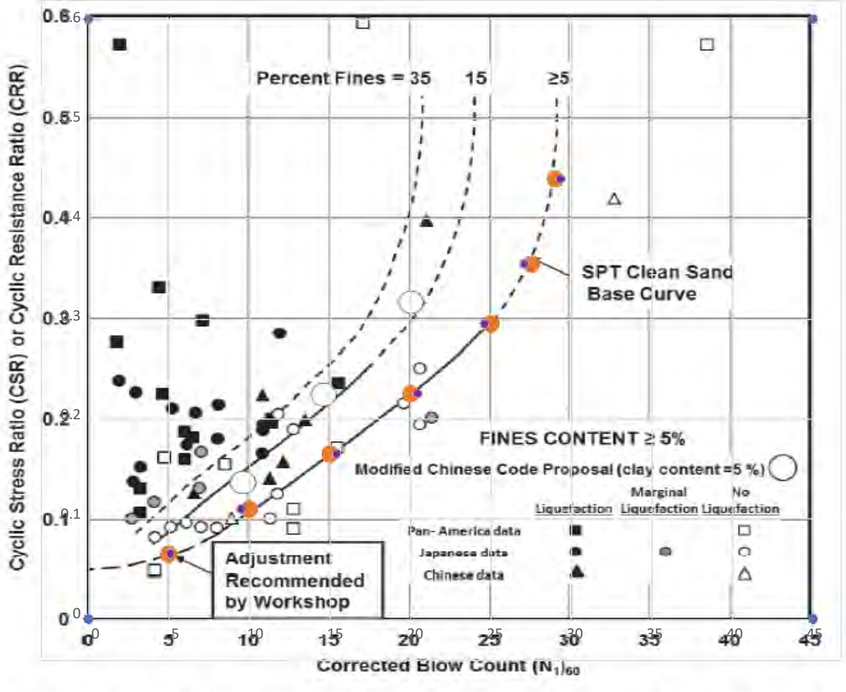


Figure 2.83 Cyclic resistance ratio for clean and silty sand at earthquake magnitude of 7.5 based on SPT data (after Youd and Idriss, 1997).

4. Then compute the N60 values

$$(N_1)_{60} = N_{60}\sqrt{\frac{100}{\sigma'_{z0}}} \qquad (2.32)$$

where

$(N_1)_{60}$ = corrected N_{60} considering the overburden stress
σ'_{z0} = overburden stress at a depth of interest (kPa)

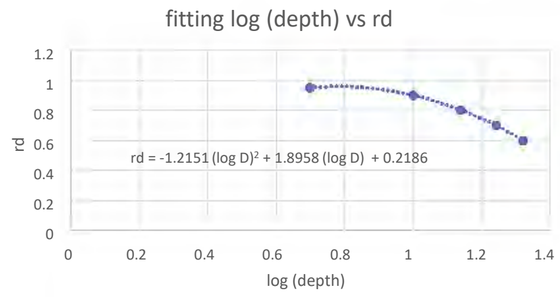
5. Assume that N60 = N

Calculations

Depth m	ft	σ (kN/m2)	u (kN/m2)	σ' (kN/m2)	log (D)	rd	CSR	CRR7.5	log(CRR7.5)	min required (N1)60	N60
1	3.3	18.86538	0	18.86538	0	0.99	0.19305	0.160806	-0.7937	15	7
2	6.6	37.73077	0	37.73077	0.30103	0.98	0.1911	0.159182	-0.79811	15	9
3	9.8	56.59615	0	56.59615	0.477121	0.95	0.18525	0.154309	-0.81161	14	11
4	13.1	75.46154	0	75.46154	0.60206	0.919577	0.179317	0.149367	-0.82575	14	12
5	16.4	94.32692	0	94.32692	0.69897	0.950108	0.185271	0.154326	-0.81156	14	14
6	19.7	113.1923	0	113.1923	0.778151	0.958113	0.186832	0.155626	-0.80792	15	15
7	23.0	132.0577	0	132.0577	0.845098	0.952995	0.185834	0.154795	-0.81024	14	17
8	26.2	150.9231	0	150.9231	0.90309	0.939759	0.183253	0.152645	-0.81632	14	17
9	29.5	169.7885	0	169.7885	0.954243	0.9213	0.179653	0.149647	-0.82493	14	18
10	32.8	188.6538	0	188.6538	1	0.8994	0.175383	0.14609	-0.83538	14	19
11	36.1	207.5192	0	207.5192	1.041393	0.875206	0.170665	0.14216	-0.84722	13	19
12	39.4	226.3846	0	226.3846	1.079181	0.849484	0.165649	0.137982	-0.86018	13	19
13	42.6	245.25	0	245.25	1.113943	0.822757	0.160438	0.133641	-0.87406	12	19
14	45.9	264.1154	0	264.1154	1.146128	0.795394	0.155102	0.129196	-0.88875	12	19
15	49.2	282.9808	0	282.9808	1.176091	0.767657	0.149693	0.124691	-0.90417	11	19
16	52.5	301.8462	7.417317	294.4288	1.20412	0.739736	0.147882	0.123182	-0.90945	11	19
17	55.8	320.7115	17.22732	303.4842	1.230449	0.71177	0.146674	0.122176	-0.91302	11	19
18	59.0	339.5769	27.03732	312.5396	1.255273	0.683859	0.144889	0.120689	-0.91833	11	19
19	62.3	358.4423	36.84732	321.595	1.278754	0.65608	0.142594	0.118777	-0.92527	11	19
20	65.6	377.3077	46.65732	330.6504	1.30103	0.628488	0.139849	0.11649	-0.93371	10	19

0	0
1	0
0	30
1	30

rd	depth	log (Depth)	rd	fit
0.6	21	1.322219	0.6	0.601123
0.7	17.5	1.243038	0.7	0.697802
0.8	13.75	1.138303	0.8	0.802279
0.9	10	1	0.9	0.8994
0.95	5	0.69897	0.95	0.950108
	4	0.60206		0.919577
	3	0.477121		0.846538
	2	0.30103		0.679191
	1	0		0.2186



With CSR and CRR, the factor of safety against liquefaction can be calculated as follows:

$$\text{FS} = \frac{\text{CRR}_M}{\text{CSR}} = \frac{\text{MSF} \cdot \text{CRR}_{M=7.5}}{\text{CSR}} \qquad (2.123)$$

where CRR_M is the cyclic resistance ratio at a specific magnitude of earthquake.

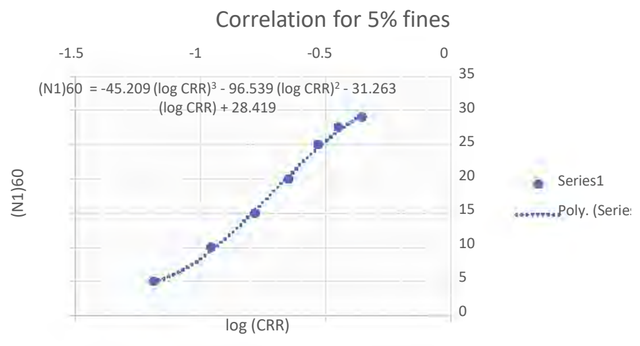
correct the magnitude effect (Idriss, 1999):

$$\text{MSF} = 6.9 \exp\left(-\frac{M_w}{4}\right) - 0.06, \quad \text{for} \quad M_w > 5.2 \qquad (2.121)$$

$$\text{MSF} = 1.82, \quad \text{for} \quad M_w < 5.2 \qquad (2.122)$$

where M_w is the moment magnitude of the earthquake.

(N1)60	log (CRR)	CRR	fit
5	-1.18709	0.065	5.116752
10	-0.95861	0.11	9.499757
15	-0.78252	0.165	15.43125
20	-0.64782	0.225	20.44832
25	-0.53018	0.295	24.5953
27.5	-0.44977	0.355	27.0643
29	-0.35655	0.44	29.34229



ATTACHMENT C-4 - Reservoir Surface Erosion Evaluation

Analysis of surface erosion in Santiago Creek Reservoirs

Overview

In addition to steep slopes and slides, erosion due to surface runoff is an issue in the southwest corner of the Smith Basin and southeast corner of the Bond Basin. Images supporting this narrative are in Attachment A. An area of surface erosion concern is the slope at the corner of Bond and Hewes in the Bond Pit.

Bond and Hewes

Description of Erosion

In 2003 there appears to be some erosion at the corner of Hewes and Bond.

By October 2007 the drainage pipe for surface drainage appears to have been extended.

By April 2018 it appears that the drainage pipe broke and erosion can be seen to begin. In June 2018 the water is lower and shows the extent of the erosion.

By Aug 2021 the pipe appears to have broken further up the slope and the erosion has significantly progressed.

There is a small cut that runs at the bottom of the slope parallel to Hewes. There has been no advancement of this erosion since 2003.

Mitigation

Structurally the slope requires some reconstruction. A well-constructed drainage pipe can be added on top of the reconstructed slope. The erosion at the toe of the Hewes slope will be addressed during the slope stabilization along Line FI (Section D-D)

Smith Basin

Description of Erosion

A large erosional feature is present in the southwest corner of the Smith Basin. The erosional feature is seen in Dec 2003.

From Dec 2003 through Nov 2009, Nov 2020, through Aug 2021 the erosional feature appears to be consistent, not increasing in depth or width.

Mitigation

If surface water cannot be directed away from the location of the existing erosion, to address this feature the slope should be stripped, graded and a layer of rip rap installed to address future erosion. If surface water can be directed away from the erosion, which may be true given the lack of progression of the erosion from 2003-2021, then the slope should be stripped and graded.

Attachment A





N

0 30 60 120 Feet

BondErosion

Dec 2003

RGB

Red: Band_1

Green: Band_2

Blue: Band_3

Extent

12/15/2003

6/15/2018

8/15/2021





N

0 30 60 120 Feet

Bond Erosion

Oct 2007

RGB

Red: Band_1

Green: Band_2

Blue: Band_3

Extent

12/15/2003

6/15/2018

8/15/2021





N

0 30 60 120 Feet

Bond Erosion

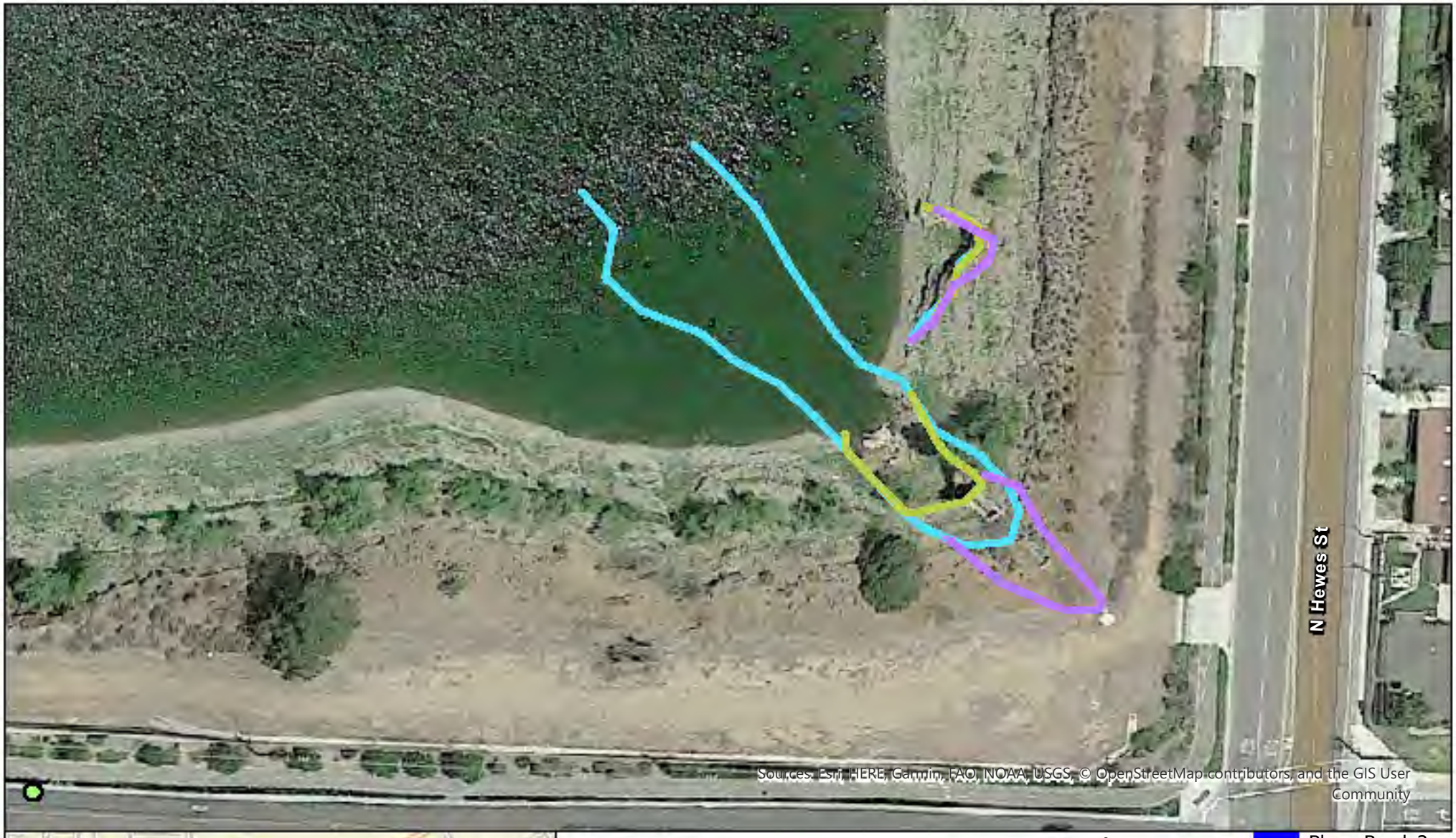
Apr 2018

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

Extent

- 12/15/2003
- 6/15/2018
- 8/15/2021





N

0 30 60 120 Feet

Bond Erosion

Jun 2018

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

Extent

- 12/15/2003
- 6/15/2018
- 8/15/2021





N

0 30 60 120 Feet

Bond Erosion

Aug 2021

RGB

Red: Band_1

Green: Band_2

Blue: Band_3

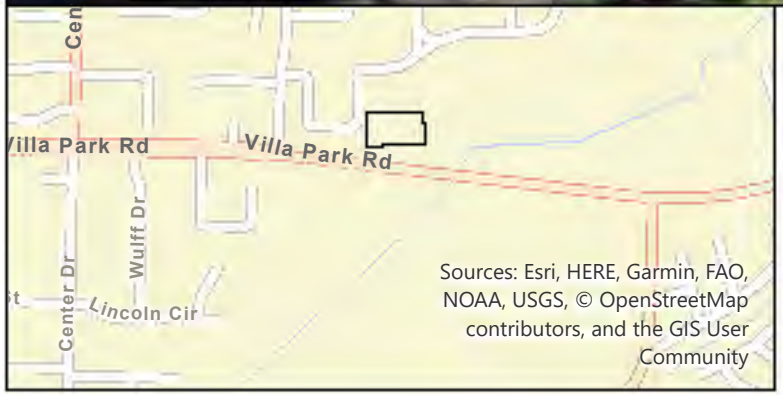
Extent

12/15/2003

6/15/2018

8/15/2021





N

0 15 30 60 Feet

SmithErosion

Limits

Dec 2003

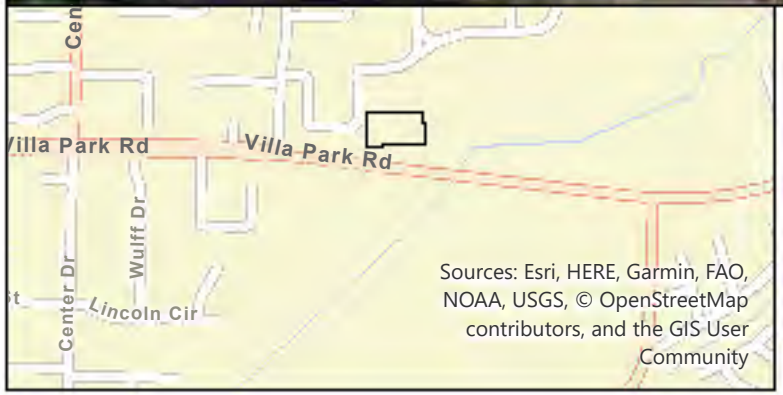
RGB

Red: Band_1

Green: Band_2

Blue: Band_3





N

0 15 30 60 Feet

SmithErosion

Limits

Nov 2009

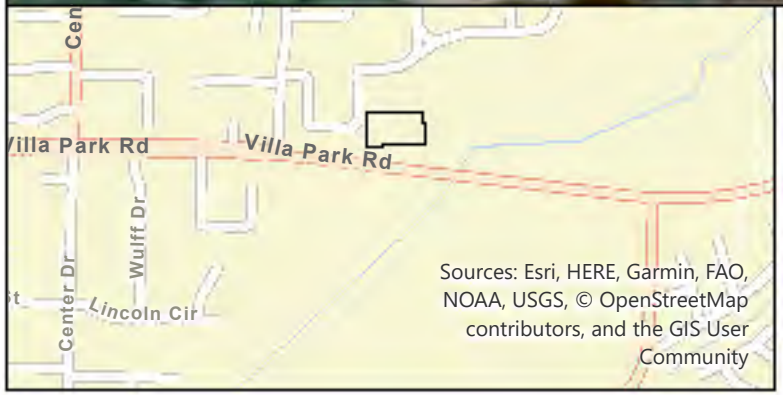
RGB

Red: Band_1

Green: Band_2

Blue: Band_3





N

0 15 30 60 Feet

SmithErosion

Limits

Nov 2020

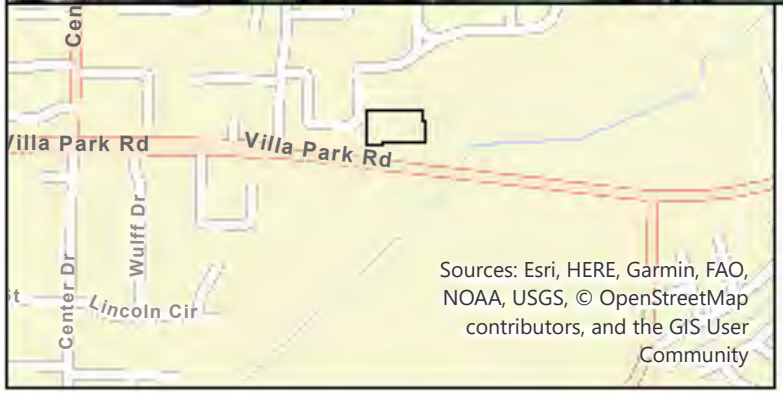
RGB

Red: Band_1

Green: Band_2

Blue: Band_3





N

0 15 30 60 Feet

SmithErosion

Limits

Aug 2021

RGB

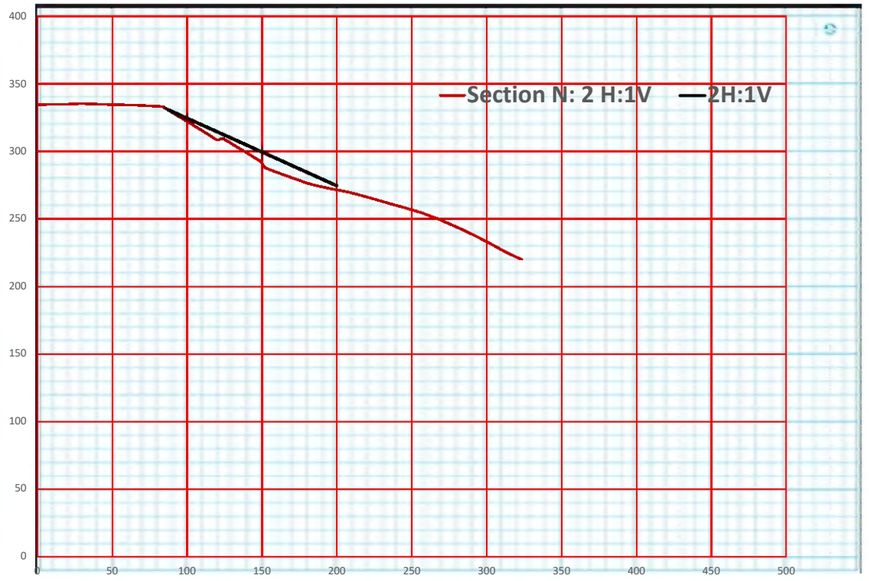
Red: Band_1

Green: Band_2

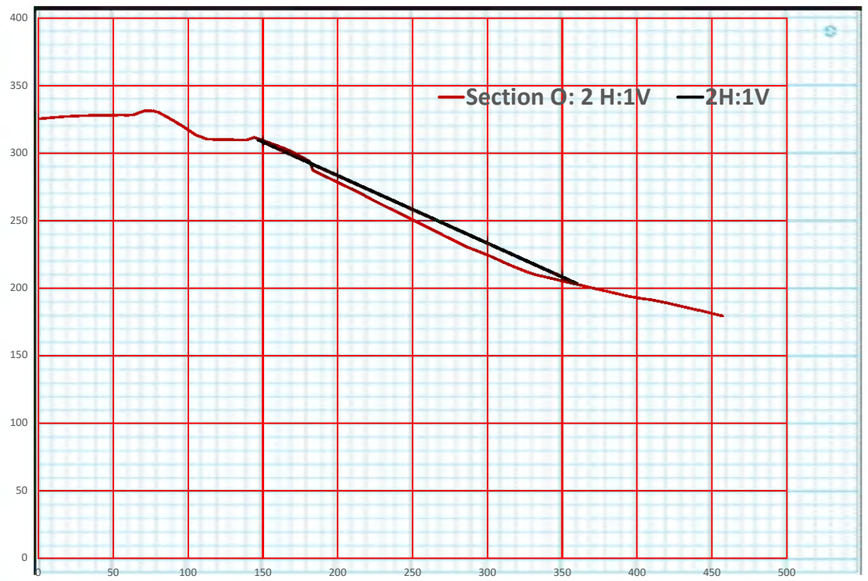
Blue: Band_3

ATTACHMENT C-5 - Evaluation of other slope in the reservoir area for instability

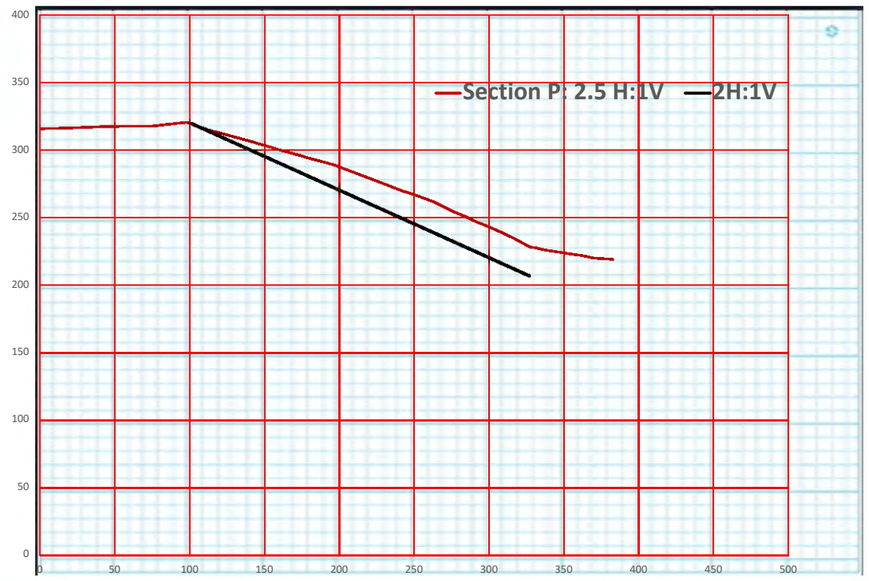
The purpose of this analysis is to evaluate other sections not evaluated in the DM18 report. To do this, sections were chosen and compared with a baseline 2H:1V slope to see if slope stabiity issues might arrise. Based on this analysis, though several sections had portions that were steeper than 2H:1V, over the entire slope all sections were determined to have slopes at or near 2H:1V. An exeption is Section T (1.7H:1V) , which is an area of erosion on the southwest corner of the Smith Basin. Section M has a steep portion but on average the slope is 2H:1V and there is a wide bench before reaching Villa Park road. So any sloughing at Section M should have low consequences.



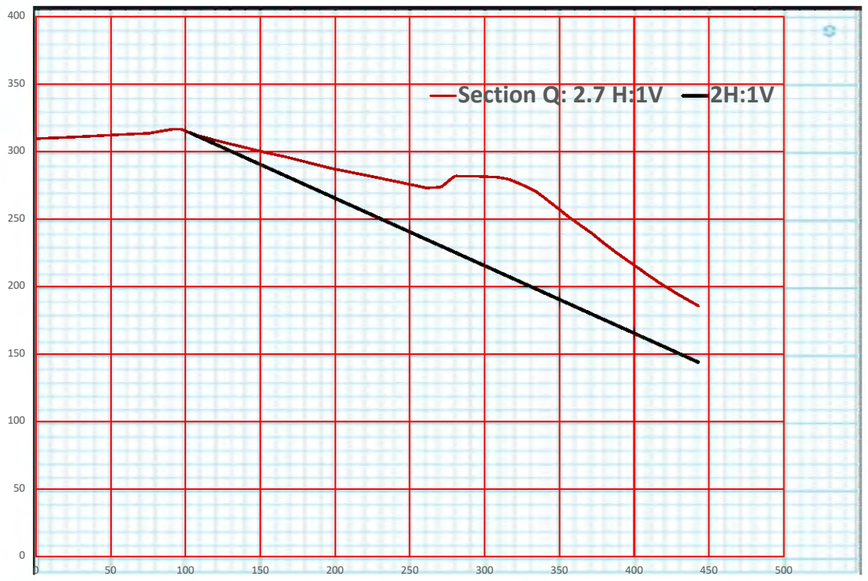
	87	331		87	331		Section N	
	200	274.5		200	274.5	slope	2	Section N: 2 H:1V
dx	113		dx	113				



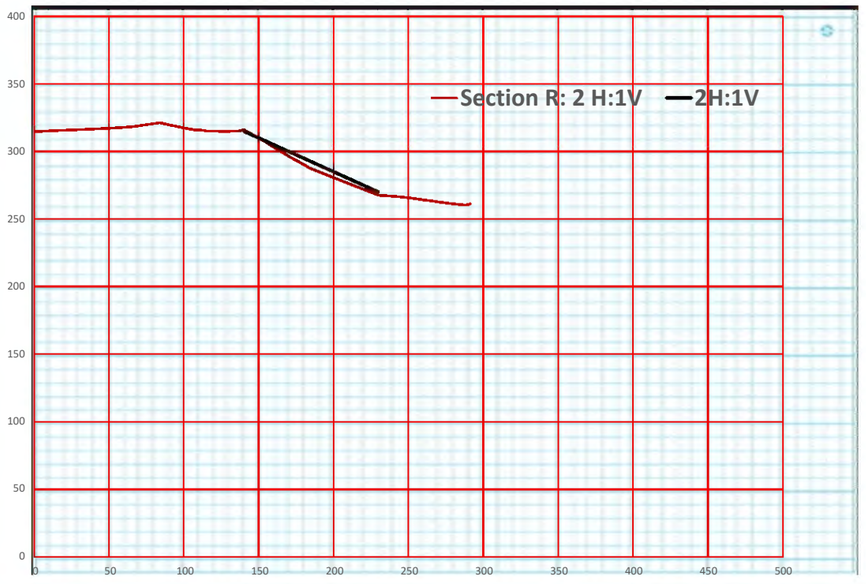
	146.5	310		146.5	310		Section O	
	360	203.25		360	203.25	slope	2	Section O: 2 H:1V
dx	213.5		dx	213.5				



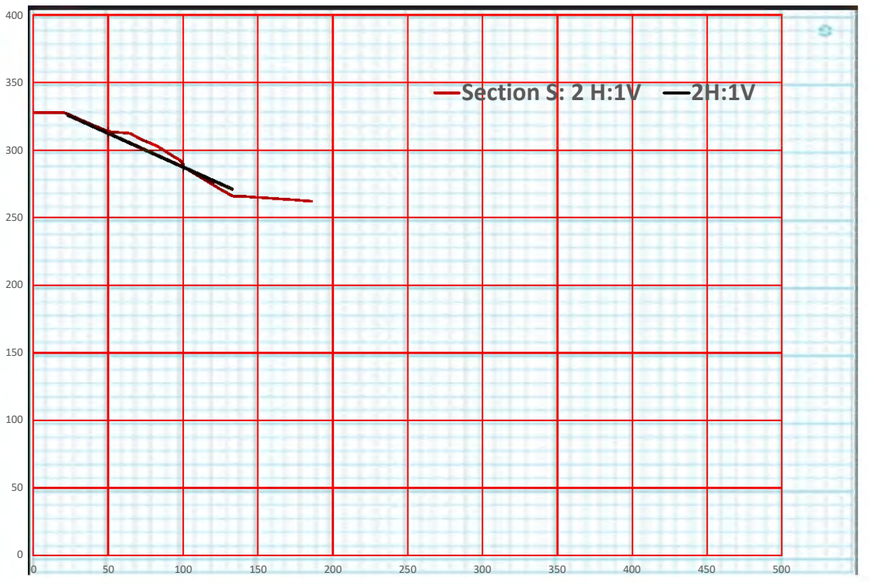
	101	320		101	320		Section P	
	327	207		327	229	slope	2.5	Section P: 2.5 H:1V
dx	226		dx	226				



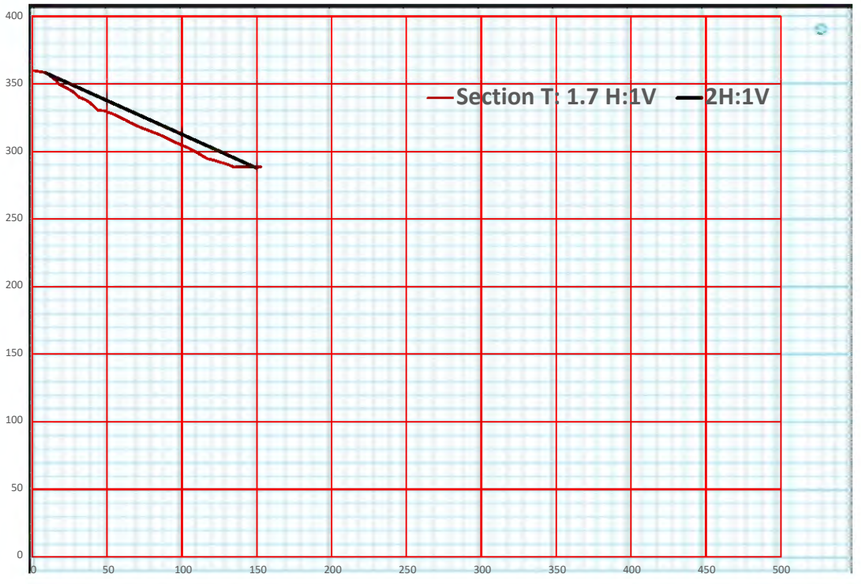
	103	314		103	314		Section Q	
	443	144		443	186	slope	2.7	Section Q: 2.7 H:1V
dx	340		dx	340				



	140	315		140	315		Section R
	230	270		230	270	slope	2 Section R: 2 H:1V
dx	90		dx	90			

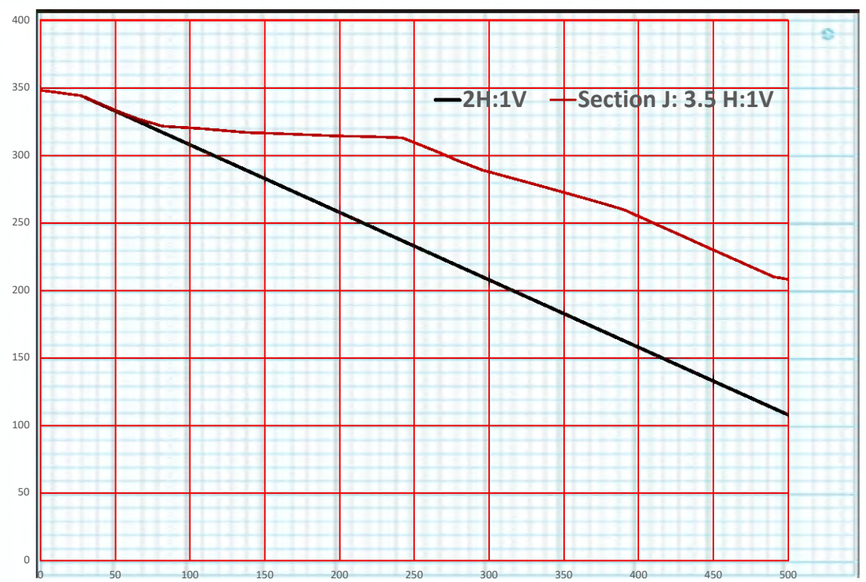


	23	326		23	326		Section S
	133	271		133	271	slope	2 Section S: 2 H:1V
dx	110		dx	110			



	9.4	358		9.4	358		Section T
	150	287.7		117	294	slope	1.7 Section T: 1.7 H:1V
dx	140.6		dx	107.6			

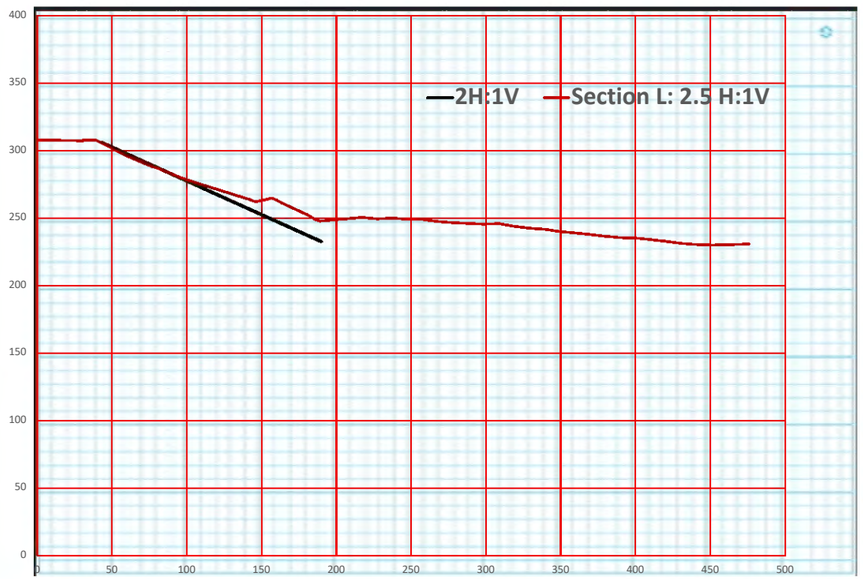




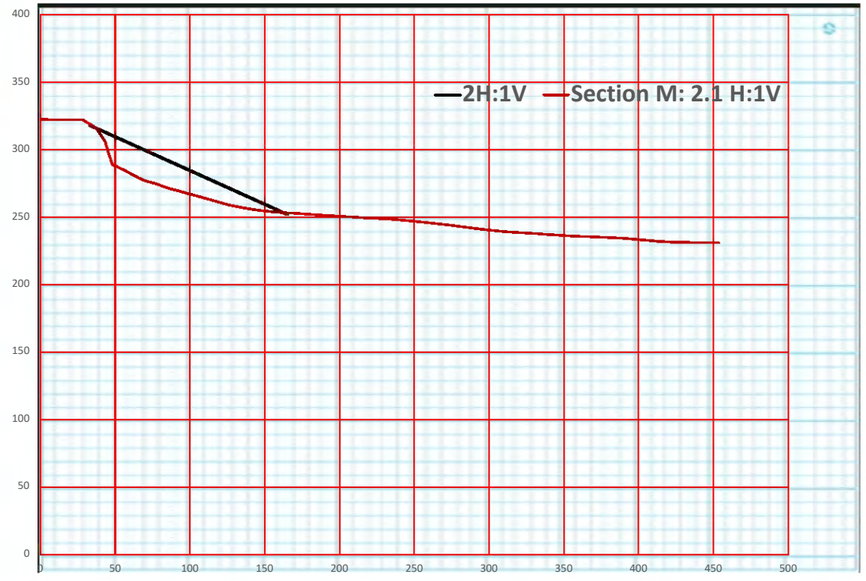
	29.5	343		29.5	343		Section J	
	500	107.75		500	208	slope	3.5	Section J: 3.5 H:1V
dx	470.5		dx	470.5				



	91	308		91	308		Section K	
	250	228.5		250	230	slope	2	Section K: 2 H:1V
dx	159		dx	159				



	43	306		43	306		Section L	
	190	232.5		190	248	slope	2.5	Section L: 2.5 H:1V
dx	147		dx	147				



	33	318		33	318		Section M	
	165	252		165	255	slope	2.1	Section M: 2.1 H:1V
dx	132		dx	132				

ATTACHMENT C-6 - Reservoir Cut/Fill Analysis

Cut Fill Analysis

I		ft2/per foot			Vol		cost	
Line I (Villa Park Slide)	Cut	Fill	Net	ft3	cy	$/cy	total	Notes
2.44H:1V	716.3118	0	-716.312	-730720	-27,064	5	135,318.47	would eliminate existing road and monitoring wells
2H:1V cut	187.67	286.4	98.73	100715.9	3,730	30	111,907	would eliminate existing road and monitoring wells
2H:1V fill	0	1486.4	1486.4	1516298	56,159	30	1,684,775	Will likely be reduced with more refined quantity analysis

		ft2/per foot			Vol		cost	
H	Cut	Fill	Net	ft3	cy	$/cy	total	
2H:1V cut	275.3	0	-275.3	-83360.3	-3,087	5	15,437	
DM18 cut/gabion	1602.9	0	-1602.9	-485355	-17,976	5	89,881	Does not include gabion cost

G no changes proposed

		ft2/per foot			Vol		cost	
FI	Cut	Fill	Net	ft3	cy	$/cy	total	
2H:1V fill	351.9	6885.3	6533.4	9009438	333,683	30	10,010,487	
DM18 cut tie back	5250	0	-5250	-7239653	-268,135	5	1,340,676	Does not include tie back wall cost

		ft2/per foot			Vol	cost		
EI	Cut	Fill	Net	ft3	cy	$/cy	total	
2H:1V cut	2078	0	-2078	-695749	-25,768	5	128,842	
DM18 cut/tie back	1635	0	-1635	-547425	-20,275	5	101,375	Does not include tie back wall cost

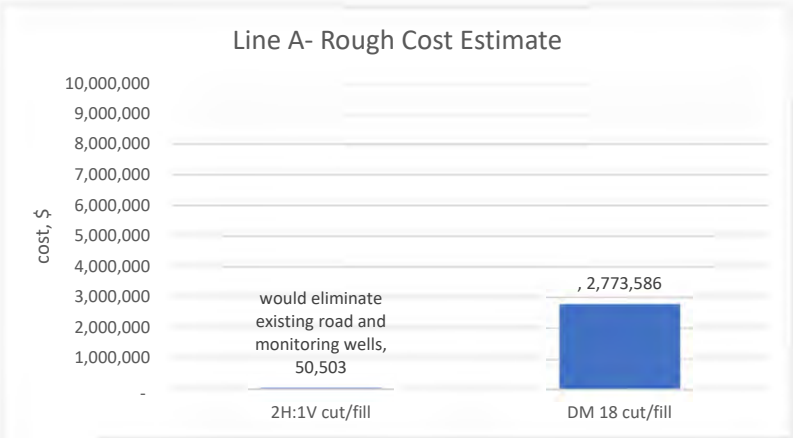
D no changes proposed

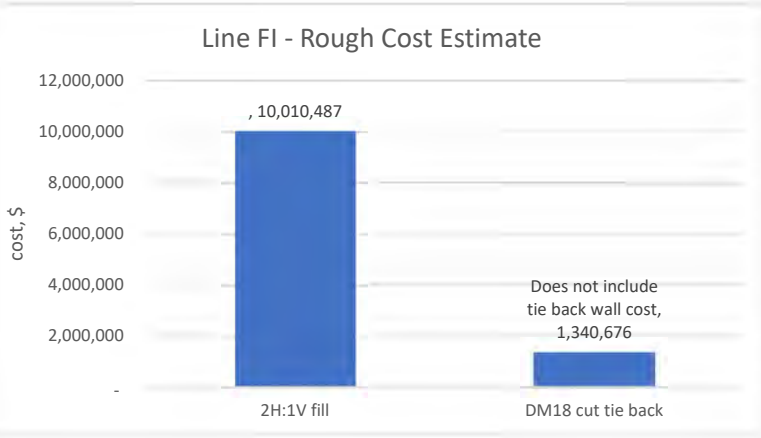
C no analysis

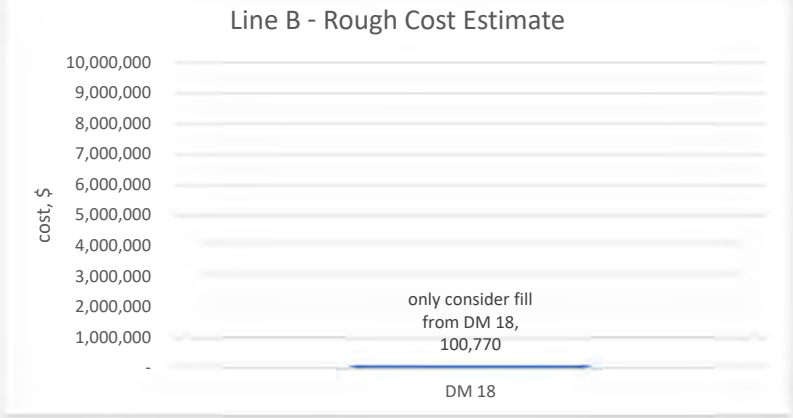
		ft2/per foot			Vol		cost	
B	Cut	Fill	Net	ft3	cy	$/cy	total	
DM 18	0	154	154	90692.8	3,359	30	100,770	only consider fill from DM 18

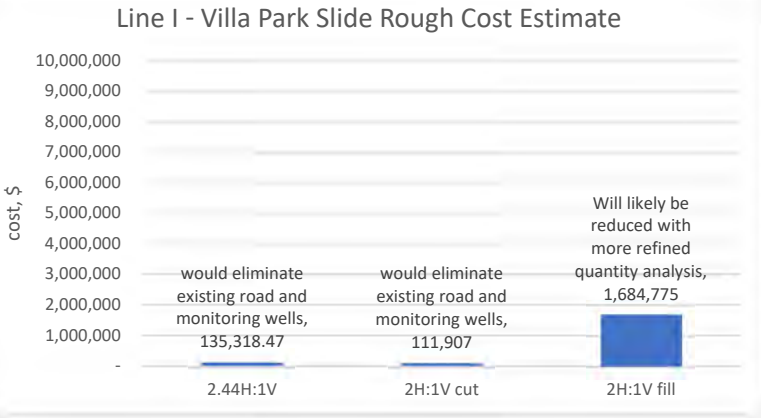
		ft2/per foot			Vol		cost	
A	Cut	Fill	Net	ft3	cy	$/cy	total	
2H:1V cut/fill	1041	763.5	-277.5	-272718	-10,101	5	50,503	would eliminate existing road and monitoring wells
DM 18 cut/fill	260	2800	2540	2496228	92,453	30	2,773,586	

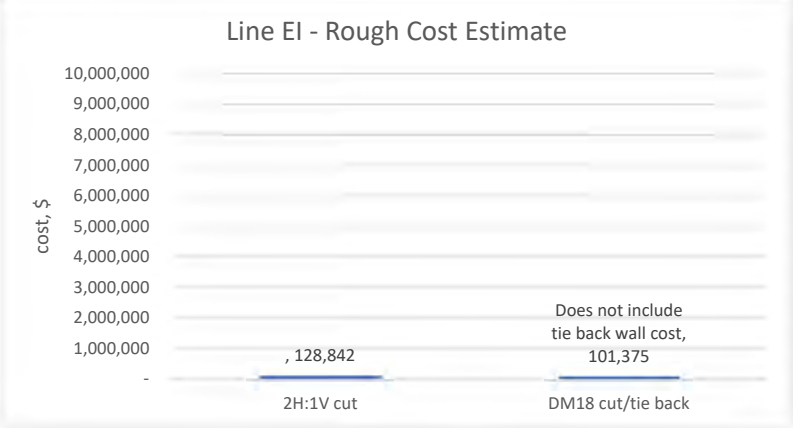
Line	length ft)
A	982.7668
B	588.9143
C	751.0791
D	861.7443
EI	334.8167
FI	1378.982
G	1753.858
H	302.7981
I	1020.114

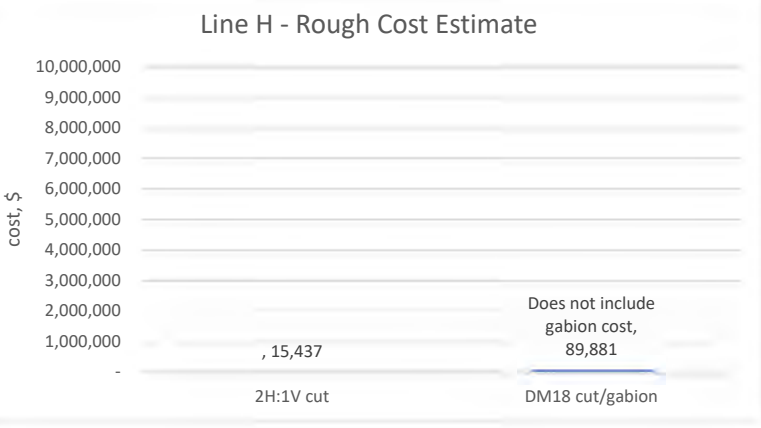

Line A- Rough Cost Estimate
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
cost, $
would eliminate existing road and monitoring wells, 50,503
, 2,773,586
2H:1V cut/fill
DM 18 cut/fill


Line FI - Rough Cost Estimate
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
-
cost, $
, 10,010,487
Does not include tie back wall cost, 1,340,676
2H:1V fill
DM18 cut tie back


Line B - Rough Cost Estimate
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
cost, $
only consider fill from DM 18, 100,770
DM 18

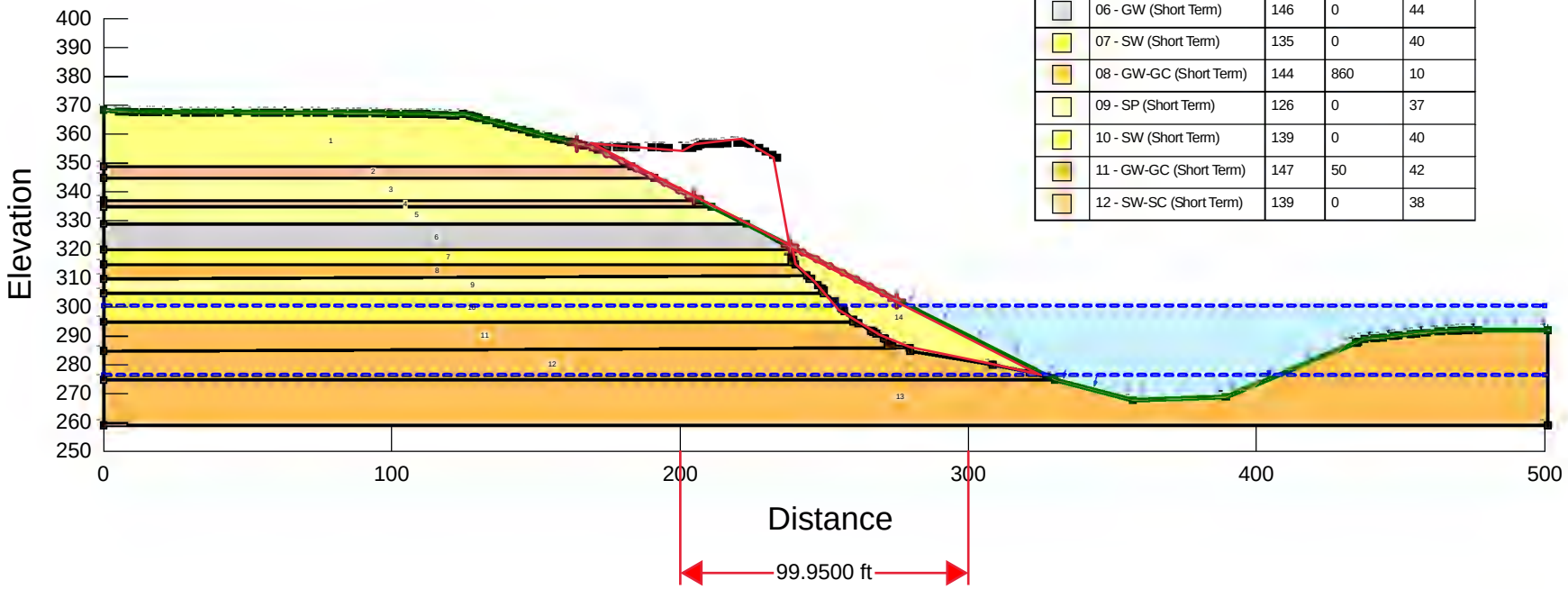

Line I - Villa Park Slide Rough Cost Estimate
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
cost, $
would eliminate existing road and monitoring wells, 135,318.47
would eliminate existing road and monitoring wells, 111,907
Will likely be reduced with more refined quantity analysis, 1,684,775
2.44H:1V
2H:1V cut
2H:1V fill


Line EI - Rough Cost Estimate
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
cost, $
, 128,842
Does not include tie back wall cost, 101,375
2H:1V cut
DM18 cut/tie back


Line H - Rough Cost Estimate
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
cost, $
, 15,437
Does not include gabion cost, 89,881
2H:1V cut
DM18 cut/gabion

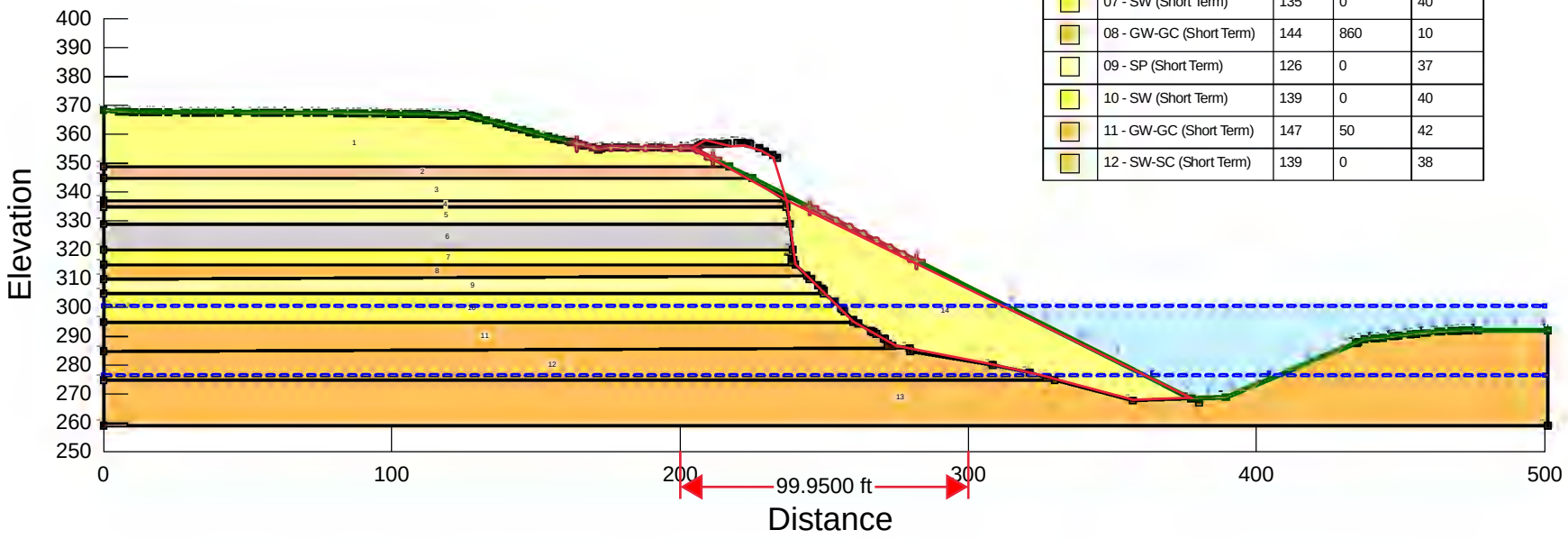

Santiago Blvd
Center Dr
Via Coria
Lemon St
Sterling Ave
Patrician Dr
Santiago Creek
B
B-B
A
A-A
Cannon St
Villa Park Rd
I
Villa Park Rd
Wulff Dr
Center Dr
Lincoln St
Lincoln Cir
C
C-C
Francisco Dr
Center Dr
N Hewes St
E Valencia Dr
N Linda Vista St
E Elsinore Ave
Vida Dr
D
H-H
G-G
N Hewes St
E Muir Dr
Fernando Cir
Collins Ave
E Stetson Ln
N Big Sky Ln
S Rancho Santiago Blvd
D-D
FI
H
F-F
N Prospect St
E-E
G
N Hewes St
E Blue Jay Ave
E Lomita Ave
E White Dove Ave
E Bond Ave
E Bond Ave
E Charter Oak Dr

Line A - 2H:1V cut/fill



Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	01 - SW (Short Term)	135	0	40
	02 - GC (Short Term)	144	0	38
	03 - SW (Short Term)	135	0	40
	04 - SM (Short Term)	126	280	15
	05 - SW (Short Term)	135	0	40
	06 - GW (Short Term)	146	0	44
	07 - SW (Short Term)	135	0	40
	08 - GW-GC (Short Term)	144	860	10
	09 - SP (Short Term)	126	0	37
	10 - SW (Short Term)	139	0	40
	11 - GW-GC (Short Term)	147	50	42
	12 - SW-SC (Short Term)	139	0	38

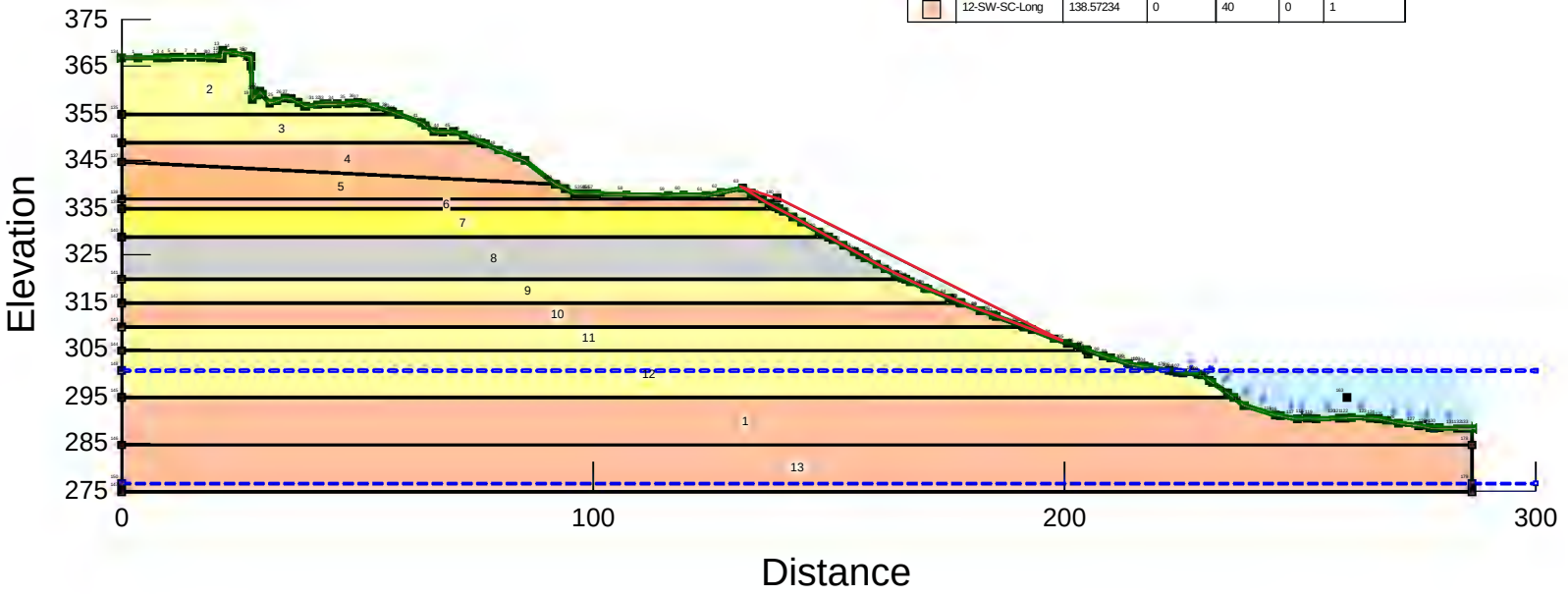
Line A 2H:1V DM18 cut/fill



Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	01 - SW (Short Term)	135	0	40
	02 - GC (Short Term)	144	0	38
	03 - SW (Short Term)	135	0	40
	04 - SM (Short Term)	126	280	15
	05 - SW (Short Term)	135	0	40
	06 - GW (Short Term)	146	0	44
	07 - SW (Short Term)	135	0	40
	08 - GW-GC (Short Term)	144	860	10
	09 - SP (Short Term)	126	0	37
	10 - SW (Short Term)	139	0	40
	11 - GW-GC (Short Term)	147	50	42
	12 - SW-SC (Short Term)	139	0	38

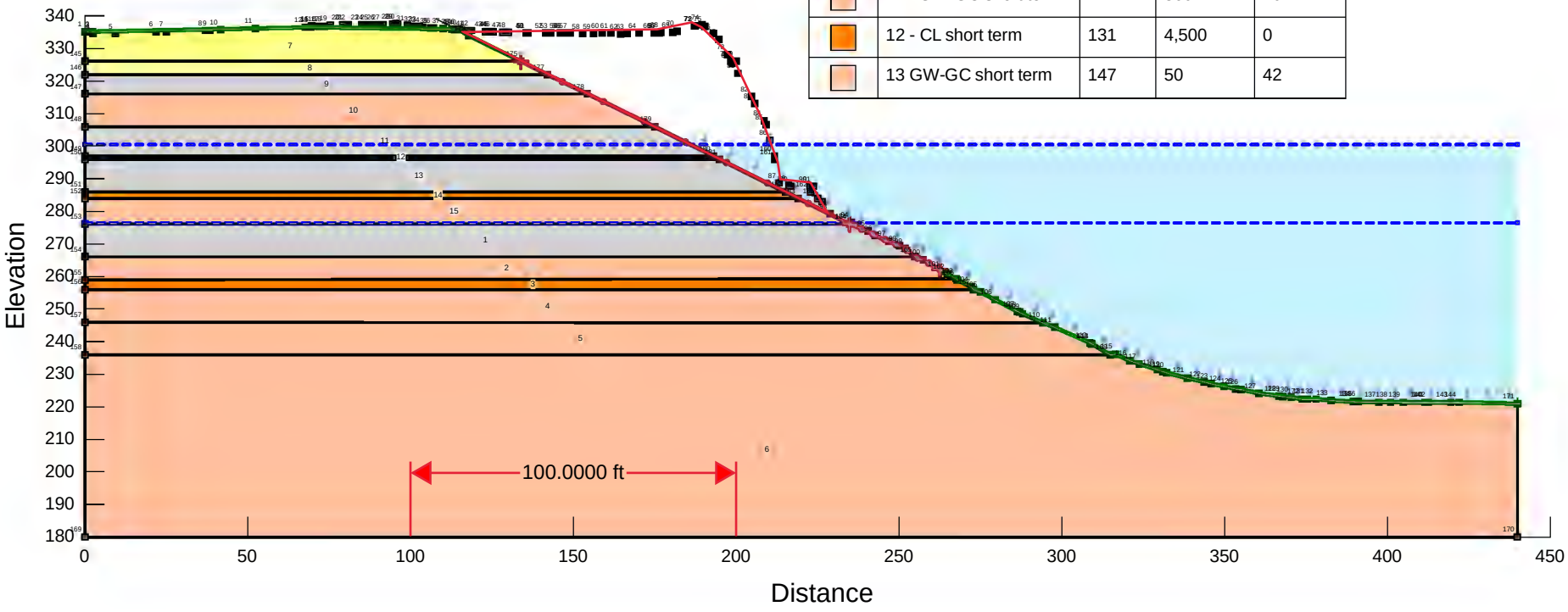
Line B DM-18 2H:1V fill

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	01-SW-Long	135.05379	0	40	0	1
	02-GC-Long	144.01524	0	38	0	1
	03-SW-Long	135.05379	0	40	0	1
	04-SM-Long	126.09234	0	38	0	1
	05-SW-Long	135.05379	0	44	0	1
	06-GW-Long	146.2556	0	44	0	1
	07-SW-Long	135.05379	0	40	0	1
	08-GW-GC-Long	144.01524	0	42	0	1
	09-SP-Long	126.09234	0	37	0	1
	10-SW-Long	138.57234	0	40	0	1
	11-GW-GC-Long	146.59048	0	42	0	1
	12-SW-SC-Long	138.57234	0	40	0	1



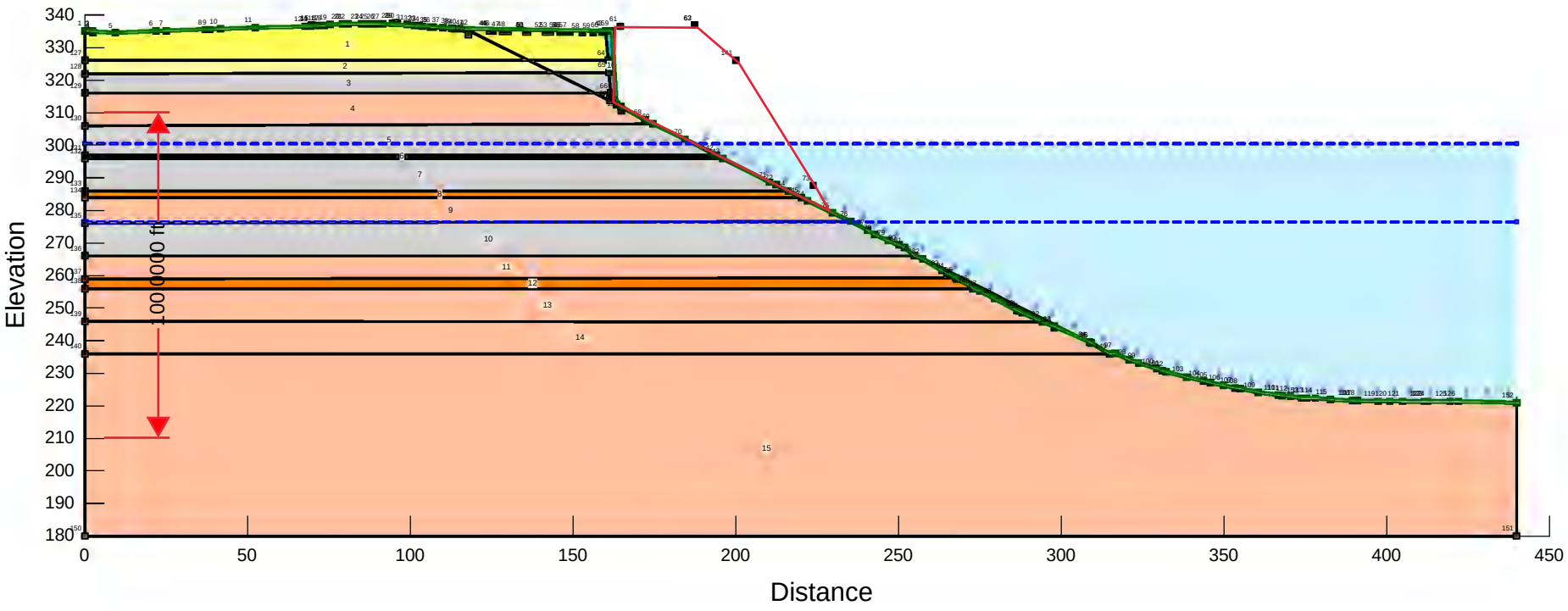
Line EI - 2H:1V Cut

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	01 - SP long term	126	0	37
	02 - SW short term	135	0	40
	03 - GW short term	146	0	44
	04 - GW-GC short term	144	860	10
	05 - GW short term	135	0	44
	06 - CL short term	126	3,000	0
	07 - GW short term	149	0	44
	08 - CL short term	126	2,250	0
	09 - GW-GC short term	147	50	42
	10 - GW short term	149	0	44
	11 - GW-GC short term	147	860	10
	12 - CL short term	131	4,500	0
	13 GW-GC short term	147	50	42



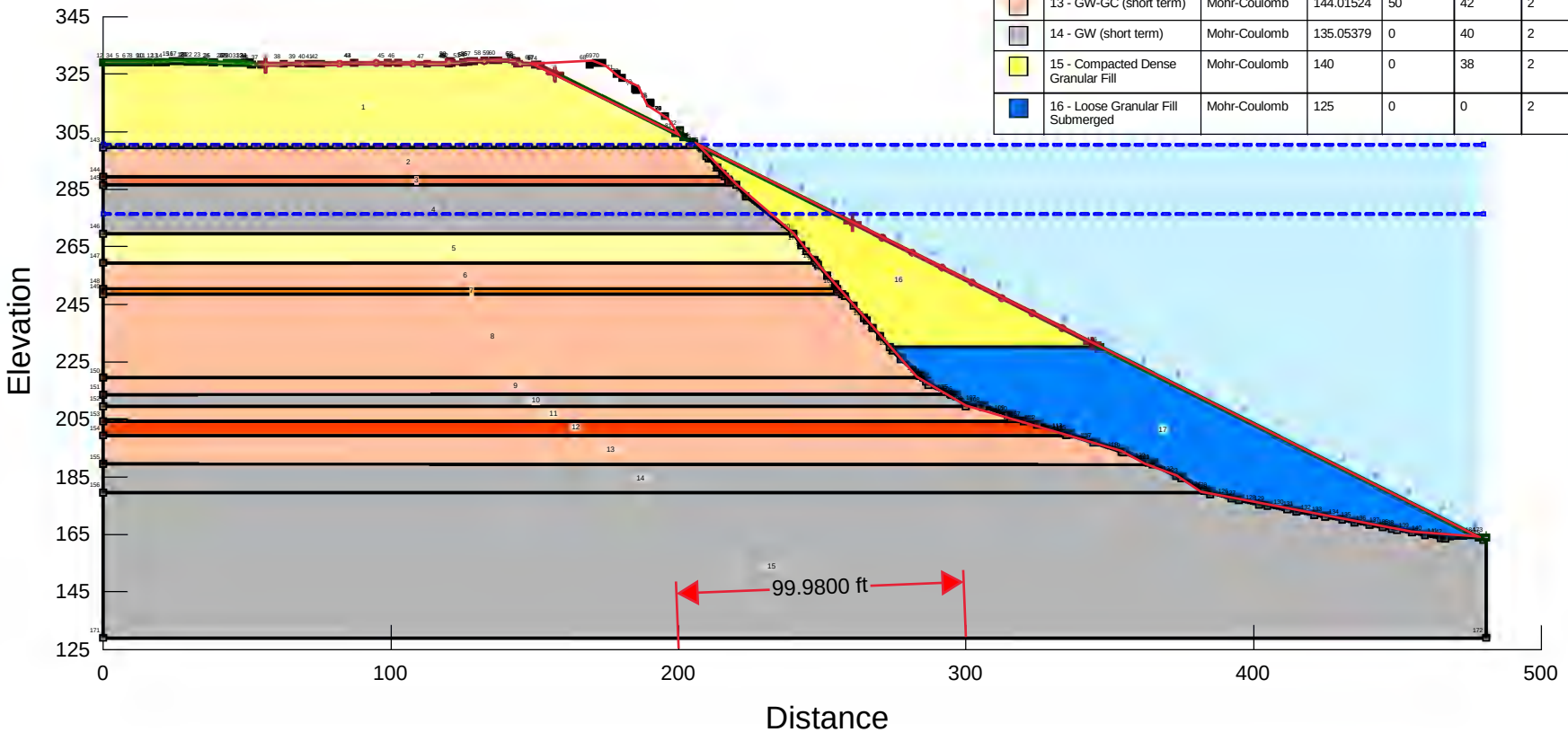
Line EI - DM18

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Line
	01 - SP short term	Mohr-Coulomb	126	0	37	0	1
	02 - SW short term	Mohr-Coulomb	135	0	40	0	1
	03 - GW short term	Mohr-Coulomb	146	0	44	0	1
	04 - GW-GC short term	Mohr-Coulomb	144	860	10	0	1
	05 - GW short term	Mohr-Coulomb	135	0	44	0	1
	06 - CL short term	Mohr-Coulomb	126	3,000	0	0	1
	07 - GW short term	Mohr-Coulomb	149	0	44	0	1
	08 - CL short term	Mohr-Coulomb	126	2,250	0	0	1
	09 - GW-GC short term	Mohr-Coulomb	147	50	42	0	1
	10 - GW short term	Mohr-Coulomb	149	0	44	0	1
	11 - GW-GC short term	Mohr-Coulomb	147	860	10	0	1
	12 - CL short term	Mohr-Coulomb	131	4,500	0	0	1
	13 GW-GC short term	Mohr-Coulomb	147	50	42	0	1
	concrete	High Strength	150				1



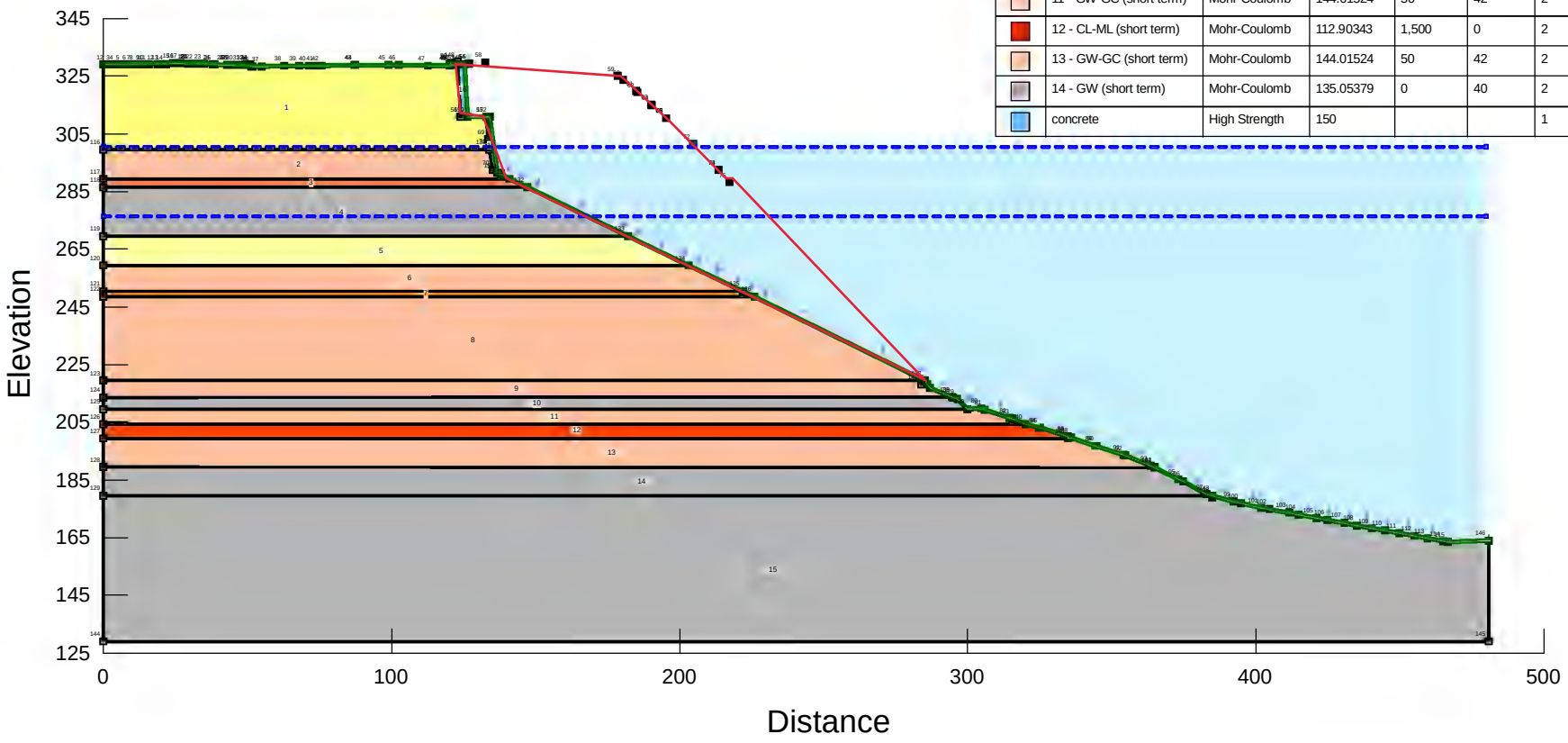
Line FI (Section D-D)
Proposed 2H:1V
Stable

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Line
	01 - SW (short term)	Mohr-Coulomb	135.05379	0	40	2
	02 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	03 - CL (short term)	Mohr-Coulomb	112.90343	1,000	0	2
	04 - GW (short term)	Mohr-Coulomb	135.05379	0	44	2
	05 - SW (short term)	Mohr-Coulomb	135.05379	0	40	2
	06 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	07 - CL (short term)	Mohr-Coulomb	126.90701	4,500	0	2
	08 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	09 - GC (short term)	Mohr-Coulomb	144.01524	2,000	20	2
	10 - GW (short term)	Mohr-Coulomb	135.05379	0	40	2
	11 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	12 - CL-ML (short term)	Mohr-Coulomb	112.90343	1,500	0	2
	13 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	14 - GW (short term)	Mohr-Coulomb	135.05379	0	40	2
	15 - Compacted Dense Granular Fill	Mohr-Coulomb	140	0	38	2
	16 - Loose Granular Fill Submerged	Mohr-Coulomb	125	0	0	2



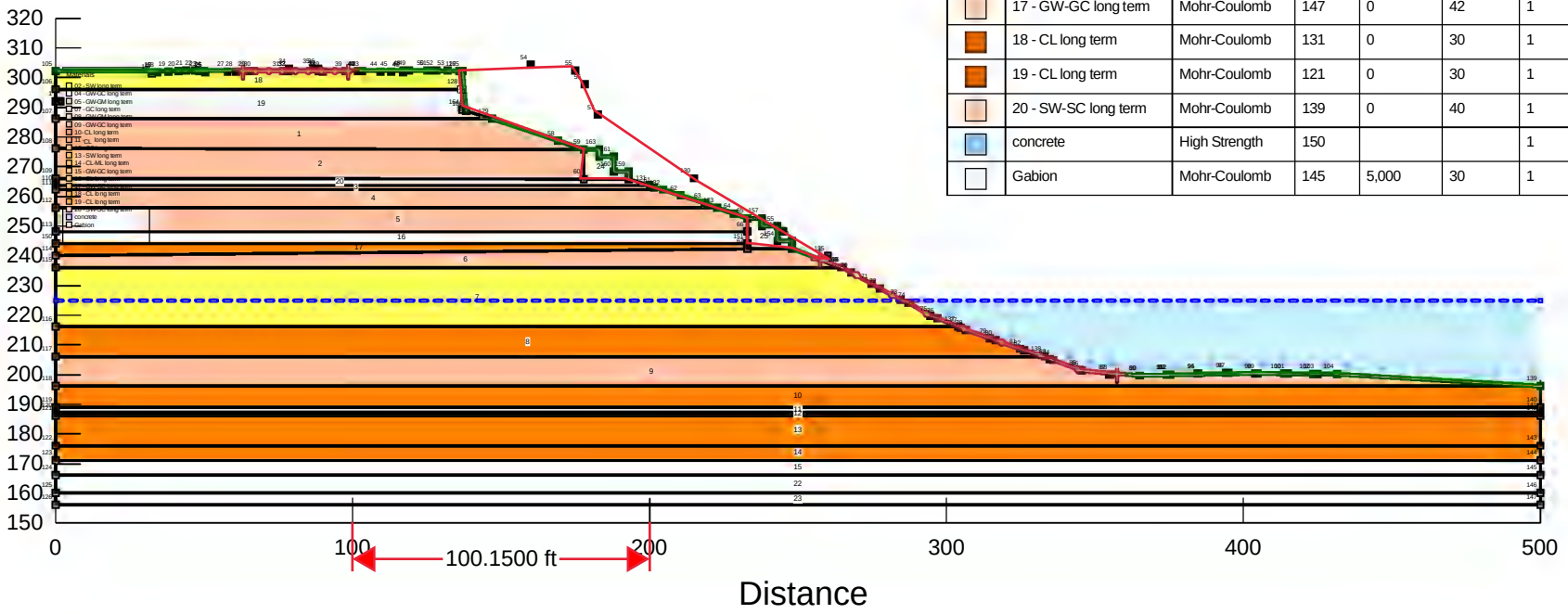
Line FI (Section D-D)
Near Limit of Stability
Existing

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Line
	01 - SW (short term)	Mohr-Coulomb	135.05379	0	40	2
	02 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	03 - CL (short term)	Mohr-Coulomb	112.90343	1,000	0	2
	04 - GW (short term)	Mohr-Coulomb	135.05379	0	44	2
	05 - SW (short term)	Mohr-Coulomb	135.05379	0	40	2
	06 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	07 - CL (short term)	Mohr-Coulomb	126.90701	4,500	0	2
	08 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	09 - GC (short term)	Mohr-Coulomb	144.01524	2,000	20	2
	10 - GW (short term)	Mohr-Coulomb	135.05379	0	40	2
	11 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	12 - CL-ML (short term)	Mohr-Coulomb	112.90343	1,500	0	2
	13 - GW-GC (short term)	Mohr-Coulomb	144.01524	50	42	2
	14 - GW (short term)	Mohr-Coulomb	135.05379	0	40	2
	concrete	High Strength	150			1

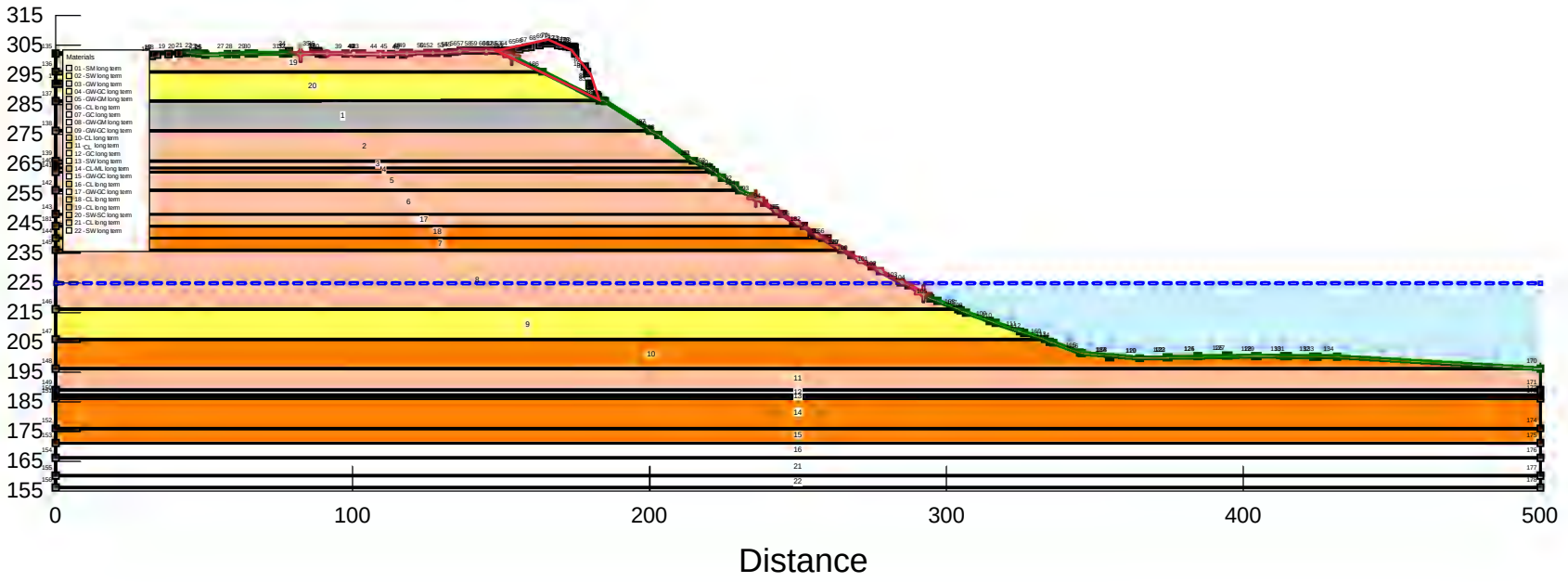


Line H - DM-18

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Line
	02 - SW long term	Mohr-Coulomb	139	0	40	1
	04 - GW-GC long term	Mohr-Coulomb	147	0	42	1
	05 - GW-GM long term	Mohr-Coulomb	147	0	42	1
	07 - GC long term	Mohr-Coulomb	126	0	38	1
	08 - GW-GM long term	Mohr-Coulomb	147	0	42	1
	09 - GW-GC long term	Mohr-Coulomb	147	0	42	1
	10- CL long term	Mohr-Coulomb	126	0	30	1
	11 - CL long term	Mohr-Coulomb	112	0	30	1
	12 - GC long term	Mohr-Coulomb	147	0	38	1
	13 - SW long term	Mohr-Coulomb	139	0	40	1
	14 - CL-ML long term	Mohr-Coulomb	121	0	30	1
	15 - GW-GC long term	Mohr-Coulomb	147	0	42	1
	16 - CL long term	Mohr-Coulomb	121	0	30	1
	17 - GW-GC long term	Mohr-Coulomb	147	0	42	1
	18 - CL long term	Mohr-Coulomb	131	0	30	1
	19 - CL long term	Mohr-Coulomb	121	0	30	1
	20 - SW-SC long term	Mohr-Coulomb	139	0	40	1
	concrete	High Strength	150			1
	Gabion	Mohr-Coulomb	145	5,000	30	1

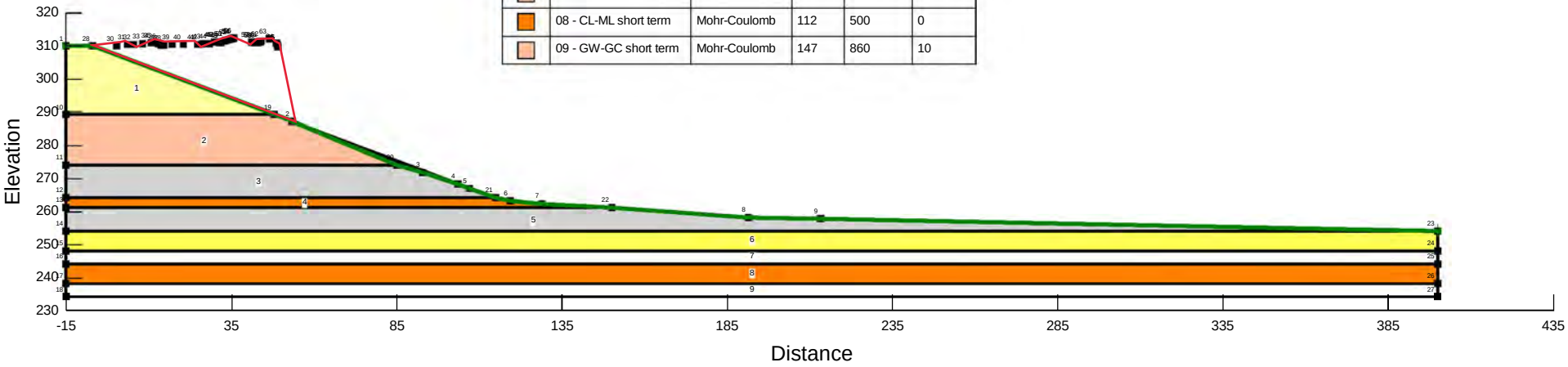


Line H - 2H:1V cut



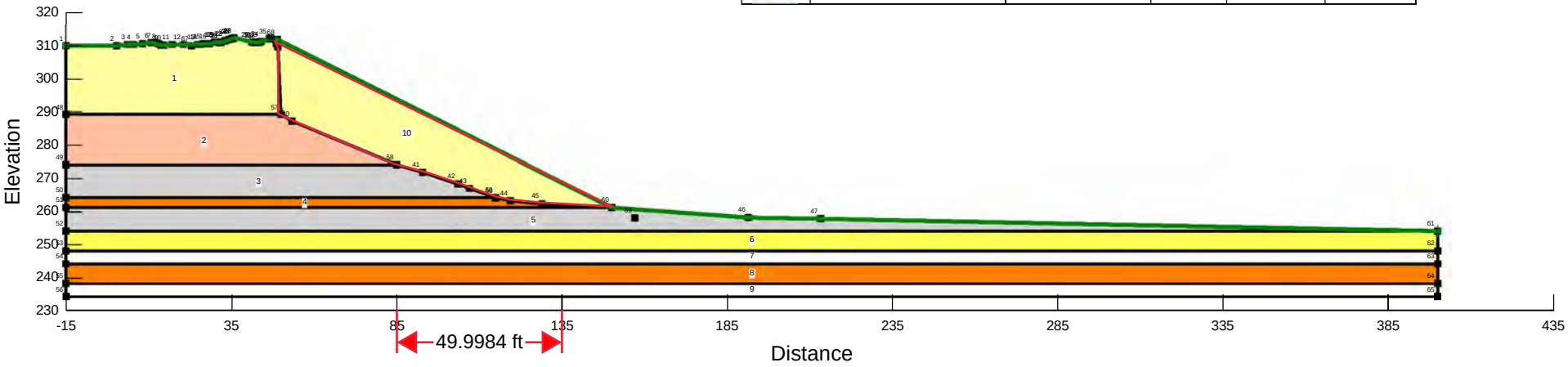
Villa Park 2.44H:1V

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	01 - SW short term	Mohr-Coulomb	139	0	40
	02 - GW-GC short term	Mohr-Coulomb	147	860	10
	03 - GW short term	Mohr-Coulomb	149	0	44
	04 - CL short term	Mohr-Coulomb	112	500	0
	05 - GW short term	Mohr-Coulomb	149	0	44
	06 - SW short term	Mohr-Coulomb	139	0	40
	07 - GC short term	Mohr-Coulomb	126	860	10
	08 - CL-ML short term	Mohr-Coulomb	112	500	0
	09 - GW-GC short term	Mohr-Coulomb	147	860	10



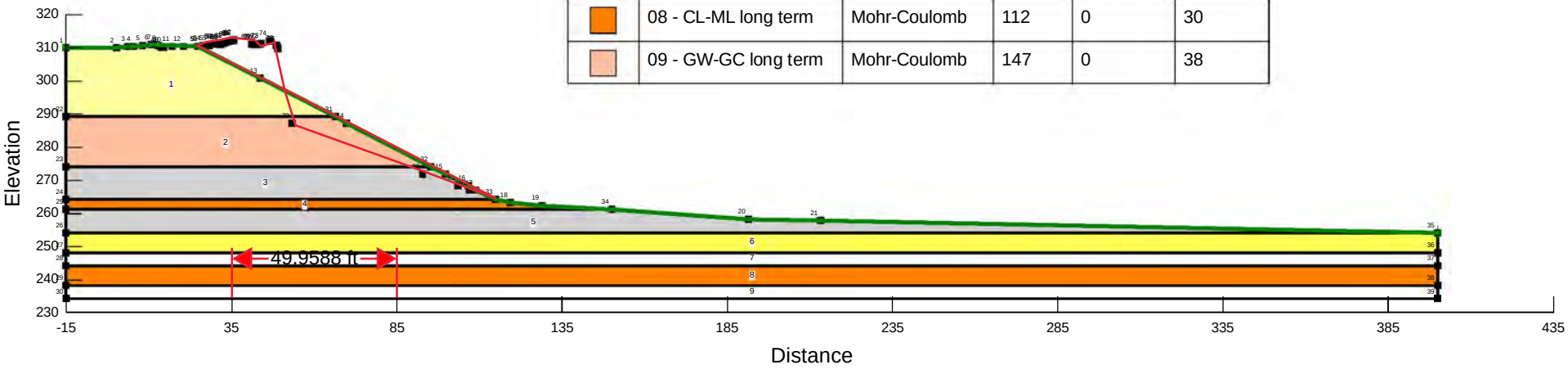
Villa Park 2H:1V fill

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	01 - SW long term	Mohr-Coulomb	139	0	40
	02 - GW-GC long term	Mohr-Coulomb	147	0	38
	03 - GW long term	Mohr-Coulomb	149	0	44
	04 - CL long term	Mohr-Coulomb	112	0	30
	05 - GW long term	Mohr-Coulomb	149	0	44
	06 - SW long term	Mohr-Coulomb	139	0	40
	07 - GC long term	Mohr-Coulomb	126	0	38
	08 - CL-ML long term	Mohr-Coulomb	112	0	30
	09 - GW-GC long term	Mohr-Coulomb	147	0	38



Villa Park 2H:1V

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	01 - SW long term	Mohr-Coulomb	139	0	40
	02 - GW-GC long term	Mohr-Coulomb	147	0	38
	03 - GW long term	Mohr-Coulomb	149	0	44
	04 - CL long term	Mohr-Coulomb	112	0	30
	05 - GW long term	Mohr-Coulomb	149	0	44
	06 - SW long term	Mohr-Coulomb	139	0	40
	07 - GC long term	Mohr-Coulomb	126	0	38
	08 - CL-ML long term	Mohr-Coulomb	112	0	30
	09 - GW-GC long term	Mohr-Coulomb	147	0	38



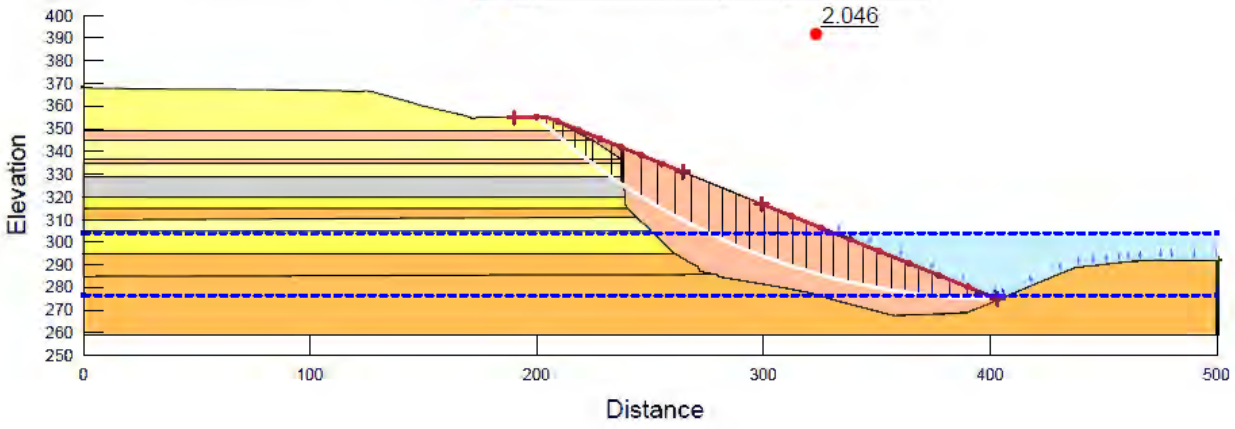
ATTACHMENT C-7 - Global stability analyses in the reservoir area

Attachment C-7 Global Stability Analyses in Reservoir Area

Line A (Section A)

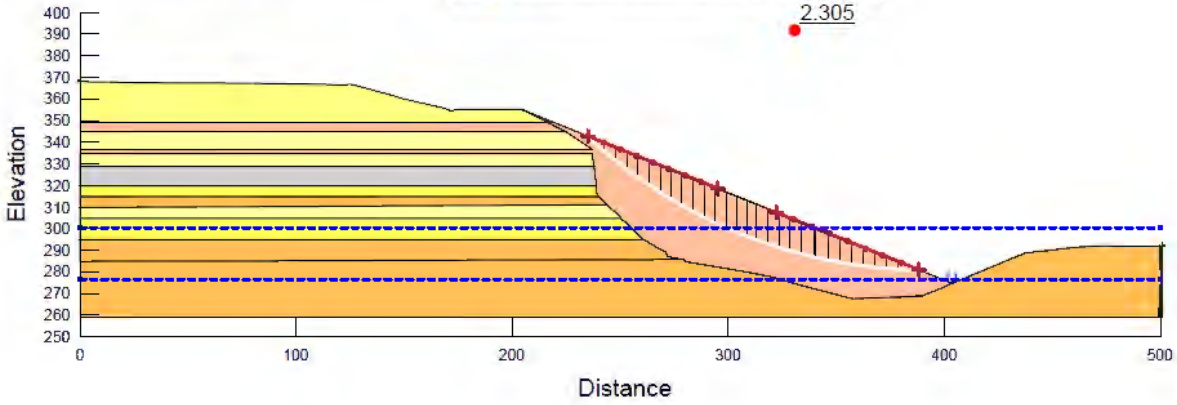
1a. Short Term High Water

Color	Name	Unit Weight (pcf)	Strength Function
	01 - SW (Short Term)	135	sand - drained
	02 - GC (Short Term)	144	gravel - drained
	03 - SW (Short Term)	135	sand - drained
	04 - SM (Short Term)	126	sand - drained
	05 - SW (Short Term)	135	sand - drained
	06 - GW (Short Term)	146	gravel - drained
	07 - SW (Short Term)	135	sand - drained
	08 - GW-GC (Short Term)	144	gravel - drained
	09 - SP (Short Term)	126	sand - drained
	10 - SW (Short Term)	139	sand - drained
	11 - GW-GC (Short Term)	147	gravel - drained
	12 - SW-SC (Short Term)	139	sand - drained



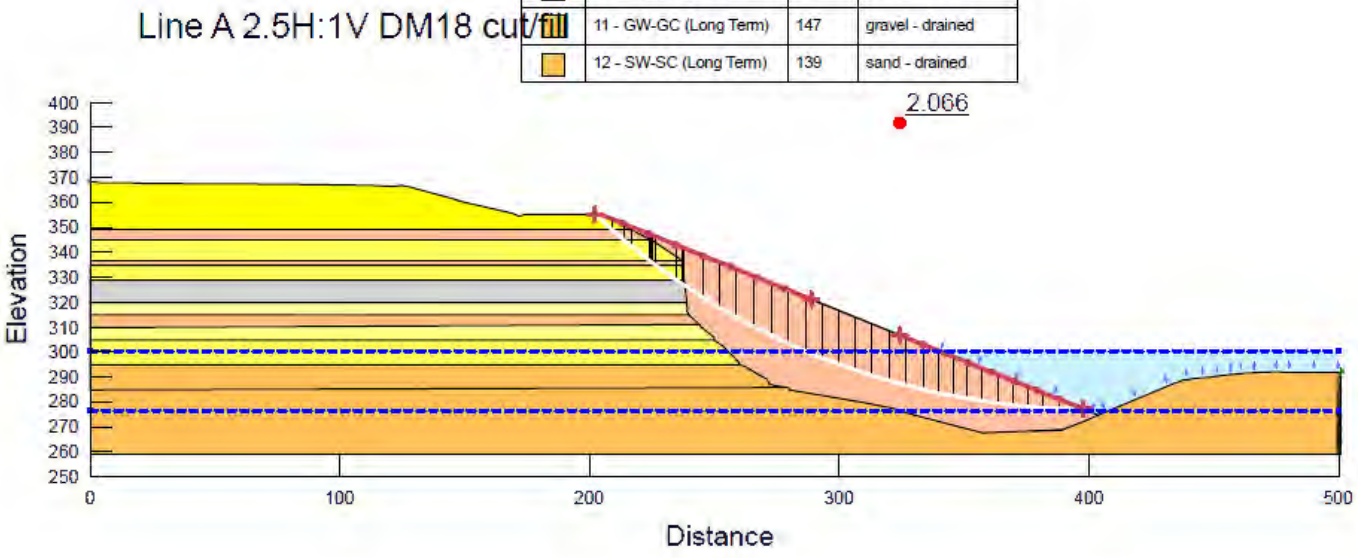
1b. Short Term Low Water

Color	Name	Unit Weight (pcf)	Strength Function
	01 - SW (Short Term)	135	sand - drained
	02 - GC (Short Term)	144	gravel - drained
	03 - SW (Short Term)	135	sand - drained
	04 - SM (Short Term)	126	sand - drained
	05 - SW (Short Term)	135	sand - drained
	06 - GW (Short Term)	146	gravel - drained
	07 - SW (Short Term)	135	sand - drained
	08 - GW-GC (Short Term)	144	gravel - drained
	09 - SP (Short Term)	126	sand - drained
	10 - SW (Short Term)	139	sand - drained
	11 - GW-GC (Short Term)	147	gravel - drained
	12 - SW-SC (Short Term)	139	sand - drained



2a. Long Term High Water

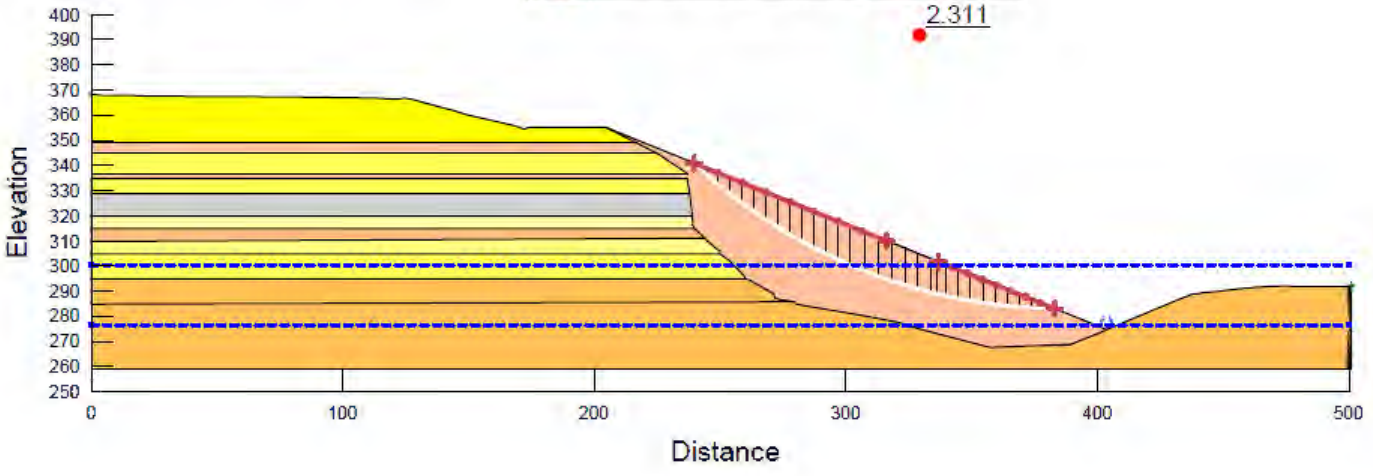
Color	Name	Unit Weight (pcf)	Strength Function
	01 - SW (Long Term)	135	sand - drained
	02 - GC (Long Term)	144	gravel - drained
	03 - SW (Long Term)	135	sand - drained
	04 - SM (Long Term)	126	sand - drained
	05 - SW (Long Term)	135	sand - drained
	06 - GW (Long Term)	146	gravel - drained
	07 - SW (Long Term)	135	sand - drained
	08 - GW-GC (Long Term)	144	gravel - drained
	09 - SP (Long Term)	126	sand - drained
	10 - SW (Long Term)	139	sand - drained
	11 - GW-GC (Long Term)	147	gravel - drained
	12 - SW-SC (Long Term)	139	sand - drained



2b. Long Term Low Water

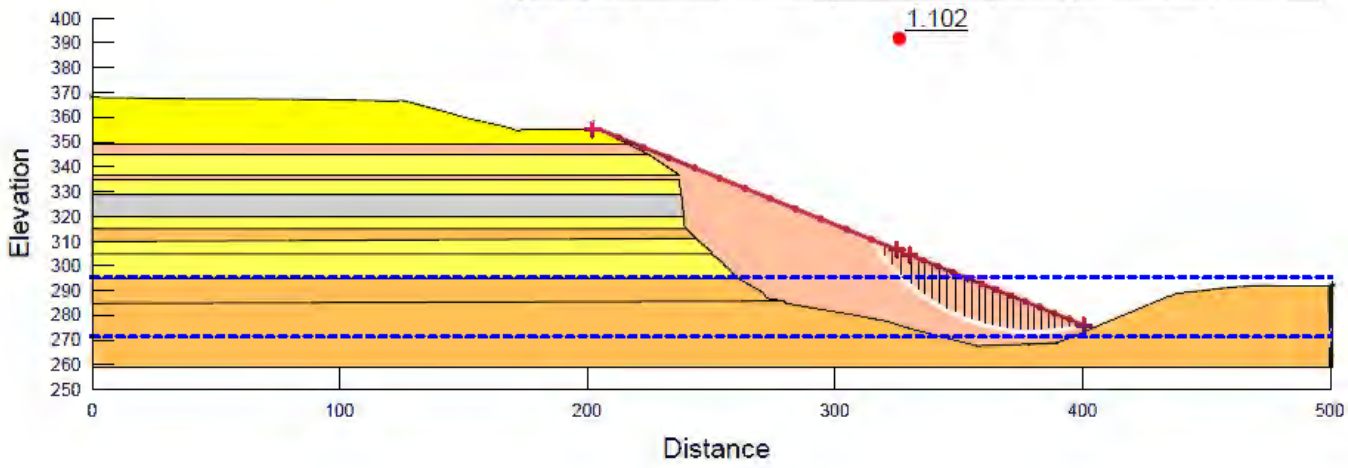
Color	Name	Unit Weight (pcf)	Strength Function
	01 - SW (Long Term)	135	sand - drained
	02 - GC (Long Term)	144	gravel - drained
	03 - SW (Long Term)	135	sand - drained
	04 - SM (Long Term)	126	sand - drained
	05 - SW (Long Term)	135	sand - drained
	06 - GW (Long Term)	146	gravel - drained
	07 - SW (Long Term)	135	sand - drained
	08 - GW-GC (Long Term)	144	gravel - drained
	09 - SP (Long Term)	126	sand - drained
	10 - SW (Long Term)	139	sand - drained
	11 - GW-GC (Long Term)	147	gravel - drained
	12 - SW-SC (Long Term)	139	sand - drained

Line A 2.5H:1V DM18 cut/fill



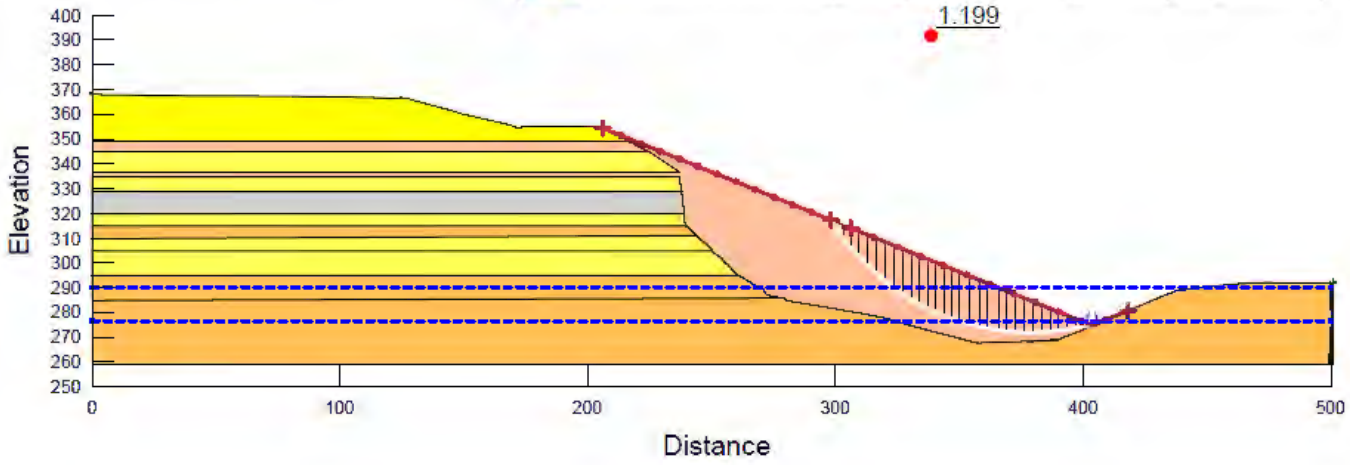
3a. Rapid Drawdown High Water

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
	01 - SW (Rapid Drawdown)	135	0	39	0	0	2
	02 - GC (Rapid Drawdown)	144	0	38	1,150	21	2
	03 - SW (Rapid Drawdown)	135	0	39	0	0	2
	04 - SM (Rapid Drawdown)	126	0	30	280	15	2
	05 - SW (Rapid Drawdown)	135	0	39	0	0	2
	06 - GW (Rapid Drawdown)	146	0	41	0	0	2
	07 - SW (Rapid Drawdown)	135	0	39	0	0	2
	08 - GW-GC (Rapid Drawdown)	144	0	38	1,150	21	2
	09 - SP (Rapid Drawdown)	126	0	39	0	0	2
	10 - SW (Rapid Drawdown)	139	0	39	0	0	2
	11 - GW-GC (Rapid Drawdown)	147	0	38	1,150	21	2
	12 - SW-SC (Rapid Drawdown)	139	0	30	280	15	2



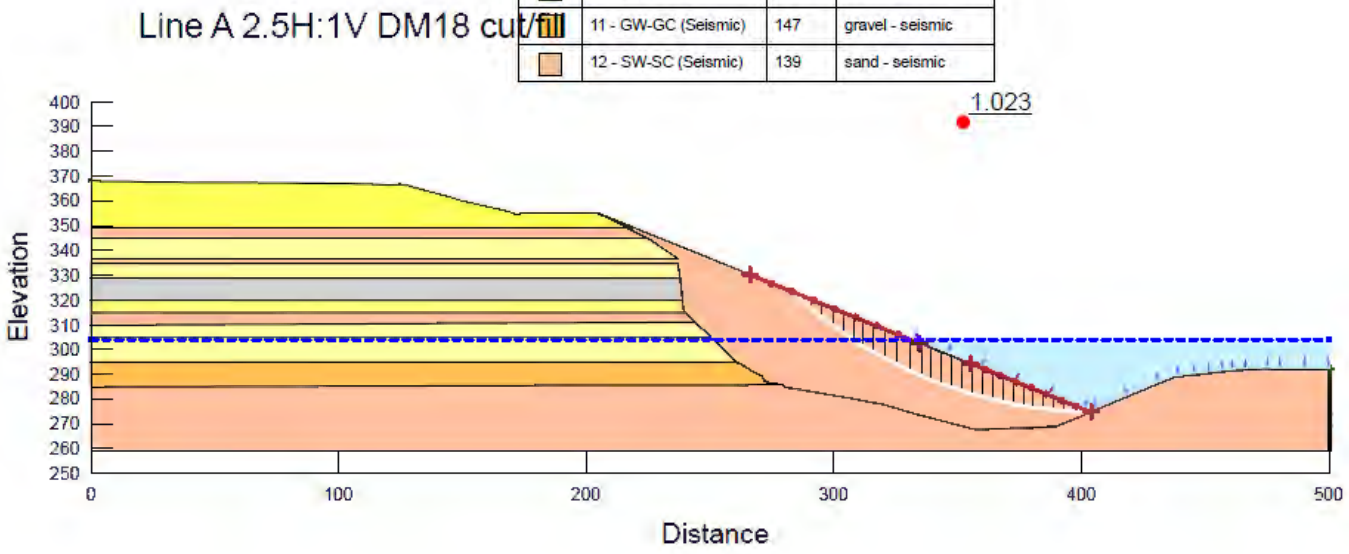
3b. Rapid Drawdown Low Water

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
	01 - SW (Rapid Drawdown)	135	0	39	0	0	2
	02 - GC (Rapid Drawdown)	144	0	38	1,150	21	2
	03 - SW (Rapid Drawdown)	135	0	39	0	0	2
	04 - SM (Rapid Drawdown)	126	0	30	280	15	2
	05 - SW (Rapid Drawdown)	135	0	39	0	0	2
	06 - GW (Rapid Drawdown)	146	0	41	0	0	2
	07 - SW (Rapid Drawdown)	135	0	39	0	0	2
	08 - GW-GC (Rapid Drawdown)	144	0	38	1,150	21	2
	09 - SP (Rapid Drawdown)	126	0	39	0	0	2
	10 - SW (Rapid Drawdown)	139	0	39	0	0	2
	11 - GW-GC (Rapid Drawdown)	147	0	38	1,150	21	2
	12 - SW-SC (Rapid Drawdown)	139	0	30	280	15	2



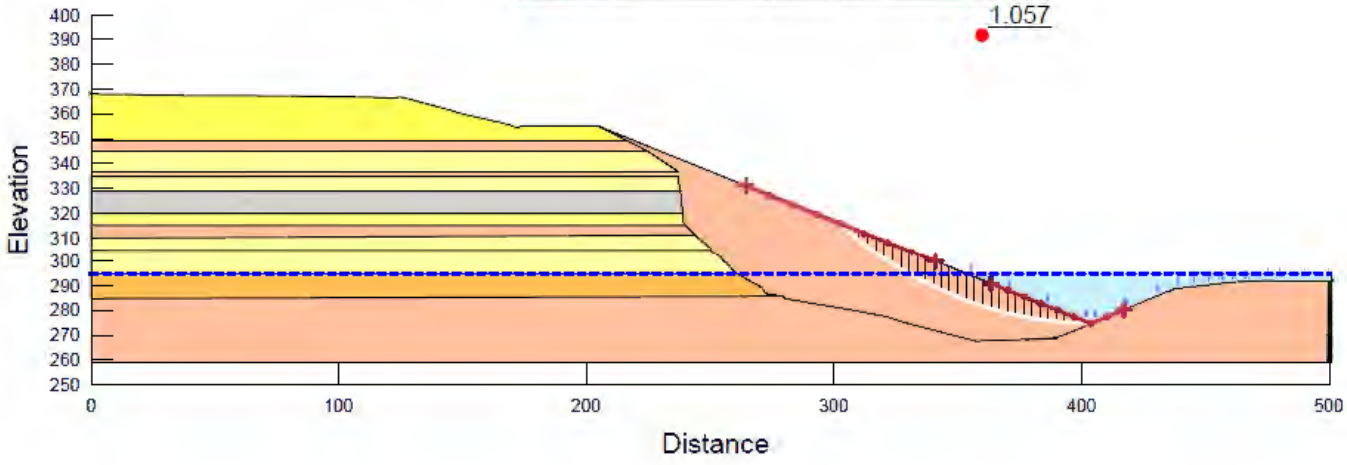
4a. Pseudo Static High Water

Color	Name	Unit Weight (pcf)	Strength Function
	01 - SW (Seismic)	135	sand - seismic
	02 - GC (Seismic)	144	gravel - seismic
	03 - SW (Seismic)	135	sand - seismic
	04 - SM (Seismic)	126	sand - seismic
	05 - SW (Seismic)	135	sand - seismic
	06 - GW (Seismic)	146	gravel - seismic
	07 - SW (Seismic)	135	sand - seismic
	08 - GW-GC (Seismic)	144	gravel - seismic
	09 - SP (Seismic)	126	sand - seismic
	10 - SW (Seismic)	139	sand - seismic
	11 - GW-GC (Seismic)	147	gravel - seismic
	12 - SW-SC (Seismic)	139	sand - seismic



4b. Pseudo Static Low Water

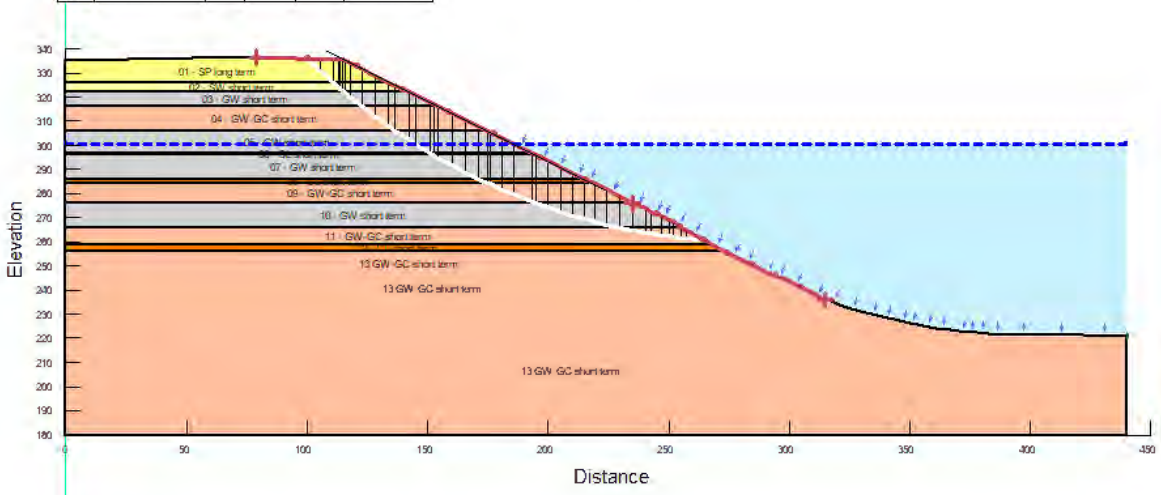
Color	Name	Unit Weight (pcf)	Strength Function
	01 - SW (Seismic)	135	sand - seismic
	02 - GC (Seismic)	144	gravel - seismic
	03 - SW (Seismic)	135	sand - seismic
	04 - SM (Seismic)	126	sand - seismic
	05 - SW (Seismic)	135	sand - seismic
	06 - GW (Seismic)	146	gravel - seismic
	07 - SW (Seismic)	135	sand - seismic
	08 - GW-GC (Seismic)	144	gravel - seismic
	09 - SP (Seismic)	126	sand - seismic
	10 - SW (Seismic)	139	sand - seismic
	11 - GW-GC (Seismic)	147	gravel - seismic
	12 - SW-SC (Seismic)	139	sand - seismic



Line E (Section C)

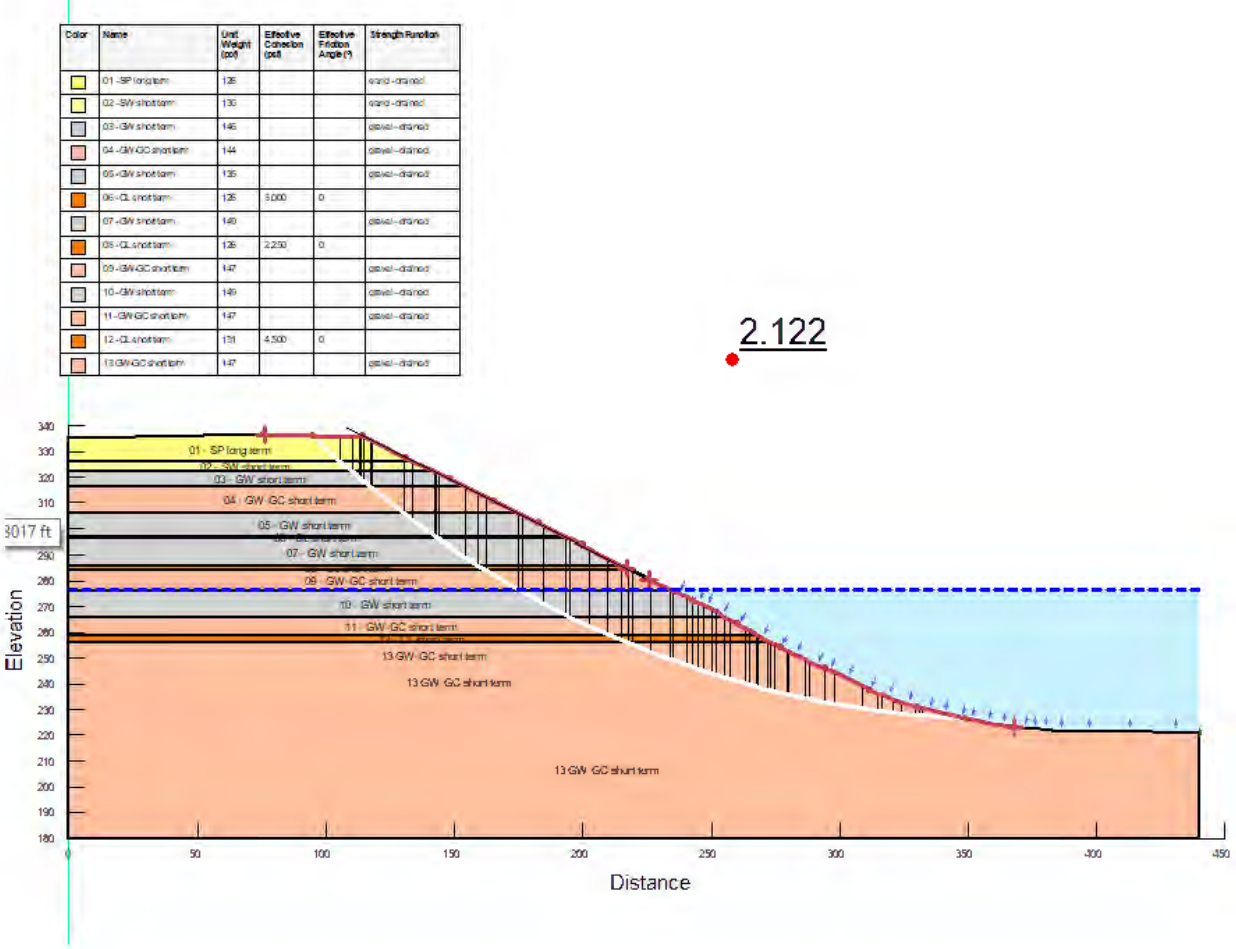
1a. Short Term High Water

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function
	01 - SP long term	125			sand - drained
	02 - SW short term	135			sand - drained
	03 - GW short term	146			gravel - drained
	04 - GW-GC short term	144			gravel - drained
	05 - GW short term	135			gravel - drained
	06 - CL short term	125	3,600	0	
	07 - GW short term	149			gravel - drained
	08 - CL short term	125	2,250	0	
	09 - GW-GC short term	147			gravel - drained
	10 - GW short term	149			gravel - drained
	11 - GW-GC short term	147			gravel - drained
	12 - CL short term	131	4,500	0	
	13 GW-GC short term	147			gravel - drained

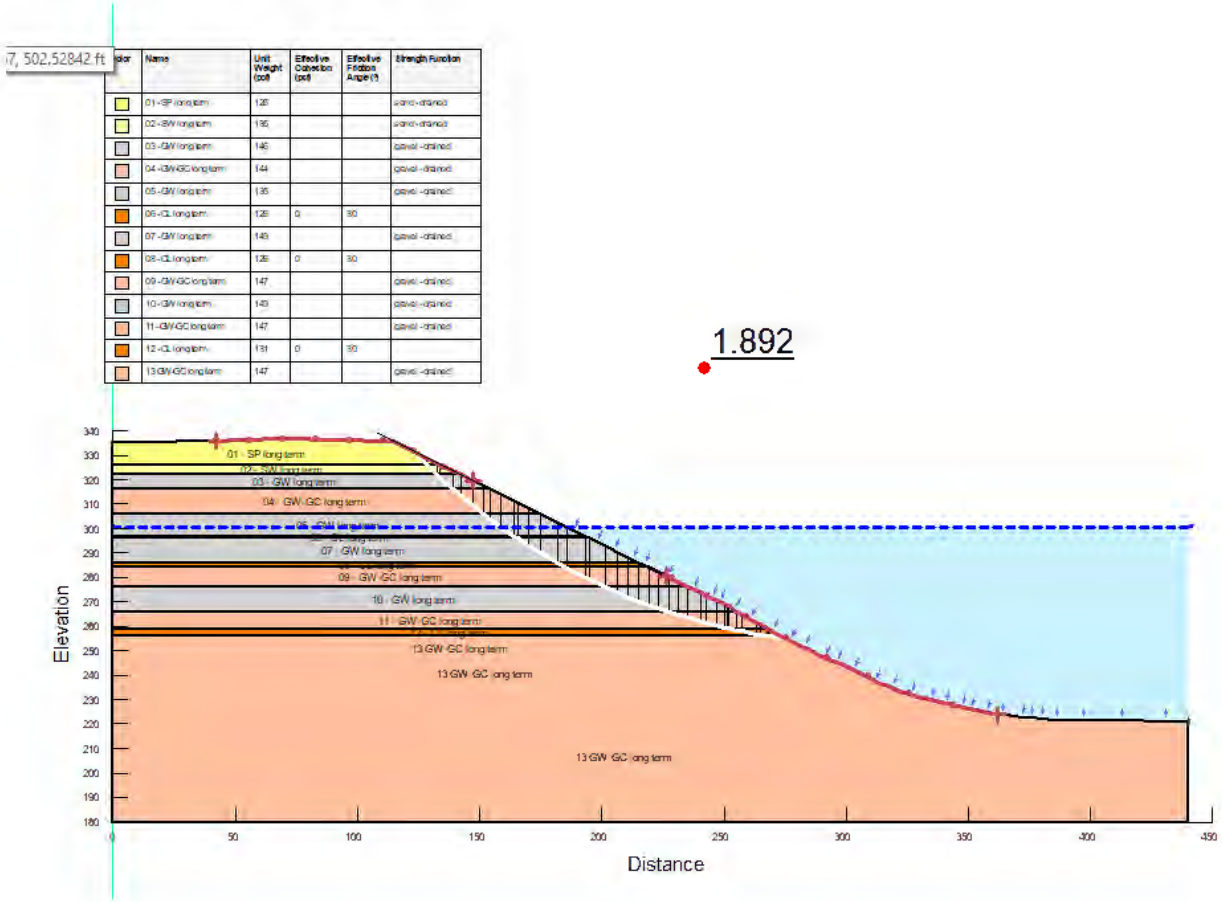


1b. Short Term Low Water

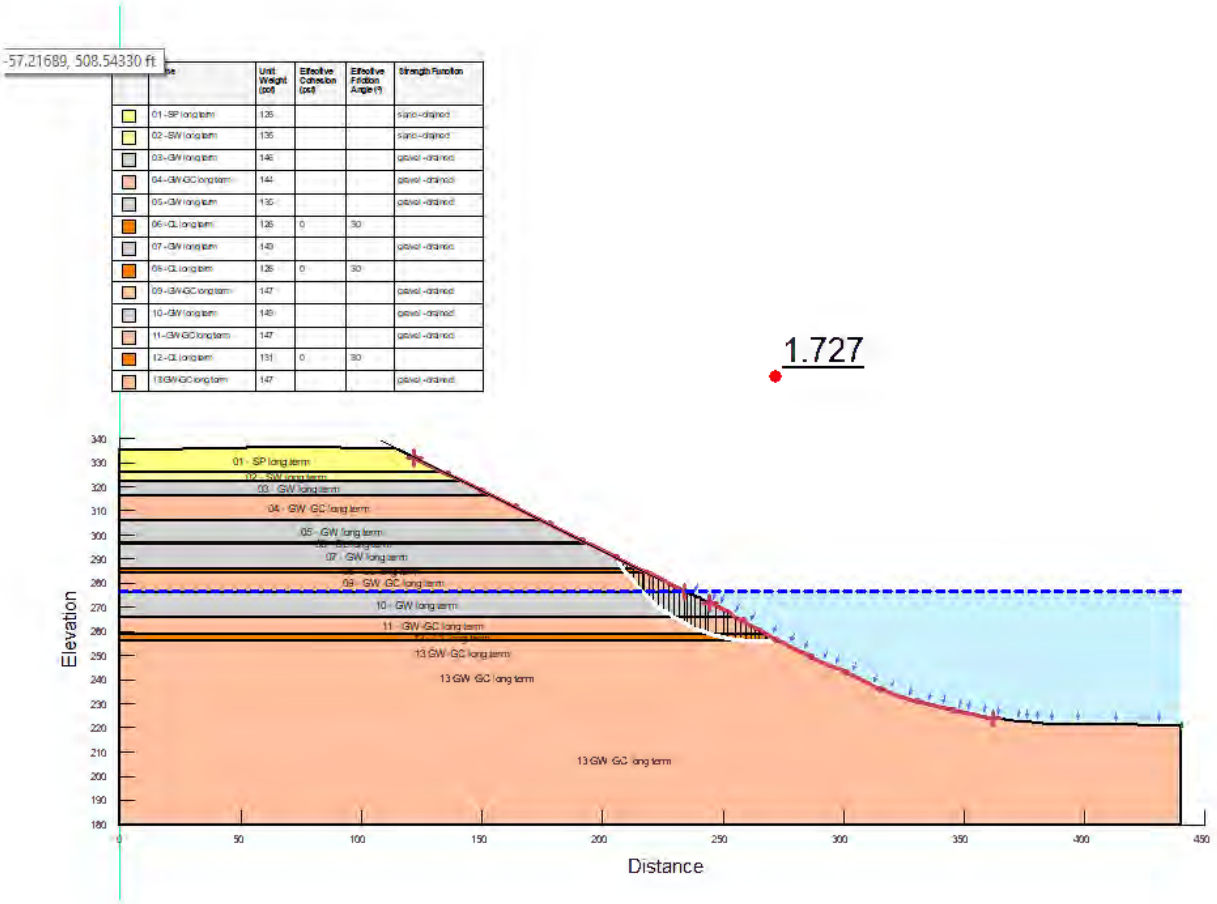
Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function
	01 - SP long term	126			sand - drained
	02 - SW short term	130			sand - drained
	03 - GW short term	146			gravel - drained
	04 - GW-GC short term	144			gravel - drained
	05 - GW short term	135			gravel - drained
	06 - CL short term	126	5,000	0	
	07 - GW short term	140			gravel - drained
	08 - CL short term	126	2,250	0	
	09 - GW-GC short term	147			gravel - drained
	10 - GW short term	149			gravel - drained
	11 - GW-GC short term	147			gravel - drained
	12 - CL short term	131	4,500	0	
	13 GW-GC short term	147			gravel - drained



2a. Long Term High Water

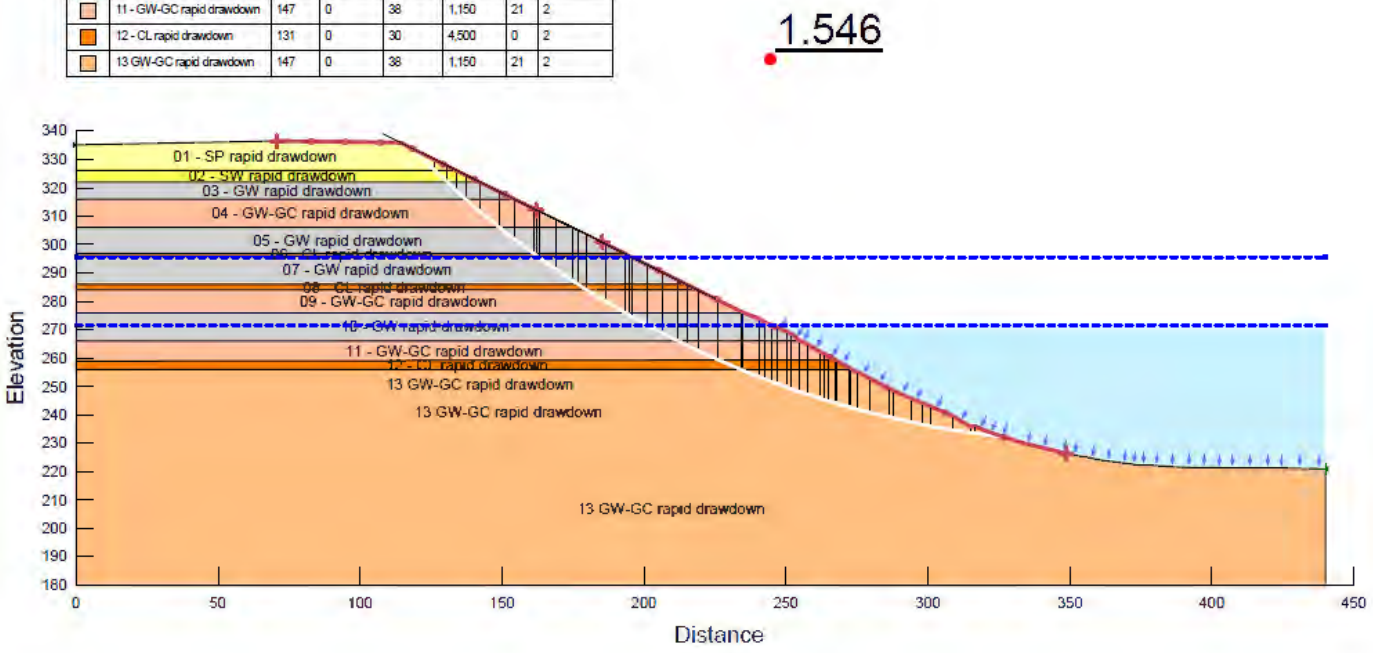


2b. Long Term Low Water



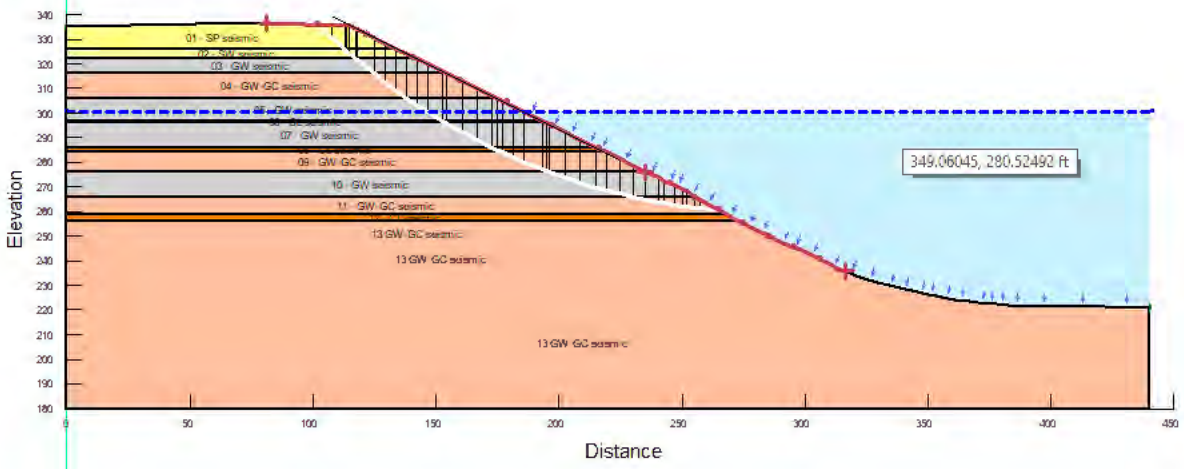
3a. Rapid Drawdown High Water

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line After Drawdown
	01 - SP rapid drawdown	126	0	39	280	15	2
	02 - SW rapid drawdown	135	0	39	280	15	2
	03 - GW rapid drawdown	146	0	38	1,150	21	2
	04 - GW-GC rapid drawdown	144	0	38	1,150	21	2
	05 - GW rapid drawdown	139	0	41	0	0	2
	06 - CL rapid drawdown	126	0	30	3,000	0	2
	07 - GW rapid drawdown	149	149	41	0	0	2
	08 - CL rapid drawdown	126	0	30	2,250	0	2
	09 - GW-GC rapid drawdown	147	0	38	1,150	21	2
	10 - GW rapid drawdown	149	0	41	0	0	2
	11 - GW-GC rapid drawdown	147	0	38	1,150	21	2
	12 - CL rapid drawdown	131	0	30	4,500	0	2
	13 GW-GC rapid drawdown	147	0	38	1,150	21	2



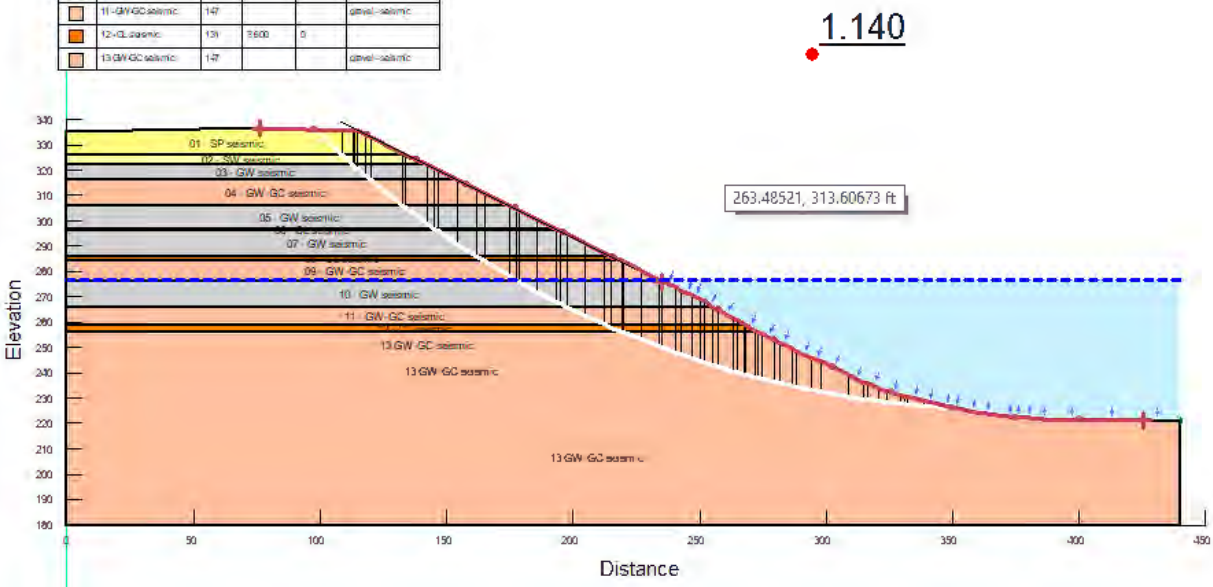
4a. Pseudo Static High Water

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function
	01 - SP seismic	126			sand - seismic
	02 - SW seismic	135			sand - seismic
	03 - GW seismic	148			gravel - seismic
	04 - GW-GC seismic	144			gravel - seismic
	05 - GW seismic	135			gravel - seismic
	06 - CL seismic	126	2,400	0	
	07 - GW seismic	140			gravel - seismic
	08 - CL seismic	126	1,800	0	
	09 - GW-GC seismic	147			gravel - seismic
	10 - GW seismic	149			gravel - seismic
	11 - GW-GC seismic	147			gravel - seismic
	12 - CL seismic	131	3,600	0	
	13 GW-GC seismic	147			gravel - seismic



4b. Pseudo Static Low Water

Color	Name	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function
	01 - SP seismic	135			sand - seismic
	02 - SW seismic	135			sand - seismic
	03 - GW seismic	140			gravel - seismic
	04 - GW-GC seismic	144			gravel - seismic
	05 - GW seismic	139			gravel - seismic
	06 - CL seismic	126	2,400	0	
	07 - GW seismic	149			gravel - seismic
	08 - CL seismic	126	1,800	0	
	09 - GW-GC seismic	147			gravel - seismic
	10 - GW seismic	140			gravel - seismic
	11 - GW-GC seismic	147			gravel - seismic
	12 - CL seismic	131	3,600	0	
	13 GW-GC seismic	147			gravel - seismic

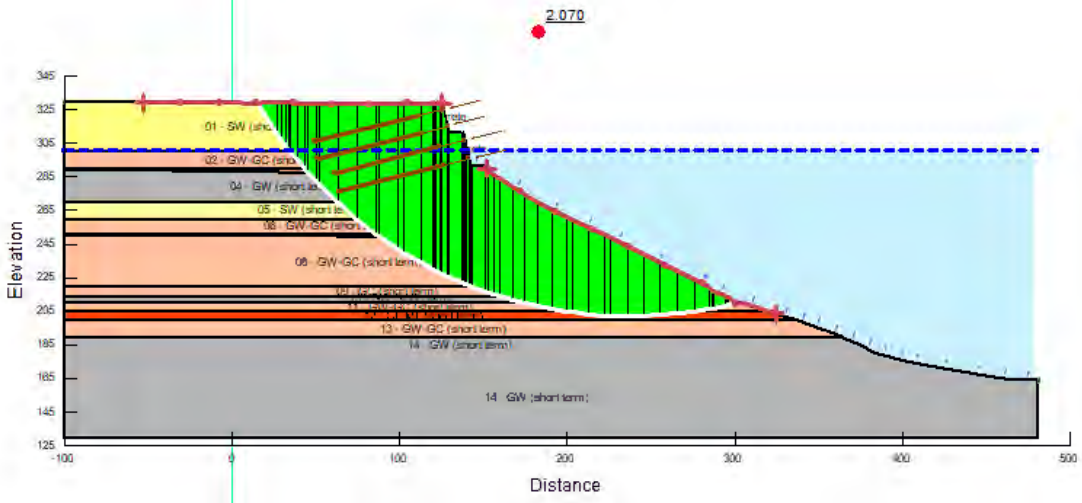


Line F (Section D)

1a. Short Term High Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW (short term)	SHANSEP NC/OC	130.0/130.0			sand - drained	1
	02 - GW-GC (short term)	SHANSEP NC/OC	144.0/144.0			gravel - drained	1
	03 - CL (short term)	Mohr-Coulomb	112.0/112.0	1,000	0		1
	04 - GW (short term)	SHANSEP NC/OC	130.0/130.0			gravel - drained	1
	05 - SW (short term)	SHANSEP NC/OC	130.0/130.0			sand - drained	1
	06 - GW-GC (short term)	SHANSEP NC/OC	144.0/144.0			gravel - drained	1
	07 - CL (short term)	Mohr-Coulomb	126.0/126.0	4,500	0		1
	08 - GW-GC (short term)	SHANSEP NC/OC	144.0/144.0			gravel - drained	1
	09 - GC (short term)	SHANSEP NC/OC	144.0/144.0			gravel - drained	1
	10 - GW (short term)	SHANSEP NC/OC	130.0/130.0			gravel - drained	1
	11 - GW-GC (short term)	SHANSEP NC/OC	144.0/144.0			gravel - drained	1
	12 - CL-ML (short term)	Mohr-Coulomb	112.0/112.0	1,000	0		1
	13 - GW-GC (short term)	SHANSEP NC/OC	144.0/144.0			gravel - drained	1
	14 - GW (short term)	SHANSEP NC/OC	130.0/130.0			gravel - drained	1
	concrete	High Strength	150				

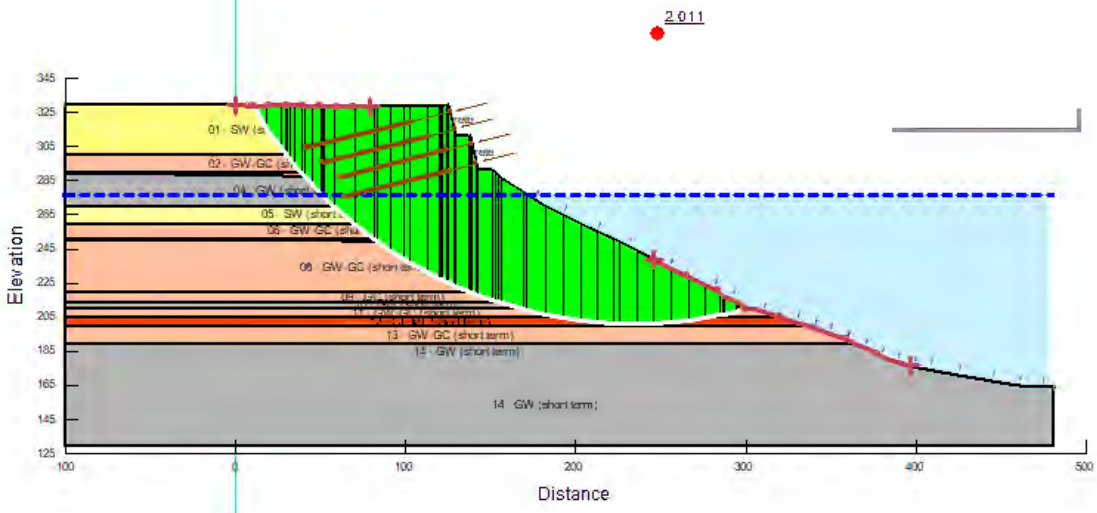
Line F (Section D)
DM-18



1b. Short Term Low Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW (short term)	Shear Normal R...	130.053 79			sand - drained	1
	02 - GW-GC (short term)	Shear Normal R...	144.015 24			gravel - drained	1
	03 - CL (short term)	Mohr-Coulomb	112.903 43	1,000	0		1
	04 - GW (short term)	Shear Normal R...	130.053 79			gravel - drained	1
	05 - SW (short term)	Shear Normal R...	130.053 79			sand - drained	1
	06 - GW-GC (short term)	Shear Normal R...	144.015 24			gravel - drained	1
	07 - CL (short term)	Mohr-Coulomb	126.907 01	4,500	0		1
	08 - GW-GC (short term)	Shear Normal R...	144.015 24			gravel - drained	1
	09 - GC (short term)	Shear Normal R...	144.015 24			gravel - drained	1
	10 - GW (short term)	Shear Normal R...	130.053 79			gravel - drained	1
	11 - GW-GC (short term)	Shear Normal R...	144.015 24			gravel - drained	1
	12 - CL-ML (short term)	Mohr-Coulomb	112.903 43	1,500	0		1
	13 - GW-GC (short term)	Shear Normal R...	144.015 24			gravel - drained	1
	14 - GW (short term)	Shear Normal R...	130.053 79			gravel - drained	1
	concrete	High Strength	150				1

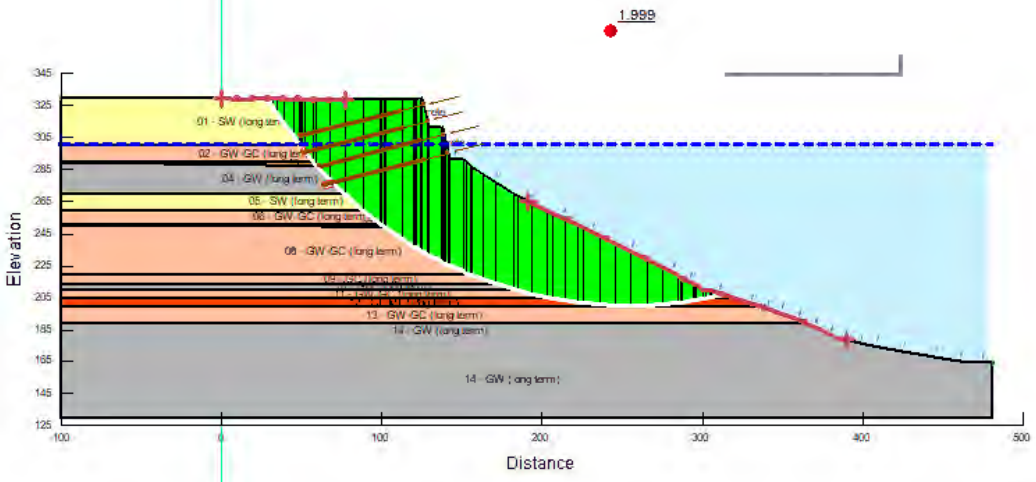
Line F (Section D)
DM-18



2a. Long Term High Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW (long term)	Shear Normal Pr...	135.03379			sand - drained	1
	02 - GW-GC (long term)	Shear Normal Pr...	144.01524			gravel - drained	1
	03 - CL (long term)	Mohr-Coulomb	112.50343	0	30		1
	04 - GW (long term)	Shear Normal Pr...	135.03379			gravel - drained	1
	05 - SW (long term)	Shear Normal Pr...	135.03379			sand - drained	1
	06 - GW-GC (long term)	Shear Normal Pr...	144.01524			gravel - drained	1
	07 - CL (long term)	Mohr-Coulomb	126.907.01	0	30		1
	08 - GW-GC (long term)	Shear Normal Pr...	144.01524			gravel - drained	1
	09 - GC (long term)	Shear Normal Pr...	144.01524			gravel - drained	1
	10 - GW (long term)	Shear Normal Pr...	135.03379			gravel - drained	1
	11 - GW-GC (long term)	Shear Normal Pr...	144.01524			gravel - drained	1
	12 - CL-ML (long term)	Mohr-Coulomb	112.50343	0	30		1
	13 - GW-GC (long term)	Shear Normal Pr...	144.01524			gravel - drained	1
	14 - GW (long term)	Shear Normal Pr...	135.03379			gravel - drained	1
	concrete	High Strength	150				

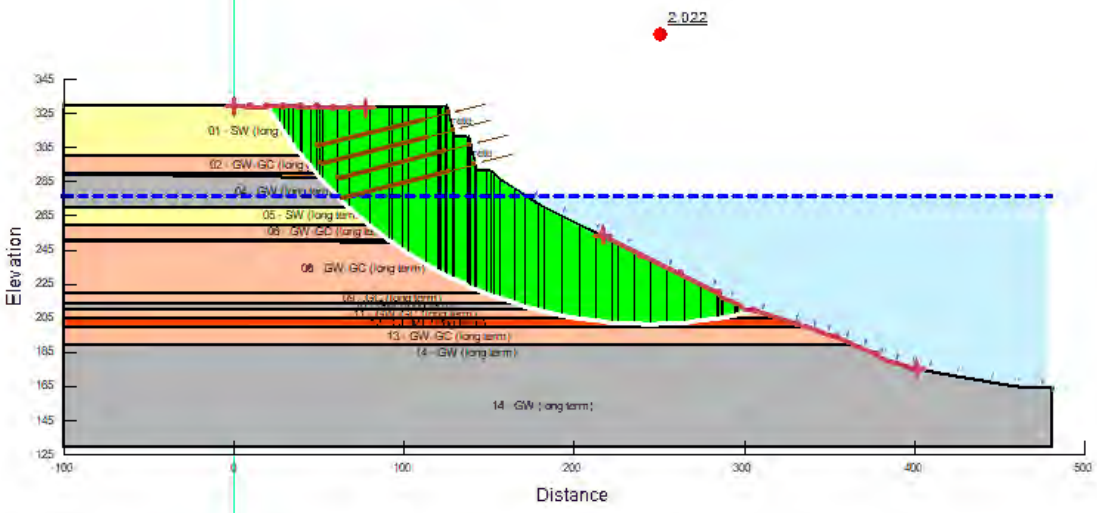
Line F (Section D)
DM-18



2b. Long Term Low Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW (long term)	Shear/Normal Fr	139.053 79			sand - drained	1
	02 - GW-GC (long term)	Shear/Normal Fr	144.015 24			gravel - drained	1
	03 - CL (long term)	Mohr-Coulomb	112.908 43	0	30		1
	04 - GW (long term)	Shear/Normal Fr	139.053 79			gravel - drained	1
	05 - SW (long term)	Shear/Normal Fr	139.053 79			sand - drained	1
	06 - GW-GC (long term)	Shear/Normal Fr	144.015 24			gravel - drained	1
	07 - CL (long term)	Mohr-Coulomb	136.997 01	0	30		1
	08 - GW-GC (long term)	Shear/Normal Fr	144.015 24			gravel - drained	1
	09 - GC (long term)	Shear/Normal Fr	144.015 24			gravel - drained	1
	10 - GW (long term)	Shear/Normal Fr	139.053 79			gravel - drained	1
	11 - GW-GC (long term)	Shear/Normal Fr	144.015 24			gravel - drained	1
	12 - CL-ML (long term)	Mohr-Coulomb	112.908 43	0	30		1
	13 - GW-GC (long term)	Shear/Normal Fr	144.015 24			gravel - drained	1
	14 - GW (long term)	Shear/Normal Fr	139.053 79			gravel - drained	1
	concrete	High Strength	150				1

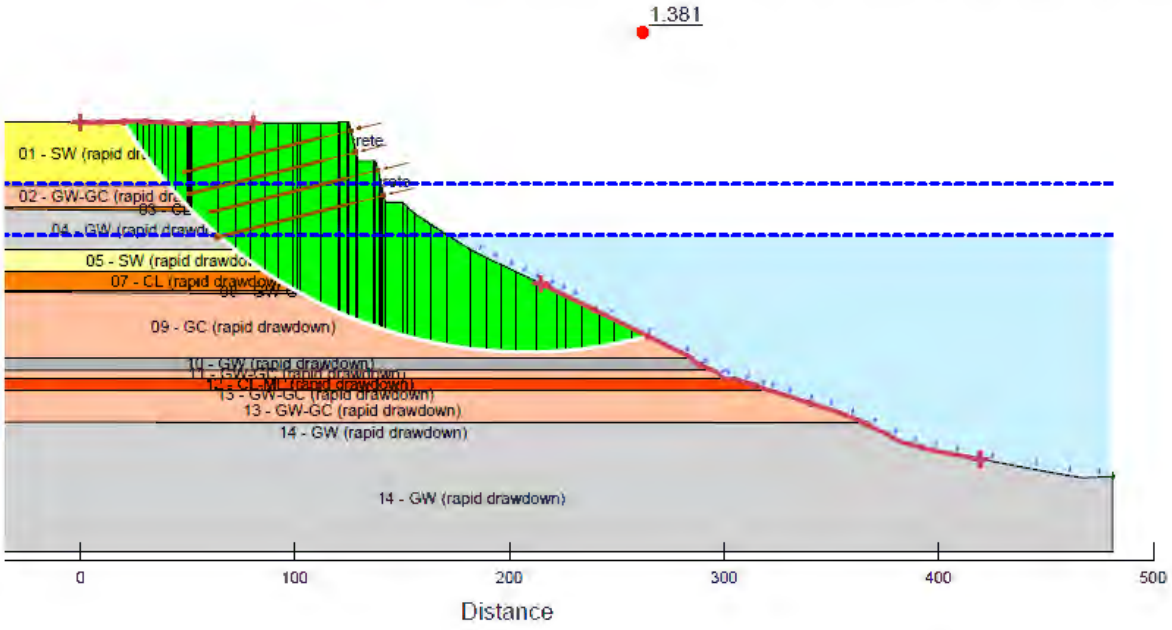
Line F (Section D)
DM-18



3a. Rapid Drawdown High Water

Line F (Section D)
DM-18

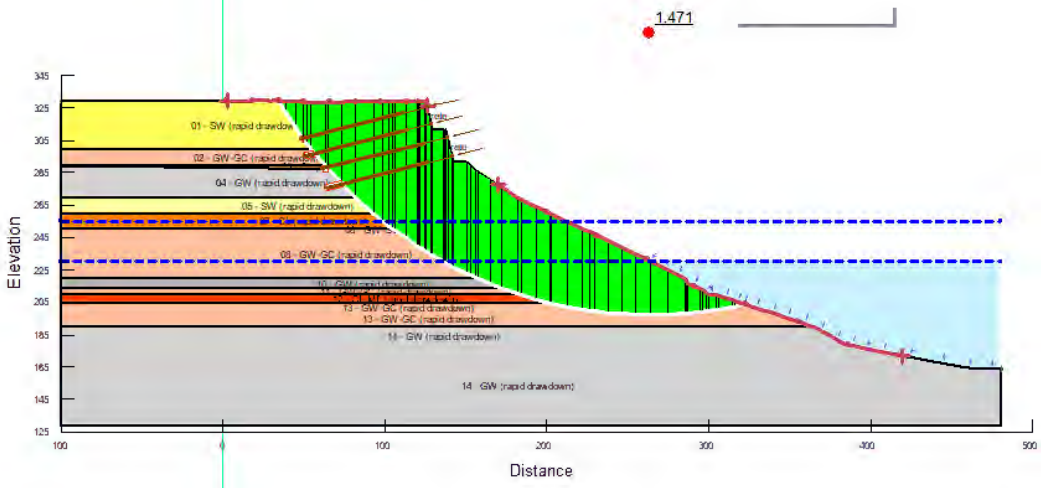
	03 - CL (rapid drawdown)	Mohr-Coulomb	113	0	30	1,000	0	1	2
	04 - GW (rapid drawdown)	Mohr-Coulomb	135	0	41	0	0	1	2
	05 - SW (rapid drawdown)	Mohr-Coulomb	135	0	39	0	0	1	2
	07 - CL (rapid drawdown)	Mohr-Coulomb	127	0	30	4,500	0	1	2
	08 - GW-GC (rapid drawdown)	Mohr-Coulomb	144	0	38	1,150	21	1	2
	09 - GC (rapid drawdown)	Mohr-Coulomb	144	0	38	860	10	1	2
	10 - GW (rapid drawdown)	Mohr-Coulomb	135	0	41	0	0	1	2
	11 - GW-GC (rapid drawdown)	Mohr-Coulomb	144	0	38	1,150	21	1	2
	12 - CL-ML (rapid drawdown)	Mohr-Coulomb	113	0	30	1,500	0	1	2
	13 - GW-GC (rapid drawdown)	Mohr-Coulomb	144	0	38	1,150	21	1	2
	14 - GW (rapid drawdown)	Mohr-Coulomb	135	0	41	0	0	1	2
	concrete	High Strength	150					1	2



3b. Rapid Drawdown Low Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line	Piezometric Line After Drawdown
	01 - SW (rapid drawdown)	Mohr-Coulomb	135	0	39	0	0	1	2
	02 - GW-GC (rapid drawdown)	Mohr-Coulomb	144	0	38	1,150	21	1	2
	03 - CL (rapid drawdown)	Mohr-Coulomb	113	0	30	1,000	0	1	2
	04 - GW (rapid drawdown)	Mohr-Coulomb	135	0	41	0	0	1	2
	05 - SW (rapid drawdown)	Mohr-Coulomb	135	0	39	0	0	1	2
	07 - CL (rapid drawdown)	Mohr-Coulomb	127	0	30	4,500	0	1	2
	08 - GW-GC (rapid drawdown)	Mohr-Coulomb	144	0	38	1,150	21	1	2
	10 - GW (rapid drawdown)	Mohr-Coulomb	135	0	41	0	0	1	2
	11 - GW-GC (rapid drawdown)	Mohr-Coulomb	144	0	38	1,150	21	1	2
	12 - CL-ML (rapid drawdown)	Mohr-Coulomb	113	0	30	1,500	0	1	2
	13 - GW-GC (rapid drawdown)	Mohr-Coulomb	144	0	38	1,150	21	1	2
	14 - GW (rapid drawdown)	Mohr-Coulomb	135	0	41	0	0	1	2
	concrete	High Strength	150					1	2

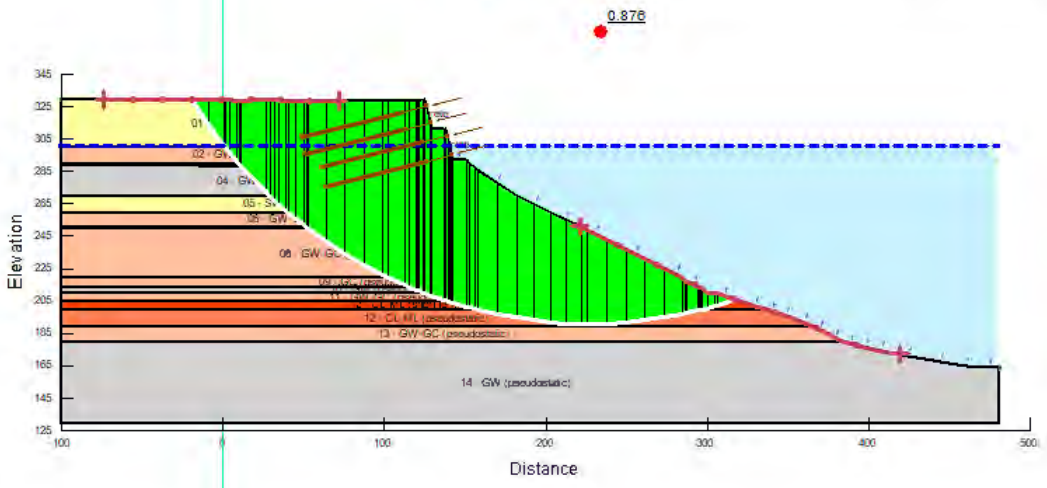
Line F (Section D)
DM-18



4a. Pseudo Static High Water

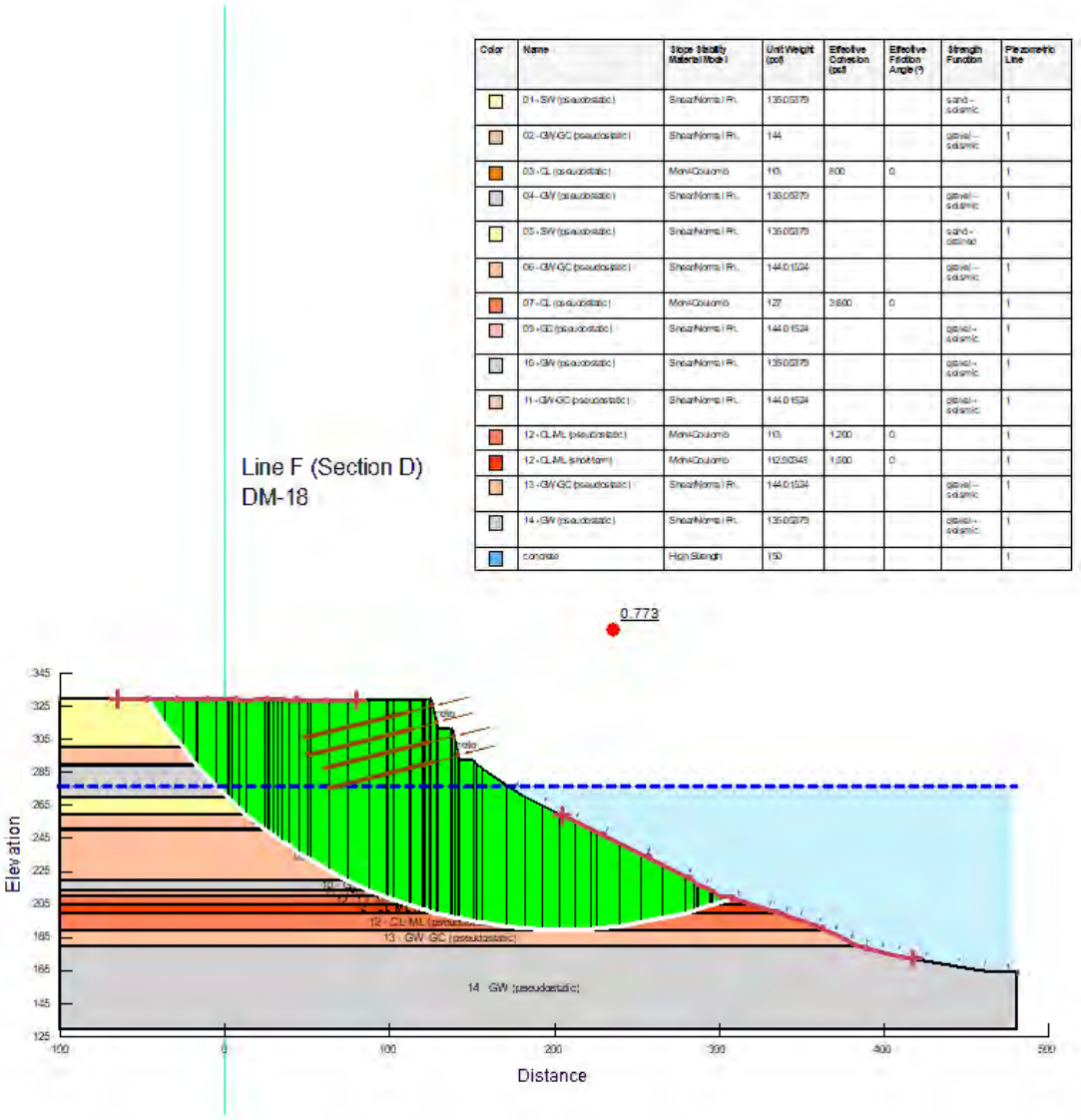
Line F (Section D)
DM-18

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01-SW (pseudostatic)	Sheafflorma	135.0379			sand - seismic	1
	02-GW-GC (pseudostatic)	Sheafflorma	144			gravel - seismic	1
	03-CL (pseudostatic)	Mohr-Coulomb	110	800	0		1
	04-GW (pseudostatic)	Sheafflorma	135.0379			gravel - seismic	1
	05-SW (pseudostatic)	Sheafflorma	135.0379			sand - seismic	1
	06-GW-GC (pseudostatic)	Sheafflorma	144.0152			gravel - seismic	1
	07-CL (pseudostatic)	Mohr-Coulomb	127	3,600	0		1
	08-GW-GC (pseudostatic)	Sheafflorma	144.0152			gravel - seismic	1
	09-GC (pseudostatic)	Sheafflorma	144.0152			gravel - seismic	1
	10-GW (pseudostatic)	Sheafflorma	135.0379			gravel - seismic	1
	11-GW-GC (pseudostatic)	Sheafflorma	144.0152			gravel - seismic	1
	12-CL-ML (pseudostatic)	Mohr-Coulomb	110	1,200	0		1
	12-CL-ML (bottom)	Mohr-Coulomb	112.9043	1,500	0		1
	13-GW-GC (pseudostatic)	Sheafflorma	144.0152			gravel - seismic	1
	14-GW (pseudostatic)	Sheafflorma	135.0379			gravel - seismic	1
	concrete	High Strength	150				



4b. Pseudo Static Low Water

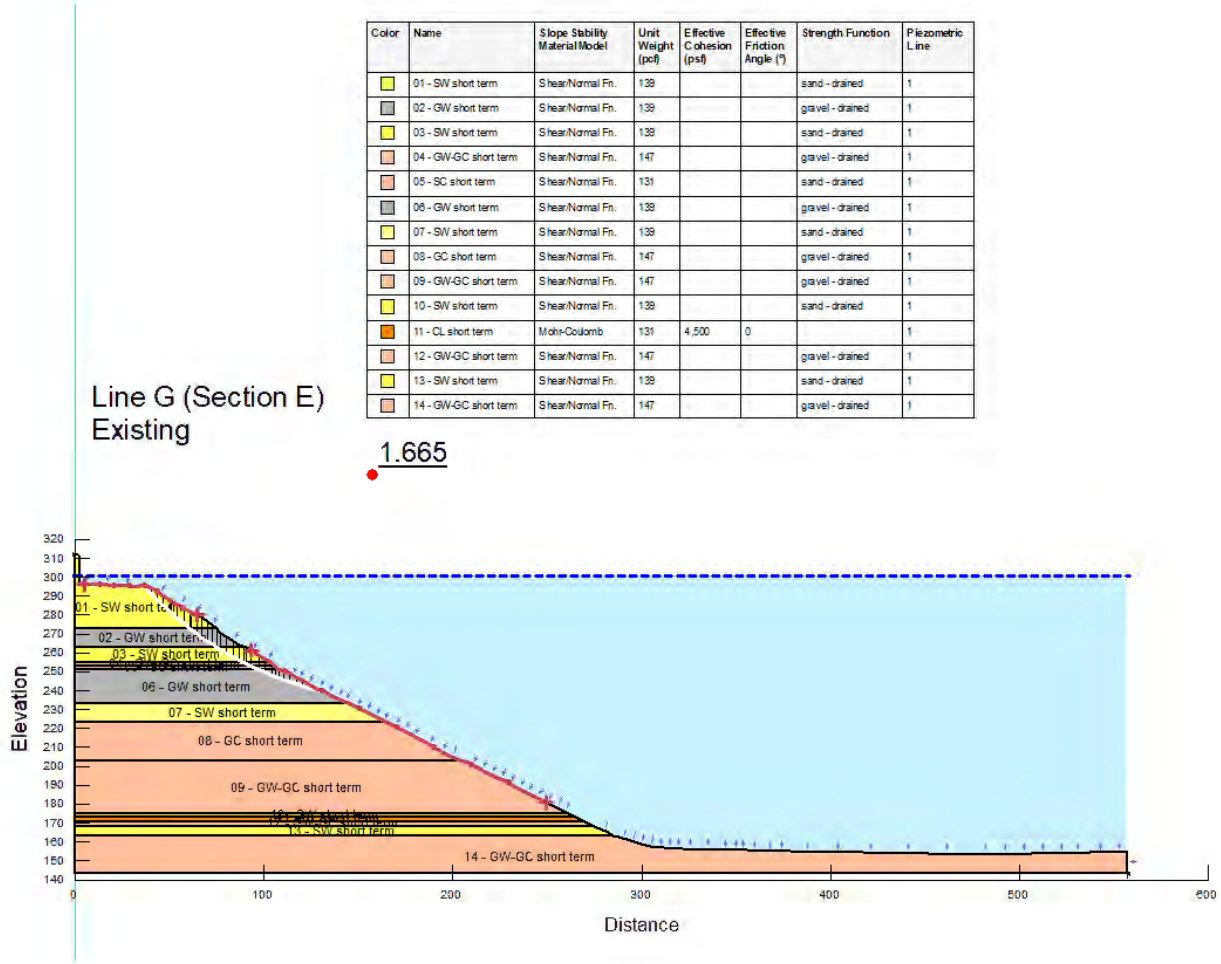
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW (pseudostatic)	SheafNorms	135.0379			sand - seismic	1
	02 - GW-GC (pseudostatic)	SheafNorms	144			gravel - seismic	1
	03 - CL (pseudostatic)	Mohr-Coulomb	115	800	0		1
	04 - GW (pseudostatic)	SheafNorms	135.0379			gravel - seismic	1
	05 - SW (pseudostatic)	SheafNorms	135.0379			sand - seismic	1
	06 - GW-GC (pseudostatic)	SheafNorms	144.0152			gravel - seismic	1
	07 - CL (pseudostatic)	Mohr-Coulomb	127	3600	0		1
	08 - GC (pseudostatic)	SheafNorms	144.0152			gravel - seismic	1
	10 - GW (pseudostatic)	SheafNorms	135.0379			gravel - seismic	1
	11 - GW-GC (pseudostatic)	SheafNorms	144.0152			gravel - seismic	1
	12 - CL-ML (pseudostatic)	Mohr-Coulomb	115	1,200	0		1
	12 - CL-ML (short term)	Mohr-Coulomb	112.9043	1,000	0		1
	13 - GW-GC (pseudostatic)	SheafNorms	144.0152			gravel - seismic	1
	14 - GW (pseudostatic)	SheafNorms	135.0379			gravel - seismic	1
	concrete	High Strength	150				1



Line G (Section E)

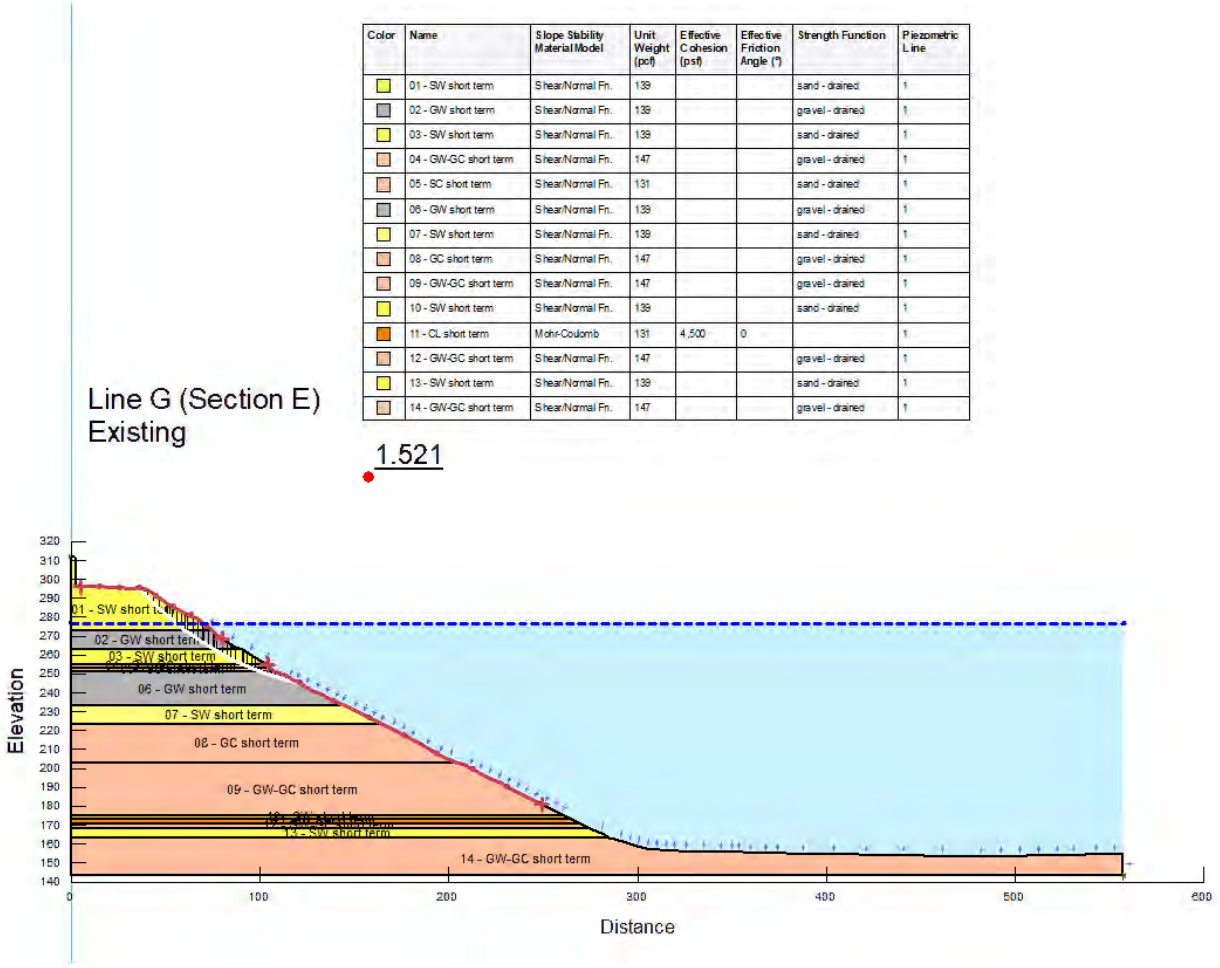
1a. Existing Short Term High Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW short term	Shear/Normal Fn.	139			gravel - drained	1
	03 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	04 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	05 - SC short term	Shear/Normal Fn.	131			sand - drained	1
	06 - GW short term	Shear/Normal Fn.	138			gravel - drained	1
	07 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	08 - GC short term	Shear/Normal Fn.	147			gravel - drained	1
	09 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	10 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	11 - CL short term	Mohr-Coulomb	131	4,500	0		1
	12 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	13 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	14 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1



1b. Existing Short Term Low Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW short term	Shear/Normal Fn.	139			gravel - drained	1
	03 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	04 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	05 - SC short term	Shear/Normal Fn.	131			sand - drained	1
	06 - GW short term	Shear/Normal Fn.	139			gravel - drained	1
	07 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	08 - GC short term	Shear/Normal Fn.	147			gravel - drained	1
	09 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	10 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	11 - CL short term	Mohr-Coulomb	131	4,500	0		1
	12 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	13 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	14 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1

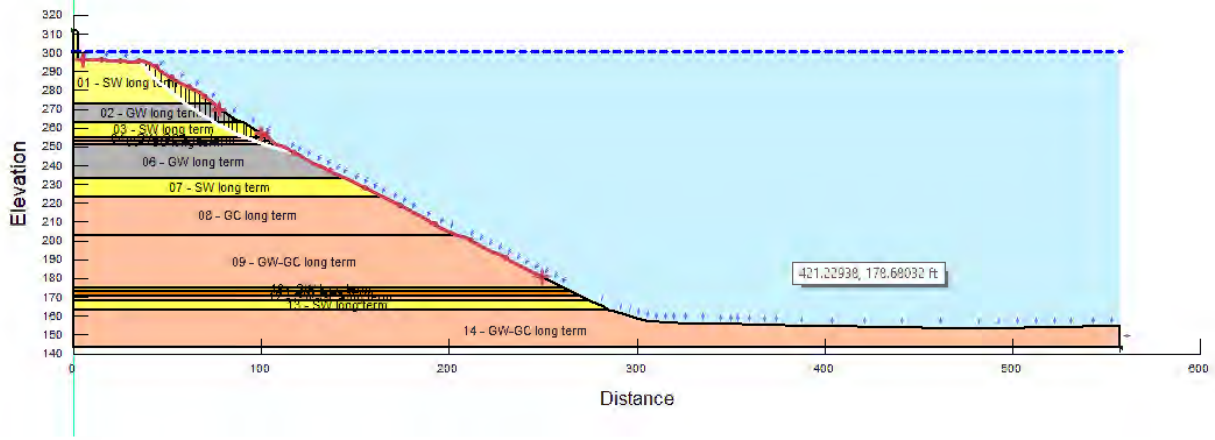


2a. Existing Long Term High Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW long term	Shear/Normal Fn.	139			gravel - drained	1
	03 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	04 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	05 - SC long term	Shear/Normal Fn.	131			sand - drained	1
	06 - GW long term	Shear/Normal Fn.	139			gravel - drained	1
	07 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	08 - GC long term	Shear/Normal Fn.	147			gravel - drained	1
	09 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	10 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	11 - CL long term	Mohr-Coulomb	131	0	30		1
	12 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	13 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	14 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1

Line G (Section E)
Existing

1.651

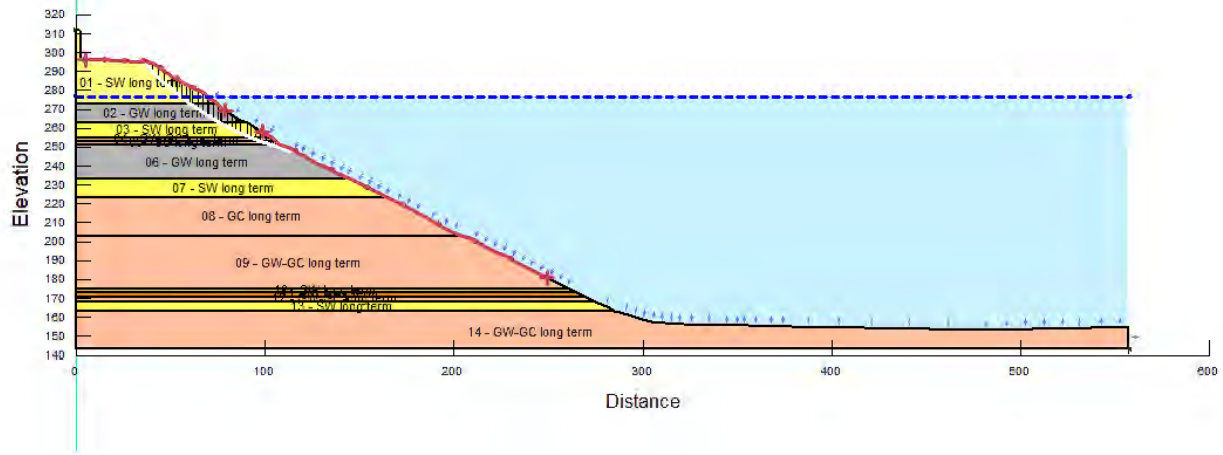


2b. Existing Long Term Low Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW long term	Shear/Normal Fn.	139			gravel - drained	1
	03 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	04 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	05 - SC long term	Shear/Normal Fn.	131			sand - drained	1
	06 - GW long term	Shear/Normal Fn.	139			gravel - drained	1
	07 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	08 - GC long term	Shear/Normal Fn.	147			gravel - drained	1
	09 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	10 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	11 - CL long term	Mohr-Coulomb	131	0	30		1
	12 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	13 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	14 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1

Line G (Section E)
Existing

1.513

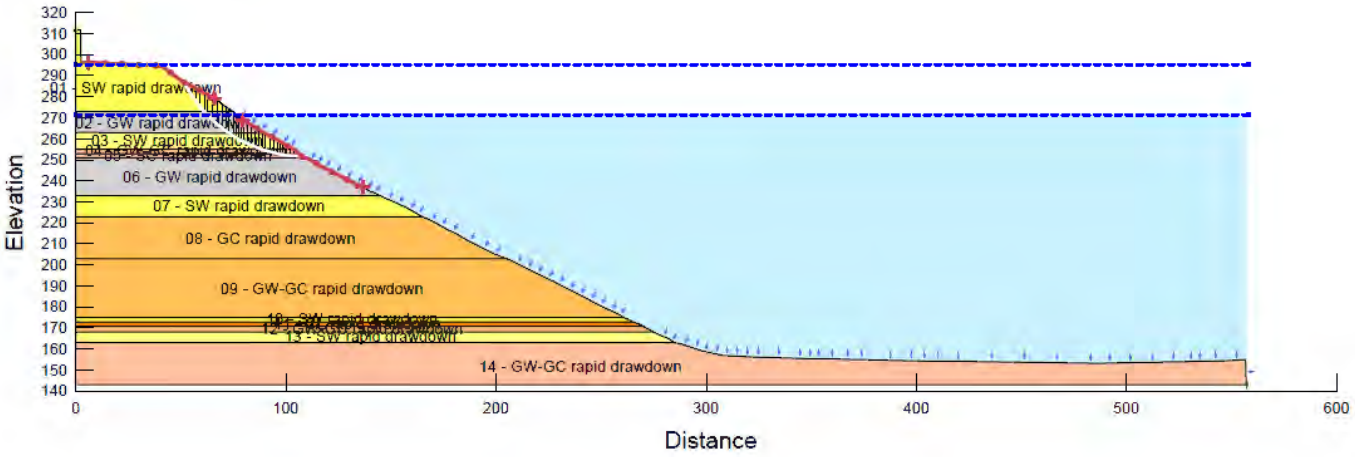


3a. Existing Rapid Drawdown High Water

	01 - SW rapid drawdown	Mohr-Coulomb	139	0	39	0	0	1	2
	02 - GW rapid drawdown	Mohr-Coulomb	139	0	41	0	0	1	2
	03 - SW rapid drawdown	Mohr-Coulomb	139	0	39	0	0	1	2
	04 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38	1,150	21	1	2
	05 - SC rapid drawdown	Mohr-Coulomb	131	0	30	280	15	1	2
	06 - GW rapid drawdown	Mohr-Coulomb	139	0	41	0	0	1	2
	07 - SW rapid drawdown	Mohr-Coulomb	139	0	39	0	0	1	2
	08 - GC rapid drawdown	Mohr-Coulomb	147	0	38	1,150	21	1	2
	09 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38	1,150	21	1	2
	10 - SW rapid drawdown	Mohr-Coulomb	139	0	39	0	0	1	2
	11 - CL rapid drawdown	Mohr-Coulomb	131	0	30	4,500	0	1	2
	12 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38	1,150	21	1	2
	13 - SW rapid drawdown	Mohr-Coulomb	139	0	39	0	0	1	2
	14 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38	1,150	21	1	2

Line G (Section E)
Existing

1.304

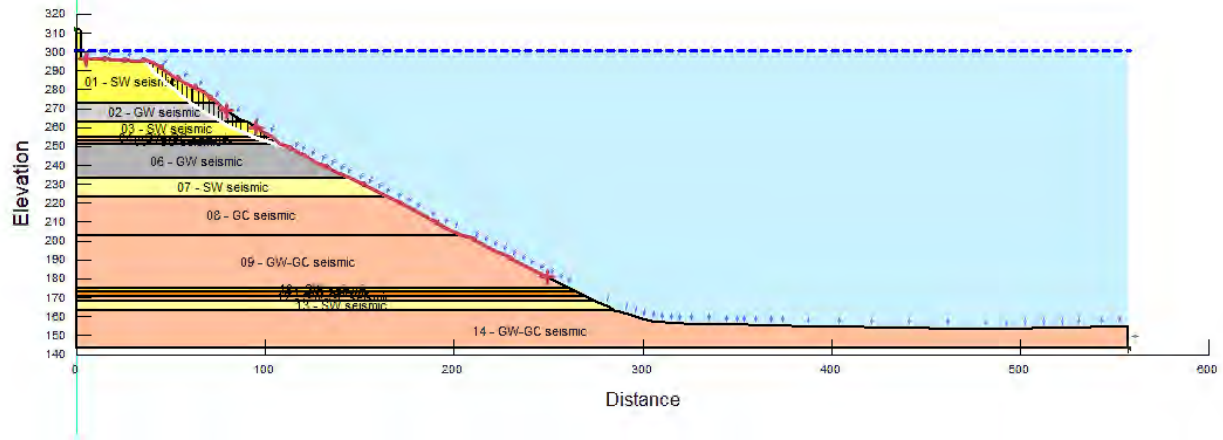


4a. Existing Pseudo Static High Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	02 - GW seismic	Shear/Normal Fn.	139			gravel - seismic	1
	03 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	04 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	05 - SC seismic	Shear/Normal Fn.	131			gravel - seismic	1
	06 - GW seismic	Shear/Normal Fn.	139			gravel - seismic	1
	07 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	08 - GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	09 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	10 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	11 - CL seismic	Mohr-Coulomb	131	3,600	0		1
	12 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	13 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	14 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1

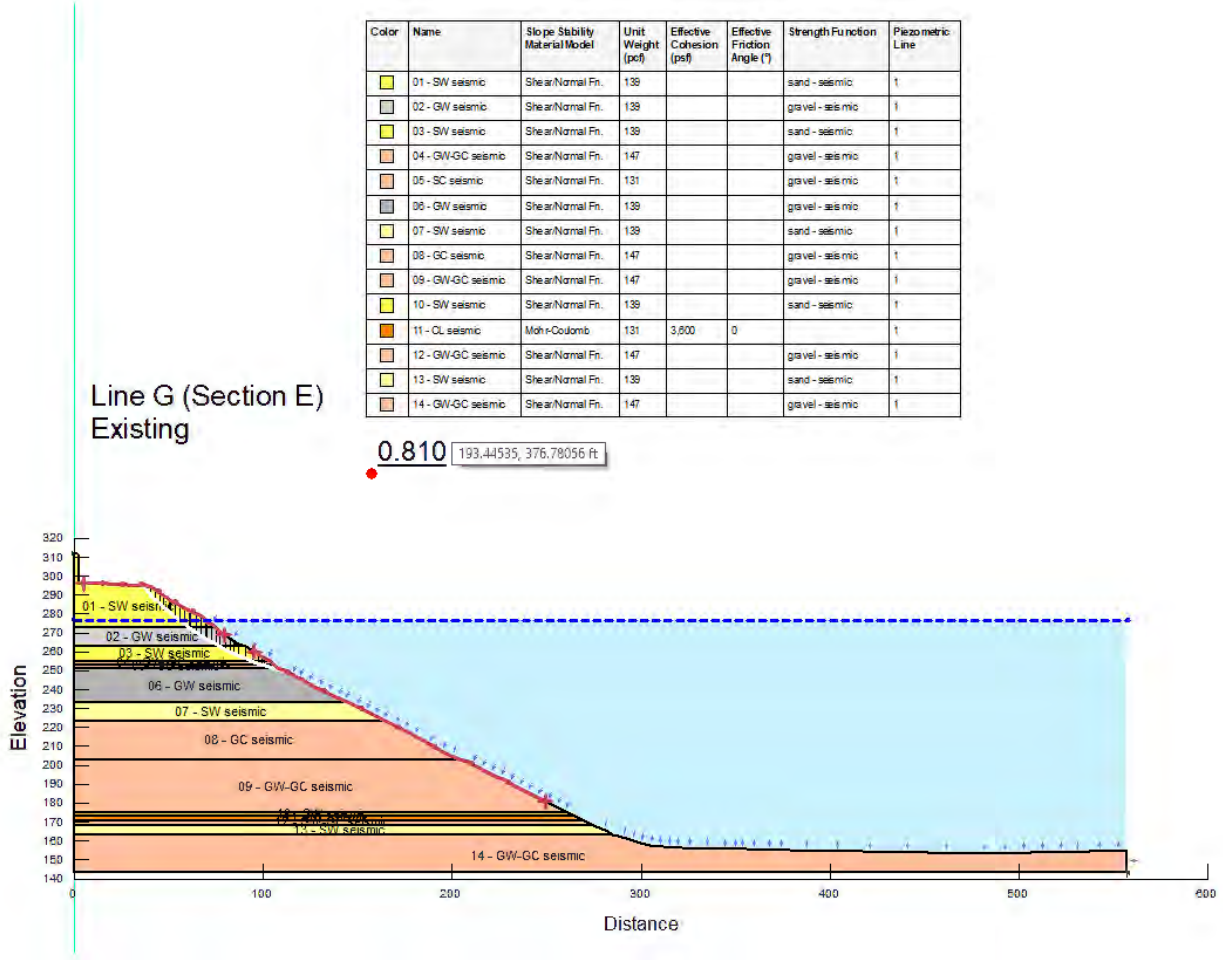
Line G (Section E)
Existing

0.791



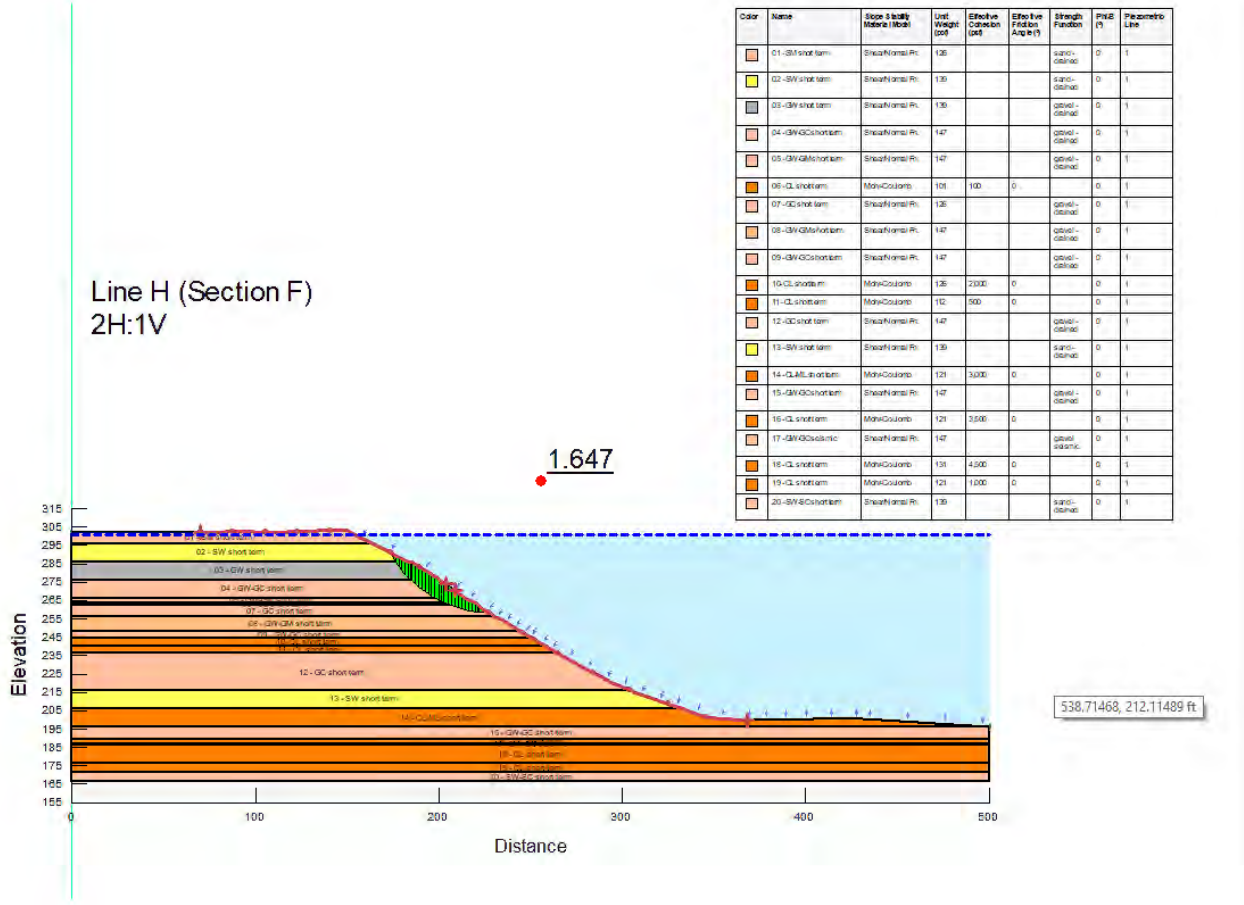
4b. Existing Pseudo Static Low Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	02 - GW seismic	Shear/Normal Fn.	139			gravel - seismic	1
	03 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	04 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	05 - SC seismic	Shear/Normal Fn.	131			gravel - seismic	1
	06 - GW seismic	Shear/Normal Fn.	139			gravel - seismic	1
	07 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	08 - GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	09 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	10 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	11 - CL seismic	Mohr-Coulomb	131	3,600	0		1
	12 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	13 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	14 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1



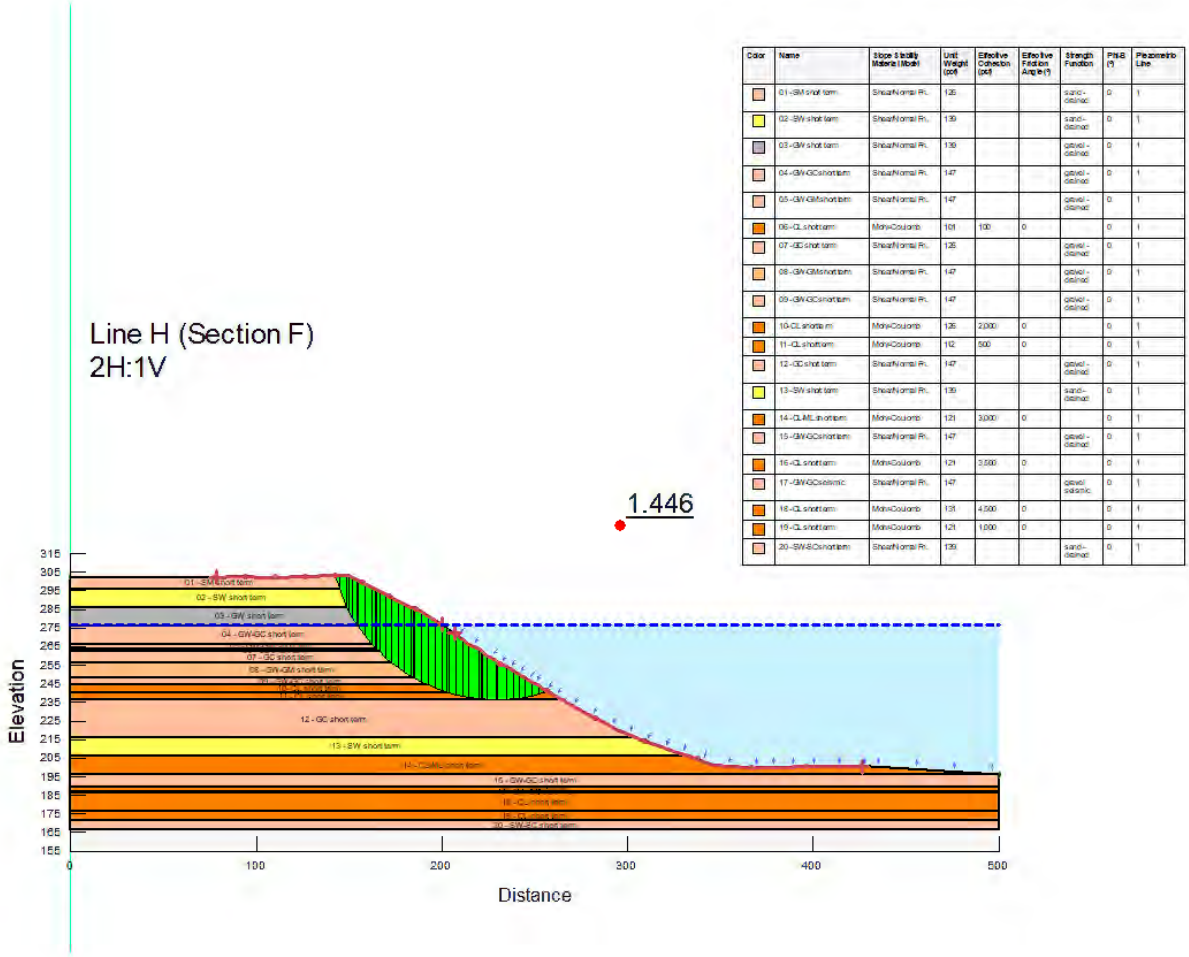
Line H (Section F)

1a. Short Term High Water



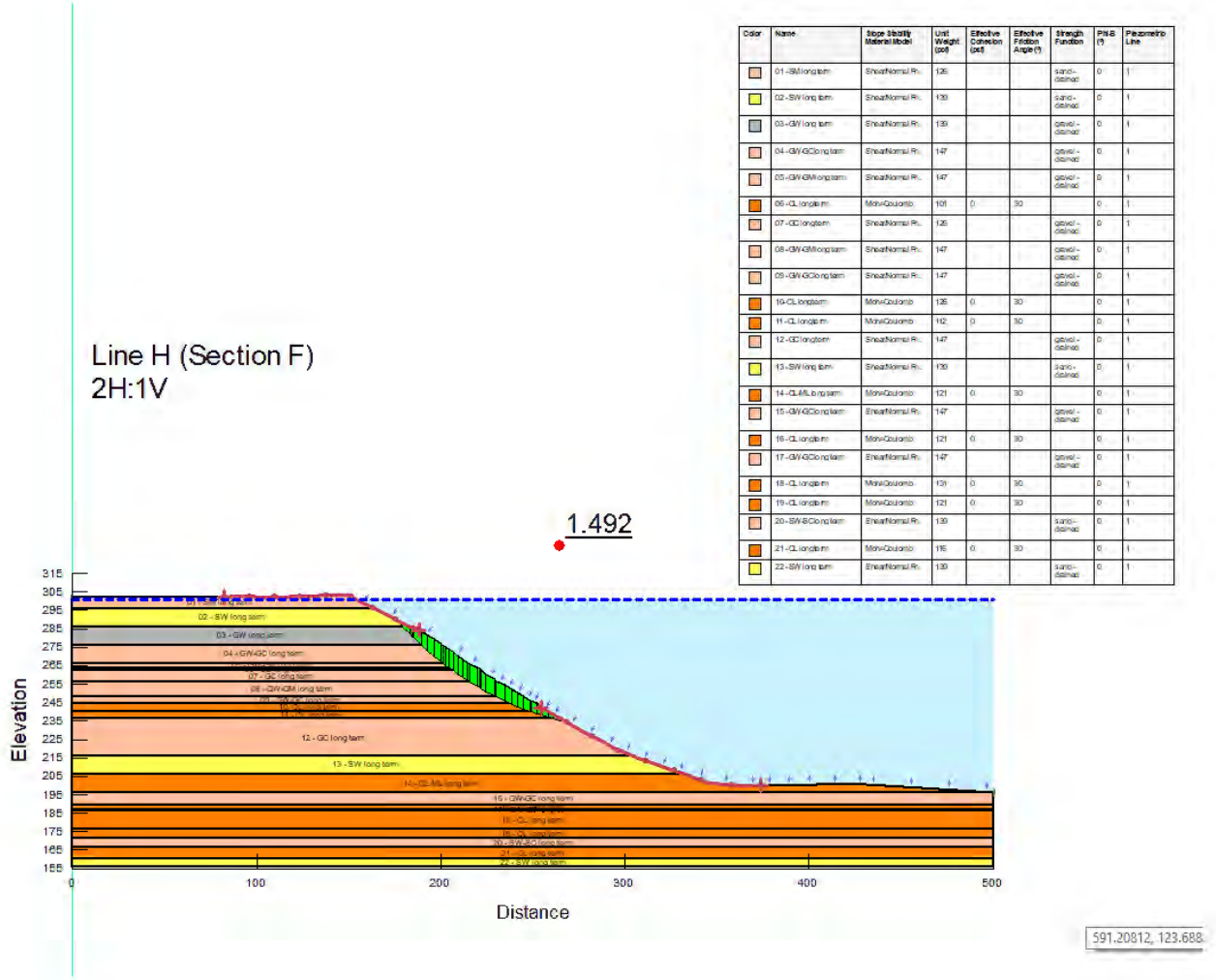
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Ru (%)	Piezometric Line
	01 - SM short term	Sheaf Normalized	126			sand - drained	0	1
	02 - SW short term	Sheaf Normalized	139			sand - drained	0	1
	03 - GW short term	Sheaf Normalized	139			gravel - drained	0	1
	04 - GW-GC short term	Sheaf Normalized	147			gravel - drained	0	1
	05 - GW-GM short term	Sheaf Normalized	147			gravel - drained	0	1
	06 - CL short term	Mohr-Coulomb	101	100	0		0	1
	07 - GC short term	Sheaf Normalized	126			gravel - drained	0	1
	08 - GW-GM short term	Sheaf Normalized	147			gravel - drained	0	1
	09 - GW-GC short term	Sheaf Normalized	147			gravel - drained	0	1
	10 - CL short term	Mohr-Coulomb	126	2,000	0		0	1
	11 - CL short term	Mohr-Coulomb	112	500	0		0	1
	12 - GC short term	Sheaf Normalized	147			gravel - drained	0	1
	13 - SW short term	Sheaf Normalized	139			sand - drained	0	1
	14 - CL-ML short term	Mohr-Coulomb	121	3,000	0		0	1
	15 - GW-GC short term	Sheaf Normalized	147			gravel - drained	0	1
	16 - CL short term	Mohr-Coulomb	121	3,500	0		0	1
	17 - GW-GC seismic	Sheaf Normalized	147			gravel - seismic	0	1
	18 - CL short term	Mohr-Coulomb	131	4,000	0		0	1
	19 - CL short term	Mohr-Coulomb	121	1,000	0		0	1
	20 - SW-SC short term	Sheaf Normalized	139			sand - drained	0	1

1b. Short Term Low Water



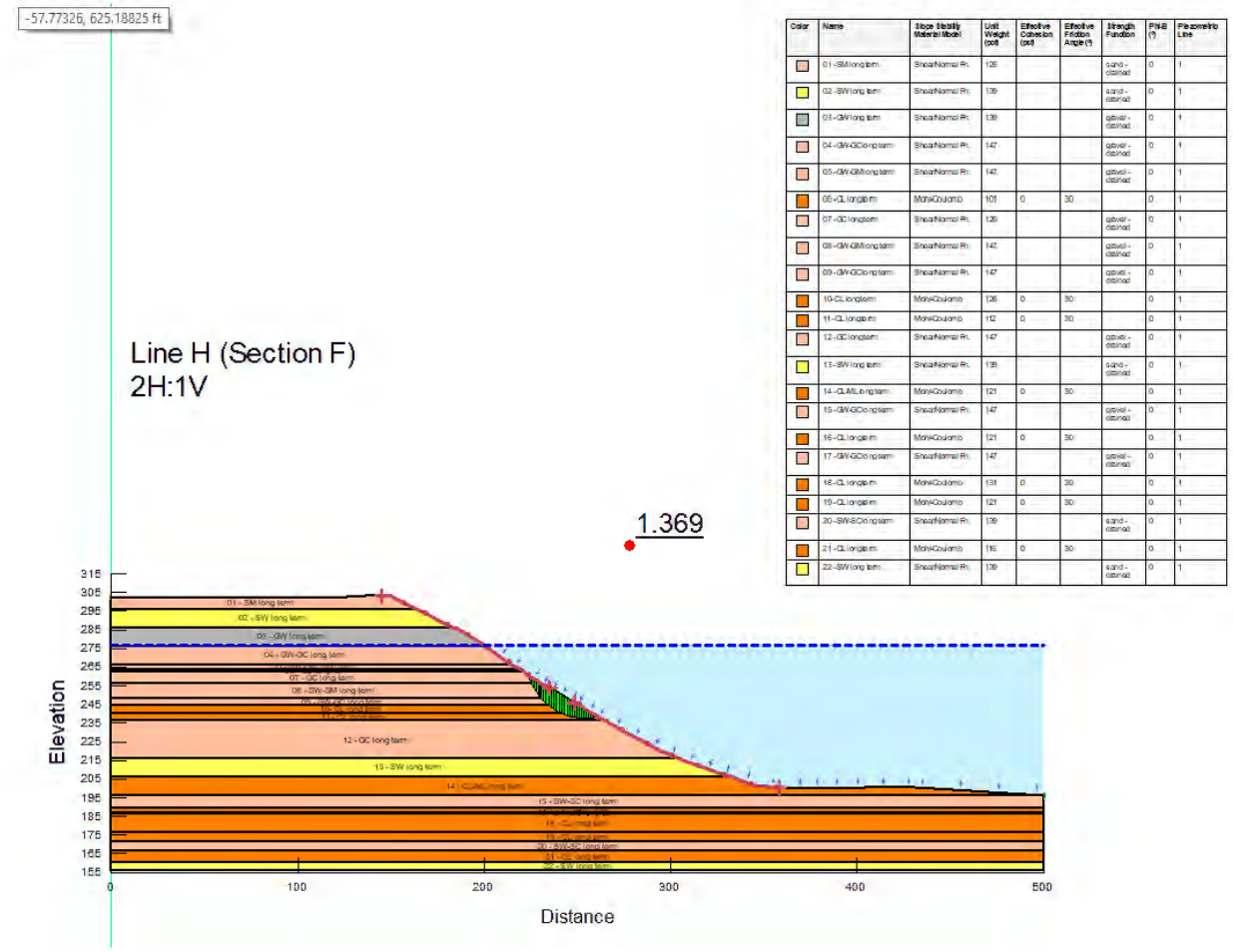
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Ru/B (*)	Piezometric Line
	01 - SM short term	Sheafn Normal Pr.	126			sand - drained	0	1
	02 - SW short term	Sheafn Normal Pr.	139			sand - drained	0	1
	03 - GW short term	Sheafn Normal Pr.	139			gravel - drained	0	1
	04 - GW-GC short term	Sheafn Normal Pr.	147			gravel - drained	0	1
	05 - GW-GM short term	Sheafn Normal Pr.	147			gravel - drained	0	1
	06 - CL short term	Mohr-Coulomb	101	100	0		0	1
	07 - GC short term	Sheafn Normal Pr.	126			gravel - drained	0	1
	08 - GW-GM short term	Sheafn Normal Pr.	147			gravel - drained	0	1
	09 - GW-GC short term	Sheafn Normal Pr.	147			gravel - drained	0	1
	10 - CL short term	Mohr-Coulomb	126	2,000	0		0	1
	11 - CL short term	Mohr-Coulomb	112	500	0		0	1
	12 - GC short term	Sheafn Normal Pr.	147			gravel - drained	0	1
	13 - SW short term	Sheafn Normal Pr.	139			sand - drained	0	1
	14 - CL-ML short term	Mohr-Coulomb	121	3,000	0		0	1
	15 - GW-GC short term	Sheafn Normal Pr.	147			gravel - drained	0	1
	16 - CL short term	Mohr-Coulomb	129	3,500	0		0	1
	17 - GW-GC seismic	Sheafn Normal Pr.	147			gravel - seismic	0	1
	18 - CL short term	Mohr-Coulomb	131	4,500	0		0	1
	19 - CL short term	Mohr-Coulomb	121	1,000	0		0	1
	20 - SW-SC short term	Sheafn Normal Pr.	139			sand - drained	0	1

2a. Long Term High Water



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Ru	Piezometric Line
	01 - SM long term	Shear Normal Pl...	126			sand - drained	0	1
	02 - SW long term	Shear Normal Pl...	130			sand - drained	0	1
	03 - GW long term	Shear Normal Pl...	139			gravel - drained	0	1
	04 - GW-GC long term	Shear Normal Pl...	147			gravel - drained	0	1
	05 - GW-GM long term	Shear Normal Pl...	147			gravel - drained	0	1
	06 - CL long term	Mohr-Coulomb	101	0	30		0	1
	07 - GC long term	Shear Normal Pl...	126			gravel - drained	0	1
	08 - GW-GM long term	Shear Normal Pl...	147			gravel - drained	0	1
	09 - GW-GC long term	Shear Normal Pl...	147			gravel - drained	0	1
	10 - CL long term	Mohr-Coulomb	126	0	30		0	1
	11 - CL long term	Mohr-Coulomb	142	0	30		0	1
	12 - GC long term	Shear Normal Pl...	147			gravel - drained	0	1
	13 - SW long term	Shear Normal Pl...	130			sand - drained	0	1
	14 - CL-ML long term	Mohr-Coulomb	121	0	30		0	1
	15 - GW-GC long term	Shear Normal Pl...	147			gravel - drained	0	1
	16 - CL long term	Mohr-Coulomb	121	0	30		0	1
	17 - GW-GC long term	Shear Normal Pl...	147			gravel - drained	0	1
	18 - CL long term	Mohr-Coulomb	131	0	30		0	1
	19 - CL long term	Mohr-Coulomb	121	0	30		0	1
	20 - SW-SC long term	Shear Normal Pl...	139			sand - drained	0	1
	21 - CL long term	Mohr-Coulomb	116	0	30		0	1
	22 - SW long term	Shear Normal Pl...	139			sand - drained	0	1

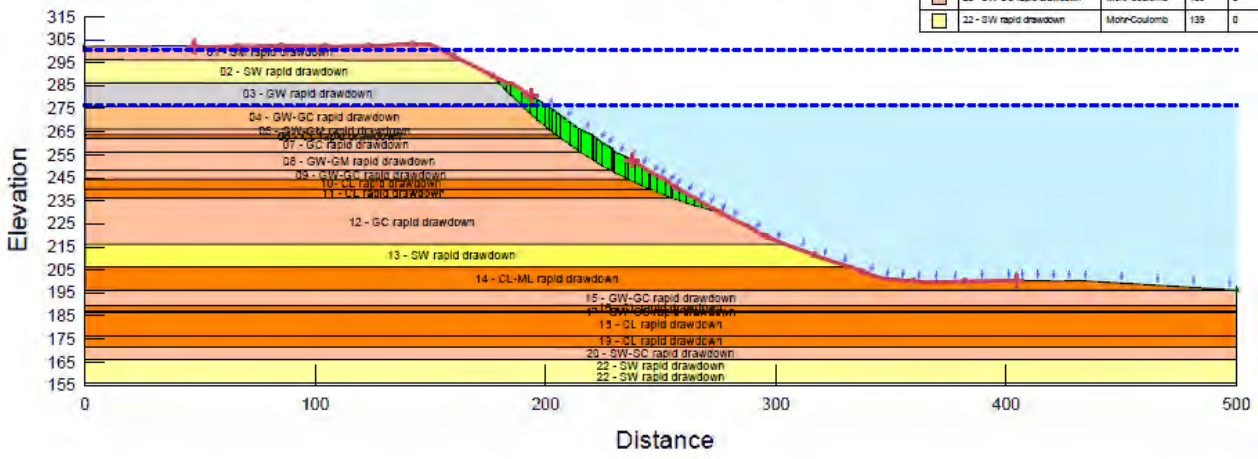
2b. Long Term Low Water



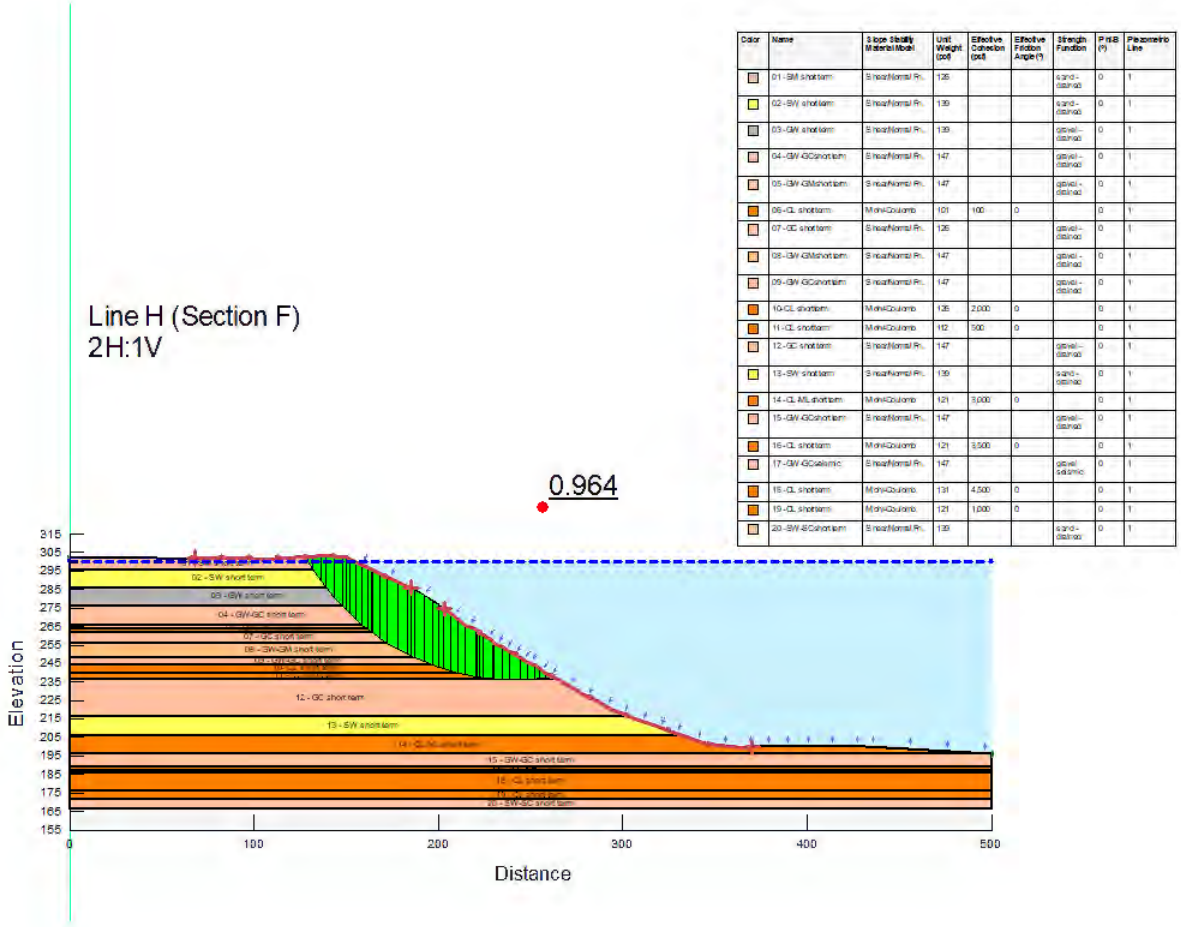
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Pi/B (°)	Piezometric Line
	01 - SM long term	Shear/Normal Rl...	126			sand - default	0	1
	02 - SW long term	Shear/Normal Rl...	139			sand - default	0	1
	03 - GW long term	Shear/Normal Rl...	139			gravel - default	0	1
	04 - GW-GC long term	Shear/Normal Rl...	147			gravel - default	0	1
	05 - GW-GM long term	Shear/Normal Rl...	147			gravel - default	0	1
	06 - CL long term	Mohr-Coulomb	101	0	30		0	1
	07 - GC long term	Shear/Normal Rl...	126			gravel - default	0	1
	08 - GW-GM long term	Shear/Normal Rl...	147			gravel - default	0	1
	09 - GW-GC long term	Shear/Normal Rl...	147			gravel - default	0	1
	10 - CL long term	Mohr-Coulomb	126	0	30		0	1
	11 - CL long term	Mohr-Coulomb	112	0	30		0	1
	12 - GC long term	Shear/Normal Rl...	147			gravel - default	0	1
	13 - SW long term	Shear/Normal Rl...	139			sand - default	0	1
	14 - CL-ML long term	Mohr-Coulomb	121	0	30		0	1
	15 - GW-GC long term	Shear/Normal Rl...	147			gravel - default	0	1
	16 - CL long term	Mohr-Coulomb	121	0	30		0	1
	17 - GW-GC long term	Shear/Normal Rl...	147			gravel - default	0	1
	18 - CL long term	Mohr-Coulomb	133	0	30		0	1
	19 - CL long term	Mohr-Coulomb	121	0	30		0	1
	20 - SW-SC long term	Shear/Normal Rl...	139			sand - default	0	1
	21 - CL long term	Mohr-Coulomb	116	0	30		0	1
	22 - SW long term	Shear/Normal Rl...	139			sand - default	0	1

3a. Rapid Drawdown High Water

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	01 - SM rapid drawdown	Mohr-Coulomb	126	0	30
	02 - SW rapid drawdown	Mohr-Coulomb	139	0	39
	03 - GW rapid drawdown	Mohr-Coulomb	139	0	41
	04 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38
	05 - GW-GM rapid drawdown	Mohr-Coulomb	147	0	38
	06 - CL rapid drawdown	Mohr-Coulomb	101	0	30
	07 - GC rapid drawdown	Mohr-Coulomb	126	0	38
	08 - GW-GM rapid drawdown	Mohr-Coulomb	147	0	38
	09 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38
	10- CL rapid drawdown	Mohr-Coulomb	126	0	30
	11 - CL rapid drawdown	Mohr-Coulomb	112	0	30
	12 - GC rapid drawdown	Mohr-Coulomb	147	0	38
	13 - SW rapid drawdown	Mohr-Coulomb	139	0	39
	14 - CL-ML rapid drawdown	Mohr-Coulomb	121	0	30
	15 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38
	16 - CL rapid drawdown	Mohr-Coulomb	121	0	30
	17 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38
	18 - CL rapid drawdown	Mohr-Coulomb	131	0	30
	19 - CL rapid drawdown	Mohr-Coulomb	121	0	30
	20 - SW-SC rapid drawdown	Mohr-Coulomb	139	0	30
	22 - SW rapid drawdown	Mohr-Coulomb	139	0	39

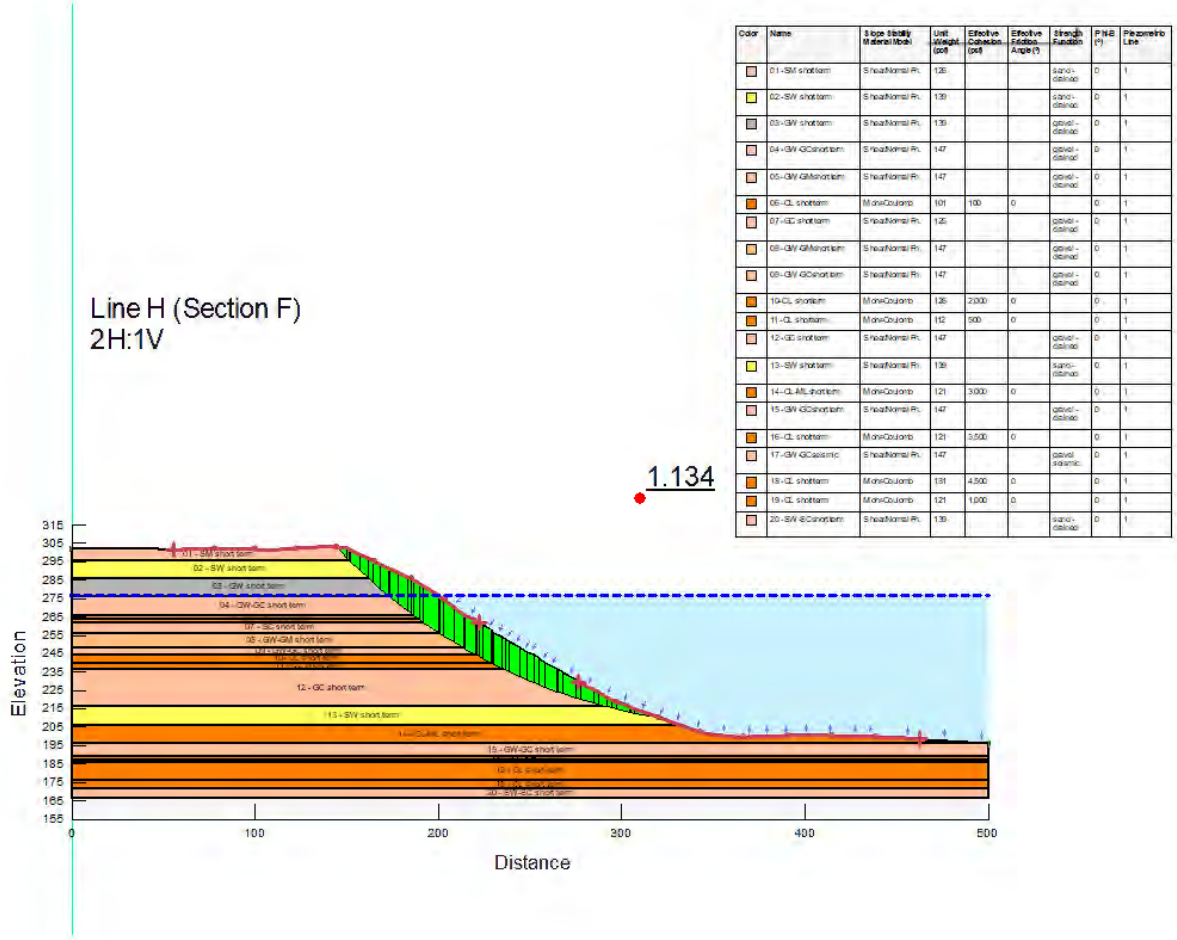


4a. Pseudo Static High Water



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	P+B (°)	Piezometric Line
	01 - SM short term	Sheaf/Normal Fr...	126			sand - drained	0	1
	02 - SW short term	Sheaf/Normal Fr...	139			sand - drained	0	1
	03 - GW short term	Sheaf/Normal Fr...	139			gravel - drained	0	1
	04 - GW-GC short term	Sheaf/Normal Fr...	147			gravel - drained	0	1
	05 - GW-GM short term	Sheaf/Normal Fr...	147			gravel - drained	0	1
	06 - CL short term	Mohr-Coulomb	101	100	0		0	1
	07 - GC short term	Sheaf/Normal Fr...	126			gravel - drained	0	1
	08 - GW-GM short term	Sheaf/Normal Fr...	147			gravel - drained	0	1
	09 - GW-GC short term	Sheaf/Normal Fr...	147			gravel - drained	0	1
	10 - CL short term	Mohr-Coulomb	126	2,000	0		0	1
	11 - CL short term	Mohr-Coulomb	112	500	0		0	1
	12 - GC short term	Sheaf/Normal Fr...	147			gravel - drained	0	1
	13 - SW short term	Sheaf/Normal Fr...	139			sand - drained	0	1
	14 - CL-ML short term	Mohr-Coulomb	121	3,000	0		0	1
	15 - GW-GC short term	Sheaf/Normal Fr...	147			gravel - drained	0	1
	16 - CL short term	Mohr-Coulomb	121	3,500	0		0	1
	17 - GW-GC seismic	Sheaf/Normal Fr...	147			gravel seismic	0	1
	18 - CL short term	Mohr-Coulomb	131	4,500	0		0	1
	19 - CL short term	Mohr-Coulomb	121	1,000	0		0	1
	20 - SW-SC short term	Sheaf/Normal Fr...	139			sand - drained	0	1

4b. Pseudo Static Low Water



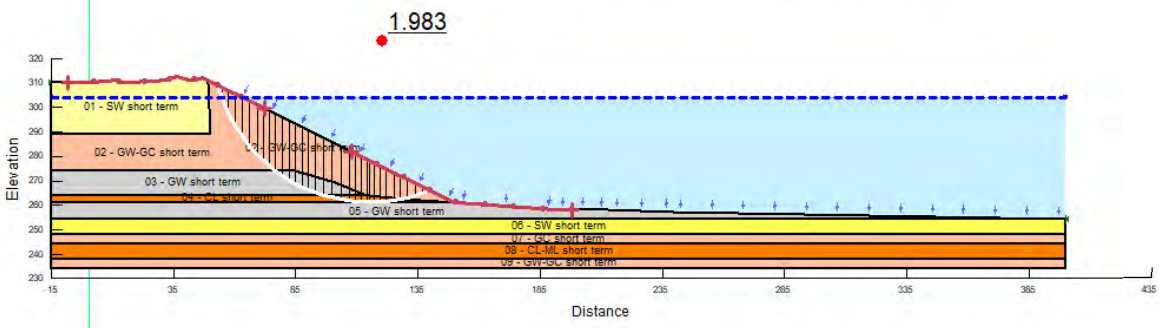
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	P:N:B (°)	Piezometric Line
	01-SM short term	SHeatNormal Pr.	126			sand - drained	0	1
	02-SW short term	SHeatNormal Pr.	139			sand - drained	0	1
	03-GW short term	SHeatNormal Pr.	139			gravel - drained	0	1
	04-GW-GC short term	SHeatNormal Pr.	147			gravel - drained	0	1
	05-GW-GM short term	SHeatNormal Pr.	147			gravel - drained	0	1
	06-CL short term	MohrCoulomb	101	100	0		0	1
	07-GC short term	SHeatNormal Pr.	126			gravel - drained	0	1
	08-GW-GM short term	SHeatNormal Pr.	147			gravel - drained	0	1
	09-GW-GC short term	SHeatNormal Pr.	147			gravel - drained	0	1
	10-CL short term	MohrCoulomb	126	2,000	0		0	1
	11-CL short term	MohrCoulomb	112	500	0		0	1
	12-GC short term	SHeatNormal Pr.	147			gravel - drained	0	1
	13-SW short term	SHeatNormal Pr.	139			sand - drained	0	1
	14-CL-ML short term	MohrCoulomb	121	3,000	0		0	1
	15-GW-GC short term	SHeatNormal Pr.	147			gravel - drained	0	1
	16-CL short term	MohrCoulomb	121	3,500	0		0	1
	17-GW-GC seismic	SHeatNormal Pr.	147			gravel seismic	0	1
	18-CL short term	MohrCoulomb	131	4,500	0		0	1
	19-CL short term	MohrCoulomb	121	1,000	0		0	1
	20-SW-SC short term	SHeatNormal Pr.	139			sand - drained	0	1

Line I

1a. Short Term High Water

Line I - Villa Park Slide
2H:1V Fill

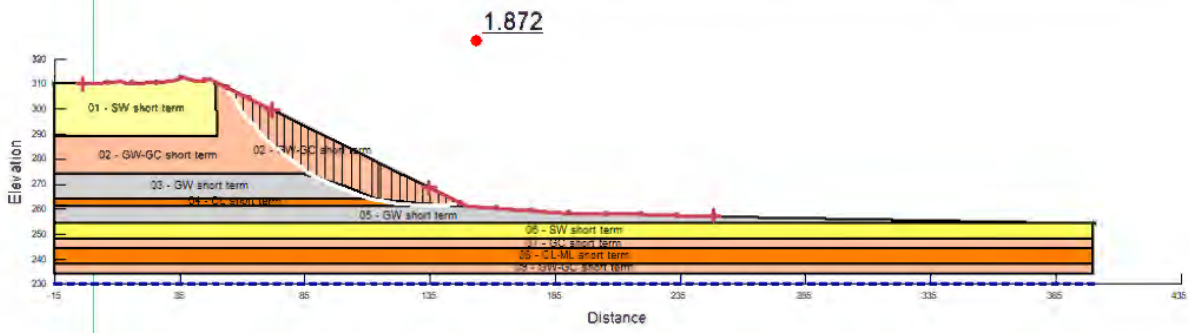
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	03 - GW short term	Shear/Normal Fn.	149			gravel - drained	1
	04 - CL short term	Mohr-Coulomb	112	500	0		1
	05 - GW short term	Shear/Normal Fn.	149			gravel - drained	1
	06 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	07 - GC short term	Shear/Normal Fn.	126			gravel - drained	1
	08 - CL-ML short term	Mohr-Coulomb	112	500	0		1
	09 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1



1b. Short Term Low Water

Line I - Villa Park Slide
2H:1V Fill

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1
	03 - GW short term	Shear/Normal Fn.	149			gravel - drained	1
	04 - CL short term	Mohr-Coulomb	112	500	0		1
	05 - GW short term	Shear/Normal Fn.	149			gravel - drained	1
	06 - SW short term	Shear/Normal Fn.	139			sand - drained	1
	07 - GC short term	Shear/Normal Fn.	126			gravel - drained	1
	08 - CL-ML short term	Mohr-Coulomb	112	500	0		1
	09 - GW-GC short term	Shear/Normal Fn.	147			gravel - drained	1

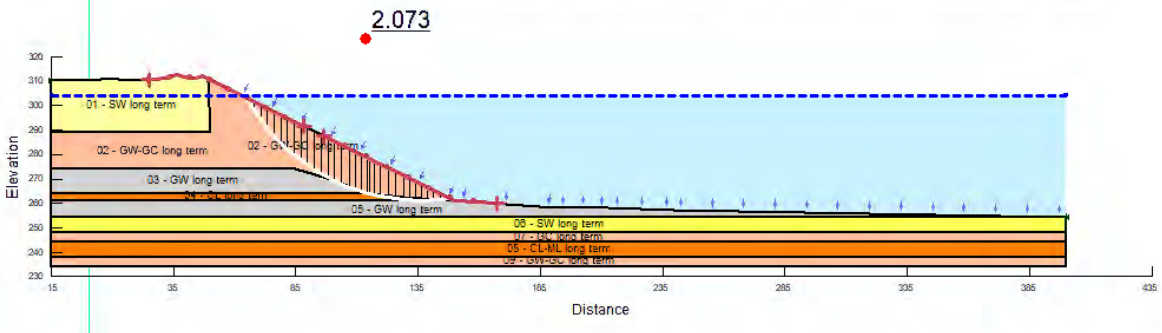


2a. Long Term High Water

Line I - Villa Park Slide
2H:1V Fill

375.08737, 495.95676 ft

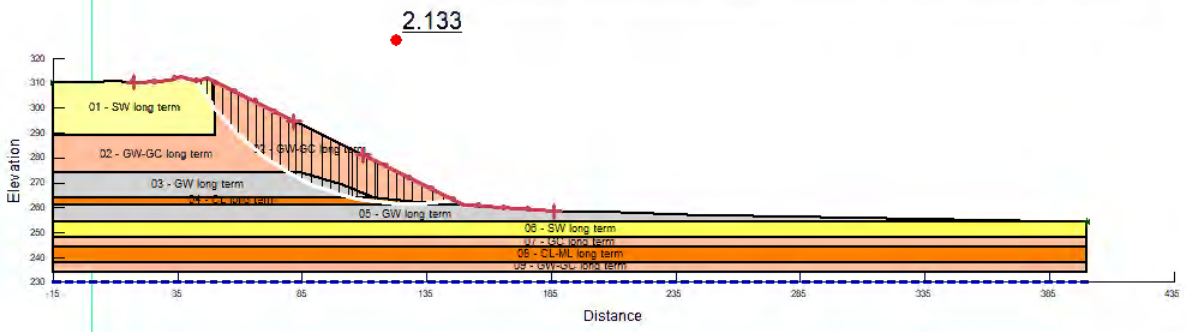
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	03 - GW long term	Shear/Normal Fn.	149			gravel - drained	1
	04 - CL long term	Mohr-Coulomb	112	0	30		1
	05 - GW long term	Shear/Normal Fn.	149			gravel - drained	1
	06 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	07 - GC long term	Shear/Normal Fn.	126			gravel - drained	1
	08 - CL-ML long term	Mohr-Coulomb	112	0	30		1
	09 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1



2b. Long Term Low Water

Line I - Villa Park Slide
2H:1V Fill

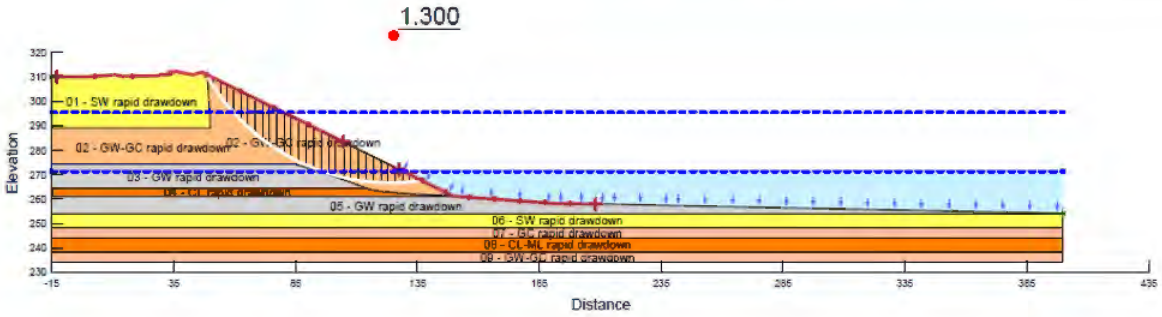
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	02 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1
	03 - GW long term	Shear/Normal Fn.	149			gravel - drained	1
	04 - CL long term	Mohr-Coulomb	112	0	30		1
	05 - GW long term	Shear/Normal Fn.	149			gravel - drained	1
	06 - SW long term	Shear/Normal Fn.	139			sand - drained	1
	07 - GC long term	Shear/Normal Fn.	126			gravel - drained	1
	08 - CL-ML long term	Mohr-Coulomb	112	0	30		1
	09 - GW-GC long term	Shear/Normal Fn.	147			gravel - drained	1



3a. Rapid Drawdown High Water

Line I - Villa Park Slide
2H:1V Fill

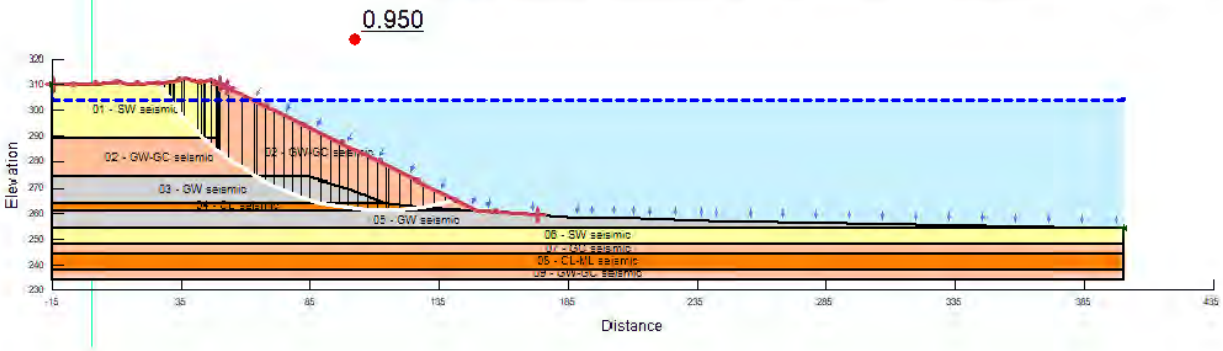
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Cohesion R (psf)	Phi R (°)	Piezometric Line	Piezometric Line After Drawdown
	01 - SW rapid drawdown	Mohr-Coulomb	139	0	39	0	0	1	2
	02 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38	860	10	1	2
	03 - GW rapid drawdown	Mohr-Coulomb	149	0	41	0	0	1	2
	04 - CL rapid drawdown	Mohr-Coulomb	112	0	30	500	0	1	2
	05 - GW rapid drawdown	Mohr-Coulomb	149	0	41	0	0	1	2
	06 - SW rapid drawdown	Mohr-Coulomb	139	0	39	0	0	1	2
	07 - GC rapid drawdown	Mohr-Coulomb	126	0	38	860	10	1	2
	08 - CL-ML rapid drawdown	Mohr-Coulomb	112	0	30	500	0	1	2
	09 - GW-GC rapid drawdown	Mohr-Coulomb	147	0	38	860	10	1	2



4a. Pseudo Static High Water

Line I - Villa Park Slide
2H:1V Fill

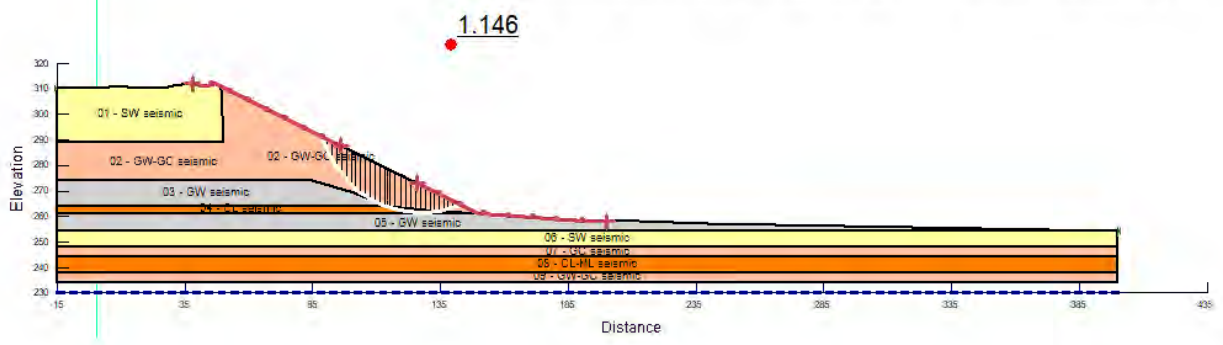
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	02 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	03 - GW seismic	Shear/Normal Fn.	149			gravel - seismic	1
	04 - CL seismic	Mohr-Coulomb	112	400	0		1
	05 - GW seismic	Shear/Normal Fn.	149			gravel - seismic	1
	06 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	07 - GC seismic	Shear/Normal Fn.	126			gravel - seismic	1
	08 - CL-ML seismic	Mohr-Coulomb	112	400	0		1
	09 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1



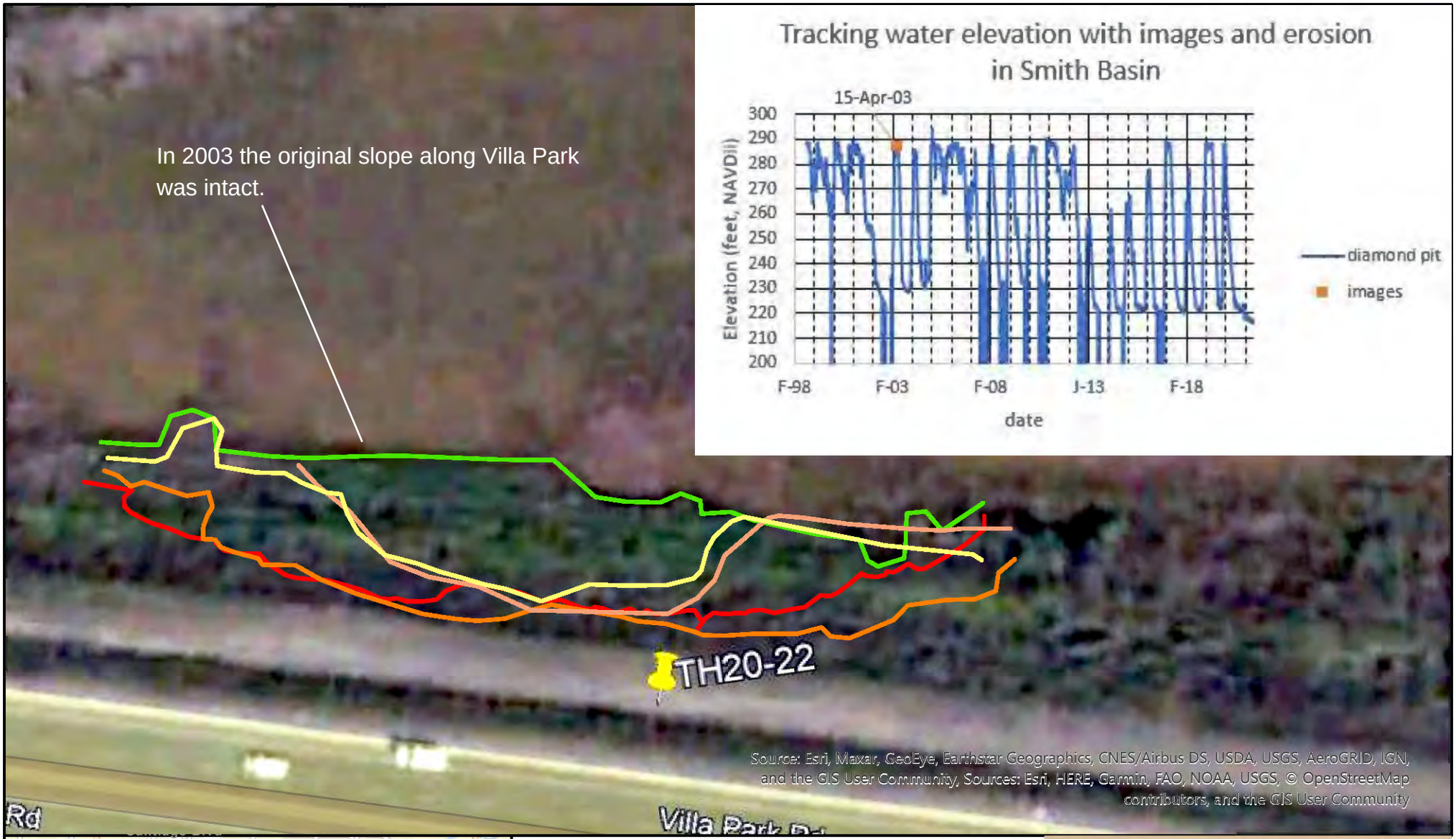
4b. Pseudo Static Low Water

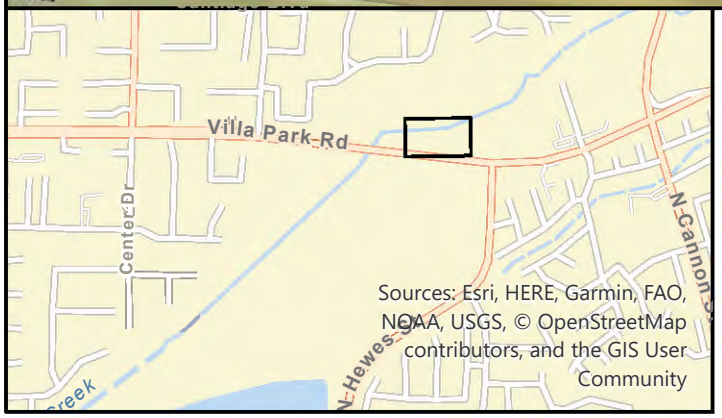
Line I - Villa Park Slide
2H:1V Fill

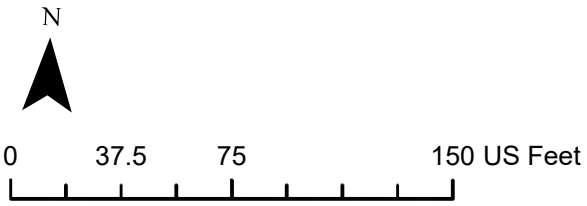
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Strength Function	Piezometric Line
	01 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	02 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1
	03 - GW seismic	Shear/Normal Fn.	149			gravel - seismic	1
	04 - CL seismic	Mohr-Coulomb	112	400	0		1
	05 - GW seismic	Shear/Normal Fn.	149			gravel - seismic	1
	06 - SW seismic	Shear/Normal Fn.	139			sand - seismic	1
	07 - GC seismic	Shear/Normal Fn.	126			gravel - seismic	1
	08 - CL-ML seismic	Mohr-Coulomb	112	400	0		1
	09 - GW-GC seismic	Shear/Normal Fn.	147			gravel - seismic	1



ATTACHMENT C-8 - Detailed analysis of Smith Basin slope failure using Google Earth imagery







Smith Slide Scarp

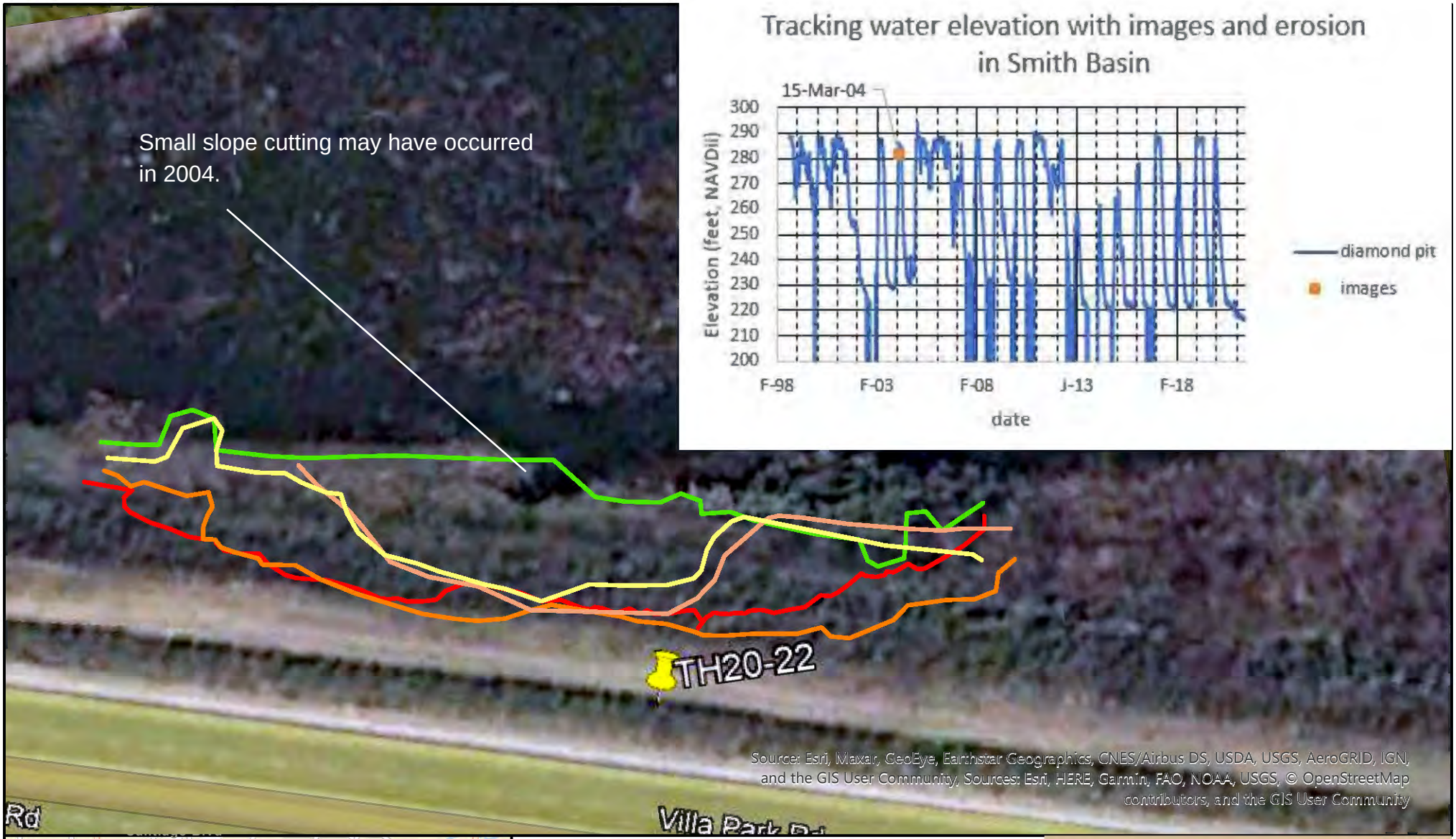
Date

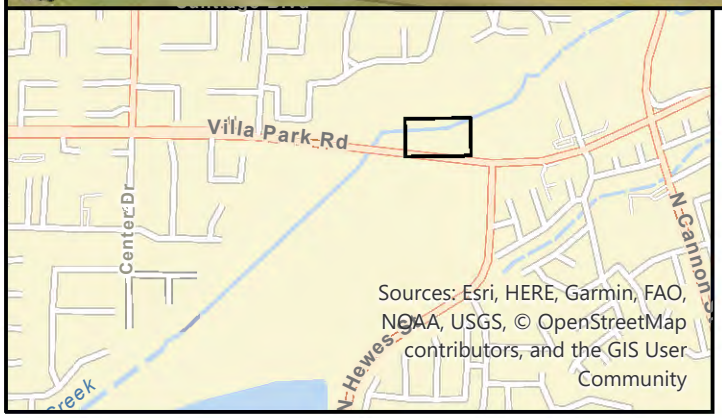
- 4/1/2003
- 8/1/2005
- 10/1/2007
- 3/1/2011
- 5/1/2019

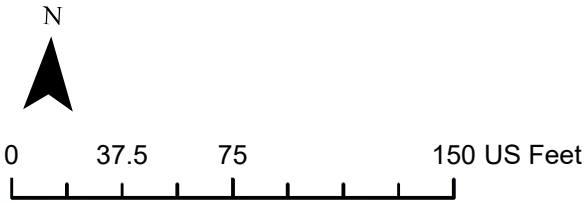
Google Earth Apr 2003

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3







Smith Slide Scarp

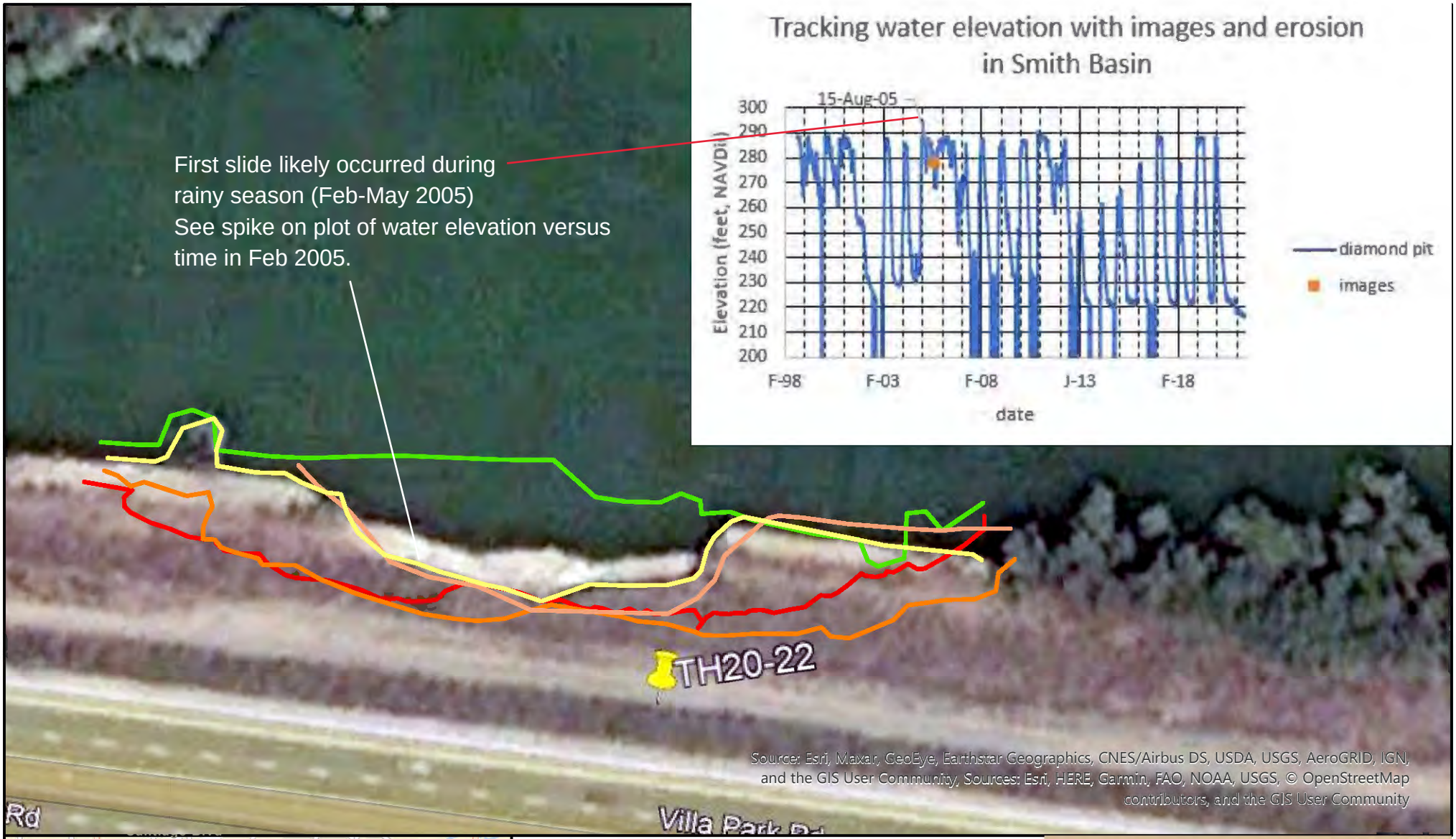
Date

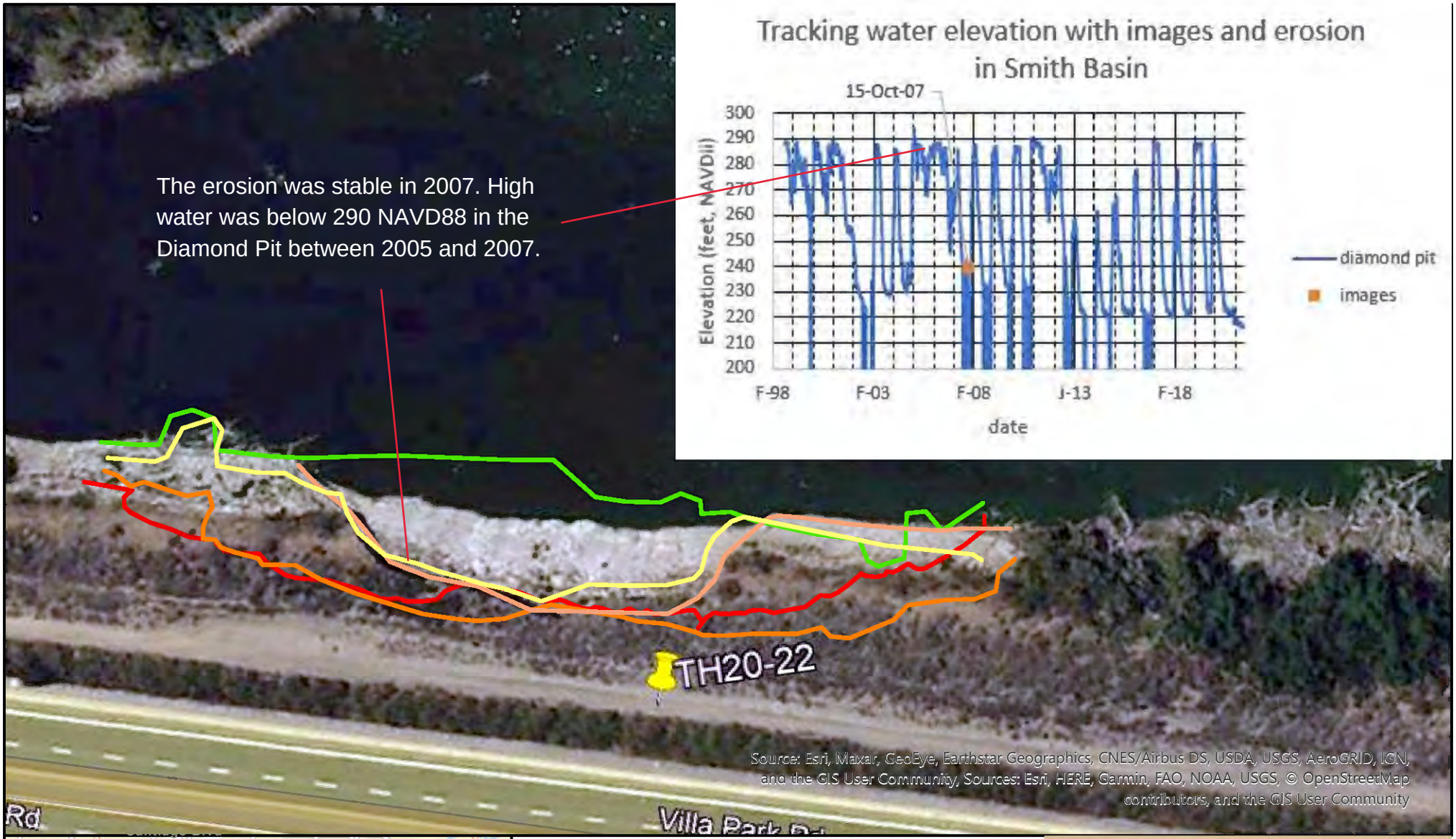
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- 8/1/2005
- 10/1/2007
- 3/1/2011
- 5/1/2019

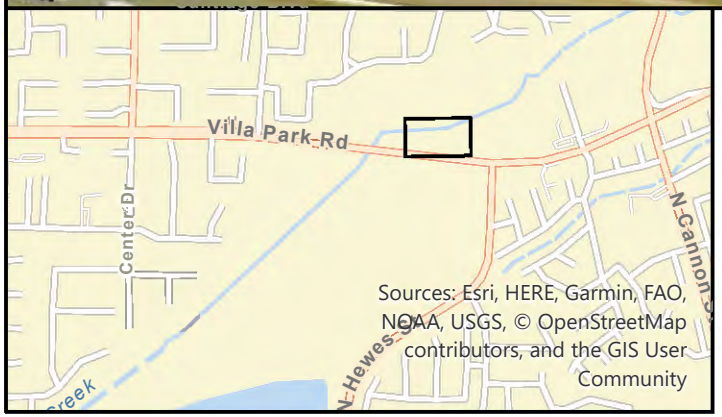
Google Earth Mar 2004

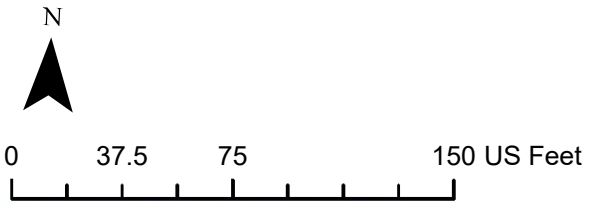
RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3


First slide likely occurred during rainy season (Feb-May 2005)
See spike on plot of water elevation versus time in Feb 2005.
Tracking water elevation with images and erosion in Smith Basin
15-Aug-05
Elevation (feet, NAVDii)
300
290
280
270
260
250
240
230
220
210
200
F-98
F-03
F-08
J-13
F-18
date
diamond pit
images
TH20-22
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Villa Park Rd
Villa Park Rd
Center Dr
N Gannon
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
N
0
37.5
75
150 US Feet
Smith Slide Scarp Date
4/1/2003
8/1/2005
10/1/2007
3/1/2011
5/1/2019
Google Earth Aug 2005 RGB
Red: Band_1
Green: Band_2
Blue: Band_3





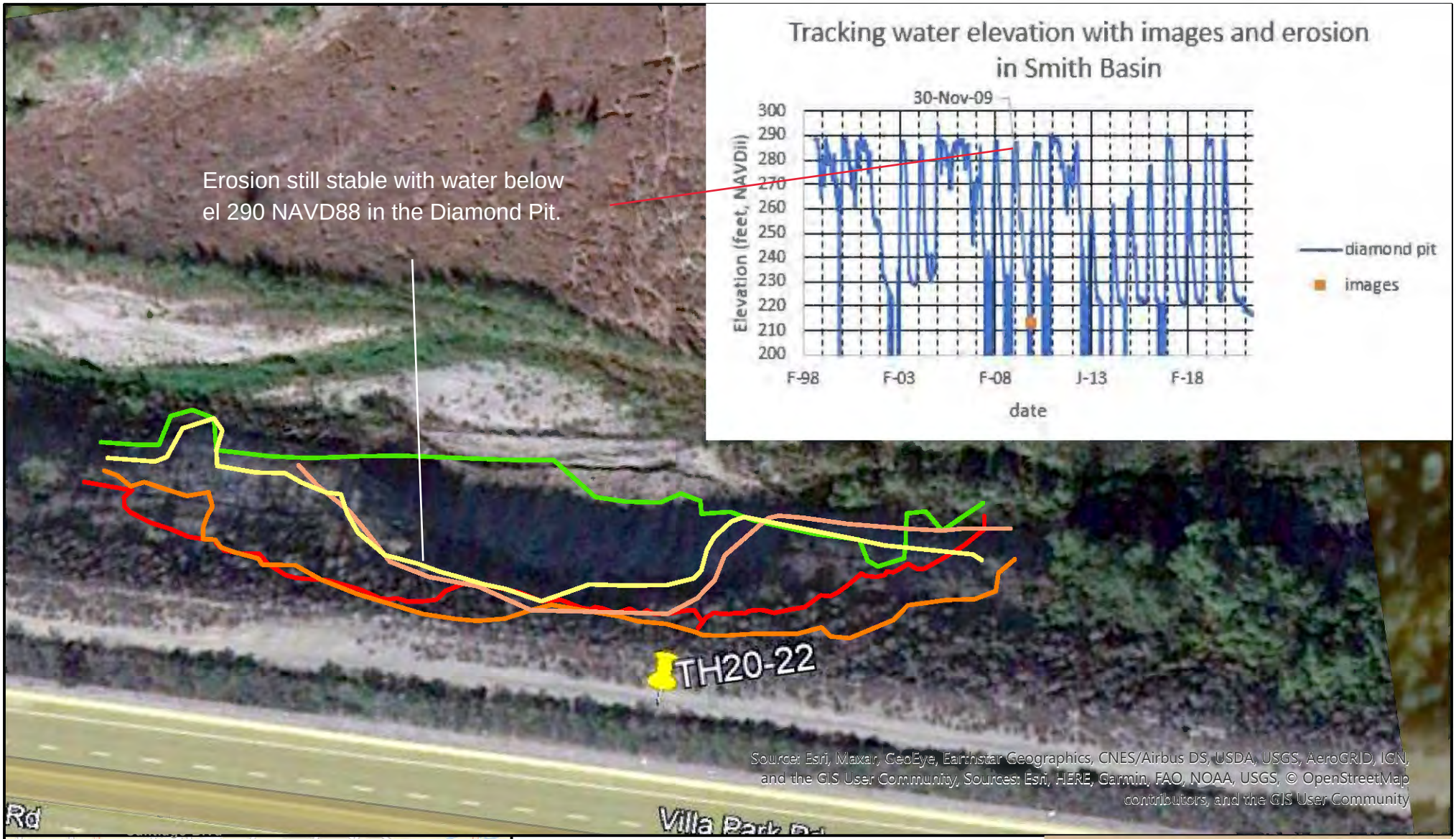


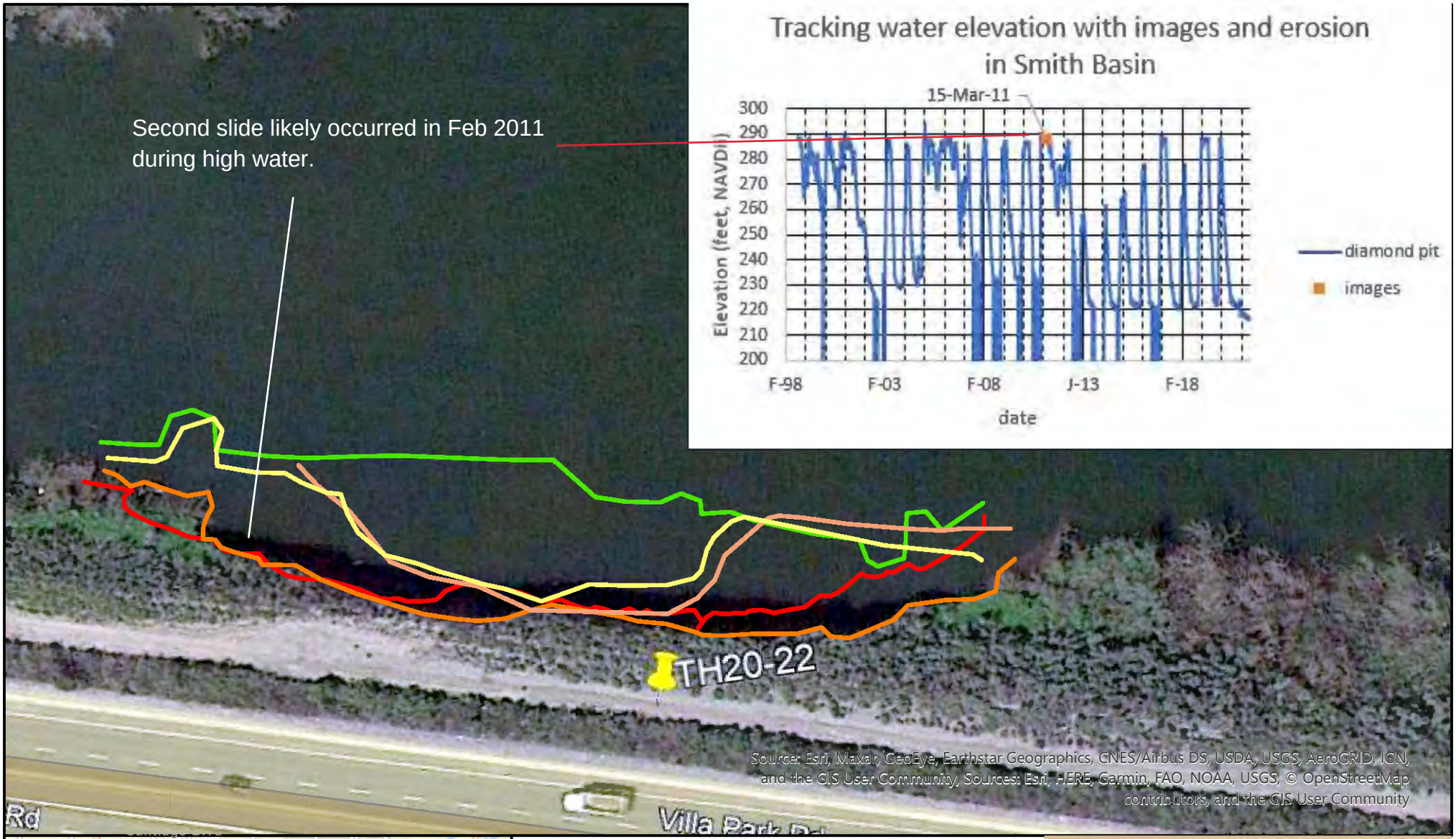
Smith Slide Scarp Date

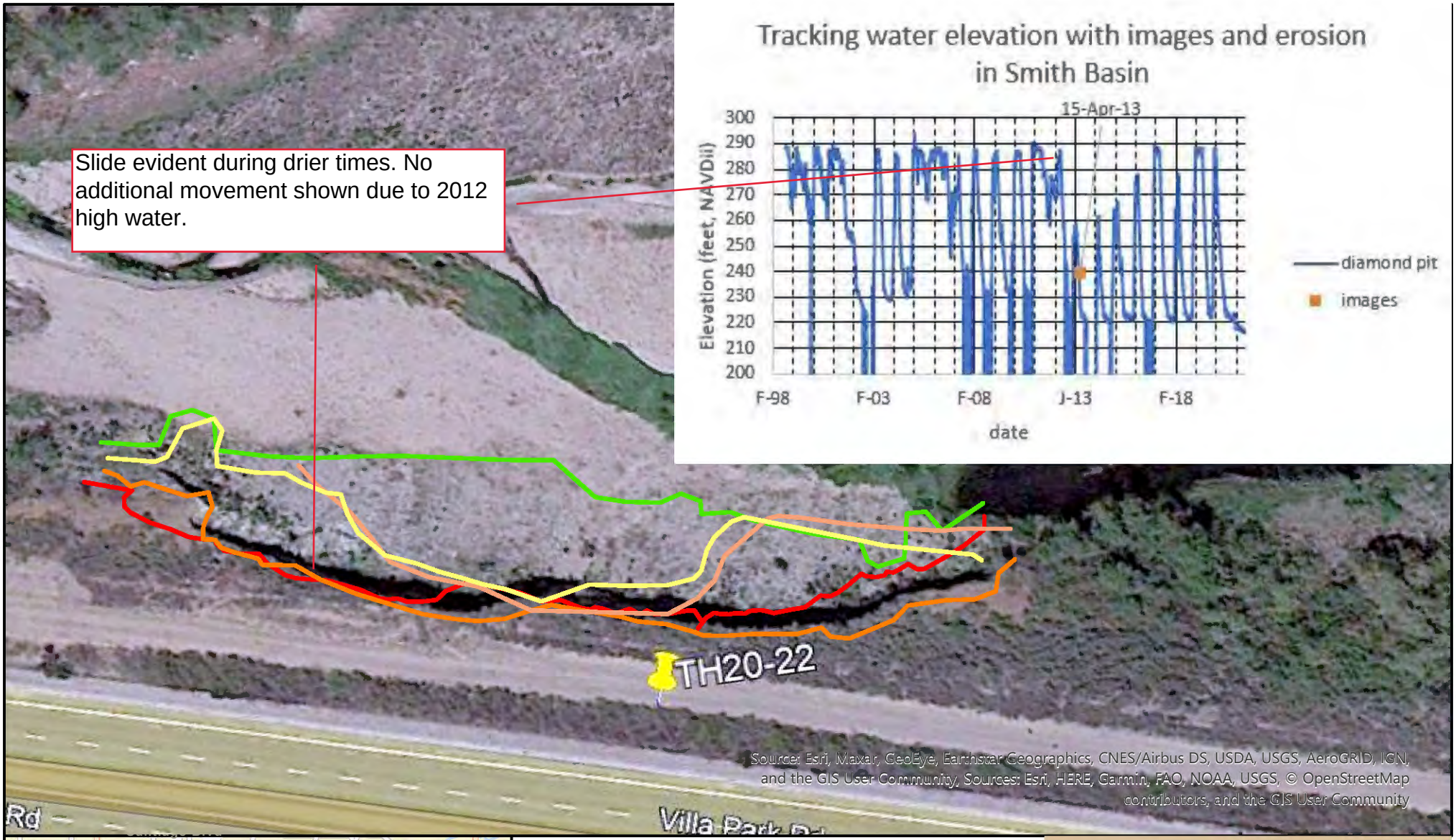
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- 8/1/2005
- 10/1/2007
- 3/1/2011
- 5/1/2019

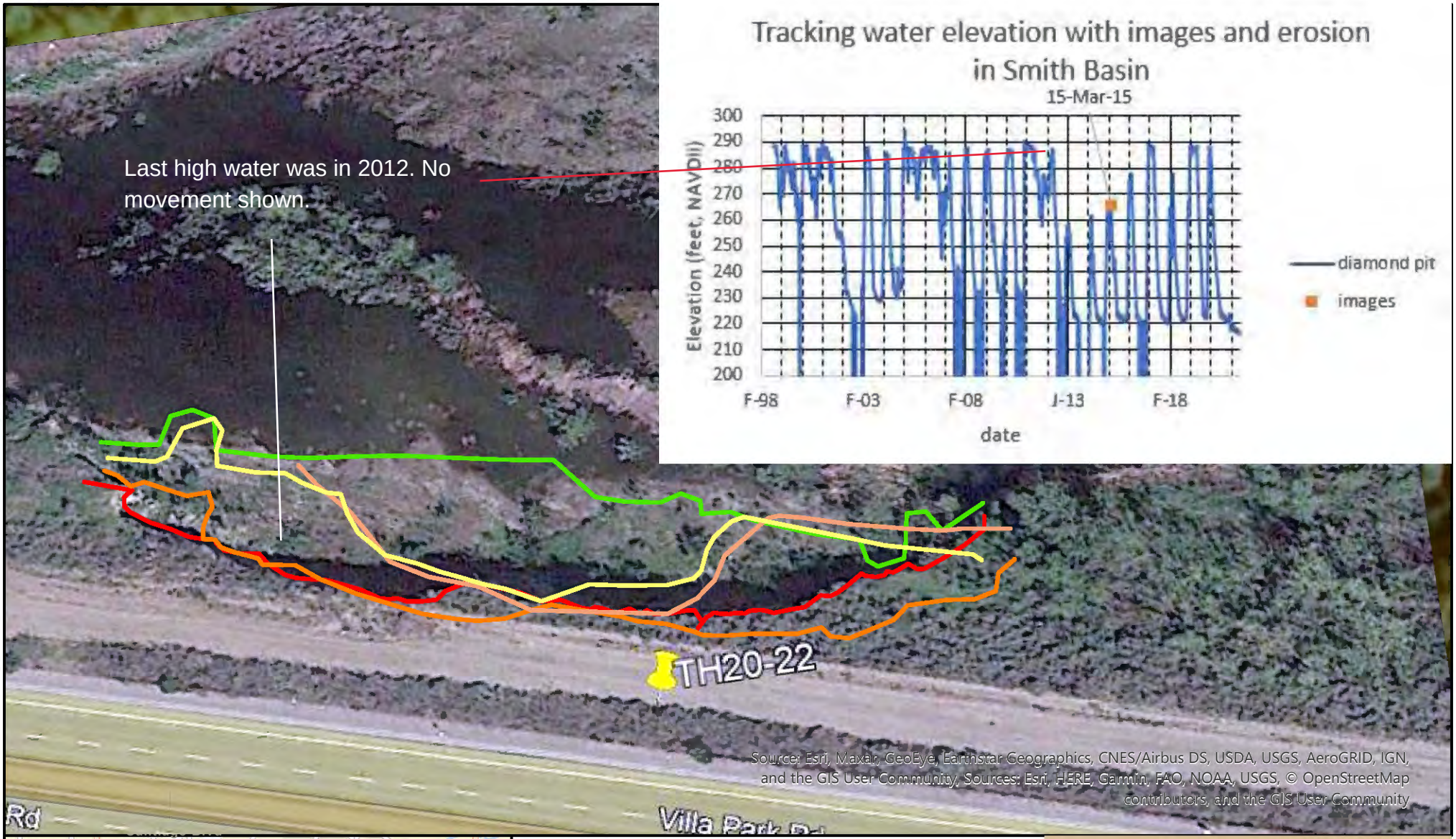
Google Earth Oct 2007 RGB

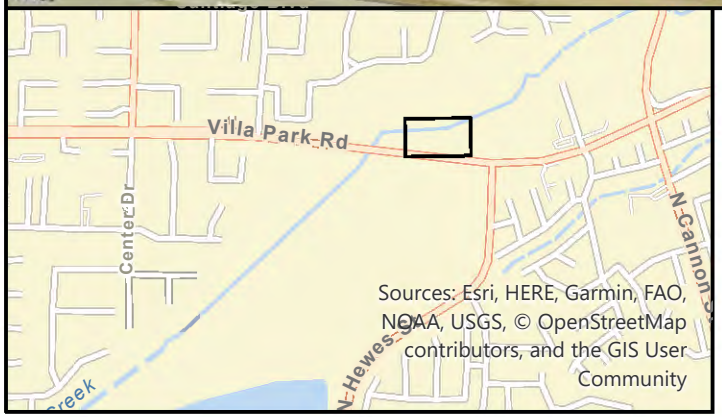
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- Green: Band_2
- Blue: Band_3

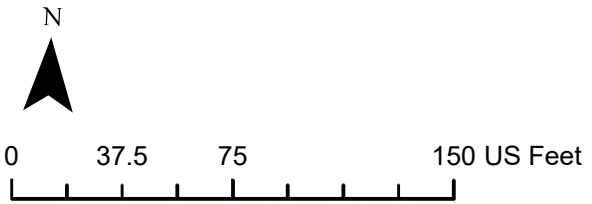

Erosion still stable with water below
el 290 NAVD88 in the Diamond Pit.
Tracking water elevation with images and erosion
in Smith Basin
30-Nov-09
Elevation (feet, NAVDii)
300
290
280
270
260
250
240
230
220
210
200
F-98
F-03
F-08
J-13
F-18
date
diamond pit
images
TH20-22
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Villa Park Rd
Villa Park Rd
Center Dr
N Gannon
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
N
0
37.5
75
150 US Feet
Smith Slide Scarp
Date
4/1/2003
8/1/2005
10/1/2007
3/1/2011
5/1/2019
Google Earth Nov 2009
RGB
Red: Band_1
Green: Band_2
Blue: Band_3


Second slide likely occurred in Feb 2011 during high water.
Tracking water elevation with images and erosion in Smith Basin
15-Mar-11
Elevation (feet, NAVD88)
300
290
280
270
260
250
240
230
220
210
200
F-98
F-03
F-08
J-13
F-18
date
diamond pit
images
TH20-22
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Villa Park Rd
Villa Park Rd
Center Dr
N Gannon
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
N
0
37.5
75
150 US Feet
Smith Slide Scarp Date
4/1/2003
8/1/2005
10/1/2007
3/1/2011
5/1/2019
Google Earth Mar 2011 RGB
Red: Band_1
Green: Band_2
Blue: Band_3


Slide evident during drier times. No additional movement shown due to 2012 high water.
Tracking water elevation with images and erosion in Smith Basin
15-Apr-13
Elevation (feet, NAVDii)
300
290
280
270
260
250
240
230
220
210
200
F-98
F-03
F-08
J-13
F-18
date
diamond pit
images
TH20-22
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Villa Park Rd
Villa Park Rd
Center Dr
N Gannon
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
N
0
37.5
75
150 US Feet
Smith Slide Scarp
Date
4/1/2003
8/1/2005
10/1/2007
3/1/2011
5/1/2019
Google Earth Apr 2013
RGB
Red: Band_1
Green: Band_2
Blue: Band_3







Smith Slide Scarp

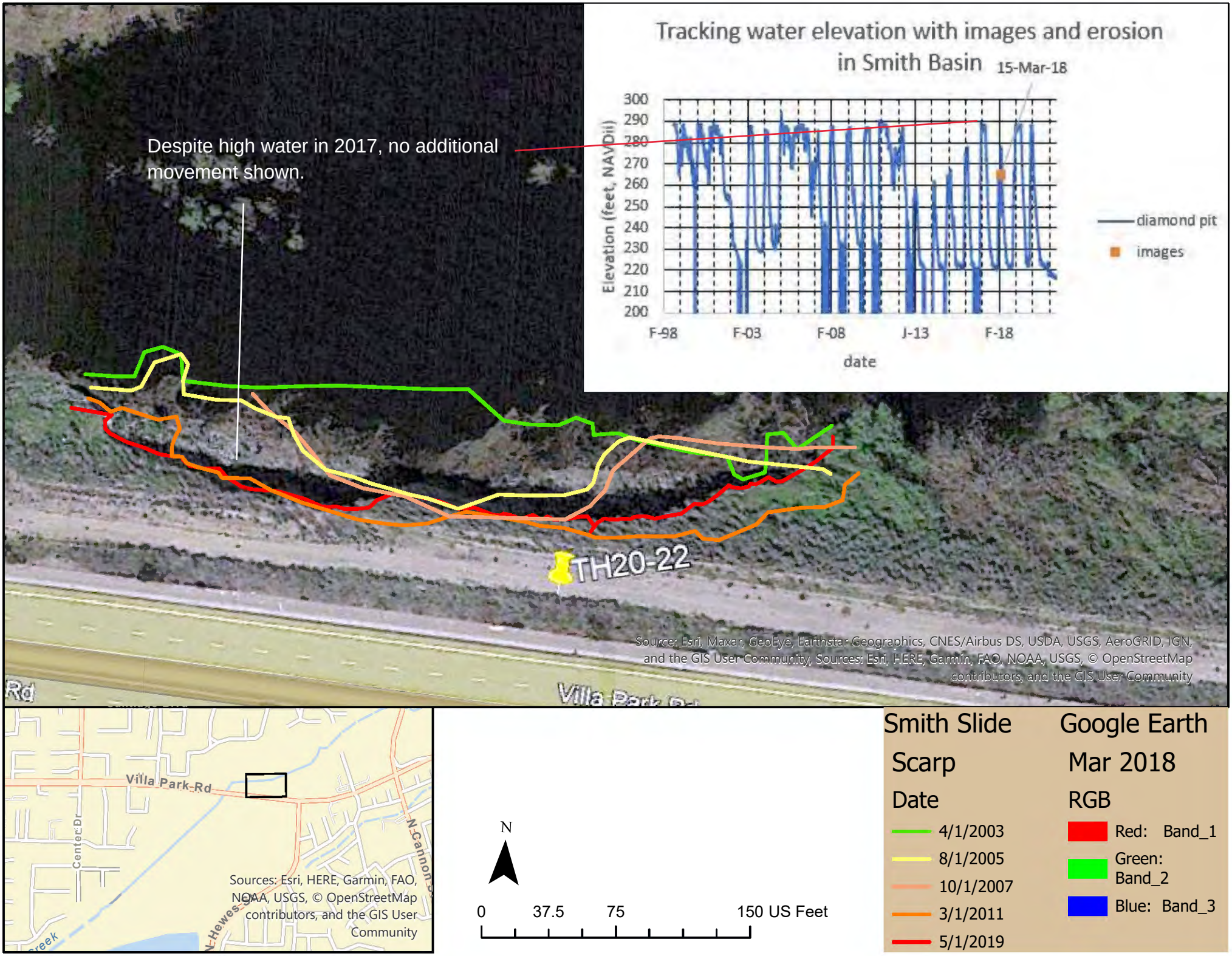
Date

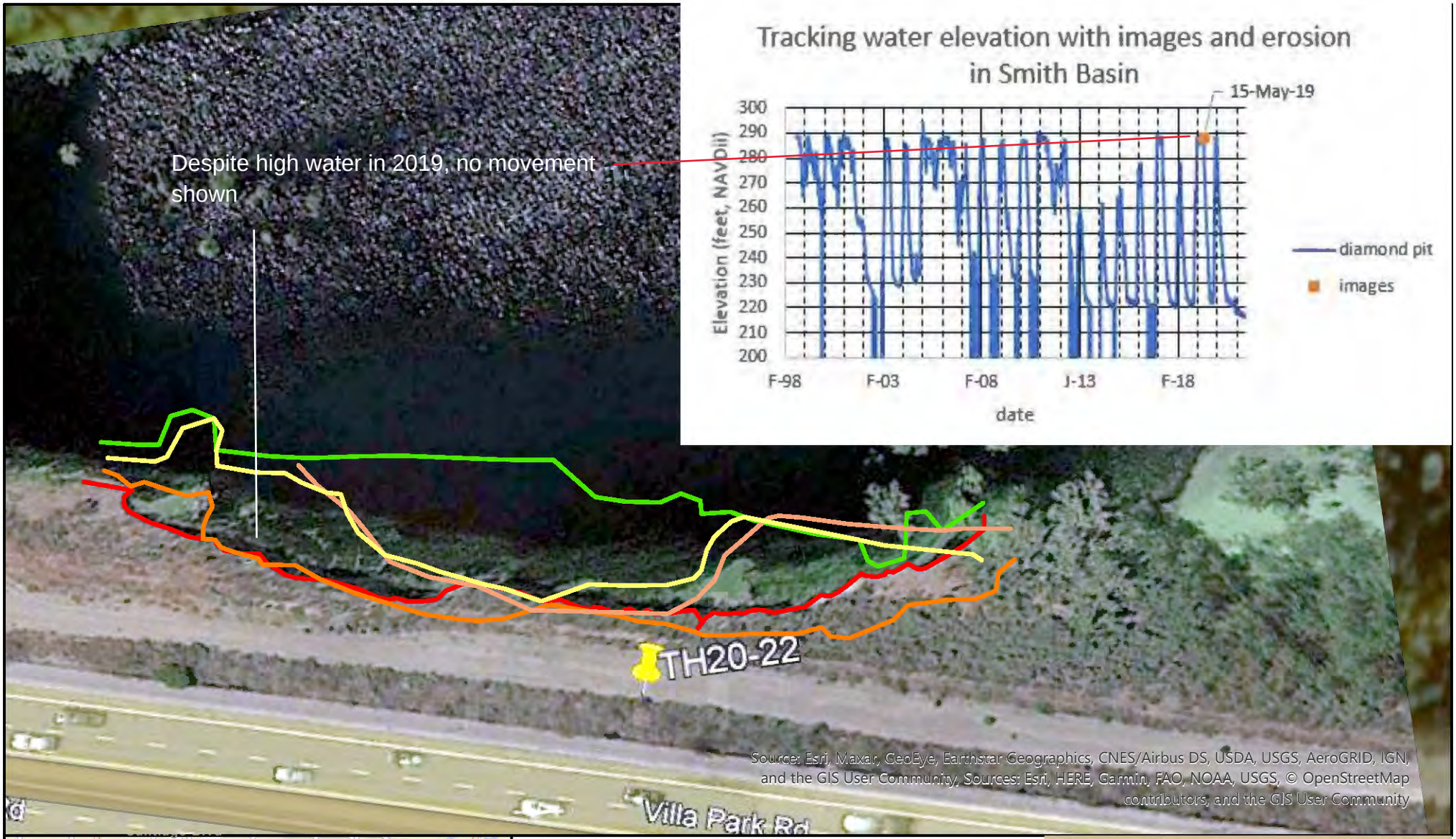
- 4/1/2003
- 8/1/2005
- 10/1/2007
- 3/1/2011
- 5/1/2019

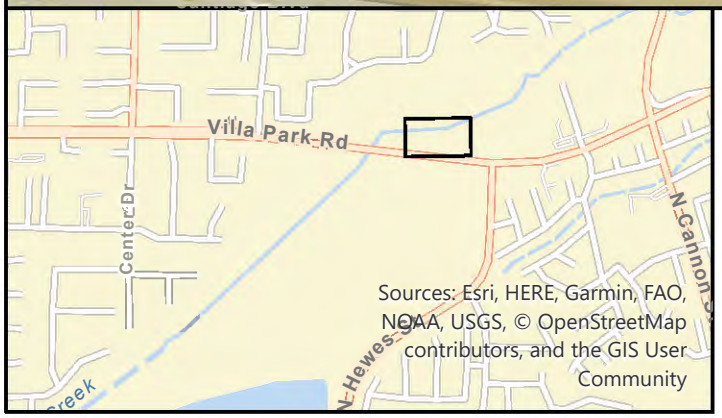
Google Earth Mar 2015

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3


Despite high water in 2017, no additional movement shown.
Tracking water elevation with images and erosion in Smith Basin
15-Mar-18
Elevation (feet, NAVDii)
300
290
280
270
260
250
240
230
220
210
200
F-98
F-03
F-08
J-13
F-18
date
diamond pit
images
TH20-22
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Villa Park Rd
Villa Park Rd
Center Dr
N Gannon
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
N
0
37.5
75
150 US Feet
Smith Slide Scarp
Date
4/1/2003
8/1/2005
10/1/2007
3/1/2011
5/1/2019
Google Earth Mar 2018
RGB
Red: Band_1
Green: Band_2
Blue: Band_3





N

0 37.5 75 150 US Feet

Smith Slide Scarp

Date

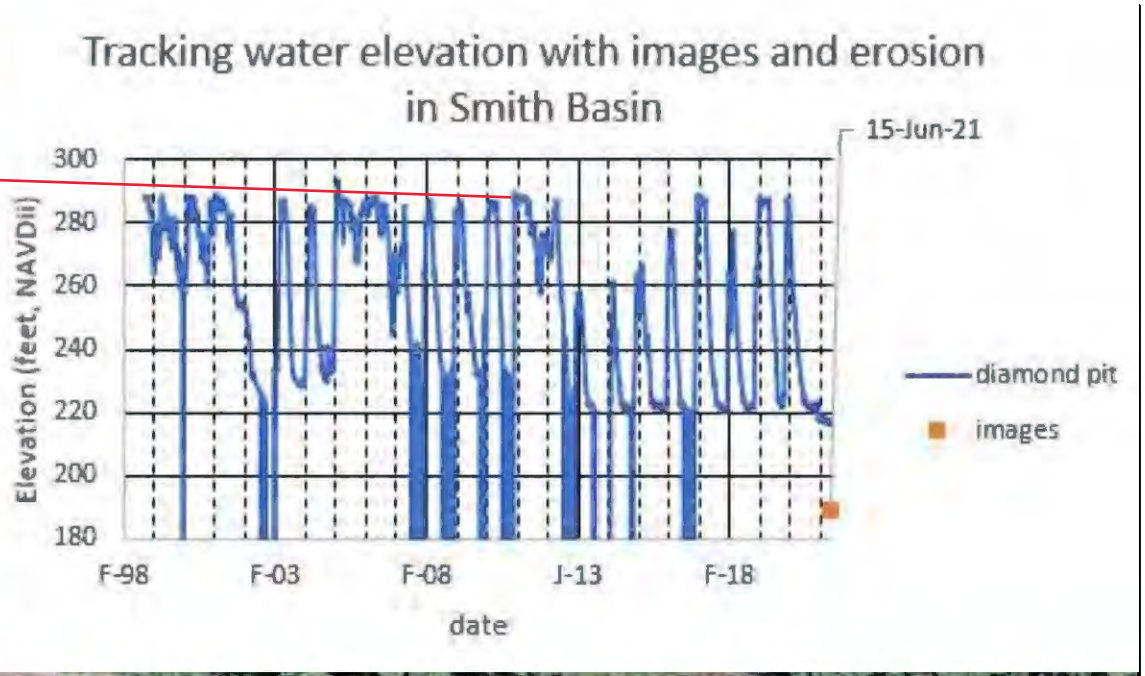
- 4/1/2003
- 8/1/2005
- 10/1/2007
- 3/1/2011
- 5/1/2019

Google Earth May 2019

RGB

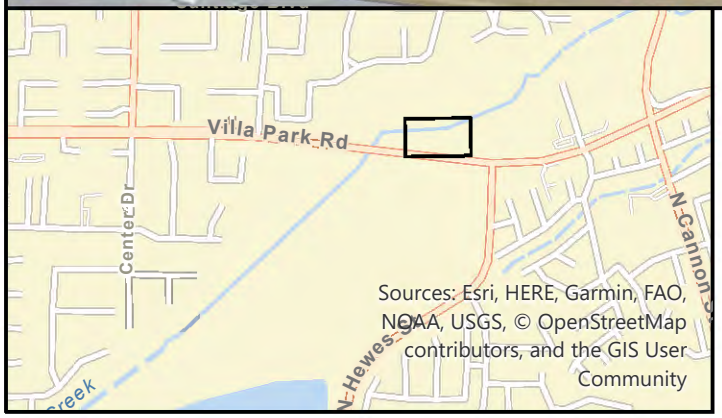
- Red: Band_1
- Green: Band_2
- Blue: Band_3

Slide has been stable since 2011 despite four additional high water levels. However, a very large even (elevation 302 ft NAVD) has not been recorded during the period of record (1998-present). Should an event such as this occur, there would likely be significant additional erosion at the Villa Park slide.



TH20-22

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community



N

0 37.5 75 150 US Feet

Smith Slide Scarp

Date

- 4/1/2003
- 8/1/2005
- 10/1/2007
- 3/1/2011
- 5/1/2019

Google Earth Aug 2021

RGB

- Red: Band_1
- Green: Band_2
- Blue: Band_3

ATTACHMENT C-9 - Site-specific geotechnical laboratory testing

DRILLING LOG	DIVISION: South Pacific Division	INSTALLATION:	SHEET 1 OF 1 SHEETS

1. PROJECT: Santiago Creek		9. COORDINATE SYSTEM: State Plane - California VI	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: 4.75" carbide tipped	
2. HOLE NUMBER: TH20-01	LOCATION COORDINATES: N 6065432.419 E 2227458.742	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC	
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District		12. TOTAL SAMPLES	DISTURBED: 0 / UNDISTURBED: 0
4. NAME OF DRILLER: John Verret		13. TOTAL NUMBER CORE BOXES: 0	
		14. ELEVATION GROUND WATER: See Remarks	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING: 347	15. DATE BORING	STARTED: 10/13/21 / COMPLETED: 10/13/21
6. THICKNESS OF OVERBURDEN: >10'		16. ELEVATION TOP OF BORING: 112.258' (Estimated from plans)	
7. DEPTH DRILLED INTO ROCK: 0'		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 10'		18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
110.3	2.0		GRAVELLY SAND (SW), fine to coarse; (10YR 5/2), grayish brown, dry, no plasticity, some gravel, trace silt, trace organics, no odor, no staining, concrete debris.						
			CLAYEY SAND (SW-SC), fine to coarse; (7.5YR 4/6), strong brown, dry, no plasticity, some gravel, little clay, no odor, no staining, clayey from 6-10'.						
102.3	10.0								

0
5
10

BOTTOM OF BOREHOLE AT 10.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 1 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-02
LOCATION COORDINATES	N 6065839.513 E 2227421.272
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	171
6. THICKNESS OF OVERBURDEN	>10'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	10'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terrasonic Tsi 150CC
12. TOTAL SAMPLES	
DISTURBED	0
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING STARTED	10/13/21
COMPLETED	10/13/21
16. ELEVATION TOP OF BORING	113.695' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
103.7	10.0		SAND (SW), fine to coarse; (10YR 4/3), brown, dry, little gravel, few silt, no odor, no staining, silty in upper 2' and concrete debris from 5-7'.						

0
5
10

BOTTOM OF BOREHOLE AT 10.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 1 SHEETS

1. PROJECT: Santiago Creek

2. HOLE NUMBER: TH20-04

LOCATION COORDINATES: N 6064284.141 E 2227571.171

3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District

4. NAME OF DRILLER: John Verret

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:

6. THICKNESS OF OVERBURDEN: >21.5'

7. DEPTH DRILLED INTO ROCK: 0'

8. TOTAL DEPTH OF BORING: 21.5'

9. COORDINATE SYSTEM: State Plane - California VI; HORIZONTAL: NAD83; VERTICAL: NAVD88

10. SIZE AND TYPE OF BIT: 4.75" carbide tipped

11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC

12. TOTAL SAMPLES: DISTURBED 3; UNDISTURBED 0

13. TOTAL NUMBER CORE BOXES: 0

14. ELEVATION GROUND WATER: See Remarks

15. DATE BORING: STARTED 10/8/21; COMPLETED 10/8/21

16. ELEVATION TOP OF BORING: 118.912' (Estimated from plans)

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
109.9	9.0		SILTY SAND (SM), fine to medium; (7.5YR 6/4), light brown, dry, medium dense, no plasticity, little silt, few gravel, trace clay, no odor, no staining, Fill.	67	S-1			8 9 8	17
102.9	16.0		SILTY CLAY (CL), fine; (7.5YR 4/6), strong brown, moist, hard, low plasticity, some silt, trace sand, no odor, no staining.	53	S-2			4 4 5	9
97.4	21.5		SILTY SAND (SM), fine; (7.5YR 5/6), strong brown, moist, soft, no plasticity, little silt, trace clay, no odor, no staining.	93	S-3			5 6 6	12

BOTTOM OF BOREHOLE AT 21.5 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Boring Designation TH20-05

DRILLING LOG	DIVISION: South Pacific Division	INSTALLATION	SHEET 1 OF 3 SHEETS

1. PROJECT: Santiago Creek		9. COORDINATE SYSTEM: State Plane - California VI	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: 4.75" carbide tipped	
2. HOLE NUMBER: TH20-05	LOCATION COORDINATES: N 6066733.475 E 2227548.3	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC	
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District		12. TOTAL SAMPLES	DISTURBED: 2 / UNDISTURBED: 0
4. NAME OF DRILLER: John Verret		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: See Remarks	
		15. DATE BORING	STARTED: 10/10/21 / COMPLETED: 10/10/21
6. THICKNESS OF OVERBURDEN: >100'		16. ELEVATION TOP OF BORING: 113.304' (Estimated from plans)	
7. DEPTH DRILLED INTO ROCK: 0'		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 100'		18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
110.3	3.0		SANDY CLAY (CL), fine to coarse; (10YR 4/3), brown, wet, no plasticity, some sand, trace gravel, few clay.				MC = 20		
105.3	8.0		SILTY CLAY (CL), medium to coarse; (7.5YR 4/6), strong brown, moist, low plasticity, some silt, trace sand.				MC = 13		
103.3	10.0		SILTY SAND (SM), fine; (7.5YR 4/6), strong brown, no plasticity, some silt, few clay.						
100.3	13.0		SILTY CLAY (CL-ML), (7.5YR 4/6), strong brown, wet, low plasticity, some silt.	67	S-1			3 4 4	8
94.3	19.0		CLAYEY SAND (SC), fine to medium; (10YR 6/4), light yellowish brown, moist, no plasticity, some clay, trace gravel, clean sand.				MC = 16		
93.3	20.0		CLAYEY SAND (SC), fine; (7.5YR 4/6), strong brown, moist, low plasticity, some clay, little silt, trace gravel.	67	S-2			1 2 3	5
			SILTY CLAY (SC), fine; (7.5YR 5/6), strong brown, moist, low plasticity, some silt, trace sand.				MC = 17		
							MC = 19		
							MC = 21		

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6066733.475 E 2227548.3

ELEVATION TOP OF BORING: 113.304'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
75.8	37.5		SILTY CLAY (SC), fine; (7.5YR 5/6), strong brown, moist, low plasticity, some silt, trace sand. *(continued)*						
71.3	42.0		CLAYEY SAND (SC), fine to medium; (7.5YR 6/4), light brown, moist, no plasticity, little clay, some gravel, more gravel from 40-42'.				MC = 6		
67.3	46.0		SILTY CLAY (CL), (7.5YR 5/6), strong brown, moist, soft, low plasticity, some silt.				MC = 9		
63.3	50.0		CLAYEY SAND (SC), fine to coarse; (7.5YR 6/3), light brown, moist, no plasticity, some gravel, slow drilling, pulverized gravel @47'.				MC = 2		
61.3	52.0		SILTY CLAY (CL-ML), fine; (7.5YR 5/4), brown, wet, very soft, low plasticity, some silt, few sand.						
43.3	70.0		SILTY SAND (SP-SM), fine to coarse; (7.5YR 5/4), brown, wet, no plasticity, some gravel, trace silt at 69'.				MC = 8		
			SAND (SW), fine to coarse; (7.5YR 4/6), strong brown, wet, no plasticity, little gravel, few silt.						

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 3 OF 3 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
N 6066733.475 E 2227548.3	113.304'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
32.3	81.0		SAND (SW), fine to coarse; (7.5YR 4/6), strong brown, wet, no plasticity, little gravel, few silt. *(continued)*				MC = 8		
24.3	89.0		SANDY CLAY (CL), fine to coarse; (7.5YR 4/3), brown, low plasticity, some sand, little silt, few gravel, gravelly 87-89'.				MC = 12 MC = 9		
13.3	100.0		CLAYEY ORGANICS (SW-SC), fine to coarse; (7.5YR 4/6), strong brown, wet, no plasticity, little clay, little gravel, less clayey at 95-98'.						

80 85 90 95 100

BOTTOM OF BOREHOLE AT 100.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/10/2021 3:02:00 PM	55.7	

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 1 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-06
LOCATION COORDINATES	N 6066812.707 E 2227581.255
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	344
6. THICKNESS OF OVERBURDEN	>10'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	10'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terrasonic Tsi 150CC
12. TOTAL SAMPLES	
DISTURBED	0
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING STARTED	10/13/21
COMPLETED	10/13/21
16. ELEVATION TOP OF BORING	116.591' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
113.6	3.0		SANDY GRAVEL (GW), fine to coarse; (10YR 5/2), grayish brown, dry, no plasticity, some cobbles, some sand, few silt.						
106.6	10.0		SILTY SAND (SM), fine to medium; (10YR 6/3), pale brown, moist, no plasticity, some silt, few gravel.						

0
5
10

BOTTOM OF BOREHOLE AT 10.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

DRILLING LOG	DIVISION: South Pacific Division	INSTALLATION	SHEET 1 OF 3 SHEETS

1. PROJECT: Santiago Creek		9. COORDINATE SYSTEM: State Plane - California VI	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: 4.75" carbide tipped	
2. HOLE NUMBER: TH20-07	LOCATION COORDINATES: N 6063388.896 E 2227583.254	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC	
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District		12. TOTAL SAMPLES	DISTURBED: 3 / UNDISTURBED: 0
4. NAME OF DRILLER: John Verret		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: See Remarks	
		15. DATE BORING	STARTED: 10/8/21 / COMPLETED: 10/8/21
6. THICKNESS OF OVERBURDEN: >100'		16. ELEVATION TOP OF BORING: 114.557' (Estimated from plans)	
7. DEPTH DRILLED INTO ROCK: 0'		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 100'		18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
105.6	9.0		SILTY SAND (SM), fine to medium; (7.5YR 6/3), light brown, dry, medium dense, no plasticity, little silt, few gravel, trace clay.	67	S-1		LL = 26; PI = 11; MC = 2	7 10 12	22
103.6	11.0		SAND (SP), fine to medium; (10YR 7/4), very pale brown, dry, loose, no plasticity, few fine gravel, trace silt.	67	S-2		LL = 46; PI = 26; MC = 10	4 3 3	6
97.6	17.0		SILTY CLAY (CL), (10YR 3/3), dark brown, moist, low plasticity, little silt, trace fine gravel, lighter brown from 15-17'.				LL = 50; PI = 29; MC = 22 MC = 20 LL = 41; PI = 21; MC = 18		
94.6	20.0		CLAYEY SAND (SC), fine; (7.5YR 5/8), strong brown, moist, no plasticity, little clay.				LL = 29; PI = 13; MC = 14		
86.6	28.0		SILTY CLAY (CL-ML), fine; (7.5YR 4/4), brown, low plasticity, trace sand.	87	S-3		LL = 34; PI = 15; MC = 22	4 5 6	11
79.6	35.0		SILTY SAND (SM), fine to medium; (10YR 5/2), grayish brown, moist, no plasticity, little silt, trace clay.				LL = 21; PI = 4; MC = 22		

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6063388.896 E 2227583.254

ELEVATION TOP OF BORING: 114.557'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			SILTY CLAY (CL), (7.5YR 4/4), brown, moist, very soft, low plasticity, little silt.				LL = 37; PI = 15; MC = 27		
66.6	48.0								
			SANDY CLAY (CL), fine to coarse; (10YR 4/3), brown, moist, soft, low plasticity, few silt, trace fine gravel, more sandy from 50-52' increasing amount of gravel from 55-58'.				LL = 23; PI = 8; MC = 14		
56.6	58.0						MC = 10		
			GRAVELLY SAND (SW), fine to coarse; (7.5YR 4/6), strong brown, wet, no plasticity, some gravel, some cobbles, trace silt.						
54.6	60.0								
			SANDY GRAVEL (GW), fine to coarse; (10YR 5/3), brown, wet, no plasticity, some sand.				MC = 5		

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 3 OF 3 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88

LOCATION COORDINATES: N 6063388.896 E 2227583.254

ELEVATION TOP OF BORING: 114.557'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
~~36.6~~	~~78.0~~								
			SANDY CLAY (CL), (7.5YR 5/6), strong brown, wet, low plasticity, little sand, few gravel, trace silt.						
34.6	80.0								
			SILTY CLAY (CL), (7.5YR 5/8), strong brown, moist, soft, low plasticity, some silt, trace fine gravel.				MC = 17		
							LL = 31; PI = 12; MC = 21		
							LL = 29; PI = 9; MC = 23		
20.6	94.0								
			SANDY CLAY (CL), fine; (7.5YR 4/6), strong brown, wet, soft, low plasticity, some sand, little silt.						
17.6	97.0								
			SILTY SAND (SM), fine; (7.5YR 4/6), strong brown, no plasticity, little silt, trace clay.				LL = 24; PI = 6; MC = 20		
14.6	100.0								

80 85 90 95 100

BOTTOM OF BOREHOLE AT 100.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
24 hours	8/10/2021 8:04:00 AM	50	

DRILLING LOG	DIVISION: South Pacific Division	INSTALLATION:	SHEET 1 OF 1 SHEETS

1. PROJECT: Santiago Creek		9. COORDINATE SYSTEM: State Plane - California VI	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: 4.75" carbide tipped	
2. HOLE NUMBER: TH20-09	LOCATION COORDINATES: N 6067188.739 E 2227632.282	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC	
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District		12. TOTAL SAMPLES	DISTURBED: 0 / UNDISTURBED: 0
4. NAME OF DRILLER: John Verret		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: ---	BEARING: 131	14. ELEVATION GROUND WATER: See Remarks
		15. DATE BORING	STARTED: 10/13/21 / COMPLETED: 10/13/21
6. THICKNESS OF OVERBURDEN: >10'		16. ELEVATION TOP OF BORING: 117.011' (Estimated from plans)	
7. DEPTH DRILLED INTO ROCK: 0'		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 10'		18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
107.0	10.0		SAND (SW-SM), fine to coarse; (10YR 5/2), grayish brown, dry, no plasticity, some gravel, some cobbles, little silt, few plant debris, silty from 0-3'.						

0
5
10

BOTTOM OF BOREHOLE AT 10.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 1 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-10
LOCATION COORDINATES	N 6067402.838 E 2227820.479
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	326
6. THICKNESS OF OVERBURDEN	>10'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	10'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terrasonic Tsi 150CC
12. TOTAL SAMPLES	
DISTURBED	0
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING STARTED	10/13/21
COMPLETED	10/13/21
16. ELEVATION TOP OF BORING	119.555' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
109.6	10.0		GRAVELLY SAND (SW), fine to coarse; (7.5YR 5/4), brown, dry, little gravel, little cobbles, trace silt, light red staining.						

0 5 10

BOTTOM OF BOREHOLE AT 10.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Boring Designation TH20-12

DRILLING LOG	DIVISION: South Pacific Division	INSTALLATION	SHEET 1 OF 3 SHEETS

1. PROJECT: Santiago Creek		9. COORDINATE SYSTEM: State Plane - California VI	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: 4.75" carbide tipped	
2. HOLE NUMBER: TH20-12	LOCATION COORDINATES: N 6067867.238 E 2228151.305	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC	
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District		12. TOTAL SAMPLES	DISTURBED: 2 / UNDISTURBED: 1
4. NAME OF DRILLER: John Verret		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: See Remarks	
		15. DATE BORING	STARTED: 10/12/21 / COMPLETED: 10/12/21
6. THICKNESS OF OVERBURDEN: >100'		16. ELEVATION TOP OF BORING: 136.64' (Estimated from plans)	
7. DEPTH DRILLED INTO ROCK: 0'		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 100'		18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
129.1	7.5		SAND (SP), fine; (7.5YR 6/4), light brown, dry, no plasticity, hand auger first 2' ; strong roots at 2.5' and 4'.				MC = 5		
			SILTY CLAY (CL-ML), fine; (10YR 4/3), brown, dry, low plasticity, some silt, few wood, trace sand, more roots at 8'.	100	U1		LL = 33; PI = 15; MC = 18		
				80	S-1		LL = 27; PI = 9; MC = 24	3 3 5	8
118.6	18.0						LL = 24; PI = 7; MC = 12		
116.6	20.0		SAND (SC), fine; (10YR 5/3), brown, no plasticity, little clay, few gravel.						
			SILTY CLAY (CL-ML), fine; (7.5YR 5/4), brown, moist, hard, low plasticity, some silt, little sand, trace gravel, gravel/sand at 27 and 29' ; crumbly, cobblsized rocks at 31'.	67	S-2		LL = 27; PI = 10; MC = 11	4 5 6	11
101.6	35.0								

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6067867.238 E 2228151.305

ELEVATION TOP OF BORING: 136.64'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
98.6	38.0		SANDY CLAY (CL), fine; (10YR 5/3), brown, moist, soft, low plasticity, little silt, trace fine gravel, SP @ 35-36'.				LL = 26; PI = 10; MC = 18		
90.6	46.0		SILTY CLAY (CL), (10YR 4/3), brown, soft, low plasticity, little silt.				MC = 20 MC = 19		
86.6	50.0		SANDY GRAVEL (GW), fine to coarse; (10YR 5/2), grayish brown, moist, no plasticity, some sand, few clay.				MC = 3		
83.6	53.0		GRAVELLY CLAY (CL-ML), (10YR 4/3), brown, wet, very soft, low plasticity, little gravel, some silt.				LL = 27; PI = 12; MC = 12		
77.6	59.0		CLAYEY SAND (SW-SC), fine to coarse; (10YR 4/3), brown, moist, no plasticity, little clay, few gravel, few cobbles, trace silt; calyey at 53-55'.				LL = 23; PI = 7; MC = 8		
76.6	60.0		SILTY SAND (SM), (7.5YR 5/6), strong brown, moist, no plasticity, some silt, little clay.						
70.6	66.0		SILTY CLAY (CL-ML), fine; (10YR 5/8), yellowish brown, soft, low plasticity, some silt, little sand, trace fine gravel, sandy 65-66'.				LL = 27; PI = 9; MC = 20		
66.6	70.0		GRAVELLY SAND (SW), fine to coarse; (7.5YR 5/4), brown, no plasticity, little gravel, little cobbles, trace silt.				MC = 6		
61.6	75.0		SANDY CLAY (CL), (10YR 4/6), dark yellowish brown, moist, soft, low plasticity, little sand, few gravel.				MC = 13		
			GRAVELLY SAND (SP), fine to coarse; (10YR 4/3), brown, moist, no plasticity, little gravel.						

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 3 OF 3 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88

LOCATION COORDINATES: N 6067867.238 E 2228151.305

ELEVATION TOP OF BORING: 136.64'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
57.6	79.0		GRAVELLY SAND (SP), fine to coarse; (10YR 4/3), brown, moist, no plasticity, little gravel. *(continued)*				MC = 4		
53.6	83.0		SANDY CLAY (CL), fine to medium; (10YR 4/3), brown, hard, low plasticity, some sand, little silt, iron oxide staining, light red stains.				LL = 29; PI = 14; MC = 13		
46.6	90.0		SILTY SAND (SM), (10YR 6/4), light yellowish brown, moist, no plasticity, some silt, trace clay.				MC = 18		
36.6	100.0		SAND (SP), fine to coarse; (10YR 5/2), grayish brown, wet, no plasticity, few silt, some coarser grains.				MC = 16		

BOTTOM OF BOREHOLE AT 100.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
24 hours	12/10/2021 7:49:00 AM	75.4	

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 1 SHEETS

1. PROJECT: Santiago Creek

2. HOLE NUMBER: TH20-13

LOCATION COORDINATES: N 6069065.555 E 2228211.574

3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District

4. NAME OF DRILLER: John Verret

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING: 309

6. THICKNESS OF OVERBURDEN: >12'

7. DEPTH DRILLED INTO ROCK: 0'

8. TOTAL DEPTH OF BORING: 12'

9. COORDINATE SYSTEM: State Plane - California VI; HORIZONTAL: NAD83; VERTICAL: NAVD88

10. SIZE AND TYPE OF BIT: 4.75" carbide tipped

11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC

12. TOTAL SAMPLES: DISTURBED: 0; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: 0

14. ELEVATION GROUND WATER: See Remarks

15. DATE BORING: STARTED: 10/10/21; COMPLETED: 10/10/21

16. ELEVATION TOP OF BORING: 128.228' (Estimated from plans)

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
123.2	5.0		CLAYEY GRAVEL (GW-GC), fine to coarse; no plasticity, some clay, few sand, very hard rip rap rocks; slow drilling.				MC = 4		
120.2	8.0		SILTY CLAY (CL), low plasticity, some silt, few gravel, few cobbles.				LL = 33; PI = 17; MC = 10		
117.2	11.0		SANDY CLAY (CL), fine; dry, low plasticity, some sand, little silt.						
116.2	12.0		SILTY CLAY (CL-ML), dry, very hard, low plasticity, some silt.				LL = 31; PI = 15; MC = 9		

BOTTOM OF BOREHOLE AT 12.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 4 SHEETS

1. PROJECT: Santiago Creek	9. COORDINATE SYSTEM: State Plane - California VI; HORIZONTAL: NAD83; VERTICAL: NAVD88
	10. SIZE AND TYPE OF BIT: 4.75" carbide tipped
2. HOLE NUMBER: TH20-14; LOCATION COORDINATES: N 6087453.876 E 2237863.406	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District	12. TOTAL SAMPLES: DISTURBED 6; UNDISTURBED 0
4. NAME OF DRILLER: John Verret	13. TOTAL NUMBER CORE BOXES: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	14. ELEVATION GROUND WATER: See Remarks
	15. DATE BORING: STARTED 9/22/21; COMPLETED 9/24/21
6. THICKNESS OF OVERBURDEN: >150'	16. ELEVATION TOP OF BORING: 292.999' (Estimated from plans)
7. DEPTH DRILLED INTO ROCK: 0'	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 150'	18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			GRAVELLY SAND (SW), fine to medium; (10YR 6/2), light brownish gray, dry, very dense, no plasticity, some gravel, some cobbles.	100	S-1			22 50	50 /5"
							MC = 4		
			Fine to coarse; (7.5YR 5/8), strong brown, moist, few clay, slightly more clayey 15-20'.	93	S-2			44 37 43	100+
							MC = 4		
273.0	20.0								
			CLAYEY GRAVEL (GW), fine to coarse; (7.5YR 6/4), light brown, moist, very dense, no plasticity, little clay, little sand, fill, clayey sand matrix with gravel/cobbles; light red staining at 28-30'.	100	S-3			25 47 50	100+
							MC = 4		
263.0	30.0								
			GRAVELLY SAND (SW), fine to coarse; (10YR 4/3), brown, moist, very dense, no plasticity, little gravel, little cobbles, trace clay.	87	S-4			24 40 43	100+
							MC = 6		

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 4 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6087453.876 E 2237863.406

ELEVATION TOP OF BORING: 292.999'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
255.0	38.0		GRAVELLY SAND (SW), fine to coarse; (10YR 4/3), brown, moist, very dense, no plasticity, little gravel, little cobbles, trace clay. *(continued)*						
253.0	40.0		CLAYEY GRAVEL (GW-GC), fine to medium; (7.5YR 4/6), strong brown, moist, no plasticity, little clay, little sand.				LL = 20; PI = 7; MC = 3		
251.0	42.0		CLAYEY SAND (SC), fine to medium; (7.5YR 5/8), strong brown, moist, dense, no plasticity, some clay, few gravel.	67	S-5		LL = 20; PI = 6; MC = 6	4 15 27	42
243.0	50.0		SANDY GRAVEL (GW), fine to coarse; (10YR 5/2), grayish brown, moist, no plasticity, some sand, trace clay.				MC = 2		
233.0	60.0		(10YR 5/3), brown, dry, very dense, few clay.	73	S-6		LL = 26; PI = 9; MC = 11 MC = 7	43 44 40	100+
223.0	70.0		GRAVELLY SAND (SW), fine to coarse; (10YR 5/2), grayish brown, moist, no plasticity, some gravel, few clay, some thin clayey layers.				MC = 3		
			CLAYEY GRAVEL (GC), medium; (5YR 5/8), yellowish red, moist, no plasticity, some clay, little sand, iron oxide staining.				LL = 27; PI = 12; MC = 8		

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 3 OF 4 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6087453.876 E 2237863.406

ELEVATION TOP OF BORING: 292.999'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			CLAYEY GRAVEL (GC), medium; (5YR 5/8), yellowish red, moist, no plasticity, some clay, little sand, iron oxide staining. *(continued)*						
							LL = 27; PI = 12; MC = 6		
203.0	90.0		CLAYEY GRAVEL (GW-GC), fine to coarse; (7.5YR 5/8), strong brown, moist, no plasticity, little clay, little sand.						
							LL = 28; PI = 10; MC = 6		
			(10YR 5/3), brown.						
							LL = 31; PI = 13; MC = 7		
			(2.5Y 4/2), dark grayish brown, dry.						
							LL = 26; PI = 13; MC = 5		
175.0	118.0		GRAVELLY SAND (SW), fine to coarse; (7.5YR 4/6), strong brown, dry, no plasticity, some gravel, few clay.						
173.0	120.0								

80 85 90 95 100 105 110 115 120

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 4 OF 4 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6087453.876 E 2237863.406

ELEVATION TOP OF BORING: 292.999'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
171.0	122.0		SANDY CLAY (CL), fine; (7.5YR 4/6), strong brown, moist, low plasticity, some sand, few gravel.						
168.0	125.0		CLAYEY GRAVEL (GW-GC), fine to coarse; (7.5YR 6/4), light brown, dry, no plasticity, little clay, little sand.				LL = 29; PI = 13; MC = 9		
163.0	130.0		GRAVELLY SAND (SW), fine to medium; (10YR 6/2), light brownish gray, dry, no plasticity, some gravel, some cobbles, little silt, trace clay.				LL = 23; PI = 7; MC = 3		
			GRAVEL (GW-GC), fine to coarse; (7.5YR 5/4), brown, moist, no plasticity, some clay, little sand, large hard crystalline rock at bottom slow drilling.				LL = 27; PI = 11; MC = 3		
			CLAYEY, 1/2 recovery.						
143.0	150.0						LL = 29; PI = 15; MC = 5		

BOTTOM OF BOREHOLE AT 150.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/23/2021 2:18:00 PM	81.7	

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 4 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-15
LOCATION COORDINATES	N 6086499.644 E 2238499.907
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	
6. THICKNESS OF OVERBURDEN	>150'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	150'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terrasonic Tsi 150CC
12. TOTAL SAMPLES	DISTURBED 0 / UNDISTURBED 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING	STARTED 9/20/21 / COMPLETED 9/21/21
16. ELEVATION TOP OF BORING	306.169' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
302.2	4.0		SILT SAND (SM), fine to coarse gravel-sized; (7.5YR 6/4), light brown, fine-grained sand-sized grained, dry, no odor, Ph: 7.8 ORP:200mV, fill.				MC = 3		
296.2	10.0		SAND (SW), gravel to cobble-sized; (10YR 6/2), light brownish gray, fine to coarse-grained sand-sized grained, dry, no odor, Fill.				MC = 3		
286.2	20.0		CLAY SAND (GW), (10YR 5/2), grayish brown, gravel to cobble-sized grained, dry, no odor, Large cobbles @10-15' ph: 8.5; ORP: 240mV, fill.				MC = 1		
276.2	30.0		SAND CLAY (GW-GC), fine to coarse-grained sand-sized; (7.5YR 4/4), brown, gravel to cobble-sized grained, moist, no odor, Ph: 7.64; ORP: 240mV, fill.				LL = 30; PI = 14; MC = 6		
			CLAY SAND (GW-GM), fine to medium-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, dry, no odor, Ph: 7.6; ORP: 220mV, slow drilling, fill.						

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 4 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086499.644 E 2238499.907

ELEVATION TOP OF BORING: 306.169'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
266.2	40.0		CLAY SAND (GW-GM), fine to medium-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, dry, no odor, Ph: 7.6; ORP: 220mV, slow drilling, fill. *(continued)*				LL = 21; PI = 5; MC = 7		
263.7	42.5		SAND CLAY (CL), fine-grained sand-sized; fine to coarse gravel-sized; (7.5YR 5/8), strong brown, moist, very soft, no odor, Pocket pen: o.o tsf @42' ; ph: 8.1 ; ORP: -580Mv , fill.				LL = 27; PI = 12; MC = 15		
262.2	44.0		CLAY (GC), (7.5YR 5/3), brown, gravel to cobble-sized grained, moist, no odor, Transition from clay to gravel , fill.				LL = 27; PI = 13; MC = 11		
256.2	50.0		CLAY SAND (GW-GM), fine to medium-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, dry, no odor, , slow drilling, hard large rock @ 49' fill.				LL = 22; PI = 8; MC = 3		
248.2	58.0		SAND CLAY (GW-GC), fine to coarse-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, moist, no odor, Fill.				LL = 29; PI = 12; MC = 15		
246.2	60.0		SILT CLAY (CL), (7.5YR 5/8), strong brown, moist, firm, discontinue, no odor, Ph: 8.0; ORP: 240mV ; pocket pen: 2.0@59' natural.				LL = 29; PI = 14; MC = 5		
244.2	62.0		SAND SILT CLAY (CL), fine-grained sand-sized; (10YR 4/6), dark yellowish brown, moist, soft, trace, no odor, Ph: 8.3; ORP: 180mV; pocket pen: 0.5 @ 61' , natural.				LL = 27; PI = 12; MC = 12		
240.2	66.0		SAND CLAY (GC), fine to coarse-grained sand-sized; (10YR 5/3), brown, gravel to cobble-sized grained, wet, no odor.				LL = 28; PI = 13; MC = 18		
236.2	70.0		CLAY SAND (SW), sand to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist.				MC = 9		
			SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, Trace clay, ph: 6.7, ORP: 230mV.				MC = 5		
							MC = 5		

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 3 OF 4 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086499.644 E 2238499.907

ELEVATION TOP OF BORING: 306.169'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
226.2	80.0						MC = 5		
			CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, Ph: 6.2; ORP: 230mV.				MC = 1		
216.2	90.0		SAND SILT CLAY (CL-ML), fine-grained sand-sized; (7.5YR 4/6), strong brown, moist, firm, trace, no odor, Pocket pen: 4.0@ 94'; 2.75@ 96' ; 2.0@ 98' ph: 6.7; ORP: 240mV.				LL = 26; PI = 8; MC = 17		
206.2	100.0		SAND CLAY (GW-GC), fine to coarse-grained sand-sized; (7.5YR 4/4), brown, gravel to cobble-sized grained, moist, no odor, Ph: 7.3; ORP: 250 mV.				LL = 29; PI = 13; MC = 6		
196.2	110.0		SAND CLAY (CL), gravel to cobble-sized; fine-grained sand-sized; (7.5YR 6/4), light brown, moist, firm, no odor, Pocket pen: 3.5 @ 113'; 3.0 @ 115' ; ph: 6.4 ; ORP: 140 mV.				LL = 29; PI = 14; MC = 6		
189.2	117.0		SAND CLAY (GW-GC), fine to medium-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, moist, no odor.				MC = 8		
187.2	119.0		SILT CLAY (CL), gravel to cobble-sized; (10YR 4/2),						
186.2	120.0								

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 4 OF 4 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086499.644 E 2238499.907

ELEVATION TOP OF BORING: 306.169'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			dark grayish brown, dry, very hard, no odor, Pocket pen: 4.5+.						
176.2	130.0		SAND CLAY (CL), fine gravel-sized; (7.5YR 5/8), strong brown, wet, soft, no odor, Pocket pen: 1.5@42'; 1.5@44' ; 1.0 @46' ; 1.75@48' ; 2.0 @ 50' ph: 8.6; ORP: 180mV.				LL = 28; PI = 12; MC = 12		
171.2	135.0		SILT SAND CLAY (CL), fine-grained sand-sized; (7.5YR 5/8), strong brown, wet, very soft, no odor, Pocket pen: 0.25 @ 131'; 0.5 @ 133', 1.5@ 135' ph: 7.6; ORP: -10mV.				LL = 31; PI = 15; MC = 18		
166.2	140.0		CLAY SAND (SW-SC), gravel to cobble-sized; (10YR 5/3), brown, fine to coarse-grained sand-sized grained, moist, no odor.				MC = 9		
160.2	146.0		SAND SILT CLAY (CL), fine-grained sand-sized; (7.5YR 4/4), brown, soft, no odor, Pocket pen: 1.0 @ 141' ; 1.25@ 143' ; 1.25@ 145' ph: 7.1; ORP: 160 mV.				MC = 19		
156.2	150.0		CLAY SAND (SW), gravel to cobble-sized; (10YR 6/2), light brownish gray, fine to coarse-grained sand-sized grained, moist, no odor.				MC = 8		

BOTTOM OF BOREHOLE AT 150.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

missing water table.

note some borings missing ORP

-623 ORP (TH20-20, 90-100 ft) and - 580

ORP (TH20-15, 40-42 ft) are likely in error

Boring Designation TH20-16

DRILLING LOG	DIVISION: South Pacific Division	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Santiago Creek		9. COORDINATE SYSTEM: State Plane - California VI	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: 4.75" carbide tipped	
2. HOLE NUMBER: TH20-16	LOCATION COORDINATES: N 6085923.286 E 2238710.367	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC	
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District		12. TOTAL SAMPLES	DISTURBED: 0 / UNDISTURBED: 0
4. NAME OF DRILLER: John Verret		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: See Remarks	
		15. DATE BORING	STARTED: 9/16/21 / COMPLETED: 9/16/21
6. THICKNESS OF OVERBURDEN: >30'		16. ELEVATION TOP OF BORING: 283.127' (Estimated from plans)	
7. DEPTH DRILLED INTO ROCK: 0'		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 30'		18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
273.1	10.0		SAND (SW), gravel to cobble-sized; (10YR 6/2), light brownish gray, fine to coarse-grained sand-sized grained, dry, trace clay, no odor, ph: 8.3, ORP: 220mV, Af.				MC = 1 MC = 6		
263.1	20.0		SAND (SW), sand to cobble-sized; (7.5YR 6/4), light brown, fine to coarse-grained sand-sized grained, dry, no odor, Ph: 8.1 ; ORP: 280mV, Fill.				MC = 4 MC = 5		
261.1	22.0		(CL), (7.5YR 6/4), light brown, dry, soft, no odor, Pocket pen: 1.5, fill.				LL = 30; PI = 14; MC = 9		
253.1	30.0		SAND (SW), gravel to cobble-sized, subrounded to rounded; (10YR 6/2), light brownish gray, fine to coarse-grained sand-sized grained, dry, no odor, Ph: 7.7; ORP:190mV, fill.				MC = 6		

BOTTOM OF BOREHOLE AT 30.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%,

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/16/2021 1:24:00 PM		Not Encountered

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 2 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-17
LOCATION COORDINATES	N 6086187.238 E 2238871.582
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	
6. THICKNESS OF OVERBURDEN	>50'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	50'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terrasonic Tsi 150CC
12. TOTAL SAMPLES	
DISTURBED	0
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING STARTED	9/16/21
COMPLETED	9/16/21
16. ELEVATION TOP OF BORING	296.938' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
291.9	5.0		SILT SAND (SM), gravel to cobble-sized; (10YR 6/3), pale brown, fine-grained sand-sized grained, dry, Ph: 6.6 ORP: 230mV, fill.				LL = 24; PI = 9; MC = 2		
286.9	10.0		SAND (SW), gravel to cobble-sized; (2.5Y 6/2), light brownish gray, fine to coarse-grained sand-sized grained, dry, no odor, Larger hard cobbles, slow drilling. Fill.				MC = 3		
276.9	20.0		CLAY SAND (SW-SC), sand to cobble-sized; (2.5Y 5/2), grayish brown, fine to coarse-grained sand-sized grained, dry, no odor, Fill , ph: 7.5; ORP: 270mV.				MC = 5 LL = 26; PI = 13; MC = 4 LL = 28; PI = 12; MC = 6		
272.9	24.0		SAND FINES (CL-ML), gravel to cobble-sized; (7.5YR 5/8), strong brown, dry, no odor, Soft, pocket pen 0.75, ph: 7.5, ORP: 190mV.						
266.9	30.0		CLAY SAND (SW-SC), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, dry, no odor, Sandier at bottom.				MC = 8		
264.9	32.0		SAND FINES (CL-ML), gravel to cobble-sized; (7.5YR 5/8), strong brown, dry, no odor, Soft, pocket pen 0.5-1.5 ph: 7.1 ORP: 260mV.						
			SAND (SW), gravel to cobble-sized; (10YR 4/2), dark grayish brown, fine to medium-grained sand-sized grained, moist, no odor.				MC = 13		

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)	INSTALLATION	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
N 6086187.238 E 2238871.582	296.938'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
256.9	40.0		SAND (SW), gravel to cobble-sized; (10YR 4/2), dark grayish brown, fine to medium-grained sand-sized grained, moist, no odor. *(continued)*				MC = 8		
246.9	50.0		CLAY SAND (SW-SC), gravel to cobble-sized; (10YR 4/2), dark grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, Ph: 7.7, ORP: 170mV,.				LL = 25; PI = 11; MC = 9		

35 40 45 50

BOTTOM OF BOREHOLE AT 50.0 ft

hole is 8ft east of fence

1. Soils visually field classified in accordance with ASTM D2488.2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval,unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a140-pound hammer falling 30 inches.3. The drilling rig utilized an automatic trip hammer.4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%,Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/16/2021 2:51:00 PM		Not Encountered

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 3 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-18
LOCATION COORDINATES	N 6086421.608 E 2238979.297
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	
6. THICKNESS OF OVERBURDEN	>100'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	100'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terrasonic Tsi 150CC
12. TOTAL SAMPLES	
DISTURBED	0
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING STARTED	9/18/21
COMPLETED	9/18/21
16. ELEVATION TOP OF BORING	304.223' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			SILT SAND (SM), gravel to cobble-sized; (10YR 5/2), grayish brown, fine-grained sand-sized grained, dry, no odor, Ph: 8.8, ORP: 240 mV, fill.				LL = 21; PI = 5; MC = 2		
							MC = 2		
294.2	10.0		(GW-GC), (10YR 5/2), grayish brown, dry, no odor, Pocket pen at 16': 4.5+, very hard clayey gravel from 15-18', ph: 8.6; ORP: 220 mV, fill.				LL = 26; PI = 12; MC = 1		
284.2	20.0		CLAY SAND (GW-GC), fine to coarse-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, dry, More clayey from 20-25', ph: 8.3; ORP: 220mV, fill.				MC = 2		
							LL = 29; PI = 12; MC = 2		
							MC = 7		
274.2	30.0		CLAY SAND (SW), gravel to cobble-sized; (7.5YR 4/4), brown, fine to coarse-grained sand-sized grained, moist, no odor, A little more clay @30-32' ph: 8.3, ORP: 220mV, fill.				MC = 6		

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086421.608 E 2238979.297

ELEVATION TOP OF BORING: 304.223'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
264.2	40.0		CLAY SAND (SW), gravel to cobble-sized; (7.5YR 4/4), brown, fine to coarse-grained sand-sized grained, moist, no odor, A little more clay @30-32' ph: 8.3, ORP: 220mV, fill. *(continued)*				MC = 3		
254.2	50.0		CLAY SAND (SW), sand to cobble-sized; (10YR 6/3), pale brown, fine to coarse-grained sand-sized grained, moist, no odor, Pocket pen @45': 3.5 stiff, ph: 8.3; oR: 260mV, fill.				MC = 5		
249.2	55.0		SAND CLAY (CL), fine-grained sand-sized; fine to coarse gravel-sized; (7.5YR 5/8), strong brown, moist, soft, no odor, Pocket pen: 1.0@ 51', 0.75@ 53', 0.75@55', fill.				LL = 31; PI = 15; MC = 20		
244.2	60.0		CLAY SILT SAND (SM), (7.5YR 5/8), strong brown, fine to medium-grained sand-sized grained, moist, trace, no odor, Ph: 7.8, ORP: 260mV, fill.				LL = 25; PI = 8; MC = 13		
234.2	70.0		CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to medium-grained sand-sized grained, moist, no odor, Ph: 6.3; ORP 240mV, fill.				MC = 1		
			CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, Ph: 6.3; ORP 240mV, fill.				MC = 2		

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)

INSTALLATION		SHEET 3 OF 3 SHEETS
PROJECT: Santiago Creek	COORDINATE SYSTEM: State Plane / HORIZONTAL: NAD83	VERTICAL: NAVD88
LOCATION COORDINATES: N 6086421.608 E 2238979.297	ELEVATION TOP OF BORING: 304.223'	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
224.2	80.0		CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, Slighly clayey from 81-83' , ph: 6.4; ORP: 240mV, fill.						
213.2	91.0		SAND SILT CLAY (CL), (5YR 4/4), reddish brown, moist, soft, trace, iron oxide staining, Pocket pen: 1.25 @ 92' ; 0.5 @ 94'; 1.5 @ 96'; 1.5@ 98; 4.5+ @ 100' ph: 7.9; ORP: 190 mV; hard gravelly clay from 99-100'.				LL = 26; PI = 11; MC = 1		
204.2	100.0		BOTTOM OF BOREHOLE AT 100.0 ft				LL = 28; PI = 12; MC = 3		

80 85 90 95 100

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/18/2021 2:01:00 PM	92.4	

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 4 SHEETS

1. PROJECT: Santiago Creek	9. COORDINATE SYSTEM: State Plane - California VI; HORIZONTAL: NAD83; VERTICAL: NAVD88
	10. SIZE AND TYPE OF BIT: 4.75" carbide tipped
2. HOLE NUMBER: TH20-19; LOCATION COORDINATES: N 6089014.53 E 2239339.556	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District	12. TOTAL SAMPLES: DISTURBED 5; UNDISTURBED 0
4. NAME OF DRILLER: John Verret	13. TOTAL NUMBER CORE BOXES: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	14. ELEVATION GROUND WATER: See Remarks
	15. DATE BORING: STARTED 9/27/21; COMPLETED 9/28/21
6. THICKNESS OF OVERBURDEN: >150'	16. ELEVATION TOP OF BORING: 329.488' (Estimated from plans)
7. DEPTH DRILLED INTO ROCK: 0'	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 150'	18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			GRAVELLY SAND (SW), fine to medium; (7.5YR 5/6), strong brown, dry, no plasticity, little gravel, little cobbles, few clay.				MC = 5		
			Fine to coarse; (7.5YR 4/3), brown, dense, some gravel, some cobbles, little clay.	67	S-1			8 19 21	40
			(10YR 5/2), grayish brown, very dense, trace silt.	100	S-2			47 50	50 /2"
299.5	30.0		GRAVEL (GW-GC), fine to coarse; (10YR 5/2), grayish brown, dry, very dense, no plasticity, little clay, little sand, fill.	80	S-3			28 35 42	100+

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 4 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6089014.53 E 2239339.556

ELEVATION TOP OF BORING: 329.488'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
289.5	40.0		GRAVEL (GW-GC), fine to coarse; (10YR 5/2), grayish brown, dry, very dense, no plasticity, little clay, little sand, fill. *(continued)*				LL = 24; PI = 9; MC = 1		
286.5	43.0		GRAVELLY CLAY (CL), fine; (7.5YR 5/8), strong brown, moist, soft, low plasticity, some silt, little gravel, trace sand.	63	S-4		LL = 34; PI = 20; MC = 22	9 50	50 /4"
269.5	60.0		SANDY GRAVEL (GW), fine to coarse; (10YR 7/3), very pale brown, dry, no plasticity, some sand, few clay, a little more clayey 43-45' pulverized gravel.				MC = 2		
			GRAVEL (GW), fine to coarse; (10YR 5/3), brown, dry, very dense, no plasticity, some sand, trace clay.	100	S-5			33 50	50 /4"
259.5	70.0		GRAVELLY SAND (SW), fine to coarse; (7.5YR 6/4), light brown, dry, no plasticity, some gravel, some cobbles, little clay.				MC = 4		
			CLAYEY GRAVEL (GW-GC), (7.5YR 5/6), strong brown, dry, no plasticity, some clay.				LL = 26; PI = 12; MC = 1		

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)	INSTALLATION		SHEET 3 OF 4 SHEETS
PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88
LOCATION COORDINATES	ELEVATION TOP OF BORING		
N 6089014.53 E 2239339.556	329.488'		

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
250.5	79.0		CLAYEY GRAVEL (GW-GC), (7.5YR 5/6), strong brown, dry, no plasticity, some clay. *(continued)*				LL = 28; PI = 13; MC = 6		
248.5	81.0		GRAVELLY CLAY (CL), (7.5YR 4/6), strong brown, moist, hard, low plasticity, little gravel, little cobbles, few silt.						
			CLAYEY GRAVEL (GW-GC), fine to coarse; (7.5YR 5/6), strong brown, moist, dense to very dense, no plasticity, some clay, little sand, trace silt, wet @ 87'.				LL = 27; PI = 10; MC = 5		
			(7.5YR 4/3), brown, sandy @ 94-96'.				MC = 4		
229.5	100.0		CLAYEY GRAVEL (GC), fine to coarse; (10YR 5/3), brown, moist, no plasticity, some clay, little sand.				LL = 29; PI = 14; MC = 2		
							LL = 27; PI = 12; MC = 9		
			Fine; (10YR 4/2), dark grayish brown, trace sand.				LL = 30; PI = 14; MC = 11		
213.5	116.0						LL = 32; PI = 15; MC = 6		
209.5	120.0		GRAVEL (GW), fine to coarse; (10YR 5/3), brown, moist, no plasticity, little sand, few clay.				MC = 6		

DRILLING LOG (Cont Sheet)

INSTALLATION		SHEET 4 OF 4 SHEETS
PROJECT: Santiago Creek	COORDINATE SYSTEM: State Plane / HORIZONTAL: NAD83	VERTICAL: NAVD88
LOCATION COORDINATES: N 6089014.53 E 2239339.556	ELEVATION TOP OF BORING: 329.488'	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
204.5	125.0		CLAYEY GRAVEL (GW-GC), fine to coarse; (2.5Y 4/4), olive brown, wet, no plasticity, some clay, little sand.						
199.5	130.0		CLAY (CL-ML), (7.5YR 5/6), strong brown, moist, soft, low plasticity, some silt, few gravel.				LL = 30; PI = 13; MC = 13		
189.5	140.0		GRAVEL (GW-GC), fine to coarse; (10YR 5/3), brown, moist, no plasticity, some clay, little sand, pulverized gravel 135-137'.				LL = 29; PI = 13; MC = 6		
179.5	150.0		GRAVEL (GW), fine to coarse; (7.5YR 5/2), brown, moist, very dense, no plasticity, little clay, few sand.						

BOTTOM OF BOREHOLE AT 150.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
24 hours	9/28/2021 7:53:00 AM	143.6	

DRILLING LOG	DIVISION: South Pacific Division	INSTALLATION	SHEET 1 OF 5 SHEETS

1. PROJECT: Santiago Creek		9. COORDINATE SYSTEM: State Plane - California VI	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT: 4.75" carbide tipped	
2. HOLE NUMBER: TH20-20	LOCATION COORDINATES: N 6086535.765 E 2239075.596	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC	
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District		12. TOTAL SAMPLES	DISTURBED: 0 / UNDISTURBED: 0
4. NAME OF DRILLER: John Verret		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: See Remarks	
		15. DATE BORING	STARTED: 9/13/21 / COMPLETED: 9/15/21
6. THICKNESS OF OVERBURDEN: >186'		16. ELEVATION TOP OF BORING: 289.409' (Estimated from plans)	
7. DEPTH DRILLED INTO ROCK: 0'		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 186'		18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
288.9	0.5		CONCRETE.						
			CLAY (GC), fine to coarse gravel-sized; dry, no odor, 7.38 ph and 98 orp, light brown.				LL = 34; PI = 19; MC = 2		
279.4	10.0		CLAY (GW-GC), subangular to subrounded, gravel to cobble-sized grained, dry, no odor, Orp is161, ph is 7.89, artificial fill, light grayish brown, sandier from 16-20' clay is med stiff to stiff.				LL = 24; PI = 6; MC = 3		
269.4	20.0		CLAY SAND (SW), gravel to cobble-sized; fine to coarse-grained sand-sized grained, dry, no odor, 8.01 ph, light grayish brown 130 orp, artificial fill.				LL = 24; PI = 9; MC = 4		
259.4	30.0		SILT CLAY (GW-GC), sand to cobble-sized grained, moist, no odor, 20 orp, 8.13 ph, soft fine silty sand at 39', grayish brown.				MC = 6		

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 5 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086535.765 E 2239075.596

ELEVATION TOP OF BORING: 289.409'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			SILT CLAY (GW-GC), sand to cobble-sized grained, moist, no odor, 20 orp, 8.13 ph, soft fine silty sand at 39', grayish brown. *(continued)*				LL = 29; PI = 14; MC = 7		
249.4	40.0								
			SILT SAND (SM), gravel to cobble-sized; fine to coarse-grained sand-sized grained, moist, no odor, 8.0 ph, 5.4 orp light brown to grayish, more cemented and siltier from 40-44' more fines and less gravel.				LL = 26; PI = 11; MC = 18		
239.4	50.0								
			CLAY SAND (SW), gravel to cobble-sized; medium to coarse-grained sand-sized grained, moist, no odor, Orp: 224 ph: 7.43, light brown to light gray, clayey layer at 54'.				LL = 35; PI = 16; MC = 12		
229.4	60.0						MC = 4		
			SAND (SW-SM), gravel to cobble-sized; medium to coarse-grained sand-sized grained, moist, no odor, ORP: 222 ph: 7.62, light grayish brown.				LL = 25; PI = 10; MC = 5		
219.4	70.0						MC = 5		
			SILT SAND (SW), gravel to cobble-sized; fine to coarse-grained sand-sized grained, moist, no odor, Ph: 8.31; ORP: 193mV, light brown.				LL = 26; PI = 9; MC = 8		

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 3 OF 5 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086535.765 E 2239075.596

ELEVATION TOP OF BORING: 289.409'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
209.4	80.0		SILT SAND (SW), gravel to cobble-sized; fine to coarse-grained sand-sized grained, moist, no odor, Ph: 8.31; ORP: 193mV, light brown. *(continued)*				MC = 8		
199.4	90.0		CLAY SAND (SW-SC), gravel to cobble-sized; fine to medium-grained sand-sized grained, dry, no odor, Ph: 8.2 ORP: 203 mV, light brown, with some clayey layers.				LL = 26; PI = 8; MC = 7 MC = 7		
189.4	100.0		CLAY (GC), fine to coarse gravel-sized grained, moist, no odor, Ph: 7.89 ORP: -623 mV, light brown with med stiff silty clay.				LL = 29; PI = 15; MC = 9		
179.4	110.0		SAND FINES (CL-ML), gravel to cobble-sized; fine-grained sand-sized; moist, no odor, ORP: 296 mV ph: 6.96, tan to light brown, less gravel, natural.				LL = 23; PI = 9; MC = 13		
169.4	120.0		SAND FINES (CL-ML), gravel to cobble-sized; fine-grained sand-sized; moist, no odor, Ph: 7.29; ORP: 190mV, brown, soft.				LL = 31; PI = 15; MC = 20		

80 85 90 95 100 105 110 115 120

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 4 OF 5 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086535.765 E 2239075.596

ELEVATION TOP OF BORING: 289.409'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			SILT SAND (SM), gravel to cobble-sized; fine-grained sand-sized grained, moist, no odor, Soft silt-sand, light brown, ORP: 308mV; ph: 7.00; medium sized grain sand at bottom with gravel.				LL = 28; PI = 10; MC = 4		
							MC = 13		
159.4	130.0								
			SILT SAND (SW-SM), gravel to cobble-sized; fine to coarse-grained sand-sized grained, moist, no odor, Ph 7.42; ORP:240 mV, dry gravel/cobble layer from 133-137', light brownish gray.				LL = 21; PI = 6; MC = 5		
149.4	140.0								
			CLAY SAND (SW-SC), gravel to cobble-sized; fine to coarse-grained sand-sized grained, moist, no odor, Light gray and brown, with silty clay layers, ph: 7.59, ORP: 246mV.				LL = 23; PI = 9; MC = 2		
							MC = 13		
139.4	150.0								
			SAND FINES (CL-ML), gravel to cobble-sized; fine to medium-grained sand-sized; wet, no odor, Light brown to brownish orange, gravelly clay from 150-154' wet sticky silty clay from 154-160', medium stiff ORP: -176mV; ph: 8.0, natural soil.				LL = 28; PI = 13; MC = 11		
129.4	160.0								
			SILT CLAY (CL), gravel to cobble-sized, subrounded; moist, few sand, no odor, Light brown, sandy at 168', very dense, slow drilling, well graded, ph: 7.7; ORP: 240mV, natural soil.						

120 125 130 135 140 145 150 155 160

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 5 OF 5 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88

LOCATION COORDINATES: N 6086535.765 E 2239075.596

ELEVATION TOP OF BORING: 289.409'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
119.4	170.0		SILT CLAY (CL), gravel to cobble-sized, subrounded; moist, few sand, no odor, Light brown, sandy at 168', very dense, slow drilling, well graded, ph: 7.7; ORP: 240mV, natural soil. *(continued)*				LL = 24; PI = 8; MC = 8		
109.4	180.0		SAND CLAY (CL-ML), fine-grained sand-sized; fine to coarse gravel-sized; wet, firm, no odor, strong cementation, iron oxide staining, Orangish brown, pH: 7.0, ORP: 230 mV.				LL = 32; PI = 15; MC = 19		
103.4	186.0		SAND CLAY (CL-ML), fine gravel-sized; wet, soft, no odor, Light brownish orange, very hard and dense crystalline rock at bottom broke off sonic bit ph: 6.80; ORP: 260mV.						

BOTTOM OF BOREHOLE AT 186.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/15/2021 4:00:00 PM	92.3	

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 3 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-21
LOCATION COORDINATES	N 6086683.507 E 2239446.549
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	
6. THICKNESS OF OVERBURDEN	>100'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	100'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terrasonic Tsi 150CC
12. TOTAL SAMPLES	
DISTURBED	0
UNDISTURBED	0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING STARTED	9/18/21
COMPLETED	9/19/21
16. ELEVATION TOP OF BORING	312.053' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
			SILT SAND (SW), gravel to cobble-sized; (7.5YR 6/4), light brown, fine to coarse-grained sand-sized grained, dry, trace clay, no odor, Hard cemented clayey gravel layer at 7-8', Ph: 7.6, ORP: 210mV.				MC = 4		
							MC = 6		
302.1	10.0								
			SAND (GW-GM), fine to coarse-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, dry, no odor, Ph: 8.2; ORP: 230mV.				LL = 29; PI = 14; MC = 4		
292.1	20.0								
			CLAY SAND (GW-GM), fine to coarse-grained sand-sized; (7.5YR 6/3), light brown, gravel to cobble-sized grained, moist, no odor, 8.2 pH ; ORP: 230mV.				LL = 29; PI = 14; MC = 7		
282.1	30.0								
			CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, dry, no odor, PH: 8.9; ORP: 240mV.						

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6086683.507 E 2239446.549

ELEVATION TOP OF BORING: 312.053'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
272.1	40.0		CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, dry, no odor, PH: 8.9; ORP: 240mV. *(continued)*				MC = 4		
262.1	50.0		CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, dry, no odor, ph: 8.9; ORP: 150mV.				LL = 23; PI = 9; MC = 1		
252.1	60.0		CLAY SAND (GW-GM), fine to coarse-grained sand-sized; (10YR 5/2), grayish brown, gravel to cobble-sized grained, dry, no odor, Ph: 7.8; ORP: 240mV, fill.						
249.1	63.0		SILT SAND (SP), fine to coarse gravel-sized; (7.5YR 5/6), strong brown, fine to medium-grained sand-sized grained, no odor.				LL = 26; PI = 10; MC = 2		
245.1	67.0		SAND CLAY (CL), fine-grained sand-sized; fine to coarse gravel-sized; (7.5YR 4/4), brown, moist, firm, no odor, Pocket pen: 2.0 @ 64'; 3.25 @ 66'; ph: 7.2; ORP: 240mV.				LL = 29; PI = 11; MC = 9		
242.1	70.0		CLAY SAND (SW-SC), fine to coarse gravel-sized; (7.5YR 5/4), brown, fine to coarse-grained sand-sized grained, moist, no odor.				LL = 28; PI = 11; MC = 16		
			CLAY SAND (SW), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, Ph: 7.4; ORP: 170 mV.				MC = 16		

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)

INSTALLATION		SHEET 3 OF 3 SHEETS
PROJECT: Santiago Creek	COORDINATE SYSTEM: State Plane / HORIZONTAL: NAD83	VERTICAL: NAVD88
LOCATION COORDINATES: N 6086683.507 E 2239446.549	ELEVATION TOP OF BORING: 312.053'	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
232.1	80.0								
			SILT SAND (SW-SM), gravel to cobble-sized; (10YR 5/3), brown, fine to coarse-grained sand-sized grained, moist, no odor, Well graded silty sand with gravel to cobbles, ph: 8.3, ORP: 210 mV.				LL = 24; PI = 10; MC = 4 MC = 4		
222.1	90.0								
			SAND (SW), gravel to cobble-sized; (7.5YR 6/4), light brown, fine to coarse-grained sand-sized grained, moist, no odor, Ph: 7.6 orp: 270 mV.						
215.1	97.0								
			FINES SAND (GW), fine to coarse-grained sand-sized; (10YR 6/2), light brownish gray, gravel to cobble-sized grained, moist, very dense, no odor.						
212.1	100.0								

80 85 90 95 100

BOTTOM OF BOREHOLE AT 100.0 ft

Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval,
unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a
140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%,
Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/19/2021 12:49:00 PM	87.71	

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 3 SHEETS

1. PROJECT: Santiago Creek	9. COORDINATE SYSTEM: State Plane - California VI; HORIZONTAL: NAD83; VERTICAL: NAVD88
	10. SIZE AND TYPE OF BIT: 4.75" carbide tipped
2. HOLE NUMBER: TH20-22; LOCATION COORDINATES: N 6089980.122 E 2242012.3	11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC
3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District	12. TOTAL SAMPLES: DISTURBED 5; UNDISTURBED 0
4. NAME OF DRILLER: John Verret	13. TOTAL NUMBER CORE BOXES: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:	14. ELEVATION GROUND WATER: See Remarks
	15. DATE BORING: STARTED 9/29/21; COMPLETED 9/29/21
6. THICKNESS OF OVERBURDEN: >80'	16. ELEVATION TOP OF BORING: 314.226' (Estimated from plans)
7. DEPTH DRILLED INTO ROCK: 0'	17. TOTAL CORE RECOVERY FOR BORING: N/A
8. TOTAL DEPTH OF BORING: 80'	18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist

ELEV	DEPTH	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
		GRAVELLY SAND (SW), fine to coarse; (10YR 7/4), very pale brown, dry, no plasticity, some gravel, some cobbles, trace silt.						
		(7.5YR 5/6), strong brown, trace clay.						
		(10YR 6/3), pale brown, very loose, little gravel, little cobbles, few clay.	100	S-1			50	50/
						MC = 4		
		Very dense, hard large cobbles at 25'.	86	S-2			31 37 50	100+
289.2	25.0							
		CLAYEY GRAVEL (GW-GC), fine to coarse; (5YR 4/4), reddish brown, dry, no plasticity, some clay, little sand, iron oxide staining, light reddish clay @ 28'.				LL = 25; PI = 8; MC = 5		
		(10YR 5/2), grayish brown, moist, dense, some sand.	87	S-3			16 21 25	46

DRILLING LOG (Cont Sheet)	INSTALLATION	SHEET 2 OF 3 SHEETS
PROJECT: Santiago Creek	COORDINATE SYSTEM: State Plane / HORIZONTAL: NAD83 / VERTICAL: NAVD88	
LOCATION COORDINATES: N 6089980.122 E 2242012.3	ELEVATION TOP OF BORING: 314.226'	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
274.2	40.0		CLAYEY GRAVEL (GW-GC), fine to coarse; (5YR 4/4), reddish brown, dry, no plasticity, some clay, little sand, iron oxide staining, light reddish clay @ 28'. *(continued)*				LL = 26; PI = 10; MC = 13		
264.2	50.0		SANDY GRAVEL (GW), fine to coarse; (10YR 5/2), grayish brown, dry, very dense, no plasticity, some sand, few clay.	67	S-4		MC = 4	36 44 24	100+
261.2	53.0		GRAVELLY CLAY (CL), fine to medium; (7.5YR 4/4), brown, moist, soft, low plasticity, little gravel, few silt, trace sand.	87	S-5		LL = 26; PI = 11; MC = 7	21 41 50	100+
254.2	60.0		SANDY GRAVEL (GW), fine to coarse; (10YR 6/2), light brownish gray, dry, no plasticity, some sand, few clay, hard gravelly clay at bottom.						
248.2	66.0		SAND (SW), fine to coarse; (7.5YR 5/4), brown, moist, no plasticity, little gravel, few clay, clayey at 60'.				MC = 5		
244.2	70.0		CLAYEY GRAVEL (GC), fine; (5Y 4/2), olive gray, wet, no plasticity, some clay, few sand, large hard cobbles.				LL = 41; PI = 18; MC = 19		
238.2	76.0		GRAVELLY CLAY (CL-ML), (2.5Y 4/3), olive brown, moist, soft, low plasticity, some silt, little gravel, little cobbles, boulder at 70'.				LL = 44; PI = 21; MC = 18		

DRILLING LOG (Cont Sheet)	INSTALLATION	SHEET 3 OF 3 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
N 6089980.122 E 2242012.3	314.226'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
234.2	80.0		GRAVEL (GW-GC), fine to coarse; (10YR 6/2), light brownish gray, moist, no plasticity, little clay, little sand. *(continued)*				LL = 40; PI = 19; MC = 15		

80

BOTTOM OF BOREHOLE AT 80.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 3 SHEETS

1. PROJECT	Santiago Creek
2. HOLE NUMBER	TH20-23
LOCATION COORDINATES	N 6088489.843 E 2240137.623
3. DRILLING AGENCY	U.S. Army Corps of Engineers - Savannah District
4. NAME OF DRILLER	John Verret
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL	---
BEARING	
6. THICKNESS OF OVERBURDEN	>100'
7. DEPTH DRILLED INTO ROCK	0'
8. TOTAL DEPTH OF BORING	100'
9. COORDINATE SYSTEM	State Plane - California VI
HORIZONTAL	NAD83
VERTICAL	NAVD88
10. SIZE AND TYPE OF BIT	4.75" carbide tipped
11. MANUFACTURER'S DESIGNATION OF DRILL	Terra Sonic
12. TOTAL SAMPLES	DISTURBED 0 / UNDISTURBED 0
13. TOTAL NUMBER CORE BOXES	0
14. ELEVATION GROUND WATER	See Remarks
15. DATE BORING	STARTED 9/17/21 / COMPLETED 9/17/21
16. ELEVATION TOP OF BORING	325.791' (Estimated from plans)
17. TOTAL CORE RECOVERY FOR BORING	N/A
18. SIGNATURE AND TITLE OF INSPECTOR	Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
315.8	10.0		CLAY SAND (SW-SM), coarse gravel-sized; (7.5YR 6/3), light brown, fine to medium-grained sand-sized grained, dry, no odor, PH: 8.7; ORP: 230mV, fill.				LL = 30; PI = 16; MC = 5		
305.8	20.0		SAND (SW), gravel to cobble-sized; (7.5YR 5/8), strong brown, fine-grained sand-sized grained, dry, no odor, Hard Clayey layer 16-17', pocket pen: 4.0, ph: 8.1; ORP: 270mV, fill,.				MC = 7 MC = 9		
295.8	30.0		SILT SAND (SM), gravel to cobble-sized; (7.5YR 5/6), strong brown, fine to medium-grained sand-sized grained, few clay, no odor, Thin soft soft clayey layer at around 26', less gravel, ph: 8.2; ORP: 240mV, fill.				LL = 26; PI = 11; MC = 6		
290.8	35.0		SILT CLAY (CL-ML), fine to coarse gravel-sized; (7.5YR 5/4), brown, moist, soft, no odor, Pocket pen: 1.25@31', .75 @33', 2.25@35' ph: 8.0; ORP: 250 mV, fill.						

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6088489.843 E 2240137.623

ELEVATION TOP OF BORING: 325.791'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
285.8	40.0		CLAY SAND (SW-SC), gravel to cobble-sized; (10YR 6/2), light brownish gray, fine to medium-grained sand-sized grained, dry, Fill.				LL = 52; PI = 37; MC = 19 MC = 5		
275.8	50.0		CLAY SAND (GW), fine to coarse-grained sand-sized; (10YR 6/2), light brownish gray, gravel to cobble-sized grained, dry, dense, no odor, Ph: 8.0, ORP: 245mV, fill.						
268.8	57.0		CLAY SAND (SW-SC), sand to cobble-sized; (10YR 4/3), brown, moist, Ph: 8.6; ORP: 160mV, fill.				LL = 31; PI = 15; MC = 6		
265.8	60.0		CLAY SAND (GW), fine-grained sand-sized; (10YR 7/3), very pale brown, gravel to cobble-sized grained, dry, no odor, Large cobbles and gravel, mixed in with clayey sand, fill.				MC = 5		
255.8	70.0		CLAY SAND (SW-SC), gravel to cobble-sized; (10YR 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, More clayey 69-70', ph: 8.20, ORP: 210mV, fill.				MC = 5 LL = 29; PI = 13; MC = 8 MC = 8		
			CLAY SAND (SW-SC), gravel to cobble-sized; (7.5YR 5/3), brown, fine to coarse-grained sand-sized grained, moist, no odor, Pocket pen: 3.0 @ 71' stiff gravelly clay, ph: 7.1; ORP: 220mV, fill,.				LL = 26; PI = 10; MC = 5		

DRILLING LOG (Cont Sheet)

INSTALLATION		SHEET 3 OF 3 SHEETS
PROJECT: Santiago Creek	COORDINATE SYSTEM: State Plane / HORIZONTAL: NAD83	VERTICAL: NAVD88
LOCATION COORDINATES: N 6088489.843 E 2240137.623	ELEVATION TOP OF BORING: 325.791'	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
245.8	80.0								
235.8	90.0		CLAY SAND (SW-SC), gravel to cobble-sized; (2.5Y 5/2), grayish brown, fine to coarse-grained sand-sized grained, moist, no odor, Wet at 89' pH: 8.2; ORP: 230mV, fill.				LL = 31; PI = 14; MC = 8		
231.8	94.0		SAND CLAY (CL), gravel to cobble-sized; (10YR 5/3), brown, moist, no odor, Ph: 7.9, ORP: 220mV, fill.				LL = 30; PI = 14; MC = 12		
225.8	100.0		SILT SAND (SW-SM), gravel to cobble-sized; (10YR 6/2), light brownish gray, fine to coarse-grained sand-sized grained, moist, trace clay, no odor, Fill.				LL = 27; PI = 12; MC = 6		

BOTTOM OF BOREHOLE AT 100.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/17/2021 2:43:00 PM	66	wl may have still been droppi

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 3 SHEETS

1. PROJECT: Santiago Creek

2. HOLE NUMBER: TH20-24

LOCATION COORDINATES: N 6091055.504 E 2242513.425

3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District

4. NAME OF DRILLER: John Verret

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:

6. THICKNESS OF OVERBURDEN: >80'

7. DEPTH DRILLED INTO ROCK: 0'

8. TOTAL DEPTH OF BORING: 80'

9. COORDINATE SYSTEM: State Plane - California VI; HORIZONTAL: NAD83; VERTICAL: NAVD88

10. SIZE AND TYPE OF BIT: 4.75" carbide tipped

11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC

12. TOTAL SAMPLES: DISTURBED 5; UNDISTURBED 0

13. TOTAL NUMBER CORE BOXES: 0

14. ELEVATION GROUND WATER: See Remarks

15. DATE BORING: STARTED 9/28/21; COMPLETED 9/28/21

16. ELEVATION TOP OF BORING: 354.801' (Estimated from plans)

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
348.8	6.0		GRAVELLY SAND (SW), fine to coarse; (10YR 6/3), pale brown, dry, no plasticity, some gravel, trace clay.				LL = 29; PI = 14; MC = 6		
344.8	10.0		CLAYEY GRAVEL (GC), (7.5YR 5/4), brown, dry, no plasticity, some clay, few sand.				LL = 35; PI = 17; MC = 8		
336.8	18.0		SAND (SW), fine to coarse; (10YR 5/2), grayish brown, dry, dense, no plasticity, some gravel, some cobbles, little clay.	87	S-1			7 15 30	45
334.8	20.0		SILTY SAND (SM), fine to medium; (10YR 4/6), dark yellowish brown, moist, no plasticity, little silt, few clay, trace fine gravel, more clayey at 17-18'.				LL = 35; PI = 17; MC = 9		
328.8	26.0		GRAVELLY SAND (SW), fine to coarse; (7.5YR 5/2), brown, moist, very dense, no plasticity, some gravel, some cobbles, trace clay, pulverized concrete 25-26'.	100	S-2		MC = 6	50	50 /4"
319.8	35.0		GRAVEL (GW), fine to coarse; (7.5YR 5/2), brown, moist, very dense, no plasticity, some sand, little clay.				MC = 7		
				93	S-3		MC = 5	39 36 42	100+

0 5 10 15 20 25 30 35

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6091055.504 E 2242513.425

ELEVATION TOP OF BORING: 354.801'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
314.8	40.0		GRAVELLY SAND (SW), fine to coarse; (7.5YR 4/6), strong brown, moist, no plasticity, little gravel, little cobbles, few clay.						
309.8	45.0		CLAYEY GRAVEL (GW-GC), fine to medium; (7.5YR 5/6), strong brown, moist, very dense, no plasticity, little clay, little sand.	80	S-4		LL = 30; PI = 14; MC = 7	11 28 40	68
304.8	50.0		SAND (SP), fine to medium; (7.5YR 6/4), light brown, moist, no plasticity, few fine gravel, trace silt, clayey at 49-50'.						
294.8	60.0		GRAVELLY SAND (SW), fine to coarse; (10YR 5/2), grayish brown, moist, very dense, no plasticity, little gravel, little cobbles, few clay.	89	S-5		MC = 2	36 50	50 /5"
284.8	70.0		GRAVEL (GW-GC), fine to coarse; (7.5YR 4/6), strong brown, moist, no plasticity, some sand, little clay, iron oxide staining, large cobbles throughout.				MC = 6 LL = 23; PI = 8; MC = 7		
			SAND (SW-SC), fine to coarse; (7.5YR 4/6), strong brown, dry, no plasticity, some clay, little gravel, iron oxide staining, not cohesive.				LL = 32; PI = 15; MC = 8		

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)	INSTALLATION	SHEET 3 OF 3 SHEETS

PROJECT	COORDINATE SYSTEM	HORIZONTAL	VERTICAL
Santiago Creek	State Plane	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
N 6091055.504 E 2242513.425	354.801'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
274.8	80.0		SAND (SW-SC), fine to coarse; (7.5YR 4/6), strong brown, dry, no plasticity, some clay, little gravel, iron oxide staining, not cohesive. *(continued)*						

80

BOTTOM OF BOREHOLE AT 80.0 ft

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

Water Level Data

Reading	Date	Depth	Notes
After drilling	9/28/2021 4:02:00 PM	42	wl not static

DRILLING LOG

DIVISION: South Pacific Division

INSTALLATION:

SHEET 1 OF 3 SHEETS

1. PROJECT: Santiago Creek

2. HOLE NUMBER: TH20-25

LOCATION COORDINATES: N 6089217.706 E 2239824.474

3. DRILLING AGENCY: U.S. Army Corps of Engineers - Savannah District

4. NAME OF DRILLER: John Verret

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ---; BEARING:

6. THICKNESS OF OVERBURDEN: >100'

7. DEPTH DRILLED INTO ROCK: 0'

8. TOTAL DEPTH OF BORING: 100'

9. COORDINATE SYSTEM: State Plane - California VI; HORIZONTAL: NAD83; VERTICAL: NAVD88

10. SIZE AND TYPE OF BIT: 4.75" carbide tipped

11. MANUFACTURER'S DESIGNATION OF DRILL: Terrasonic Tsi 150CC

12. TOTAL SAMPLES: DISTURBED 5; UNDISTURBED 0

13. TOTAL NUMBER CORE BOXES: 0

14. ELEVATION GROUND WATER: See Remarks

15. DATE BORING: STARTED 9/27/21; COMPLETED 9/27/21

16. ELEVATION TOP OF BORING: 335.989' (Estimated from plans)

17. TOTAL CORE RECOVERY FOR BORING: N/A

18. SIGNATURE AND TITLE OF INSPECTOR: Tyler Castellaw, Geologist

ELEV	DEPTH	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
326.0	10.0	SAND (SP), fine to medium; (7.5YR 6/4), light brown, dry, no plasticity, few gravel, few cobbles, few silt.				MC = 4		
322.0	14.0	GRAVELLY SAND (SW), fine to coarse; (10YR 6/2), light brownish gray, dry, dense, no plasticity, little gravel, little cobbles.	67	S-1		MC = 4	47 29 21	50
316.0	20.0	SANDY GRAVEL (GW), fine to coarse; (7.5YR 4/6), strong brown, moist, no plasticity, some sand, few clay.				MC = 6		
306.0	30.0	GRAVEL (GW-GC), fine to coarse; dry, very dense, no plasticity, some sand, little clay.	100	S-2		LL = 29; PI = 14; MC = 3	27 32 31	63
		SANDY GRAVEL (GW), fine to coarse; (10YR 5/2), grayish brown, dry, very dense, no plasticity, some sand, little clay.	100	S-3		MC = 5	50	50 /5"

DRILLING LOG (Cont Sheet)

INSTALLATION

SHEET 2 OF 3 SHEETS

PROJECT: Santiago Creek

COORDINATE SYSTEM: State Plane | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: N 6089217.706 E 2239824.474

ELEVATION TOP OF BORING: 335.989'

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
297.0	39.0		SANDY GRAVEL (GW), fine to coarse; (10YR 5/2), grayish brown, dry, very dense, no plasticity, some sand, little clay. *(continued)*						
296.0	40.0		SANDY CLAY (CL), (7.5YR 4/6), strong brown, moist, stiff, low plasticity, little sand, few fine gravel.				LL = 31; PI = 14; MC = 16		
			GRAVEL (GW), fine to coarse; (10YR 5/2), grayish brown, dry, very dense, no plasticity, little sand, trace clay.	75	S-4			42 50	50 /4"
286.0	50.0						MC = 4		
284.0	52.0		GRAVELLY CLAY (CL), fine to medium; (7.5YR 4/6), strong brown, moist, stiff, low plasticity, little gravel, little sand.	67	S-5		LL = 28; PI = 13; MC = 8	37 35 23	58
276.0	60.0		GRAVEL (GW-GC), fine to coarse; (10YR 5/2), grayish brown, dry, no plasticity, some sand, little clay.				MC = 4 MC = 4		
266.0	70.0		GRAVEL (GW), fine to coarse; (10YR 5/3), brown, moist, no plasticity, some sand, few clay.				MC = 4		
259.0	77.0		GRAVEL (GW-GC), fine to coarse; (7.5YR 4/6), strong brown, moist, no plasticity, some clay, little sand, iron oxide staining.				LL = 30; PI = 14; MC = 8		

35 40 45 50 55 60 65 70 75

DRILLING LOG (Cont Sheet)	INSTALLATION	SHEET 3 OF 3 SHEETS
PROJECT: Santiago Creek	COORDINATE SYSTEM: State Plane / HORIZONTAL: NAD83 / VERTICAL: NAVD88	
LOCATION COORDINATES: N 6089217.706 E 2239824.474	ELEVATION TOP OF BORING: 335.989'	

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	RQD %	REMARKS	Blows/ 0.5 ft	N-Value
256.0	80.0		GRAVELLY CLAY (CL), fine to coarse; (5YR 4/4), reddish brown, hard, low plasticity, little gravel, little cobbles, little silt, trace sand, natural soil. *(continued)*				LL = 26; PI = 12; MC = 8		
			GRAVEL (GW-GC), fine to coarse; (7.5YR 4/6), strong brown, moist, no plasticity, some clay, little sand, iron oxide staining, Natural, very hard gravelly clay @ 89-90'.				LL = 26; PI = 10; MC = 3		
							MC = 3		
			GRAVEL (GW-GC), fine to coarse; (7.5YR 4/6), strong brown, moist, no plasticity, some clay, little sand, iron oxide staining.						
							MC = 6		
236.0	100.0		BOTTOM OF BOREHOLE AT 100.0 ft						

80
85
90
95
100

1. Soils visually field classified in accordance with ASTM D2488.
2. N-Value: Total blows over last 1.0 foot of 1.5-foot driven interval, unless otherwise indicated, using a 1 3/8-inch ID split-spoon with a 140-pound hammer falling 30 inches.
3. The drilling rig utilized an automatic trip hammer.
4. Component Percentages: Trace: 0-5%, Few: 5-10%, Little: 15-25%, Some: 30-45%, Mostly: 50-100%.

ATTACHMENT C-10 - Infinite Slope Analyses

seismic acceleration	k	0.15	g
effective cohesion	c'	0	psf
soil unit weight	γ	130	pcf
unit weight of water	γ_w	62.4	pcf
depth	z	20	ft
slope angle	β	19.70811	deg
		0.343971	rad
soil friction angle	ϕ	38	deg
		0.663225	rad
angle of water	αs	19.70811	deg
with respect to slope		0.343971	rad
pore pressure	u	1248	

αs	0	parallel
$\alpha s = \beta$		horizontal seepage

Duncan, Wright, and Brandon Calculator

No submerged

F 2.181073

submerged slope - no flow

F 2.181073

seepage parallel (α = 0)

F 1.134158

seepage horizontal ($\alpha = \beta$)

F 0.999823

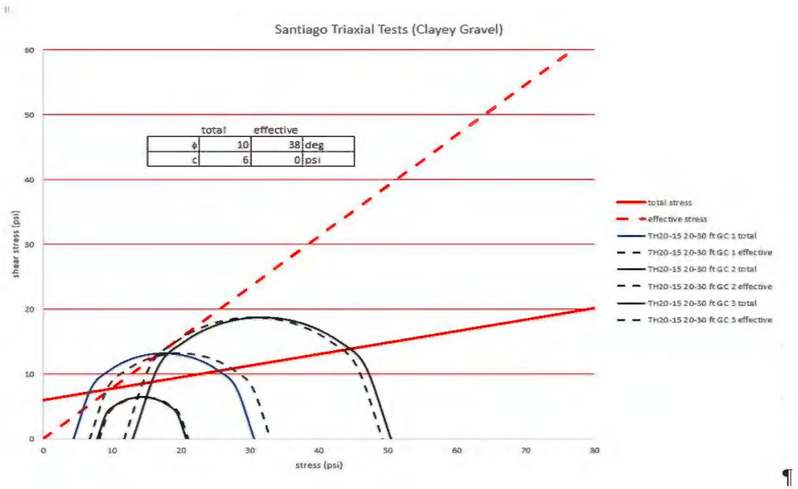
with seismic (strengths reduced by factor of 0.8)

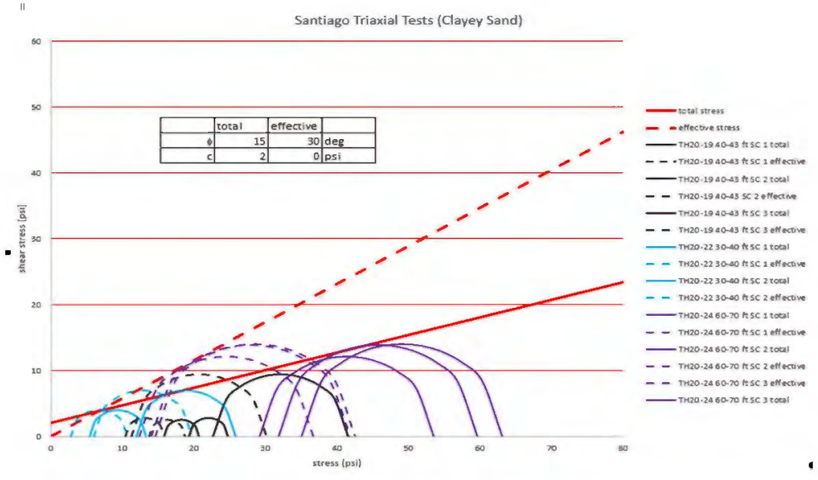
F 1.454721

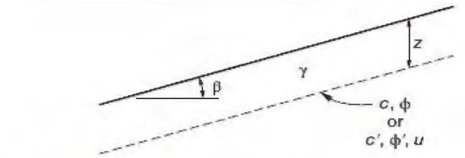
max slope		H:1V
37.9953704	deg	1.3
22.1099174	deg	2.5
19.70811561	deg	2.8
21.85825757	deg	2.5

Maximum stable slope (FS = 1). Flatter slopes are more critical.

	clayey gravel		clayey sand		
	angle (β)	slope #H:1V	angle (β)	slope #H:1V	
submerged slope - no flow	38.0	1.3	30.0	1.7	long term
seepage parallel (α = 0)	22.1	2.5	16.7	3.3	
seepage horizontal ($\alpha = \beta$)	19.7	2.8	15.6	3.6	
with seismic	21.9	2.5	15.5	3.6	long term reduced by 80%
rapid drawdown	29.2	1.8	20.1	2.7	S-R parameters







Total Stresses: $s = c + \sigma \tan \phi$

Subaerial (not submerged) slopes:

$$F = \frac{c}{\gamma z} \frac{2}{\sin(2\beta)} + [\cot \beta] \tan \phi$$

Submerged slopes ($\phi = 0$ only):

$$F = \frac{c}{(\gamma - \gamma_w) z} \frac{2}{\sin(2\beta)}$$

Effective Stresses: $s = c' + \sigma' \tan \phi'$

General case (subaerial slope):

$$F = \frac{c'}{\gamma z} \frac{2}{\sin(2\beta)} + \left[\cot \beta - \frac{u}{\gamma z} (\cot \beta + \tan \beta)\right] \tan \phi'$$

Submerged slopes—no flow:

$$F = \frac{c'}{(\gamma - \gamma_w) z} \frac{2}{\sin(2\beta)} + [\cot \beta] \tan \phi'$$

Subaerial slope—seepage parallel to slope face:

$$F = \frac{c'}{\gamma z} \frac{2}{\sin(2\beta)} + \left[\cot \beta - \frac{\gamma_w}{\gamma} (\cot \beta)\right] \tan \phi'$$

Subaerial slope—horizontal seepage:

$$F = \frac{c'}{\gamma z} \frac{2}{\sin(2\beta)} + \left[\cot \beta - \frac{\gamma_w}{\gamma} (\cot \beta + \tan \beta)\right] \tan \phi'$$

EM 1110-2-1902
31 Oct 03

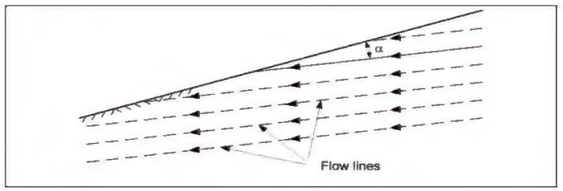


Figure C-17. Infinite slope with parallel flow lines

H	2.734963	
V	1	
ϕ'	30	deg
	0.523599	rad
c'	0	psf
ϕ_R	15	deg
	0.261799	rad
C_R	144	psf
β	0.350536	rad
	20.08421	deg
z	5	ft
hw	100	ft
γ	130	pcf
γw	62.4	pcf
$d_{Kc=1}$	162.5222	psf
$\psi_{Kc=1}$	0.29367	rad
	16.82608	deg
c'	0	psf
ϕ'	30	deg
	0.523599	rad

First-stage

σ	6850.142
u	6552
σ'	298.1416
τ	109.0112

Second-stage

tff(Kc=1)	252.6845
tff(Kc=Kf)	172.1321
K1	2.07035

PSR 3 principal stress ratio (same as Kp)

τff	209.5749
τ	209.6369
F	0.999704

Third-stage

σ'	573.3493
τdrained	331.0234

if τdrained is < tff from second stage, use tdrained

F	0.999704

$$d_{K_c=1} = c_R \frac{\cos\phi_R \cos\phi'}{1-\sin\phi_R} \tag{9.6}$$

$$\psi_{K_c=1} = \arctan\frac{\sin\phi_R \cos\phi'}{1-\sin\phi_R} \tag{9.7}$$

The R envelope is sometimes drawn such that it passes through points corresponding to stresses on the failure plane. If the R envelope is drawn in this manner (Figure 9.3*b*), the slope and intercept of the $K_c = 1$ envelope are computed from

$$d_{K_c=1} = \frac{c_R}{1+(\sin\phi'-1)\tan\phi_R/\cos\phi'} \tag{9.8}$$

$$\psi_{K_c=1} = \arctan\frac{\tan\phi_R}{1+(\sin\phi'-1)\tan\phi_R/\cos\phi'} \tag{9.9}$$

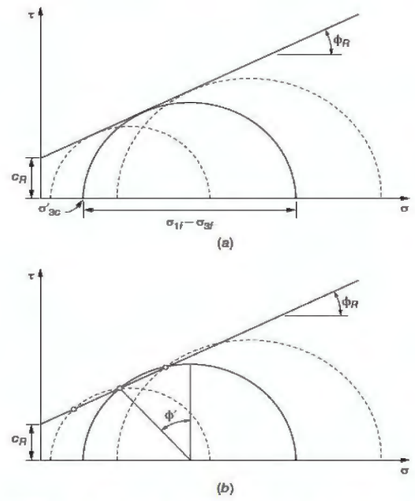


Figure 9.3 Shear strength envelopes used to define the undrained shear strengths for the second stage of three-stage analyses: (*a*) failure envelope tangent to circles and (*b*) failure envelope through points representing stresses on the failure plane.

First-Stage Analysis The total normal stress on the slip surface is computed for a submerged infinite slope from the equation

$$\sigma = \gamma z\cos^2\beta + \gamma_w(h_w + z\sin^2\beta) \tag{9.18}$$

Thus, for the slip surface at a depth of 5 ft,

$$\sigma = (125)(5)\cos^2(18.4°) + (62.4)[100 + (5)\sin^2(18.4°)]$$
$$= 6834 \text{ psf} \tag{9.19}$$

Similarly, for the slip surface at a depth of 30 ft, the total normal stress is 9803 psf. The pore water pressure on the slip plane is computed from

$$u = \gamma_w(z + h_w) \tag{9.20}$$

For the slip surface at a depth of 5 ft, the pore water pressure is

$$u = (62.4)(5 + 100) = 6552 \text{ psf} \tag{9.21}$$

and, similarly, the pore water pressure at a depth of 30 ft is u = 8112 psf. The effective normal stress is computed by subtracting the pore water pressure from the total stress (i.e., $\sigma' = \sigma - u$). Thus, for the slip surface at a depth of 5 ft the effective stress is

$$\sigma' = 6834 - 6552 = 282 \text{ psf} \tag{9.22}$$

and for the slip surface at a depth of 30 ft, the effective normal stress is 1691 psf (= 9803 − 8112). These represent the effective normal stresses after consolidation, σ'_{fc}. The effective normal stresses can also be calculated directly using submerged unit weights (γ') and the following equation because there is no flow:

$$\sigma' = \gamma' z\cos^2\beta \tag{9.23}$$

The shear stress on the slip surfaces is calculated from

$$\tau = (\gamma - \gamma_w)z\sin\beta\cos\beta \tag{9.24}$$

For the slip surface at a depth of 5 ft, this gives

$$\tau = (125 - 62.4)(5)\sin(18.4°)\cos(18.4°) = 94 \text{ psf} \tag{9.25}$$

and, similarly, for the slip surface at a depth of 30 ft the shear stress is 562 psf. These stresses represent the shear stresses, τ_{fc}, on the two potential slip surfaces after consolidation. The consolidation stresses are summarized in Table 9.2.

Second-Stage Analysis For the second-stage analysis the undrained shear strengths are determined based on σ'_{fc} and τ_{fc}. The undrained shear strengths for the $K_c = 1$ shear strength envelope are computed using the equation

$$\tau_{ff(K_c=1)} = d + \sigma'_{fc}\tan\psi \tag{9.26}$$

For the slip surface at a depth of 5 ft, this gives

$$\tau_{ff(K_c=1)} = 2000 + (282)\tan(20°) = 2103 \text{ psf} \tag{9.27}$$

The corresponding value for the slip surface at a depth of 30 ft is $\tau_{ff(K_c=1)}$ = 2615 psf. The shear strengths from the envelope for $K_c = K_f$ are computed from

$$\tau_{ff(K_c=K_f)} = c' + \sigma'_{fc}\tan\phi' \tag{9.28}$$

For the slip plane at a depth of 5 ft, this gives

$$\tau_{ff(K_c=K_f)} = 0 + (252)\tan(40°) = 237 \text{ psf} \tag{9.29}$$

Similarly, for the slip surface at 30 ft depth, $\tau_{ff(K_c=K_f)}$ is 1419 psf.

The undrained shear strengths for the second-stage analysis are interpolated using the effective principal stress ratios and the undrained shear strength values determined above. The effective principal stress ratios after consolidation are calculated using the stresses from the first-stage analysis and Eq. (9.10). For the slip surface at a depth of 5 ft,

$$K_1 = \frac{282 + 94\{[\sin(40°)+1]/\cos(40°)\}}{282 + 94\{[\sin(40°)-1]/\cos(40°)\}} = 2.0 \tag{9.30}$$

The effective principal stress ratio for consolidation for the slip surface at a depth of 30 ft is also equal to 2.0.

The effective principal stress ratio at failure is calculated from Eq. (9.12). The effective principal stress ratio at failure is 4.6 and is the same for both depths because $c' = 0$.

Undrained shear strengths are determined using Eq. (9.11). For the slip surfaces at depths of 5 and 30 ft, the shear strengths are as follows:

$$\tau_{ff} = \begin{cases} \dfrac{(4.6-2.0)2103 + (2.0-1)237}{4.6-1} = 1585 \text{ psf} \\ \text{for 5-ft depth} \end{cases} \tag{9.31}$$

$$\begin{cases} \dfrac{(4.6-2.0)2615 + (2.0-1)1419}{4.6-1} = 2283 \text{ psf} \\ \text{for 30-ft depth} \end{cases} \tag{9.32}$$

The next step in the second-stage analysis is to calculate the factor of safety after drawdown using the undrained shear strengths. For the infinite slope and complete drawdown (no water above slope), the shear stress is calculated from

$$\tau = \gamma z\sin\beta\cos\beta \tag{9.33}$$

For the slip surface at a depth of 5 ft, this gives

$$\tau = (125)(5)\sin(18.4°)\cos(18.4°) = 187 \text{ psf} \tag{9.34}$$

Similarly, for the slip surface at a depth of 30 ft the shear stress is 1123 psf. The factors of safety for the slip surfaces are calculated by dividing the undrained shear strength by the shear stress. For the slip surfaces at depths of 5 and 30 ft, this gives, respectively,

$$F = \begin{cases} \dfrac{1585}{187} = 8.48 & \text{for 5-ft depth} \\ \dfrac{2283}{1123} = 2.03 & \text{for 30-ft depth} \end{cases} \tag{9.35, 9.36}$$

These values represent the factors of safety for undrained conditions during drawdown.

Third-Stage Analysis The third-stage analysis is begun by estimating the fully drained shear strengths of the soil (assuming that all excess pore water pressures due to drawdown have dissipated). For this example the water level is assumed to be lowered to such a depth that there will be no pore water pressures after drainage is complete. The total normal stress and effective stress are equal since the pore water pressures are zero. The effective stress for drained conditions after drawdown is computed from the equation

$$\sigma' = \gamma z\cos^2\beta \tag{9.37}$$

For the slip surface at a depth of 5 ft, this gives

$$\sigma' = (125)(5)\cos^2(18.4°) = 563 \tag{9.38}$$

The drained shear strength is then

$$\tau_{drained} = 0 + (563)\tan(40°) = 472 \text{ psf} \tag{9.39}$$

This value (472 psf) is much less than the value of undrained shear strength (1585 psf) determined earlier. Therefore, the factor of safety would be lower if drainage occurred.

The shear stress was calculated above [Eq. (9.34)] to be 187 psf, and the factor of safety for the slip surface at a depth of 5 ft is, therefore,

$$F = \frac{472}{187} = 2.52 \tag{9.40}$$

For the slip surface at a depth of 30 ft, the effective normal stress after drainage is calculated as

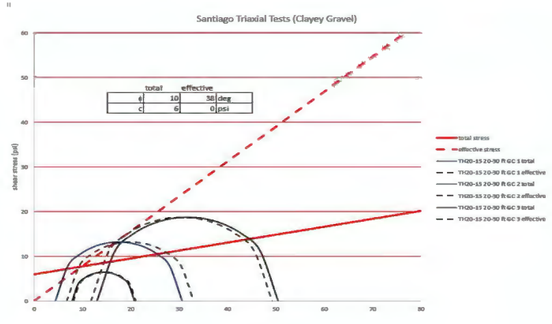
$$\sigma' = (125)(30)\cos^2(18.4°) = 3376 \tag{9.41}$$

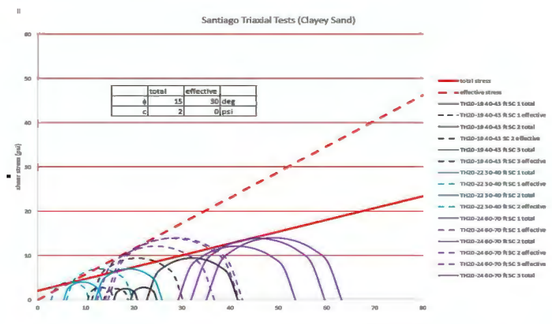
and the corresponding drained shear strength is

$$\tau_{drained} = 0 + (3376)\tan(40°) = 2833 \tag{9.42}$$

This value of 2833 psf for the drained shear strength is higher than the value of 2283 psf determined earlier for the undrained shear strength. Thus, the undrained shear strength controls, and the factor of safety is equal to the value of 2.02 that was calculated earlier [Eq. (9.36)].

The calculations for this example show that the drained shear strength controls the stability after drawdown for the shallow (5 ft) depth while the undrained shear strength controls the stability for deeper (30 ft) depth. It is commonly found that drained shear strength is smaller at shallower depths, and undrained shear strength is smaller at deeper depths. Generally, this pattern of drained and undrained shear strengths controlling the stability is expected to happen. For slip surfaces that encompass a range of depths, the controlling shear strength may be the drained strength in some parts and the undrained strength in others.





Appendix 7 – Draft Fish and Wildlife Coordination Act Report

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250
Carlsbad, California 92008

In Reply Refer to:
22-0987654-FWCA-OR

Sent Electronically

Colonel Paul Culberson
U.S. Army Corps of Engineers – Chicago District
231 South LaSalle St., Suite 1500
Chicago, IL 60604-1437

Attention: Susan Davis, Chief, Planning Branch

Subject: Draft Coordination Act Report for the Proposed Santiago Creek Flood Risk Management Project, Orange County, California (Army Corps Reference: IPaC Consultation Code 08ECAR00-2021-SLI-0373 and 08ECAR00-2021-SLI-0374)

Dear Colonel Culberson:

The U.S. Fish and Wildlife Service (Service) has prepared this Draft Coordination Act Report (Draft CAR) for the U.S. Army Corps of Engineers (Corps) on the proposed Santiago Creek Flood Risk Management Project (Project) to describe biological resources, outline potential opportunities, and provide recommendations related to the conservation and enhancement of fish and wildlife resources in the Project action area.[1]

The Corps Chicago District is partnering with the Corps Los Angeles District to develop a Design Documentation Report (DDR) for the Santiago Creek component (the proposed Project) of the Santa Ana River Mainstem Flood Risk Management Project SARMP (Corps 2022a). Recharge basin/reservoir improvements are proposed at the Santiago Basins located in Orange County (Figure 1), California; these proposed modifications are deemed necessary to accommodate water storage and regulation of flood waters released within Santiago Creek. Generally, the existing Santiago Basins (which include the Blue Diamond Pit, Bond Pit, and Smith Pit basins) would be modified to allow storage of additional flood control volume and to give the Basin operators/owners additional flexibility in managing water levels to accommodate both water conservation and flood storage needs. An additional purpose of the Project is to reduce flood risks for the developed community within a downstream section of the Santiago Creek (Lower Santiago Creek) floodplain. The design modifications would be directed toward increasing the flood risk management capacity and reducing flooding-induced erosion along the urbanized areas of the Lower Santiago Creek region. The congressionally authorized design

[1] The action area herein is defined as all areas to be affected directly or indirectly by the proposed Project and not merely the immediate area (Project footprint) involved in the Project.

objective for the Project is to contain the 1-percent annual chance exceedance (1-percent ACE) storm flows of Lower Santiago Creek within the channel and reservoir (Santiago Basins) area.

The Corps Chicago District is also developing a Supplemental Environmental Assessment (SEA) for the proposed Project, pursuant to the National Environmental Policy Act (NEPA). The Project action area encompasses the two separate areas mentioned above: the Santiago Creek Basins and the lower reach of Santiago Creek extending downstream from Interstate 5 to the confluence of Santiago Creek with the Santa Ana River. The proposed Project would be a Federal action authorized under the Water Resources Development Act (WRDA) 1986 (P.L. 99-662), Energy and Water Appropriations Act 1988 (P.L. 100-371; San Timoteo), WRDA 1990 (P.L. 101-640; Santa Ana Trails), WRDA 1996 (P.L. 104-303; Prado Dam, State Route 71), and WRDA 2007 (P.L. 110-114; Santa Ana River Interceptor Line) (Corps 2022b).

The DRR will advance previous designs for a version of the Project presented in the General Design Memorandum Phase II (Corps 1988). The updated proposed Project design reflects changes to the Project region since the 1988 design for the Project and incorporates modernized engineering design processes developed since the 1980s. The estimated total proposed Project cost and Federal cost is $175 million.

This Draft CAR is provided in accordance with the Fish and Wildlife Coordination Act (FWCA) of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et seq.*), the Endangered Species Act (ESA) of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*), and the scope of work agreed upon by the Corps and the Service (Corps 2022c). This Draft CAR does not constitute a biological opinion under section 7 of the ESA. This Draft CAR does not constitute a “2(b) report” pursuant to the FWCA. The purpose of this Draft CAR is to deliver information and recommendations for use by the Corps design-planning team in developing goals, objectives, and alternatives/modifications to the Project, including measures that could be implemented for the conservation and enhancement of fish and wildlife resources in the action area.

This Draft CAR will cover the following topics:

Project Coordination History

Fish and Wildlife Coordination Act

Proposed Project

Project Background

Ecosystems

Bioengineering

Description of Biological Resources of the Action Area

Potential Impacts on the Proposed Project on Biological Resources

Recommendations

PROJECT COORDINATION HISTORY

The Corps Chicago District is developing a SEA for the SARMP, Santiago Creek Component Flood Risk Management Project, pursuant to NEPA. The proposed Project is an integral component of the SARMP comprehensive flood risk management system that was authorized for construction by Section 401(a) of the WRDA of 1986. The SARMP was addressed initially in a Biological Opinion (BO) issued on October 1, 1980. Since 1980, a subsequent series of BO and BO amendments have been issued by the Service (i.e., 1989, 2000, 2001, 2002, 2003, 2013, and 2020) addressing the effects of constructing, operating, and maintaining the SARMP on federally listed species and their designated critical habitat. On March 27, 2012, the Service issued an amendment (2012 amendment) to the 2001 BO to address proposed changes to the mitigation approach for the SARMP that is being applied to the remaining SARMP components.

The Corps and Service previously coordinated on the SARMP during the Corps' preparation of an Environmental Impact Statement in 1975, a Supplemental Environmental Impact Statement (SEIS) in 1980, and a SEIS in 1988 (Corps 2022b). The scope of the proposed Project reportedly follows the 1988 SARMP designs, although certain features have been eliminated from the proposed Project as they have been implemented over the previous years by entities other than the Corps (Corps 2022b).

On June 3, 2021, Jason Zylka (Corps Ecologist) met with Christine Medak (Fish and Wildlife Biologist of the Service's Carlsbad Fish and Wildlife Office) to discuss the proposed Project SEA and to discuss the Service's concerns regarding potential effects on fish and wildlife resources. The Corps Chicago District, Chris Medak, and Jon Avery (Federal Projects Coordinator for the Service's Carlsbad Fish and Wildlife Office) met virtually (teleconference) numerous times in 2022 and 2023 to discuss Project description changes, suggest Project modifications to reduce and offset potential ecological effects, provide recommendations for enhancing ecological resources beyond offsetting Project effects, and furnish detailed resource information for both Endangered Species Act consultation and FWCA coordination.

FISH AND WILDLIFE COORDINATION ACT

The Fish and Wildlife Coordination Act of 1934 (the predecessor to the Fish and Wildlife Coordination Act of 1958 noted above) included requirements that were the first formal expressions in U.S. law of a duty to minimize the negative environmental impacts of major water resource development projects and to compensate for the impacts that remained (Bean 2016).

The FWCA was a response to a U.S. era of large dam building and reflected a concern for the impact of those dams, particularly on anadromous fish (Bean 2016). As originally enacted in 1934, it required consultation with the Bureau of Fisheries (as the Service was then known) prior to the construction of any dam to determine if fish ladders or other aids to migration were necessary and economically practical to minimize impacts on fish populations. It required, as well, the opportunity to use the impounded waters for hatcheries to offset impacts that could not

otherwise be avoided. The duties imposed by the FWCA were reinforced and expanded by the passage of NEPA in 1969 (Bean 2016). Under NEPA and its implementing regulations, all Federal agencies have a duty to assess the impacts of the major actions they propose to undertake and to consider reasonable alternatives to reduce or eliminate those impacts (Bean 2016). The Service, as the Federal agency charged with the responsibility for management, conservation, and protection of fish and wildlife resources by Congress in the Fish and Wildlife Act of 1956, routinely recommends mitigation measures to Federal agencies through the NEPA and FWCA processes (Bean 2016). Section 2 of the FWCA requires the reports and recommendations of the Service be included in project reports to Congress or any other relevant agency for authorization or approval; it also provides authorization to Federal agencies to implement Service recommendations, including land acquisition and modification or additions to project structures and operations. Section 6 of the FWCA authorizes appropriations of funds to carry out the purposes of the FWCA.

The FWCA directs and authorizes consultation, reporting, consideration, and installation/implementation of fish and wildlife conservation features. The authorities of the FWCA are considered to be “supplementary legislation” to the various Federal project authorizations, such as the Corps public works authorizations (Smalley and Mueller 2004). The FWCA conditions or supplements other water development statutes to require full consideration of recommendations generated under the FWCA procedures, including portions of the Clean Water Act [*Zabel* v. *Tabb*, 430 F2d 199 (5th Cir. 1970) cert. denied 401 U.S. 910 (1972)].

For Federal water resources development projects, the FWCA requires that fish and wildlife conservation receive equal consideration by Federal agencies with other project purposes, and that such conservation be coordinated with other project features. Notably, the FWCA authorizes the Federal project implementation of these noted means and measures for both mitigating losses of fish and wildlife resources, and for enhancing these resources beyond the scope of offsetting project effects (Smalley and Mueller 2004).

The term mitigation is defined differently by various Federal and State laws, regulations, and policies. In a broad sense, mitigation may include a range of measures from complete avoidance of adverse effects to compensation for adverse effects by preserving, restoring, or creating similar resources at onsite or offsite locations (NOAA 2014). The Corps and the Environmental Protection Agency (EPA) have issued regulations governing compensatory mitigation for offsetting unavoidable project adverse effects to waters of the United States that are authorized by Clean Water Act section 404 permits (73 FR 19594; April 10, 2008). For those regulations (33 CFR 332.2 and 40 CFR 230.92, respectively), the Corps and EPA define "compensatory mitigation" as "the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse effects which remain after all appropriate and practicable avoidance and minimization has been achieved."

PROPOSED PROJECT

Project Location

The Project footprint[2] involves two separate zones of proposed Project construction activity (Figure 2), both along Santiago Creek: (a) the Santiago Basins and (b) the Lower Santiago Creek.

The Santiago Basins (Figures 3 and 4) are bounded by Prospect Avenue to the west, Hewes Avenue to the east, Bond Avenue to the south, and Villa Park Road to the north. The Santiago Basins are located downstream of Villa Park Dam and receive incoming stream flows from Santiago Creek, which drains into and through the Basins. The creek drains out of the Santiago Basins into the lower reaches of Santiago Creek.

The Lower Santiago Creek portion of the proposed Project (Figure 5) is about 3.7 to 4.9 miles downstream of the Santiago Basins. The Lower Santiago Creek action area is along the creek between Interstate 5 and the confluence of the creek with the Santa Ana River.

Proposed Project Description[3]

Major elements of the Corps' proposed Project were described in the 1988 design in the Corps' Phase II General Design Manual,[4] but were updated by the Corps based on existing conditions, current design criteria, and current design practice. The following are major elements of the proposed Project.

Reservoir Slope Stabilization (Santiago Basins) – The existing slopes of the Santiago Basins require repair that is necessary to accommodate the 1-percent Annual Exceedance Probability (AEP)[5] water surface elevation. Several locations have been identified along the Basins which would require stabilization. Stabilization would occur through installation of buttress fill at a slope of approximately 2:1, installation of retaining walls, or installation of armoring. Buttress fill would be used to stabilize slopes and to construct a bike trail berm within the Blue Diamond Basin and Bond Basin (Figure 6). At this stage of design, riprap is not considered necessary by the Corps to stabilize the above slopes; however, two concrete tie-back walls measuring approximately 3 feet in width would be required for stabilization. The tie-back walls would be similar to what has already been constructed to stabilize the slope that runs along Bond Avenue in Blue Diamond Basin and Bond Basin. Buttress fill would be used to stabilize slopes within

[2] The Project footprint includes those areas that would be directly affected by the Project activities, such as clearing, grading, structure construction, staging areas, haul and access roads, etc.
[3] The Project Description, outside of the Construction Schedule, was provided to Service by the Corps via email on 04/21/23 and is based on a revised Biological Evaluation (Corps 2023). The Construction Schedule within the Project Description was provided by the Corps via email on May 8, 2023.
[4] The Santiago Creek Project was previously analyzed in the 1988 Phase II General Design Memorandum/SEIS (GDM/SEIS). A different version of the Project, as described in the 1988 GDM/SEIS, would have consisted of reservoir expansion and channel improvements for containment of 100-year flooding events: the storage of flood flows in existing gravel pits, installation of an outlet structure to regulate outflows from the gravel pits, and construction of a trapezoidal channel in the lower channel of Santiago Creek. (Corps 2019; Corps 2021)
[5] In the 1960s, the United States government decided to use the 1-percent AEP flood as the basis for the National Flood Insurance Program. The 1-percent AEP flood was thought to be a fair balance between protecting the public and instituting potentially overly stringent regulation. Because the 1-percent AEP flood has a 1 in 100 chance of being equaled or exceeded in any 1 year, it has an average recurrence interval of 100 years and is often referred to as the "100-year flood." (USGS 2018)

Smith Basin (Figure 7). At this stage of design, riprap is considered necessary to stabilize the slope in some of these areas; riprap would extend from the toe of the slope and up the slope for approximately 40 to 45 feet. Upslope from these areas with newly placed riprap, buttress fill with no riprap would be used to stabilize the slope. In addition, riprap placed to stabilize these two slopes would be buried with approximately two feet of soil to allow for native vegetation to be replanted on top of the riprap. Areas with just buttress fill would also be replanted with native vegetation. The replanting scheme would include mulefat on top of the buried riprap graduating to coastal sage scrub where only buttress fill is located.

The Project's slope stabilization measures include the re-establishment of a former access road within Smith Basin. This currently defunct access road is located along the northern slope of Smith Basin, mostly along the toe of slope. As proposed, it would be regraded and restored to vehicle use. This road would become the Project's main construction access into and out of the bottom of Smith Basin and would be accessed by vehicles from Santiago Road located along the northeast edge of Smith Basin.

In addition to reservoir slope stabilization within Smith Basin, the floor of Smith Basin would also require rehabilitation to protect the repaired slopes from future erosion (Figure 7). Currently, the existing creek channel flows up against an eroded slope of Smith Basin. In order to repair and stabilize the eroded slopes, the existing channel would need to be filled in and re-routed. Therefore, the Project would include grading a new low flow channel largely through the center of Smith Basin and redirecting the existing channel to this location. If in the future the channel moves (naturally meanders) back south towards its existing alignment along the slope of Smith Basin, no need to redirect the channel a second time should exist as the slopes will have been repaired and effectively stabilized at the toe with buried riprap. The new proposed low flow channel through Smith Basin would be an approximately 1-foot-deep depression by approximately 20 feet in width through the middle of Smith Basin. The newly graded-out channel depression would not include stream veins or stream training structures. Once the new low flow channel has been graded and the Smith Basin slopes have been stabilized, replanting of native riparian vegetation (i.e., willow and mulefat) within the bottom of Smith Basin would occur.

Lastly, reservoir slope stabilization also includes the rehabilitation of a historic maintenance access road within Smith Basin. The access road is located along the toe of the northern slope of Smith Basin (Figure 7) and would be restored and graded to its original condition. This road would become the main access into and out of the bottom of Smith Basin and would be accessed from Santiago Road located along the northeast edge of Smith Basin.

Channel Improvements (Lower Santiago Creek) – Flow velocities within Santiago Creek are erosive during large storm events (estimated as approximately 9-13 feet per second during the 1-percent AEP), potentially compromising adjacent properties along the highly urbanized floodway. To rehabilitate and improve the creek's flood conveyance capability, the proposed Project would install buried riprap along the Lower Santiago Creek portion of the Project, the full downstream channel extent between the Interstate-5 Freeway and Santa Ana River (Figure 5). Riprap would then be covered with native substrate with the goals of: (i) enhancing access for

ongoing operation and maintenance within the channel; (ii) maintaining a native, semi-arid ephemeral appearance; (iii) maintaining existing aesthetics; and (iv) enhancing environmental integrity of the stream corridor. The proposed Project would involve excavating surficial material from the channel bottom and installing riprap. Re-placing the excavated surficial substrate overlying the riprap layer would stabilize the slopes. A channel operation and maintenance program would be provided that would prevent invasive vegetation, large woody growth, debris, and other flow inhibiting features/concerns from re-establishing within the channel.

In total, the proposed stream stabilization measures in the Lower Santiago Creek portion of the Project would include 6,400 feet of trapezoidal channel armored with riprap that would then be buried. The proposed cross section of construction layers (Figure 8) would include a gravel bedding layer and riprap armor layer. The riprap armor layer would be covered with approximately 1 foot of native substrate harvested from the channel. The planting palette would be comprised of two native vegetation species mixes, a low-growth mix for the channel invert (floor or bottom of the channel), and a coastal sage scrub mix for the channel bank. The channel invert width would vary from 30 feet to 80 feet, depending on location and available right-of-way. The riprap size would vary from 36 inches to 12 inches, depending on armoring requirements for given reaches. Proposed construction of side slopes of the channel would be restricted to the width of the existing channel right-of-way and would be installed to a slope of 1.75:1.

The removal of essentially all trees in the channel right-of-way in the Lower Santiago Creek portion of the Project would be necessary to complete the proposed grading and channel construction. The trees in these creek reaches (Figure 9) are primarily exotic species such as eucalyptus (*Eucalyptus* sp.), black locust (*Robinia pseudoacacia*), and tree of heaven (*Ailanthus* sp.). Native vegetation would be established along the top of the bank and side slopes of the Lower Santiago Creek channel after channel construction is complete. Native plantings would consist of container plantings and hydroseed. Drip irrigation would be installed for approximately 2 to 3 years to allow plant establishment, and monitoring and maintenance of the restored areas would occur for a 5-year period starting from the initiation of planting. Once the 5-year monitoring and maintenance period is over, the Corps would provide the non-Federal sponsor with an Operations and Maintenance (O&M) manual for the constructed Project channel reaches.

Floodwalls (Lower Santiago Creek) – Floodwalls (Figure 10) would be required in select locations along Santiago Creek under the proposed Project. Floodwalls would extend for approximately 2,600 feet between Bristol Avenue and Flower Street on both the north and south sides of the Lower Santiago Creek channel, and for 900 feet on the north side of the Lower Santiago Creek channel west of Bristol Avenue. The floodwalls would be steel sheet pile varying in total length (height) from 19 to 30 feet with a reinforced concrete cap extending from 2 feet below the existing grade to the Project design elevation based on the hydraulic model for the system. Typical total height of the concrete cap is 4 to 5 feet. The proposed location of the wall alignment would be at the top of the proposed bank in all areas defined above.

Staging Areas (Lower Santiago Creek and Santiago Basins) - A total of six staging areas would be included in the proposed Project. Within the Lower Santiago Creek portion of the Project (Figure 5), moving downstream to upstream, the first of two staging areas (approximately 0.45 acre in size) would be located just downstream of the Bristol Street Bridge within the unvegetated channel of Santiago Creek, with access to the staging area from Bristol Street. The second staging area (approximately 0.63 acre in size) within would be located just upstream of Flower Street Bridge within the unvegetated channel of Santiago Creek, with access to the staging area from Flower Street.

Within the Blue Diamond and Bond Basins of the Santiago Basins portion of the Project (Figure 3), moving south to north, the first of three staging areas (approximately 0.94 acre in size) would be located near the corner of Prospect Street and Bond Avenue, with access to the staging area from Prospect Street. The second staging area (approximately 0.67 acre in size) would be located near the corner of Bond Avenue and Hewes Street, with access to the staging area from Hewes Street. The third staging area (approximately 0.81 acre in size) would be located adjacent to Hewes Street across from the dead-end Stetson Lane, with access to the staging area from Hewes Street.

Within Smith Basin of the Santiago Basins portion of the Project (Figure 4), the only staging area (approximately 1.41 acre) would be located adjacent to Villa Park Road between Lemon Street and Hewes Street, with access to the staging area from Villa Park Road.

Site Access and Haul Routes (Lower Santiago Creek and Santiago Basins) - Project construction vehicles would access the Lower Santiago Creek Project footprint using existing Orange County Public Works-owned maintenance access ramps at Bristol Road Bridge and Flower Street Bridge. Construction and operation of the proposed Project would utilize existing streets, existing maintenance access ramps, and channel bottom (Lower Santiago Creek) for site access. Project construction vehicles would access the Blue Diamond and Bond basins Project footprint using existing Orange County Water District (OCWD) -owned maintenance access ramps at Bond Avenue and Hewes Street. Construction and operation of the proposed Project would utilize existing streets, existing maintenance access ramps, and existing maintenance roads. Construction vehicles would access the Smith Basin Project using existing OCWD-owned maintenance access ramps at Villa Park Road and Santiago Boulevard. In addition, within Smith Basin the old maintenance road along the north side of the Basin would be used for site access during construction as well as future operations and maintenance activities once improved as discussed above (located off Santiago Boulevard

Haul roads requiring vehicular access would be needed during the removal of vegetation and sediment, to transport equipment, fill material, and other construction materials. Construction equipment and haul trucks would utilize existing highways, roadways, existing maintenance roads, and stream channel (Lower Santiago Creek) for the proposed Project. The haul route for transportation of fill material begins at Stone Valley Materials and runs approximately 41.3 miles to the action area. The haul route primarily follows State Route 60 (west- to east-running paved road), State Route 57 (north- to south-running paved road), and Interstate 5 (north- to south-

running paved road). The haul route would be on existing paved roads that have relatively consistent use by vehicles.

For disposal, the haul route would begin at the Project footprint and end at a commercial landfill, Prima Deshecha Landfill, located approximately 30.2 miles south of the action area. Construction equipment and haul trucks would utilize the Project footprint's existing maintenance roads and existing roadways (e.g., Interstate 5 and State Route 74).

Organic materials (e.g., trees and shrubs) and inorganic materials would be disposed of by hauling to the Prima Deshecha Landfill. Disposal of these materials by burning or burying in the action area would not be permitted. Although it is not anticipated that hazardous substances would be present in the material removed, prior to disposal, the collected material would undergo testing (by the contractor) to determine appropriate disposal techniques. If potentially toxic soils are encountered, lay down yards for drying and/or sorting of materials are located in the cities of Pomona or Riverside.

Construction Equipment (Lower Santiago Creek and Santiago Basins) - Construction equipment would likely include a combination of water trucks, waste trucks, haul trucks, crawler and front-end loaders, dozers, skid-steers, excavators, loaders, pile drivers, and pickup trucks.

Construction Schedule (Lower Santiago Creek and Santiago Basins) - Project construction is scheduled to commence in early 2025 and continue through 2027. Vegetation removal would only occur during periods when least Bell's vireo (*Vireo bellii pusillus*; "vireo") and coastal California gnatcatcher (*Polioptila californica californica*; "gnatcatcher") are not nesting (vireo avoidance from March 15 – September 15 and gnatcatcher avoidance from February 15 – August 15). It is possible that the Project would be constructed in stages, with multiple start dates and construction periods for various features depending on funding, environmental windows, and weather delays. Construction phasing may result in an extension of the overall Project duration beyond 2027.

Proposed construction hours would be 7:00 a.m. to 7:00 p.m., Monday through Friday, and 8:00 a.m. to 7:00 p.m. on Saturday. Occasional overtime work may be required to maintain the construction schedule, but timing would comply with local noise ordinances.

Future Operation, Maintenance, Repair, Replacement, and Rehabilitation (Lower Santiago Creek and Santiago Basins) - Maintenance, including routine inspections and minor repairs, of the Project features, would be required after construction is completed. The following activities may occur within the Project footprint:

- Routine and special inspection with pickup trucks and sport utility vehicles, as needed, with up to daily inspections during flood events.
- Infrequent use of dump trucks and hydraulic excavators outside of the nesting bird season (February 15 through September 15) to place stones along eroded areas of the Lower Santiago Creek channel bank and/or Santiago Basins slopes to protect and reinforce the

slopes, as necessary, during flood damage reduction activities occurring during and immediately following flood events.
- Repair of maintenance roads and ramps every few years.
- Ecological maintenance activities outside the bird nesting season, including weeding, herbicide application, and re-seeding.
- Vegetation management within the Lower Santiago Creek channel and only where floodwalls are located. Vegetation management in the areas with floodwalls would be in accordance with Corp of Engineers Engineering Pamphlet 1110-2-18; at a minimum 15-feet down slope of the floodwall would need to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except for grasses for the purpose of erosion control.
- Periodic clearing of debris around drainage structures.
- Periodic mending of fencing and gates.
- Periodic graffiti removal and vandalization repair.

Rarely, following large and erosive flood flows in Santiago Creek, larger-scale maintenance and repairs may be required along the channel and the toes of the slopes of the Santiago Basins, which could require access and use of heavy equipment within the floodplain adjacent to Project features (such as slope protection). Equipment would need to traverse the creek channel and maintenance roads within and along the Santiago Basins. A temporary work area may need to be established around repair sites. The local sponsor would be required to obtain emergency or standard permits from regulatory agencies, including the Corps, who would coordinate and consult, if needed, with the Service. These permits would likely require active habitat restoration of temporary construction and access roads. Specific impacts would not be evaluated until or unless damage occurs and repair work is defined.

Measures Intended to Avoid, Minimize, or Offset Effects of the Proposed Project (Santiago Basins) - The Corps does not currently propose biological mitigation measures for the Lower Santiago Creek portion of the Project. As such, the measures and acreages below only apply to the Santiago Basins portion of the proposed Project:

The proposed Project footprint in the Santiago Basins portion of the Project would cover approximately 25.99 acres. This 25.99 acres includes vegetated areas, unvegetated areas, and developed areas (Figures 11 and 12). Within this footprint, about 3.84 acres are unvegetated channel or developed cover types. Since these cover types are of typically of low ecological function, the Corps does not propose mitigation for this acreage within the Project footprint. Of the remaining 22.15 acres of the Project footprint, about 3.28 acres would result in permanent losses of riparian or upland vegetation.

The remaining 18.87 acres of direct impacts that would occur from the Project are considered temporary by the Corps. Proposed planting palettes for revegetation of this 18.87 acres are shown below. In addition to restoring native vegetation where temporary impacts would occur, other conservation measures would also be employed to minimize effects of the Project during construction.

Table 1: Coastal Sage Scrub Habitat Plant Palette.

Coastal Sage Scrub Plant Palette	
Scientific Name	**Common Name**
Acmispon glaber	Deerweed
Acmispon americanus	Purshing lotus
Artemisia californica	California Sagebrush
Collinsia heterophylla	Chinese houses
Encelia californica	Bush sunflower
Eriogonum fasciculatum	California buckwheat
Eriophyllum confertiflorum	Golden yarrow
Eschscholzia californica	California poppy
Festuca microstachys	Small fescue
Isocoma menziesii	Coast goldenbush
Lasthenia gracilis[6]	Common goldfields
Lupinus succulentus	Arroyo lupine
Diplacus puniceus	Mission red monkeyflower
Salvia apiana	White sage
Salvia mellifera	Black sage
Sisyrinchium bellum	Blue-eyed grass
Stipa pulchra	Purple needlegrass

Table 2: Mulefat Thicket Plant Palette.

Mulefat Thicket Plant Palette	
Scientific Name	**Common Name**
Baccharis pilularis	Coyote Bush
Baccharis salicifolia	Mulefat
Artemisia douglasiana	Mugwort
Artemisia dracunculus	Tarragon
Isocoma menziesii	Coast goldenbush

Table 3: Riparian Southern Willow Scrub Plant Palette.

Riparian Southern Willow Scrub Plant Palette	
Scientific Name	**Common Name**
Artemisia douglasiana	Douglas Mugwort
Rosa californica	Wild Rose
Urtica dioica	Stinging Nettle
Ambrosia psilostachya	Western Ragweed
Stipa lepida	Foothill Needlegrass
Artemisia dracunculus	Tarragon

[6] *Lasthenia gracilis,* or common goldfields, is the appropriate species for Orange County, California.

Elymus triticoides	Beardless Wild Rye
Toxicodendron diversilobum	Poison Oak
Acmispon americanus	Purshing lotus
Solanum douglasii	Douglas' Nightshade
Platanus racemosa	Western Sycamore
Salix goodingii	Goodings' Black Willow
Salix laevigata	Red Willow
Salix lasiolepsis	Arroyo Willow
Salix exigua	Sandbar Willow
Baccharis pilularis	Coyote Bush
Baccharis salicifolia	Mulefat
Rubus ursinus	California Blackberry
Cyperus sp.	Nutsedge
Juncus sp.	Rush
Elymus condensatus	Giant Wild-rye
Elymus triticoides	Beardless Wild-rye

To offset Project impacts to vireo habitat (i.e., riparian vegetation types), the Corps proposes as part of the Project a 5:1 ratio for permanent impacts and a 2:1 ratio for temporary impacts. To offset impacts to upland vegetation types and gnatcatcher habitat, the Corps proposes a 3:1 ratio for permanent impacts and a 2:1 ratio for temporary impacts. Table 4 summarizes the direct impacts, offset ratios, and the number of acres intended to offset permanent and temporary impacts of the proposed Project within the Santiago Basins. A combined total of 31.63 acres of native vegetation would be restored/enhanced off site to offset permanent and temporary impacts to vireo and gnatcatcher habitats.

Habitat Enhancement Activities Would Meet the Following Condition: Enhancement activities must be initiated immediately following the completion of the construction portion of the Project; removal of exotic/invasive plant species would only occur during periods when vireos and gnatcatchers are not breeding (breeding period is from March 15 – September 15 for vireo and February 15 – August 15 for gnatcatcher).

Table 4. Summary of Proposed Offset and Vegetation/Cover Categories.

Vegetation/Cover Type	**Impact Type**	**Acres Affected**	**Mitigation Ratio**	**Acres of Onsite Restoration/ Enhancement**	**Acres of Offsite Mitigation**
Goodding's Willow – Red Willow Riparian Woodland and Forest	Permanent Temporary	1.29 9.19	5:1 2:1	0.00 9.19	6.45 9.19

Mulefat Thickets	Permanent Temporary	0.17 1.43	5:1 2:1	0.00 1.43	0.85 1.43
California Sagebrush – Black Sage Scrub	Permanent Temporary	1.53 7.18	3:1 2:1	0.00 7.18	4.59 7.18
Wild Oats and Annual Brome Grasslands	Permanent Temporary	0.00 0.19	3:1 2:1	0.00 0.19	0.00 0.19
Unvegetated channels and Slopes	Permanent Temporary	0.16 0.00	NA NA	0.00 0.00	0.00 0.00
Fountain Grass Swards	Permanent Temporary	0.29 0.64	3:1 2:1	0.00 0.64	0.87 0.64
Laurel Sumac Scrub	Permanent Temporary	0.00 0.24	3:1 2:1	0.00 0.24	0.00 0.24
Developed	Permanent Temporary	3.53 0.15	NA NA	0.00 0.00	0.00 0.00
	Total Vegetation/Cover Acres	25.99	**Total Mitigation Acres**	18.87	31.63

Proposed Project Environmental Commitments (Santiago Basins) - The measures below only apply to the Santiago Basins portion of the proposed Project:

The following measures are either intended to avoid or minimize impacts during construction (e.g., conducting surveys, ensuring activities remain within the Project footprint) or provide habitat enhancement and passive restoration within the Project footprint and outside the Project action area to offset permanent and temporary losses to wetland and riparian habitat and upland habitat:

- **BIO-1** A monitoring program would be developed and implemented that entails surveys for the vireo and gnatcatcher during the year prior to construction, and each year of construction.

- **BIO-2** The construction contractor would minimize grading activities and leave root systems intact, to the extent practicable.

- **BIO-3** Any vegetation within the Project footprint with the potential to support vireos and gnatcatchers would be cleared outside of the breeding season, defined as February 15 – September 15.

- **BIO-4** To the maximum extent practicable, haul routes and staging areas would be located outside of the floodplain (e.g., along bike trails, levees, and roads).

- **BIO-5** A Corps biologist (or qualified biological monitor) would monitor construction activities to ensure environmental impacts remain consistent with those described in the Corps' Biological Evaluation document (Corps 2023). This includes ensuring vegetation removal occurs only in designated areas and riparian and coastal sage scrub areas to be avoided are flagged and not encroached upon.

- **BIO-6** The Corps would offset permanent impacts to vireo-occupied native riparian habitat at a 5:1 ratio by restoring currently degraded areas outside the Project footprint and managing those areas for 5 years post-construction, and then arranging for the local sponsor [i.e., Orange County Public Works (OCPW)] and/or another approved entity, such as the Santa Ana Watershed Association (SAWA), to maintain this acreage arundo-free for the life of the SARMP. The Corps would also provide for brown-headed cowbird (*Molothrus ater*; cowbird) removal trapping in the vicinity of the enhanced habitat area for the life of the SARMP.

- **BIO-7** Enhancement of riparian habitat would be considered successful when the following target/threshold objectives are met: (1) a minimum of 30 percent absolute ground cover of native plant species; (2) less than 10 percent absolute ground cover of exotic plant species (including 0 percent arundo); (3) the absolute ground cover of native species must be represented by at least five dominant or co-dominant plant species; (4) the recruitment of native plant seedlings must be documented to occur within the replanted areas; (5) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and (6) the structure and composition of the revegetated area is statistically similar to (i.e., not significantly different from) habitat occupied by vireos in the vicinity. Alternatively, riparian vegetation efforts can be considered successful if the habitat is occupied by a breeding pair of vireos, southwestern willow flycatchers (*Empidonax traillii extimus*), and/or yellow-breasted chats (*Icteria virens*). In addition, habitat must sustain itself for 2 consecutive years without supplemental water.

- **BIO-8** The Corps would offset temporary losses of vireo-occupied habitat by restoring degraded areas to riparian vegetation at 2:1. This would result in restoration of the temporarily affected areas within the Project footprint (1:1 onsite); in addition, the Corps would restore currently degraded areas to riparian vegetation likely to support vireo at 1:1 offsite, outside the Project footprint. The Corps would manage these offsite restoration areas for 1 year, and then arrange for the local sponsor (i.e., OCPW) and/or another approved entity such as SAWA to maintain this acreage arundo-free for the life of the SARMP. With implementation of this measure, 10.62 acres of temporary impacts to riparian vegetation would be offset with a total of 10.62 acres restored onsite and 10.62 acres restored offsite. OR[7]

  The Corps would offset temporary direct losses to vireo-occupied habitat at 4:1. This would occur by restoring the temporarily affected area within the Project footprint at 1:1,

[7] The Corps has proposed the option implementing one of the two specified measures here.

plus restoring additional areas outside the Project footprint that are currently degraded areas to riparian vegetation likely to support vireo at a 3:1 ratio. The Corps would maintain this enhanced offsite acreage arundo-free for a minimum of 5 years. It is anticipated with this measure that 10.62 acres of temporary impacts to riparian vegetation would be offset with a total of 10.62 acres restored onsite and 31.86 acres would be restored offsite.

- **BIO-9** The Corps would offset permanent impacts to gnatcatcher-occupied coastal sage scrub habitat at a 3:1 ratio by restoring currently degraded areas outside the Project footprint and managing those areas for 8 years post-construction. It is anticipated that 1.82 acres of impacts to coastal sage scrub would be offset with a total of 5.46 acres restored.

- **BIO-10** The Corps would offset temporary losses to occupied gnatcatcher habitat (i.e., both native and non-native vegetation types)[8] at a ratio of at least 2:1. This would be accomplished by restoring affected areas within the Project footprint at 1:1 and by and restoring currently degraded areas to coastal sage scrub outside the Project footprint at a 2:1 ratio (if restoration occurs after impact), a 1:1 ratio (if restoration occurs prior to impact). or any combination thereof (i.e., if some restoration can occur prior to impact). This acreage would be managed and kept free of exotics for 8 years post construction. Permanent Project footprint impacts to areas occupied by gnatcatcher but occurring in non-native vegetation areas would follow this same approach.

- **BIO-11** The Corps would restore all temporary disturbance areas within the Project footprint, not including existing roads or operations areas, with riparian, coastal sage scrub, or other native vegetation community as appropriate to the location. All temporarily disturbed areas would be kept free of exotic plants for a period of 8 years. If the sites have not begun to recover in 5 years (i.e., 50 percent of the disturbed areas are not vegetated with native plants), then the site would be replanted or hydroseeded again as needed. Acreage of actual disturbance would be documented and compared to acreage restored; any shortfalls would be addressed through additional restoration as needed.

- **BIO-12** All acres of restored/enhanced riparian habitat would be protected in perpetuity through proper legal instruments for the conservation of Federal and State listed species and their habitats.

- **BIO-13** During construction, riparian vegetation adjacent to de-watering areas would be monitored. Supplemental water would be added to this vegetation as necessary to avoid water stress to adjacent riparian vegetation.

- **BIO-14** Vegetation mapping of the Project footprint would occur every 10 years to document long-term trends and monitor post-flood recovery. Actions would be taken to

[8] Within the Project footprint recent gnatcatcher surveys have mapped occupancy of some areas of predominantly non-native vegetation adjacent to coastal sage scrub occupied areas.

re-establish the baseline if post-flood recovery does not occur within 10 years or does not meet the criteria that would be established in the *Habitat Management Plan*.

- **BIO-15** Within 1 year after initiation of construction activities, the Corps would finalize a *Habitat Management Plan* for the areas where wildlife agencies have legal rights/jurisdiction. The *Habitat Management Plan* would be coordinated with the California Department of Fish and Wildlife (CDFW) and the Service, provide assurances of funding, and address how the baseline amount of riparian habitats would be maintained or increased by the Project. The Corps and OCPW have agreed to gain consensus with the Service and CDFW throughout the development and implementation of the *Habitat Management Plan*. The *Habitat Management Plan* would define the composition and structure of the management oversight committee and the explicit decision-making process. The *Habitat Management Plan* would include rules for timely resolution of disagreements to avoid biologically costly delays in management responses, "trigger points" for implementing management actions, and a clearly defined mechanism (e.g., consensus among agencies; one agency with full authority) for modifying the trigger points.

- **BIO-16** At a minimum, the *Habitat Management Plan* completed for the Project would address the following: 1) measurable conservation goals that clearly articulate a measurable standard, desired state, threshold value, amount of change, and/or trend that the Corps is striving to achieve for the particular species; 2) measurable sampling objectives; 3) quantitative monitoring methodologies; 4) a strategy to determine the effectiveness and feasibility of possible alternate management, restoration, and/or translocation methods; 5) a strategy to evaluate the proposed monitoring and quantitatively establish the existing status (i.e., baseline) of covered species; 6) well-defined initial management thresholds (i.e., triggers) and a range of alternate, feasible responses; 7) an explicit process for evaluating monitoring data; 8) a defined management committee and decision-making process for implementing management responses (i.e., explicitly defined feedback loops that link implementation and monitoring to a decision-making process and, thereby, result in appropriate changes in management); and 9) reporting requirements, contents, and review procedures.

- **BIO-17** Construction personnel would strictly limit their activities, vehicles, equipment, and construction materials to the Project footprint, including designated borrow areas, staging areas, and routes of travel. The Project footprint construction areas would be the maximal area (outer limits) necessary to complete the proposed Project and would be specified as such in the construction plans. Highly visible barriers (such as orange construction fencing or sound walls) would be installed around all riparian and other sensitive habitats adjacent to the Project footprint to designate Project footprint limits of construction activities. These barriers would be maintained until the completion of all construction activities.

- **BIO-18** The Project contractor would construct sound walls/blankets, prior to the vireo and gnatcatcher breeding season (i.e., prior to February 15), along sensitive vireo and

gnatcatcher habitats that would be remaining adjacent to the Project footprint. The sound walls would be constructed of materials typically used to lessen general noise impacts and at a height tall enough to account for construction equipment noise effects.

- **BIO-19** Portable sound walls/blankets would be placed around demolition activities occurring on the Project spillway, regardless of breeding season, to minimize potential noise impacts on resident gnatcatchers.

- **BIO-20** The Project biological monitor would monitor noise regularly (twice weekly) during the breeding seasons for vireo and gnatcatcher (combined breeding seasons: February 15 – September 15). Ambient noise levels would be recorded by the Corps biologist prior to construction to determine ambient noise levels. During Project construction, noise monitoring would ensure that 1) noise does not exceed 60 A-weighted decibels (dBA) of equivalent continuous sound level (Leq) hourly where ambient noise is less than 60 dBA Leq hourly, or another agreed upon limit with the Service, within occupied gnatcatcher and vireo habitats during the breeding season; or (2) noise does not exceed 5 dBA Leq hourly above ambient conditions if said levels are above 60 dBA Leq hourly, or another agreed upon limit with the Service, within occupied gnatcatcher and vireo habitats during the breeding season. If construction noise levels within occupied adjacent habitats cannot be reduced below 60 dBA Leq hourly, or 5 dBA Leq hourly above ambient, or another agreed upon limit with the Service, in adjacent occupied vireo or gnatcatcher habitat during breeding season of any year, the Corps or Project proponent would offset impacts at a 1:1 ratio per any period during the breeding season affected by such noise levels. This 1:1 ratio would be based on the acreage of occupied coastal sage scrub or riparian habitat (per gnatcatcher or vireo potential impacts, respectively) outside the Project footprint subject to noise levels above agreed-upon thresholds during the breeding season, per the number of breeding seasons affected (e.g., 1 acre of coastal sage scrub habitat affected by noise in two breeding seasons would result in 2 acres of restoration). The area affected would be determined by the periodic Project noise monitoring. The Corps would identify restoration areas for offsetting noise impacts to vireo and/or gnatcatcher (e.g., enhancement areas within or near Prado Basin) in coordination with the Service and would maintain (e.g., continue weeding) those areas for a period of 8 years.

- **BIO-21** Prior to construction activities, a Corps biologist (or the biological monitor approved by the Corps) would conduct pre-construction environmental training for all construction crew members, including those onboarding mid-Project. The training would focus on required avoidance/minimization measures and conditions of regulatory agency permits and approvals (if required). The training would also include a summary of sensitive species and habitats potentially present within and adjacent to the Project sites.

- **BIO-22** Dust control measures would be implemented during Project construction to reduce excessive dust emissions. Methods for reducing dust emissions may include wetting work areas, such as dirt access roads and sediment stockpiles, on a regular basis, as well as covering truck beds carrying material and stockpiles.

- **BIO-23** Prior to any ground-disturbing activities (e.g., mechanized clearing or rough grading) for all Project related construction activities, a Corps biologist (or biological monitor) would conduct pre-construction surveys of the Project footprint for terrestrial special-status species. During these surveys, the biologist would:

  a. Inspect the proposed Project footprint for any sensitive wildlife species; and

  b. In the event of the discovery of a non-listed, special-status ground-dwelling animal, such as a burrowing owl or special-status reptile, attempts would be made to recover and relocate the animal to adjacent suitable habitat within the action area at least 200 feet from the limits of construction activities. Burrowing owl surveys and relocations would follow established protocols.

- **BIO-24** The Corps biologist or qualified monitor would continue to monitor and survey the Project footprint and adjacent habitats throughout construction and restoration activities for the presence of special status species and would confirm that conservation measures are sufficient to avoid or minimize impacts to these species or shall recommend additional measures as warranted.

- **BIO-25** Best management practices (BMPs) would be implemented to reduce impacts to native vegetation communities/habitats, including the following:

  a. All equipment maintenance, staging, and dispensing of fuel, oil, coolant, or any other toxic substance would occur in developed or designated non-sensitive upland areas. BMPs would be implemented in these areas to prevent runoff carrying toxic substances from entering Santiago Creek and associated drainages. If a spill occurs outside of a designated area, the cleanup would be immediate and documented.

  b. Fire suppression equipment including shovels, water, and extinguishers would be available onsite during the fire season (as determined by Orange County Fire Authority) and whenever activities may produce sparks.

  c. To the extent feasible, the contractor would prevent invasive exotic plants from establishing within the work site during construction. Construction equipment would be cleaned of mud or other debris prior to mobilizing and before leaving the site to reduce the potential spread of invasive exotic plants and/or seeds.

- **BIO-26** A monitoring protocol would be developed and implemented for raptor monitoring, including bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) in the proposed Project footprint during construction. If eagles are foraging, the Corps would coordinate with the Service to develop appropriate avoidance measures.

- **BIO-26** The Corps would consult with the Service prior to initiating any actions that have not been explicitly defined as part of this Project and may affect federally-listed species or designated critical habitat. Actions that have not been defined as part of this Project

include, but are not limited to, the development of recreational trails and the maintenance of existing or planned utilities.

PROJECT BACKGROUND

The Project region involves west-draining (coastal slope) watersheds of the southern Peninsular Range in Orange County, California. This area experiences a Mediterranean climate with mild winters and dry summers and is part of the southern California/northern Baja California coast ecoregion (Griffith et al. 2016). Predominant natural communities in the region include chaparral, coastal sage scrub, grasslands, riparian woodland, oak woodland, coastal bluff scrub, and salt marsh.

The Santiago Creek System

OCWD owns and operates approximately 1,100 acres of groundwater recharge facilities located in and adjacent to the Santa Ana River and Santiago Creek. Water is recharged into local groundwater aquifers in four interconnected systems: the main Santa Ana River system, the Off-River system, Anaheim/Kraemer system, and the Burris Basin/Santiago Creek system. OCWD has the primary responsibility for managing a section of the Santa Ana River that is approximately 6 miles long in Orange County; its groundwater recharge management activities extend from the Imperial Highway crossing downstream to an area approximately 0.4 miles north of the Katella Avenue crossing.

When the water elevation in the Santiago Basins is at the spill elevation, a pool of water covers much of the Santiago Basins. Over the last few decades, the thalweg[9] of Santiago Creek has meandered (migrated) southward and eastward against the Smith Basin slopes adjacent to Villa Park Road, causing erosion and creating several large scarps (eroded steep banks) on these slopes. Additionally, water impoundment, when the water elevations of the Santiago Basins have risen to high levels, has contributed to the noted slope erosion.

Santiago Creek (Figure 1) is about 34 miles long and drains most of the northern Santa Ana Mountains, and the watershed covers about 101 square miles in northern Orange County. At the upper end of the watershed, Santiago Creek begins in the Cleveland National Forest, between Santiago Peak and Modjeska Peak (Watershed and Coastal Resources Division of Orange County 2009). Santiago Creek runs south-southwest toward Portola Hills before turning northwest. The creek's perennial surface flows are currently limited to this upper stretch, with many of the upper tributaries also remaining perennial.

Santiago Creek then empties into Irvine Lake, which is also fed by Limestone Canyon. The 700-acre reservoir is formed by the 110-foot-tall Santiago Dam. Irvine Lake provides domestic water to the communities of Villa Park and Orange. Because this water diversion takes the entire base flow of Santiago Creek, below the dam the creek is now usually dry except during storm flows (Rancho Santiago Community 2016). Below the dam, the typically dry creek bed crosses underneath California State Route 241 and then flows northwest, bisecting Irvine Regional Park.

[9] The thalweg is the deepest part of a channel or valley.

Near Villa Park, the Villa Park Dam forms a flood risk management reservoir to control storm flows coming down Santiago Creek from Irvine Lake. Villa Park Dam is located in a low-gradient portion of Santiago Creek near the mouth of Weir Canyon about 3 miles upstream of the Santiago Basins, and Santiago Dam/Irvine Lake is about 3 miles upstream of Villa Park Dam.

The Santiago Basins facility is located within the portion of Santiago Creek that is owned by OCWD, including Blue Diamond Basin, Bond Basin, and Smith Basin. The pit of Blue Diamond Basin covers about 82 acres and holds roughly 4,990 acre-feet of water storage capacity, Bond Basin covers about 87 acres and holds 8,350 acre-feet of capacity, and Smith Basin covers about 24 acres and holds around 310 acre-feet of capacity (OCWD 2007). Santiago Creek through this Project reach is now confined by the basins, with some ongoing down-cutting of the creek channel at the upstream entrance to Smith Basin and episodic bank/slope erosion of portions of the other basins. The primary purpose of Smith Basin is to add additional storage capacity to the Santiago Basins (as compared to being utilized largely for direct groundwater recharge).

Water is diverted out of the Santa Ana River and into OCWD's Burris Basin, near California State Route 57 and Ball Road. The water diverted from the river is then pumped to the Basins through the District's 66-inch diameter Santiago Pipeline. The water held in Santiago Basins percolates through the banks and bottom of the basins and into the local groundwater aquifer, where it is subsequently pumped out for domestic water use. During heavy rain years, the Basin pits eventually fill up with storm flows to the elevation of Santiago Creek at the southwest corner of Blue Diamond Basin, and the flow spills into the lower reaches of Santiago Creek near Collins Avenue, creating ephemeral surface flow in the lower downstream reaches of Santiago Creek.

Below Villa Park and the Santiago Basins, Santiago Creek is largely confined to a flood risk management channel for the remaining 7 miles of its course through the cities of Orange and Santa Ana. Because the creek is now dry most of the year below the Santiago Basins, a portion of the creek bed in this reach is used as a parking lot (for Hart Park). The City of Orange has an agreement with OCWD percolation flows along Santiago Creek will be managed so they will not flow into the Hart Park parking area (Corps 2023). The creek then crosses under Interstate 5 and continues west toward the Santa Ana River.

The lowest portion of Santiago Creek is located in the City of Santa Ana. This Project reach extends from just downstream of Interstate 5 to the confluence of Santiago Creek with the Santa Ana River, a reach length of about 1.2 miles. The Project footprint in this area is centered on Santiago Creek as it traverses the neighborhoods of Fisher Park, Floral Park, West Floral Park, Casa de Santiago, and Riverview. The residential backyard fences of these neighborhoods are adjacent to the channelized Santiago Creek in this reach.

At the downstream end of the Project footprint is the River View Golf Course, which includes the confluence of Santiago Creek with the Santa Ana River. The golf course sits on a total of 114 acres, with portions of the golf course owned by the City of Santa Ana and the Orange County Flood Control District. Immediately downstream of the golf course, the Santa Ana River transitions into a concrete-lined flood channel with very limited natural communities, little public access, and severely diminished function as a wildlife corridor.

Existing Mitigation Sites

The OCWD has a Streambed Alteration Agreement with the California Department of Fish and Wildlife for the Santiago Basins. The Agreement outlines the Regional Maintenance Plan for Groundwater Recharge Facilities, which includes the existing water conveyance structures within the Santiago Basins including the transfer pipeline between the Blue Diamond and Bond basins and the existing box culvert, existing access roads and ramps, and disturbance of sediment within the Santiago Basins (OCWD 2019).[10] Smith, Blue Diamond and Bond Basins include designated mitigation sites that were set aside as part of that process. A total of 31.80 acres in Smith Basin and 48.08 acres in Blue Diamond and Bond Basins were anticipated to be preserved and managed by OCWD, for both riparian and upland ecosystems. Overlap between the proposed Project footprint and these existing mitigation sites would occur in several areas. The OCWD Habitat Management Plan (HMP) is a management plan for groundwater facilities maintenance at a series of sites, including the Santiago Basins (OCWD 2020). That management plan specifies the creation and conservation of various mitigation sites to be implemented by OCWD (OCWD 2022a).[11]

Project Region History

Historically, Santiago Creek provided surface water for the Tongva people, whose territory extended over much of northern present-day Orange County and into the Los Angeles Basin. Native Americans have reportedly inhabited the region for up to 12,000 years. Santiago Creek likely historically had perennial flows upstream and through what is now the Santiago Basins portion of the action area. Santiago Creek was named by the Spanish Portolá Expedition, which camped along the creek upstream of Chapman Ave, downstream of the Santiago Basins (near current-day Grijalva Community Park) (Brown 2001; SWCA Consultants 2006; City of Villa Park 2022). In July of 1769, Juan Crespi described this Portolá Expedition camp location as follows: “[w]here we set up camp, Father Gomez and I saw quite a large stream in among dense willow, sycamore, and live-oak...” (Brown 2001; Villa Park 2022).

In 1801 Juan Pablo Grijalva petitioned the Spanish government for land that became Rancho Santiago de Santa Ana, Orange County’s first rancho. The 63,000-acre former rancho boundary includes the action area. The Grijalva Adobe, located just east of Blue Diamond Basin in the action area, was probably built shortly after 1800. The Grijalva Adobe was very likely located

[10] CDFW Streambed Alternation Agreement Notification No. 1600-2012-0013-R5, Orange County Water District Regional Maintenance Plan for Groundwater Recharge Facilities, California Department of Fish and Wildlife, February 2013.

[11] “To compensate for impacts to Waters of the U.S. and Waters of the State associated with implementation of the Orange County Water District (OCWD) Groundwater Recharge Facilities Maintenance Plan, OCWD has prepared the Orange County Water District Habitat Management Plan. This Habitat Management Plan identifies restoration activities that provide compensatory mitigation for ongoing routine maintenance impacts to Waters of the U.S. and Waters of the State associated with OCWD groundwater management operations. The Orange County Water District Habitat Management Plan has been prepared in accordance with the Corps Final Rule on Compensatory Mitigation for Losses of Aquatic Resources and has been prepared to meet California Department Fish and Wildlife compensatory mitigation requirements for a Streambed Alteration Agreement…” (OCWD 2020).

purposely near the perennial water that was available from the adjacent Santiago Creek location at the time.

The Santiago Basins area was first developed in the 1870s. In July 1873, a water diversion dam was built on Santiago Creek at a location known as Point of Rocks upstream of the Santiago Basins. From this dam, much of the Santiago Creek perennial surface low flow of the creek was diverted through ditches to adjacent lands for irrigation (Bradshaw 1935). The Carpenter and Serrano Irrigation districts, established around 1878, constructed a clay barrier dam[12] across Santiago Creek, acquired riparian rights, and developed an irrigation system of diverted water for orchards along the banks of Santiago Creek easterly of the then new City of Orange (Nelson 2013). This dam was built in the location of what is now Santiago Oaks Regional Park, about 1.75 miles upstream of the Santiago Basins (Bradshaw 1935; OC Parks 2022). A second dam on this site was built in 1892 (OC Parks 2022).

By 1880 the flow in the middle and lower portions of Santiago Creek had reportedly become intermittent with the upstream dams. An extract from the "News" of August 27, 1880, in Thompson and West's History of Los Angeles County states: "Santiago Creek runs through the Santa Ana Valley, and in winter is frequently impassable, but in the summer is dry" (as quoted in Nelson and Fellow 2009).

In June 1893, James Irvine II erected a dam upstream of the Santiago Basins, built flumes and ditches, and diverted surface flows of Santiago Creek (Bradshaw 1935). This dam and the diversion of flows of Santiago Creek were subject to lawsuit and trial in 1895.

For many years the City of Santa Ana that includes the Lower Santiago Creek portion of the action area was a ranching and farming community. To provide water to the agricultural and domestic communities that existed in the area at the time, a municipal water system was formed in 1886 (City of Santa Ana 2018). Expansive fruit orchards were established in the area in the late 19th and early 20th century. In 1931 the city joined with 12 other southern California cities to form the Metropolitan Water District of Southern California, in order to tap into diverted water sources from the Colorado River and the State Water Project to bolster local water production from diversions and groundwater pumping (City of Santa Ana 2018; Safe Drinking Water Information System 2023). The City of Santa Ana currently has groundwater wells producing municipal water across the city, including a series of wells pumping groundwater along Santiago Creek near the action area (City of Santa Ana 2018; SDWIS 2022; OCWD 2022b). The Lower Santiago Creek area was largely developed with residential housing after the 1920s. The residences of Floral Park adjacent to Lower Santiago Creek portion of the action area were predominantly constructed in the early 1920s. The homes of the Fisher Park neighborhood were mostly built in the 1950s. Within the Project footprint near the North Flower Street Bridge over Santiago Creek are reportedly some 1930s-era Works Progress Administration-built retaining walls and steps leading down to the streambed (L.A. Creek Freak 2009). The City of Santa Ana, including area surrounding Lower Santiago Creek, is built out today.

[12] A dam constructed below ground down to bedrock.

In 1929 the Santiago Dam was built on Santiago Creek to form Irvine Lake to divert surface water from Santiago Creek for irrigation (City of Villa Park 2022). From the 1950s to around 1980, the Santiago Basins were used as an aggregate quarry operation along Santiago Creek and are up to 150 feet deep. A 1969 flood destroyed a road bridge that previously existed over Santiago Creek at Santiago Boulevard, at the upstream edge of Smith Basin within the Project footprint. Santiago Boulevard now “dead-ends” where the bridge used to exist.

About 0.4 mile upstream of the Santiago Basins is a 109-acre former sand and gravel quarry property known as the Sully Miller site; it was used for surface sand and gravel mining from 1919 to 1995. In the early 1970s, three local general plans were approved designating 96 acres on the Sully Miller quarry site as Open Space once the sand and gravel extraction life was depleted. In 2019 a developer got approval from the Orange City Council to build 128 single-family homes at the former Sully-Miller quarry site. This site is currently vacant.

Outside the Project footprint, but immediately upstream of Smith Basin, is another former sand and gravel quarry site that was reportedly in mining use before the 1980s. The Hurwitz former quarry operation site (also known as the Chandler site) is located west of Cannon Street, near Santiago Canyon Road. This site includes a former mining pit that currently supports about 2 acres of willow woodland. Chandler’s Sand & Gravel, LLC, has reportedly purchased the Hurwitz property and applied for a permit for an inert material dumpsite for 1,250,000 cubic yards of construction waste and demolition debris on the site to fill the noted former mining pit and pond (Hillman 2020). OC Reclamation, a subsidiary of Chandler’s Sand & Gravel, LLC; has received a tentative order from the Santa Ana Regional Water Quality Control Board to fill the existing pond and mining pit in February 2023 (SARWQCB 2023). A permit from State Water Resources Control Board is apparently still needed to perform construction on the site. This site is currently vacant.

The 365-acre Santiago Basins site was purchased by OCWD following closure as a mine for use as a groundwater recharge facility. Prior to the early 1990s, the only source of water to the Santiago Basins was rainfall and streamflow from Santiago Creek flowing through the Basins (Villa Park 2022). In 1991 the Santiago Creek Recharge Project was completed by OCWD, including development of Santiago Basins along Santiago Creek, a pump station at Burris Basin, and a pipeline to convey water back and forth from the Santiago Basins and recharge basins along the Santa Ana River. The Burris Basin Pump Station and Santiago Pipeline provided for diverted Santa Ana River water to be pumped to Santiago Basins for groundwater recharge (Villa Park 2022).

In 2003 an underwater pump station was installed by OCWD in Bond Basin to increase groundwater recharge capacity. With the completion of the Santiago Basins Pump Station in 2003, OCWD had capacity to move water in both directions within the Santiago Pipeline. This allowed for faster draining of the Santiago Basins, freeing up storage for stormwater capture, and increasing OCWD’s groundwater recharge capacity. During average rainfall years, OCWD captures and recharges an estimated 50,000 to 70,000 acre-feet per year of water, with much of this recharge taking place in the Santiago Basins.

The previously noted underwater pump station at the Santiago Basins was replaced in 2012 with a floating pump station. The floating pump station was constructed to dewater the Santiago Basins to increase storm flow capture and percolation, to make water storage capacity in the Basins available for winter season use, to provide water to the Santiago Creek for percolation, and to allow for the transfer of stored water from the Santiago Basins to other OCWD facilities. Operation of the pump station for the Basins increased recharge capacity and allowed for more flexible and efficient operations by OCWD.

ECOSYSTEMS

Coastal Sage Scrub Ecosystems

Coastal sage scrub is a natural scrubland community found in coastal California and northwestern coastal Baja California. Coastal sage scrub is characterized by low-growing, aromatic, and drought-deciduous subshrubs[13] adapted to the semi-arid Mediterranean climate of the coastal slopes and lowlands. The community is sometimes called "soft chaparral" due to the predominance of soft, drought-deciduous leaves in contrast to the hard, waxy-cuticled leaves on sclerophyllous plants of California's chaparral communities.

Plants typically characterizing coastal sage scrub include California sagebrush (*Artemisia californica*), black sage (*Salvia mellifera*), white sage *(Salvia apiana*), California buckwheat (*Eriogonum fasciculatum*), coast brittlebush (*Encelia californica*), golden yarrow (*Eriophyllum confertifolium*). Larger woody shrubs often found in coastal sage scrub include toyon (*Heteromeles arbutifolia*) and lemonade berry (*Rhus integrifolia*).

The metropolitan areas of Los Angeles, Orange, and San Diego Counties are located predominantly in the southern coastal scrublands, and most of the scrublands in these areas have been lost or fragmented due to urbanization, agriculture, industrial land uses, grazing pressure, altered fire regimes, and air pollution. It is estimated that less than 10 percent of the coastal sage scrublands remain undeveloped in California.

Large numbers of sensitive and listed species occur in southern coastal scrub natural communities in California. For example, the coastal California gnatcatcher is a federally-threatened bird species endemic to the coastal sage scrub communities. The remaining areas of coastal sage scrub in California provide habitats for nearly 100 species of plants and animals currently classified as rare, sensitive, threatened, or endangered by Federal and State agencies (Davis et al.1994). Since 1990, coastal sage scrub in areas from Los Angeles to San Diego has been the target of intensive conservation planning and management activities.

Stream and Riparian Ecosystems

Riparian areas (Figure 13) are three-dimensional ecotones (the transition zone between two adjoining communities) of interaction that include terrestrial and aquatic components that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-

[13] A subshrub is a small bushy plant that is woody except for the tips of the branches.

slopes that drain to the water, laterally into the terrestrial ecosystem, and along the watercourse at variable widths (USDA Forest Service 2019).

Riparian areas are physical transitional zones between terrestrial and aquatic systems that exhibit characteristics of both systems (Wildlife Conservation Board 2022). The plants and animals associated with riparian areas are heavily influenced by the associated water body because of enhanced water availability to plants and animals and/or disturbance due to flooding. Riparian areas are typically vegetated with comparatively lush growth of grasses, forbs, shrubs, and/or trees that are tolerant of periodic flooding, and often have sediments that are relatively rich in nutrients and organic matter. Riparian systems possess ecological and hydrological characteristics such as important fish and wildlife habitats, water storage, flood risk management, nutrient cycling, water quality protection, and recreational and economic benefits (Wildlife Conservation Board 2022). California riparian forest and woodland areas receive increased nutrients as well as water from their rivers and streams (compared to nearby upland areas), except in locations where artificial dams attenuate floods and trap sediments and nutrients (Warner and Hendrix 1984). Despite their small overall area, California's riparian forests and woodlands are especially well known for the abundance and diversity of their bird fauna (Small 1974; Gaines 1977). Their breeding avifauna is particularly important because it includes many species that occur in virtually no other California habitats. These birds are frequently insectivorous foliage gleaners that winter in tropical forests (Warner and Hendrix 1984). Riparian and aquatic ecosystems include many resources that are of high ecological, recreational, subsistence, and economic value. Riparian areas supply food, cover, thermal relief, and water for a large diversity of native animals and typically serve as migration routes and stopping points between habitats for a variety of wildlife.

Numerous human land and water uses affect the character and viability of riparian and aquatic systems throughout the United States. More than 95 percent of the historic wetland area and over 90 percent of the riparian corridors in California have been destroyed or modified (Gilmer et al. 1982; Ortega 2009). As much as 95 to 97 percent of the riparian community has been eliminated in floodplain areas of southern California (Faber 1989). Stressors to riparian and aquatic systems include dams, water diversions, groundwater pumping, nonnative invasive species, channelization, ditches, conversion to agricultural uses, urbanization, grazing, roads, fires, mining, and logging. Continued population growth, associated recreational use, and climate change put additional disturbance pressure on already affected areas (USDA Forest Service 2019). Many of these stressors result in altered stream storm and low flow regimes that disrupt the connection between the stream and its floodplain (USDA Forest Service 2020).

To accomplish a variety of public and private purposes, streams are often impounded and areas inundated; streams are frequently channelized and otherwise altered; the vegetation of riparian areas is often cleared; and large quantities of water are withdrawn, diverted, or pumped from stream systems (Plantico 1984). In many cases, the result of such practices is the major physical alteration of riparian and aquatic systems and the degradation/elimination of the natural functions performed by them (Plantico 1984).

BIOENGINEERING

Bioengineering involves the use of engineering practices that relate to stabilizing stream banks using natural vegetation by itself or in conjunction with stone, rock, dead vegetation structures, or organic erosion control matting (Corps 2008).[14] It should be noted that from a streambank erosion reduction perspective, streambed stability[15] must typically first be achieved in a stream before any bank erosion problems can be effectively addressed with engineering solutions (Corps 1997). Vegetation, per se, is not a panacea for controlling erosion and must be considered in light of site-specific characteristics (Corps 1997). Nevertheless, when vegetation is combined with building materials or engineered structures, numerous techniques can be designed and implemented for streambank erosion control (Corps 1997).

Trees are noted for their value in stabilizing banks of streams and rivers (Seibert 1968; Sigafoos 1964). The trees typically have much deeper roots than grasses and shrubs and therefore will normally hold the upper stream bank together to resist erosion (Corps 1997). The banks of some rivers have not eroded for durations of 100 to 200 years because heavy tree roots bind the alluvium of floodplains (Sigafoos 1964; Corps 1997).

Vegetation typically aids in erosion control and stream slope protection through five main mechanisms: reinforces soil through roots (Gray 1977; Gray and Sotir 1996), dampens waves or dissipates wave energy, intercepts water, enhances water infiltration, and depletes soil water by uptake and transpiration (Corps 1997). Vegetation can protect streambanks in four specific ways (Klingeman and Bradley 1976; Corps 1997): (1) the root system helps hold the soil together and increases the overall bank stability by its binding network structure (i.e., the ability of roots to hold soil particles together); (2) the exposed vegetation (e.g., stalks, stems, branches, and foliage) can increase the resistance to flow and reduce the local flow velocities, causing the flow to dissipate energy against the deforming plant rather than the soil; (3) the vegetation acts as a buffer against the abrasive effect of transported materials; and (4) close-growing vegetation can induce sediment deposition by causing zones of slow velocity and low shear stress near the bank, allowing coarse sediments to deposit. Native vegetation is usually less expensive than most structural slope protection methods alone. It also typically improves the ecological functions for fish and wildlife, improves water quality, and can protect cultural/archeological resources (Corps 1997).

Using planted or restored native vegetation for streambank erosion control has limitations, however. These include vegetation's occasional failure to grow and reproduce, inappropriate site conditions for the plants selected, vegetation becoming undermined by stream flows, vegetation being uprooted by wind and water, and vegetation maintenance requirements that go unmet (Corps 1997). Most of these limitations, such as undermining, can be lessened or prevented by use of bioengineering measures (Corps 1997).

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[14] The use of the term bioengineering also refers to soil bioengineering. Soil bioengineering is a method of stabilizing soils using living and dead plant material and biodegradable manufactured products (Polster 2003).

[15] Rosgen (1996) defined streambed stability as: "…the ability of a stream, over time, in the present climate, to transport the sediment and flows produced by its watershed in such a manner that the stream maintains its dimension, pattern and profile without either aggrading nor degrading."

DESCRIPTION OF BIOLOGICAL RESOURCES OF THE ACTION AREA

Vegetation and Other Cover Types

Vegetation and other cover types within two proposed construction areas of the Project (Santiago Basins and Lower Santiago Creek) consist generally of riparian vegetation, upland vegetation, open water, and other land cover types associated with human use. These are described below, and acreages of the vegetation and other cover types of the Project footprint are presented in Tables 5 and 6, and shown in Figures 9, 11, and 12. The following descriptions were largely taken from Aspen Environmental Group (2022).

Table 5. Vegetation and Other Cover Types in the Lower Santiago Creek Project Footprint

Vegetation and Other Cover Types	**Project Footprint (acres)**
Eucalyptus - tree of heaven - black locust groves	8.29
Coast live oak woodland and forest	0.38
Unvegetated channels and slopes	8.05
Total	16.72

Table 6. Vegetation and Other Cover Types in the Santiago Basins Project Footprint

Vegetation and Other Cover Types	**Project Footprint (acres)**
California sagebrush - black sage scrub	8.71
Laurel sumac scrub	0.24
Wild oats and annual brome grasslands	0.19
Fountain grass swards	0.93
Goodding's willow - red willow riparian woodland/forest	10.48
Mulefat thickets	1.60
Unvegetated channels and slopes	0.16
Developed	3.68
Total	25.99

Riparian and Wetland Vegetation Types

Goodding's Willow - Red Willow Riparian Woodland and Forest
Goodding's willow - red willow riparian woodland and forest are winter deciduous woodland and forest natural communities that are dominated by Goodding's willow. Additional species such as Pacific willow (*Salix lasiandra*), red willow, California sycamore, and mulefat are also present in the action area. Goodding's willow - red willow riparian woodland and forest are present along Santiago Creek in the Santigo Basins. In the Project footprint, it is the dominant natural community in the seasonally inundated portions of Smith Basin. Goodding's willow - red willow riparian woodland is a sub-type of southern riparian woodland, a natural community recognized by CDFW as a sensitive natural community (CDFW 2022).

Mulefat Thickets
Mulefat thickets (mulefat scrub) are a winter deciduous shrubland or scrub dominated by mulefat. Additional species such as oleander (*Nerium oleander*), coyote brush, and shrubby willows (*Salix* spp.) are also present in these areas in the action area. Mulefat thickets are present along Santiago Creek in the Project footprint within the Santiago Basins, mostly around the margins of Smith Basin. Mulefat thickets usually occur along intermittent streams with a fairly coarse substrate and a moderate distance to the water table compared to other riparian vegetation. Understory vegetation is often lacking altogether or sometimes is composed of exotic species. This community is maintained by frequent flooding. Mulefat thickets are a subset of southern riparian scrub, a CDFW sensitive natural community (CDFW 2018; CDFW 2022).

Upland Vegetation Types

California Sagebrush - Black Sage Scrub
California sagebrush - black sage scrub is a type of coastal sage scrub community that is dominated by California sagebrush. Black sage, sweetbush (*Bebbia juncea*), and California buckwheat are present. Within the Project footprint, this natural community occurs surrounding all three of the Santiago Basins.

Coast Live Oak Woodland and Forest
Coast live oak woodland and coast live oak forest are natural communities dominated by *Quercus agrifolia*, an evergreen oak that reaches 30 – 80 feet in height. Within the Project footprint, coast live oak woodland occurs in several patches along the channel within the Lower Santiago Creek portion of the Project, predominantly in the vicinity of North Flower Street. In this area coast live oak woodland occurs as a remnant of what was likely more extensive coast live oak woodland before development of the area. The understory vegetation in these areas includes nonnative ornamental species such as Canary ivy (*Hedera canariensis*). A large number of large coast live oak trees occur in the residential neighborhoods surrounding the Lower Santiago Creek action area, with the trees incorporated as residential landscaping.

The Lower Santiago Creek portion of the action area supports a stream that is now artificially xeric, ephemeral, and quite degraded. Santiago Creek in this section now rarely receives stormwater flows or low flows, and groundwater is apparently now too distant from the creek bed surface to support typical riparian trees such as cottonwoods (*Populus* sp.) or willows. The Lower Santiago Creek Project footprint currently supports coastal live oak woodland. The shrub layer in intact areas of coast live oak woodland is normally only moderately developed but often includes toyon, laurel sumac (*Malosma laurina*), and/or elderberry (*Sambucus mexicana*). Correspondingly, restoration of coast live oak woodland typically includes these species. Coast live oak trees generally naturally occur in Orange County on mesic sites such as north slopes, canyon bottoms, or upper streambanks (Dougherty and Riggin 1982; Brown 1982; Minnich 1987).

Coast live oaks in the Project region typically grow where they can access groundwater, but mature individual trees also have extensive shallow root networks (Knops and Koenig 1994).

Coast live oaks establish lengthy taproots, often growing more than 40 feet deep when mature. Several additional deep main roots often develop; these deep roots typically draw up stream-associated soil moisture and groundwater from much deeper levels underground than coastal-slope southern California riparian phreatophytes (typical streamside trees, such as willows and cottonwoods) that grow where groundwater is closer to the surface. Nevertheless, mature coast live oaks mostly depend on a wide and relatively shallow network of branching horizontal roots and surface feeding roots to collect most of the water and essential nutrients the tree needs to live (Plumb 1980; Bornyasz et al. 2002; Guldimann 2021). The greatest concentration of roots is in the top 4 inches of soil along the ground surface (Avery and Cass 1990). The resultant root system of mature coast live oak trees is very extensive at depths within several feet of the ground surface, and typically extends to a width of 1.5 to 3 times the dripline width of the tree (California Oak Foundation 1991; Avery and Cass 1990). This root system network effectively provides major soil holding and erosion control functions where these trees grow along streams and steep slopes.

The importance of protecting oak woodlands in California is recognized through the passage of the Oak Woodlands Conservation Act (2009 California Fish and Game Code - Section 1360-1372) and California Public Resources Code Section 21083.4, which address how county lead agencies must address impacts to oak woodlands in environmental documents. Oak woodlands provide important habitats to numerous common and special-status wildlife species supporting some 5,000 species of insects, over half of California's 662 species of terrestrial vertebrates, and several thousand plant taxa (CDFW 2015; McCreary 2009). As such, oak woodland communities are considered sensitive natural communities by wildlife resource agencies, including the Service and CDFW, and many California counties have ordinances protecting oak woodlands (California Board of Forestry and Fire Protection 2019).

Eucalyptus - Tree of Heaven - Black Locust Groves
Eucalyptus - tree of heaven - black locust groves were mapped as the vegetation type for all vegetation dominated by nonnative trees within the action area, including eucalyptus, Peruvian pepper (*Schinus molle*), yew plum pine (*Podocarpus macrophyllus*), prairie sumac (*Rhus lanceolata*), and many others. Native tree species such as California sycamore and coast live oak are also present in some areas of this vegetation type in the Lower Santiago Creek portion of the Project footprint.

Fountain Grass Swards
Fountain grass swards are a nonnative grassland vegetation type dominated by crimson fountain grass (*Pennisetum setaceum*), an exotic robust perennial bunchgrass. Other nonnative species such as gazania (*Gazania linearis*) and summer mustard (*Hirschfeldia incana*), are also present in the action area, as well as scattered natives such as desert wishbone bush (*Mirabilis laevis*). Fountain grass swards are present on the large slope on the north side of Smith Basin and along the eastern slopes of the Bond and Blue Diamond basins.

Laurel Sumac Scrub
Laurel sumac scrub is dominated by laurel sumac, which forms a short woodland community, interspersed with native coastal sage scrub species such as California sage brush and California

buckwheat. Additional species such as tamarisk (*Tamarix* sp.) are also present in laurel sumac scrub in the action area. Laurel sumac scrub is present in the action area in upland areas surrounding Bond, Blue Diamond, and Smith Basins.

Upland Mustards or Star-Thistle Fields
Upland mustards or star-thistle fields are a nonnative vegetation type, and within the action area this community is dominated by black mustard (*Brassica nigra*). Other nonnative species are also present including white horehound (*Marrubium vulgare*), tocalote (*Centaurea melitensis*), fennel (*Foeniculum vulgare*), and others. This vegetation type occurs in previously disturbed portions of upland areas surrounding the Santiago Basins.

Wild Oats and Annual Brome Grasslands
This grassland vegetation type is dominated by a variety of nonnative grasses such as wild oat (*Avena* spp.), ripgut brome (*Bromus diandrus*), and red brome (*Bromus rubens*). Nonnative herbs are also present including Bermuda buttercup (*Oxalis pescaprae*), fine-leaved fumitory (*Fumaria parviflora*), mustard, and others. Wild oats and annual brome grasslands are present in formerly disturbed sites within the Santiago Basins action area, especially around the perimeter of the Basins adjacent to surrounding residential development with coastal sage scrub areas often nearby.

Other Land Cover Types

Developed
This cover type includes heavily disturbed and developed areas within the action area including paved roads, unpaved roads, buildings, residential areas, and other unvegetated areas. It also includes a large area in the central portion of Santiago Basins that was recently affected by construction activities.

Open Water
Open water is mapped on portions of the action area that have had extensive surface water present during recent periods. This includes some lower elevation portions of Bond Basin, Blue Diamond Basin, and Smith Basin within the Project footprint. The water depths in these basins are predominantly associated with OCWD's water conservation activities, and for typically shorter periods these water levels are associated with storm flows from Santiago Creek. These water levels change throughout the year and year to year, and most of the open water areas in the Basins eventually become dry areas in the late summer and fall in typical years.

Unvegetated Channels and Slopes
This land cover type includes flood control channels, unvegetated slopes, and other maintained areas within the action area. Vegetation is either absent or very sparse. This includes areas that have been physically disturbed and are no longer recognizable as a native or naturalized vegetation association but continue to retain a soil substrate. Typically, vegetation, if present, is nearly exclusively composed of nonnative plant species such as ornamentals or ruderal exotic species that thrive in disturbed areas. This land cover type typically occurs in areas with regular clearing and grading, inundation for long periods, or poor soils such as along the Santiago Basins

pit slopes and access roads. Examples of such disturbed land include areas that have been repeatedly cleared for fuel management purposes or experienced repeated human use that prevents natural re-vegetation (i.e., dirt parking lots, trails that have been present for several decades), as well as recently graded firebreaks, graded construction pads, construction staging areas, and off-road vehicle trails. Species occurring in these areas include prickly Russian thistle (*Salsola kali*), telegraph weed (*Heterotheca grandiflora*), sow thistle (*Sonchus oleraceus*), summer mustard, and a mix of nonnative grasses.

Wildlife Habitats, Linkages, and Movement

Wildlife habitats are often described in terms of vegetation or natural community, though a more meaningful explanation includes detail such as availability of or proximity to water, suitable nesting or denning sites, thermal cover/shade, foraging perches, cover sites to escape from predators, soils that are suitable for burrowing or hiding, proximity of noise and disturbance, patch size, connectivity to other natural areas, and other factors that are unique to each species. For many wildlife species, vegetation reflects important components of their habitat, including regional climate, physical structure, biological productivity, and food resources. Thus, the vegetation type descriptions above are useful overarching general descriptors for wildlife habitats.

The Lower Santiago Creek and Santiago Basins portions of the action area are not located within major wildlife connectivity areas or integral parts of major natural landscape blocks. Due to extensive surrounding development and degradation of the Creek corridor in the region, the Lower Santiago Creek action area is essentially isolated and likely supports only localized movement of more common wildlife generalist species that are adapted to urban environments. The Lower Santiago Creek area likely provides only low- to moderate-functions for movement corridor along Santiago Creek. For example, this portion of the action area likely provides for mid-sized mammal generalist species (e.g., coyote) movement to and from the channelized Santa Ana River confluence downstream. Only limited potential exists to improve the wildlife movement function along Santiago Creek and nearby Santa Ana River in this Project region due to the extensive surrounding development, narrow constrained floodway, and artificial lack of water (and associated riparian vegetation) in this region of Santiago Creek.

The Santiago Basins are part of a semi-degraded, medium-function ecological landscape block, with dense residential development both downstream and adjacent on three sides. This portion of the action area consists of a series of deep pits that artificially capture most of the remaining water and fluvial flows of Santiago Creek that enter the Santiago Basins. Passive/active revegetation and mitigation have occurred within portions of the Santiago Basins action area, likely resulting in ecological improvements to the degraded ecological conditions of the site post-mining. Some additional undeveloped former sand and gravel mining lands occur to the east of the Santiago Basins along Santiago Creek. Santiago Oaks Regional Park and extensive undeveloped natural lands occur to the northeast of those mining areas. These undeveloped former mining parcels just upstream of the Santiago Basins currently provide an intermediate-function landscape linkage to the Santiago Basins. Together with the Santiago Basins, these parcels form an undeveloped “peninsula” within the larger developed landscape matrix. Portions

of these intervening parcels southwest of Santiago Oaks Regional Park are planned for development that would likely further degrade this linkage to the Santiago Basins. Some artificially-limited water flows continue to occur within Santiago Creek from Villa Park Dam downstream to the Santiago Basins. These flows support some riparian ecological resources along this 2.3-mile-long reach of Santiago Creek, including riparian vegetation cover, foraging resources, periodic wildlife access to water, and wildlife occupation and movement. Very little water flows downstream out of the Santiago Basins; as a result, the reaches of Santiago Creek downstream are subsequently heavily degraded and largely devoid of riverine resources and riparian vegetation, having large gaps with little cover. Wildlife movement to and from areas west of Santiago Basins is likely restricted to the creek channel and consists predominantly of small- to mid-sized generalist species that are adapted to urban environments.

Intermediate potential exists to improve the wildlife movement and linkage function along Santiago Creek upstream of Santiago Basins, such as conserving/legally protecting the remaining open vacant parcels along the creek and enhancing/restoring riparian, coastal sage scrub, and oak woodland natural communities along the floodplain and environs. This intermediate potential is based on the limited existing development along this reach of Santiago Creek, availability of intermittent water flows, and remaining functional connectivity to large natural open space to the northeast.

Wildlife detected during the field surveys by others (Aspen Environmental Group 2022) include species common in undeveloped areas of the region, such as western fence lizard (*Sceloporus occidentalis*), night snake (*Hypsiglena torquata*), lesser goldfinch (*Spinus psaltria*), Bewick's wren (*Thryomanes bewickii*), turkey vulture (*Cathartes aura*), and California ground squirrel (*Otospermophilus beecheyi*). Western grebes (*Aechmophorus occidentalis*) are noted as regularly occurring in the Santiago Basins, including reported nesting attempts (Villa Park 2022). Great blue herons (*Ardea herodias*) also are regularly reported from the Santiago Basins. Mule deer (*Odocoileus hemionus*), bobcat (*Lynx rufus*), and mountain lion (*Puma concolor*) have been reported from the Santiago Basins (Villa Park 2022). Coyotes (*Canis latrans*) were observed within the Lower Santiago Creek channel Project footprint. Several exotic fish including bluegill (*Lepomis macrochirus*), and nonnative invasive red-eared slider turtles (*Trachemys scripta elegans*) have been reported from the Santiago Basins (Villa Park 2022; Fishidy 2017). Several special-status wildlife species were detected during surveys and are listed below (Aspen Environmental Group 2022).

Special Status Species

The special status species in Table 7 below have moderate to high potential to occur in the action area. The life history, conservation status, and potential to occur in the action area for these species are analyzed by Aspen Environmental Group (2022) and that analysis incorporated herein by reference.

Table 7. Special Status Species with Potential for Occurrence in Action Area

Species Name	Habitat Requirements	Potential to Occur
Juglans californica Southern California black walnut	Small tree; chaparral, woodlands, coastal scrub, and riparian woodlands;	**High**; two individuals observed upstream of Smith Basin,
Romneya coulteri Coulter's matilija poppy	Chaparral and coastal scrub, often in burned areas,	**Present**; several individuals planted along Hewes St. along east side of Santiago Basins.
Bombus crotchii Crotch's bumble bee	Colonial insect; open grassland and scrub; underground colonies,	**High**; not observed, suitable habitat and food plants present.
Danaus plexippus Monarch – California overwintering population	Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby.	**High**; not observed, likely to be present however they are unlikely to overwinter this far inland.
Aspidoscelis hyperythra Orange-throated whiptail	Prefers washes and other sandy areas with patches of brush and rocks.	**High**; not observed, suitable habitat present.
Aspidoscelis tigris stejnegeri Coastal whiptail	Occurs in deserts and semi-arid areas with sparse vegetation in firm soil, sandy, or rocky soils.	**High**; not observed, suitable habitat present, known from within 1 mile.
Accipiter cooperii Cooper's hawk	Woodland, chiefly of open, interrupted, or marginal type; nest sites mainly in riparian growths of deciduous trees.	**Present;** suitable foraging and nesting habitat throughout.
Aimophila ruficeps canescens Southern California rufous-crowned sparrow	Arid and steep rocky areas chaparral and coastal sage scrub including low grasses and shrubs.	**High**; not observed, suitable habitat present.
Ardea herodias Great blue heron	Rookery sites in close proximity to foraging areas: marshes, lake margins, tide-flats, rivers and streams.	**Moderate** (nesting); **Present** (foraging only); multiple individuals observed foraging.
Eremophila alpestris actia California horned lark	Open, flat lands incl. sparse sagebrush or grassland, meadows, alkali flats; wide elev. range; breeds in western Calif (San Diego Co through Humboldt Co) and Baja Calif; winters in same range.	**High** (seasonal foraging); **Low** (nesting); Marginally suitable nesting habitat, expected to forage in the action area.
Falco peregrinus anatum American peregrine falcon	Near wetlands, lakes, rivers or other water; on cliffs, banks, dunes, and human-made structures.	**Low** (nesting); **High** (foraging only); limited suitable nesting habitat; known within 1 mile.

Species Name	Habitat Requirements	Potential to Occur
Haliaeetus leucocephalus Bald eagle	Lower montane, old growth, coniferous forests, near lakes and rivers.	**Low** (nesting); **Moderate** (foraging only); marginal foraging habitat, observed onsite in 2012.
Icteria virens Yellow-breasted chat	Inhabits riparian thickets of willow and other brushy tangles near water courses;	**High**; not observed, assumed to nest on-site.
Vireo bellii pusillus Least Bell's vireo	Inhabits dense riparian vegetation in the vicinity of water or intermittent streams, often dominated by willows, cottonwoods, and mulefat	**Present**; suitable habitat present.
Pandion haliaetus Osprey	Ocean shores, bays, freshwater lakes and large streams.	**Present**; 1 individual observed foraging on-site.
Polioptila californica californica Coastal California gnatcatcher	Permanent resident of coastal sage scrub	**Present**; suitable habitat present.
Lasiurus cinereus Hoary bat	Prefers deciduous and coniferous woodlands; primarily roosts in tree foliage.	**Low** (roosting); **High** (foraging); Suitable foraging habitat is present; suitable roosting habitat is limited.
Myotis yumanensis Yuma myotis	Distribution tied to water bodies, optimal habitats are open forests and woodlands.	**Low** (roosting); **High** (foraging); Suitable foraging habitat is present; suitable roosting habitat is limited.

Candidate and Listed Threatened or Endangered Wildlife

The following noted species are listed as threatened or endangered under the California Endangered Species Act (CESA) or ESA and were detected or have a high potential to be present in the action area. Two listed species (least Bell's vireo and coastal California gnatcatcher) were observed by others in the Project footprint during surveys, and several additional species have a considerable potential to be present. No designated critical habitat for federally listed species is present within the action area.

Least Bell's vireo

The vireo is a small songbird that is listed as endangered under both the ESA and the CESA. The vireo was once widespread and common in southern California, but its range and numbers were greatly reduced due to parasitism by brown-headed cowbirds concurrent with major losses of riparian natural communities due to direct elimination (e.g., development and channelization of floodplains and floodways), indirectly through drying of streams from water diversions and groundwater pumping, and lost space and resources for native riparian vegetation due to exotic

plant invasions. Suitable riparian habitat for the vireo is present in Smith Basin, Bond Basin, Blue Diamond Basin, and along Santiago Creek upstream of Smith Basin. Suitable habitat for the vireo is not present within the Lower Santiago Creek portion of the action areas due lack of riparian scrub/woodland/forest habitat; habitat for the species probably existed in that area before ongoing water withdrawals occurred upstream and residential development occurred in Santiago Creek's former floodplain.

The vireo breeds only within California and northern Baja California. The vireo is migratory; it spends the non-breeding season in Mexico, and it is usually present in southern California breeding zones from approximately mid-March through mid-September. The species typically breeds in dense riparian vegetation in the vicinity of water or intermittent streams, often dominated by willows, cottonwoods, mulefat, and California wild rose (*Rosa californica*), but it may also utilize other various shrubs, trees, and vines. Nests are typically found in low-lying, dense vegetation in riparian zones, most frequently in 5- to 10-year-old stands.

Coastal California gnatcatcher

The gnatcatcher is a small gray songbird listed as threatened under the ESA. It is designated as a Bird Species of Special Concern by the State of California. Its habitat is coastal sage scrub, usually composed of California sagebrush, California buckwheat, and other low-growing, drought-deciduous subshrubs. Gnatcatchers are also known to use disturbed mixed scrub, chaparral, grassland, and riparian natural communities in proximity to coastal sage scrub for dispersal and foraging. Gnatcatchers are known to breed in the action area, with occupied habitat for the gnatcatcher present on the upland slopes around Smith, Bond, and Blue Diamond Basins. Suitable habitat for the gnatcatcher is not present within the Lower Santiago Creek portion of the action area due lack of suitably large patches of coastal sage scrub in that region of the Project. Gnatcatchers are year-round (non-migratory) residents of southern California, and they are insectivores. Gnatcatchers are monogamous; the pair establishes a territory and stays within the same territory year-round. The breeding season extends from approximately February 15 through August 15, with peak breeding activity occurring from mid-March through mid-May. Ongoing coastal sage scrub restoration by OCWD has likely increased the carrying capacity for gnatcatchers in the Santiago Basins (Aspen Environmental Group 2022).

Bald eagle

The bald eagle has been State-listed as endangered in California since 1971 (CDFW 2022). It was federally listed as endangered in 1978, then down-listed to threatened in 1995, and delisted in 2007. It is also protected under the Federal Bald and Golden Eagle Protection Act and is a Service Bird of Conservation Concern. The bald eagle is an opportunistic, generalized predator and scavenger adapted to hunting and foraging over aquatic habitats. Breeding bald eagles require relatively large bodies of water containing resident populations of suitable-sized fish. Most bald eagles in California breed near reservoirs or lakes. They typically nest in large trees in close proximity to large bodies of water and may occasionally nest on large powerline structures and steep cliff faces. A single immature bald eagle was reported from the action area in 2012, and the species has a moderate to high potential to forage in the Santiago Basins in the future

(Aspen Environmental Group 2022). Bald eagles are known to nest approximately 5 miles to the east, near Irvine Lake. Bald eagles have a very low potential to nest in the action area due to the lack of appropriate nesting trees, but they have a moderate potential to forage when the Santiago Basins hold water and support adequate numbers of larger fish.

Swainson's hawk

Swainson's hawks are listed as threatened under the CESA (CDFW 2022). In California, they nest in the San Joaquin Valley, western Antelope Valley, and Owens Valley. They migrate to South America every fall and return to California every spring. Swainson's hawks migrate along the Pacific flyway, and several have been observed in the vicinity of the action area during migration (Aspen Environmental Group 2022). The action area is well outside of the breeding range of the species, but Swainson's hawks have a moderate to high potential to be present in the Santiago Basins area during migration (Aspen Environmental Group 2022).

Monarch butterfly

The listing of the Monarch butterfly was determined to be warranted in the Service's 12-month Finding on the species (85 FR 81813-81822). Improved management of overwintering populations of monarchs in California was identified as an important element in the conservation of the species. Monarchs and their nectar plants are somewhat widespread in California. Although milkweed (*Asclepius* sp.) host plants for the species were not detected in the action area, individual monarchs have a high potential to be present (Aspen Environmental Group 2022). Winter roost sites extend along the west coast from northern Mendocino County, California, to Baja California, Mexico, and such roosts are generally located in select wind-protected tree groves. The action area is likely too far inland to support winter-roosting habitat for the species.

Species Protected Under the Federal Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668d; BGEPA) prohibits take of bald eagles and golden eagles. The BGEPA defines *take* to include "pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, and disturbing." The bald eagle is discussed above.

Golden eagle

The golden eagle is a California Fully Protected species and a Service Bird of Conservation Concern (CDFW 2022). Golden eagles are year-round residents throughout most of their range in the western U.S. In the southwestern U.S., they are more common during winter months. They nest in steep, rugged, and remote terrain in the Santa Ana Mountains. Golden eagles are wide-ranging predators, especially outside of the breeding season. A single golden eagle was reported from the Santiago Basins in 2011, and the species has a moderate potential to forage in action area in the future. Golden eagle nesting habitat is absent from the action area.

California Wildlife Species of Special Concern

Coastal whiptail

Coastal whiptails are found in coastal southern California, mostly west of the Peninsular Ranges and south of the Transverse Ranges. Their range extends north into Ventura County and south to Baja California. The coastal whiptail occurs in a variety of natural communities including various upland and riparian habitats. It is most commonly associated with areas of dense vegetation but is also found around sandy areas along gravelly arroyos or washes (Stebbins 2003). Coastal whiptails were not observed within the action area but have a high potential to be present throughout the Santiago Basins (Aspen Environmental Group 2022).

Yellow-breasted chat

Yellow-breasted chat is a migratory species, occurring in California only during the breeding season which is typically between April and August. In California, it primarily breeds in the northern portion of the state. It typically utilizes dense riparian thickets and tangles near watercourses for breeding (CDFW 2022). Yellow-breasted chats were not detected in the action area but have a high potential to be present during the breeding season in appropriate riparian natural communities within the Santiago Basins (Aspen Environmental Group 2022).

Yellow warbler

Yellow warbler is a migratory species, occurring in California only during the breeding season, which is typically between April and August. In California, it is widespread in riparian habitats throughout much of the State. It typically nests in dense riparian vegetation near watercourses (CDFW 2022). Yellow warblers were previously detected in the action area in 2008 and 2011 but were not detected during recent surveys of the area (Aspen Environmental Group 2022). Suitable habitat is present in the action area in the Santiago Basins, and they are likely to be present during the breeding season.

Bats

Several special-status bat species have at least a low potential to forage over the Santiago Basins: pallid bat (*Antrozous pallidus*), western mastiff bat (*Eumops perotis californicus*), Mexican long-tongued bat (*Choeronycteris mexicana*), hoary bat, Yuma myotis, big free-tailed bat (*Nyctinomops macrotis*), and pocketed free-tailed bat (*Nyctinomops femorosaccus*). The pallid bat and western mastiff bat forage in open areas over grasslands, agricultural areas, and other shrublands, and they roost in a variety of habitats including buildings, rock crevices, and caves. The pocketed free-tailed bat forages over water and open shrublands and roosts in crevices in cliffs. Hoary bats may roost in tree foliage within the Santiago Basins portion of the action area. The remaining bat species are unlikely to roost in the action area because of a lack of suitable roosting habitats.

Other Special-Status Wildlife Species

Crotch's bumble bee

Crotch's bumble bee was recently petitioned for listing under the CESA but was determined to not be eligible for protection under CESA. It is currently recognized as a special animal

but may be petitioned again in the future based on a recent interpretation of CESA, which indicates that some invertebrates may be eligible for protection. Crotch's bumble bee is a widespread secretive species that is known from more than two hundred locations over a broad geographic range (CDFW 2022). It is typically found in openings in grassland and natural scrub communities where it burrows into the ground and lives in colonies. It feeds on native plants including milkweed, pincushion (*Chaenactis* sp.), lupine (*Lupinus* sp.), phacelia (*Phacelia* sp.), sage, snapdragon (*Antirrhinum* sp.), clarkia (*Clarkia* sp.), bush poppy (*Dendromecon* sp.), and buckwheat . Many of these food plants are present in the action area around the Santiago Basins, and suitable burrowing habitat is also present. Crotch's bumblebee has a high potential to be present in the action area.

Orange-throated whiptail

Orange-throated whiptails are found in coastal southern California, mostly from Riverside and Orange Counties south into San Diego County and Baja California. The orange-throated whiptail occurs in a variety of natural communities including woodlands, coastal sage scrub, and chaparral. It is often found in sandy areas with patches of brush and rocks (CDFW 2022). Orange-throated whiptails were not observed within the action area but have a high potential to be present in some areas surrounding the Santiago Basins (Aspen Environmental Group 2022).

Raptors

In addition to the raptors discussed above, several other special-status birds of prey including Cooper's hawk, American peregrine falcon, and osprey (*Pandion haliaetus*) were observed in the action area or have a high potential to be present. These raptors are typically found in the region seasonally, especially during winter and migration. Both an individual Cooper's hawk and an individual Osprey were detected in the action area within the Santiago Basins in 2022.

Other special-status birds

Southern California rufous-crowned sparrow, great blue heron, and California horned lark are "Watch List" wildlife species with at least a moderate potential to be present in the action area. None of these species are afforded specific protection under either state or Federal regulations, outside of the Migratory Bird Treaty Act (Aspen Environmental Group 2022).

Native Birds: Migratory Bird Treaty Act (MBTA) / California Fish and Game Code

The Federal MBTA prohibits take of any migratory bird, including eggs or active nests, except as permitted by regulation (e.g., licensed hunting of waterfowl or upland game species). Under the MBTA, "migratory bird" is broadly defined as "any species or family of birds that live, reproduce or migrate within or across international borders at some point during their annual life cycle" and thus applies to most native bird species. California Fish and Game Code Section 3503 prohibits take, possession, or needless destruction of bird nests or eggs; Section 3503.5 prohibits take or possession of birds of prey or their eggs; and Section 3513 prohibits take or possession of

any migratory nongame bird. With the exception of a few nonnative birds, such as European starling (*Sturnus vulgaris*), the take of any birds or loss of active bird nests or young is regulated by these statutes. Most of these species have no other special conservation status as defined above. The Project footprint has many trees, shrubs, and open areas that may provide breeding habitats for birds. Numerous common and special-status birds are known to nest in the action area or have potential to breed there.

During surveys of the action area performed by others, two active red-tailed hawk nests and three lesser nighthawk nests were observed in the Santiago Basins portion of the action area (Aspen Environmental Group 2022).

Directed Survey Results for Least Bell's Vireo and Coastal California Gnatcatcher in the Santiago Basins[16]

Least Bell's Vireo

Directed vireo surveys of the Santiago Basins action area were conducted by OCWD and SAWA in 2022 (Corps 2023). During these surveys, no vireo territories were located within the Blue Diamond Basin and Bond Basin Project footprints. Two vireo territories were located within the broader Blue Diamond Basin and Bond Basin portion of the action area. Three vireo territories were located within the Project footprint in Smith Basin. One additional vireo territory was documented within the Smith Basin action area. In total, 3 vireo territories were detected in the Project footprint and 6 vireo territories were detected within the overall action area that includes the Project footprint during these 2022 surveys (Corps 2023).

Coastal California Gnatcatcher

Directed surveys of the Santiago Basins action area were conducted for gnatcatchers by OCWD and SAWA in 2022 (Corps 2023). During these surveys one gnatcatcher territory was located within the Blue Diamond and Bond Basins Project footprint. Ten gnatcatcher territories were located within the broader Blue Diamond Basin and Bond Basin action area. No gnatcatcher territories were located within the Project footprint in Smith Basin, but one gnatcatcher territory was located within the Smith Basin portion of the action area. In total, 1 gnatcatcher territory was detected in the Project footprint, and 12 gnatcatcher territories were detected within the overall action area that includes the Project footprint during these 2022 surveys (Corps 2023).

[16] The Service considers vireo and gnatcatcher occupation of the Lower Santiago Creek portion of the action area highly unlikely due to lack of suitable habitats for these species. Relatedly, no directed surveys for these species were performed by the Corps in this area. We do not anticipate any impacts to these species or other listed species from Project activities in the Lower Santiago Creek.

POTENTIAL IMPACTS OF THE PROPOSED PROJECT ON BIOLOGICAL RESOURCES

The proposed Project would involve direct losses and indirect effects, primarily to riparian and coastal sage scrub natural communities in the Santiago Basins portion of the Project, and to a degraded/dewatered stream with exotic vegetation and oak woodland in the Lower Santiago Creek portion of the Project. Mitigation measures are proposed that would reduce and partially offset both temporary and permanent impacts of the Project.

Potential Project Effects and Proposed Mitigation

The total action area for the proposed Project consists of about 151.1 acres. The total Project footprint would cover about 42.7 acres. The Lower Santiago Creek portion of the Project consists of an action area of about 17.2 acres with a Project footprint of about 16.7 acres. The Santiago Basins portion of the Project consist of an action area of about 133.9 acres with a Project footprint of about 26.0 acres.

The Corps does not propose mitigation for the following vegetation and land cover types in the Project footprint: Coast Live Oak Woodland and Forest, Eucalyptus – Tree of Heaven – Black Locust Groves, unvegetated stream channel, and developed.

The 22.15 acres of direct impacts in the Project footprint proposed for mitigation by Corps consists of riparian and upland vegetation communities (See Table 4). This would include about 3.28 acres of permanent impacts.

About 18.87 acres of riparian and upland vegetation community direct effects are characterized by the Corps as temporary impacts within the Project footprint. As proposed, some of this acreage would involve cut or fill, riprap stabilization measures, and overtopping with soil, followed by replanting of these stabilized slopes with native vegetation. An undetermined portion of these areas characterized as temporary impacts by the Corps would likely result in final ground surface grades that are considerably different from the existing ground surface in those locations due to amount of cut or fill involved. These changes would likely result in areas that no longer would hydrologically support the existing or functionally equivalent riparian natural communities (e.g., through increased root distance to soil moisture or changes in the period of basin reservoir inundation or creek surface moisture) in some areas. In addition, the placement of proposed riprap and a shallow amount of soil (e.g., 24 inches) over riprap is likely to functionally limit the root growth of and ultimately preclude the proposed mitigation of riparian natural communities (e.g., Goodding's Willow – Red Willow Riparian Woodland and Forest) in these areas characterized by the Corps as temporary impacts, including vireo habitat. While we could not identify minimum soil depths needed by these species, general references on typical root depths of trees and shrubs (Foxx et al. 1984, Canadell et al. 1996, and Schenk and Jackson 2002) indicate the following typical root depths: 10-19 feet for deciduous trees, 7-10 feet for shrubs, and 4-5 feet for subshrubs. With the Project as proposed, some of these impacts characterized by the Corps as temporary would likely end up being permanent through degraded or limited functions in the replacement natural communities, or they may convert over time to

other vegetation community types. We also cannot confirm with the available information that the Project as proposed would fully offset the losses that would occur within OCWD mitigation sites due to potential discrepancies in the mapping or disposition of those sites.

The vegetation and cover types within the action area are generally categorized as: riparian vegetation communities, upland vegetation communities, or other vegetation/cover types. From a potential equivalency perspective, specific natural community categories within the riparian cover types (i.e., Goodding's Willow – Red Willow Riparian Woodland and Forest and Mulefat Thickets) in the appropriate configuration and structure could provide suitable habitat for the vireo where they have been found in the past or in other locations that are appropriately enhanced to support them in the future within portions of the Santiago Basins. Nevertheless, Goodding's Willow – Red Willow Riparian Woodland and Forest generally provides considerably higher productivity and greater effective territory usage (e.g., preferred for breeding and foraging areas) for the vireo than Mulefat Thickets. As such, we do not consider Mulefat Thickets as a functional replacement for Goodding's Willow – Red Willow Riparian Woodland and Forest when considering whether impacts are temporary or permanent. As proposed, and for the reasons described above, portions of the Project footprint that are currently Goodding's Willow – Red Willow Riparian Woodland and Forest would be replaced with Mulefat Thickets, with this considered only a temporary impact by the Corps. Given the functional limitations of Mulefat Thickets, we would consider this to result in a permanent loss of habitat value.

Certain upland (coastal sage scrub) vegetation community types in the appropriate configuration/diversity/density would be expected to provide potential or suitable habitat for gnatcatchers within Santiago Basins. From a potential equivalency perspective, California Sagebrush – Black Sage Scrub and Laurel Sumac Scrub in the appropriate configuration and structure could provide suitable habitat for the gnatcatcher where they have been found in the past or in other locations that are appropriately enhanced to support them in the future within portions of the Santiago Basins. We expect that California Sagebrush – Black Sage Scrub within the Santiago Basins would generally provide higher productivity and would be preferred for breeding and foraging by gnatcatchers as compared to Laurel Sumac Scrub.

To offset impacts to riparian vegetation types, the Corps proposes a 5:1 ratio for permanent impacts and a 2:1 ratio for temporary impacts. To offset impacts to upland vegetation types, the Corps proposes a 3:1 ratio for permanent impacts and a 2:1 ratio for temporary impacts. Table 4 summarizes the impacts and offset ratios of the proposed Project.

Migratory birds are expected to occupy the action area during the breeding season. Resident birds will likely occupy the action area year-round. Per the proposed Construction Schedule, vegetation clearing and grubbing is scheduled to occur during the non-breeding season for most birds; vegetation removal for Project construction would occur outside of the period of February 15 through September 15. This measure would reduce potential direct effects to most birds by clearing the Project footprint of vegetation during the period when migratory birds have typically left the area for the season, and resident birds are not breeding or raising young. Resident birds during the non-breeding season are expected to fly away from construction equipment during vegetation clearing and grubbing activities in the Project footprint during the non-breeding

season (thus, avoiding direct injury). These species and returning migratory birds that formerly used the Project footprint would likely attempt to find unoccupied habitats suitable for survival outside the Project footprint, likely resulting in reduced breeding productivity or survival as these birds often end up in unoccupied suboptimal habitats or in competition for remaining occupied habitats. Similarly, highly mobile resident wildlife would likely move out of the Project footprint during initial vegetation clearing activities and attempt to find unoccupied suitable habitats in the region. Most wildlife of low mobility occurring within the Project footprint would likely be killed during Project vegetation clearing and grubbing.

Most Project construction activities are scheduled to occur year-round, including during of the breeding season. Potential indirect effects from Project activities include disturbance of wildlife near to the Project footprint from noise, human presence, fugitive dust, and/or nighttime lighting (e.g., lighting associated with overtime construction work or construction equipment maintenance activities).

Potential Project Effects and Proposed Measures within Lower Santiago Creek

The Lower Santiago Creek action area currently consists of a degraded semi-natural creek configuration with a denuded streambed of rock and cobble, lightly vegetated slopes consisting of soil at varied but generally steep angles, and a woodland over-story cover dominated by large trees along the upper channel slopes. These trees provide shade/thermal cover along much of the creek. Santiago Creek in this reach is effectively dewatered of almost all low flows and the majority of high flows.

To increase Santiago Creek's flow capability during storm flow events, the proposed Project would construct a trapezoidal channel with buried riprap along the full extent of the Lower Santiago Creek Project reach. The Project in the Lower Santiago Creek would require the removal of essentially all trees in the channel right-of-way to perform grading and channel construction. The channel right-of-way consists of almost the total area between backyard fences of adjacent residences along the creek. The trees in this reach are primarily exotic landscaping species with some native coast live oak and California sycamore trees.

As proposed, riprap to be installed in this portion of the Project would be covered with native substrate excavated from the channel floor and slopes. The excavated creek bed substrate would be overlayed on top of the riprap layer on the creek slopes and floor/invert. Since this excavated creek bed material would be predominately rock and cobble, this overlaying substrate would likely not allow for the establishment of native vegetation. The combination of gravel bedding layer (under the riprap), riprap, and the shallow overlayment of predominately rock and cobble (not soil) would preclude almost all growth of proposed native vegetation to be established in this area through lack of soil and extensive barriers to root growth. The resultant creek bed and slopes would likely remain essentially devoid of native vegetation in the short and long term. This would likely preclude establishment of any potential vegetated mitigation areas within the creek slopes or bed in the Lower Santiago Creek portion of the Project.

As discussed above in the project description, once a monitoring and maintenance period is over, the Corps would provide the non-Federal sponsor with an O&M manual, including development of a channel operation and maintenance program. The program would require the prevention (through early and ongoing removal) of large woody growth, invasive vegetation, debris, and other flow-inhibiting features from becoming established within the Project channel. This O&M would maintain the channel creek bed and slopes free of trees and larger woody shrubs, limiting their habitat potential.

Potential Project Effects and Proposed Mitigation Measures within the Santiago Basins

As proposed, about 9.19 acres of Goodding's Willow – Red Willow Riparian Woodland and Forest would be temporarily lost from Project construction. These temporary impacts are proposed to be mitigated at 2:1. As partial mitigation for those losses, 9.19 acres would be replanted on-site, but 1.29 acres of that on-site vegetative cover would be replaced with Mulefat Thickets rather than Goodding's Willow – Red Willow Riparian Woodland. This is because the 1.29 acres would be located on top of buried riprap with limited vertical depth of overtopping soil (24 inches of soil) that is not adequate to support Goodding's Willow – Red Willow Riparian Woodland in the long term, reducing the potential replacement on site to 7.9 acres. Per the 2:1 ratio, an additional 9.19 acres of riparian or wetland enhancement is proposed offsite in Prado Basin to help offset temporary impacts to Goodding's Willow – Red Willow Riparian Woodland.

As proposed, about 1.43 acres of Mulefat Thickets would temporarily lost from Project construction and are proposed to be mitigated at 2:1. As specified mitigation for those losses, 1.43 acres would be replanted on-site. An additional 1.43 acres of riparian or wetland enhancement is proposed offsite in Prado Basin to help offset temporary impacts to Mulefat Thickets.

Permanent direct impacts from the Project to gnatcatcher habitat consist of 1.53 acres of natural communities dominated by native plant species and 0.29 acres of non-native vegetation that is used by gnatcatchers. For these impacts, the Corps has proposed measure BIO-9 above that would result in 1.82 acres of impacts being offset with a total of 5.46 acres of restored coastal sage scrub within the Santiago Basins area. This acreage will be managed for 8 years post-construction.

Temporary direct impacts from the Project to gnatcatcher habitat (both native and non-native) would total about 8.25 acres. For such impacts, the Corps has proposed measure BIO-10 above. The total restored acreage (16.5 acres) would include the disturbed area and a like amount of restoration/enhancement elsewhere in the basins. This acreage will be managed for 8 years post-construction.

The Project's Santiago Basins slope stabilization measures include the re-establishment of a former access road within Smith Basin. From satellite imagery it appears this road was last used by vehicles in 2010; it now includes limited ongoing disturbance from use of a single-track trail and otherwise is currently in an early seral stage of passive ecological restoration to coastal sage scrub. As proposed, the travel surface of this rehabilitated road would likely remain permanently

disturbed following Project implementation. The improved maintenance road would cover approximately 2 acres.

Least Bell's Vireo

Three vireo territories were detected within the total Project footprint during surveys in 2022 (Corps 2023).

A total of approximately 1.46 acres of vireo-occupied habitat would be permanently lost with the Project; this would occur from construction within Smith Basin. In addition, a total of approximately 10.62 acre of vireo occupied habitat would be temporarily affected, also during construction within Smith Basin. This same acreage is proposed to be replanted with native riparian vegetation once construction is complete (Corps 2023). The 10.62 acre of riparian vegetation within the Project footprint would be monitored and managed according to measure BIO-11.

It is unlikely that the proposed replanting on 10.62 acres would replace lost functions and values for vireos in the Project footprint in areas where riprap and soil covering is proposed. As noted herein, we predict that such revegetation/restoration when attempted on less than a minimum of 4 feet of soil placed atop riprap would not likely be successful to support target riparian trees and would fail to replace lost functions and values in-kind, including similar habitat productivity and carrying capacity for the vireo. If such restoration is unsuccessful, permanent losses to occupied habitat would be greater than predicted by the Corps.

Approximately 26.2 acres of the overall action area (all within the Santiago Basins) currently provide potential or occupied habitat for the vireo. Direct and indirect impacts to vireos likely would include displacement of vireo territories within the Project footprint, likely causing adverse effects to three vireo pairs (based on 2023 survey data) within the Project footprint. Roughly 16.2 acres of potential vireo habitat (intact woody riparian natural communities) within the Santiago Basins action area would remain during the Project construction. Vireos returning to Santiago Basins (after Project vegetation clearing) that previously utilized territories in the Project footprint would likely attempt to set up new territories in the remaining smaller area of riparian woodland/scrub in the Santiago Basin action area outside of the Project footprint for several breeding seasons following Project initiation, likely with reduced productivity or survival as compared to the productivity or survival that would have likely otherwise occurred.

Replacement/restoration of vireo habitat to conditions like those of the existing occupied habitat within the Project footprint typically takes about 4-7 years with appropriate soil and hydrological conditions (e.g., soil moisture) and modest habitat restoration efforts. If restoration would occur onsite so as to replace lost vireo functions and values including habitat with appropriate hydrology and soils, replacement of lost vireo carrying capacity in the Project footprint would likely take the same amount of time to accomplish from initiation of restoration. Thus, temporal losses would then be about 4-7 years plus the time of Project construction of approximately 2 years, for a total of 6-9 years. If restoration and replacement of lost vireo habitat functions are

not successful (such as from inappropriate soil or hydrological conditions within the areas to be restored), then the noted losses would be essentially permanent.

To reduce impacts to vireos, the Corps would complete vegetation clearing activities outside of the vireo breeding season, when vireos would not be in the Project region. Project construction activities would occur near to vireos expected in action area (outside the Project footprint) during the breeding season. Additional measures to reduce or avoid impacts to vireos during the breeding season include surveys for vireos annually during construction activities, limiting construction activities to designated areas, weekly Project biological monitoring to ensure compliance, pre-construction training and surveys, BMPs for erosion and pollutants, and construction of sound walls and use of blast blankets to lessen potential noise impacts.

To help offset effects to the vireo from the proposed Project, the Corps proposes the restoration/enhancement of the noted 10.62 acres on-site and 17.92 acres of wetland and riparian vegetation offsite within Prado Basin (Corps 2023). Figure 14 shows areas reportedly available for use as mitigation for the Project (solid blue polygons). These parcels are located on Corps land and are reportedly not existing mitigation sites for other projects. The 17.92 acres of wetland/riparian vegetation to be restored/enhanced off site would be monitored and managed. Because the specific location and other details of the restoration and/or enhancement in the Prado Basin have not been provided, we are currently unable to determine the likelihood of these mitigation sites actually supporting use by the vireo following the proposed general wetland and riparian vegetation enhancement.

Coastal California Gnatcatcher

One gnatcatcher territory was detected within the total Project footprint in 2022 (within Smith Basin) (Corps 2023). Four gnatcatcher territories were detected within the Project footprint in 2020 (Corps 2022b). The differences in occupation between years likely has to do with variation in gnatcatcher habitat function during the recent extended drought that ended in 2023.

A total of approximately 1.82 acres of habitat occupied by gnatcatchers in 2022 would be permanently directly affected by the Project. In addition, a total of approximately 8.25 acres of occupied habitat would be temporarily directly affected by the Project. This same area is proposed to be replanted with coastal sage scrub vegetation once Project construction is complete.

Approximately 58.54 acres of the action area (all in and around the Santiago Basins) provide potential habitat for gnatcatchers, with some areas more suitable for the species than others based on native and exotic plant species diversity, cover, plant structure, insect fauna, time since last disturbance, etc. Gnatcatchers likely utilize territories that incorporate the highest function habitat available at the time that is effectively defensible by a gnatcatcher pair. Proposed Project vegetation clearing for construction would likely directly affect parts or all of one gnatcatcher territory, with high likelihood of displacement of this pair of gnatcatchers into nearby areas. This pair would likely attempt to remain in the Santiago Basins area and would be expected to re-establish a new territory, probably within the remaining coastal sage scrub areas in the action

area or environs that are not occupied by other gnatcatchers at that time. Since about 11 other pairs of gnatcatchers currently occupy the remainder of the Santiago Basins action area, the area adopted as a new territory by this displaced pair would likely be of lower function than the one lost, probably with reduced survival or productivity. About 47.65 acres of potential gnatcatcher habitat is expected to remain within the Santiago Basins action area during Project construction.

Once construction of the Project is completed, as currently proposed (see BIO-10), about 8.25 acres of the Project footprint would be replanted with coastal sage scrub vegetation as suitable habitat for gnatcatchers. The proposed replanted coastal sage scrub revegetation would include similar species occurring within the Santiago Basins currently (i.e., black sage scrub, California sagebrush, laurel sumac, etc.).

Potential indirect impacts from the proposed Project on gnatcatchers would occur in the areas adjacent to the Project footprint, including impacts from noise, fugitive dust, and human presence.

To reduce potential Project direct and indirect effects to gnatcatcher, the Corps would complete all vegetation removal activities outside of the breeding season (i.e., Project vegetation clearing and grubbing would not occur between February 15 to September 15 in any year). Additional Project measures to reduce impacts to gnatcatchers include the implementation of surveys for gnatcatchers in spring and early summer annually during construction, limiting construction activities to designated areas, weekly biological monitoring to ensure compliance, pre-construction training, construction of sound walls and use of blast blankets to lessen construction noise impacts, preconstruction training, BMPs for erosion and pollutants, and sensitive species monitoring throughout the duration of construction activities.

The Corps proposes that 8.25 acres of upland vegetation (including coastal sage scrub species) would be planted within the Project footprint to help offset temporary impacts gnatcatchers from the Project. The 8.25 acres of native upland vegetation to be planted within the Project footprint would be monitored and managed (weeded) annually after construction to reduce the potential for infestation by nonnative vegetation.

Replacement/restoration of gnatcatcher habitat to conditions like those of existing occupied habitat within the Project footprint typically takes about 4-8 years with appropriate soil conditions and relatively intensive restoration efforts (e.g., faster results with extensive coastal sage scrub container plantings, salvaged topsoil, regular exotic plant removal, and artificial irrigation; slower results with heavy dependence on subsoils, seeding, rainfall, and infrequent exotics removal). Gnatcatchers typically do not make extensive use of early successional stage coastal sage scrub, such as is typical of new restoration sites. If gnatcatcher habitat restoration would occur on site to replace lost gnatcatcher habitat functions and values in a timely manner, replacement of lost gnatcatcher carrying capacity in the Project footprint would likely take about 4-8 years to accomplish from initiation of restoration efforts. Thus, temporal losses would then be about 4-8 years plus the time for Project construction of approximately 2 years, for total temporal losses of about 6-10 years.

To help offset effects to gnatcatchers from the proposed Project, the Corps is also proposing the restoration/enhancement of 13.71 acres of coastal sage scrub habitat within Prado Basin, outside of the action area. Figure 14 shows parcels that are apparently available for gnatcatcher mitigation for the Project. The two separate potential parcels that are noted suitable for coastal sage scrub restoration/enhancement by the Corps; these areas total approximately 9.02 acres (solid green polygons, one large and one small; “Potential CSS Parcel”). Two additional locations outside of Prado Basin that are also reportedly suitable for Project coastal sage scrub restoration/enhancement are also shown on Figure 14 (“Offsite Area 1” and Offsite Area 2”), these parcels are approximately 32.75 acres. All the parcels are located on Corps land and are not existing mitigation areas for other projects. As proposed, the 13.71 acres of coastal sage scrub habitat to be restored/enhanced off site from the Santiago Basins would be monitored and managed according to proposed Project conservation measures. Because the specific location and other details of the restoration and/or enhancement in the Prado Basin have not been provided, we are currently unable to determine the likelihood of these mitigation sites actually supporting use by the gnatcatcher following the proposed restoration or enhancement.

Impacts to Existing Mitigation Sites

As described above, much of Smith, Blue Diamond and Bond basins are designated mitigation sites associated with previous permitting and laid out in the noted HMP. According to the HMP, City of Orange General Plan and Zoning Code designate these areas as Open Space. The Open Space land use designation was anticipated to prohibit the construction of any permanent or temporary structures on the mitigation sites. The proposed Project footprint in the Santiago Basins is located largely within the existing mitigation sites. The Corps has indicated that they will resolve any discrepancies between the proposed Project and the status of the Project site as mitigation with OCWD and the pertinent agencies (i.e., California Department of Fish and Wildlife, Regional Water Quality Control Board, Service, and Corps) prior to initiation of Project construction. We expect that resolution may result in changes to the proposed Project conservation measures, such as the mitigation ratios.

RECOMMENDATIONS

The Fish and Wildlife Coordination Act states that "...wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development projects through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation...." (16 U.S.C. 661). The proposed Project contains a number of best management practices, standard operating procedures, conservation measures, and mitigation measures to reduce the effects of the Project on biological resources. Except where noted in our recommendations below, the Service expects the noted Project mitigation and conservation measures to be integral components of the proposed Project and expects that all proposed activities would be completed consistent with those measures. We suggest incorporation of the following recommendations to improve Project planning and avoid, minimize, and compensate potential impacts to fish and wildlife resources. Consistent with the Fish and Wildlife

Coordination Act, some of the suggested measures would enhance ecological resources beyond the scope of offsetting of Project effects:

1. The Corps should fully replace any lost or degraded riparian, aquatic, and coastal sage scrub functions and values likely to result from the Project, so as to at least ensure no net loss of these resources, including temporal losses. This should include practicable compensatory measures of restoration, establishment (creation), and/or enhancement of in-kind riparian, oak woodland, coastal sage scrub, and other resources for the purpose of offsetting unavoidable adverse impacts. This should also include in-kind replacement/enhancement of sensitive species habitats that would be affected by the Project, including ensuring that specific mitigation areas are likely to support and benefit vireo or gnatcatcher with implementation of conservation measures. For example, the Project proposes offsetting temporary impacts to willow forest/woodland/scrub with restoration of riparian southern willow scrub within Smith Basin in areas that are currently open water that would be subject to Project excavation. These areas are unlikely to support willow scrub in the future, as the frequent and prolonged inundation that currently maintains them as open water would likely be increased with a lower final grade as ground level (continuing to maintain them as open water). We suggest that the elevations in Smith Basin that currently demarcate the edge between open water and willow forest/woodland/scrub be utilized for the predicted edge of proposed restoration of riparian southern willow scrub per the Project's final grade elevations within Smith Basin. Similarly, the current elevations that demarcate the edge between willow forest/woodland/scrub and upland natural communities should be utilized for the predicted edge of proposed mulefat thickets or willow scrub restoration and coastal sage scrub restoration within Smith Basin.

2. We recommend the Corps minimize impacts to existing biological mitigation sites in the Santiago Basins. While the current existence of some of these mitigation sites remains in question, much of the Smith Basin floor and slopes may be existing mitigation sites and managed open space. If these mitigation sites are extant, offsetting measures for likely adverse effects to existing mitigation resources (i.e., mitigation sites within the Project footprint) should occur at higher ratio of at least twice the otherwise appropriate ratio for the natural community/habitats to be affected than for areas that are not existing mitigation sites, due to the extra conservation value, long term protection expectations, importance afforded these sites, and the current management and quantification as compensation for impacts from other previous projects.

3. We encourage the Corps to design and implement appropriate soil covering over riprap that is compatible with the target natural communities planned for restoration/mitigation replacement over that riprap. We predict that soil coverings over riprap that include more than minor amounts of rock, cobble, or gravel would not function effectively as growing soil media for any of the Project target restoration vegetation types. We anticipate that soil coverings that are less than 4 feet deep would not function effectively as growing soil media for restoration of riparian scrub or riparian woodland/forest vegetation. We predict that soil coverings that are less than 3 feet deep would not function effectively as soil

media for restoration of coastal sage scrub vegetation. The goal of providing at least the minimum specified soil depths is to provide appropriate minimum topsoil/subsoil covering for both sufficient rooting depth of target native plants and root access for these plants to obtain adequate soil nutrients and moisture, including through predicted extended drought periods. We suggest Project conservation measures involving soil over riprap include a minimum of 3 feet of appropriate friable soil growing matrix (to be placed over slope protection armoring) for the growth of subshrubs, and a minimum soil depth of 4 feet for shrubs and riparian trees (i.e., willow and cottonwood). This recommended soil covering should have very little gravel, cobble, or rocks.

4. The Corps should not direct mitigation for Project potential biological impacts into the Lower Santiago Creek Project reach, considering the herein noted constraints in that area. Overall Project impacts to oak woodland, coastal sage scrub, and riparian natural communities should be mitigated within Santiago Basins, upstream of Santiago Basins, or other locations with both high potentials to support these natural communities and the target sensitive species and to maintain appropriate ecological connectivity. The Lower Santiago Creek area is highly constrained and ecologically isolated; these conditions greatly diminish or eliminate this area's effective mitigation potential. Compounding this is the proposed Project would essentially use all the channel right-of-way space with construction/operation of an armored trapezoidal channel, further constraining the Project footprint area. This would effectively not allow space for riparian trees, oak trees, or larger woody shrubs once constructed, based on both proposed Project channel design and Project O&M vegetation restrictions for the channel. Additionally, the proposed riprap armoring (and sheet pile in some locations) would preclude the ability to restore oak woodland in this area due to the resultant barriers to root growth of mature oaks from the riprap or riprap and sheet pile combined. The proposed substrate covering over the channel riprap armoring in this reach would be mostly rock and only 12 inches deep. This mostly rock substrate on top of riprap would preclude the ability to restore coastal sage scrub or most other types of vegetation.

5. More than 17 relatively large coast live oak and California sycamore trees occur within the Project footprint in Lower Santiago Creek portion of the Project. Project impacts to these trees and the associated 0.38 acre of oak woodland natural community in the Project footprint should be offset, including replacement in-kind of at least 10:1 per tree and minimum 2:1 coast live oak woodland creation per acre affected, with appropriate plant establishment periods. This oak woodland mitigation should be accomplished in one of the areas noted in Recommendation #9 below or within other appropriate locations in the Project region, such as disturbed open areas within Santiago Oaks Regional Park or Corps-owned lands within Prado Basin that are upland areas currently dominated by eucalyptus trees where groundwater is about 10-25 feet from the ground surface (e.g., along the south side of Prado Basin).

6. The Corps should incorporate native nectar and host plants for monarch butterflies into Project restoration and revegetation plans, where appropriate. The propagules for such plantings should be from Orange County ecotypes to the maximum extent practicable. In

addition, food plants for Crotch's bumble bee should be incorporated into such plans where appropriate, including regionally appropriate seed and plant stock of: *Chaenactis* sp., *Lupinus* sp., *Clarkis sp., Phacelia* sp., *Salvia* sp., and *Eriogonum fasciculatum.* For additional information, please see:

https://xerces.org/sites/default/files/publications/18-003_02_Monarch-Nectar-Plant-Lists-FS_web%20-%20Jessa%20Kay%20Cruz.pdf

https://www.fs.usda.gov/wildflowers/pollinators/Monarch_Butterfly/habitat/index.shtml#:~:text=Milkweed%20is%20the%20host%20plant,feed%20exclusively%20on%20milkweed%20leaves.

https://www.fws.gov/training/monarch-butterfly-conservation-webinar-series

https://www.cnps.org/gardening/gardening-for-butterflies-3106

https://lpfw.org/our-region/wildlife/crotchs-bumblebee/

7. The Corps should investigate alternative stream slope erosion control measures for the Santiago Basins portion of the proposed Project. Specifically, alternatives that potentially provide for improved restoration of riparian woodland/scrub on top of armoring should be evaluated and considered. For example, utilization of an open cell system of articulated concrete blocks that are interconnected by polyester or galvanized steel cables (product types such as Contech Armor-Flex or Shoretec Shorebloc) should be evaluated/considered as alternatives to riprap slope protection within this Project reach. These concrete block mattresses have open cells (approximately 20 percent open area) within the blocks for providing increased (albeit limited) vegetated/root growth compared to most riprap applications with otherwise similar applications of soil on top of armoring. Please see the following examples:

   https://www.conteches.com/Portals/0/Documents/Brochures/Armortec%20Bro.pdf?ver=2018-05-16-090418-283

   https://shoretec.com/wp-content/uploads/2021/01/EPEC-System-Brochure.pdf

8. The Corps should design and implement, to extent practicable and appropriate, Project stream storm flow energy dissipating structures within Santiago Creek at or above the upstream end of Smith Basin. Stream flows upstream and entering Smith Basin are likely out of "Lane's balance" due to existing artificial fluvial and stream flow changes to the creek and are thus erosive within the local floodplain and floodway, causing downcutting[17] of the streambed upstream and within Smith Basin. This is evidenced by the currently eroded slopes in the Project footprint and downcut creek bed upstream of

[17] Downcutting, also called erosional downcutting, downward erosion, or vertical erosion, is a geological process by hydraulic action that deepens the channel of a stream or valley by removing material from the stream's bed or the valley's floor.

Smith Basin. These stream-energy-dissipating structures would be ecologically designed and function to reduce the flow energy of storm flows, thereby reducing the velocity of storm flows entering the Basin, in order to prevent scour and erosion at the upstream end of Smith Basin and effectively reduce future streambed and bank/slope erosion in the area of the Basin. Reducing erosion and scour in this area of the Project should materially reduce the need for future operations and maintenance activities (e.g., periodic slope repair, Basin channel grading, such as could occur with the proposed Project) that would likely repeatedly adversely affect riparian and coastal sage scrub communities that currently (or are expected to occur in the future with revegetation/restoration) along the bank slopes and floor of Smith Basin.

9. The Corps should investigate, and implement if practicable, the acquisition of a property(ies) or conservation easements along Santiago Creek that are upstream of Smith Basin. For example, vacant former sand and gravel mining parcels downstream of Santiago Oaks Regional Park (approximately 1 mile upstream of Smith Basin) should be considered. This acquisition, possibly in partnership with OCWD or Orange County Public Works, would: (a) provide space for riparian, oak woodland, and coastal sage scrub natural community mitigation for the Project; (b) conserve and protect open space to help maintain the partially constrained wildlife linkage and connectivity for east-west wildlife movement between the Santiago Basins and expansive natural open space areas to northeast and east; (c) provide space for potential storm flow energy dissipation features upstream of Smith Basin, including Santiago Creek channel and floodplain re-widening/restoration measures; and (d) provide needed Project soil fill (borrow) material (to be excavated from the noted upstream conservation properties) for the proposed reconstruction/stabilization of the Smith Basin slopes, thus potentially reducing the Project impact footprint within the floor of Smith Basin.

10. The Corps should minimize proposed Project clearing/grading within the riparian vegetation areas occurring within the floor of Smith Basin. This would include implementing the minimum grading of the Basin floor necessary to re-direct the existing thalweg of Santiago Creek away from Basin slopes proposed for Project repair. This would also include minimizing the excavation of fill from the Basin floor to be utilized for re-building the eroded slopes of Smith Basin. As an alternative, we recommend that the Corps utilize parcel(s) upstream of Smith Basin (mentioned above) for maintaining cut and fill balance for the Project. The upstream parcel(s) could be used to provide most of the necessary fill for the Project Smith Basin slope repair work, potentially reducing the disturbance footprint within the floor of Smith Basin.

11. We recommend that the Corps incorporate Project designs that specifically include minimization of future needs for potential O&M associated with flood risk management within Smith Basin. Project designs for Smith Basin should anticipate and clearly minimize the associated needs for future O&M by OCWD or OCPW within the Basin that would potentially affect natural communities, particularly riparian scrub/woodland/forest and coastal sage scrub. A potential example of such future O&M would include re-grading of the Smith Basin floor following flood-caused scour of slopes

or invert, deposition, or considerable stream alignment changes during larger flood events. The suggested design changes would include designing maintenance roads and slope armoring (as well as the stream-energy-dissipation structures suggested above) that would provide allowance for future natural meandering (without structure or armoring damage concerns) of the Santiago Creek thalweg horizontally over time within Smith Basin. This would also include designing all pertinent Project structural features in and near riparian areas to be highly flood damage resistant, such that appreciable damage (e.g., to the Basin floor or slopes armoring) would have a very low likelihood of occurrence from associated future stream scour, erosion, or deposition during modest flow events, such as at least the 4 percent chance exceedance flood event.[18] This would include structure designs with a high likelihood of remaining undamaged if/when the thalwag of Santiago Creek does again naturally meander across Smith Basin to areas along its slopes.

12. Proposed Project vegetation clearing in vireo and gnatcatcher habitats would only occur during periods when vireo and gnatcatchers are not breeding. We recommend that the Corps require all proposed Project vegetation clearing and grubbing (not just within potential vireo or gnatcatcher habitats) only occur outside the breeding season for all native migratory and resident birds, including raptors.

13. Considering the heavily "built" environment surrounding most of the action area, and the lack of standing tree snags and suitable rock cavities within the Project region, we suggest the Corps provide artificial nesting and roosting structures for specific wildlife within the Santiago Basins to help offset temporal ecological losses associated with the proposed Project and to quickly enhance fish and wildlife resources in the area beyond offsetting mitigation. This would include providing and incorporating artificial nesting and roosting structures for local bats, owls, swifts, swallows, and other native species that would likely utilize such features in the Project region, including artificial snags and nest/roost boxes. Some of these features should be designed to remain intact for at least several decades, through the use of slowly degrading materials that are also low in potential exposure of wildlife to contaminants (e.g., avoiding the use of treated wood). Additionally, development of artificial and semi-natural rookery sites for herons and egrets within the Santiago Basins area should be considered.

14. The Corps should ensure that relocation of any burrowing owls performed as part of the Project be accomplished consistent with the current CDFW burrowing owl relocation protocol or other protocol approved by the Service. The CDFW 2012 Staff Report on Burrowing Owl Mitigation describes CDFW's comprehensive conservation and mitigation strategy for the species (CDFW 2012).

[18] The 4 percent chance exceedance flood has a 1 in 25 chance of being exceeded in any given year, or a 4 percent annual exceedance probability (Corps 2015).

15. We encourage the Corps to incorporate the use of Soft Engineering[19] and Engineering with Nature[20] into the proposed Project, including designs for slope protection/armoring, where practicable. These practices utilize ecologically compatible features and measures that are essentially self-sustaining or very low in periodic or ongoing maintenance needs. Such design practices would likely reduce future disturbances to the noted Project natural communities, such as within Smith Basin. We recommend the Corps also utilize "bioengineered"[21] slope protection practices where technologically feasible in the Project designs. Bioengineered materials can often be effective for use in floodways on eroding banks of streams (Indiana Natural Resource Commission 2021). Bioengineering integrates live plant materials with structural support to create a living system capable of stabilizing stream banks and providing erosion, sediment, and flood control (Indiana Natural Resource Commission 2021). Please see:

    https://erdc-library.erdc.dren.mil/jspui/bitstream/11681/9983/1/TR-EL-97-8-1.pdf

    https://www.wbdg.org/FFC/DOD/UFGS/UFGS%2031%2032%2039.pdf

The Service is committed to working with local communities, state and Federal agencies, Tribes, conservation groups and private sector partners to ensure they have the tools they need to protect and recover America's imperiled species. Thank you for the Corps' coordination to date regarding the subject Project, and we look forward to working with you in the future. If you have any questions regarding this report, please contact Jon Avery, Federal Projects Coordinator, at 760-431-9440, extension 309.

Sincerely,

Scott A. Sobiech
Field Supervisor

[19] Soft engineering is a bank and shore management practice that uses sustainable ecological principles to restore bank stabilization and protect riparian habitats. Soft engineering uses the strategic placement of organic materials such as vegetation, stones, sand, debris, and other structural materials to reduce erosion, enhance aesthetics, soften the land-water interface, and lower costs of ecological restoration (Corps 2006).

[20] Engineering With Nature is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaboration (https://ewn.erdc.dren.mil/).

[21] "Bioengineering" practices as related to stabilizing stream banks using natural vegetation by itself or in conjunction with stone, rock, dead vegetation structures, or organic erosion control matting. The use of the term bioengineering also refers to soil bioengineering. Soil bioengineering is a method of stabilizing soils using living and dead plant material and biodegradable manufactured products.

FIGURES

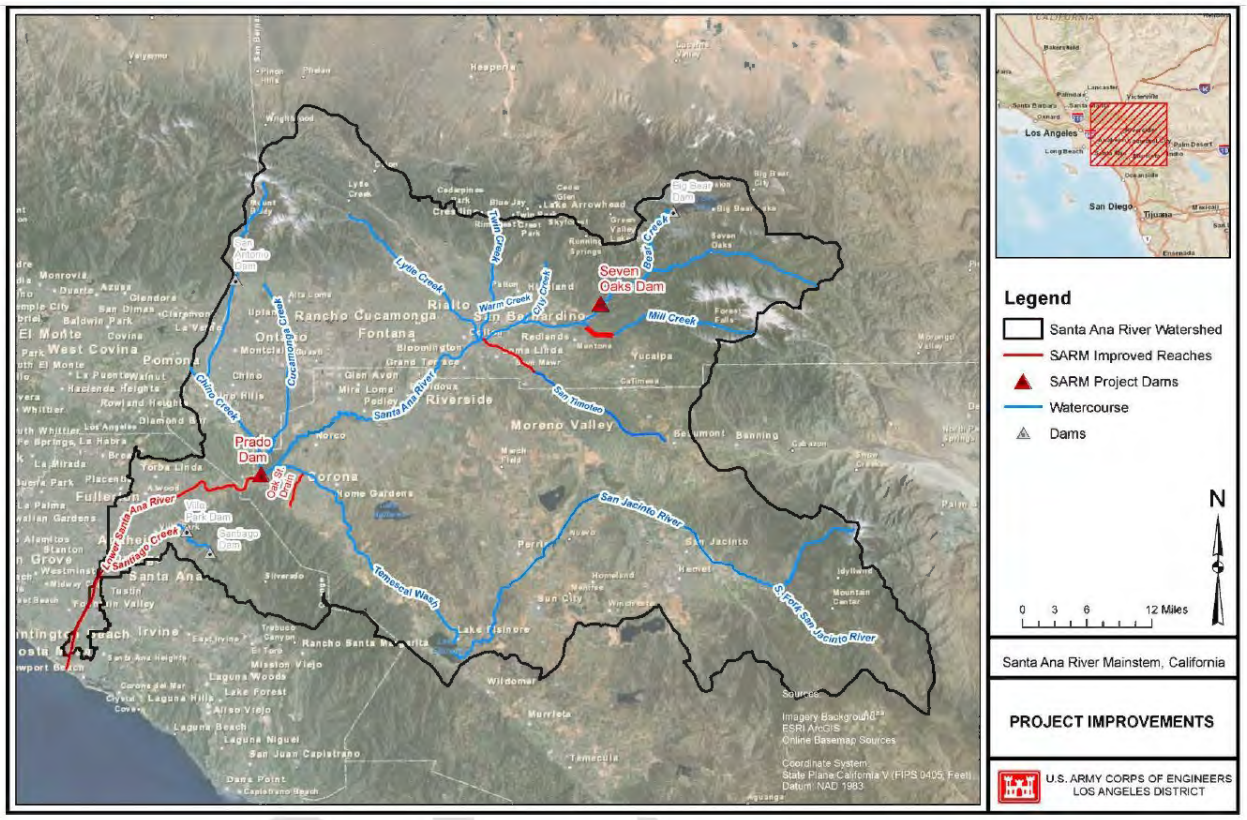


Figure 1. Project Region, Santa Ana River Mainstem Project Features, and Santa Ana River Watershed (Corps 2022a).

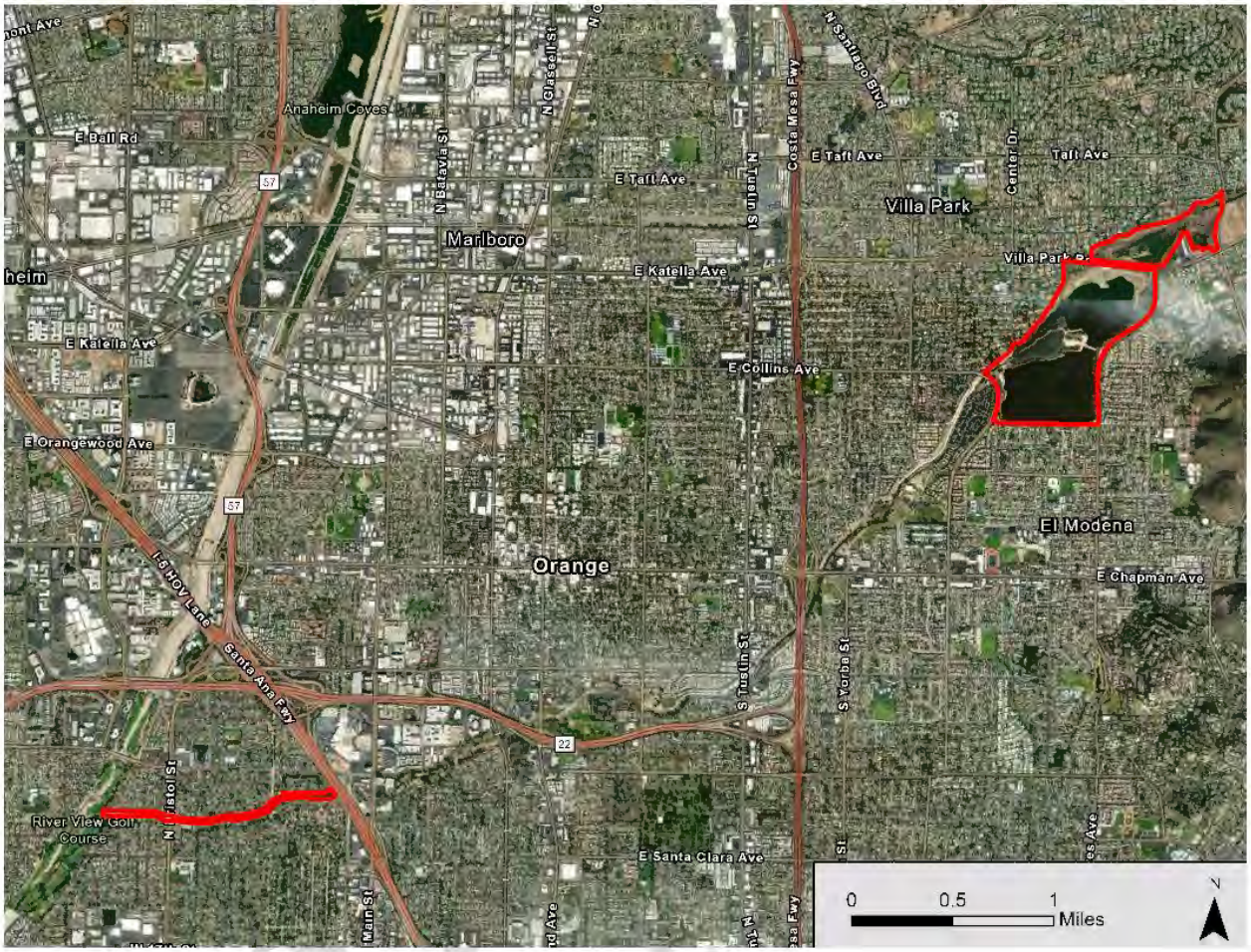


Figure 2. Project Action Area: The two zones of the action area are outlined in red (Corps 2023).



Figure 3. Action Area and Project Footprint for the Bond Basin and Blue Diamond Basin Portion of Project (Corps 2023).

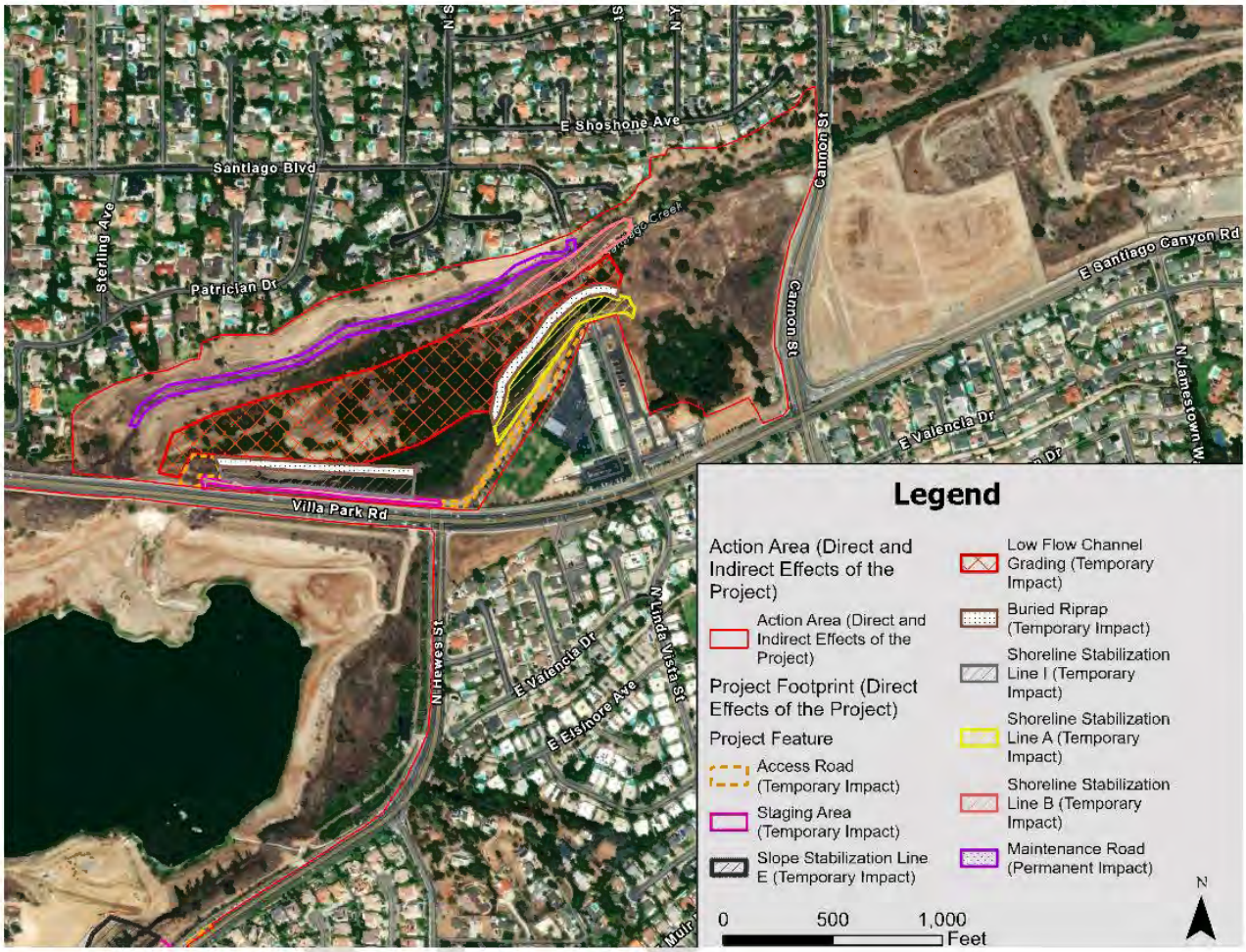


Figure 4. Action Area and Project Footprint for the Smith Basin Portion of the Project (Corps 2023).



Figure 5. Action Area and Project Footprint for the Lower Santiago Creek Portion of Project (Corps 2023).



Figure 6. Proposed Project Vegetation Restoration Areas within the Blue Diamond Basin and Bond Basin Portion of the Project (Corps 2022b).



Figure 7. Proposed Project Vegetation Restoration Areas within the Smith Basin Portion of the Project (Corps 2023).

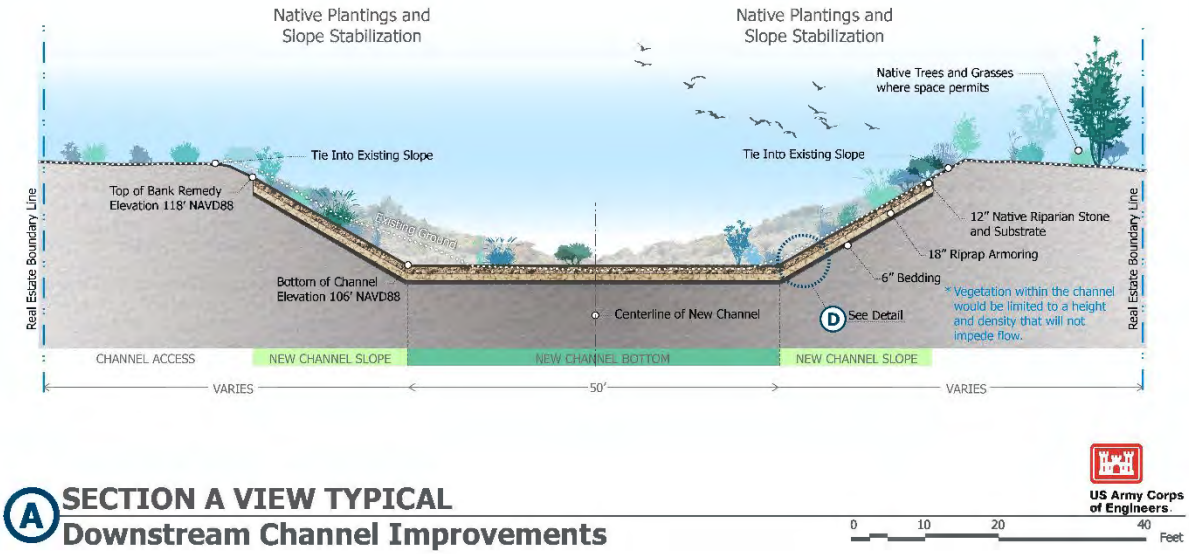


Figure 8. Lower Santiago Creek Proposed Project Channel Modifications; Proposed Alternative without New Wall on Top of Slope.

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Figure 9. Vegetation and Cover Types within the Lower Santiago Creek (Corps 2023).

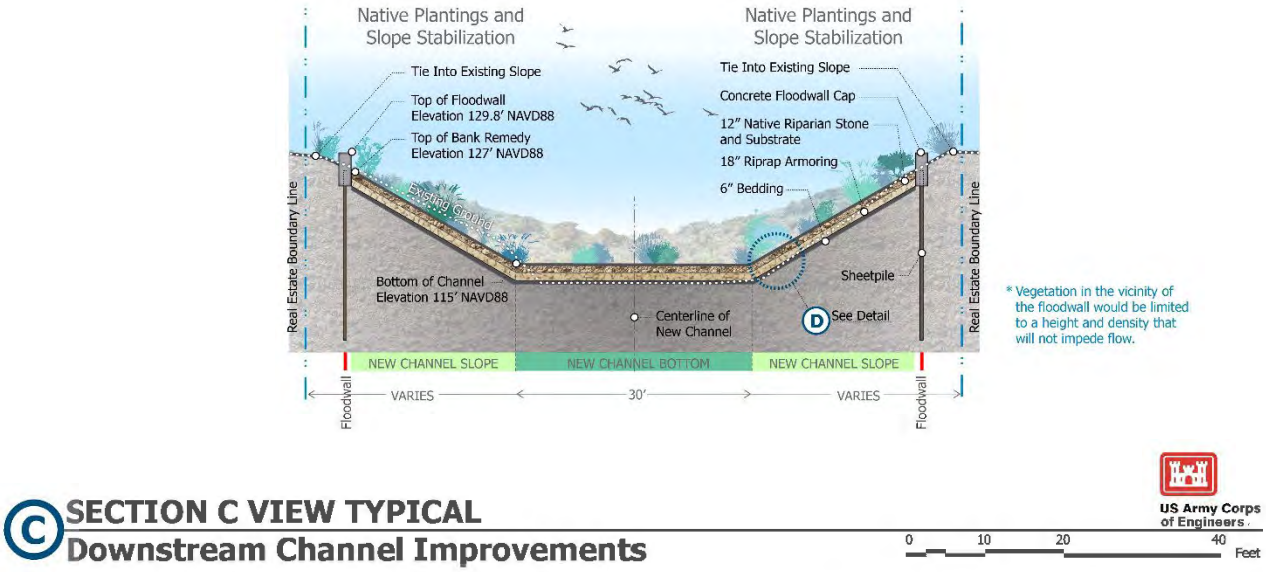


Figure 10. Lower Santiago Creek Proposed Project Channel Modifications; Proposed Alternative with New Wall on Top of Slope.

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Figure 11. Vegetation and Cover Types within Bond Basin and Blue Diamond Basin (Corps 2023)

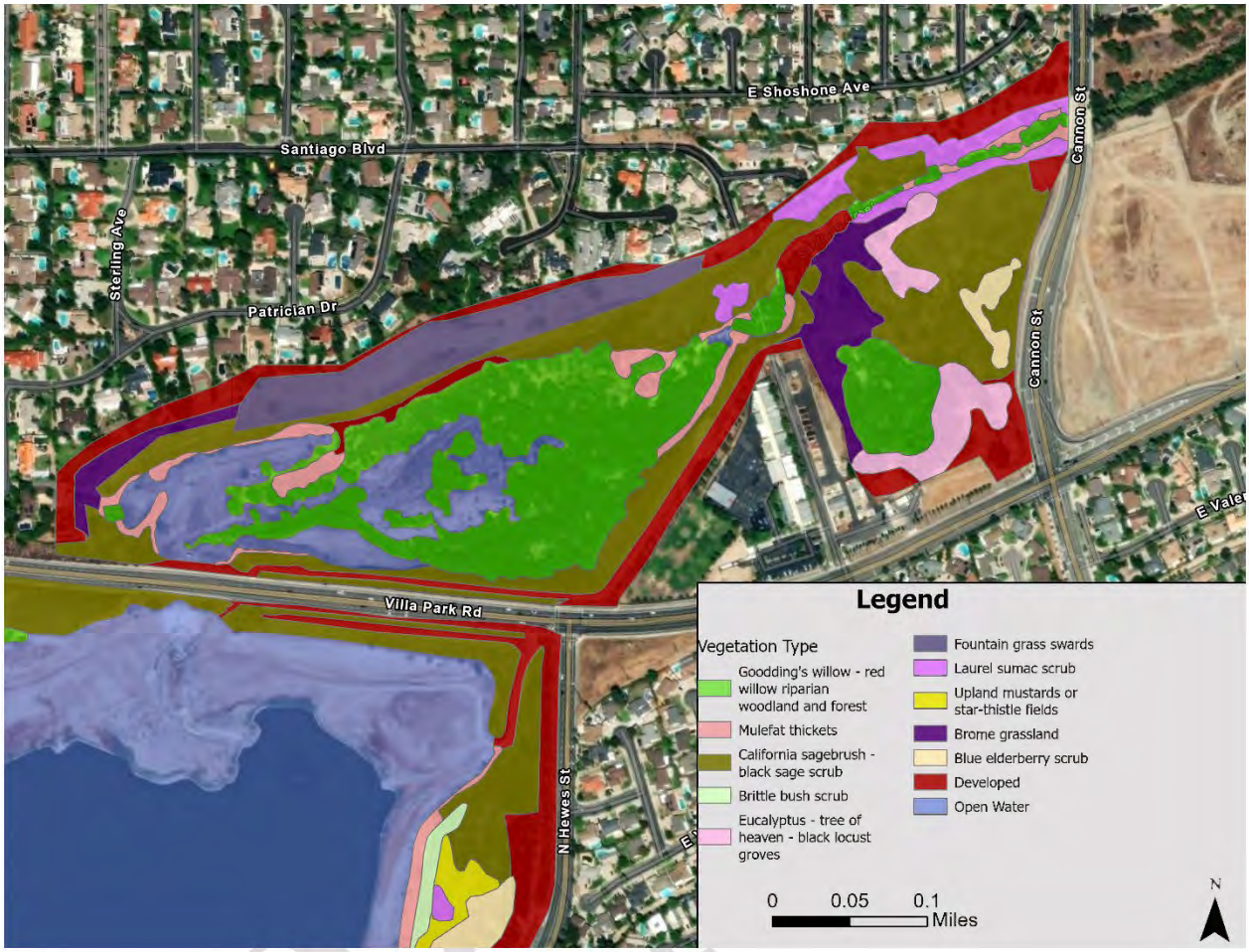


Figure 12. Vegetation and Cover Types within the Smith Basin Portion of the Project (Corps 2023).

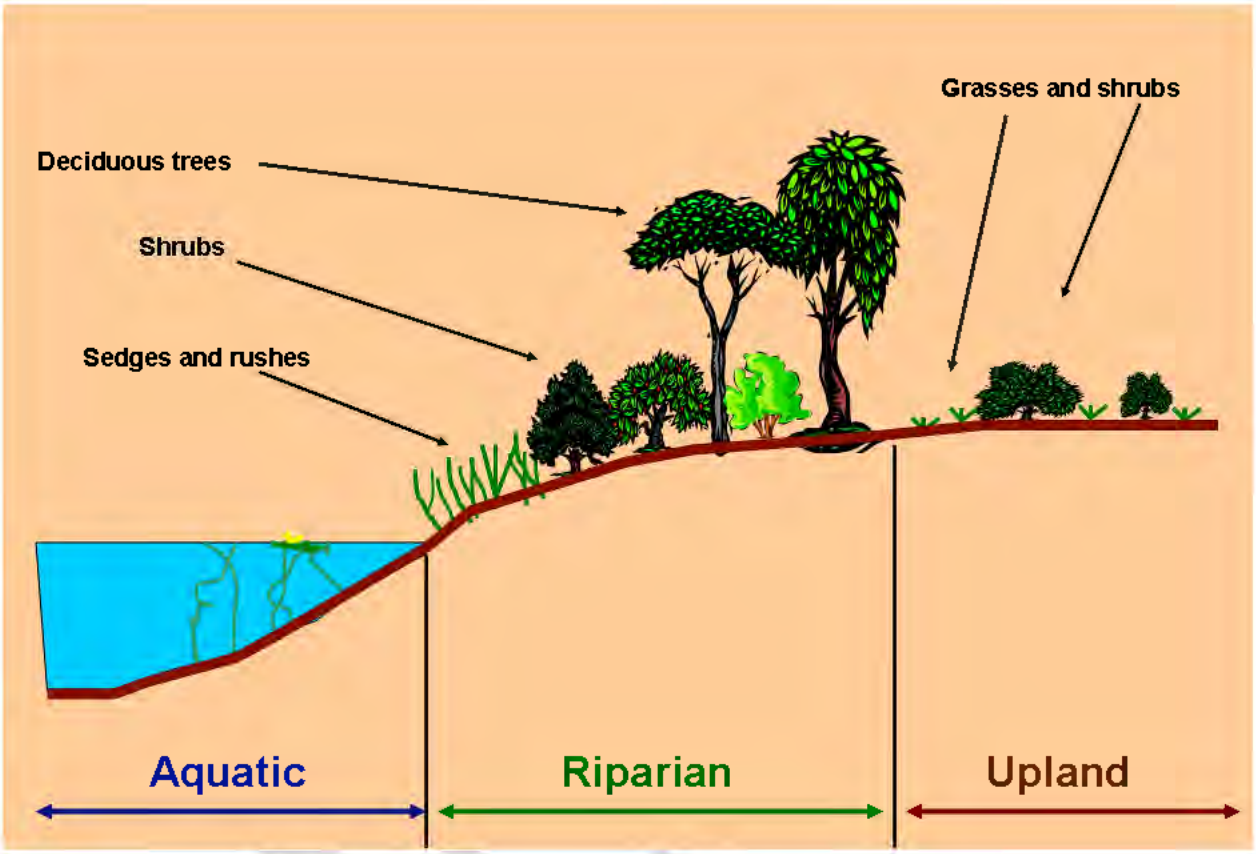


Figure 13. Delineating between typical aquatic, riparian, and upland areas (Zaimes et al. 2007)

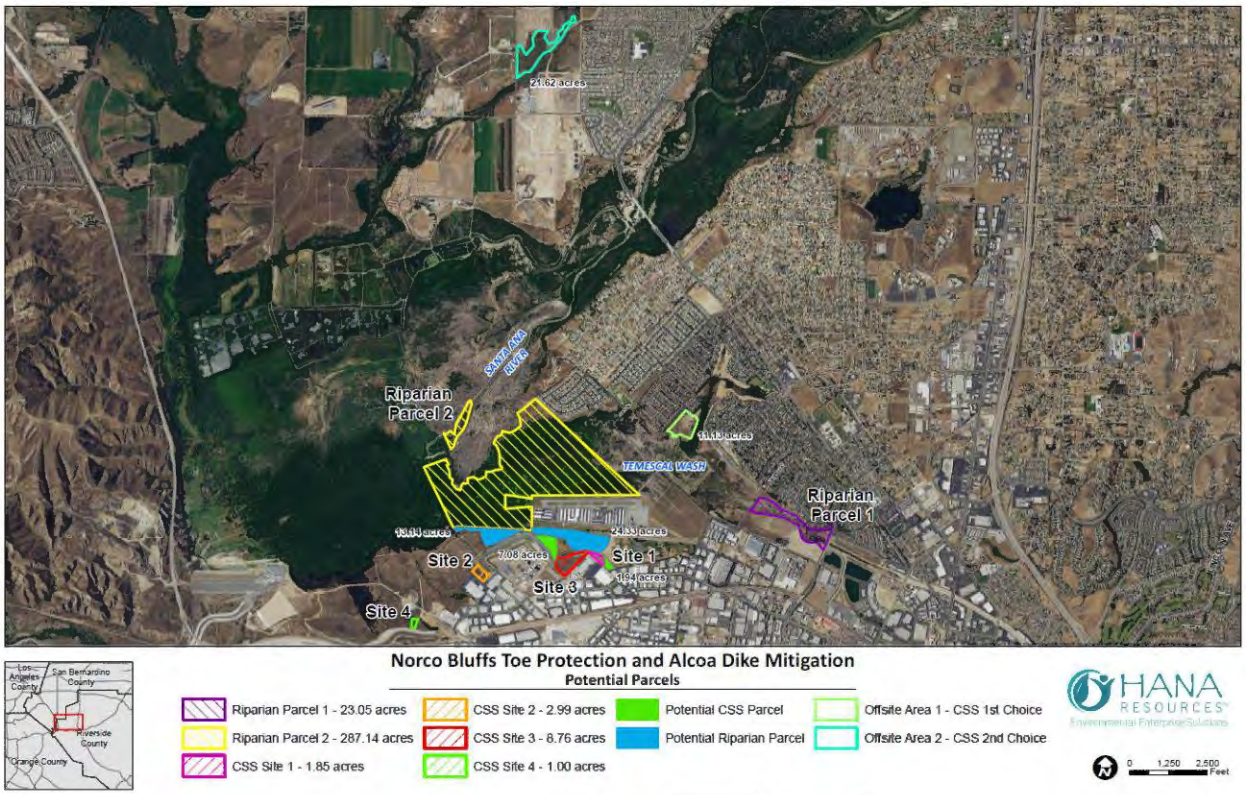


Figure 14. Existing and Potential Riparian and Coastal Sage Scrub Mitigation Sites within Prado Basin

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Appendix 8 – Agency Coordination

US Army Corps of Engineers®
CHICAGO DISTRICT
LEADERS IN CUSTOMER CARE

SANTA ANA RIVER MAINSTEM
SANTIAGO CREEK
ORANGE COUNTY, CALIFORNIA

Appendix 8 – Agency Coordination

September 2023

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SECTION 1 – USFWS FWCA COORDINATION

DEPARTMENT OF THE ARMY
U. S. ARMY CORPS OF ENGINEERS, CHICAGO DISTRICT
231 SOUTH LASALLE STREET, SUITE 1500
CHICAGO, IL 60604-1437

March 10, 2022

REPLY TO ATTENTION OF

Environmental and Cultural Resources Section
Planning Branch
Planning, Programs and Project Management Division

Reference: IPaC Consultation Code 08ECAR00-2021-SLI-0373 and 08ECAR00-2021-SLI-0374

Mr. Jon Avery, Biologist
U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250
Carlsbad, CA 92008

Dear Mr. Avery:

The Chicago District, U.S. Army Corps of Engineers (Corps) is developing a supplemental environmental assessment (SEA) for the Santiago Creek component of the Santa Ana River Mainstem Flood Risk Management Project located in Orange County, California, pursuant to the National Environmental Policy Act (NEPA). The project area encompasses the lower reach of Santiago Creek extending downstream from Interstate 5 to the confluence of Santiago Creek with the Santa Ana River. The project area also encompasses an area known as the Santiago Creek Recharge Basins, which includes the Blue Diamond Pit, Bond Pit, and the Smith Basin (seen enclosed project area maps). The project is a federal action authorized under the Water Resources Development Act (WRDA) 1986 (P.L. 99-662), Energy & Water Appropriations Act, 1988 (San Timoteo), WRDA 1990 (Santa Ana Trails), WRDA 1996 (Prado Dam, SR71), and WRDA 2007 (SARI Line).

The Corps previously consulted the USFWS in preparation of an Environmental Impact Statement in 1975, a Supplemental Environmental Impact Statement in 1980, and a Supplemental Environmental Impact Statement in 1988. The scope of the project follows the 1988 design although certain features have been eliminated as they have been implemented over the previous years by other entities than the Corps (see enclosed figure depicting design features from the 1988 design that have been previously constructed).

On June 3, 2021, Jason Zylka, Corps Ecologist met with Christine Medak, Fish and Wildlife Biologist, to discuss the SEA and understand potential concerns the USFWS may have regarding effects to fish and wildlife resources under the authority of the Fish and Wildlife Coordination Act (FWCA) of 1934 [16 U.S.C. 661 et seq.; 48 Stat. 401], as amended. During this meeting your staff expressed an interest in green infrastructure along the I-5 Channel, incorporating maintenance features into the final project design, and expressed concerns over potential sedimentation and other impacts to Smith Basin. These and any future comments or recommendations from the USFWS will be considered in the design of this project and will become a part of the administrative record.

Pursuant to the FWCA, the Corps provides for your review, a draft Scope of Work for the preparation of the Fish and Wildlife Coordination Act Report. The Scope of Work also includes a description of the authorized project in order to assist the USFWS in drafting a Fish and Wildlife Coordination Act Report that describes any conservation recommendations and best management practices that you believe will help conserve fish and wildlife resources under your jurisdiction. The Corps appreciates your coordination and assistance in the planning and development of this authorized project.

As part of the SEA, we will continue to coordinate the planning and development of this project with the USFWS in accordance with the FWCA, the NEPA and Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), as amended. We appreciate your cooperation on this matter and respectfully request a Draft Fish and Wildlife Coordination Act Report, including any conservation recommendations for fish and wildlife resources, within 60 days of receipt of this letter via email.

Should you have any questions, comments, or wish to request either an extension for response or a meeting to discuss this request, please contact Ms. Shawna Herleth-King, Regional Technical Specialist of my staff, at (312) 846-5407 or shawna.s.herleth-king@usace.army.mil.

Sincerely,

Susanne J. Davis

Susanne J. Davis, P.E.
Chief, Planning Branch
USACE, Chicago District

Copies furnished:
1) Chris Medak, Fish and Wildlife Biologist, USFWS Carlsbad Office
2) Jennifer Blackhall, Environmental Scientist, CDFW

Fish and Wildlife Coordination Act Scope of Work
Santiago Creek Component of the Santa Ana River Mainstem
Flood Risk Management Project
FY 2023

U.S. Army Corps of Engineers
Los Angeles District

U.S. Fish and Wildlife Service
Carlsbad Field Office,
Scott Sobiech, Field Supervisor
2177 Salk Avenue, Suite 250
Carlsbad, California 92008

1.0 Purpose

This Scope of Work (SOW) defines the expectations between the U.S. Corps of Engineers (Corps) and the U.S. Fish and Wildlife Service (USFWS) pursuant to coordination under the Fish and Wildlife Coordination Act (FWCA) for the Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project (SARMP), Orange County, California.

2.0 Fish and Wildlife Coordination Act

This SOW is directed at implementing coordination between the Corps and USFWS in accordance with the FWCA of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 et seq.). The Fish and Wildlife Coordination Act of 1934 included requirements that were the first formal expressions in U.S. law of a duty to minimize the negative environmental impacts of major water resource development projects and to compensate for those impacts that remained[1]. The duties imposed by the FWCA were reinforced and expanded by the National Environmental Policy Act of 1969 (NEPA)[2]. Under NEPA and its implementing regulations, all federal agencies have a duty to assess the impacts of the major actions they propose to undertake and to consider reasonable alternatives to reduce or eliminate those impacts[3]. The Service, as the federal agency charged by Congress in the Fish and Wildlife Act of 1956 with the responsibility for management, conservation, and protection of fish and wildlife resources, routinely recommends mitigation measures to other federal agencies through the NEPA and FWCA processes[4].

The FWCA directs and authorizes consultation, reporting, consideration, and installation/implementation of fish and wildlife conservation features. The authorities of the FWCA are "supplementary legislation" to the various Federal project authorizations, such as the Corps public works authorizations[5]. The FWCA conditions or supplements other water development statutes to require consideration of recommendations generated under the FWCA procedures, including portions of the Clean Water Act [*Zabel* v. *Tabb*, 430 F2d 199 (5th Cir. 1970) cert. denied 401 U.S. 910 (1972)]. For Federal water resources development projects, the general policy is that fish and wildlife conservation recommendations under the FWCA receive equal consideration by Federal agencies with other project purposes, and that such conservation

[1] Michael J. Bean (Principal Deputy Assistant Secretary for Fish and Wildlife and Parks). "Testimony Concerning the U.S. Fish and Wildlife Service Mitigation Policy, before the Senate Environment and Public Works Committee, Subcommittee on Fisheries, Water, and Wildlife." (Date: 9/21/2016). Text from: Federal Document Clearing House Congressional Testimony. Available from: https://www.fws.gov/sites/default/files/testimony/92116BeanEPW%2520MitigationTestimony.pdf
[2] Refer to 1.
[3] Refer to 1.
[4] Refer to 1
[5] Smalley, D.H. and A.J. Mueller. 2004. Water Resources Development Under the Fish and Wildlife Coordination Act. Available from: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.422.9941&rep=rep1&type=pdf

be coordinated with other project features. The FWCA authorizes the Federal project implementation of these noted means and measures for both mitigating losses of fish and wildlife resources, and for enhancing these resources beyond the offsetting of project effects[6].

3.0 Authorized Project Area

The Santiago Creek Component of SARMP (Santiago Creek project) is a joint cooperative effort between the Corps and the Orange County Public Works (OCPW) on behalf of the Orange County Flood Control District (OCFCD). The Santiago Creek project was initially authorized in the Water Resources Development Act (WRDA) 1986 (P.L. 99-662). The recommended plan for the SARMP is contained in the Phase I General Design Memorandum/Supplemental Environmental Impact Statement[7] (GDM/SEIS) and included eight elements, which were subsequently reevaluated in the Phase II GDM/SEIS[8]. The Phase II GDM/SEIS modified the SARMP by redefining the authorized SARMP features.

The project area for the Santiago Creek project consists of the lower reach of Santiago Creek extending from the Santa Ana Freeway to the creek's confluence with the Santa Ana River. The project area also consists of the reach of Santiago Creek that flows through the Santiago Recharge Basins (i.e., Blue Diamond Pit, Bond Pit, and Smith Basin) (Figure 1).

[6] Refer to 5.
[7] U.S. Army Corps of Engineers (USACE). 1980. Santa Ana River, Design Memorandum No. 1, Phase I GDM on the Santa Ana River Mainstem including Santiago Creek: Main Report and Supplemental Environmental Impact Statement. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA.
[8] U.S. Army Corps of Engineers [USACE]. 1988. Santa Ana River, Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem including Santiago Creek: Main Report & Supplemental Environmental Impact Statement. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA. 588 pp.

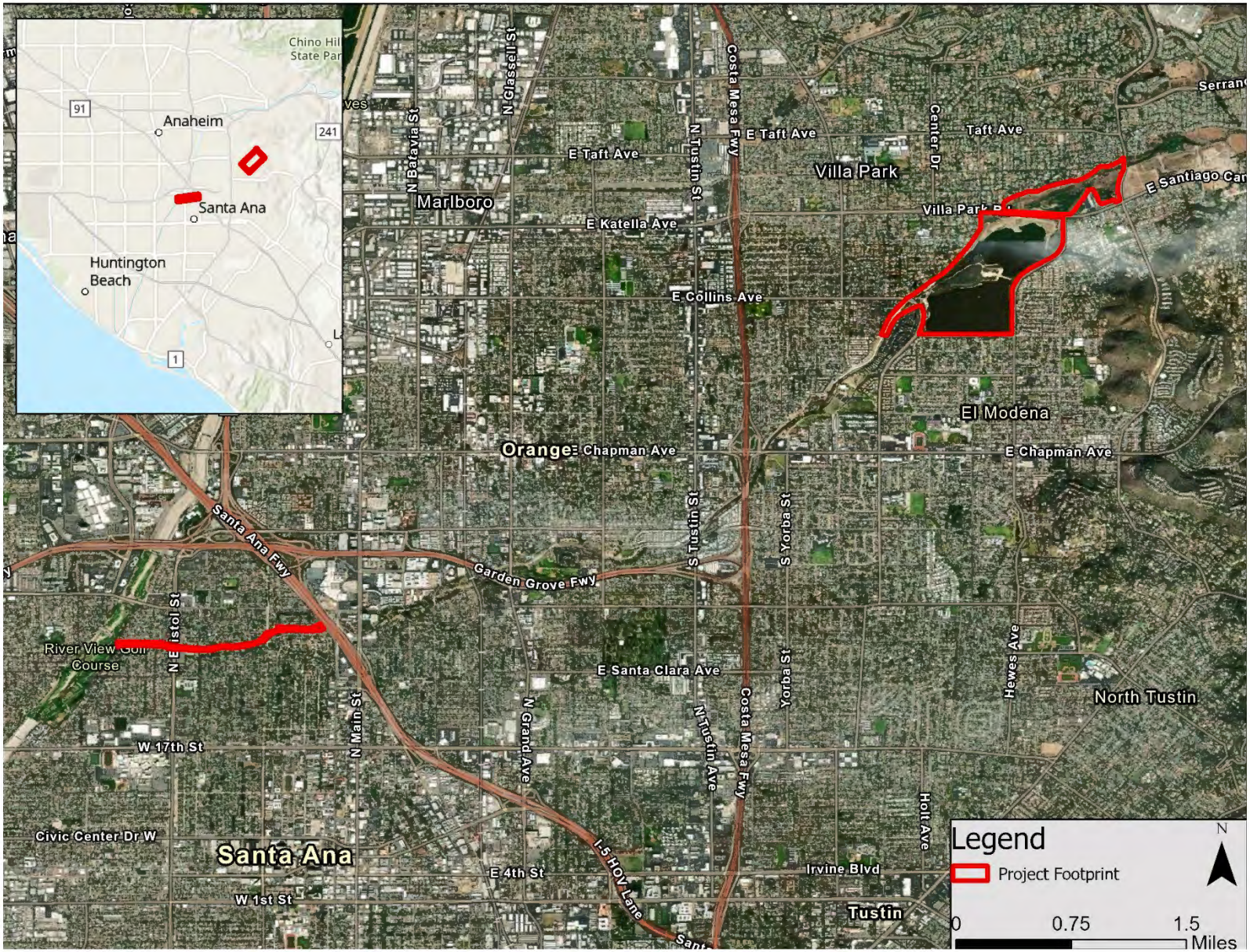


Figure 1: Project Area.

4.0 Authorized Project Objective

Consistent with the authorized plan, the congressionally authorized design objective for the Santiago Creek Project is to contain the 1% annual exceedance probability (1% AEP) flows of lower Santiago Creek within the channel and reservoir area. The construction features necessary for control of the 1% AEP were identified in the Phase II GDM[9] to be consistent with both the authorized plan and public preference.

5.0 Design Documentation Report

The Corps Chicago District has been tasked with updating the 1988 Phase II GDM[10] design and completing an Interim Design Documentation Report (DDR). The updated design will reflect changes to the project area since the refinement and project decision making by the Corps Headquarters Change Control Board (CCB). It will be used to guide a future detailed design for the Plans and Specification (P&S) phase of the project. The Corps Chicago District is developing this SOW to ensure the updated design is in compliance with the FWCA.

The DDR also includes a supplemental Environmental Assessment to the 1988 SEIS[11]. The alternatives evaluated in the SEA to the DDR include No Construction Alternative, No Change Alternative, and Proposed Action.

No Construction Alternative

The No Construction Alternative is required pursuant to NEPA, and a No Project Alternative is required for CEQA. Under the No Construction Alternative, the Corps and OCPW would not implement the flood control improvements. The No Construction alternative constitutes the future without project conditions based on all currently available data. It would serve as the environmental baseline: (1) evaluate the environmental impacts of the Proposed Action; and (2) update the 1988 SEIS by determining if any new information or conditions create additional environmental impacts not previously analyzed in the SEIS.

No Change Alternative

The No Change Alternative in this case is the previously approved design from the 1988 Phase II GDM[12]. The No Change Alternative will evaluate the previously approved design against current conditions. It would serve as the project impact baseline to compare the environmental impacts of the Proposed Action again the updated environmental impacts of the previously approved plan.

Proposed Action

The Proposed Action Alternative is synonymous with the Proposed Action. Major elements of this alternative were based off the 1988 design in the Phase II GDM[13], but were updated based on existing conditions, current design criteria, and current design practice. The following are major elements of the Proposed Action alternative:

[9] Refer to 8.
[10] Refer to 8.
[11] Refer to 8.
[12] Refer to 8.
[13] Refer to 8.

Reservoir Slope Stabilization - The existing slopes of the reservoir require repair. To increase the water elevation in the reservoir and permit rapid drawdown in advance of flood conditions, several locations have been identified along the reservoir which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H):1 Vertical (V), installation of retaining walls, or installation of armoring.

Channel Improvements - Flow velocities within Santiago Creek are erosive during large storm events (approximately 9-13 feet per second during the 1% AEP), potentially compromising adjacent properties along the highly urbanized floodway. To rehabilitate and improve the creek, the Proposed Action will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will be buried with native substrate to (i) enhance access for ongoing operation and maintenance, (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) anticipate local interests and concerns; (iv) improve recreational opportunities; and (v) enhance environmental integrity of the stream corridor. The Proposed Action will involve excavating surficial material from the channel bottom and installing the buried riprap. Surficial substrate overlying the riprap layer will maintain the channel's natural appearance and allow for establishment of native, ecologically desirable vegetation. A channel operation and maintenance program will be necessary to prevent invasive vegetation, large woody growth, debris, and other flow inhibiting concerns from re-establishing within the channel. The proposed stream stabilization measure includes 6,400-feet of trapezoidal channel armored with buried riprap. The proposed cross section includes a gravel bedding layer, riprap armor layer, and surficial substrate layer. The channel invert width varies from 30-feet to 80-feet, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitations and will be installed to a slope of 1.75H:1V.

The removal of trees in the downstream channel right-of-way would impact resident views and habitat. To off-set the impacts, native vegetation would be established along the top of the bank and side slopes of the Santiago Creek channel. Native plantings would consist of container plantings and hydroseed, drip irrigation would be installed for approximately 2 to 3 years to allow plant establishment, and ongoing maintenance of the native plants would be carried out in perpetuity by the local sponsor, OCPW.

Floodwalls – Floodwalls may be required in select locations along Santiago Creek under the Proposed Action. Additional analysis is currently underway to determine if floodwalls are necessary, where they are needed, and their design. As details of the floodwalls are developed this information will be provided to USFWS.

In summary, Table 1 shows a comparison between the No Change Alternative and the Proposed Action.

Table 1: Differences between the No Change Alternative and the Proposed Action Alternative

No Change Alternative	**Proposed Action Alternative**	**Difference**
Project Features		
Reservoir Flow Regulation <u>*Outlet Structure*</u> -Construction of gated outlet structure at Prospect Street (southwest corner of Santiago Recharge Basins) to provide outflow regulation. -Outlet structure controlled and regulated so that peak	**Reservoir Flow Regulation** <u>*Outlet Structure*</u> -The outlet structure will no longer be constructed.	**Reservoir Flow Regulation** <u>*Outlet Structure*</u> -The outlet structure, that was part of the Previously Approved Design will no longer be constructed under the Proposed Action Alternative.

discharge does not exceed 3,500 cubic feet per second (ft^3/s) during the 100-year design flood. *Overflow Structure* -Grouted riprap overflow structure located along the left bank of the existing channel of Santiago Creek upstream of Prospect Street. Overflow structure will provide 2-feet (ft) of freeboard for the design flood. *Outlet Channel* -Rectangular concrete box culvert under Prospect Street. Downstream of box culvert 300-ft-long concrete transition channel. Downstream of the transition, a trapezoidal riprap channel for 4,000 ft (stopping near Walnut Avenue).	*Overflow Structure* -The overflow structure will no longer be constructed. *Outlet Channel* -The outlet channel will no longer be constructed.	*Overflow Structure* -The overflow structure that was part of the Previously Approved Design will no longer be constructed under the Proposed Action Alternative. *Outlet Channel* -The outlet channel that was part of the Previously Approved Design will no longer be constructed under the Proposed Action Alternative.
Reservoir Slope Stabilization -Smith Basin – Santiago Road (North) for 1,000-ft compacted buttress fill 2 Horizontal (H) :1 Vertical (V) -Smith Basin – Santiago Road (South) for 500-ft compacted buttress fill at 2H:1V -Santiago Creek Interconnecting Channel for 500-ft excavated trapezoidal channel -Saddle Area Interconnecting Channel for 500-ft excavated trapezoidal channel -Blue Diamond Pit – Hewes Avenue for 300-ft excavated and compacted buttress fill 2H:1V -Bond Pit – Hewes Avenue for 1,400 ft excavation and compacted fill with tie back wall and buttress slope at 2H:1V	**Reservoir Slope Stabilization** -Smith Basin – Santiago Road (North) for 1,000-ft compacted buttress fill at 3.5H:1V -Smith Basin – Santiago Road (South) for 500-ft compacted buttress fill at 2H:1V -Blue Diamond Pit – Hewes Avenue for 300-ft excavation and compacted fill at 2H:1V -Bond Pit – Hewes Avenue for 1,400 ft excavation and compacted fill with tie back wall and buttress slope at 2H:1V -Bond Pit – Prospect Street for 400-ft excavation and compacted fill at 2H:1V -Smith Basin – Villa Park Road for 750 ft excavation and compacted fill at 2H:1V	**Reservoir Slope Stabilization** -The No Change Alternative included 6,300 linear ft of reservoir slope stabilization. -The Proposed Action Alternative includes 4,350 linear ft of reservoir slope stabilization (decrease of 1,950 linear ft)

-Bond Pit – Bond Avenue for 1,700 ft excavation and compacted buttress fill at 3H:1V along with 10-ft gabion retaining wall and tie back wall -Bond Pit – Prospect Street for 400-ft excavation and compacted buttress fill at 2H:1V.		
Channel Improvements -Downstream of the Santa Ana Freeway to confluence of Santiago Creek with the Santa Ana River a 6,400 ft long riprap trapezoidal channel. -Construction of 24-inch thick, 50-ft-long grouted rock apron placed 10 ft below the design invert of the mainstem at the confluence of Santiago Creek with the Santa Ana River.	**Channel Improvements** -Downstream of the Santa Ana Freeway to confluence of Santiago Creek with the Santa Ana River install buried riprap along full downstream channel extent. Riprap will be buried with native substrates and drought resistant vegetation will be installed along the channel banks.	**Channel Improvements** -The Proposed Action Alternative includes the same amount of linear feet of channel (6,400), but design has changed to an 'engineering with nature' design. -The Proposed Action Alternative does not include construction of a rock apron at confluence (already constructed).
Recreational Features -Bicycle, hiking, and jogging trail running upstream from Walnut Avenue to Prospect Street on the maintenance access road. -Trail rest area developed on the west side of Hewes Road directly adjacent to an as yet unnamed County Regional Park.	**Recreational Features** -The recreational features will no longer be constructed.	**Recreational Features** -The Proposed Action Alternative does not include bicycle/hiking/jogging trail (already constructed). -The Proposed Action Alternative does not include trail rest area (regional park never constructed)
Floodwalls -No floodwalls were included under the No Change Alternative.	**Floodwalls** -Floodwalls would need to be constructed in specific areas within the downstream channel of Santiago Creek due to the Reservoir Flow Regulation features no longer being constructed under the Proposed Action Alternative.	**Floodwalls** -Floodwalls, which were not part of the No Change Alternative, are now included under the Proposed Action due to Reservoir Flow Regulation features no longer being constructed. -Engineering is still determining the exact location and extent of floodwalls, but they would generally be located in the downstream channel of Santiago Creek that is part of the Channel Improvements area.

6.0 USFWS and Corps tasks to be Completed under the Fish and Wildlife Coordination Act

Coordination
The USFWS and Corps will coordinate pursuant to the FWCA. The California Department of Fish and Wildlife (CDFW) and other agencies will be included as appropriate regarding the Santiago Creek project.

Environmental Coordination Meetings
The Corps shall facilitate meetings with USFWS, CDFW, and other agencies as appropriate for the purpose of exchanging information, identifying concerns and potential impacts to fish and wildlife resources, and resolving fish and wildlife resource issues related to the Santiago Creek project and document these interactions for use in the Coordination Act Report (CAR) and in the final Design Documentation Report and Environmental Document for the Santiago Creek project.

Draft and Final Coordination Act Report
The USFWS with assistance from the Corps shall prepare a Draft and Final CAR that describes project related opportunities and constraints regarding fish and wildlife resources (including listed species), potential modifications, potential impacts of the authorized project and other alternatives on fish and wildlife, measures to avoid, minimize, and mitigate these impacts, and any opportunities for enhancement of fish and wildlife resources that consider the Corps' authorized project purpose for the Santiago Creek project (i.e., flood risk management). The FWCA report will become a part of the Santiago Creek Supplemental Environmental Assessment. The Final CAR will address the above items for the Draft CAR and comments received from the Corps.

Based on the current schedule, it is anticipated that the Corps will define the final array of alternatives that will be included in the Draft Supplemental Environmental Assessment/Environmental Impact Report by October 31, 2022. In order to have time to integrate USFWS recommendations into the project description and impact analysis prior to completing the Public Draft document, the Corps requests a Draft CAR within 60 days after a written description of the alternatives is provided to the USFWS. A Final CAR is requested within 30 days after Corps comments have been provided on the Draft CAR. All due dates and timelines are subject to change in coordination with the USFWS.

7.0 Dissemination of Data

All data, reports, and materials related to this SOW are and will be the property of the Corps. The USFWS shall not release any material of any nature obtained or prepared under this SOW to any environmental organization or other federal, state, or local government agency without prior contact and written approval of the Corps. The Corps understands that the USFWS retains the authority to publish the results of this work and use it in connection with related work (e.g., scientific presentations and journals, part of larger regional analyses).

8.0 Other Requirements

The USFWS shall not depart from or perform beyond the SOW and the criteria on which it is based without the written direction of the Corps.

The USFWS shall not enter any subcontracts without prior approval of the Corps.

9.0 Exchange of Information

A. The Corps shall provide the USFWS with necessary information, including engineering drawings for alternatives and the preferred plan, conceptual plans, maps, aerial photographs, environmental and biological reports on related projects, and any other support documents that are available, including the most recent biological baseline report.

B. The draft and final CAR will be submitted electronically in Microsoft Word and PDF formats to the Corps Environmental Coordinator/Biologist.

C. The USFWS shall submit the Draft CAR to the Corps within 60 calendar days after the Corps provides details on the project alternatives and all other supporting information. The USFWS shall provide the Final CAR within 30 days of receipt of the Corps' comments on the Draft CAR. The USFWS will acknowledge receipt of the supporting materials from the Corps by letter or email message.

10.0 Points of Contact

Name	Phone	Email
U.S. Army Corps of Engineers:		
Shawna Herleth-King	312-846-5407	shawna.s.herleth-king@usace.army.mil
Michael Padilla	(312) 846-5427	Michael.C.Padilla@usace.army.mil
Tiffany Bostwick	(213) 328-8104	Tiffany.R.Bostwick@usace.army.mil
U.S. Fish and Wildlife Service:		
Jon Avery	760-431-9440 x309	jon_avery@fws.gov
Financial Point of Contact (USFWS)		
Ihyns Tumaliuan		ihyns_tumaliuan@fws.gov

11.0 Reimbursable Fund Agreement

It is understood that all work will be accomplished during FY2023. If the Corps cannot perform its responsibilities under this SOW by September 30, 2023, a new funding agreement will be reached whenever the work is reinitiated.

If the USFWS cannot or does not perform its responsibilities under this SOW by fiscal year 2023, USFWS should be aware that the Corps reserves the right to de-obligate funds transferred under this SOW to perform these tasks.

12.0 Payment for Work and Services

Project funding of $**25,230.26** is provided for fiscal year 2023 to cover USFWS involvement for this SOW (see detailed budget [attached]).

SUBMITTED:

_____
Tiffany Bostwick
Chief, Environmental Resources Branch
U.S. Army Corps of Engineers
Los Angeles District

ACCEPTED:

_____
Scott Sobiech
Field Supervisor
U.S. Fish and Wildlife Service
Carlsbad Field Office

Government Estimate

Task	USFWS (days)
Meetings with Corps and CDFW, as needed, for preparation of Draft Fish and Wildlife CAR	2
Draft Fish and Wildlife CAR	12
Meetings with Corps and CDFW, as needed, for preparation of the Final Fish and Wildlife CAR	1
Prepare Final Fish and Wildlife CAR	5
Total Number of Days	**20**
Cost (Daily rate of $914.14/day)	$ 18,282.80
Overhead (38% of total cost)	$6,947.46
Total Cost	**$25,230.26**

SECTION 2 – USFWS SECTION 7 CONSULTATION

Herleth-King, Shawna S CIV USARMY CELRC (USA)

From: Roberts, Carol <carol_a_roberts@fws.gov>
Sent: Wednesday, April 5, 2023 7:50 PM
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Cc: Hoxsie, Alex R CIV USARMY CELRC (USA); Padilla, Michael C CIV USARMY CELRC (USA); Medak, Christine; Avery, Jon
Subject: [Non-DoD Source] Santiago Creek - Agency Coordination Meeting Today and ESA consultation
Attachments: Prado_Basin_Hydroseed_Monthly_Report_2013-10.docx; Attachment E_HydroseedAreas_sm.pdf; 08B0408-13F0036_OR_Final Santa Ana River Reach 9 Phase 3 Project_s20130207_kag_with Highlights.pdf

In reply refer to:
23-0019344-S7-TA-OR

Shawna,

I was able to determine where things were on the consultation thanks to an e-mail exchange I had with Chris prior to her departure. I apologize that I was not able to recall the details on our call today. We have reviewed your letter, dated February 24, 2023, and draft biological evaluation (BE), dated February 2023, addressing information we requested in our December 21, 2022, response to your request to initiate formal consultation on the Santa Ana River Mainstem (SARP), Santiago Creek Flood Risk Management Project (Project) and its effects on the federally endangered least Bell's vireo (*Vireo bellii pusillus*; vireo) and threatened coastal California gnatcatcher (*Polioptila californica californica*; gnatcatcher). The information provided includes the minimum necessary to initiate consultation as outlined in the regulations governing interagency consultation (50 CFR 402.14). However, to assist us in determining the full extent of direct and indirect effects to be considered in the biological opinion for this action, we request additional information, as described below:

Future Maintenance
Anticipated future maintenance activities are discussed in the BE, Section 1.5.3 (page F-21). The Corps intends to prepare a manual for the local sponsor that identifies how maintenance must occur (BE, page F-15). There is currently no analysis of the potential effects to species associated with the anticipated future maintenance activities in the BE, Section 3. Please clarify the potential effects to vireo and gnatcatcher from maintenance of proposed structures. Please see attached consultation on Reach 9 Phase 3 of the SARP for an example of how maintenance of structures was addressed in a past consultation (highlighted sections). In that consultation, no habitat for species was anticipated to be supported in areas that would require future maintenance; however, measures proposed as part of the consultation were anticipated to be implemented during maintenance and would minimize the potential for noise-related effects to species.

Impacts to existing mitigation sites
The issue as to whether the proposed project will impact existing mitigation sites has not yet been resolved. It appears proposed measures to offset impacts to habitat do not account for impacts to existing mitigation sites. We request the Corps clarifies if it is proposing to change the status of mitigation sites within the proposed Project footprint prior to initiation of project impacts. Alternatively, measures to offset impacts to habitat should address the existing status of mitigation sites.

Proposed Habitat Restoration

We understand that some of the measures in prior SARP consultations are not appropriate for this project, but we are concerned that proposed measures offset permanent and temporary losses to wetland, and riparian, and upland habitats are not consistent with the original intent of the 2001 biological opinion and 2012 amendment for the SARP. In particular, we are concerned that the distinction between habitat creation and removal of invasive species, appears to have been lost by substituting "restoration" in proposed measures (e.g., BIO 8). In addition, one of the proposed restoration sites included in BE (Figure 26, green Potential CSS Parcel) was previously restored as part of the Sewage Treatment Plant component of the SARP but was impacted by Corps operations. This area was anticipated to be restored to offset those impacts (see attached hydroseed monthly report, Hydroseed Area 3 and associated Hydroseed Areas figure). We would appreciate the opportunity to further discuss measures to fully offset project-related impacts to vireo and gnatcatcher.

The formal consultation process for this Project was initiated upon receipt of your response letter on February 24, 2023. As a reminder, the Act requires that after initiation of formal consultation, the Federal action agency make no irreversible or irretrievable commitment of resources that limits future options. This practice ensures that agency actions do not preclude the formulation or implementation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

If you have any questions regarding this message, please contact me or Christine Medak of this office at christine_medak@fws.gov.
Thank you,

-Carol (she, her, hers)
The Endangered Species Act is turning 50! https://www.fws.gov/esa50

Carol A. Roberts, Division Supervisor
Environmental Contaminants/Federal Projects/ESA Sec 7 & 10
Collateral Duty Safety Officer
Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250, Carlsbad, CA 92008
760-431-9440, ext. 271
Mobile phone including spill emergencies: 760-607-9768

DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, CORPS OF ENGINEERS
231 SOUTH LASALLE STREET, SUITE 1500
CHICAGO, IL 60604

February 24, 2023

Planning Branch

Scott Sobiech
Field Supervisor
U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
2177 Salk Avenue
Carlsbad, CA 92008

Dear Mr. Sobiech:

On December 21, 2022, we received the U.S. Fish and Wildlife Service's (the Service's) request for additional information for the Santa Ana River Mainstem, Santiago Creek Flood Risk Management Project, Orange County, California. The Service noted in the letter that the Biological Assessment (BA) for the project, dated December 2022, did not include all the information necessary to initiate formal consultation for the vireo and gnatcatcher as outlined in the regulations governing interagency consultation (50 CFR 402.14). However, the letter stated that providing the requested information or a statement explaining why the information cannot be made available would begin the formal consultation process.

Therefore, the Corps is providing the additional information that was requested by the Service in the letter dated December 21, 2022. Please see below for the Corps' responses to the Service's additional information request:

1. Description of the action

a. Project Footprint – The December 2022 BA described the action area as the area where direct effects could occur and the project footprint as the area where indirect effects could occur. Based on discussions held during the meeting on December 19, 2022, the Service noted that the terms should be switched. This means that the action area should be the area where indirect and direct effects could occur, and the project footprint should be the areas where direct effects could occur. This has been corrected in the BA, and in particular figures 4 through 6.

b. Reservoir Slope Stabilization

i. The Corps has revised figures 5 and 6 in the BA to show the location of hard structure areas within the slope stabilization features. These figures were shared with the Service during a meeting on January 18, 2023, and ArcPro shapefiles were shared with the Service on January 18 and January 25, 2023. During the meeting on January 18 and January 30, the Corps discussed how

there would only be permanent impacts to vegetation where the two concrete tie-back walls are located in the Blue Diamond and Bond Basins and the rehabilitated maintenance road within Smith Basin. These two features combined would permanently impact 2.08 acres of habitat (i.e., approximately 19.5 acres in Smith Basin and 0.13 acre in Blue Diamond and Bond Basins). In addition to the rehabbed maintenance road, two of the three slope stabilization features in Smith Basin would have riprap buried at the toe of the slope and extending up the side of the slope 40 – 45 feet. As noted, this riprap would be buried by approximately two (2) feet of soil that would be conducive for revegetating with native riparian species such as mulefat which has a root depth of approximately 12 inches (https://sagebud.com/mule-fat-baccharis-salicifolia). As a note, the depth to groundwater in Smith Basin is approximately 20 feet (see Attachment 1). In addition, during the January 30 meeting with the Service, Jenni Snibbe (biologist with the Corps) stated that she has observed mulefat establishing on buried riprap covered with only approximately 18 inches of soil within the Corps' Murrietta Creek project (documents provided to the Service on February 14, 2023). Regardless, since the existing vegetation type of Goodding's Willow - Red Willow Riparian Woodland and Forest cannot be reestablished on the buried riprap, the acreage of buried riprap that is currently classified as Goodding's Willow – Red Willow Riparian Woodland and Forest vegetation type has been included as a permanent impact (i.e., 1.29 acres; refer to revised Table 3 in the BA).

The BA has also been updated to include two figures showing where native vegetation will be replanted in the project footprint and the type of native vegetation. Refer to figures 10 and 11 in the BA.

ii. During the meeting held on May 27, 2022, the Corps discussed with the Service the plan to include components of the Smith Basin Rehabilitation project, originally intended to be carried out by Orange County Water District, as part of the Santiago Creek FRM project. OCWD did prepare a draft initial study/mitigated negative declaration for the Smith Basin Rehabilitation project (refer to Attachment 2). During the meeting held on July 15, 2022, the Corps stated (in attached meeting notes [Attachment 3] that were provided to the Service) that the Smith Basin component of the project would include some minor regrading of the Santiago Creek channel – the grading of an approximately 1-foot depression roughly through the middle of Smith Basin. The Corps noted that the graded-out depression would not include stream veins or stream training structures (as proposed in OCWD's Initial Study/MND for the Smith Basin Rehabilitation Project). The intent of the minor grading is to move Santiago Creek to the north so that the slope stabilization work on the south side of Smith Basin can occur. Currently, Santiago Creek flows head on into two of the slopes that are being undercut and need stabilization. Figure 6 in the BA has been revised to differentiate between where grading would occur to realign Santiago Creek and slope stabilization activities. Cross-sections were also provided to the Service on February 13, 2023. Although the Service requested a topographic map of Smith

Basin after project construction, this is not required to be part of the formal consultation initiation package under 50 CFR 402.14.

c. Future Maintenance – The Corps disagrees that during the meeting on December 19, 2022, we "indicated that certain areas in Smith Basin (e.g., hardened slope) may be limited to certain vegetation types (i.e., require ongoing vegetation clearing)." Per the notes of the December 19 meeting, which were provided to the Service, the Corps noted that the toes of two slopes within Smith Basin would be hardened; however, we also stated that we do plan on revegetating to some degree the toe of these slopes. It is correct that the toe of the slopes would likely be limited to certain vegetation types, as the Service has even indicated. It's been noted by the Service that the hardened slope toes may not be able to have large woody trees growing on top, because of the soil depth over the riprap; but the hardened slope toes can likely have some type of vegetation planted (e.g., mulefat thicket possibly) (Refer to Attachment 4).

The Corps would not have authority over the project once it is constructed, as the responsibility of maintaining the project would be handed over to the non-federal sponsor, Orange County Public Works (OCPW). When the project is handed over to OCPW, an Operations and Maintenance Manual will be provided to OCPW. The maintenance activities that were listed in the BA are consistent with maintenance activities in other Corps BA's for similar projects (e.g., Santa Ana River Mainstem Project: Lower Norco Bluffs Toe Protection and Prado Dam Spillway Raise and Dam Safety Modifications). There is no "ongoing vegetation clearing" that would be required by the Corps as part of operation and maintenance of the project within the Santiago Recharge Basins. It was noted in the December 2022 BA that "rarely, following large and erosive flood flows, larger-scale maintenance and repairs may be required along the slopes of the Santiago Recharge Basins, which could require access and use of heavy equipment within the floodplain adjacent to the structure. Equipment needed for potential larger-scale repairs would use the maintenance roads within the basins to access repair sites. A temporary work area may need to be established around repair sites. The local sponsor would be required to obtain emergency or standard permits from regulatory agencies, including Corps Regulatory, who would coordinate and consult, if needed, with the USFWS."

2. Impacts to Existing Mitigation Sites – The Corps cannot provide at this a time a solid conclusion as to whether the Habitat Management Plan (HMP) will be updated by Orange County Water District (OCWD); therefore, this information cannot be made available to the Service at this time. However, a call was held on February 9, 2023, between Corps Regulatory, Corps Planning, the Service, and OCWD to discuss a potential addendum to the HMP. During the meeting it was alluded to that OCWD may have already satisfied their mitigation requirements for operations and maintenance activities within their groundwater recharge basins and that a surplus might exist. Therefore, mitigation areas denoted within the HMP for Smith Basin and the Blue Diamond and Bond Basins (i.e., Santiago Basin) may no longer be necessary for OCWD to meet their mitigation requirements. If this is the case, there is the potential

that OCWD may provide an addendum to the HMP removing Smith Basin and Santiago Basin from their mitigation obligations. This would mean that the Corps' proposed action would not permanently impact existing mitigation sites.

3. Impacts to Habitat for the Vireo and Gnatcatcher

a. Vegetation Mapping – The Corps has revised the extent of riparian vegetation on the Smith Basin figure as requested by the Service. Refer to figure 14 in the updated BA.

b. BIO-3 – The Corps has revised the ratios for offsetting permanent and temporary impacts to riparian and upland vegetation communities to be consistent with the ratios set forth in the Formal Section 7 Consultation for the Lower Norco Bluffs Toe Stabilization Project (FWS-WRIV-08B0408-20F1132 [March 15, 2021]) and Formal Section 7 Consultation for the Prado Dam Spillway Raise and Dam Safety Modifications (FWS-WRIV-08B0408-21F1233). Refer to Table 3 in the updated BA. The Corps has provided the Service with additional opportunity to discuss options to fully offset project-related impacts to vireo and gnatcatcher during meetings held on January 19, January 30, and February 13, 2023. The Corps requests that any further discussions occur during the formal consultation process as outlined in 50 CFR 402.14(g).

i. As stated above under 3(b), temporary impact ratios for riparian and upland vegetation communities were revised to be consistent with the ratios set forth in the Formal Section 7 Consultation for the Lower Norco Bluffs Toe Stabilization Project (FWS-WRIV-08B0408-20F1132 [March 15, 2021]) and Formal Section 7 Consultation for the Prado Dam Spillway Raise and Dam Safety Modifications (FWS-WRIV-08B0408-21F1233]). The additional mitigation opportunities upstream of proposed impacts in Smith Basin, as stated in the Service's December 21, 2022, letter do not exist. As discussed with the Service during the January 30 and February 13, 2023, meetings, the site upstream of Smith Basin, known as the Chandler Site, has a proposed project that is beginning 2023 and ending in 2027. The Service even provided a 'take' permit for this action on February 6, 2019. After the Service proposed the Chandler site as a potential mitigation site for the Corps project, the Service mentioned during the February 13, 2023, meeting that they were now concerned that the Corps project would potentially impact the Chandler project's proposed mitigation site. The Corps has inserted a statement in the BA (refer to Section 2.1) that says the Corps will not interfere with the Chandler project's mitigation site and the Corps project would be adjusted to avoid areas that the Chandler project has likely already stabilized or where mitigation is located.

ii. The Corps has updated the BA with a proposed mitigation site for wetland/ riparian restoration/enhancement within Prado Basin (refer to Figure 26 in the BA). To offset impacts to least Bell's vireo, restoration/enhancement of 17.92

acres of wetland/riparian habitat is proposed within Prado Basin. The potential riparian parcels are approximately 37.47 acres. Both parcels are located on USACE land, are in the green "environmentally sensitive areas", and are not existing mitigation sites for other projects.

iii. The Corps has updated the BA with a proposed mitigation site for coastal sage scrub restoration/enhancement within Prado Basin (refer to Figure 26 in the BA). To offset impacts to coastal California gnatcatcher, restoration/enhancement of 13.71 acres of coastal sage scrub habitat is proposed within Prado Basin. There are two potential parcels suitable for coastal sage scrub that are approximately 9.02 acres and are connected to other mitigation sites. There are also two offsite locations suitable for coastal sage scrub that are approximately 32.75 acres and are not connected to other mitigation sites. All the parcels are located on USACE land, are in the green "environmentally sensitive areas", and are not existing mitigation areas for other projects.

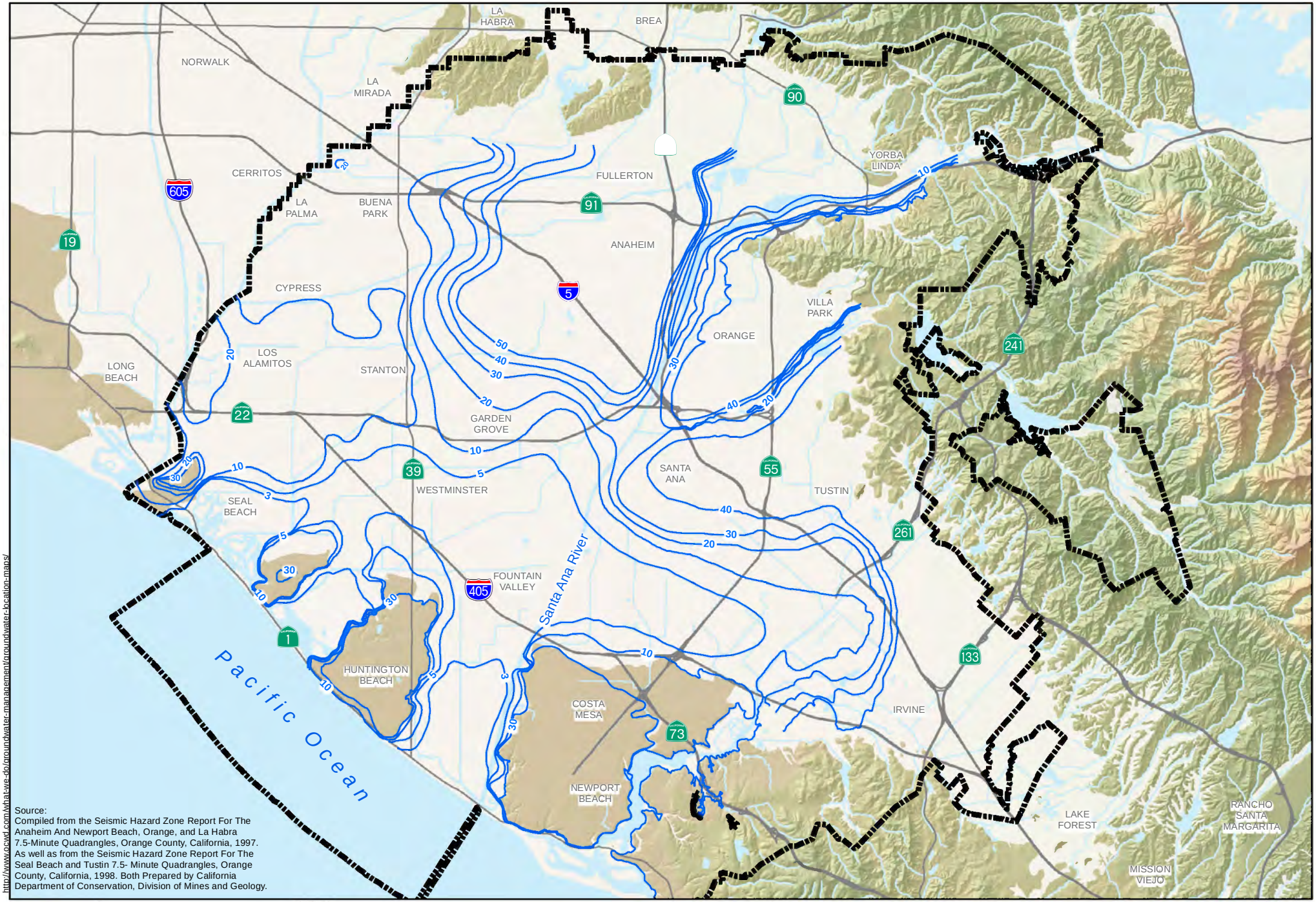
With the above responses to the Service's December 21, 2022, letter, the Corps is requesting formal consultation be initiated under the authority of and in accordance with Section 7 of the Endangered Species Act of 1973 (16 U.S.C 1531 et seq.), as amended. If the Service has an additional request for information prior to initiating formal consultation, the Corps respectfully requests that the Service identify specifically the required information that has not been provided that is listed under 50 CFR 402.14(c)(1)(i-vi). Should you have any questions or comments, please contact Ms. Shawna Herleth-King, Regional Technical Specialist in my Environmental and Cultural Resources Section, at (312) 846-5407 or shawna.s.herleth-king@usace.army.mil.

Sincerely,

Alex Hoxsie
Chief, Environmental and
Cultural Resources Section
Chicago District

Enclosures

Attachment 1



Source:
Compiled from the Seismic Hazard Zone Report For The Anaheim And Newport Beach, Orange, and La Habra 7.5-Minute Quadrangles, Orange County, California, 1997. As well as from the Seismic Hazard Zone Report For The Seal Beach and Tustin 7.5- Minute Quadrangles, Orange County, California, 1998. Both Prepared by California Department of Conservation, Division of Mines and Geology.

http://www.ocwd.com/what-we-do/groundwater-management/groundwater-location-maps/

N
W E
S

Depth to Groundwater
(Feet below Ground Surface)

3 - 50

OCWD Service Boundary

0 10,000 20,000
Feet

1997 Depth to Shallowmost Groundwater

Date Prepared: 11/02/15

DISCLAIMER: This map is provided only as a convenience to the user to provide general information. The Orange County Water District does not regularly update this the map or the information contained on it, and is provided in an "as-is" condition for you to view, access, copy, distribute and otherwise use at your own risk. The map and the information contained on it should be considered out of date and they should not be relied upon for any legal, engineering, surveying or similar purposes. Orange County Water District makes no representation or warranty of any kind, whether express or implied, regarding the map or any of the information contained on it. By accessing the map, you release the Orange County Water District from any liability for any injury or damage that may result from your reliance upon the map or any of the information contained on it.

Attachment 3

Agenda for Santiago Creek Authorized Project
Environmental Coordination Team Meeting with U.S. Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW)
15 July 2022

1. **Log-In Information:**

   https://usace1.webex.com/meet/shawna.s.herleth-king

   OR

   Call-In: 1-844-800-2712
   Access Code: 1994846088 #

2. **Attendance:**

	Name	Organization	Email
X	Chris Medak	USFWS	Christine_medak@fws.gov
X	Jon Avery	USFWS	Jon_avery@fws.gov
X	Jennifer Blackhall	CDFW	Jennifer.Blackhall@wildlife.ca.gov
	Jennifer Turner	CDFW	Jennifer.Turner@wildlife.ca.gov
	Alexandra Troeller	CDFW	Troeller.Alexandra@wildlife.ca.gov
	Simona Altman	CDFW	Altman.Simona@wildlife.ca.gov
X	Mike Padilla	USACE	Michael.C.Padilla@usace.army.mil
	Sue Davis	USACE	Susanne.J.Davis@usace.army.mil
	Alex Hoxsie	USACE	Alex.R.Hoxsie@usace.army.mil
	Hayley Lovan	USACE	Hayley.J.Lovan@usace.army.mil
	Chris Solek	USACE	Christopher.W.Solek@usace.army.mil
	Jenni Snibbe	USACE	Jenni.J.Snibbe@usace.army.mil
X	Jason Zylka	USACE	Jason.J.Zylka@usace.army.mil
X	Ben O'Neil	USACE	Benjamin.R.O'Neil@usace.army.mil
X	Shawna Herleth-King	USACE	Shawna.S.Herleth-king@usace.army.mil

3. **Status Update**

A. Project Update
   a. Review of the 95% DDR by LA District USACE staff and Orange County Public Works is currently underway
   b. Potential change to scope of project – Reduced Basin Alternative
      i. Would NOT INCLUDE construction of the proposed outlet structure
      ii. Would STILL INCLUDE the engineering with nature channel (downstream reach of Santiago Creek); shoreline stabilization features; improvement of maintenance road in Smith Basin; floodwalls (?)
      iii. Impact to current schedule – DDR submittal date potentially extended from September 2022 to January 2023
   c. **MEETING NOTES:**
      i. Objective of the Santiago Creek FRM project is to pass 1% storm event

ii. Passive Reservoir Alternative (instead of Reduced Basin Alternative name) now under consideration – the Corps would not construct any part of the outlet structure system (i.e., overflow channel, outlet structure, and outlet channel) in the Blue Diamond/Bond Pits
iii. The Gated Outlet Structure that is part of the Authorized Plan from 1988 has been found to not provide much benefit when compared to the cost of the structure:
    1. A small benefit is observed around the 100-yr storm event; storm events larger than the 100-yr no benefit is observed as the reservoir begins to overflow even with the gated outlet structure present
iv. Under the Passive Reservoir Alternative the project would focus on ensuring basin slopes are stabilized and the downstream Santiago Creek channel is stabilized; the maintenance road along the north side of Smith Basin would also still be improved.
v. The reason the Corps has not pursued the Passive Reservoir Alternative until now is we were working to understand how much authority we had to remove these structures from a plan that was already authorized. Corps leadership has officially told the project delivery team to go ahead and design the project without the outlet structure system (i.e., move forward with the Passive Reservoir Alternative)
    1. Benefit is that this is a less expensive project with the outlet structure system not being constructed. It also negates the risk of conservation water being released prior to a projected storm event and then the storm event not materializing.
vi. Therefore, the Preferred Alternative that the Corps is moving forward with at this time is the Passive Reservoir Alternative
    1. Remaining risk of moving forward with this alternative is if we get further down the line and the authorization language doesn't allow us to not construct the outlet structure then the Corps would have to reinitiate consultation for this feature.
    2. The Passive Reservoir Alternative still includes stabilization of the Santiago Creek Recharge Basin's slopes, but the holding of water within the basins (includes Smith Basin, Blue Diamond and Bond Pits) once the project is constructed be the same as under existing/current conditions
        a. Operation of the Santiago Creek Recharge Basins would be the same as under existing/current conditions. The gated outlet structure was the feature that allowed for the operation changes; without construction of the gated outlet structure the operation of the reservoir would not change with the other project features. To reiterate, the construction of the gated outlet structure is what would have allowed for the additional 10 feet of water storage within the Santiago Creek Recharge Basins; without the construction of this feature the reservoirs would no longer be able to achieve that extra capacity.
    3. The Engineering with Nature Channel in the downstream reach of Santiago Creek (or "green" channel) would have the objective of reducing erosion of the channel thereby reducing the threat to adjacent properties (would not necessarily prevent the overflow of water).

4. Within Smith Basin would still have some minor regrading of the Santiago Creek channel – approximately grading 1 foot depression; would not include stream veins or stream training. The minor regrading would try and get the water to flow more through the middle of Smith Basin.
    a. Operations and Maintenance within Smith Basin specifically: There is no plan by the Corps to go out there every year and regrade the Santiago Creek channel to correct the stream. If there was an issue there could potentially be regrading every decade by the NFS. The Corps would harden the toe of the reservoirs banks (i.e., base of the slope would be hardened). If over time undercutting of the hardened toe was observed then may have to go out and correct.
    b. **Concern: USFWS would like to see the toe hardened and then the channel left alone within Smith Basin. No regrading of the depression to get the channel away from the reservoir banks and direct flow more through the middle of Smith Basin. Even doing this every decade would be environmentally impactful. Instead, design for medium size storm events (e.g., 15-25 year event) and leave it alone. Recommend burying riprap 3-4 feet down; that way the banks/slopes of Smith Basin are protected from erosion but allows the creek to meander within the basin. Riprap would then be covered with approximately 3 feet of topsoil to allow for native plantings.**
    c. The native plantings are part of the Preferred Alternative. Other than the buried riprap for slope protection in Smith Basin, fill is earthen. This is true for Blue Diamond and Bond Pits also, allowing revegetation of the slopes with native plants.
    d. **Concern: Does the shoreline stabilization at the upstream end of Smith Basin create a constriction that would increase flow velocities and potential erosion of the slopes? USACE needs to evaluate this still as the width of the shoreline stabilization features is still being refined.**

vii. Therefore, the Preferred Alternative that the Corps is moving forward with at this time is the Passive Reservoir Alternative

B. Fish and Wildlife Coordination Act
    a. USACE working on setting up the MIPR
    b. Discussion on how we move forward with potential scope change – should both alternatives be evaluated in the CAR (with and without the outlet structure)?
    c. **MEETING NOTES:**
        i. The CAR is different from Section 7 consultation in that the report can evaluate more than one alternative. Recommendation is to still come in with only the Passive Reservoir Alternative for the CAR moving forward.

C. Section 7 Consultation
    a. We have the Draft botanical/wildlife survey and Draft Final aquatic resources survey reports

b. USACE reviewing and hope to provide comments back to contractor by COB Monday
c. Once we get the final reports will share with USFWS and CDFW
d. Allows us to finish the Draft Biological Assessment and provide to USFWS for review (see if document is complete, what else may be needed)
e. Similar to CAR, should we include both potential alternatives in the Section 7 Consultation?
f. **MEETING NOTES:**
    i. By law, Section 7 consultation is only supposed to look at one alternative. Therefore, it is recommended that consultation take place on the Preferred Alternative which is now the Passive Reservoir Alternative moving forward.
    ii. Although one alternative is by law, 10% of the time or less USFWS has evaluated two alternatives (don't recommend though).
    iii. By moving forward with consultation for the Passive Reservoir Alternative remaining risk is that Corps has to reinitiate consultation of the authority doesn't allow us to remove construction of the outlet structure system.
    iv. **Corps will move forward with consultation only on the Passive Reservoir Alternative.**

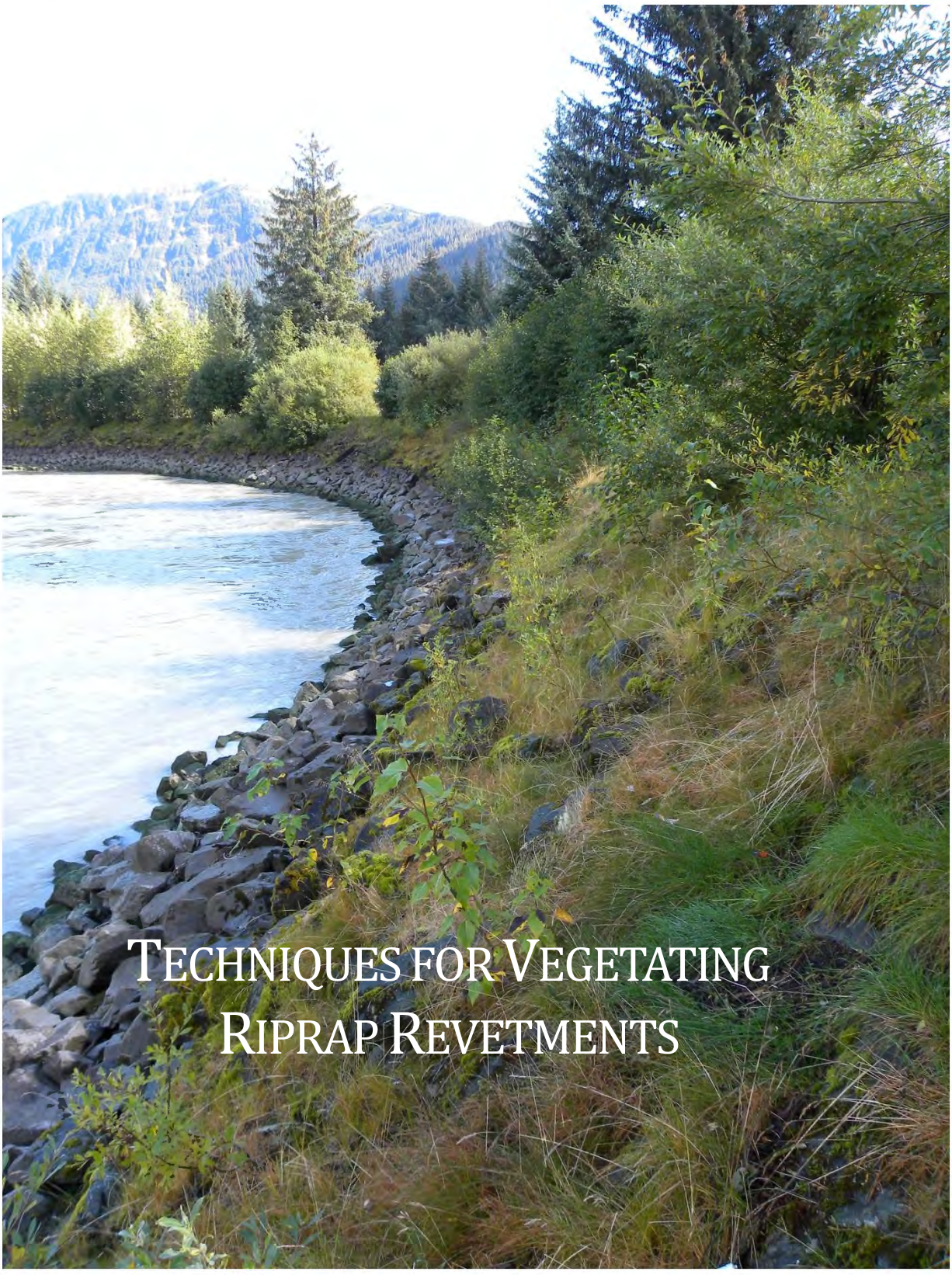
D. CDFW Coordination
a. See above for Section 7 consultation.
b. **MEETING NOTES:**
    i. Looking forward to additional information on the Passive Reservoir Alternative to fully understand potential impacts.

E. Design Documentation Report Schedule
a. 95% DDR currently undergoing review; however, with potential scope change associated documents will require changes
b. The project delivery team is working on developing a new submittal schedule; tentative date is final submittal will be pushed from September 2022 to January 2023.

4. Due Outs for Current/Previous Meeting

-Send Final Survey Reports to USFWS as USACE receives them **(Remaining Due Out)**
-Prepare maps with existing/proposed mitigation at the Santiago Recharge Basins (timeline for installation of proposed mitigation part of OCWD's maintenance of groundwater recharge facilities) **(Remaining Due Out)**
-Send USFWS updated write-ups of proposed action (including EWN channel and features of the Smith Basin Improvement Project [armoring shoreline banks and maintenance road]) **(Remaining Due Out – also include write-up for full Passive Reservoir Alternative)**
-Send Draft BA to USFWS once final survey reports have been received **(Remaining Due Out – Now Dependent on Sufficient Information on the Passive Reservoir Alternative in addition to the surveys)**
-Make sure to include in the BA a table of impacts that identifies all potential work areas and the amount/type of habitat impacted **(Remaining Due Out)**

Attachment 4



Techniques for Vegetating Riprap Revetments

JUNEAU WATERSHED PARTNERSHIP

Juneau Watershed Partnership

Our mission is to promote watershed integrity in the City and Borough of Juneau through education, research and communication while encouraging sustainable use and development.

Organization Name: Juneau Watershed Partnership

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This BMP guidance was funded with qualified outer continental shelf oil and gas revenues by the Coastal Impact Assistance Program, Fish and Wildlife Service, U.S. Department of Interior

GRANT # 10 – CIAP – 030 CFDA 15.688

Dormant Cuttings and Techniques for Vegetating Riprap Revetments in Juneau

Purpose and Description
Improve riparian and fish habitat by using dormant cuttings and joint planting techniques to vegetate riprap revetments stabilizing eroding streambanks.

Riparian vegetation has several important ecological roles:

- Providing cover and food resources for terrestrial invertebrates, birds, and mammals;
- Shading streams to maintain cool water temperatures necessary for salmon and other aquatic organisms;
- Providing a source of large woody debris, allowing complexity in stream habitats;
- Delivering leaf litter, organic debris, and terrestrial invertebrates, which are sources of food for fish and aquatic invertebrates;
- Protecting streambanks from erosion; and
- Providing stormwater treatment

When riparian vegetation is removed and replaced with riprap revetments, these benefits are completely lost with the exception of erosion control.

Dormant cuttings are living, woody plant cuttings capable of establishing root systems and growing into shrubs or trees after being placed into the streambank. Dormant cuttings can be used in a variety of bioengineering techniques such as live staking, pole planting, brush layering, etc. Planting dormant cuttings will not provide immediate erosion protection, so they are best used in combination with other techniques. The two techniques discussed here are joint planting and vegetated riprap.

Joint planting uses a combination of rock and dormant cuttings to stabilize a streambank. In this application, dormant cuttings are prepared into live stakes and poles, and planted in the rock joints in order re-establish riparian vegetation and cover. The cuttings are planted after the construction of a new riprap revetment, or in an existing riprap revetment. This allows, over time, recovery of some riparian vegetation and the associated benefits.

Vegetated riprap is another method for using a combination of rock and dormant cuttings to stabilize a streambank. However, this typically refers to when dormant cuttings are placed during the construction of a new riprap revetment as part of the design. In addition to live staking and pole planting, brush layering techniques may also be incorporated to provide additional vegetative coverage.

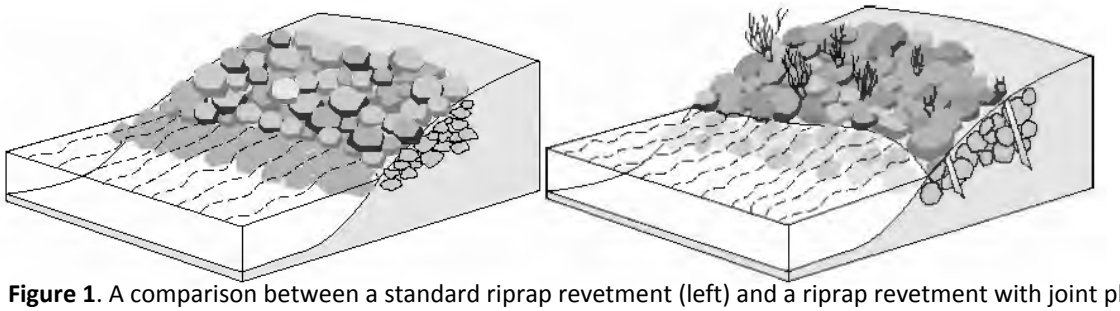


Figure 1. A comparison between a standard riprap revetment (left) and a riprap revetment with joint planting (right). Figures from Stream Corridor Restoration: Principles, Processes, and Practices, 10/98, by the Federal Interagency Stream Restoration Working Group (FISRWG), accessed online at http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/manage/restoration/?cid=nrcs143_026887

Applicability
Techniques discussed in this document are applicable where the primary objectives include habitat improvement, erosion control, water quality improvement, and aesthetics. These techniques are applicable for existing and new riprap revetments with slopes of 2:1 or flatter.

Advantages/Disadvantages

Advantages	Disadvantages
• Inexpensive • Relatively easy method • Improves aesthetics • Improves riparian and fish habitat • Can be used to improve existing structures • Easy installation when incorporated as part of new riprap revetment • Over time, adds to stability of riprap revetment	• Limited to certain species • Can be time intensive • Harvest, preparation and planting of stakes is time sensitive • Construction best during dormant season of selected species • Plant loss of 30 – 50% is common • Planting density will be dictated by the availability of voids.

Dormant cuttings can be placed after the installation of rock for new riprap revetments or in an existing riprap revetment. This is called joint planting. Installing cuttings during construction of a new revetment is called vegetated riprap.

For new construction, implementing vegetated riprap techniques will make it easier to install the dormant cuttings, though it will extend the time it takes to install the rock. This is because equipment will have to carefully place, not end dump, the rock in order to prevent damage to the cuttings. Installation after the rock has been placed, or in an existing revetment, may result in more difficult installation due to having to work between the rock. For this reason, it is encouraged to design and schedule installation to coincide with construction for new revetments. However, where there is existing riprap, joint planting provides a means to improve riparian and fish habitat along these previously modified streambanks.

Preparation of Dormant Cuttings
The success of joint planting is largely dependent on properly selecting, collecting and preparing the dormant cuttings.

Site and Species selection: Dormant cuttings can only be prepared from certain plant species. Willow (*Salix* spp.) is the most common species used for live stakes throughout the country and has been used successfully in Juneau.

Other species from which dormant cuttings can be made are as follows:
Black cottonwood* (*Populus balsamifera*)
Red-osier dogwood* (*Cornus stolonifera*)
Nootka rose+ (*Rosa nutkana*)
Salmonberry+ (*Rubus spectabilis*)
Red elderberry+ (*Sambucus racemosa*)

*used with success in Juneau and recommended by Alaska Dept. of Fish and Game
+ known to root well from cuttings but are less commonly used in this application

Identify a harvest site with healthy populations of the selected plant species. Harvest sites are easier to identify when leaves are present in the spring or summer. The site should have at least 3 times the needed harvest material. If necessary, harvest from multiple sites to prevent over harvesting.

Always get permission from the landowner for accessing the site and plant collection. Collecting dormant cuttings from State land may require a permit; contact the Department of Natural Resources prior to collecting cuttings from State land.

Harvest: Harvest must occur when the selected species are dormant (not actively growing), in winter or early spring, preferably before March 31. The best wood to use is healthy, live wood that is 2 – 5 years old with smooth bark that is not deeply furrowed and is reasonably strait. Younger wood will lack sufficient energy to sprout.

Dormant cuttings are generally harvested for three preparations as shown in Figure 2 and outlined in Table 1.

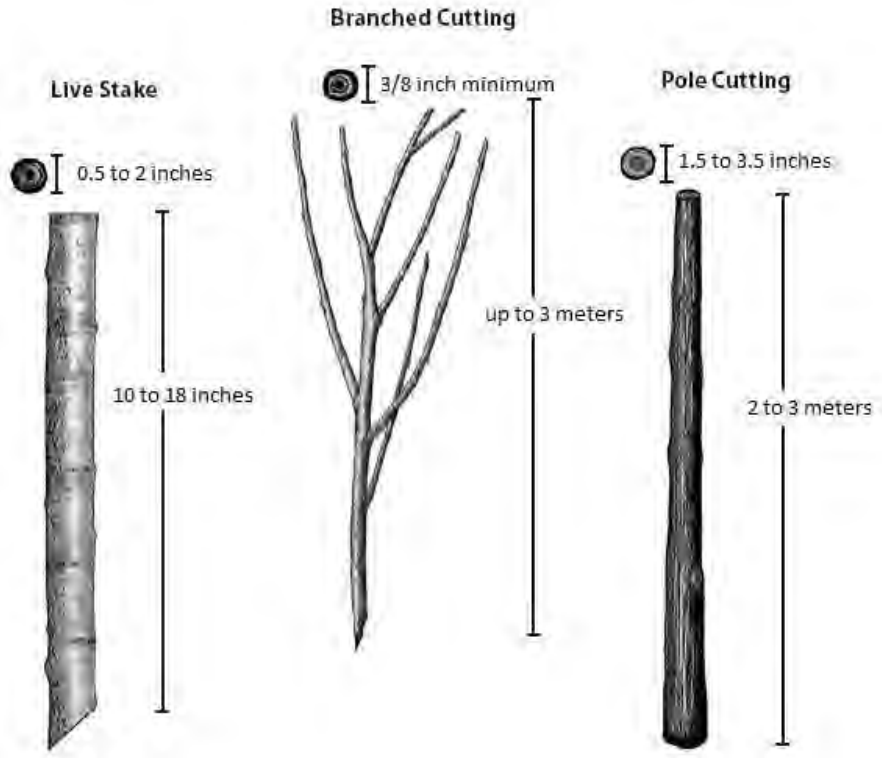


Figure 2. A comparison in dormant cuttings prepared into live stakes, branched cuttings and poles.

Table 1. Information for preparing dormant cuttings into live stakes, branched cuttings and poles.

Type	Diameter (inches)	Typical Length	Technique	Notes
Stakes	0.5 – 2	10 – 18 inches*	Joint planting and Vegetated Riprap	• Smaller diameter stakes (diameter less than 1.5 inches) must be at least be 18 inches long • Harvest length can be up to 4 feet, and then trimmed to size of stake (Figure 3)
Poles	1.5 – 3.5	2 – 3 meters*	Joint planting and Vegetated Riprap	• Generally better survival due to size • Long enough to reach beyond the riprap, though may require mechanical measures for installation
Branch cuttings	3/8 minimum	Up to 3 meters*	Vegetated Riprap	• Branches kept intact

**length of the cutting should be long enough to reach moist soil (vadose zone).*

Fabrication of Cuttings: Both stakes and poles are prepared in the same manner. When harvesting, make clean cuts without splitting the ends. Spread harvest activity throughout the site to minimize visual impact. Do not thin more than 2/3 of the donor plant to avoid harming it, and remove cuttings from inside the crown of the plant. Cuttings for stakes can be up to 4 feet in length, and trimmed to create stakes (Figure 3). However, the cutting length is dependent on the application and, in the case of joint planting and vegetated riprap, both live stakes and poles should be cut to lengths that allow the cuttings to extend 6 to 8 inches into the vadose zone.

The end that will go into the ground shall be pointed or angled (hence "stake") and the top cut straight across.

When using willow, trim off flower buds (pussy willows) on the top 2/3 of branch that was produced last growing season and trim all leaf buds except two leaf buds near the top of the stake

When using cottonwood, retain one side branch and trim all but the terminal bud on that side branch.

In preparing branched cuttings, some side branches are kept. Branched cuttings are not used joint planting and, therefore do not need to be prepared unless vegetated riprap is planned.

For easy storage and installation, cuttings can be placed so that they are oriented the same way, and bundled and labeled by species.

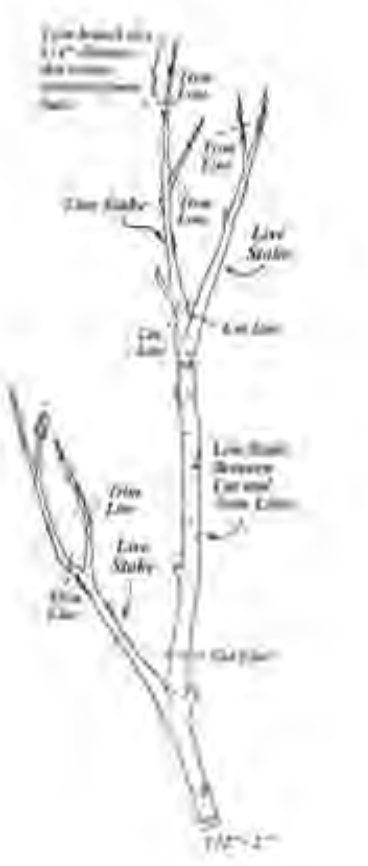


Figure 3. Preparing multiple live stakes from a dormant cutting. From ADFG 2005.

Soaking and Storage: After harvesting, the dormant cuttings should be bundled so that they are oriented the same way for ease of transport and installation. If different species were harvested, they can be group and labeled by species for identification. Dormant cuttings must not be allowed to dry out. All cuttings should be initially soaked in water for 1 to 4 days. Soaking significantly increases the survival rate of the cuttings. While soaking, the dormant cuttings should be stored in a location where they are protected from the sun, wind, cold, heat and physical damage.

Dormant cuttings are more successful when planted the same day they are removed from water. However, if it is necessary to harvest the dormant cuttings well before installation, the cuttings should be stored based on when they were harvested. If harvested at temperatures below freezing, freeze cuttings at no colder than 0 degrees Fahrenheit or refrigerate cuttings until planting. If harvested at temperatures above freezing, cuttings should be refrigerated between 31 to 40 degrees Fahrenheit and 60 to 70 percent humidity. Do not store plants beyond one season; instead, plan on preparing new cuttings (see Timing below). Stored stakes must be soaked in water for a minimum of 24 hours prior to installation, but not for more than 48 hours.

Installation

Dormant cuttings can be placed after the installation of rock for new riprap revetments or in the rock joints of an existing riprap revetment. This is called joint planting. Installing cuttings during construction of a new revetment is called vegetated riprap. Both methods are discussed separately, with timing and general installation guidelines that apply to both discussed first. All standard drawings for installation are provided in Appendix A.

Timing: Installation is most successful if the dormant cuttings are installed during the dormant season immediately after harvesting and soaking in water for 4 days. However, dormant cuttings can be installed any time of the year, except for when the ground is frozen and late summer. Installation outside of the dormant season will only be successful if the cuttings are properly stored (as described above) and are soaked for a minimum of 24 hours prior to installation.

Fall is the preferred installation time with early winter being the next best time for installation. If a spring installation is necessary, irrigation/watering will be essential for survival. Summer installation is generally not recommended due to dry conditions. If a summer planting is necessary, dormant cuttings should not be planted after July 1 as the ability of plantings to establish quickly declines after this date. If cuttings cannot be installed before July 1, do not store the cuttings until the following fall; instead, plan on getting new cuttings.

Table 2. Timing of activities associated with dormant cuttings.

Activity	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
Harvest	→	→	→	→	→	→	→					
Storage	→	→	→	→	→	→	→	→	→	→		
Planting	→	→	Potential for Frozen Ground				→	→	→	→		

General Guidelines: If installation is expected to take multiple days, only the amount of material required for planting each day should be removed from soaking. Before installing, inspect the cuttings and do not use those that have begun to root or mold, or that have appeared to dry or leaf out. Cuttings

stored onsite should be kept soaking or wet, and protected from the sun, wind, cold, heat and physical damage.

In addition, during planting, be careful not to damage the buds, strip the bark or split the stake during installation. Any stakes or poles that have split during installation should be replaced as materials allow.

Dormant cuttings should be installed at random intervals between rocks in the available joint spaces above the Mean High Water (MHW) line, but not exceeding the number of cuttings per square meter recommended in Table 3. Soil around the cuttings should be kept moist for at least 6 weeks following planting.

Table 3. Spacing for joint planting and vegetative riprap techniques based on slope and soil cohesion. From Sotir (2007).

Slope Steepness	**Spacing – Feet on Center**	
	Cohesive soils	**Non-Cohesive Soils**
1.5:1	N/A	N/A
2:1	1.5 to 3	1.5 to 2
3:1 or flatter	3 to 5	2 to 4

Joint Planting

Joint planting involves driving live stakes and pole cuttings into the rock joints. Stakes and poles require slightly different installation methods, though all cuttings must be planted with the pointy-end in the ground and the leaf bud scars or emerging buds pointing up. As necessary add soil slurry (mix of soil and water) in the voids between rocks prior to planting the dormant cuttings in order to encourage rooting. Watering is also used to reduce air pockets and increase soil contact. Lack of soil contact, particularly within the rock joints, is one of the leading causes of mortality after installation.

Stakes: Use a rebar (3/4 inch or less in diameter) or other similar tool to establish a pilot hole for stakes. The hole must be perpendicular to the surface and must reach into the subsoil where existing rock or new rock has been placed. Much of the stake (3/4 of the length) should extend into the subsoil with only one or two leaf buds above the ground. Due to their size, stakes are generally planted towards the top of the

Poles: One-half to two-thirds of the pole should extend into the ground. While a rebar may be used to create a pilot hole, it may not be successful in creating a hole deep enough for pole installation. In this case, installation of poles may require the use of a “stinger,” which is a solid steel rod that attaches to a backhoe or excavator, or a power auger or similar tool. Some stingers have the ability to insert the cutting into the attachment so that the stinger can be used to drive the pole into the ground. When using a stinger without this capability, the attachment is used to make a pilot hole through the riprap, stopping when the softer subsoil is reached. Then the pole is placed through the pilot hole by hand and is pushed into the subsoil using the bucket of the excavator. The pole will make its own hole through the soil so there is a continuous tight fit between the soil and the pole.

Note about joint planting in existing riprap: Thick existing riprap may also require the use of a stinger, or a power auger or similar tool. Depending on the stinger attachment, they are capable of installing live stakes in riprap 4 to 5 feet thick. An excavator can also be used to lift and move rocks as needed. However, when replacing the rock, care must be taken not to damage the dormant cuttings.

Vegetated Riprap

In vegetated riprap, the cuttings are installed during construction of a new riprap revetment while the bank is being graded and the riprap is being placed. Live stakes and pole plantings are used in this application similar to joint planting. However, another technique called brushlayering, which uses branched cuttings, is also used in this application.

Live stakes and poles: Live stakes and poles are installed as described for joint planting with the exception that poles can be placed so they are angled to prevent the riprap from moving down the bank. Poles can also be placed to help key in the toe of the riprap. In addition, soil can be placed around the cuttings prior to installing the riprap. If filter fabric is being used, it may be necessary to cut a small hole in the fabric to make it easier to drive stakes and poles into the native soil.

Branched cuttings: Branched cuttings are installed just at Mean High Water (MHW) using the brush-layering technique. This requires excavating a filling terrace above the toe of the riprap. The terrace should slope back 10 to 20 degrees. Branched cuttings should be at least 6 feet long or long enough to allow at least 8 to 18 inches of the cutting to extend beyond the face of the slope. Branched cuttings are placed along the terrace at 5 to 8 branches per linear foot and should crisscross at random. After laying the cuttings the brushlayer should be covered with 6 to 18 of soil, compacted and watered (if necessary). Additional terraces can be created up the bank as desired.

Riprap: Unlike traditional riprap construction, do not end dump the rock when constructing vegetated riprap. Instead carefully place the rock in order to prevent damage to the cuttings. Some damage during placement of rocks is unavoidable and acceptable since some of the deeply rooted material will regenerate.

Maintenance

Watering may be necessary to ensure the success of the dormant cuttings. Soil around the cuttings should be kept moist for at least 6 weeks following planting. More watering may be needed if installation occurred in the spring or if the site is experiencing dry conditions.

Examine the site at minimum twice during the first year, and once per year thereafter, preferably after the flood season. Examine the cuttings for adequate survival and growth. Before replacing dead plants, determine the reason they were unsuccessful and implement corrective measures with new plantings. Voles are known to girdle the cambium layer at the base of cottonwood stakes during winter. Protect these cuttings with a collar designed to protect tree bark from rodents.

When the vegetation becomes established (up to 3 years), maintenance becomes less over time.

Construction Costs

Joint planting: According to Sotir and Fischenich (2007) the cost of joint planting can range from $6 to $15 per cutting. This estimate includes harvest, transportation, handling, fabrication and storage. This does not include the cost of the riprap component, which is assumed to be existing, or the labor and equipment costs.

Installation can vary depending on labor and equipment costs, and the size of the site. McCullah (2001) estimates 2 to 5 square meters per hour can be planted. This can be used to estimate labor costs based

on site size. In Juneau, equipment time is about $150 to $200 per hour for an excavator (Hanna, personal communication).

Vegetated riprap: For planting dormant cuttings during construction of a new riprap revetment, McCullah (2001) states that an additional 10% labor and equipment time should be added to the estimated labor and equipment costs of constructing a riprap revetment alone. This is required for careful placement of riprap to prevent damage to the cuttings.

Partnering to reduce costs: The Juneau Watershed Partnership (JWP) and the Southeast Alaska Watershed Coalition (SAWC) are willing to partner with landowners interested in implementing joint planting and vegetated riprap techniques on their property. These non-profit organizations are able to seek grant funding and solicit volunteers to pursue these projects at little to no cost to the landowner.

EXAMPLES IN JUNEAU

Joint planting was used to successfully revegetate riprap revetments on the Mendenhall River in two locations: near Quay's subdivision in April 2012 and the Riverbend site in July 2013. Vegetation was well-established on both sites after 2 years (Figures 4 – 7).



Figure 4. The riprap revetment near the Quay subdivision on the Mendenhall River immediately after joint planting in June 2012. Photo courtesy of John Hudson, US Fish and Wildlife Service.



Figure 5. The riprap revetment near the Quay subdivision on the Mendenhall River immediately after joint planting in August 2014. Photo courtesy of John Hudson, US Fish and Wildlife Service.



Figure 6. The Riverbend riprap revetment on the Mendenhall River immediately after joint planting in July 2013. Photo courtesy of John Hudson, US Fish and Wildlife Service.



Figure 7. The Riverbend riprap revetment on the Mendenhall River after vegetation from the joint planting has become established in September 2015. Photo courtesy of John Hudson, US Fish and Wildlife Service.

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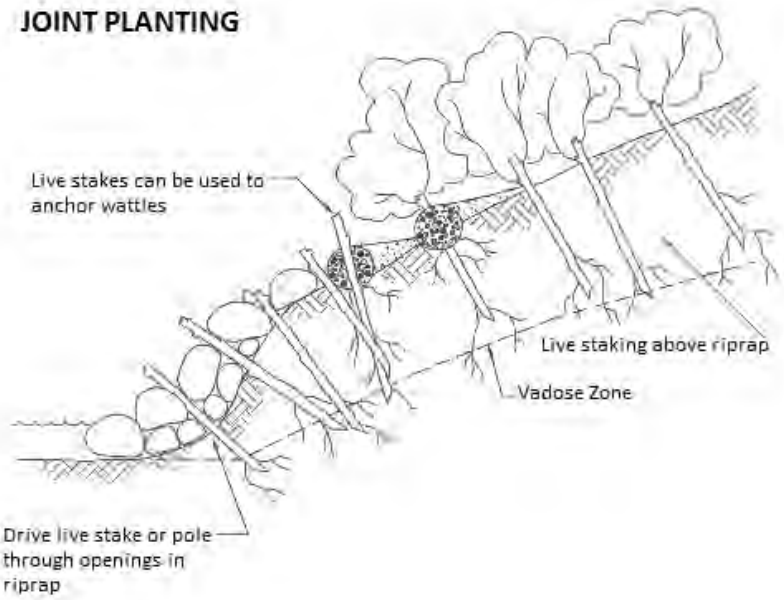
Hanna, D. Feb. 4, 2014. Personal communication (email) with Juneau Watershed Partnership regarding estimated project costs.

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APPENDIX A:

Standard Drawings for Joint Planting and Vegetated Riprap

JOINT PLANTING



Joint Planting Notes:

1. Soak cuttings 24 hours (minimum) prior to installation.

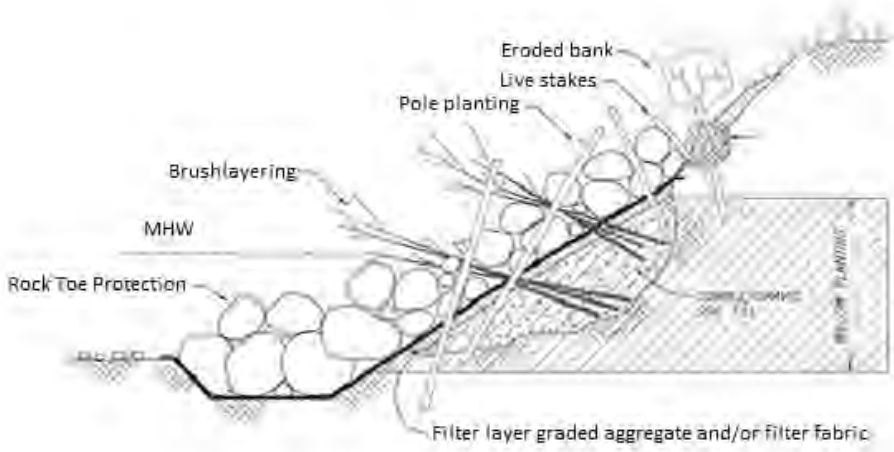
2. Stakes driven so 3/4 length is in soil and at least 2 leaf buds are above the stone layer.

3. Poles driven so 1/2 to 2/3 length is in soil and can protrude 0.5 meter above the stone layer.

4. Filling joints with mud may be necessary.

5. Mechanical means may be needed to install poles.

VEGETATED RIPRAP



Vegetated Riprap Notes:

1. Soak cuttings 24 hours (minimum) prior to installation.

2. Brushlayering and poles installed during bank grading and riprap placement.

2. Brushlayers tilt down into slope 10 to 20 degrees

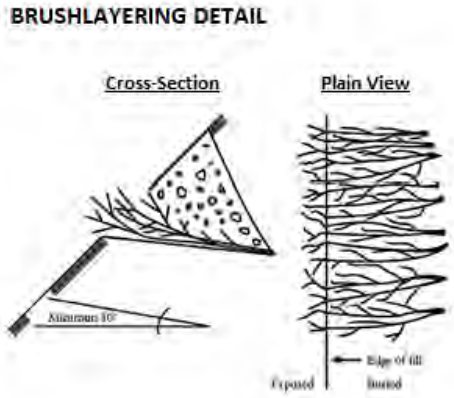
3. Brushlayers should protrude 8 to 18 inches beyond the stone layer.

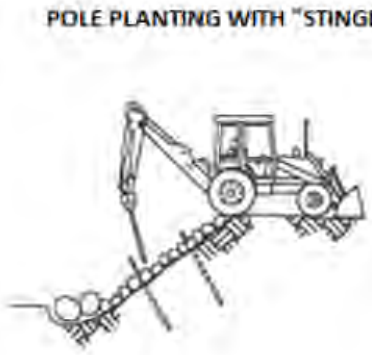
4. Place soil fill around cuttings

5. Place riprap carefully, do not end dump.

Standard drawings developed using ErosionDraw Software (© John McCullah), as modified by the Juneau Watershed Partnership to conform to the standards set forth by the Alaska Dept. of Fish and Game (2005).

DETAIL SHEET





Standard drawings developed using ErosionDraw Software (© John McCullah), as modified by the Juneau Watershed Partnership to conform to the standards set forth by the Alaska Dept. of Fish and Game (2005).

APPENDIX B:

Construction Specifications for

Joint Planting and Vegetated Riprap

JOINT PLANTINGS

Construction Specifications:

Harvesting:

- Dormant cuttings shall be harvested and planted when the willows, or other chosen species, are dormant. This period is generally from late fall to early spring, or before the buds start to break.
- When harvesting cuttings, select healthy, live wood that is reasonably straight.
- Use live wood at least 1 year old or older. Avoid suckers of current year's growth as they lack sufficient stored energy reserves to sprout consistently. The best wood is 2-5 years old with smooth bark that is not deeply furrowed.
- Make clean cuts with unsplit ends. Trim branches from cutting as close as possible. The butt end of the cutting shall be pointed or angled and the top end shall be cut square.
- Identification of the top and bottom of cutting as accomplished by angle cutting the butt end and cutting the top end.

Diameter:

- Dormant cuttings should generally be 1/2 inch or larger (Stakes = ½ inch to 2 inches; Poles = 1.5 to 3.5 inches). Highest survival rates are obtained from using cuttings 2-3 inches in diameter. Larger diameter cuttings are needed for planting into rock riprap.

Length:

- Dormant cuttings should generally be 10 inches or longer (Stakes = 10 to 18 inches; Poles = 2 to 3 meters).
- Cuttings of small diameter (up to 1.5 inches) shall be 18 inches (0.5 m) long minimum. Thicker cuttings should be longer.
- Cuttings should be long enough to reach into the mid-summer water table, if possible.
- No less than 1/2 total length must be into the ground.
- Stakes should be cut so that a terminal bud scar is within 1-4 inches of the top. At least 2 buds and/or bud scars shall be above the ground after planting.

Installation:

- Cuttings must be planted with butt-ends into the ground. Leaf bud scars or emerging buds should always point up.
- Stakes must not be allowed to dry out. All cuttings should be soaked in water for a minimum of 24 hours but no more than 48 hours prior to being planted. Soaking significantly increases the survival rate of the cuttings.
- Plant cuttings at random intervals between rocks in the available joint spaces above the Mean High Water (MHW) line, but at least 1 foot apart.
- Set cuttings as deep as possible into the rock joints, preferably with 80 percent of its length into the soil and in contact with mid-summer water table.

- It is essential to have good contact between the cuttings and soil for roots to sprout. This may require placing mud in the rock joints or watering to ensure good contact.
- Use an iron stake or bar to make a pilot hole in firm soil.
- Poles may require heavy equipment for installation.
- Do not damage the buds, strip the bark or split the stake during installation.
- Split or damaged stakes shall be removed and replaced.

Inspection and Maintenance:

- All temporary and permanent erosion and sediment control practices shall be maintained and repaired as needed to assure continued performance of their intended function.
- Streambanks and steep slopes are highly susceptible to erosion and damage from significant storm events. Willow stakes alone provide very little initial site protection during the establishment period.
- Periodic inspection repair and maintenance will be required during the first two years or until the vegetation is established.
- All temporary or permanent erosion control practices shall be maintained and repaired as needed to assure continued performance of their intended function.

Vegetated Riprap

Construction Specifications:

Harvesting:

- Dormant cuttings shall be harvested and planted when the willows, or other chosen species, are dormant. This period is generally from late fall to early spring, or before the buds start to break.
- When harvesting cuttings, select healthy, live wood that is reasonably straight.
- Use live wood at least 1 year old or older. Avoid suckers of current year's growth as they lack sufficient stored energy reserves to sprout consistently. The best wood is 2-5 years old with smooth bark that is not deeply furrowed.
- Make clean cuts with unsplit ends. Trim branches from cutting as close as possible. The butt end of the cutting shall be pointed or angled and the top end shall be cut square.
- Identification of the top and bottom of cutting as accomplished by angle cutting the butt end and cutting the top end.

Diameter:

- Dormant cuttings should generally be 1/2 inch or larger (Stakes = ½ inch to 2 inches; Poles = 1.5 to 3.5 inches). Highest survival rates are obtained from using cuttings 2-3 inches in diameter. Larger diameter cuttings are needed for planting into rock riprap.

Length:

- Dormant cuttings should generally be 10 inches or longer (Stakes = 10 to 18 inches; Poles = 2 to 3 meters).
- Cuttings of small diameter (up to 1.5 inches) shall be 18 inches (0.5 m) long minimum. Thicker cuttings should be longer.
- Cuttings should be long enough to reach into the mid-summer water table, if possible.
- No less than 1/2 total length must be into the ground.
- Stakes should be cut so that a terminal bud scar is within 1-4 inches of the top. At least 2 buds and/or bud scars shall be above the ground after planting.

Installation:

- Cuttings must be planted with butt-ends into the ground. Leaf bud scars or emerging buds should always point up.
- Stakes must not be allowed to dry out. All cuttings should be soaked in water for a minimum of 24 hours but no more than 48 hours prior to being planted. Soaking significantly increases the survival rate of the cuttings.
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- It is essential to have good contact between the cuttings and soil for roots to sprout. This may require placing mud in the rock joints or watering to ensure good contact.
- Use an iron stake or bar to make a pilot hole in firm soil.
- Poles may require heavy equipment for installation.
- Do not damage the buds, strip the bark or split the stake during installation.
- Split or damaged stakes shall be removed and replaced.

Inspection and Maintenance:

- All temporary and permanent erosion and sediment control practices shall be maintained and repaired as needed to assure continued performance of their intended function.
- Streambanks and steep slopes are highly susceptible to erosion and damage from significant storm events. Willow stakes alone provide very little initial site protection during the establishment period.
- Periodic inspection repair and maintenance will be required during the first two years or until the vegetation is established.
- All temporary or permanent erosion control practices shall be maintained and repaired as needed to assure continued performance of their intended function.

United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250
Carlsbad, California 92008

In Reply Refer to:
23-0019344-S7-TA-OR

December 21, 2022
Sent Electronically

Susanne J. Davis, PE
Chief, Planning Branch
Regulatory Division
U.S. Army Corps of Engineers – Chicago District
231 South LaSalle Street, Suite 1500
Chicago, Illinois 60604

Attention: Shawna Herleth-King, Regional Technical Specialist

Subject: Request for Additional Information for the Santa Ana River Mainstem, Santiago Creek Flood Risk Management Project, Orange County, California

Dear Susanne Davis:

On December 1, 2022, we received your request to initiate formal consultation in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq*.) for the proposed Santa Ana River Mainstem, Santiago Creek Flood Risk Management Project, Orange County, California. With your request, you provided the Biological Assessment for the project, dated December 2022 (BA). We also received project information from the U.S. Army Corps of Engineers' (Corps) staff during a meeting held on December 19, 2022.

The Corps has determined that the proposed project is likely to adversely affect the federally endangered least Bell's vireo (*Vireo bellii pusillus*; vireo) and threatened coastal California gnatcatcher (*Polioptila californica californica*; gnatcatcher). Your request and supplementary information did not include all the information necessary to initiate formal consultation for the vireo and gnatcatcher as outlined in the regulations governing interagency consultation (50 CFR 402.14). To complete the initiation package and to assist us in determining the full extent of potential effects to be considered in the biological opinion for the action, we request additional information as described below:

1. Description of the action

a. Project Footprint – The proposed "Project Footprint" is displayed on Figures 4 through 6; however, based on discussions held during the meeting on December 19, 2022, it is our understanding that the total of direct disturbances that would occur to the ground in association with the proposed project are limited to a smaller area identified in Figures 4 through 6 as "Reservoir Slope

Stabilization," "Maintenance Road," "Staging Area," and "Access Road." We would appreciate confirmation of this understanding.

b. Reservoir Slope Stabilization

i. Reservoir slope stabilization is anticipated to include compacted buttress fill, retaining walls, tie back walls and/or armoring; however, all impacts associated with stabilization are identified as temporary. The potential to restore a native vegetation community within the noted temporary impact areas will depend on the depth of functional soil over the stabilization structures relative to the root depth of proposed vegetation, and the frequency and extent of stabilization structure maintenance that is expected to be required in the future. Please clarify on the figures where the hard structures are located for all slope stabilization areas and proposed methods for restoring temporary impact areas to their current or better vegetative condition. Impacts to vegetation that cannot be restored to the pre-existing or a higher function vegetation community constitute permanent impacts to that vegetation community and the associated ecosystem.

ii. The footprint of "Reservoir Slope Stabilization" displayed in Figure 6 of the BA apparently includes grading beyond what is needed to stabilize the slopes in Smith Basin. During our meeting on December 19, 2022, you clarified that the existing low flow channel in the basin would be redirected and a meandering low flow channel would be created through the center of the basin. Please clarify how the proposed project would change the topography of the basin and which portions of the impact area would be associated with slope stabilization.

c. Future Maintenance – The BA identifies the need for routine inspections and repair of project features after construction is completed and includes a list of potential maintenance activities. A proposed new permanent access road would be constructed within Smith Basin from top of slope to the bottom of the basin. The purpose and extent of use of the maintenance road is not clear; however, the Corps indicated during the meeting on December 19, 2022, that certain areas (e.g., hardened slope) may be limited to certain vegetation types (i.e., require ongoing vegetation clearing). If the Corps has continued authority over the project once construction is completed and routine or periodic maintenance is a part of the proposed action, then the project description will need to include a detailed description of proposed maintenance activities and the manner in which the maintenance activities may affect the vireo and gnatcatcher.

2. **Impacts to existing mitigation sites** – On August 18, 2021, we completed informal consultation with the Corps (Service 2021a) regarding potential effects to listed species from Orange County Water District's (OCWD) implementation of the proposed Groundwater Recharge Facilities Maintenance Plan (Maintenance Plan). As part of

ongoing maintenance of groundwater facilities, OCWD proposed to preserve and manage a total of 107.29 acres of native vegetation, including 31.8 acres in Smith Basin (27.47 acres of existing vegetation[1] and 4.33 acres of restored vegetation) and 48.08 acres in Santiago Basin[2] (34.44 acres of existing vegetation and 13.64 acres of restored vegetation) in accordance with a Habitat Management Plan (HMP; OCWD 2020). At the time the consultation was completed, a total of 4 acres of native communities had been restored in Santiago Basin. The BA acknowledges the impacts to mitigation sites restored by OCWD but does not acknowledge that most of the vegetated areas within Smith Basin and Santiago Basin are anticipated to be preserved and managed by OCWD. Permanent impacts to existing mitigation sites are typically mitigated at a higher ratio than areas that are not existing mitigation sites. Please clarify if the HMP will be amended to identify alternative mitigation sites to compensate for the permanent losses of native vegetation communities that were anticipated to be preserved and managed by OCWD as part of the HMP.

3. Impacts to habitat for the vireo and gnatcatcher

a. Vegetation Mapping – Vegetation maps are provided in the BA, Figures 11 through 13. Existing willow trees (i.e., Goodding's Willow – Red Willow Riparian Woodland and Forest) that occur in Smith Basin are currently mapped as open water area in the BA. The extent of open water displayed on the vegetation maps appears to reflect a relatively uncommon condition when the basins are near water holding capacity; however, we would expect water levels to be lower in the spring and summer when vireo are present. We request that vegetation mapping in Smith Basin be updated to delineate the extent of riparian vegetation that is available when vireos are present.

b. BIO-3 –Proposed measures to offset permanent and temporary impacts to riparian and upland vegetation communities, as described in BIO-3, are inconsistent with the Corps' commitments in prior consultations on Santa Ana River Project (SARP) since 2001 (e.g., Service 2001, 2012, 2015, 2021b, 2021c). We request an opportunity to discuss additional options to fully offset project-related impacts to vireo and gnatcatcher. We have the following specific concerns with BIO-3, as currently proposed:

i. Temporary impacts to 18.59 acres of riparian and upland vegetation are proposed to be restored on site and actively maintained for a 10-year period. The proposed measures do not appear to adequately address the temporal loss of habitats for vireo and gnatcatcher, nor to the existing mitigation sites in Santiago and Smith Basins. We recommend temporary impacts to riparian vegetation and temporary impacts to upland vegetation both be offset consistent with previous Service direction (2021b, 2021c). Additional

[1] Includes 8.6 acres of open water habitat that would not be disturbed.
[2] Santiago Basin is referred to as Blue Diamond and Bond Basins in the BA.

mitigation opportunities likely exist to improve habitat function within the project footprint by replacing mapped non-native vegetation types with native upland and riparian vegetation, particularly upstream of proposed impacts in Smith Basin.

ii. Permanent impacts to upland vegetation are proposed to be offset through restoration of 4.08 acre of coastal sage scrub in lower Santiago Creek channel and purchase of credits from a local mitigation bank. The proposed coastal sage scrub restoration in lower Santiago Creek would occur in two discontinuous areas of the channel, and each is likely insufficient to support gnatcatchers with restoration due to their small size and the isolated/fragmented nature of these areas. The sites are also surrounded by residential development and located over 4 miles from the nearest gnatcatcher-occupied habitat. While the proposed expansion of native vegetation into an area that is currently largely vegetated with non-native trees is desirable, as indicated above, this area is unlikely to become occupied by gnatcatchers. If credits are proposed to be purchased from a mitigation bank, please clarify what bank will be used that has credits available for impacts to the gnatcatcher. Due to the development constraints of the project area, another option to consider would be the acquisition and enhancement of property outside of the project footprint (e.g., adjacent to the Santa Ana River) to expand opportunities for native upland habitat restoration/creation.

iii. According to the BA, permanent impacts to riparian vegetation would be limited to 0.19 acre of mulefat thickets; however, during the December 19th meeting, the Corps clarified that some areas of the project footprint would not support willow trees (e.g., over hardened slopes) following project completion as proposed. If areas mapped as Goodding's Willow – Red Willow Riparian Woodland and Forest cannot be maintained to the current extent that they occur within the project footprint, then we would consider this a permanent impact to Goodding's Willow – Red Willow Riparian Woodland and Forest that should be offset as permanent impacts. If credits are proposed to be purchased from a mitigation bank, please clarify what bank will be used that has credits available for impacts to the vireo. We are not aware of mitigation banks available in this area for such credits. Another option to consider would be the acquisition of property outside of the project footprint (e.g., adjacent to the Santa Ana River) to expand opportunities for native riparian habitat restoration/creation.

The formal consultation process for this project will not begin until we receive the requested information, or a statement explaining why the information cannot be made available. We will notify you that the initiation package is complete when we receive this additional information. This notification will also include the dates within which formal consultation is anticipated to be completed.

As a reminder, the Act requires that after initiation of formal consultation, the Federal action agency make no irreversible or irretrievable commitment of resources that limits future options. This practice ensures that agency actions do not preclude the formulation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

If you have any questions about this response, please contact Christine Medak[3] of my staff.

Sincerely,

for Jonathan D. Snyder
Assistant Field Supervisor

[3] christine_medak@fws.gov

LITERATURE CITED

[OCWD] Orange County Water District. 2020. Orange County Water District Habitat Management Plan. August.

[Service] U.S. Fish and Wildlife Service. 2001. Biological Opinion on the Prado Mainstem and Santa Ana River Reach 9 Flood Control Projects and Norco Bluffs Stabilization Project, Orange, Riverside, and San Bernardino Counties, California On file, Carlsbad Fish and Wildlife Office, Carlsbad, California (FWS-SB-909.6).

[Service] U.S. Fish and Wildlife Service. 2012. Reinitiation of Formal Section 7 Consultation on the Prado Mainstem and Santa Ana River Reach 9 Flood Control Projects and Norco Bluffs Stabilization Project, Orange, Riverside, and San Bernardino Counties, California. On file, Carlsbad Fish and Wildlife Office, Carlsbad, California (FWS-SB/ WRIV/OR-08B0408-11F0551).

[Service] U.S. Fish and Wildlife Service. 2015. Reinitiation of Formal Section 7 Consultation on the Santa Ana River Mainstem Flood Control Project to Address Proposed Reach 9 Bank and Bridge Protection Components (Phases 4, SA, 58, and BNSF Bridge Project) along the Santa Ana River in San Bernardino, Riverside and Orange Counties, California. On file, Carlsbad Fish and Wildlife Office, Carlsbad, California (FWS-OR-08B0408-15F0592).

[Service] U.S. Fish and Wildlife Service. 2021a. Reinitiation of Informal Section 7 Consultation for Orange County Water District Groundwater Recharge Facilities Maintenance Plan, Orange County, California. On file at U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California (FWS-OR-13B0009-13I0017-R001).

[Service] U.S. Fish and Wildlife Service. 2021b. Formal section 7 consultation for the Lower Norco Bluffs Toe Stabilization Project, Riverside County, California. On file at U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California (FWS-WRIV-08B0408-20F1132).

[Service] U.S. Fish and Wildlife Service. 2021c. Formal section 7 consultation for the Prado Dam Spillway Raise and Dam Safety Modifications, Riverside County, California. On file at U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California (FWS-WRIV-08B0408-21F1233).

DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, CORPS OF ENGINEERS
231 SOUTH LASALLE STREET, SUITE 1500
CHICAGO, IL 60604

December 1, 2022

Planning Branch

Scott Sobiech
Field Supervisor
U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
2177 Salk Avenue
Carlsbad, CA 92008

Dear Mr. Sobiech:

The Chicago District, U.S. Army Corps of Engineers is developing a supplemental environmental assessment (SEA) for the Santa Ana River Mainstem, Santiago Creek Component Flood Risk Management Project located in Orange County, California, pursuant to the National Environmental Policy Act (NEPA). The project area consists of the reach of Santiago Creek extending from the Santa Ana Freeway downstream to the creek's confluence with the Santa Ana River mainstem. The project area also consists of the reach of Santiago Creek that flows through the Santiago Recharge Basins (i.e., Blue Diamond Pit, Bond Pit, and Smith Basin). This project is an integral component of the Santa Ana River Mainstem comprehensive flood risk management system that was authorized for construction by Section 401(a) of the Water Resources Development Act (WRDA) of 1986.

The Santa Ana River Mainstem Project (SARMP) was addressed initially in a biological opinion (BiOp) issued on October 1, 1980. Since 1980, a subsequent series of BiOps and amendments have been issued by the U.S. Fish and Wildlife Service ((USFWS) i.e., 1989, 2000, 2001, 2002, 2003, 2013, 2020) addressing the effects of constructing, operating, and maintaining the SARMP on federally listed species and their designated critical habitat. On March 27, 2012, the USFWS issued an amendment (2012 amendment) to the 2001 BiOp to address proposed changes to the mitigation approach for the SARMP that is being applied to the remaining SARMP components.

An official list of Federally listed species under the jurisdiction of the USFWS that may occur within the lower Santiago Creek channel (Project Code: 2023-0019345) and the Santiago Recharge Basins (Project Code: 2023-0019344) was obtained from the USFWS's Information for Planning and Consultation (IPaC) website. Federally listed species with the potential to occur in the project area are:

- Ventura Marsh Milk-*Vetch (Astragalus pycnostachyus var. lanosissimus), endangered*
- Least Bell's Vireo *(Vireo bellii pusillus), endangered*
- Coastal California Gnatcatcher *(Polioptila californica californica), endangered*

- Santa Ana Sucker *(Catostomus santaanae), threatened*
- Monarch Butterfly (*Danaus plexippus), candidate*

There is no designated critical habitat within the action area.

The Corps prepared the enclosed biological assessment (BA) to document the Corps' evaluation of the project impacts on Federally listed species within the action area which is defined as the temporary construction easement areas where channel improvements and shoreline stabilization features will occur, staging areas, haul routes, and proposed enhancement areas (see Figure 4, Figure 5, and Figure 6 of the enclosure). Based on a review of the best available scientific information, the Corps has determined that the proposed action will have no effect on Ventura marsh milk-vetch, Santa Ana sucker, and monarch butterfly and may affect and is likely to adversely affect the least Bell's vireo and the coastal California gnatcatcher. Reference the biological assessment for a complete evaluation and substantiating rationale in support of this effect determination.

As part of the SEA, we are initiating formal consultation with the USFWS under the authority of and in accordance with Section 7 of the Endangered Species Act of 1973 (16 U.S.C 1531 et seq.), as amended. We appreciate your cooperation on this matter and respectfully request to begin the formal consultation process which can take up to 90 days after receipt of this letter. In addition, we respectfully request the USFWS to prepare a biological opinion and incidental take permit, if deemed necessary, within 45 days of completion of formal consultation.

We will continue to coordinate this effort with you as the project progresses and the NEPA document is developed. Should you have any questions, comments, or wish to request either an extension for response or a meeting to discuss this request, please contact Ms. Shawna Herleth-King, Regional Technical Specialist in my Civil and Public Works Planning Branch, at (312) 846-5407 or Shawna.s.herleth-king@usace.army.mil.

Sincerely,



Susanne J. Davis, P.E.
Chief, Planning Branch
Chicago District

Enclosure

Draft Biological Evaluation of Threatened and Endangered Species for the Santa Ana River Mainstem, Santiago Creek Flood Risk Management Project, Orange County, California

Under the Endangered Species Act of 1972, As Amended

Submitted by:

U.S. Army Corps of Engineers Chicago District
231 South LaSalle Street, Suite 1500
Chicago, IL 60604

Submitted to:

U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
2177 Salk Avenue – Suite 250
Carlsbad, CA 92008

December 1, 2022

Last Revision: August 9, 2023

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Attachment B – Santiago Creek Aquatic Resources Report
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1.0 Introduction

This Biological Evaluation (BE) for the Santiago Creek component (Proposed Action) of the Santa Ana River Mainstem Project (SARMP) has been prepared by the U.S. Army Corps of Engineers (Corps) in accordance with the requirements set forth under regulations for implementing Section 7 of the Endangered Species Act (ESA) (50 C.F.R. § 402). This BE evaluates the potential effects of the Proposed Action on listed and proposed species and designated and proposed critical habitat and determines whether any species or habitat are likely to be adversely affected by the Proposed Action, as required in 50 C.F.R. § 402.12.

1.1 Background

The Proposed Action is located along Santiago Creek in the County of Orange, California. For the purposes of this document, the project site consists of the reach of Santiago Creek extending from the Santa Ana Freeway downstream to the creek's confluence with the Santa Ana River mainstem. The project site also consists of the reach of Santiago Creek that flows through the Santiago Recharge Basins (i.e., Blue Diamond Basin, Bond Basin, and Smith Basin). It is an integral component of the Santa Ana River mainstem comprehensive flood risk management system that was authorized for construction by Section 401(a) of the Water Resources Development Act (WRDA) of 1986. Figure 1 shows the regional location of the project sites.

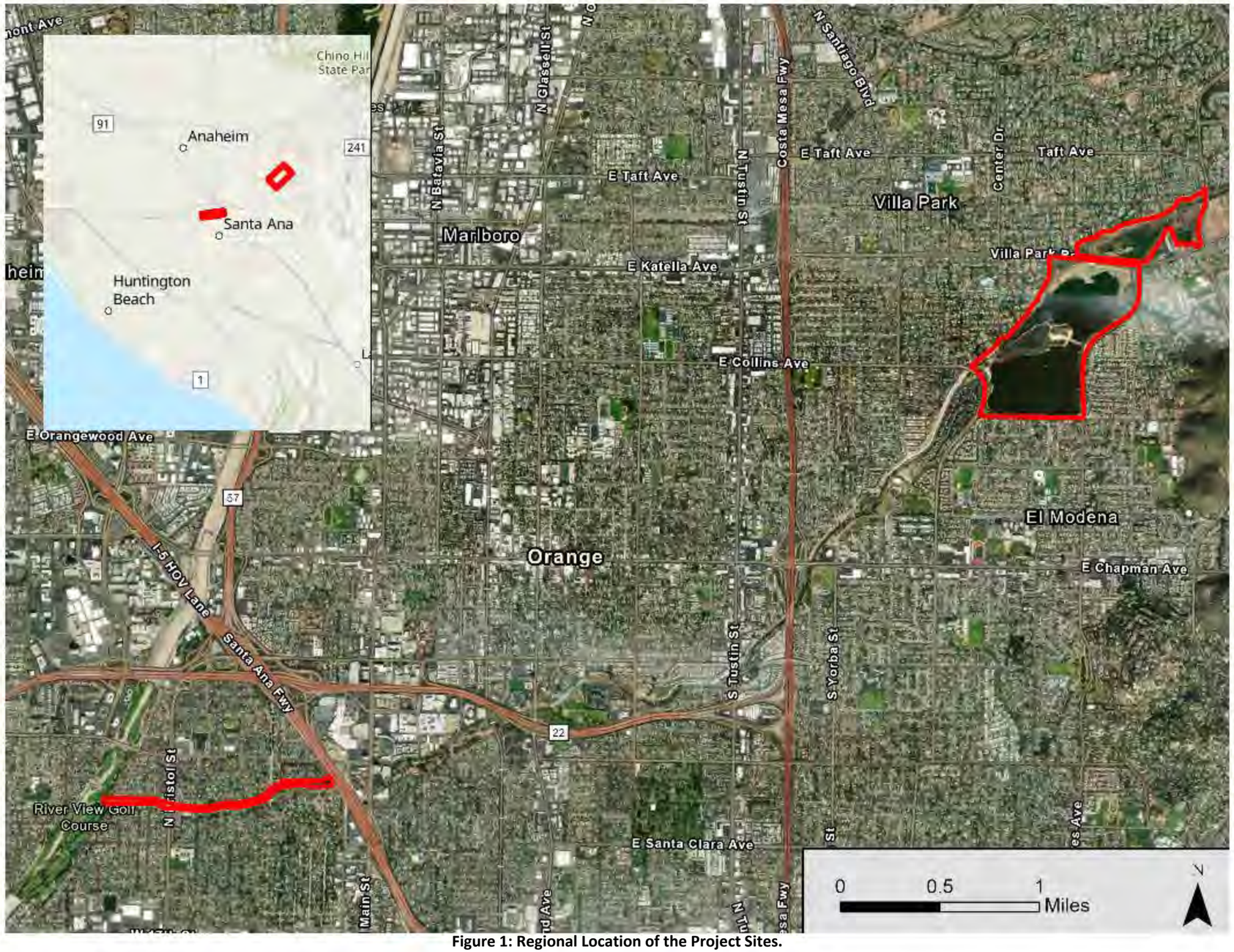


Figure 1: Regional Location of the Project Sites.

1.2 Purpose and Need of the Proposed Action

The purpose of the Proposed Action is to contain the 1% annual exceedance probability (AEP) floods, providing flood protection for approximately 74,000 people living in the vicinity of the Santiago Creek project area (2017 population).

As discussed in the 1988 Supplemental Environmental Impact Statement (SEIS), the need for the Proposed Action is due to significant flooding along the Santa Ana River — including Santiago Creek — within Orange, Riverside, and San Bernardino counties in California, which has been documented since at least 1897. According to Corps documentation, the largest recorded flooding event by peak flow occurred in 1938 following a series of large storm events, the flooding caused at least $4,000,000 in damages within Orange County along (1938 price levels) (USACE, 1980, 1988, and 2018). In February 1969, a series of significant storms resulted in approximately $22,000,000 damages within Orange County (1969 price levels) and at least twelve deaths. Flooding at Santiago Creek is a continuing concern among stakeholders. Unprotected banks along Santiago Creek are subject to erosion which could cause damage to residential and commercial developments along the creek (USACE, 1988).

1.3 Threatened, Endangered, Proposed Threatened or Proposed Endangered Species, Designated Critical Habitat

An official species list for the lower Santiago Creek channel (Project Code: 2023-0019345) and the Santiago Recharge Basins (Project Code: 2023-0019344) was obtained from the U.S. Fish and Wildlife Service's Information for Planning and Consultation (IPaC) website (Attachment A). Table 1 contains the federally listed and proposed species and designated and proposed critical habitat that may be present in the vicinity of the project sites (defined in Section 1.5.2) and the Corps' assessment of whether the Proposed Action is likely to adversely affect such species or habitat based on habitat suitability and best scientific and commercial data available. This table includes species that are part of the Corps' formal consultation request for the Proposed Action under Section 7 of the ESA, as well as species for which the Corps has made a no effect determination. Supporting analyses are provided in Chapters 2 and 3 of this document.

Table 1: Federally Endangered, Threatened, Proposed Endangered or Proposed Threatened Species, Designated or Proposed Critical Habitat in the Vicinity of the Project Sites.

Common Name	Scientific Name	Status	Corps' Determination
Ventura Marsh Milk-vetch	*Astragalus pycnostachyus var. lanosissimus*	E	No Effect
Least Bell's Vireo	*Vireo bellii pusillus*	E	May Affect – Likely to Adversely Affect
Coastal California Gnatcatcher	*Polioptila californica californica*	E	May Affect – Likely to Adversely Affect
Santa Ana Sucker	*Catostomus santaanae*	T	No Effect
Monarch Butterfly	*Danaus plexippus*	C	No Effect
E = endangered, T = threatened, C = candidate			

Critical habitat has not been designated within the project area for the species listed in Table 1.

1.4 Consultation History

The United States Fish and Wildlife Service (USFWS) has issued a series of biological opinions (i.e., USFWS 1980, 1989, 2000, 2001, 2002, 2003, 2004, 2012, 2013a, 2013b, 2020) addressing the effects of

constructing, operating, and maintaining the SARMP on federally listed species and their designated critical habitat.

The SARMP was addressed initially in a biological opinion issued on October 1, 1980 (USFWS, 1980). As noted above, a subsequent series of biological opinions and amendments have been issued. On December 5, 2001, the USFWS issued a biological opinion (2001 biological opinion) that addressed, in part, components of the SARMP that were added or modified.

On March 27, 2012, the USFWS issued an amendment (2012 amendment) to the 2001 biological opinion to address proposed changes to the mitigation approach for the SARMP that will be applied to the remaining SARMP components (USFWS, 2012); that document is incorporated by reference herein.

On February 25, 2022, the Corps held a teleconference with the USFWS to discuss the Santiago Creek Project. Subsequent meetings with the USFWS have been held via teleconference on May 27, 2022; July 15, 2022; September 19, 2022; November 7, 2022; December 19, 2022; January 17, 2023; January 30, 2023; February 13, 2023; February 27, 2023; April 5, 2023; April 17, 2023; May 4, 2023; May 24, 2023; June 1, 2023; July 10, 2023; July 24, 2023; and August 8, 2023, to discuss project design modifications and potential minimization measures that could be implemented to avoid or minimize impacts to known listed species within the vicinity of the project sites.

1.5 Description of Action Area and Proposed Action

1.5.1 Project Location

The Proposed Action is in the cities of Orange, Villa Park, and Santa Ana, Orange County, approximately 27 miles southeast of downtown Los Angeles, and 10 miles upstream of the Pacific Ocean. The lower Santiago Creek channel Proposed Action site is generally located south of State Route 22, north of 17th Street, west of Interstate 5, and east of the Santa Ana River mainstem (Figure 2). The Santiago Recharge Basins Proposed Action site is located generally south of Taft Avenue, north of Chapman Avenue, west of Cannon Street, and east of State Route 55 (Figure 3). The Proposed Action is located on county land.



Figure 2: Lower Santiago Creek Channel Project Site.



Figure 3: Santiago Recharge Basins Project Site.

1.5.2 Action Area and Project Footprint

The action area is defined in 50 CFR 502.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." Therefore, the action area is the entire lower Santiago Creek channel and the entire extent of the Santiago Recharge Basins as shown in Figure 2 and Figure 3, respectively. The action area was determined by accounting for direct impacts of the Proposed Action and indirect impacts from the Proposed Action such as noise and vibrations that extend beyond the project footprint. The project footprint is being defined in this BE as the area where direct effects of the Proposed Action could occur. The project footprint includes the areas where channel improvements, shoreline stabilization, and grading will occur as well as, staging areas, access areas, haul routes, and proposed restoration areas (Figure 4, Figure 5, and Figure 6).



Figure 4: Project Footprints of the Proposed Action (i.e., construction areas, staging areas, and access roads) within the Lower Santiago Creek Channel Action Area.



Figure 5: Project Footprints of the Proposed Action (i.e., temporary construction areas, staging areas, and access roads) within the Blue Diamond and Bond Basins Action Area.

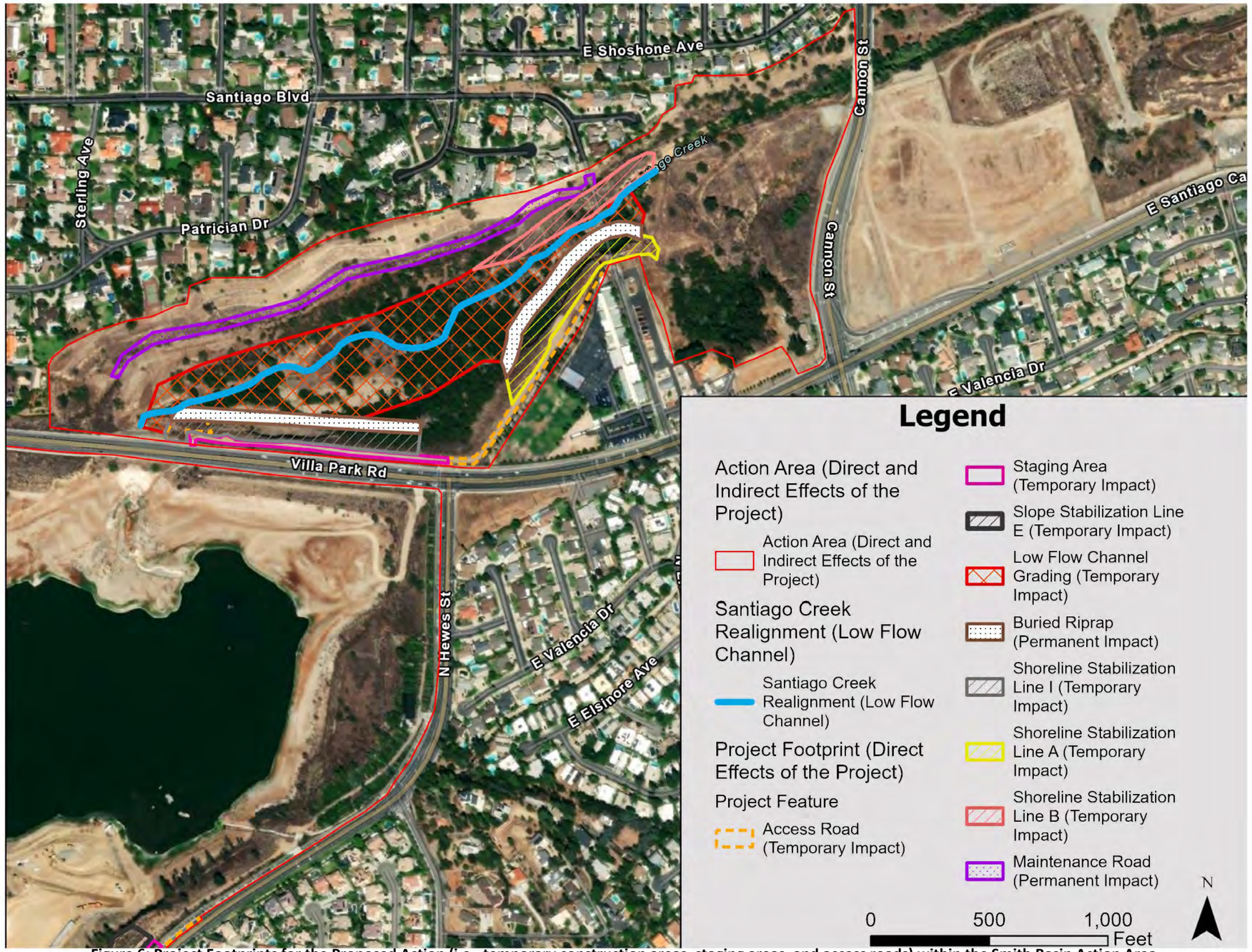


Figure 6: Project Footprints for the Proposed Action (i.e., temporary construction areas, staging areas, and access roads) within the Smith Basin Action Area.

1.5.3 Detailed Description of Proposed Action

Major elements of the Proposed Action were described in the 1988 design in the Phase II GDM, but were updated based on existing conditions, current design criteria, and current design practice. The following are major elements of the Proposed Action:

Reservoir Slope Stabilization – The existing slopes of the Santiago Recharge Basins require repair and is necessary to accommodate the 1% AEP water surface elevation. Several locations have been identified along the basins which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H): 1 Vertical (V), installation of retaining walls, or installation of armoring. As shown in Figure 5, buttress fill will be used to stabilize slopes Line H, Line F, and Line E and to construct the bike trail berm within the Blue Diamond and Bond basins project site. At this stage of design, riprap is not necessary to stabilize the above slopes; however, two concrete tie-back walls measuring approximately three feet in width are required for stabilization of Line F. The tie-back walls would be similar to what has already been constructed to stabilize the slope that runs along Bond Avenue in the Blue Diamond and Bond basins. As shown in Figure 6, buttress fill will be used to stabilize slopes Line B, Line A, and Line I within the Smith Basin project site. At this stage of design, riprap is necessary to stabilize Line A and Line I, but not Line B. For Line A, riprap would extend from the toe of the slope and up the slope for approximately 45 feet. Similarly, for Line I riprap would extend from the toe of the slope and up the slope for approximately 40 feet. After the riprap, buttress fill with no riprap would be used to stabilize the slope. In addition, riprap placed to stabilize these two slopes would be buried with approximately two feet of soil allowing for native vegetation to be replanted on top of the riprap. Areas with just buttress fill would also be replanted with native vegetation. The replanting scheme would include mulefat on top of the buried riprap graduating to coastal sage scrub where only buttress fill is located.

In addition to reservoir slope stabilization within Smith Basin, the floor of Smith Basin will also require rehabilitation to protect the repaired slopes from future erosion. Currently, the existing creek channel flows head on into Line A and portions of Line I. Just to repair and stabilize the slopes, the existing creek channel would need to be filled in. Therefore, the Proposed Action includes grading a low flow channel more through the center of Smith Basin and redirecting the existing channel to this location. If in the future the channel moves back south towards Line A and Line I there should be no need to redirect the channel a second time as the slopes will have been repaired and stabilized at the toe with buried riprap. The low flow channel through Smith Basin would be an approximately 1-foot depression by approximately 20 feet in width through the middle of Smith Basin. The design of the graded out depression does not include stream veins or stream training structures. Once the low flow channel is created and the slopes have been stabilized, replanting of native riparian vegetation (i.e., willow and mulefat) within the bottom of Smith Basin would occur.

Lastly, reservoir slope stabilization also includes the rehabilitation of a historic maintenance access road within Smith Basin. The access road is located along the toe of the northern slope of Smith Basin and would be restored and graded to its original condition. This 12-foot wide road would become the main access into and out of the bottom of Smith Basin and would be accessed from Santiago Road located along the northeast edge of Smith Basin.

Channel Improvements – Flow velocities within Santiago Creek are erosive during large storm events (approximately 9-13 feet per second during the 1% AEP), potentially compromising adjacent properties along the highly urbanized floodway. To rehabilitate and improve the creek's flood conveyance capability, the Proposed Action will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will then be covered with native substrate to (i) enhance access for ongoing operation and maintenance, (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) maintain existing aesthetics; and (iv) enhance environmental integrity of the stream corridor. The Proposed Action will involve excavating surficial material from the channel bottom and installing the buried riprap. Re-placing that excavated surficial substrate overlying the riprap layer will stabilize the slopes, maintain the channel's natural appearance, and allow for establishment of native, ecologically desirable vegetation. A channel operation and maintenance program will be necessary to prevent invasive vegetation, large woody growth, debris, and other flow inhibiting concerns from re-establishing within the channel.

In total, the proposed stream stabilization measures include 6,400-feet of trapezoidal channel armored with buried riprap. The proposed cross section includes a gravel bedding layer and riprap armor layer. The riprap armor layer would be covered with approximately one (1) foot of native substrate harvested from the channel. The surficial layer will provide suitable substrate for native vegetation growth. The planting palette is comprised of two native vegetation species mixes, a low-growth mix for the channel invert and a coastal sage scrub mix for the channel bank (i.e., mitigation areas). The channel invert width varies from 30-feet to 80-feet, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitations and will be installed to a slope of 1.75H:1V.

The removal of trees in the downstream channel right-of-way would be necessary to complete grading and channel construction. The trees in the downstream reaches are primarily invasive species such as eucalyptus, black locust, and tree of heaven. To improve the vegetation quality in the channel, native vegetation would be established along the top of the bank and side slopes of the lower Santiago Creek channel after earthmoving and channel construction is complete. Native plantings would consist of container plantings and hydroseed. Drip irrigation would be installed for approximately 2 to 3 years to allow plant establishment, and monitoring and maintenance of the restored areas would occur for a 5-year period. The goal of the restored habitat is to create a self-sustaining ecosystem that would require minimal long-term maintenance. Once the 5-year monitoring and maintenance period is over, the Corps would provide the non-federal sponsor with an Operations and Maintenance (O&M) manual.

Floodwalls – Floodwalls are required in select locations along Santiago Creek under the Proposed Action. Floodwalls will extend for approximately 2,600 feet between Bristol Avenue and Flower Street on both the north and south sides of the lower Santiago Creek channel, and for 900 feet on the north side of the lower Santiago Creek channel west of Bristol Avenue. The floodwalls will be steel sheetpile varying in total length from 19 to 30 feet with a reinforced concrete cap extending from two feet below the existing grade to the design elevation based on the hydraulic model for the system. Typical total height of the concrete cap is four to five feet. The location of the wall alignment is at the top of the proposed bank in all areas defined above.

In summary, Table 2 shows a comparison between the No Change Alternative (i.e., the 1988 GDM Phase II design) and the Proposed Action.

Table 2: Differences between the No Change Alternative and the Proposed Action Alternative.

No Change Alternative	Proposed Action	Difference
Project Features		
Reservoir Flow Regulation *Outlet Structure* -Construction of gated outlet structure at Prospect Street (southwest corner of Santiago Recharge Basins) to provide outflow regulation. -Outlet structure controlled and regulated so that peak discharge does not exceed 3,500 cubic feet per second (ft^3/s) during the 100-year design flood.	**Reservoir Flow Regulation** *Outlet Structure* -The outlet structure will no longer be constructed.	**Reservoir Flow Regulation** *Outlet Structure* -The outlet structure that was part of the No Change Alternative will no longer be constructed under the Proposed Action Alternative.
Overflow Structure -Grouted riprap overflow structure located along the left bank of the existing channel of Santiago Creek upstream of Prospect Street. Overflow structure will provide 2-feet (ft) of freeboard for the design flood.	*Overflow Structure* -The overflow structure will no longer be constructed.	*Overflow Structure* -The overflow structure that was part of the No Change Alternative will no longer be constructed under the Proposed Action Alternative.
Outlet Channel -Rectangular concrete box culvert under Prospect Street. Downstream of box culvert 300-ft-long concrete transition channel. Downstream of the transition, a trapezoidal riprap channel for 4,000 ft (stopping near Walnut Avenue).	*Outlet Channel* -The outlet channel will no longer be constructed.	*Outlet Channel* -The outlet channel that was part of the Previously Approved Design will no longer be constructed under the Proposed Action Alternative.

No Change Alternative	Proposed Action	Difference
Project Features		
Reservoir Slope Stabilization -Smith Basin – Santiago Road (Line A) for 1,000-ft compacted buttress fill 2 Horizontal (H) :1 Vertical (V). -Smith Basin – Santiago Road (Line B) for 500-ft compacted buttress fill at 2H:1V. -Santiago Creek Interconnecting Channel (Line C) for 500-ft excavated trapezoidal channel. -Saddle Area Interconnecting Channel (Line D) for 500-ft excavated trapezoidal channel. -Blue Diamond Basin – Hewes Avenue (Line E) for 300-ft excavated and compacted buttress fill 2H:1V. -Bond Basin – Hewes Avenue (Line F) for 1,400 ft excavation and compacted fill with tie back wall and buttress slope at 2H:1V. -Bond Basin – Bond Avenue (Line G) for 1,700 ft excavation and compacted buttress fill at 3H:1V along with 10-ft gabion retaining wall and tie back wall. -Bond Basin – Prospect Street (Line H) for 400-ft excavation and compacted buttress fill at 2H:1V.	**Reservoir Slope Stabilization** -Smith Basin – Santiago Road (Line A) for 1,000-ft compacted buttress fill with buried riprap at 2.5H:1V. -Smith Basin – Santiago Road (Line B) for 500-ft compacted buttress fill at 2H:1V. -Smith Basin – Villa Park Road (Line I) for 750 ft excavation and compacted fill at 2H:1V -Smith Basin – Rehabilitation of basin to include debris removal, floor regrading, 12 ft wide maintenance road rehabilitation, and replanting. -Blue Diamond Basin – Hewes Avenue (Line E) for 300-ft excavation and compacted fill at 2H:1V. -Bond Basin – Hewes Avenue (Line F) for 1,400 ft excavation and compacted fill with tie back wall and buttress slope at 2H:1V. -Bond Basin – Prospect Street (Line H) for 400-ft excavation and compacted fill at 2H:1V. -Bond Basin – Prospect Street (Line K) for 150 ft compacted fill berm along bike tunnel.	**Reservoir Slope Stabilization** -The No Change Alternative included 6,300 linear ft of reservoir slope stabilization. -The Proposed Action includes 4,500 linear ft of reservoir slope stabilization (decrease of 1,800 linear ft).

No Change Alternative	Proposed Action	Difference
Project Features		
Channel Improvements -Downstream of the Santa Ana Freeway to confluence of Santiago Creek with the Santa Ana River a 6,400 ft long riprap trapezoidal channel. -Construction of 24-inch thick, 50-ft-long grouted rock apron placed 10 ft below the design invert of the mainstem at the confluence of Santiago Creek with the Santa Ana River.	**Channel Improvements** -Downstream of the Santa Ana Freeway to confluence of Santiago Creek with the Santa Ana River install buried riprap along full downstream channel extent. Riprap will be buried with native substrates and drought resistant vegetation will be installed along the channel banks.	**Channel Improvements** -The Proposed Action includes the same amount of linear feet of channel (6,400), but design has changed to an 'engineering with nature' design. -The Proposed Action does not include construction of rock apron at confluence (already constructed).
Recreational Features -Bicycle, hiking, and jogging trail running upstream from Walnut Avenue to Prospect Street on the maintenance access road. -Trail rest area developed on the west side of Hewes Road directly adjacent to an as yet unnamed County Regional Park.	**Recreational Features** -The recreational features will no longer be constructed.	**Recreational Features** -The Proposed Action does not include bicycle/hiking/jogging trail (already constructed). -The Proposed Action does not include trail rest area (regional park never constructed).
Floodwalls -No floodwalls were included under the No Change Alternative.	**Floodwalls** -West of Bristol Avenue; north side of the channel only; total 900 feet concrete topped steel sheetpile floodwall. -Bristol Avenue to Flower Street; north and south sides of the channel; total 5,200 feet (2,600 feet on each side) concrete topped steel sheetpile floodwall.	**Floodwalls** -The Proposed Action includes a total of 6,100 ft of floodwall which was not part of the No Change Alternative.

Staging Areas

A total of six staging areas are included in the Proposed Action. Within the lower Santiago Creek channel, moving downstream to upstream, the first of two staging areas (approximately 0.45 acre in size) would be located just downstream of the Bristol Street Bridge within the unvegetated channel of Santiago Creek, with access to the staging area from Bristol Street (Figure 4). The second staging area (approximately 0.63 acre in size) within the lower Santiago Creek channel would be located just

upstream of Flower Street Bridge within the unvegetated channel of Santiago Creek, with access to the staging area from Flower Street.

Within the Blue Diamond and Bond Basins of the Santiago Recharge Basins, moving south to north, the first of three staging areas (approximately 0.94 acre in size) would be located near the corner of Prospect Street and Bond Avenue, with access to the staging area from Prospect Street (Figure 5). The second staging area (approximately 0.67 acre in size) would be located near the corner of Bond Avenue and Hewes Street, with access to the staging area from Hewes Street (Figure 5). The third staging area (approximately 0.81 acre in size) would be located adjacent to Hewes Street across from the dead-end Stetson Lane, with access to the staging area from Hewes Street (Figure 5).

Within Smith Basin of the Santiago Recharge Basins, the only staging area (approximately 1.41 acres) would be located adjacent to Villa Park Road between Lemon Street and Hewes Street, with access to the staging area from Villa Park Road (Figure 6).

Site Access and Haul Routes

Construction vehicles would access the lower Santiago Creek channel project area using existing Orange County Public Works owned maintenance access ramps at Bristol Road Bridge and Flower Street Bridge (Figure 4). Construction and operation of the Proposed Action would utilize existing streets, existing maintenance access ramps, and channel bottom for site access. Construction vehicles would access the Blue Diamond and Bond Basins project area using existing Orange County Water District owned maintenance access ramps at Bond Avenue and Hewes Street (Figure 5). Construction and operation of the Proposed Action would utilize existing streets, existing maintenance access ramps, and existing maintenance roads within the project area. Construction vehicles would access the Smith Basin project area using existing Orange County Water District owned maintenance access ramps at Villa Park Road and Santiago Boulevard (Figure 6). In addition, within Smith Basin an old maintenance road along the north side of the basin would be improved as part of the Proposed Action and used for site access during construction as well as future operations and maintenance activities (located off Santiago Boulevard). The improved maintenance road within Smith Basin will cover approximately two acres.

Haul roads requiring vehicular access would be needed during the removal of vegetation and sediment, to transport equipment, fill material, and other construction materials. Construction equipment and haul trucks would utilize existing highways, roadways, existing maintenance roads, and stream channel for the Proposed Action. The haul route for transportation of fill material begins at Stone Valley Materials and runs approximately 41.3 miles to the project area (Figure 7). The haul route primarily follows State Route 60 (west to east running paved road), State Route 57 (north to south running paved road), and Interstate 5 (north to south running paved road). The haul route is on existing paved road that have relatively consistent use by vehicles.

For disposal, the haul route would begin at the project area and end at a commercial landfill, Prima Deschecha Landfill, located approximately 30.2 miles south of the project area (Figure 8). Construction equipment and haul trucks would utilize the project areas existing maintenance roads and existing roadways (e.g., Interstate 5 and State Route 74).

Organic materials, trees, shrubs, as well as inorganic materials, would be disposed of by hauling to the Prima Deschecha Landfill (Figure 8). Disposal of these materials by burning or burying at the project area would not be permitted. Although it is not anticipated that hazardous substances would be present in

the material removed, prior to disposal, the collected material would undergo testing (by the contractor) to determine appropriate disposal techniques. If potentially toxic soils are encountered, lay down yards for drying and/or sorting of materials are located in the cities of Pomona or Riverside and would be used for disposal.



Figure 7: Proposed Haul Route from Quarry to Proposed Action Area.

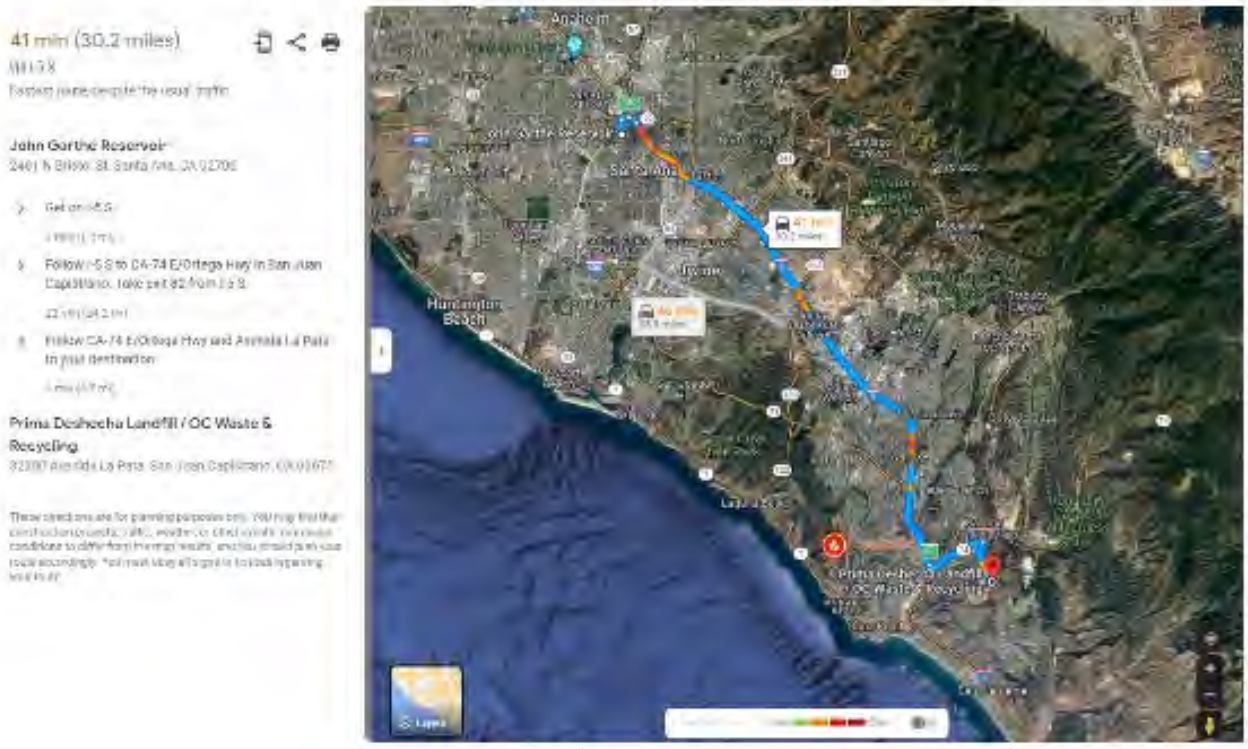


Figure 8: Proposed Haul Route from Proposed Action Area to Landfill.

Construction Equipment

Construction equipment would likely include a combination of water trucks, waste trucks, haul trucks, crawler and front-end loaders, dozers, skid-steers, excavators, loaders, pile driver, and pickup trucks.

Construction Schedule

Construction is scheduled to commence early 2025 through 2027. Vegetation clearing would only occur during periods when least Bell's vireo ((LBVI) *Vireo bellii pusillus*) and coastal California gnatcatcher ((CAGN) *Polioptila californica californica*) are not nesting (February 15 through August 15). It is possible that the Proposed Action would be constructed in stages, with multiple start dates and construction periods for various features depending on funding, environmental windows, and weather delays. Construction phasing may result in an extension of the overall project duration beyond Winter 2027.

Proposed construction hours would be 7:00 a.m. to 7:00 p.m., Monday through Friday, and 8:00 a.m. to 7:00 p.m. on Saturday. Occasional overtime work may be required to maintain the construction schedule, but timing would comply with local noise ordinances.

Future Operation, Maintenance, Repair, Replacement, and Rehabilitation

Maintenance, including routine inspections and minor repairs, of the Santiago Creek project and its associated project features, would be required after construction is completed. The following activities may occur:

- Routine and special inspection with pickup trucks and sport utility vehicles, as needed, and up to daily during flood events.
- Repair of maintenance roads and ramps is anticipated every few years.
- Ecological maintenance activities outside the bird nesting season (i.e., February 15 – August 15), including weeding, herbicide application, and re-seeding.
- Vegetation management within the lower Santiago Creek channel and only where floodwalls are located. Vegetation management in the areas with floodwalls would be in accordance with Corp of Engineers Engineering Pamphlet 1110-2-18; at a minimum 15-feet down slope of the floodwall would need to be a vegetation free zone (VFZ). The VFZ applies to all vegetation except for grasses for the purpose of erosion control.
- Periodic mending of existing fencing and gates.
- Periodic graffiti removal and repair of vandalized infrastructure.

The above maintenance activities will be limited to the project footprint. Maintenance activities occurring outside the project footprint are not covered under this BE.

Rarely, following large and erosive flood flows, larger-scale maintenance and repairs may be required along the channel and the toe of the basin slopes, which could require access and use of heavy equipment within the floodplain adjacent to the structure. Equipment would need to traverse the channel and maintenance roads along the Santiago Recharge Basins. A temporary work area may need to be established around repair sites. The local sponsor would be required to obtain emergency or standard permits from regulatory agencies, including Corps Regulatory, who would coordinate and consult, if needed, with the USFWS. These permits would likely require active habitat restoration of temporary construction and access roads. It is likely that a storm event large enough to damage the channel or basin slopes would also have removed vegetation in the immediate area, but specific impacts cannot be evaluated until or unless damage occurs, and repair work is defined.

1.5.4 Measures Intended to Avoid, Minimize, or Offset Effects of the Proposed Action

Regarding potential effects of the Proposed Action, there would only be potential effects to federally listed species within the Blue Diamond and Bond basins and Smith Basin. There are no federally listed species or their preferred habitat within the lower Santiago Creek channel, therefore, this component of the Proposed Action is not discussed further in this BE.

The Proposed Action would impact approximately 25.99 acres of vegetation within the 133.86 acre project footprint. Of the total 25.99 acres impacted, 3.84 acres are unvegetated channel or developed vegetation cover types. Since the above cover types are low quality and are generally maintained maintenance roads, the Corps does not recommend mitigation for this acreage.

Of the remaining 22.15 acres of riparian and upland habitat impacts, 3.39 acres are permanent impacts due to either rehabilitation of a maintenance road along the north side of Smith Basin, buried riprap in Smith Basin which would not have sufficient soil cover to support willow habitat, and construction of two concrete tie-back walls along Hewes Street within the Blue Diamond and Bond Basins. In addition, 0.24 acres of the above 3.92 acres are permanent impacts to existing restored habitat mitigation sites within the Blue Diamond and Bond Basins (Figure 9). The remaining 18.76 acres of impacts due to project construction are considered temporary by the Corps. The temporary impacts would be due to grading of the low flow channel within Smith Basin, shoreline stabilization of the slopes within Santiago

Recharge Basins, and replanting stabilized slopes with native vegetation (Figure 10 and Figure 11). Potential planting palettes for the habitat types identified in Figure 10 and Figure 11 are shown in Table 3 through Table 5. In addition to restoring native vegetation where there are temporary impacts, conservation measures would also be employed, to the extent practicable, to minimize significant effects of the Proposed Action during construction.

Table 3: Coastal Sage Scrub Habitat Plant Palette.

Coastal Sage Scrub Plant Palette	
Scientific Name	**Common Name**
Acmispon glaber	Deerweed
Acmispon americanus	Purshing lotus
Artemisia californica	California Sagebrush
Collinsia heterophylla	Chinese houses
Encelia californica	Bush sunflower
Eriogonum fasciculatum	California buckwheat
Eriophyllum confertiflorum	Golden yarrow
Eschscholzia californica	California poppy
Festuca microstachys	Small fescue
Isocoma menziesii	Coast goldenbush
Lasthenia californica	Dwarf goldfields
Lupinus succulentus	Arroyo lupine
Mimulus aurantiacus puniceus	Mission red monkeyflower
Salvia apiana	White sage
Salvia mellifera	Black sage
Sisyrinchium bellum	Blue-eyed grass
Stipa pulchra	Purple needlegrass

Table 4: Mulefat Thicket Plant Palette.

Mulefat Thicket Plant Palette	
Scientific Name	**Common Name**
Baccharis pilularis	Coyote Bush
Baccharis salicifolia	Mulefat
Artemisia douglasiana	Mugwort
Artemisia dracunculus	Tarragon
Isocoma menziesii	Coast goldenbush

Table 5: Riparian Southern Willow Scrub Plant Palette.

Riparian Southern Willow Scrub Plant Palette	
Scientific Name	**Common Name**
Artemisia douglasiana	Douglas Mugwort
Rosea californica	Wild Rose
Urtica dioica	Stinging Nettle
Ambrosia psilostachya	Western Ragweed
Stipa lepida	Foothill Needlegrass
Artemisia dracunculus	Tarragon
Elymus triticoides	Beardless Wild Rye

Toxicodendron diversilobum	Poison Oak
Acmispon pursianus	Deerweed
Solanum douglasii	Douglas' Nightshade
Platanus racemosa	Western Sycamore
Salix goodingii	Goodings' Black Willow
Salix laevigata	Red Willow
Salix lasiolepsis	Arroyo Willow
Salix exigua	Sandbar Willow
Baccharis pilularis	Coyote Bush
Baccharis salicifolia	Mulefat
Rubus ursinus	California Blackberry
Cyperus odoratus	Fragrant Flatsedge
Juncus acutus	Diffuse Rush
Elymus condensatus	Giant Wild-rye
Elymus triticoides	Beardless Wild-rye

The vegetation cover types within the project footprint were categorized as either being riparian and wetland vegetation, upland vegetation, or other vegetation types. Vegetation categories within the riparian and wetland vegetation cover types (i.e., Goodding's Willow – Red Willow Riparian Woodland and Forest and Mulefat Thickets) would provide suitable habitat for LBVI. Certain upland vegetation cover types (i.e., California Sagebrush – Black Sage Scrub, Brittle Bush Scrub, and Laurel Sumac Scrub) would provide suitable habitat for CAGN.

To offset impacts to LBVI habitat (i.e., riparian and wetland vegetation cover types), the Corps proposes a 5:1 ratio for permanent impacts and a 2:1 ratio for temporary impacts (similar to ratios outlined in the Formal Section 7 Consultation for the Lower Norco Bluffs Toe Stabilization Project [FWS-WRIV-08B0408-20F1132]). To offset impacts to upland vegetation cover types, the Corps proposes a 3:1 ratio for permanent impacts and a 2:1 ratio for temporary impacts (similar to ratios outlined in the Formal Section 7 Consultation for the Prado Dam Spillway Raise and Dam Safety Modifications [FWS-WRIV-08B0408-21F1233]). Table 6 summarizes the impacts, offset ratios, and the number of acres intended to offset permanent and temporary impacts of the Proposed Action. A detailed description of vegetation types is provided in Section 2.2.

A combined total of 31.63 acres of native vegetation would need to be restored offsite to offset permanent and temporary impacts to LBVI and CAGN habitat.

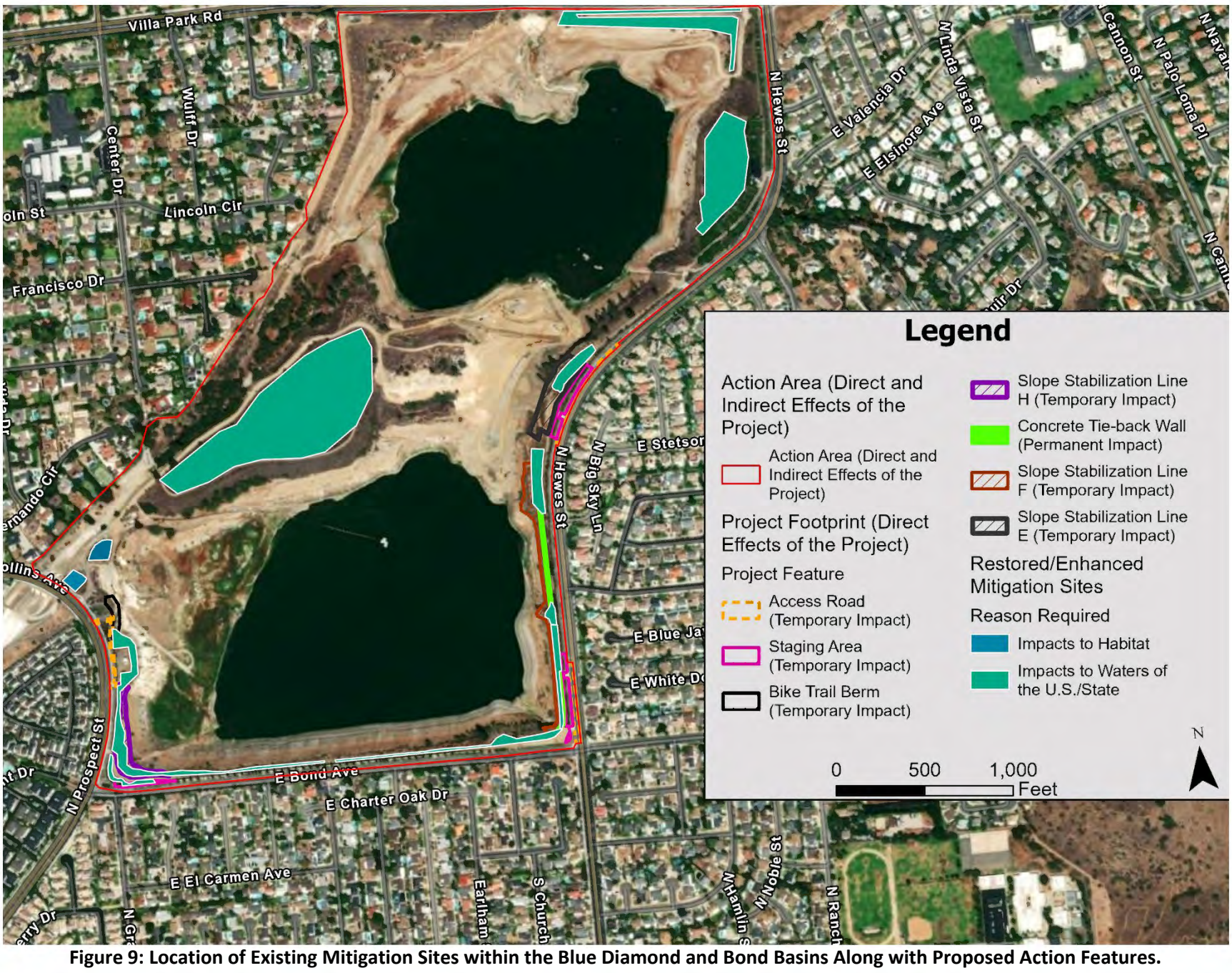


Figure 9: Location of Existing Mitigation Sites within the Blue Diamond and Bond Basins Along with Proposed Action Features.



Figure 10: General Overview of Planting Scheme for Temporarily Impacted Areas in the Blue Diamond and Bond Basins.



Figure 11: General Overview of Planting Scheme for Temporarily Impacted Areas in Smith Basin.

Vegetative Cover Categories (see Figure 12, Figure 13, Figure 14, and Table 3) Include:

1. Goodding's Willow – Red Willow Riparian Woodland and Forest
2. Mulefat Thickets
3. California Sagebrush – Black Sage Scrub
4. Brittle Bush Scrub
5. Fountain Grass Swards
6. Laurel Sumac Scrub
7. Upland Mustards or Star-Thistle
8. Wild Oats and Annual Brome Grasslands
9. Unvegetated Channels and Slopes
10. Developed

Habitat Restoration Activities Would Meet the Following Conditions:

- Restoration activities must be initiated immediately following the completion of the construction of the Proposed Action; exotic/invasive removal of plant species will only occur during periods when LBVI and CAGN are not nesting (i.e., between February 15 and August 15).

Table 6: Summary of Proposed Offset and Vegetation Categories.

Plant Community Type	Total Acreage	Impact Type	Acres Impacted	Mitigation Ratio	Acres of Onsite Restoration	Acres of Offsite Mitigation
Riparian and Wetland Vegetation Types						
Goodding's Willow – Red Willow Riparian Woodland and Forest	21.73	Permanent	1.29	5:1	0.00	6.45
		Temporary	9.19	2:1	9.19	9.19
Mulefat Thickets	4.47	Permanent	0.17	5:1	0.00	0.85
		Temporary	1.43	2:1	2.72	1.43
Upland Vegetation Types						
California Sagebrush – Black Sage Scrub	35.87	Permanent	1.53	3:1	0.00	4.59
		Temporary	7.18	2:1	7.18	7.18
Brittle Bush Scrub	16.57	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00
Fountain Grass Swards	5.58	Permanent	0.29	3:1	0.00	0.87
		Temporary	0.64	2:1	0.64	0.64
Laurel Sumac Scrub	6.10	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.24	2:1	0.24	0.24
Upland Mustards or	1.97	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.00	2:1	0.00	0.00

Plant Community Type	Total Acreage	Impact Type	Acres Impacted	Mitigation Ratio	Acres of Onsite Restoration	Acres of Offsite Mitigation
Star-Thistle						
Wild Oats and Annual Brome Grasslands	3.78	Permanent	0.00	3:1	0.00	0.00
		Temporary	0.19	2:1	0.19	0.19
Other Vegetation Types						
Unvegetated Channels and Slopes	3.81	Temporary	0.16	NA[1]	0.00	0.00
		Permanent	0.00	NA[1]	0.00	0.00
Developed	33.98	Temporary	3.53	NA[1]	0.00	0.00
		Permanent	0.15	NA[1]	0.00	0.00
Total Vegetation Acres	**133.86**	**Total Vegetation Acres Impacted**	**25.99**	**Total Mitigation Acres**	**20.16**	**31.63**

[1] No offsite mitigation is required for temporary impacts to non-riparian habitat.

1.5.5 Environmental Commitments

The following measures are either intended to avoid or minimize impacts during construction (e.g., conducting surveys, ensuring activities remain within the project footprint) or provide habitat restoration and passive restoration within the project footprint and the project action area to offset temporary and permanent losses to wetland and riparian habitat and upland habitat. Conservation measures (i.e., environmental commitments henceforth) from the 2001 Santa Ana River Mainstem Flood Risk Management Project SEIS/EIR and Supplemental EA/EIR Addendum, as modified by USFWS 2001 biological opinion and 2012 amendment are being adopted for the proposed action; however, the environmental commitments have been modified specifically for the proposed action.

Temporary Disturbance of Riparian/Wetland Habitat

BIO-1 Successfully restore each acre of riparian vegetation that is temporarily disturbed during construction-related activities. Keep all temporarily disturbed areas free of exotic plants until riparian vegetation is re-established. If the site(s) have not begun to recover within 5 years (i.e., 50 percent of the disturbed areas are not vegetated with young riparian vegetation), then the site(s) will be replanted with cuttings from native riparian species.

BIO-2 Remove 1 acre of giant reed from the upper Santa Ana River watershed and/or action area for each acre of riparian/wetland vegetation that is temporarily disturbed during construction related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage giant reed-free for the life of the project;

OR:

Remove 3 acres of giant reed for each acre of temporary impact and maintain this acreage giant reed-free for a minimum of 5 years.

BIO-3 Conduct brown-headed cowbird (*Molothrus ater*, "cowbird") removal trapping at a minimum of 2 sites in the Santiago Basins (or other areas along the Santa Ana River watershed and environs where trapping would likely be more effective for vireo productivity, subject to review and approval by the Service) during all years when construction of the Project is occurring and 5 years following construction. Trapping will occur during the vireo egg-laying season (March 15 to July 30). This effort is intended to supplement on-going cowbird trapping activities elsewhere in Prado Basin and the Santa Ana River Watershed.

Temporary Disturbance of Non-riparian (Upland) Habitat Within the Flood Plain

BIO-4 Successfully restore[1] each acre of non-riparian vegetation that is temporarily disturbed during construction-related activities. Non-riparian areas that are temporarily disturbed will be maintained free of exotic/invasive plants[2] for a minimum of 8 years. Container plants will be planted and irrigated in upland areas to expedite the restoration process. Restoration plantings will achieve 70 percent plant cover, including 60 percent native shrub cover, after 5 years, with understory species and less than 10 percent cover by non-native species. If 70 percent of the disturbed areas are not vegetated with woody native shrub species within 5 years, then the site will be replanted or re-seeded as needed until a minimum of 70 percent cover is attained.

BIO-5 Restore 1 acre of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat (i.e., both native and non-native)[3] that is temporarily disturbed during construction-related activities; actively monitor and manage this acreage for a period of 1 year; and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage free of non-native/exotic plant species for the life of the project.

Permanent Loss of Riparian Habitat

BIO-6 Successfully restore 3 acres of riparian vegetation within the action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities.

OR

BIO-7 Remove 5 acres of giant reed from the upper Santa Ana River watershed and/or action area for each acre of riparian vegetation that is permanently destroyed or isolated from the flood plain during construction-related activities; actively monitor and manage this acreage for a period of 5 years; and then arrange for the local sponsors and/or another approved entity such as the SAW A to maintain this

[1] Restoration is defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Society of Ecological Restoration and Policy Working Group 2002). Existing native vegetation within a proposed restoration area will not be counted towards the acreage restored.

[2] Plants identified by the California Invasive Plant Council as invasive plants for southern California.

[3] All upland vegetation types (BE, Table 6) are considered occupied gnatcatcher habitat.

acreage giant reed-free for the life of the project; and conduct cowbird removal trapping in the vicinity of the restored habitat for the life of the project.

Note: A combination of these alternatives can be used to fulfill the requirements of this conservation measure.

Permanent Loss of Non-riparian (Upland) Habitat Within the Flood Plain

BIO-8 Successfully restore 3 acres of coastal sage scrub within the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Dam for each acre of occupied gnatcatcher habitat that is permanently destroyed or isolated from the flood plain during construction-related activities (estimated total of destroyed or isolated gnatcatcher habitat is approximately 1.82 acres and then arrange for the local sponsors (i.e., the County of Orange, County of Riverside, and County of San Bernardino) and/or another approved entity such as the SAWA to maintain this acreage free of exotic/invasive plants for the life of the project.

General Habitat Restoration Measures

BIO-9 Restoration activities will be initiated as soon as project activities within the restoration area are completed. Restoration activities will be initiated immediately following the completion of project activities within the restoration area. Restoration activities will occur during the non-breeding season for vireos (if adjacent to occupied vireo habitat).

BIO-10 Restoration of coastal sage scrub habitat will be considered successful when the following target/threshold objectives are met: 1) a minimum absolute ground cover of 70 percent native woody plant species and 10 percent native herbaceous species; 2) no more than 10 percent absolute ground cover of exotic/invasive plants, including no plants identified by the California Invasive Plant Council as invasive plants for southern California with an invasive rating of "high"[4]; 3) the shrub layer will consist of a minimum of 30 percent absolute ground cover of California sagebrush (*Artemisia californica*), and a minimum of 5 percent absolute ground cover of each of 4 or more of the following: California buckwheat (*Eriogonum fasciculatum*), California brittlebush (*Encelia californica*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), coast goldenbush (*Isocoma menzesii*); coyote bush (*Baccharis pilularis*), and bush monkey flower (*Diplacus aurantiacus*), 4) the herbaceous layer will consist of a minimum of 5 percent relative cover of each of 5 or more species from the seed mix provided in the BE or the following species: ladies' tobacco (*Pseudognaphalium californicum*), clustered tarplant (*Deinandra fasciculata*), golden yarrow (*Eriophyllum confertiflorum*), purple needlegrass (*Stipa pulchra*), California poppy (*Eschscholzia californica*), small fescue (*Festuca microstachys*), California brome (*Bromus carinatus*), dwarf goldfields (*Lasthenia californica*), dove lupine (*Lupinus bicolor*), and giant wild rye (*Elymus condensatus*); 5) the recruitment of native plant seedlings must be documented to occur within the replanted areas, 6) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 7) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to suitable coastal sage scrub habitat occupied by gnatcatchers in the vicinity. Alternatively, coastal sage scrub restoration efforts can be considered successful if the habitat is

[4] These species must be treated with lethal control methods and removed, cut down, or destroyed prior to seed production in any given year.

occupied by a breeding pair of gnatcatchers. In addition, habitat must sustain itself for 2 consecutive years without supplemental water.

BIO-11 Restoration of riparian habitat will be considered successful when the following target/threshold objectives are met: 1) a minimum of 30 percent absolute ground cover of native plant species; 2) less than 10 percent absolute ground cover of exotic plant species (including 0 percent giant reed); 3) the absolute ground cover of native species must be represented by, at least, five dominant or co-dominant plant species; 4) the recruitment of native plant seedlings must be documented to occur within the replanted areas; 5) a positive trend in the diversity and absolute ground cover of native plant species must be observed based on appropriate statistical analyses that account for natural, year to year variations; and 6) the structure and composition of the revegetated area is statistically similar (i.e., not significantly different) to habitat occupied by vireos in the vicinity. Alternatively, riparian revegetation efforts can be considered successful if the habitat is occupied by a breeding pair of vireos, flycatchers, and/or yellow-breasted chats *(Icteria virens).* In addition, habitat must sustain itself for 2 consecutive years without supplemental water.

BIO-12 All acres of restored coastal sage scrub and riparian habitats for offset of permanent impacts will be protected in perpetuity through proper legal instruments for the conservation of Federal and State listed species and their habitats.

BIO-13 The Corps will ensure that the local sponsors commit to funding a cowbird trapping program in the vicinity of the restored riparian habitat for the life of the project. Program specifics (e.g., number and locations of traps) will be determined in conjunction with permitting processes for the CDFW and our agency.

BIO-14 Mitigation will be initiated as soon as practicable for impacts that occur during the first year of construction. Afterwards, mitigation will be initiated-prior to construction of individual project features. For restoration options that include management for the life of the project, the Corps will continue exotic species removal (e.g., giant reed) and cowbird control until such time as the Service receives written documentation that the local sponsors and/or another approved entity (such as SAW A) have accepted responsibility for management of the restored area(s). Written documentation will include an estimate of costs associated with management responsibilities and a description of the funding mechanism(s) that will be used to ensure management will continue for the life of the project. If SAWA or another non-public entity accepts management responsibility and then becomes unwilling or unable to continue, then responsibility for continued management will revert to the local sponsors. Any advance mitigation that exceeds the requirements of the project (i.e., if actual project impacts are less than what was anticipated when the mitigation was initiated), may be credited as compensation for the effects of future projects.

BIO-15 Identify and delineates on well-labeled maps the specific areas in the upper Santa Ana River watershed and/or action area from which giant reed will be or has been removed, and riparian vegetation restored, as compensation for the proposed action. These areas must be approved by the local sponsors, CDFW, and our agencies. An annual report will be prepared for the Service by the approved management entity (e.g., SAWA) that addresses the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management; and 4) updated mapping that delineates areas in the upper Santa Ana River watershed and/or action area from which giant reed has been removed.

BIO-16 Identify and delineate on well-labeled maps the specific areas in the action area, which includes Prado Basin, and/or within the Santa Ana River watershed downstream of Prado Basin that coastal sage scrub will be restored, as compensation for the proposed action. These areas must be approved by the local sponsors, and the Service prior to initiation of coastal sage scrub restoration An annual report will be prepared for the Service by the Corps until coastal sage scrub is considered successful that addresses the following information: 1) accomplishments during the previous year; 2) what is anticipated to be accomplished during the upcoming year; 3) results of monitoring and management and 4) progress towards meeting success criteria.

BIO-17 Request that the administrator of the Trust Fund identify those acres within the Santa Ana Watershed where-giant reed was previously removed and/or habitat restored using the $1,000,000 contributed by the OCWD in lieu of restoring 133 acres of riparian habitat in the Prado Basin. This acreage will be actively monitored and managed until riparian habitat is completely restored, and then maintained giant reed-free for the life of the project.

General Conservation Measures for the Vireo, Gnatcatcher, and Flycatcher

BIO-18 During Project design, the Corps will consider an alternative for the proposed maintenance road in Smith Basin that allows for permanent access to Smith Basin from Villa Park Road.

BIO-19 A monitoring program will be developed and implemented within the Project site that entails surveys for the vireo and gnatcatcher during spring and early summer of the year prior to construction and, also, during each year of construction. Construction activities will be monitored to assure that vegetation is removed only in the designated areas. The limits of riparian/coastal sage scrub areas not to be disturbed will be flagged and not encroached upon.

BIO-20 Each employee, contractor, or subcontractor involved in project construction (including temporary contractors and subcontractors) will be briefed on the following information prior to working within or near areas that may affect federally listed and proposed species: 1) general types and locations of sensitive habitats and federally listed and proposed species that may occur in the action area; 2) measures that will be taken to avoid and minimize incidental take during construction activities; 3) location of conservation and protected areas within the action area; 4) reporting procedures for observations of federally listed and proposed species; 5) reporting procedures for incidents involving the take or potential for take of listed and proposed species; 6) information regarding whom to contact at this office to report non-compliance with the conservation measures in the biological opinions and terms and conditions of the incidental take statement (or other potential violations of the Act); and 7) applicable permit conditions stipulated by the CDFW and/or other regulatory agencies.

BIO-21 Vegetation clearing associated with project construction will take place only during periods when the vireo and gnatcatcher are not nesting (August 15 through February 15).

BIO-22 The construction contractor will minimize grading activities and leave root systems intact, to the extent practicable.

BIO-23 To the maximum extent practicable, haul routes and staging areas will be located outside of the flood plain (e.g., along bike trails, levees, and roads). All equipment maintenance, staging, and dispensing of fuel, oil, coolant, or any other toxic substance will occur in developed or designated non-sensitive upland areas. Best Management Practices (BMPs) will be implemented in these areas to

prevent runoff carrying potentially toxic substances from entering the Santiago Creek and associated drainages. If a spill occurs outside of a designated area, the cleanup will be immediate and documented.

BIO-24 During construction, riparian vegetation adjacent to de-watering areas will be monitored. Supplemental water will be added to this vegetation as necessary to avoid water stress.

BIO-25 To reduce fire hazards, a water truck will always be present during construction activities. Fire suppression equipment including shovels, water, and extinguishers will also be available onsite during the fire season (as determined by Orange County Fire District) and when activities may produce sparks. Construction activities will comply with the fire prevention and protection practices set forth in your agency's Safety and Health Requirements Manual (EM 385-1-1). The provisions of EM 385-1-1 will be incorporated into all construction specifications, and the contractor will be required to prepare a fire prevention and protection plan for the construction project.

BIO-26 Dust control measures will be implemented during construction to reduce excessive dust emissions. Methods for reducing dust emissions may include wetting work areas, such as dirt access roads and sediment stockpiles, on a regular basis, as well as covering truck beds carrying material and stockpiles.

BIO-27 To the extent feasible, the contractor will prevent exotic plant species from establishing within the work site during construction. Construction equipment will be cleaned of mud or other debris prior to mobilizing and before leaving the site to reduce the potential spread of invasive plants and/or seeds.

BIO-28 Excavated materials will be backfilled over the toe stabilization structures. The contractor will replace surface material and re-grade disturbed soft-bottomed substrate areas, in particular the low-flow river channel, to replicate pre-project conditions. Your agency will continue to coordinate with us to develop and improve measures for re-establishing habitat values within the construction area.

General Conservation Measures to Maintain Wildlife Movement Through Action Area

BIO-29 Native plant species will be used to revegetate disturbed upland areas.

BIO-30 A monitoring protocol will be developed and implemented for raptor monitoring, including bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) potentially occurring in the proposed Project footprint during construction. If eagles are foraging or otherwise using the Project footprint, the Corps will coordinate with the Service to develop appropriate avoidance measures.

BIO-31 Prior to any ground-disturbing activities (e.g., mechanized clearing or rough grading) for all project related construction activities, a Corps biologist (or biological monitor) will conduct pre-construction surveys of the proposed Project area for terrestrial special-status species. During these surveys, the biologist will:

a. Inspect the proposed Project area for any sensitive wildlife species; and

b. In the event of the discovery of a non-listed, special-status ground-dwelling animal, such as a burrowing owl or special-status reptile, attempts will be made to recover and relocate the animal to adjacent suitable habitat within the Proposed Project area at least 200 feet from the limits of construction activities. Burrowing owl surveys and relocations would follow the

Burrowing Owl Survey Protocol and Mitigation Guidelines (California Burrowing Owl Consortium 1993).

BIO-32 For construction activities within or adjacent to occupied vireo, or gnatcatcher habitat, the following measures shall be implemented to reduce or avoid noise impacts:

1. Prior to the commencement of construction activities, ambient noise levels will be measured at 50 feet and 100 feet from the proposed boundaries of the construction sites and recorded in a graphic format.

2. Sound walls shall be constructed at the boundary of the proposed construction site and/or haul route prior to February 15. Sound walls will probably consist of½" -thick, 8' -high plywood sheets. The construction contractor may use other materials or procedures that attenuate sound to acceptable levels, defined below.

3. Where ambient noise is less than 60dBA and it is determined that construction-related noise levels may exceed 60dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction-related noise does not exceed 60dBA within these areas. If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within occupied habitat areas outside the project footprint cannot be reduced below 60 dBA Leq hourly during the period of February 15 through August 15 of any year, the Corps will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat outside the project footprint[5] subject to noise levels over 60 dBA Leq hourly during the noted period, per the number of breeding seasons affected (e.g., 1 acre of riparian habitat affected by noise in two breeding seasons will result in 2 acres of restoration; 1 acre of riparian habitat affected by two separate project phases or segments in a single breeding season will result in 1 acre of restoration). The area affected will be determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps will identify restoration areas in coordination with the Service.

4. Where pre-construction ambient noise is greater than 60dBA: monitoring shall be conducted at 50 feet and 100 feet from the sound wall, or at the boundary of occupied habitat (if habitat areas are more than 100 feet from the construction site), to ensure that construction does not result in a significant increase over ambient conditions (i.e., noise level increases shall not exceed 5dBA over ambient). If construction noise levels exceed authorized limits, the contractor shall modify the sound barriers, equipment, or procedures (including construction schedules) as necessary to meet these conditions, to the extent practicable. If construction noise levels within riparian/coastal sage scrub habitat areas outside the project footprint cannot be reduced to or

[5] Includes all riparian and upland vegetation types (BE, Table 6) outside the mapped project footprint (Figures 5 and 6). Leq hourly noise level contours for project construction activities during the vireo and gnatcatcher breeding and nesting season will be calculated and reported for the areas adjacent to the project footprint based on noise monitoring to be performed, as appropriate.

below 5 dBA Leq hourly over ambient noise levels during the period of February 15 through August 15 of any year, the Corps will offset impacts at a 1:1 ratio per breeding season affected by such noise levels. This 1:1 ratio will be based on the acreage of riparian/coastal sage scrub habitat subject to noise levels more than 5 dBA Leq hourly over ambient during the noted period, as determined by periodic project noise monitoring. This offsetting measure will consist of habitat restoration (non-native invasive vegetation control) for 8 years, from the upper Santa Ana River watershed and/or action area. The Corps will identify restoration areas in coordination with the Service.

2.0 Environmental Baseline and Special Status Species

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the project area, without the consequences to the listed species or designated critical habitat caused by the Proposed Action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the project area, the anticipated impacts of all proposed Federal projects in the project area that have undergone Section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify (like flood risk management operations) are part of the environmental baseline (50 CFR 402.02).

The project area has been surveyed by qualified biologists from USACE, Santa Ana Watershed Association, Orange County Water District, and Aspen, Inc. to document the presence and locations of biological resources and sensitive species. California Department of Fish and Wildlife (CDFW), USFWS, and California Native Plant Society (CNPS) sensitive species occurrence databases were reviewed for the project area. This section summarizes the results of database reviews and surveys to present an up to date and thorough description of the environmental baseline.

2.1 Habitat Conditions in the Project Area

Habitat conditions within the project area are a direct result of previous projects within the area as well as modification of the Santiago Creek watershed by dams located upstream of the project area. In 1931 construction of the Santiago Creek Dam was completed along Santiago Creek and controls water from about two thirds of the Santiago Creek watershed. The Santiago Creek Dam also marks the usual ending point for surface flow in Santiago Creek, as all the upstream discharge from Santiago Creek is retained in Irvine Lake (reservoir created by the dam). Flow within Santiago Creek downstream of the Santiago Creek Dam is therefore limited to seepage from Santiago Creek Dam and stormwater.

Downstream of the Santiago Creek Dam is the Villa Park Dam which was completed in 1963. The Villa Park Dam forms a flood control reservoir to control spills from the Santiago Creek Dam. Due to flood control requirements, the Villa Park Dam was designed to stay dry during normal weather conditions and hold back most flood releases from the upstream Santiago Creek Dam. Therefore, the Villa Park Dam further regulates surface flow within Santiago Creek and typically prevents the creek from flowing except during heavy storm events. Water that does get discharged from the Villa Park Dam flows downstream where it is captured by the Santiago Recharge Basins.

The Santiago Recharge Basins (i.e., from north to south – Smith Basin, Blue Diamond Basin, and Bond Basin) originally operated as sand and gravel quarries from the early 1950's to 1990. In the early 1990's the active quarries were purchased by the Orange County Water District (OCWD) and converted into groundwater recharge reservoirs. The conversion of the quarries to groundwater recharge reservoirs was part of the Santiago Creek Recharge Project which was completed in 1991. This project by OCWD included the purchase and development of the Santiago Recharge Basins along Santiago Creek, construction of a pump station at Burris Basin, and construction of a pipeline (i.e., Santiago pipeline) to convey water back and forth from recharge basins along the Santa Ana River and the Santiago Recharge Basins. Two rubber dams were also installed on the Santa Ana River, allowing more efficient diversion of river water to the downstream recharge facilities.

The Santiago Creek Recharge Project was followed by the Santiago Basin Pump Station, which was

completed in 2003. This project by OCWD included the construction of an underwater pump station in Bond Basin to increase recharge capacity. With completion of the pump station, OCWD was able to move water both directions in the Santiago pipeline. This allowed for faster draining of the Santiago Basins, freeing up storage for stormwater capture and increasing OCWD's recharge capacity.

The Santiago Basin Pump Station project was followed by the Santiago Basin Floating Pump Station. This project in 2012 by OCWD included the replacement of the underwater pump station with a floating pump station. The floating pump station provided OCWD with the capability to dewater the Santiago Recharge Basins to increase storm flow capture and percolation, to make storage available for winter season use, to provide water to Santiago Creek downstream of the basins for percolation, and to allow for the transfer of stored water from the Santiago Recharge Basins to other OCWD facilities.

Lastly, the Santiago Basin Floating Pump Station project was followed by the Santiago Recharge Basins Saddle Repair project by OCWD in 2021. This project included reconstruction of the flow equalization box culvert for protection of the saddle apron (i.e., area that connects Blue Diamond Basin to Bond Basin) and reconstruction of failed slopes in the saddle apron area. This project was implemented to (1) alleviate safety concerns when maintenance activities are occurring, and (2) reduce risk of future slope failure that would harm or destroy riparian vegetation and environmental resources.

Therefore, the baseline environmental conditions are due to the implementation of the above projects over time within the project area. The construction of the Santiago Creek Dam in 1931 resulted in modification of historical flows within the portion of Santiago Creek below the dam. As discussed above, flows within Santiago Creek downstream of the dam are essentially limited to seepage from the dam and large storm events. Historical flows within Santiago Creek were further modified over time by the construction of the Villa Park Dam downstream of Santiago Creek Dam and the Santiago Recharge Basins. In addition, the lower Santiago Creek Channel (i.e., reach from I-5 downstream to creek's confluence with the Santa Ana River) is almost always dry with no flows due to coordination between OCWD and the City of Orange to ensure water released from the Santiago Recharge Basins percolates before reaching the parking lot for Hart Park, which is located within the Santiago Creek channel approximately 1.16 miles upstream of I-5. To ensure that surface flows do not enter the Hart Park parking area, OCWD has incorporated into their groundwater recharge facilities maintenance plan a coordination measure that requires OCWD to monitor the rate flow and make needed adjustments to ensure that flows released into Santiago Creek percolate before reaching the parking lot for Hart Park (OCWD, 2012).

Due to modification of flows within Santiago Creek, riparian vegetation, and associated wildlife within the lower Santiago Creek Channel (i.e., reach from I-5 downstream to creek's confluence with the Santa Ana River) has been altered. As discussed in the following sub-sections, vegetation within the lower Santiago Creek channel is primarily ornamental non-native and invasive species. There are a few remnant coastal oak trees within the reach that represent the only native riparian vegetation still present. The lack of native riparian vegetation is to be expected with the modification of riverine processes in the Santiago Creek watershed due to the presence of dams and recharge basins. Although riparian vegetation can exist in areas with intermittent flow, water is the major limiting factor upon which riparian vegetation is dependent.

Conversely, vegetation and associated wildlife within the Santiago Recharge Basins have benefited from the conversion of the basins from quarries to groundwater recharge facilities. Since 1991, native vegetation has reestablished within Smith Basin, and Blue Diamond and Bond Basins have seen native

vegetation reestablished through on-site mitigation. The reestablishment of native riparian and wetland vegetation within the Santiago Recharge Basins since the 1990's has allowed the LBVI to recolonize the area and establish breeding territories. Similarly, native coastal sage scrub vegetation has also reestablished within the Santiago Recharge Basins over time allowing CAGN to recolonize the area year-round.

It is important to note that adjacent and upstream to Smith Basin the OC Reclamation Mine Project is going to be constructed between 2023 and 2027. Although not implemented yet, the completed project would be part of the existing condition as it is expected to be complete prior to USACE's project commencing construction. The project includes the filling in of an abandoned open pit mine with inert material and grading the site to an elevation equal with adjacent parcels. Prior to filling in the open pit, the site would be cleared and recontoured. According to the project description, a steep, un-vegetated slope currently descends to the toe of the Santiago Creek bank. This slope would be relocated from its current location, and an elevated bench with shallow ponds would be created to allow for a wider riparian and wetland habitat adjacent to Santiago Creek. Habitat restoration along Santiago Creek would follow grading of the project site. Native habitat would be created on the elevated bench and within the ponded area by installing the same plant species occurring at the bottom of the pit mine. The slope would be planted with native vegetation like the existing conditions elsewhere on the site. The restoration of native habitat along Santiago Creek after the site has been cleared, graded, and the channel riprapped would be a mitigation site for the project. The Corps will not interfere with the OC Reclamation Mine Project mitigation site. The Corps proposed action would be adjusted to avoid areas that the OC Reclamation Mine Project has already stabilized or where the projects mitigation site is located.

The following subsections further detail the current baseline environmental conditions within the lower Santiago Creek channel and the Santiago Recharge Basins.

2.2 Vegetation

Vegetation mapping was done by drawing tentative boundaries onto high-resolution aerial images during site visits on January 12 and 26, 2022. These boundaries were then digitized into GIS shapefiles. Vegetation maps were field verified for accuracy on March 3, 2022. Vegetation was classified according to the Manual of California Vegetation (Sawyer et al., 2009). It's important to note that native and disturbed communities are at times interspersed. Therefore, breaks in community type are determined based on dominant species type and professional judgement of the biologist surveying. There are a total of 14 vegetation and other cover types within the project area. Maintenance roads and trails have been included in the developed cover type. Table 3 lists the cover types and impact types within the project area (Figure 12, Figure 13, Figure 14). Vegetation within the project area consists of riparian and wetland vegetation, upland vegetation, and other land cover types. The riparian and wetland plant communities in the project area are considered sensitive habitat types for their part in the ecological function of the watershed. These communities play important roles in the life histories for a broad diversity of both common and special-status wildlife species. While non-native habitats are not protected, these communities still provide important foraging and refugia habitat for a variety of sensitive wildlife species including CAGN and LBVI. There will not be any direct or indirect impacts on native vegetation outside of the project footprint.



Figure 12: Vegetation Communities within the Project Area (Lower Santiago Creek Channel).



Figure 13: Vegetation Communities within the Project Area (Blue Diamond and Bond Basins).

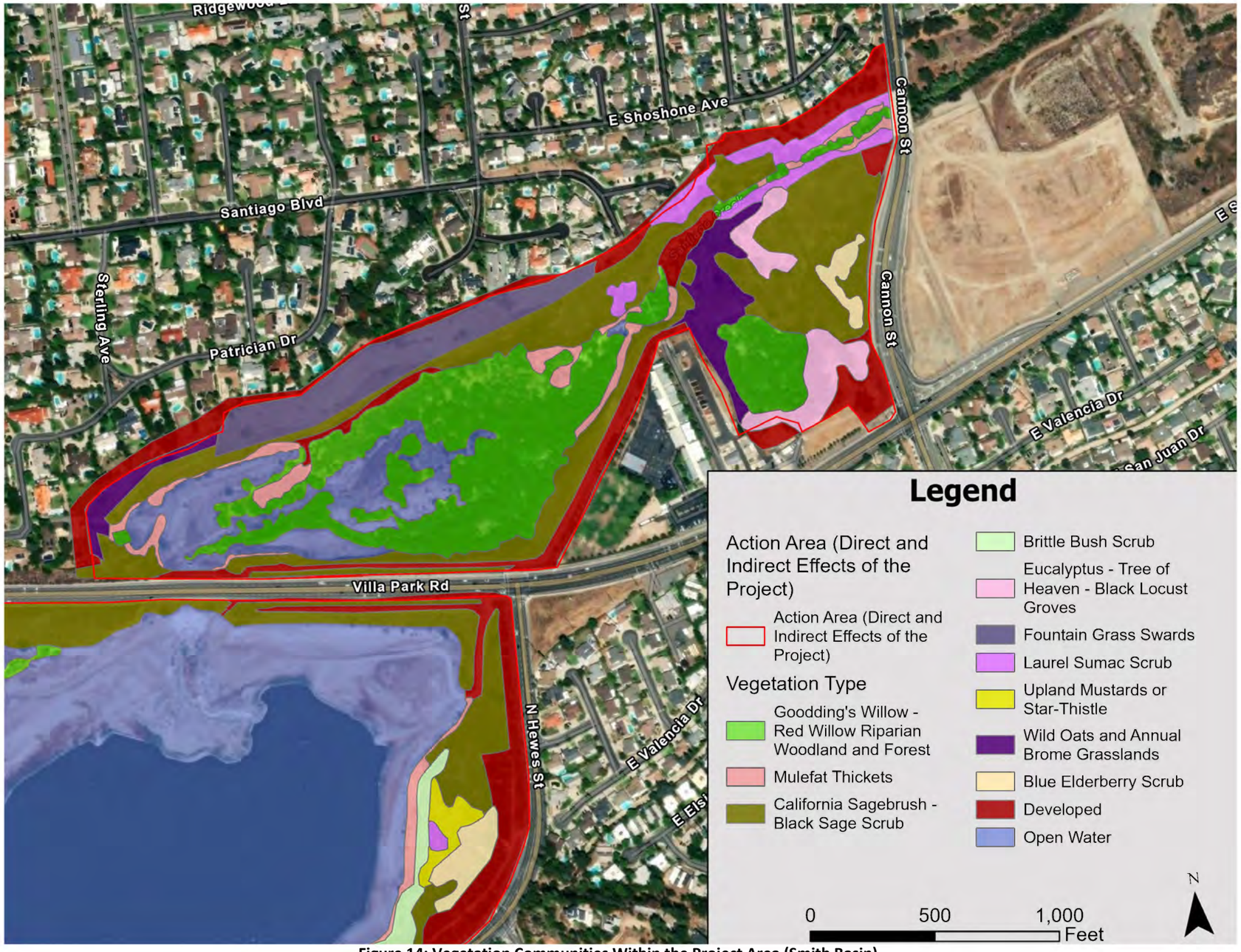


Figure 14: Vegetation Communities Within the Project Area (Smith Basin).

Riparian and Wetland Vegetation Types

Goodding's willow – red willow riparian woodland and forest (Salix gooddingii – Salix laevigata Forest and Woodland Alliance): Goodding's willow – red willow riparian woodland and forest are a winter deciduous woodland that are dominated by Goodding's willow (*Salix gooddingii*). Additional species such as Pacific willow (*Salix lasiandra*), red willow (*Salix laevigata*), California sycamore (*Platanus racemosa*), and mulefat (*Baccharis salicifolia*) are also present. Goodding's willow – red willow riparian woodland and forest are present along Santiago Creek in the northern portion of the project site and are the dominant cover type in the seasonally inundated portions of Smith Basin. They are also present in isolated locations around Bond and Blue Diamond Basins and are abundant near the earthen overflow channel. Goodding's willow – red willow riparian woodland and forest have a State Rank of S3 and are therefore recognized as a sensitive natural community by CDFW (CDFW, 2021).

Mulefat thickets (Baccharis salicifolia Shrubland Alliance): Mulefat thickets are a winter deciduous shrubland that are dominated by mulefat. Additional species such as oleander (*Nerium oleander*), coyote brush (*Baccharis pilularis*), and shrubby willows (*Salix* spp.) are also present. Mulefat thickets are present along Santiago Creek in the northern portion of the project site and around the margins of the Santiago Recharge Basins. Mulefat thickets have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Upland Vegetation Types

Blue elderberry scrub (Sambucus nigra ssp. caerulea Provisional Shrubland Alliance): Although not defined as a vegetation type in the current online version of *A Manual of California Vegetation*, blue elderberry scrub is present in the project site. This vegetation is dominated by blue elderberry (*Sambucus nigra* ssp. *caerulea*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species. Within the project site coyote brush and Peruvian pepper tree (*Schinus molle*) are also present. Blue elderberry scrub is present in the uplands near Santiago Creek in the northern portion of the project site and in the upland east of the Santiago Recharge Basins. Blue elderberry thickets do not have a State Rank and therefore is not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Brittle bush scrub (Encelia farinosa Shrubland Alliance): Brittle bush scrub is a type of coastal sage scrub vegetation that is dominated by brittle bush (*Encelia farinosa*). Additional species such as coastal sage brush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (Salvia mellifera), giant wild rye (*Elymus condensatus*), and Laurel sumac (*Malosma laurina*) are also present in low numbers. Within the project site it appears that all the brittle bush scrub was planted for mitigation. It is unclear if brittle bush is native to the project site. Brittle bush scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

California sagebrush – black sage scrub (Artemisia californica – Salvia mellifera Shrubland Alliance): California sagebrush – black sage scrub is a type of coastal sage scrub that is dominated by coastal sage brush. Within the project site, black sage is uncommon, but the vegetation still matches this description the best. Additional species such as sweetbush (*Bebbia juncea*) and California buckwheat are also present. Within the project site it appears that all the California sagebrush – black sage scrub has been planted for mitigation. California sagebrush – black sage scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Coast live oak woodland and forest (Quercus agrifolia Forest and Woodland Alliance): Coast live oak woodland and forest are dominated by coast live oaks (*Quercus agrifolia*). Within the project site, the coast live oak woodland and forest is limited to several patches along the lower Santiago Creek channel, in the vicinity of north Flower Street. The understory vegetation includes non-native ornamental species such as Canary ivy (*Hedera canariensis*). Coast live oak woodland and forest have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021). During construction of the Proposed Action coast live oak trees within the lower Santiago Creek channel will be flagged for avoidance when possible.

Eucalyptus – tree of heaven – black locust groves (Eucalyptus spp. – Ailanthus altissima – Robinia pseudoacacia Woodland Semi-Natural Alliance): Eucalyptus – tree of heaven – black locust groves are used to map all vegetation dominated by non-native trees within the project site including gum trees (*Eucalyptus* spp.), Peruvian pepper trees, yew plum pine (*Podocarpus macrophyllus*), prairie sumac (*Rhus lanceolata*), and many others. Native tree species such as California sycamore and coast live oak may also be present but generally represent single trees. Eucalyptus – tree of heaven – black locust groves have a State Rank of SNA (Not Applicable) and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Fountain grass swards (Pennisetum setaceum – Pennisetum ciliare Herbaceous Semi-Natural Alliance): Fountain grass swards are a non-native grassland dominated by fountain grass (*Pennisetum setaceum*), a robust perennial bunchgrass. Other non-native species such as gazania (*Gazania linearis*) and mustard (*Hirschfeldia incana*), are also present on the large, landscaped slope to the north of Smith Basin and along the eastern slope of the Bond and Blue Diamond Basins. Fountain grass swards have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Laural sumac scrub (Malosma laurina Shrubland Alliance): Laurel sumac scrub is dominated by Laurel sumac (*Malosma laurina*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species such as coastal sage bush and California buckwheat. Additional species such as tamarisk (*Tamarix* sp.) are also present. Laurel sumac scrub is present in the upland surrounding Santiago Creek, Smith Basin, and Bond and Blue Diamond Basins. Laurel sumac scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland mustards or star-thistle (Brassica nigra – Centaurea (solstitialis, melitensis) Herbaceous Semi-Natural Alliance): Upland mustards or star-thistle fields are a non-native/invasive plant community and within the project site are dominated by black mustard (*Brassica nigra*). Other non-native species are also present including white horehound (*Marrubium vulgare*), talcote (*Centaurea melitensis*), fennel (*Foeniculum vulgare*), and others. This vegetation type is present in previously disturbed portions of the Bond and Blue Diamond Basins. Upland mustards or star-thistle fields have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Wild oats and annual brome grasslands (Avena spp. – Bromus spp. Herbaceous Semi-Natural Alliance): This grassland vegetation is dominated by a variety of non-native grasses such as wild oat (*Avena* spp.), ripgut brome (*Bromus diandrus*), and red brome (*Bromus rubens*). Non-native herbs are also present including Bermuda buttercup (*Oxalis pes-caprae*), fine leaved fumitory (*Fumaria parviflora*), mustard (*Brassicaceae* family), and others. Wild oats and annual brome grasslands are present in disturbed sites within the project site, especially around the perimeter of the site adjacent to residential development. Wild oats and annual brome grasslands have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Other Land Cover Types

Developed: This cover type includes disturbed and developed areas within the project site including paved roads, unpaved roads, buildings, residential areas, and other unvegetated areas. It also includes a large area in the central portion of Bond and Blue Diamond Basins that was recently impacted by construction activities. Developed is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Open water: Open water is used to map portions of the project site that had surface water present during early 2022. This included the Santiago Recharge Basins. The water depths in these basins' changes throughout the year and most of the open water in these basins will eventually become dry in the late summer and fall. Open water is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW, 2021).

Unvegetated channels and slopes: This cover type includes flood control channels, unvegetated slopes, and other maintained areas within the project site. Vegetation is either absent or very sparse. Unvegetated channels and slopes is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW, 2021).

2.3 Aquatic Resources

Santiago Creek originates more than 15 miles upstream of the project area in the Santa Ana Mountains. Prior to reaching the project site, water enters Santiago Creek from numerous upstream tributaries including Silverado Canyon, Black Star Canyon, and Modjeska Canyon. Santiago Creek then flows through two upstream flood control facilities including the Villa Park Dam and Santiago Dam before entering the project site. At the downstream end of the project site, flows from Santiago Creek enter the Santa Ana River and continue downstream approximately 10.5 miles before reaching the Pacific Ocean. The Pacific Ocean is recognized by the USACE as a traditional navigable water (TNW) thereby establishing surface connectivity of the project area to navigable waters. Santiago Creek is a direct tributary to the Santa Ana River which is a direct tributary to the Pacific Ocean.

The lower Santiago Creek channel that is part of the Proposed Action is typically dry most of the year. This is due to the City of Orange indicating that surface water released by OCWD along Santiago Creek should not flow into Hart Park parking area (located approximately 1.16 miles upstream of Interstate 5). To ensure that surface water does not enter the Hart Park parking area, OCWD has incorporated into their groundwater recharge facilities maintenance plan a coordination measure that requires OCWD to monitor the flowrate and make needed adjustments to ensure that flows percolate before reaching the parking lot for Hart Park (OCWD, 2012).

The lower Santiago Creek channel and the Santiago Recharge Basins all lack suitable habitat to support native fish species, such as the Santa Ana Sucker (*Catostomus santaanae*), Arroyo Chub (*Gila orcutti*), or Santa Ana Speckled Dace (*Rhinichthys osculus*). The Santiago Recharge Basins do contain some populations of non-native fish species. Common fish species within the basins include common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), threadfin shad (*Dorosoma petenense*), channel catfish (*Ictalurus punctatus*), and tilapia (*Oreochromis spp*.) (OCWD, 2012).

A preliminary jurisdictional determination of Waters of the U.S. (WOTUS) within the project area has been prepared based on surveys conducted on January 12, 26, and March 3, 2022. During the survey the limits of the ordinary high-water mark (OHWM), as determined by changes in physical and biological features such as bank erosion, deposited vegetation or debris, and vegetative characteristics, were used in the absence of adjacent wetlands to describe potential non-wetland WOTUS. In total, there are approximately 197.55 acres of potential WOTUS in the project area as shown in Figure 15, Figure 16, and Figure 17. The aquatic resources delineation report can be reviewed in Attachment B.



Figure 15: Potential Jurisdictional Waters of the U.S. in the Project Area (Lower Santiago Creek Channel).



Figure 16: Potential Jurisdictional Waters of the U.S. in the Project Area (Blue Diamond and Bond Basins).



Figure 17: Potential Jurisdictional Waters of the U.S. in the Project Area (Smith Basin).

2.4 Wildlife

The project area contains both riparian and upland habitat for wildlife. Riparian communities support some of the most diverse assemblages of wildlife and provide access to water, shade, and cover. In addition, riparian systems and wetlands are frequently considered one of the most productive forms of wildlife habitat in North America. Portions of Santiago Creek support extensive riparian and aquatic habitat. Many bird species are wholly or partially dependent on riparian plant communities to perpetuate their kind (Warner et al., 1984). In the project area the vegetation is also critical to many aquatic and semi-aquatic wildlife species that rely on adjacent terrestrial habitats to complete their life cycles (Semlitsch and Bodie, 2003; Burke and Gibbons, 1995). Riparian vegetation provides necessary foraging and nesting habitat for many bird species (Rottenborn, 1999; Bolger et al., 1997).

The riparian and upland habitats that occur within the Proposed Action area provide habitat for a variety of resident and migratory wildlife species, including several special-status species. Of particular importance are riparian and reservoir areas that provide potential habitat for the LBVI and CAGN.

The development surrounding the riparian portion of the project area makes it part of a key movement corridor and/or dispersal habitat for several wildlife species that use Santiago Creek to connect to other areas within the watershed and/or within the Santa Ana River watershed. Continuous riparian riverine habitat is located primarily upstream of the Santiago Recharge Basins, increasing the likelihood of wildlife presence within the project area and directly adjacent. Some species, such as mourning dove and northern mockingbird, are positively correlated with urbanization, but most species are negatively correlated with urbanization and prefer to inhabit undeveloped areas. Factors associated with urbanization that are expected to contribute to lower species richness and densities in riparian zones near developed areas include an increase in the number of domestic cats (Rottenborn, 1997), an increase in people recreating in riparian areas, noise, collision on roads, and movement of people and domestic animals (Rottenborn, 1999). Therefore, the frequency of human visitation along Santiago Creek and along the Santiago Creek Bike Trail may adversely affect wildlife use in the project area to some degree. Several studies have documented the effects of pedestrian traffic on birds (Nowakowski, 1994; Fernandez-Juricic, 2000; Miller and Hobbs, 2000), but, as with development generally, species vary in their sensitivity to this type of disturbance.

The only federally listed species observed within the action area are LBVI and CAGN which occur only within the Santiago Recharge Basins action area. A full list of special-status species and determination of each species' potential to occur due to literature review and documented past observations within the project area is found in Attachment C.

2.5 Current Status of Species and Critical Habitat

The Santa Ana Watershed Association in conjunction with Orange County Water District conducted surveys for LBVI in the project area. During the surveys for LBVI, observational data for CAGN was also collected. The results of these project area surveys for these species are detailed below. The following species are not expected to occur within the action area due to marginal or no suitable habitat, lack of recent sightings, and/or due to lack of detection during focused surveys: Ventura marsh milk-vetch (*Astragalus pycnostachyus var. lanosissimus*), Santa Ana sucker (*Catostomus santaanae*), and monarch butterfly (*Danaus plexippus*) (see Attachment C). These species are not discussed further as the Corps has made no effect determinations. The following sections discuss the species of concern and results of surveys. There is no designated critical habitat for either species within the action area.

2.5.1 Least Bell's Vireo (LBVI)

The LBVI is a small gray songbird with a white breast and an inconspicuous white ring around its eyes. LBVI is a federal and state endangered species and a covered species within the County of Orange Central & Coastal Subregion Natural Community Conservation Plan and Habitat Conservation Plan. LBVI is one of four subspecies of Bell's vireo recognized by the American Ornithologist's Union (AOU, 1957). It is the western-most subspecies, breeding entirely within California and northern Baja California. LBVI was listed as a federally endangered species in 1986 (51 FR 16474). Critical habitat for the species was designated in 1994 (59 FR 4845); however, none occurs within the action area. LBVI are migratory and are only present in southern California from approximately mid-March through mid-September.

The species breeds in dense, shrubby riparian vegetation in the vicinity of water or dry-river bottoms below 2,000 feet of elevation, often dominated by willows (*Salix spp.*), mulefat (*Baccharis salicifolia*), and California wild rose (*Rosa californica*), but it may also utilize various shrubs, trees, and vines (Franzreb, 1989). Nests are typically found in low-lying, dense vegetation in riparian zones, most frequently in 5- to 10-year-old stands. When LBVI nest in mature riparian woodlands, they nest in areas with a substantial, robust understory of willows as well as other plant species. LBVI generally prefer semi-complex riparian habitats that have understory scrub and ample vertical complexity; riparian areas with no understory are less likely to be used. In California, a dense shrub layer associated with riparian habitat was found to be the most critical structural component of occupied LBVI habitat (Kus et al., 2010). In more xeric areas, this species will readily utilize unconventional habitats, including mesquites and tamarisk. In riverine habitat, in Southern California, this species typically has territory sizes that average two (2) acres in size (Kus et al., 2010). LBVI are extremely site-tenacious and return to the same nesting habitat every year (Salata, 1983).

Survey Results

The results of the 2019, 2020, 2021, and 2022 OCWD and SAWA surveys from Blue Diamond and Bond Basins (Figure 18, Figure 19, Figure 20, and Figure 21) and Smith Basin (Figure 22, Figure 23, Figure 24, and Figure 25) are presented herein.

Blue Diamond and Bond Basins

During the 2022 surveys conducted by OCWD and SAWA, no LBVI territories were located within the Blue Diamond and Bond Basins project footprint. Two LBVI territories were located within the Blue Diamond and Bond Basins action area, but outside the project footprint.

Smith Basin

During the 2022 surveys conducted by OCWD and SAWA, three LBVI territories were located within the low flow channel grading project footprint in Smith Basin. One additional LBVI territory was documented within the Smith Basin action area, but outside the project footprint.



Figure 18: 2019 CAGN and LBVI Territories Within Blue Diamond and Bond Basins.



Figure 19: 2020 CAGN and LBVI Territories Within Blue Diamond and Bond Basins.



Figure 20: 2021 CAGN and LBVI Territories Within Blue Diamond and Bond Basins.

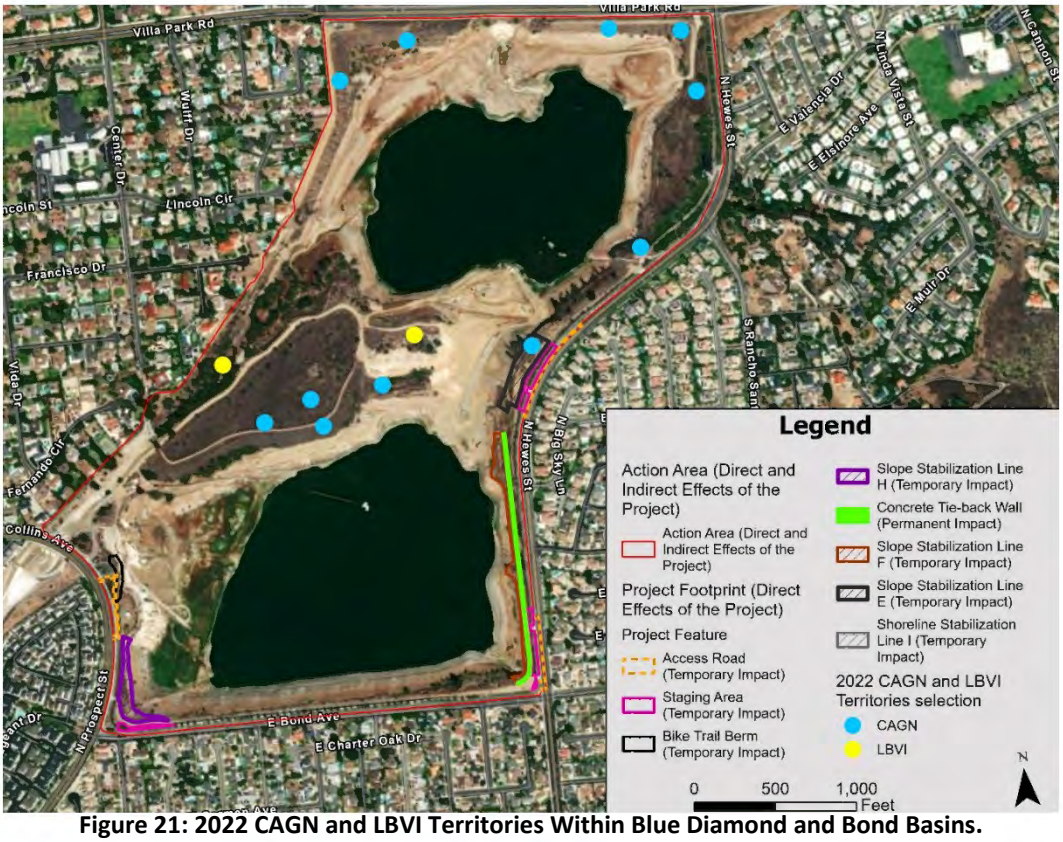


Figure 21: 2022 CAGN and LBVI Territories Within Blue Diamond and Bond Basins.



Figure 22: 2019 LBVI and CAGN Territories Within Smith Basin.



Figure 23: 2020 CAGN and LBVI Territories Within Smith Basin.



Figure 24: 2021 CAGN and LBVI Territories Within Smith Basin.

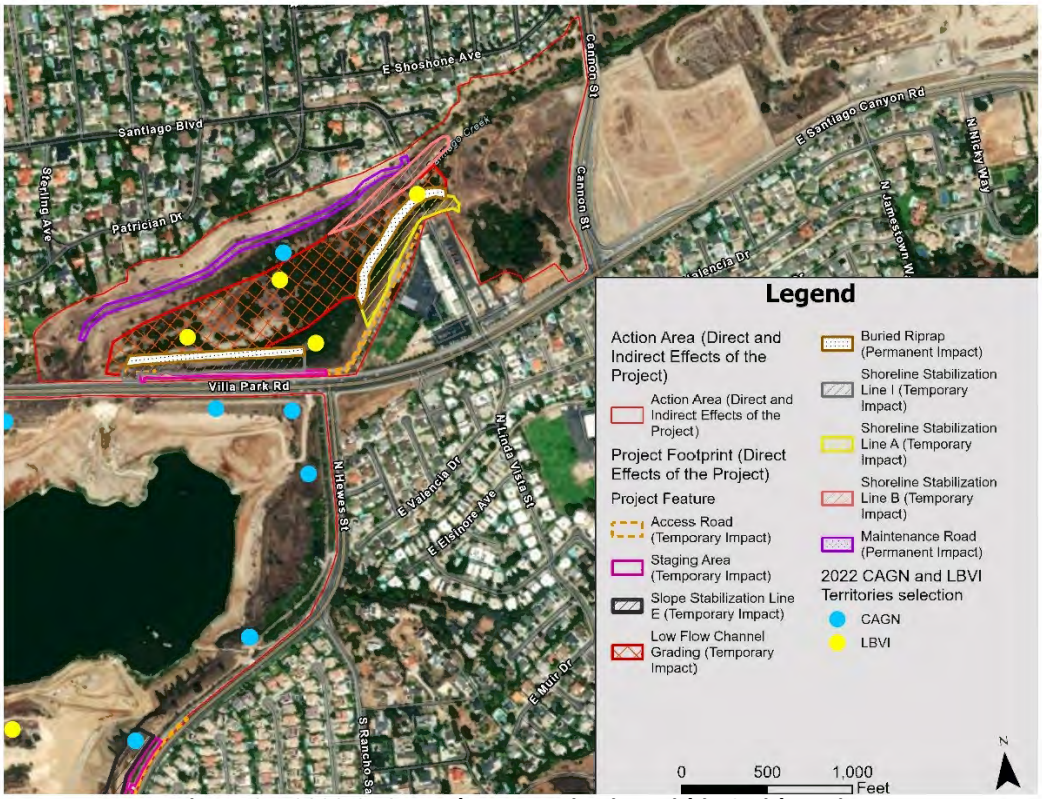


Figure 25: 2022 CAGN and LBVI Territories Within Smith Basin.

2.5.2 Coastal California Gnatcatcher (CAGN)

The coastal subspecies of the CAGN is a small gray songbird that has been observed utilizing areas of marginal habitat within areas of the Santiago Creek Recharge Basins. The species was listed as threatened by the USFWS in 1993 (USFWS, 1993). Critical habitat for this subspecies was designated by the USFWS in 2000.

CAGN are monogamous and stay paired throughout their lifetime, and the pair establishes a territory and stays within the same territory year-round. The breeding season extends from approximately February 15 through August 15, with peak nesting activity occurring from mid-March through mid-May. The incubation period takes 14 days and the young fledge at eight to 13 days. The young are dependent on their parents for up to three or four weeks; however, fledglings may continue to associate with their parents for several months (USFWS, 1997). Once juveniles reach maturity, they are flushed out of the territory and forced to disperse by parents. CAGN offspring may disperse to adjacent suitable habitat to pair and establish new territories.

Foraging by CAGN primarily consists of gleaning sessile prey from foliage while quickly moving through branches of shrubs. Larger prey items are beaten against a branch before being swallowed whole or fed to juveniles (Atwood and Bontrager, 2001).

CAGN are year-round residents of southern California. CAGN generally prefer to forage, breed, and nest in sage scrub habitat, which is a broad category of upland vegetation dominated by California sagebrush, California buckwheat, white sage (*Salvia apiana*), and black sage (*Salvia mellifera*) (Beyers and Wirtz, 1997). Historically, CAGN have been described as restricted to coastal sage scrub habitat. However, it is now known that CAGN may also use disturbed mixed scrub, chaparral, grassland, and riparian habitats in proximity to coastal sage scrub for dispersal and foraging (Atwood and Bontrager, 2020). CAGN adults of both sexes, as well as juveniles, have been observed foraging in non-coastal sage scrub for extended periods just after nesting, and diurnal shifts in CAGN habitat use from coastal sage to non-coastal sage habitats have also been observed (Campbell et al., 1998). Patterns of CAGN use of non-coastal sage scrub habitat appears to occur for a variety of reasons, often driven by site-specific dynamics, and may occur year-round. While CAGN are known to make significant use of non-coastal sage scrub habitats, CAGN are still not thought to regularly nest independent of coastal sage scrub (Campbell et al., 1998).

Survey Results

The results of the 2019, 2020, 2021, and 2022 OCWD and SAWA surveys from Blue Diamond and Bond Basins (Figure 18, Figure 19, Figure 20, and Figure 21) and Smith Basin (Figure 22, Figure 23, Figure 24, and Figure 25) are presented herein.

Blue Diamond and Bond Basins

During the 2022 surveys conducted by OCWD and SAWA, one CAGN territory was located within the slope stabilization Line E project footprint in the Blue Diamond and Bond Basins. Ten additional CAGN territories were located within the Blue Diamond and Bond Basins action area, but outside the project footprint.

Smith Basin

During the 2022 surveys conducted by OCWD and SAWA, no CAGN territories were located within the project footprint in Smith Basin. One CAGN territory was located within the Smith Basin action area, but

outside the project footprint.

3.0 Effects of the Proposed Action

The "effects of the action" include all consequences to listed species or designated critical habitat that are caused by the Proposed Action, including consequences of other activities that are caused by the Proposed Action. These effects are considered along with the environmental baseline and cumulative effects to determine the overall effects to the species. Effects of the action may occur later in time and may include consequence outside the immediate area involved in the action (50 CFR 402.02). The conservation measures listed in Chapter 1 will be implemented to avoid, minimize, or offset effects of the Proposed Action.

3.1 Effects to LBVI Individuals

Three (3) LBVI territories were observed within the action area. A total of approximately 1.46 acre of occupied habitat will be permanently impacted during implementation of shoreline stabilization within Smith Basin due to the construction of a maintenance road along the north side of the basin and placement of buried riprap where willow may not be able to reestablish. In addition, a total of approximately 10.62 acres of occupied habitat will be temporarily impacted during implementation of shoreline stabilization within Smith Basin, but this acreage will be replanted with native riparian and wetland vegetation once construction is complete. Approximately 26.2 acres of the project area provide preferred suitable biological characteristics for LBVI within the mapped areas. Therefore, permanent impacts would affect approximately 5.6% of available wetland and riparian vegetation within the Santiago Recharge Basins. Temporary impacts would affect approximately 40.5% of available wetland and riparian vegetation within the Santiago Recharge Basins. Approximately 53.9% of available wetland and riparian vegetation within the Santiago Recharge Basins that provide preferred suitable biological characteristics for LBVI would not be impacted by the Proposed Action at all.

Direct and indirect impacts to LBVI include displacement of established territories causing adverse effects to three (3) territories within the action area. This would result in potential temporary displacement of three (3) territories. This is assumed to be a temporary displacement of these three (3) territories as there are 14.12 acres of suitable LBVI habitat within the Santiago Recharge Basins that would not be impacted by the Proposed Action. Based on observations of LBVI territory size which can range between 0.5 to 7.5 acres, the unaffected 14.12 acres of suitable LBVI habitat within the Santiago Recharge Basins provides sufficient acreage for between 28 to two (2) LBVI territories while construction of the Proposed Action is occurring (USFWS, 1998b). Once construction of the Proposed Action is complete, 10.62 acres of wetland and riparian vegetation temporarily impacted would be replanted with wetland and riparian vegetation with suitable biological characteristics for LBVI. The replanted wetland and riparian vegetation would be dominated by willow species which typically take between two (2) to 10 years to become mature and begin producing seeds (Reed, 1993). Since LBVI have been characterized as preferring early successional habitat, the reestablishment of native willow vegetation within the temporarily impacted areas of the Proposed Action would provide early successional habitat that LBVI prefer to nest in (USFWS, 1998b). Therefore, as detailed above, riparian and wetland vegetation that contains preferred biological characteristics for LBVI will for the most part only be temporarily impacted and riparian and wetland vegetation unaffected during the construction of the Proposed Action should provide sufficient habitat for LBVI with temporarily displaced territories within the action area.

Indirect impacts from construction of the Proposed Action includes noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair vireos and degrade air quality and human presence can cause vireos to abandon territories and nests.

Routine maintenance, as listed under Section 1.5.3, Future Operation, Maintenance, Repair, Replacement, and Rehabilitation, for the most part is not expected to require disturbance to LBVI habitat. Ecological maintenance activities do include weeding and herbicide application of non-native species and re-seeding of native species when necessary. These activities would be conducted outside of the bird nesting season (i.e., February 15 – August 15) and are therefore not expected to directly impact nesting LBVI. The removal of non-native vegetation outside of the bird nesting season has the potential to affect LBVI habitat, but beneficially since non-native vegetation would be removed and native vegetation preferred by LBVI would be re-seeded as necessary. All other routine maintenance activities listed under Section 1.5.3 would not require disturbance to LBVI habitat. It is important to note that conservation measures that will be implemented to minimize the potential for disruption of LBVI breeding and nesting activities during project construction will also be implemented during routine maintenance activities; therefore, routing maintenance is not anticipated to substantially interfere with LBVI breeding and nesting activities.

To avoid and minimize potential impacts to LBVI, the Corps will complete vegetation clearing activities associated with project construction only during periods when LBVI is not nesting (i.e., August 15 through February 15) (BIO-21). Additional measures to minimize and avoid impacts to LBVI include (BIO-19) surveys for LBVI during spring and early summer of the year prior to construction and, also, during each year of construction; (BIO-19) ensure riparian areas not to be disturbed will be flagged and not encroached upon; (BIO-20) pre-construction environmental training for all construction crew members; and (BIO-32) construction of sound walls prior to February 15 to lessen general noise impacts. The above are just a few of the environmental commitments the Corps plans to implement to minimize and avoid impact to LBVI. Refer to Section 1.5.5 for the complete list.

To offset effects to LBVI from the Proposed Action, the Corps is proposing restoration of 17.92 acres of wetland and riparian vegetation within Prado Basin and/or within the Santa Ana River watershed below Prado Dam. Figure 26, Figure 27, and Figure 28 show potential riparian areas that may be used as mitigation for the Santiago Creek project. The potential riparian parcels are approximately 12.09 acres (Figure 26), 68.64 acres (Figure 27), and 11.35 acres (Figure 28). Two parcels are located on USACE land, are in the green “environmentally sensitive areas”, and are being confirmed as to whether they are existing mitigation sites for other projects. The third parcel is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The 17.92 acres of wetland/riparian habitat restored offsite will be monitored and managed according to BIO-2, BIO-6, BIO-7, and BIO-11. In addition, 11.91 acres of wetland and riparian vegetation would be replanted on site to offset temporary impacts to wetland and riparian vegetation within the project footprint. The 11.91 acres of native wetland and riparian vegetation within the project footprint will be monitored and managed according to BIO-1 and BIO-11.

Based on the analysis described above, the Corps has determined that the Proposed Action may affect, and is likely to adversely affect, LBVI.



Figure 26: Location of Potential Mitigation Sites Within Prado Basin for the Santiago Creek Project.

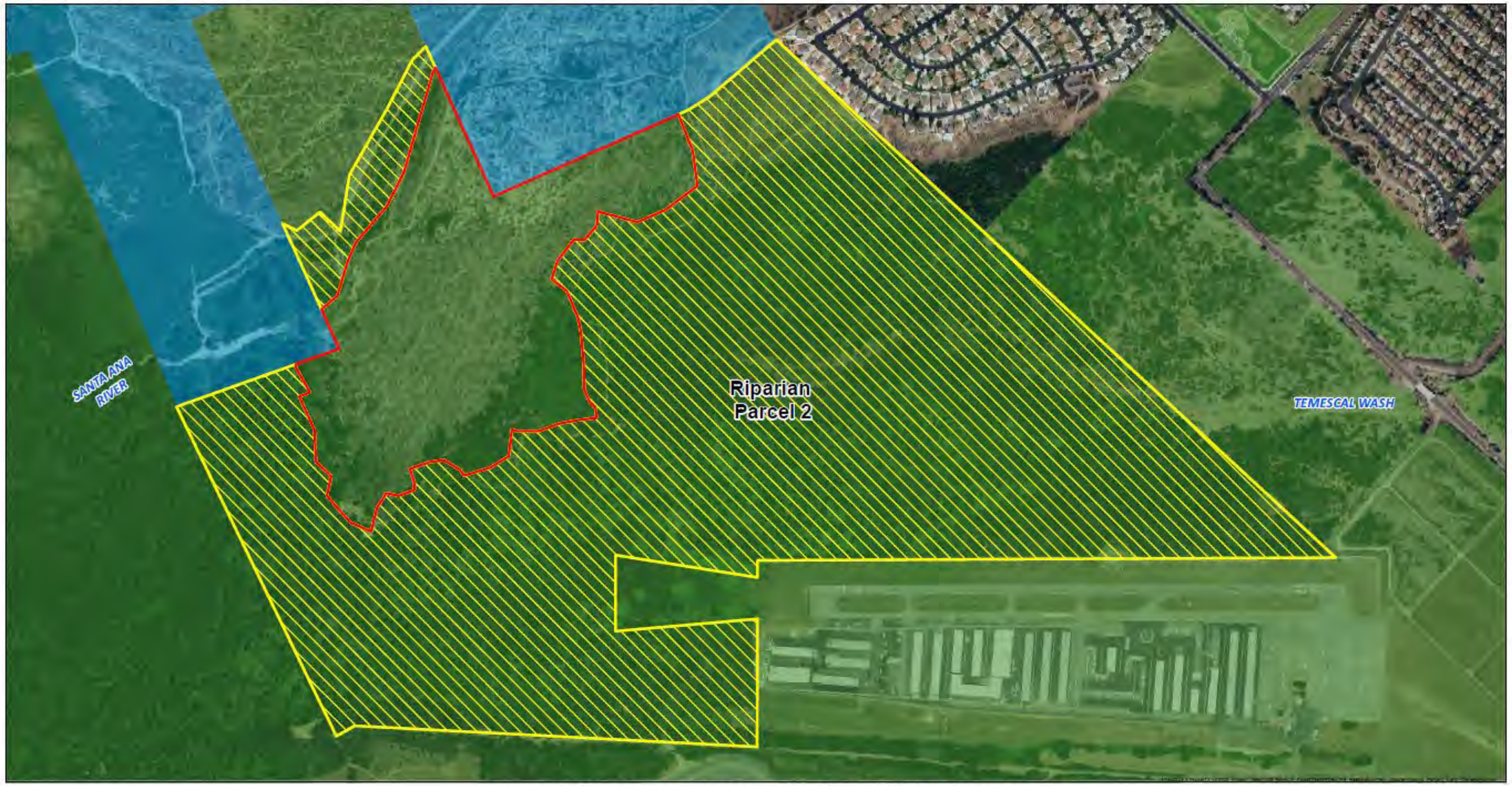


Figure 27: Location of Potential Additional Mitigation Sites Within Prado Basin for the Santiago Creek Project.

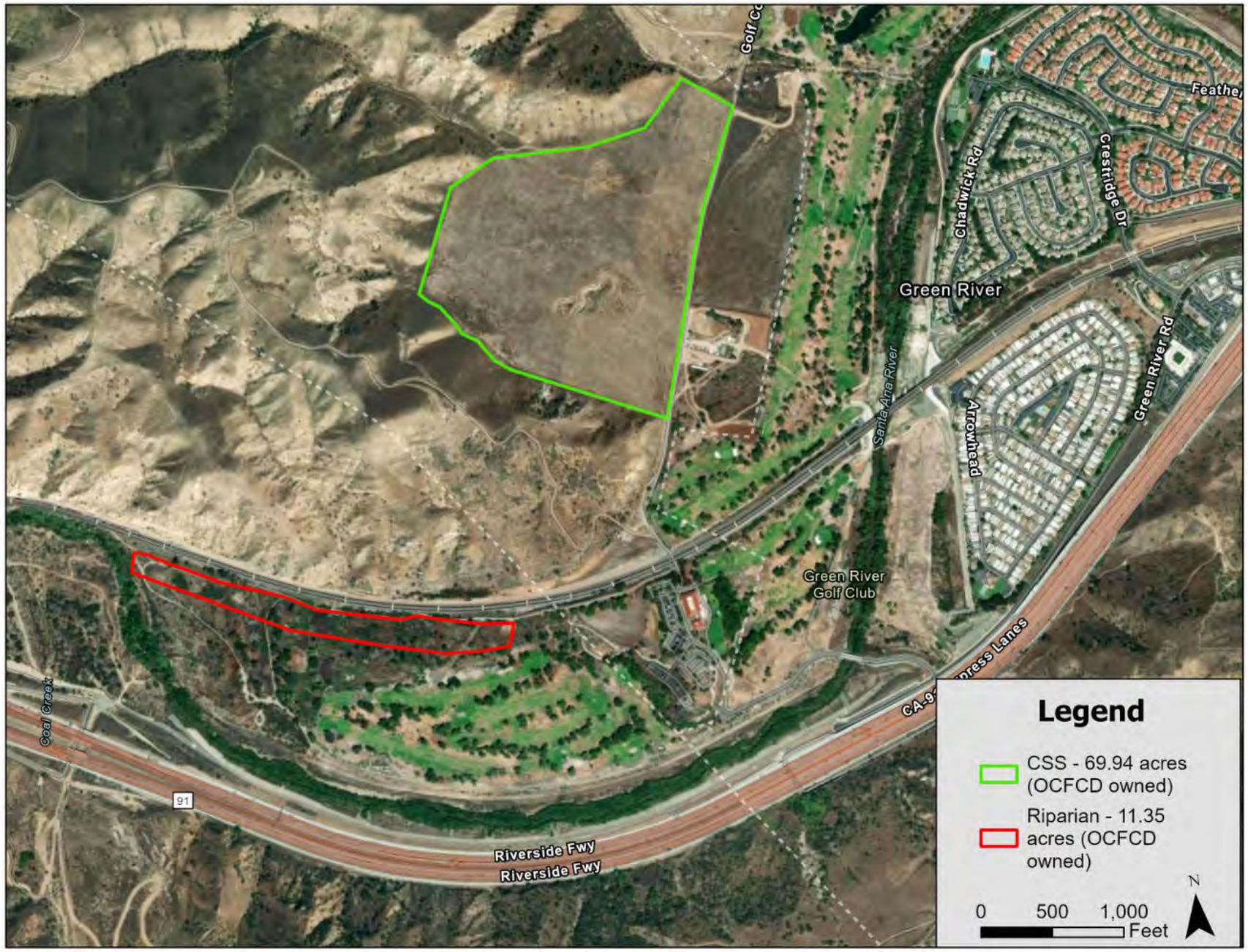


Figure 28: Location of Potential Additional Mitigation Sites Within the Santa Ana River Watershed Below Prado Dam.

3.2 Effects to CAGN Individuals

One (1) CAGN territory were observed within the action area. A total of approximately 1.82 acres of occupied habitat will be permanently impacted during implementation of shoreline stabilization within Smith Basin due to the construction of a maintenance road along the north side of the basin. In addition, a total of approximately 8.25 acres of occupied habitat (including 1.24 acre of existing mitigation sites (Figure 9)) will be temporarily impacted during implementation of shoreline stabilization within the Santiago Recharge Basins, but this acreage will be replanted with coastal sage scrub vegetation once construction is complete. Approximately 58.54 acres of the project footprint provide preferred suitable biological characteristics for CAGN within the mapped areas. Therefore, permanent impacts would affect approximately 3.1% of available sage scrub vegetation within the Santiago Recharge Basins. Temporary impacts would affect approximately 14.1% of available sage scrub vegetation within the Santiago Recharge Basins. Approximately 82.8% of available sage scrub vegetation within the Santiago Recharge Basins that provide preferred suitable biological characteristics for CAGN would not be impacted by the Proposed Action at all.

Direct and indirect impacts to CAGN include displacement of established territories causing adverse effects to one (1) territory within the action area. This would result in potential temporary displacement of one territory. This is assumed to be a temporary displacement as there are 48.47 acres of suitable CAGN habitat within the Santiago Recharge Basins that would not be impacted by the Proposed Action. Based on observations of CAGN territory size which can range between two (2) and 14 acres (USFWS, 2010), the unaffected 48.47 acres of suitable CAGN habitat within the Santiago Recharge Basins provides sufficient acreage for between 24 and three (3) CAGN territories while construction of the Proposed Action is occurring. Once construction of the Proposed Action is complete, 8.25 acres of upland vegetation temporarily impacted would be replanted with coastal sage scrub vegetation with suitable biological characteristics for CAGN. The replanted coastal sage scrub vegetation would include similar species that are within the Santiago Recharge Basins currently (i.e., black sage scrub, California sagebrush, laurel sumac, brittlebush scrub, etc.). In general, coastal sage scrub vegetation is considered early successional and can have growth ranging from 12 to 22 inches after approximately two (2) years (Howard, 1992; Tesky, 1993; and Hauser, 2006). Therefore, as detailed above, upland vegetation that contains preferred biological characteristics for CAGN will for the most part only be temporarily impacted and upland vegetation unaffected during the construction of the Proposed Action should provide sufficient habitat for CAGN with permanent and temporarily displaced territories within the action area.

Indirect impacts from construction of the Proposed Action includes noise, dust, and human presence. Birds use their sense of hearing to locate their young and mates, to establish and defend territories, and to locate and evade predators (Scherzinger, 1970). Dust can also visually impair gnatcatchers and degrade air quality and human presence can cause vireos to abandon territories and nests.

Routine maintenance, as listed under Section 1.5.3, Future Operation, Maintenance, Repair, Replacement, and Rehabilitation, for the most part is not expected to require disturbance to CAGN habitat. Ecological maintenance activities do include weeding and herbicide application of non-native species and re-seeding of native species when necessary. These activities would be conducted outside of the bird nesting season (i.e., February 15 – August 15) and are therefore not expected to directly impact nesting CAGN. The removal of non-native vegetation outside of the bird nesting season has the potential to affect CAGN habitat, but beneficially since non-native vegetation would be removed and native vegetation preferred by CAGN would be re-seeded as necessary. All other routine maintenance activities listed under Section 1.5.3 would not require disturbance to CAGN habitat. It is important to note that

conservation measures that will be implemented to minimize the potential for disruption of CAGN breeding and nesting activities during project construction will also be implemented during routine maintenance activities; therefore, routing maintenance is not anticipated to substantially interfere with CAGN breeding and nesting activities.

To avoid and minimize potential impacts to CAGN, the Corps will complete vegetation clearing activities associated with project construction only during periods when CAGN is not nesting (i.e., August 15 through February 15) (BIO-21). Additional measures to minimize and avoid impacts to CAGN include (BIO-19) surveys for CAGN during spring and early summer of the year prior to construction and, also, during each year of construction; (BIO-19) ensure coastal sage scrub areas not to be disturbed will be flagged and not encroached upon; (BIO-20) pre-construction environmental training for all construction crew members; and (BIO-32) construction of sound walls prior to February 15 to lessen general noise impacts. The above are just a few of the environmental commitments the Corps plans to implement to minimize and avoid impact to CAGN. Refer to Section 1.5.5 for the complete list.

To offset effects to CAGN from the Proposed Action, the Corps is proposing the restoration of 13.71 acres of coastal sage scrub habitat within Prado Basin and/or within the Santa Ana River watershed below Prado Dam. Figure 26 and Figure 28 show potential parcels that may be available as coastal sage scrub mitigation for the Santiago Creek project. The potential parcels are approximately 11.46 acres (Figure 26) and 69.64 acres (Figure 28). The parcel shown in Figure 26 is located on USACE land, is in the green “environmentally sensitive areas” and is being confirmed as to whether it is an existing mitigation site for another project. The second (Figure 28) is located on County of Orange land and is being confirmed as to whether it is available for mitigation for the Santiago Creek project. The 13.71 acres of coastal sage scrub habitat restored offsite will be monitored and managed according to BIO-5, BIO-8 and BIO-10. In addition, 8.25 acres of coastal sage scrub would be replanted on site to offset temporary impacts to upland vegetation within the project footprint. The 8.25 acres of native upland vegetation within the project footprint will be monitored and managed according to BIO-4 and BIO-10.

Based on the analysis described above, the Corps has determined that the Proposed Action may affect, and is likely to adversely affect, CAGN.

4.0 Cumulative Effects

Cumulative effects are “those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (40 CFR 402.02).”

For this cumulative effects analysis, reasonably foreseeable future actions within the Proposed Action area include the Smith Basin Improvement Project, OCWD Recycled Water Conveyance Improvement Project, and the Groundwater Recharge Facilities Maintenance Plan.

Smith Basin Improvement Project

The Smith Basin Improvement Project was proposed by Orange County Water District and a Draft Initial Study/Mitigated Negative Declaration was prepared in March 2020. In general, the Smith Basin Improvement Project proposes to repair and remediate erosion within Smith Basin caused by Santiago Creek. The primary cause of the erosion is undercutting of the toe of the embankment from the southerly migration of Santiago Creek within Smith Basin. Over time, the creek flow has moved from the northern side of the basin towards the south and is currently aligned along the toe of the southern and

eastern slopes of Smith Basin. The proposed project includes regrading a portion of the bottom of Smith Basin to repair the existing slope damage and reestablish Santiago Creek to its former alignment. Reestablishing the embankment slopes requires the current low-flow path of Santiago Creek to be moved northward and westward back toward its former location. Soil would be excavated from the bottom of Smith Basin and placed on the damaged slopes to restore them to a more stable grade. Due to the grading, approximately one-half of the existing vegetation in the bottom of Smith Basin would be removed to complete the slope repairs and creek alignment restoration. The embankments, groins, and slopes would all be left suitable for establishing native plants after construction. Three areas were identified where embankment slopes would be reestablished. Area 1 is located on the southern embankment slope adjacent to Villa Park Road. Area 2 is located on the eastern embankment slope adjacent to Oak Ridge Private School and the northern end of North Santiago Boulevard. Area 3 is located near the top of the embankment slope near the west corner of the basin.

Although the Smith Basin Improvement Project was identified as a potential foreseeable future action, this project is being implemented as part of the Proposed Action covered by this consultation. The authorized Santiago Creek project did include slope stabilization within Smith Basin, but implementation of the Santiago Creek project was delayed due to implementation of higher priority components of the larger SARMP. Now that most of the other components of the SARMP have been implemented, the Santiago Creek component of SARMP is now able to move forward with implementation. With the Santiago Creek component now being implemented, OCWD asked the Corps if they could implement portions of the Smith Basin Improvement Project not part of the authorized Santiago Creek project since Corps contractors would be in Smith Basin implementing parts of the Smith Basin Improvement Project that overlap with the authorized Santiago Creek project. OCWD was also uncertain as to when they would receive funding to move forward with the Smith Basin Improvement Project. Ultimately, the Smith Basin Improvement Project is not part of the cumulative effects analysis since features of that project are now part of the Santiago Creek project and as such are analyzed within this BE under direct and indirect impacts of the Proposed Action.

OCWD Recycled Water Conveyance Improvement Project

The Recycled Water Conveyance Improvement Project by OCWD proposes (1) the installation of a pipeline turnout and associated dechlorination facility that would connect an existing pipeline that conveys purified water treated at the OCWD Ground Water Replenishment System (GWRS) to Burris Basin in the City of Anaheim, and (2) the modification of the existing operational protocol for release of GWRS water into the Carbon Creek Diversion Channel (OCWD, 2022). The proposed project would eliminate the 10 percent in-stream blending requirement and allow undiluted GWRS water to be recharged in facilities downstream of Carbon Canyon Diversion Channel, provided the chlorine concentrations in the GWRS water meet regulatory requirements. The implementation of this component requires only operational changes at existing facilities, no construction or operation of new facilities would occur. The Proposed Project would result in the placement of varying quantities of highly purified water into Burris Basin and Riverview Basin that would be treated at OCWD's GWRS facility in Fountain Valley and conveyed through the GWRS pipeline to the project site. As Burris Basin is interconnected to OCWD's Santiago Recharge Basins through a pump station and the Santiago Pipeline, some quantities of purified GWRS water would be indirectly conveyed to Santiago Basin (OCWD, 2022).

Essentially the OCWD Recycled Water Conveyance Improvement Project could result in nominal amounts of GWRS water being released into the Santiago Recharge Basins and into Santiago Creek. This is possible since the Santiago Recharge Basins are connected to the Burris Basin via the Santiago Pipeline and water from the Burris Basin is sometimes transferred to the Santiago Recharge Basins for

groundwater recharge. In addition, if water is discharged from the Santiago Recharge Basins into Santiago Creek, GWRS water (if present in the basins at the time) could be discharged into the portion of Santiago Creek downstream of the Santiago Recharge Basins. The combination of the OCWD Recycled Water Conveyance Improvement Project and the Proposed Action would not have an adverse or beneficial cumulative effect on federally listed species or their habitat. Short-term, the OCWD Recycled Water Conveyance Improvement Project does not involve construction of any features within the Santiago Creek watershed, only a change in operational protocols for the release of GWRS water. Therefore, there would be no potential overlap of construction activities regarding the two projects. Long-term, there would also be no cumulative effect as the Proposed Action does not involve a change in operational protocols at the Santiago Recharge Basins. The Proposed Action primarily stabilizes the shorelines within the Santiago Recharge Basins so that erosion of the shorelines would be minimized, and native vegetation planted on top of the shoreline would not be impacted by erosion. The Proposed Action does not include any water control features that would hold GWRS water potentially discharged into the Santiago Recharge Basins from Burris Basin for a longer or shorter period. Similarly, the Proposed Action does not include a change in operations at the Santiago Recharge Basins that would alter the frequency or amount of water, including any GWRS water, being discharged into Santiago Creek downstream of the Recharge Basins. Therefore, no cumulative effect from the implementation of the OCWD Recycled Water Conveyance Project and the Proposed Action would occur.

Groundwater Recharge Facilities Maintenance Plan and Habitat Management Plan

The Groundwater Recharge Facilities Maintenance Plan includes a series of ongoing routine maintenance activities to maintain OCWD's existing groundwater recharge facilities. Routine maintenance activities include (1) sediment disturbance and removal, (2) vegetation removal, (3) maintenance and repair of existing access roads and ramps, (4) maintaining existing water conveyance structures, and (5) sand levee creation and repair. In addition to the ongoing maintenance activities that would be occurring within the Santiago Recharge Basins under the maintenance plan, restoration activities would also be occurring under an associated Habitat Management Plan (HMP) to provide compensatory mitigation for ongoing routine maintenance impacts to Waters of the U.S. and Waters of the State associated with OCWD groundwater management operations. Implementation of the HMP would create 8.6 acres of native habitat, restore 21.04 acres of existing native habitat, and maintain 77.99 acres of existing native habitat. The mitigation in the form of creation, conversion, or restoration outlined in the HMP would occur at a rate of at least 2.0 acres per year spread throughout seven OCWD basins: Smith Basin, Conrock Basin, Huckleberry Basin, Santiago Basin (i.e., Blue Diamond and Bond Basins), Five Coves Basin, Burris Basin, and Mills Pond. Specific to the Santiago Recharge Basins, the HMP includes maintaining 27.47 acres of existing native vegetation (including 8.6 acres of open water habitat that would not be disturbed) and restoring 4.33 acres of existing native vegetation within Smith Basin. Smith Basin does not include the creation of any native habitat. Regarding Blue Diamond and Bond Basins, the HMP includes maintaining 34.44 acres of existing native vegetation and restoring 13.64 acres of existing native vegetation. Like Smith Basin, the HMP does not include the creation of any native habitat within Blue Diamond and Bond Basins. Currently, 18.69 acres within the Blue Diamond and Bond Basins is being maintained and/or has been restored. None of the proposed Smith Basin mitigation outlined in the HMP has been implemented yet.

It is unlikely that short-term cumulative effects would occur from implementation of the Proposed Action along with the Groundwater Recharge Facilities Maintenance Plan. Maintenance activities proposed under the Maintenance Plan include repair work which wouldn't need to be conducted at the same time as the Proposed Action. This is because the Proposed Action would preemptively be stabilizing areas that could potentially need repair under the maintenance plan. Long-term cumulative

effects are also not anticipated from implementation of the Proposed Action along with the Groundwater Recharge Facilities Maintenance Plan. Once the Proposed Action is implemented, repaired slopes within the action area should have increased geotechnical stability which in turn should reduce the need for maintenance repairs to slopes under the Groundwater Recharge Facilities Maintenance Plan. In addition, the increased geotechnical stability of the slopes within the action area is anticipated to reduce the risk of future slope failure that could harm or destroy riparian vegetation and environmental resources. Similarly, the implementation of the HMP along with the Proposed Action would not be expected to result in any cumulative effects. Increased geotechnical stability of slopes within the action area is anticipated to reduce the risk of future slope failure that could harm existing mitigation sites within the Santiago Recharge Basins. Therefore, no cumulative effect from the implementation of the OCWD Groundwater Recharge Facilities Maintenance Plan or Habitat Management Plan would occur.

Besides the project discussed above, no other private or state projects are occurring or planned to occur in the action area. Therefore, based on the analysis above of cumulative effects for these projects in combination with the Proposed Action, the Corps has determined that there are no cumulative effects for the Proposed Project.

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Attachment A: IPaC Official Species Lists for Action Area

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Carlsbad Fish And Wildlife Office
2177 Salk Avenue - Suite 250
Carlsbad, CA 92008-7385
Phone: (760) 431-9440 Fax: (760) 431-5901

In Reply Refer To: July 26, 2023
Project Code: 2023-0019344
Project Name: Santiago Creek Project: Upper Reach

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A biological assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a biological assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a biological assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found at the Fish and Wildlife Service's Endangered Species Consultation website at:

https://www.fws.gov/endangered/what-we-do/faq.html

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Carlsbad Fish And Wildlife Office
2177 Salk Avenue - Suite 250
Carlsbad, CA 92008-7385
(760) 431-9440

PROJECT SUMMARY

Project Code: 2023-0019344
Project Name: Santiago Creek Project: Upper Reach
Project Type: New Constr - Above Ground
Project Description: Project is located within the Blue Diamond and Bond Pits (reservoirs) along Santiago Creek, Santa Ana, CA. Includes geotechnical surveys to be performed early 2021 and a larger project (proposed in an approved 1988 EIS) where construction date is unknown at this time. Larger project from the 1988 EIS includes reservoir improvements consisting of: slope stabilization, overflow structure, inlet culvert, recreational features, and aesthetic improvements (e.g., landscaping).

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@33.80756857064043,-117.80533690259195,14z



Counties: Orange County, California

ENDANGERED SPECIES ACT SPECIES

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

BIRDS

NAME	STATUS
Coastal California Gnatcatcher *Polioptila californica californica* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8178	Threatened
Least Bell's Vireo *Vireo bellii pusillus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5945	Endangered

FISHES

NAME	STATUS
Santa Ana Sucker *Catostomus santaanae* Population: 3 CA river basins There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3785	Threatened

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Army Corps of Engineers
Name: Shawna Herleth-King
Address: 231 S. LaSalle St., Suite 1500
City: Chicago
State: IL
Zip: 60604
Email herleth.king@gmail.com
Phone: 3128465407

Attachment B: Santiago Creek Aquatic Resources Report

AQUATIC RESOURCES DELINEATION REPORT
Santiago Creek Project

Prepared for:

United States Army Corps of Engineers, Los Angeles District
915 Wilshire Boulevard
Los Angeles, CA 90017

Prepared by:

Aspen Environmental Group
615 N. Benson Avenue, Suite E
Upland, CA 91786

Last Updated August 2022

Aquatic Resources Delineation Report

Santiago Creek Project
California

The undersigned certify that this report is a complete and accurate account of the findings and conclusions of a jurisdictional determination and delineation for the above-referenced project.

Justin M. Wood, M.S.
Senior Biologist
Aspen Environmental Group

Last Updated August 2022

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1.0 Introduction

This report was prepared under contract to the United States Army Corps of Engineers (USACE) to describe jurisdictional wetlands, streambeds, drainages, and other resources at the Santiago Creek Recharge Basin, Smith Basin, and along the lower reach of Santiago Creek. Throughout this report, "project" refers to the total action proposed by the USACE, while "project site" refers to all areas that may be directly or indirectly impacted by project activities as well as a slightly larger survey area. The USACE is currently designing modifications to Santiago Creek to prevent significant flood damages. The design modifications will be directed toward increasing the flood control capacity and reducing flooding induced erosion along the urbanized areas of Santiago Creek. Reservoir improvements are also proposed at Santiago Recharge Basin which are necessary to accommodate storage and regulation of flood waters released from the upstream dams. Generally, the existing Santiago Recharge Basin would be modified to allow storage of additional flood control volume and to give the basin operators additional flexibility in managing water levels to accommodate both groundwater conservation and flood storage needs.

1.1 Lead Agency Name and Address

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1.3 Site Access

Driving directions to the project site are provided below in Table 1.

Table 1. Driving Directions to the Project Site

From The Greater Los Angeles Area of Southern California:
Take Interstate 5 south towards San Diego.
Smith Basin Merge onto Highway 91 east towards Riverside. Merge onto Highway 55 south towards Newport Beach. Take Katella Ave. exit and turn left. Continue 1.6 miles to project site via locked gate on north side of Villa Park Rd. (Katella Ave.).
Santiago Recharge Basin Merge onto Highway 91 east towards Riverside. Merge onto Highway 55 south towards Newport Beach. Take Katella Ave. exit and turn left. Continue 0.6 miles and turn right on Wanda Rd. Continue 0.5 miles and turn left on Collins Ave. Continue 0.4 miles and turn left into the project site.

Table 1. Driving Directions to the Project Site
From The Greater Los Angeles Area of Southern California:
Lower Santiago Creek Take the exit towards Bristol St. Keep right onto La Veta Ave. Turn left on La Veta Ave. Continue 0.8 miles to project site on right.

2.0 Project and Property Description

2.1 Project Description

The USACE proposes to make several modifications to various features within the project site. These features would be directed toward increasing the flood control capacity and reducing flooding induced erosion along the urbanized areas of Santiago Creek. Major elements of the project include reservoir improvements, channel improvements, and recreational improvements as discussed below.

Reservoir Improvements. Reservoir improvements at Santiago Recharge Basin are necessary to accommodate storage and regulation of flood waters released from the upstream dams. Generally, the existing Santiago Recharge Basin would be modified to allow storage of additional flood control volume and to give the basin operators additional flexibility in managing water levels to accommodate both groundwater conservation and flood storage needs. The proposed reservoir improvements include:

- **Reservoir Regulation**. The maximum water elevation of the basins would increase from approximately 285-feet (ft) NAVD88 (North American Vertical Datum of 1988) – the current maximum operating elevation of the basins – to approximately 300.5-ft NAVD88. The increased elevation will increase the reservoir storage volume from approximately 13,500 acre-feet to approximately 16,100 acre-feet, enhancing both the flood control and groundwater conservation capabilities of the site. Approximately 4,620 acre-feet of storage volume is necessary to accommodate flood waters discharged from the Santiago Dam and Villa Park Dam during significant precipitation events. Site operators will release groundwater conservation stored within the basins to make room for incoming flood waters. The volume of water released will be dependent on pool elevations at the upstream dams, pool elevation within the reservoir, and time of year.

- **Outlet Structure**. An outlet structure would be installed in the northwestern corner of the Santiago Recharge Basin. The outlet structure would be a multi-chamber gated water control structure. Radial gates would be installed to allow reservoir operators capability to release conservation water at variable rates in anticipation of incoming flood water. The outlet structure would be configured to discharge conservation water down to an elevation of approximately 270-ft NAVD88 ahead of flood conditions, creating the necessary flood storage volume for the project. The structure will be constructed of concrete and steel and will be surrounded by an earthen berm and maintenance access roads. The gated outlet structure is approximately 240-ft long, 40-ft wide, and 30-ft tall. The entrance chamber is approximately 45-ft long with a slabbed roof and a trash rack at the upstream end. The gate chamber is approximately 30-ft long and includes two motorized radial gates and a single transferable bulkhead gate. The gate chamber is comprised of two individual 12-ft-tall chambers separate by a divider wall. A 30-ft long open chamber parabolic

transition leads to the 45-ft long stilling basin. The stilling basin has an invert at approximately 262.5-ft NAVD88 and a 17-ft-tall divider wall. The outlet transition is approximately 262.5-ft NAVD88 and a 17-ft-tall divider wall. The outlet transition is approximately 63-ft long and leads to the triple bay box culvert underneath Prospect Street. The box culvert opens up to a 300-ft-long rectangular and trapezoidal concrete outlet channel that joins with existing Santiago Creek near East Balmoral Drive.

- **Overflow Structure**. The overflow structure is an approximately 600-ft long designated overtopping location consisting of a grouted riprap side-channel weir in the northwestern corner of the Santiago Recharge Basin. The overflow structure provides an overflow weir with a crest set at the reservoir's maximum flood control storage elevation of 300.5-ft NAVD88. The minimum ground elevation at the downstream portion of the reservoir is approximately at elevation 302.5-ft NAVD88 at Prospect Street and Bond Avenue. The overflow structure will be tied into the surrounding grade, including the earthen berms surrounding the overflow structure, at elevation 302.5-ft. The weir is designed to convey 3,500 cfs when the pool is at elevation 302.5-ft NAVD88. During extreme flooding events, the overflow structure provides a stabilized discharge point to prevent overfilling of the reservoir.

- **Slope Stabilization**. The existing slopes of the reservoir require repair. To increase the water elevation in the reservoir and permit rapid drawdown in advance of flood conditions, several locations have been identified along the reservoir which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H):1 Vertical (V), installation of retaining walls, or installation of armoring.

Channel Improvements. Severe erosion of the channel has occurred during large flood events, compromising adjacent properties. To protect the channel during flood events, the creek must be stabilized. Between the Santa Ana Freeway (Interstate 5) and the Santa Ana River, the project will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will be buried with a native substrate in order to (i) enhance access for ongoing operation and maintenance; (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) anticipate local interests and concerns; (iv) improve recreational opportunities; and (v) enhance the environmental integrity of the stream corridor. The proposed stream stabilization measure includes 6,400-ft of trapezoidal channel armored with buried riprap. The proposed cross section includes a gravel bedding layer, riprap armor layer, and surficial substrate layer. The channel invert width varies from 30-ft to 80-ft, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitations and will be installed to a slope of 1.75H:1V.

As described above, native substrate harvested from the channel will be placed atop the proposed buried riprap layer. The surficial layer will provide suitable substrate for native vegetation growth, enhancing ecological, aesthetic, and recreational potential of the channel. At least two vegetation species mixes are included, a low-growth mix for the channel invert, and a more diverse mix for the channel banks.

2.2 Project Location

The project site is located in the cities of Orange, Santa Ana, Villa Park, and unincorporated territory within Orange County, California (see Figure 1, Attachment 1). It is within the California United States Geological Survey (USGS) Orange 7.5-minute Quadrangle. The 330-acre project site includes Smith Basin (67 acres)

and Santiago Recharge Basin (248 acres) shown in Figure 2a, and Santiago Creek Channel (15 acres) shown in Figure 2b (Attachment 1).

3.0 Existing Conditions

3.1 Topography and Surrounding Land Uses

The project site is generally located on the western slope of the Santa Ana Mountains near their transition with the valley floor below. Smith Basin and Santiago Recharge Basin are in an area with hilly terrain surrounded by dense residential development. Upstream of these basins are larger areas of open space such as Santiago Oaks Regional Park and Irvine Lake Regional Park. Lower Santiago Creek is in an area with flat topography and is also surrounded by residential development. A small narrow strip of open space is present to the west along the Santa Ana River and also to the east along Santiago Creek.

3.2 Vegetation

Vegetation mapping was done by drawing tentative boundaries onto high-resolution aerial images during site visits on January 12 and 26, 2022. These boundaries were then digitized into GIS shapefiles. Vegetation maps were field verified for accuracy on March 3, 2022. Vegetation was classified according to the *Manual of California Vegetation* (Sawyer, et al. 2009). Vegetation was mapped digitally using ArcGIS (version 10.7) and one-foot pixel aerial imagery on a 22-inch diagonal flat screen monitor. The smallest mapping unit was approximately 0.05 acre and most mapped vegetation boundaries are accurate to within approximately five feet. Any vegetation map is subject to imprecision for several reasons:

1. Vegetation types tend to intergrade on the landscape so that there are no true boundaries in the vegetation itself. In these cases, a mapped boundary represents best professional judgment.
2. Vegetation types as they are named and described tend to intergrade; that is, a given stand of real-world vegetation may not fit into any named type in the classification scheme used. Thus, a mapped and labeled polygon is given the best name available in the classification, but this name does not imply that the vegetation unambiguously matches its mapped name.
3. Vegetation tends to be patchy. Small patches of one named type are often included within mapped polygons of another type. The size of these patches varies, depending on the minimum mapping units and scale of available aerial imagery.

Vegetation within the project site consists of riparian and wetland vegetation, upland vegetation, and other land cover types. They are described in detail below and acreages of the vegetation and land cover areas are presented in Table 2 and shown in Figures 4a through 4c (Attachment 1).

Table 2. Vegetation and other cover types on the project site (acres)

Vegetation Type	Project Site (Acres)
Blue elderberry thickets	1.84
Brittle bush scrub	16.57
California live oak woodland and forest	0.38
California sagebrush - black sage scrub	35.87
Fountain grass swards	5.58
Goodding's willow - red willow riparian woodland and forest	21.73
Laurel sumac scrub	6.10
Mulefat thickets	4.47

Table 2. Vegetation and other cover types on the project site (acres)

Vegetation Type	Project Site (Acres)
Upland mustards or star-thistle fields	1.97
Wild oats and annual brome grasslands	3.78
Eucalyptus - tree of heaven - black locust groves	8.29
Other Cover Types	
Open water	174.91
Unvegetated channels and slopes	10.43
Developed	37.67
Total	329.61

Riparian and Wetland Vegetation Types

Goodding's willow - red willow riparian woodland and forest (*Salix gooddingii – Salix laevigata* Forest & Woodland Alliance). Goodding's willow - red willow riparian woodland and forest are a winter deciduous woodland that are dominated by Goodding's willow (*Salix gooddingii*). Additional species such as Pacific willow (*Salix lasiandra*), red willow (*Salix laevigata*), California sycamore (*Platanus racemosa*), and mulefat (*Baccharis salicifolia*) are also present. Goodding's willow - red willow riparian woodland and forest are present along Santiago Creek in the northern portion of the project site and are the dominant cover type in the seasonally inundated portions of Smith Basin. They are also present in isolated locations around Santiago Recharge Basin and are abundant near the earthen overflow channel. Goodding's willow - red willow riparian woodland and forest have a State rank of S3 and are therefore recognized as a sensitive natural community by California Department of Fish and Wildlife (CDFW) (CDFW 2021).

Mulefat thickets (*Baccharis salicifolia* Shrubland Alliance). Mulefat thickets are a winter deciduous shrubland that are dominated by mulefat. Additional species such as oleander (*Nerium oleander*), coyote brush (*Baccharis pilularis*), and shrubby willows (*Salix* spp.) are also present. Mulefat thickets are present along Santiago Creek in the northern portion of the project site and also around the margins of Smith Basin and Santiago Recharge Basin. Mulefat thickets have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland Vegetation Types

Blue elderberry thickets (*Sambucus nigra* ssp. *caerulea* Provisional Shrubland Alliance). Although not defined as a vegetation type in the current online version of *A Manual of California Vegetation*, blue elderberry thickets are present in the project site. This vegetation is dominated by blue elderberry (*Sambucus nigra* ssp. *caerulea*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species. Within the project site coyote brush and Peruvian pepper tree (*Schinus molle*) are also present. Blue elderberry thickets are present in the uplands near Santiago Creek in the northern portion of the project site and in the upland east of the Santiago Creek Basin. Blue elderberry thickets do not have a State Rank and therefore is not recognized as a sensitive natural community by CDFW (CDFW 2021).

Brittle bush scrub (*Encelia farinosa* Shrubland Alliance). Brittle bush scrub is a type of coastal sage scrub vegetation that is dominated by brittle bush (*Encelia farinosa*). Additional species such as coastal sage brush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Salvia mellifera*), giant wild rye (*Elymus condensatus*), and Laurel sumac (*Malosma laurina*) are also present in low numbers. Within the project site it appears that all the brittle bush scrub was planted for mitigation.

It is unclear if brittle bush is native to the project site. Brittle bush scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

California sagebrush - black sage scrub (*Artemisia californica* - *Salvia mellifera* Shrubland Alliance). California sagebrush - black sage scrub is a type of coastal sage scrub that is dominated by coastal sage brush. Within the project site, black sage is uncommon, but the vegetation still matches this description the best. Additional species such as sweetbush (*Bebbia juncea*) and California buckwheat are also present. Within the project site it appears that all the California sagebrush - black sage scrub has been planted for mitigation. California sagebrush - black sage scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Coast live oak woodland and forest (*Quercus agrifolia* Forest & Woodland Alliance). Coast live oak woodland and forest are dominated by coast live oaks (*Quercus agrifolia*). Within the project site, the coast live oak woodland and forest is limited to several patches along Santiago Creek Channel, in the vicinity of North Flower Street. The understory vegetation includes non-native ornamental species such as Canary ivy (*Hedera canariensis*). Coast live oak woodland and forest have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Eucalyptus - tree of heaven - black locust groves (*Eucalyptus* spp. - *Ailanthus altissima* - *Robinia pseudoacacia* Woodland Semi-Natural Alliance). Eucalyptus - tree of heaven - black locust groves are used to map all vegetation dominated by non-native trees within the project site including gum trees (*Eucalyptus* spp.), Peruvian pepper trees, yew plum pine (*Podocarpus macrophyllus*), prairie sumac (*Rhus lanceolata*), and many others. Native tree species such as California sycamore and coast live oak may also be present but generally represent single trees. Eucalyptus - tree of heaven - black locust groves have a State Rank of SNA (Not Applicable) and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Fountain grass swards (*Pennisetum setaceum* - *Pennisetum ciliare* Herbaceous Semi-Natural Alliance). Fountain grass swards are a non-native grassland dominated by fountaingrass (*Pennisetum setaceum*), a robust perennial bunchgrass. Other non-native species such as gazania (*Gazania linearis*) and mustard (*Hirschfeldia incana*), are also present as well as scattered natives such as desert wishbone bush (*Mirabilis laevis*). Fountain grass swards are present on the large, landscaped slope to the north of Smith Basin and along the eastern slope of the Santiago Recharge Basin. Fountain grass swards have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Laurel sumac scrub (*Malosma laurina* Shrubland Alliance). Laurel sumac scrub is dominated by Laurel sumac (*Malosma laurina*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species such as coastal sage brush and California buckwheat. Additional species such as tamarisk (*Tamarix* sp.) are also present. Laurel sumac scrub is present in the upland surrounding Santiago Creek, Smith Basin, and the Santiago Recharge Basin. Laurel sumac scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland mustards or star-thistle fields (*Brassica nigra* - *Centaurea* (*solstitialis*, *melitensis*) Herbaceous Semi-Natural Alliance). Upland mustards or star-thistle fields are a non-native plant community and within the project site are dominated by black mustard (*Brassica nigra*). Other non-native species are also present including white horehound (*Marrubium vulgare*), tocalote (*Centaurea melitensis*), fennel (*Foeniculum vulgare*), and others. This vegetation type is present in previously disturbed portion of the updates surrounding the Santiago Recharge Basin. Upland mustards or star-thistle fields have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Wild oats and annual brome grasslands (*Avena* spp. - *Bromus* spp. Herbaceous Semi-Natural Alliance). This grassland vegetation is dominated by a variety of non-native grasses such as wild oat (*Avena* spp.), ripgut brome (*Bromus diandrus*), and red brome (*Bromus rubens*). Non-native herbs are also present including Bermuda buttercup (*Oxalis pes-caprae*), fine leaved fumitory (*Fumaria parviflora*), mustard, and others. Wild oats and annual brome grasslands are present in disturbed sites within the project site, especially around the perimeter of the site adjacent to residential development. Wild oats and annual brome grasslands have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Other Land Cover Types

Developed. This cover type includes disturbed and developed areas within the project site including paved roads, unpaved roads, buildings, residential areas, and other unvegetated areas. It also includes a large area in the central portion of Santiago Recharge Basin that was recently impacted by construction activities. Developed is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Open water. Open water is used to map portions of the project site that had surface water present during early 2022. This included Smith Basin and Santiago Creek Basins. The water depths in these basins changes throughout the year and most of the open water in these basins will eventually become dry in the late summer and fall. Open water is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Unvegetated channels and slopes. This cover type includes flood control channels, unvegetated slopes, and other maintained areas within the project site. Vegetation is either absent or very sparse. Unvegetated channels and slopes is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

3.3 Climate

Climate in the region is temperate, with mild winters and hot, dry summers. Average temperatures near the project site in Anaheim, California include an average low temperature of 56 degrees Fahrenheit and an average high temperature of 78 degrees Fahrenheit. Rainfall is greatest during the months of November through March, with an average annual precipitation total of 13.43 inches (U.S. Climate Data 2022). Rainfall to-date has been below 50 percent of average with approximately 6.15 inches falling in the region since July 2021 (Orange County Public Works 2022).

3.4 Hydrology

Santiago Creek originates more than 15 miles upstream of the project site in the Santa Ana Mountains. Prior to reaching the project site, water enter Santiago Creek from numerous upstream tributaries including Silverado Canyon, Black Star Canyon, and Modjeska Canyon. Santiago Creek then flows through two upstream flood control facilities including the Via Park Dam and Santiago Dam before entering the project site. At the downstream end of the project site, flows from Santiago Creek enter the Santa Ana River and continue downstream approximately 10.5 miles before reaching the Pacific Ocean. The Pacific Ocean is recognized by the USACE as traditional navigable water (TNW) thereby establishing surface connectivity of the project area to navigable waters. Santiago Creek is a direct tributary to the Santa Ana River which is a direct tributary to the Pacific Ocean.

The National Hydrography Dataset (NHD) defines nested hydrologic units, beginning with Regions that are subdivided into subregions, basins, subbasins and watersheds. The project site is located within the South Coast Hydrologic Region of southern California (CDWR 2004). It is also located within the Coastal Plain of Orange County Groundwater Basin which is not further split into sub-regions (CDWR 2004). The project site is located within the larger Santa Ana River Watershed, an area of more than 2,400-square-mile (6,200 km^2). Elevations in the watershed range from 5,687 ft (1,733 m) at Santiago Peak to 108 ft (33 m) at the Santa Ana River confluence.

3.5 Soils and Geology

3.5.1 Soils

Historic soil data from the Natural Resources Conservation Service (NRCS) was used to determine potential soil types, including where hydric soils have historically occurred, in the project site (NRCS 2022). Figures 3a through 3c (Attachment 1) illustrates the location of historic soil types identified in the project site. Detailed information on elevation ranges, parent material, flooding potential, and drainage classes for each map unit symbol is provided below.

Table 3. Soil units occurring in the project site (acres)

Map Unit Symbol	Map Unit Name	Hydric Soil (Yes or No)	Agency Preferred Alternative (Acres)
132	Botella clay loam, 2 to 9 percent slopes	No	0.08
158	Hueneme fine sandy loam, drained	No	1.60
168	Modjeska gravelly loam, 0 to 2 percent slopes	No	5.23
178	Myford sandy loam, thick surface, 0 to 2 percent slopes	No	0.33
185	Pits	No	83.90
191	Riverwash	No	12.16
194	San Emigdio fine sandy loam, 0 to 2 percent slopes	No	29.80
197	Soboba gravelly loamy sand, 0 to 5 percent slopes	No	10.89
W	Water	No	185.63
		Total	329.61

Botella clay loam, 2 to 9 percent slopes. Botella clay loam soil is found in alluvial fans from the parent material of alluvium derived from sedimentary rock and is well drained soil. It is found in areas with 2 to 9 percent slopes at elevations of about 80 to 1,450 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of clay loam (0 to 8 inches), silty clay loam (8 to 35 inches), and clay loam (35 to 66 inches).

Hueneme fine sandy loam, drained. Hueneme fine sandy loam soil is found in alluvial fans from the parent material of stratified alluvium derived from sedimentary rock and is a poorly drained soil. It is found in areas with 0 to 2 percent slopes at elevations of about 0 to 430 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of cobbly sandy loam (0 to 20 inches), extremely cobbly sand (20 to 24 inches), and bedrock (24 to 39 inches).

Modjeska gravelly loam, 0 to 2 percent slopes. Modjeska gravelly loam contains alluvium derived from mixed parent material between 0 to 2 percent slopes. It is a well-drained soil with more than 80 inches to the water table. The substrate is comprised of gravelly loam (0 to 14 inches), very cobbly loam (14 to 63 inches) and very gravelly loamy sand (63 to 71 inches). It is not a hydric soil.

Myford sandy loam, thick surface, 0 to 2 percent slopes. Myford sandy loam found on terraces containing alluvium and is a moderately well-drained soil. Water table depth is typically more than 80 inches and these areas do not flood. The substrate is composed of sandy loam (0 to 22 inches), sandy clay (22 to 28 inches), sandy clay loam (28 to 38 inches), sandy clay loam (38 to 71 inches), and sandy loam (71 to 70 inches).

Pits. Pits contain parent material of igneous, metamorphic, and sedimentary rock. The substrate is composed of extremely gravelly coarse sand (0 to 6 inches), and very gravelly coarse sand (6 to 60 inches). In general, pits are known to contain a hydric soil rating.

Riverwash. Riverwash soils contains sandy and gravelly alluvium is a well-drained soil. It is found in areas with 0 to 5 percent slopes. Water table depth is typically 0 to 24 inches and subject to flooding. The substrate is comprised of gravelly sand (0 to 6 inches) and stratified gravelly coarse sand to sandy loam (6 to 60 inches). Riverwash does have a hydric soil rating.

San Emigdio fine sandy loam, 0 to 2 percent slopes. San Emigdio fine sandy loam soil that is found in alluvial fans from the parent material of alluvium derived from sedimentary rock and is well drained soil. It is found in areas with 0 to 2 percent slopes at elevations of about 30 to 1,190 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of fine sandy loam (0 to 7 inches) and stratified gravelly loamy coarse sand to fine sandy loam (7 to 61 inches).

Soboba gravelly loamy sand, 0 to 5 percent slopes. Soboba gravelly loamy sand soil is found in alluvial fans derived from sandy and gravelly alluvium derived from mixed sources. It is an excessively drained soil. It is found in areas with 0 to 5 percent slopes at elevations of about 30 to 4,200 feet. Water table depth is typically more than 80 inches, and these areas never flood. The substrate is comprised of gravelly loamy sand (0 to 10 inches) and very gravelly sand (10 to 60 inches).

3.5.2 Geology

The dominant geological feature in the Santiago Creek watershed is the Santa Ana Mountains. The northern portion of the mountains, which Santiago Creek drains, is composed of rocks from the pre-Triassic to the Quaternary (about 250 to 2.5 million years ago). These rocks consist primarily of sedimentary rocks such as slate, sandstone, conglomerate, and limestone. The uplift of the Santa Ana Mountains began approximately 5.5 million years ago along the Elsinore Fault Zone, which extends north from near its namesake Lake Elsinore area.

4.0 Regulatory Background

Jurisdictional waters, including some wetlands and riparian habitats, are regulated by the USACE, the Regional Water Quality Control Board (RWQCB), and CDFW. The USACE Regulatory Program regulates activities pursuant to Section 404 of the federal Clean Water Act (33 U.S.C. 1344; CWA); the CDFW regulates activities under the Fish and Game Code Section 1600-1607; and the RWQCB regulates activities under Section 401 of the CWA and the California Porter-Cologne Water Quality Control Act.

4.1 Section 404 of the Clean Water Act

Section 404 of the CWA regulates the discharge of dredged material, placement of fill material, or certain types of excavation within “waters of the U.S.” (resulting in more than incidental fallback of material) and authorizes the Secretary of the Army, through the Chief of Engineers, to issue permits for such actions. Permits can be issued for individual projects (individual permits) or for general categories of projects

(general permits). "Waters of the U.S." are defined by the CWA as "rivers, creeks, streams, and lakes extending to their headwaters and any associated wetlands." Wetlands are defined by the CWA as "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions." USACE has adopted several revisions to their regulations in order to more clearly define "waters of the U.S." Until the beginning of 2001, "waters of the U.S." included, among other things, isolated wetlands and lakes, intermittent streams, prairie potholes, and other waters that are not part of a tributary system to interstate waters or to navigable "waters of the U.S."

The jurisdictional extent of USACE regulation changed with the 2001 SWANCC (Solid Waste Agency of Northern Cook County) ruling. The U.S. Supreme Court held that the USACE could not apply Section 404 of the CWA to extend their jurisdiction over an isolated quarry pit. The Court ruled that the CWA does not extend Federal regulatory jurisdiction over non-navigable, isolated, intra-state waters. However, the Court made it clear that non-navigable wetlands adjacent to navigable waters are still subject to USACE jurisdiction.

In 2020, the U.S. Environmental Protection Agency (EPA) updated the CWA and their definition of navigable waters (USACE and USEPA, 2020). The Navigable Waters Protection Rule regulates the nation's navigable waters and the core tributary systems that provide perennial or intermittent flows into these systems. As such, "Waters of the U.S." encompass traditional navigable waters; perennial and intermittent tributaries that contribute surface waters flow to such waters; certain lakes, ponds, and impoundments of jurisdictional waters; and wetlands adjacent to other jurisdictional waters. Based on this ruling, ephemeral waters were not mapped as "Waters of the U.S." In 2021, the EPA and USACE were directed by the Biden Administration and the U.S. District Court to vacate the 2020 Navigable Waters Protection Rule and revert back to the pre-2020 rule. This revision of the Waters of the U.S. rule meant that ephemeral drainages were once again being treated as Waters of the U.S.

On April 6, 2022, the U.S. Supreme Court issued a stay of the 2021 order by the U.S. District Court for the Northern District of California that vacated the EPA's 2020 Clean Water Act Section 401 Certification Rule. Therefore, the CWA section 401 certification process is once again governed by the CWA section 401 certification regulations promulgated by EPA in 2020 (40 CFR 121). On June 1, 2022, the EPA Administrator signed a proposed rule to improve the CWA section 401 certification process. The proposed rule would replace and update the existing regulations at 40 CFR 121, to be more consistent with the statutory text of the 1972 CWA and clarify elements of section 401 certification practice that has evolved over the 50 years since the 1971 regulation was promulgated. On June 9, 2022, the proposed rule was published in the Federal Register (EPA, 2022). Based on a high degree of uncertainly and on-going changes in policy, ephemeral drainages are treated as jurisdictional Waters of the U.S. in this report.

4.2 Porter Cologne Water Quality Control Act and Section 401 of the Clean Water Act

The RWQCBs regulate activities affecting 'waters of the State' according to the Porter-Cologne Water Quality Control Act and Section 401 of the federal CWA. The Porter-Cologne Act defines waters of the State as all surface and subsurface waters. The RWQCBs may issue permits (called Waste Discharge Requirements or WDRs) or may issue a waiver for a given application. In addition, the California Water Resources Control Board (CWRCB) has started to implement a new regulatory program for all waters of the state in 2020 (CWRCB 2019). For non-wetland waters of the state, CWRCB procedures and guidelines recognize the ordinary high-water mark (OHWM) as defined by federal guidelines (CWRCB 2019, 2020; see also USACE 2008a, 2008b) as the limits of jurisdiction. However, waters of the State include isolated

waters and need not have downstream surface connection to federally jurisdictional waters. The new program uses the soils, hydrology, and vegetation criteria to identify wetlands, but may define certain unvegetated sites (e.g., mud flats or playas) as wetlands based on only the soils and hydrology criteria. The Project Area is within the jurisdictional boundaries of the Colorado River RWQCB.

Section 401 of the CWA requires that:

> *…any applicant for a Federal permit for activities that involve a discharge to "waters of the State," shall provide the Federal permitting agency a certification from the State in which the discharge is proposed that states that the discharge will comply with the applicable provisions under the Federal Clean Water Act.*

Therefore, before the USACE may issue a Section 404 permit, a permittee must apply for and receive a Section 401 Water Quality Certification from the RQWCB, Colorado River Region. The RWQCB may add conditions to their certification to remove or mitigate potential impacts to water quality standards.

On April 2, 2019, the State Water Resources Control Board (State Water Board) adopted a State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State. The adopted definitions and procedure allow for the presence of hydric substrates as a criterion for wetland identification (not just wetland soils) and wetland hydrology for an area devoid of vegetation (less than 5% cover) to be considered a wetland. Waters of the State were delineated based on the OHWM in the field.

4.4 Section 1602 of the California Fish and Game Code

Section 1602 of the California Fish and Game Code requires any person, State or local governmental agency, or public utility which proposes a project that will substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake, or use materials from a streambed, or result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake, to first notify the CDFW of the proposed project. Notification is generally required for any project that will take place in or in the vicinity of a river, stream, lake, or their tributaries. This includes rivers or streams that flow at least periodically or permanently through a bed or channel with banks that support fish or other aquatic life and watercourses having a surface or subsurface flow that support or have supported riparian vegetation. Based on the notification materials submitted, the CDFW will determine if the proposed project may impact fish or wildlife resources.

If the CDFW determines that a proposed project may substantially adversely affect existing fish or wildlife resources, a Lake or Streambed Alteration Agreement (SAA) will be required. A completed CEQA document must be submitted to CDFW before a SAA will be issued.

5.0 Waters and Wetlands Delineation Methodology

The assessment of jurisdictional wetlands, waters of the United States (U.S.), waters of the State, and other jurisdictional habitats was conducted by Aspen biologists Justin Wood and Jacob Aragon on January 12, 26, and March 3, 2022. Prior to conducting the field assessment Wood reviewed current and historic aerial photographs, the Orange County Soil Survey (NRCS, 2022), and the local and state hydric soil list (NRCS, 2022) to evaluate the potential active channels and wetland features in the project site. Wood also reviewed the National Wetland Inventory (USFWS 2022) and the 2016 wetland plant ratings in the National Wetland Plant List (Lichvar et al., 2016).

Site maps were generated with available aerial photographs and potentially jurisdictional features were identified and marked with lines and global positioning system (GPS) coordinates to assist in field verification. During the field assessment, vegetation and hydrology were mapped using an Arrow GPS unit and identified on aerial photographs (Figures 4 and 5, Attachment 1). Field maps were digitized using Global Information System (GIS) and total state and federal jurisdictional areas were calculated. Representative site photos were captured during the survey and are included in this report (see Attachment 2).

5.1 Wetland Waters of the U.S.

Federal wetlands were delineated using the USACE Wetland Delineation Manual (1987) and the Arid West Supplement (2008) based on three wetland parameters: hydrophytic vegetation, wetland hydrology, and hydric soils. A total of six transects were selected along evenly spaced lines perpendicular to the flow direction of Santiago Creek. Two paired wetland sample locations were assessed along each transect to determine if federal wetlands were present. These wetland sample locations were selected in drainage 2 and 3, which appeared to have the highest potential to support wetland parameters and are shown on Figures 5a (Attachment 1). Drainages 1 and 4 lacked evidence of wetland hydrology and drainage 4 lacked vegetation.

5.2 Non-wetland Waters of the U.S.

Jurisdictional non-wetland waters of the U.S. were delineated based on the limits of the ordinary high-water mark (OHWM) as determined by changes in physical and biological features, such as bank erosion, deposited vegetation or debris, and vegetative characteristics. In the Arid West region, the Ordinary High-Water Mark (OHWM) indicates the limits of high flows in low- to moderate-discharge events (USACE 2006). See Tables 1-1 and 1-2 in Attachment 3 (Federal Non-Wetland and Wetland Waters Indicator Information Potential Geomorphic and Vegetative Indicators of Ordinary High-Water Marks for the Arid West) for a list of key physical features for determining the OHWM identified by the arid west manual. OHWM datasheets were completed for each transect that crossed through the drainages 2 through 4, using the methods described in Curtis and Lichvar (2010) and shown on Figure 5 (Attachment 1).

5.3 RWQCB Waters of the State

RWQCB waters of the state generally match the limits of the waters of the U.S. described above. The RWQCB waters of the state are generally delineated based on the limits of the OHWM as determined by changes in physical and biological features, such as bank erosion, deposited vegetation or debris, and vegetative characteristics. The Santa Ana Regional Water Quality Control Board (SARWQCB) is the state agency responsible throughout the project site.

5.4 CDFW Jurisdictional Waters

CDFW jurisdiction was delineated to the tops of the channel banks or to the edge of the adjacent riparian vegetation, where present. CDFW jurisdictional waters were mapped to the top of the banks which was in the adjacent coastal sage scrub vegetation. CDFW has jurisdiction over a larger area than the federal jurisdiction, therefore the total acreage of CDFW jurisdictional waters and adjacent vegetation generally includes all federally jurisdictional waters, as well as additional adjacent state jurisdictional waters and habitats.

6.0 Results

Three categories of jurisdictional features were documented within the project site: USACE/SARWQCB jurisdictional non-wetland Waters of the U.S./Waters of the State, SARWQCB jurisdictional wetland Waters of the State, and CDFW jurisdictional waters and vegetation (refer to Figures 5a through 5c, Attachment 1). The SARWQCB jurisdictional wetland Waters of the State within the project site are also treated as non-wetland waters of the US with 3 parameter wetland conditions. Recent guidance from the USACE has indicated that federal wetland Waters of the U.S. cannot be present within a defined OHWM. Table 4 and Figure 5 show locations and acreages of jurisdictional features in the project site. Attachment 4 contains the Wetland Determination Data Forms for the Arid West Region and the Arid West Ephemeral and Intermittent Streams OHWM Datasheets that were completed during the assessment. Attachment 5 includes all plants observed on the project site and includes their wetland indicator status. The drainages with jurisdictional features are summarized in Table 4, and descriptions of the drainages follow the table. A complete aquatic resource table is also provided as Attachment 6.

Table 4. Acreage of Jurisdictional Wetland Waters

	USACE/SARWQCB Waters of the U.S./Waters of the State						
Drainage_ID	Area (acres)	Length (ft.)	Data Sheet Number	OHWM vs. Wetland	Cowardin Classification[1]	SARWQCB Wetlands (acres)	CDFW Jurisdiction (acres)[2]
1	--	--	N/A	N/A	R4UB	--	1.93
2	21.22	3,832	Wetland 1 & 2 OHWM 1 & 2	OHWM	R3UB, R3SB	2.30	27.57
3	83.09	4,968	Wetland 3 & 4 OHWM 3 & 4	OHWM	R3UB, L1UB	0.44	88.96
4	88.72	2,967	--	OHWM	L1UB	--	91.63
5	4.53	6,045	OHWM 5 & 6	OHWM	R4SB	--	7.95
Project Total	197.55	17,812	--	--	--	2.74	218.05

Note:
[1] = The dominant Cowardin Classification was used for each sub-drainage.
[2] = CDFW jurisdiction include streambeds, lakebeds, and adjacent vegetation.

- **Drainage 1** – Drainage 1 is a small, isolated water body more than 300 feet away from Santiago Creek. It appears to have historically been a rock quarry and now receives runoff from a very small watershed with two ephemeral channels with clearly defined beds and banks. Because of the isolated nature of this drainage, Waters of the U.S./Waters of the State are not present and instead this drainage falls only under the jurisdiction of CDFW. Drainage 1 is mapped as freshwater forested/shrub wetland (PSSCx) and freshwater pond (PUBHx) in the National Wetland Inventory (USFWS 2022). Riparian vegetation is also present around the perimeter of this isolated drainage.

- **Drainage 2** – Drainage 2 is a perennial portion of Santiago Creek from Canon St. to Villa Park Rd. Santiago Creek flows over bedrock and a series of waterfalls before entering Smith Basin. When Smith Basin is inundated, Santiago Creek is about 1,200 feet long before entering the flooded basin. Under dry conditions, Smith Basin is empty, and flows continue approximate 3,400 feet before going under Villa Park Dr. and entering Santiago Recharge Basin. The full length of Santiago Creek and Smith Basin up to the OHWM is likely to be under the jurisdiction of the USACE and SARWQCB. Waters of the U.S./Waters of the State were also determined to be present throughout Santiago Creek and the low-flow channel within Smith Basin. SARWQCB jurisdictional wetlands were also determined to be present within the OHWM in Santiago Creek and the low-

flow channel within Smith Basin. Smith Basin does not inundate for a long enough period to develop extensive wetlands. Drainage 2 is mapped as freshwater forested/shrub wetland (PFOCh and PFCO), lake (L2USKx), and riverine (R4SBC) in the National Wetland Inventory (USFWS 2022). Drainage 2 has a well-established riparian corridor that supports several sensitive bird species and the CDFW jurisdiction extends to the edge of this vegetation.

- **Drainage 3** – Drainage 3 is composed of a perennial basin known as Blue Diamond Pit which forms the northern half of Santiago Recharge Basin. Drainage 3 receives surface flows from Santiago Creek and Smith Basin to the north and Handy Creek to the east. It also receives diverted water from the Santa Ana River, which is pumped into Bond Pit, seeps into Blue Diamond Pit to the north and under certain conditions can spill into Santiago Creek Channel downstream of the basins. Lastly, a small water recharge release location is also located along the spillway channel and occasionally releases water into the Blue Diamond Pit. A narrow strip of SARWQCB jurisdictional wetlands were mapped near the earthen spillway where water from the recharge release locations makes its way north back into the basin. Except for the channel that flows from Santiago Basin to the spillway, Santiago Recharge Basin has steep slopes and frequent changes in water elevation which does not support development of wetlands. Drainage 3 is mapped as freshwater forested/shrub wetland (PSSCx), lake (L1UBKx and L2USKx), freshwater emergent wetland (PEM1Cx), and riverine (R4SBCx) in the National Wetland Inventory (USFWS 2022). Drainage 3 has a well-established riparian corridor near the spillway that supports several sensitive bird species and the CDFW jurisdiction extends to the edge of this vegetation. Riparian vegetation around the remainder of the basin is sparse and patchy.

- **Drainage 4** – Drainage 4 is composed of a perennial basin known as Bond Pit which forms the southern half of Santiago Recharge Basin. Drainage 4 receives water that is diverted from the Santa Ana River and is pumped through and existing pipeline to Santiago Recharge Basin. Water from Bond Pit seeps north into Blue Diamond Pit and under certain conditions spills into Santiago Creek Channel downstream of the basins. Bond Pit has steep slopes and frequent changes in water elevation which does not support development of wetlands. Bond Pit is mapped as freshwater forested/shrub wetland (PSSCx), and lake (L1UBKx and L2USKx) in the National Wetland Inventory (USFWS 2022).

- **Drainage 5 –** Drainage 4 includes lower Santiago Creek Channel which is an ephemeral channel fed by urban runoff and infrequent releases of water from Santiago Recharge basin. Within the project site, flows in Santiago Creek Channel travel approximately 6,300 feet from Interstate 5 before its confluence with the Santa Ana River. Drainage 4 does not support wetland hydrology or a dominance of hydrophytic vegetation. The channel bottom is composed of coarse gravels and cobbles making hydric soil development unlikely. Santiago Creek Channel has a well-established OHWM and sparse riparian vegetation. Drainage 4 is mapped as riverine (R4SBAx) in the National Wetland Inventory (USFWS 2022).

6.1 Wetland Waters of the U.S.

Based on the field assessment, including the wetland sample locations, no federal wetlands were determined to be present within the project site (see Figure 5, Attachment 1). The assessment did however determine that hydrology, hydric soils, and hydrophytic vegetation were all present in portions of drainage 2 (Smith Basin) and drainage 3 (Santiago Recharge Basin) however these locations were all below the OHWM and are therefore not treated as federal wetlands per recent guidance from the USACE. Wetland hydrology included the presence of surface water and a high ground-water table. Hydric soils

were present as indicated by a strong hydrogen sulfur odor and a sandy gleyed-matrix. A dominance of hydrophytic vegetation was also present and includes several species of willow, mulefat, and other wetland and riparian species. The Wetland Determination Data Forms for the Arid West Region are included in Attachment 4.

6.2 Non-wetland Waters of the U.S.

Based on this assessment of OHWMs and Aspen's professional opinion, 197.55 acres of the project site meet the definition of non-wetland Waters of the U.S. as outlined in 33 CFR Part 328 (Table 4 and Figure 5 of Attachment 1). This includes portions of Drainages 2, 3, and 4 as discussed above. Some of the key hydrology indicators noted during the delineation included the indicators listed below. See Tables 3-1 and 3-2 in Attachment 3 for additional information.

- A11 – Scour holes downstream of obstructions
- A16 – Desiccation/med cracks
- B3 – Benches
- B6 – Break in bank slope
- B8 – Change in particle size distribution
- B10 – Exposed root hairs below intact soil layer
- B11 – Silt deposits
- B12 – Litter (organic debris, small twigs and leaves)
- B13 – Drift (organic debris, larger than twigs)
- C8 – Soil development

6.3 RWQCB Waters of the State

Based on this assessment of OHWMs and Aspen's professional opinion, 194.82 acres of the project site meet the definition of non-wetland waters of the State (Table 4 and Figure 5 of Attachment 1). This includes portions of Drainages 2, 3, and 4 as discussed above. An additional 2.73 acres of the project site meet the definition of wetland Waters of the State as described above is Section 6.1 (Table 4 and Figure 5 of Attachment 1).

6.4 CDFW Jurisdictional Waters

Based on this assessment and Aspen's professional opinion, approximately 218.05 acres within the project site meet the definition of CDFW jurisdictional streambeds and adjacent jurisdictional vegetation (Table 4 and Figure 5 of Attachment 1). This includes portions of Drainages 1, 2, 3, and 4 as discussed above. This conclusion is primarily based on the presence of bed and bank and riparian vegetation.

7.0 Summary and Conclusions

The project site includes jurisdictional waters of the U.S. including federally regulated wetlands and non-wetlands, jurisdictional waters of the State, and CDFW jurisdictional streambeds and adjacent jurisdictional vegetation:

- 197.55 acres of jurisdictional non-wetland waters of the U.S. were mapped in portions of the project site that did not meet the hydrophytic vegetation or hydric soils criteria for wetlands but did have evidence of hydrology or a discernible OHWM.
- 194.82 acres of non-wetland Waters of the State and 2.73 acres of wetland Waters of the State were mapped within the project site. The wetlands contained wetland hydrology, hydric soils, and hydrophytic vegetation present.
- 218.05 acres of CDFW jurisdictional streambeds and adjacent jurisdictional vegetation were mapped based on the presence of clearly defined bed and banks and field observations.

The conclusions presented above represent Aspen's professional opinion based on our knowledge and experience with the USACE, SARWQCB, and CDFW, including the applicable regulatory guidance documents and manuals. However, the USACE, SARWQCB, and CDFW have final authority in determining the status and presence of jurisdictional wetlands and waters and the extent of their boundaries.

8.0. Literature Cited

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Attachment 1 – Figures



Figure 1

Project Overview

August 2022



Figure 2a

Project Site
Smith Basin and Santiago Creek Recharge

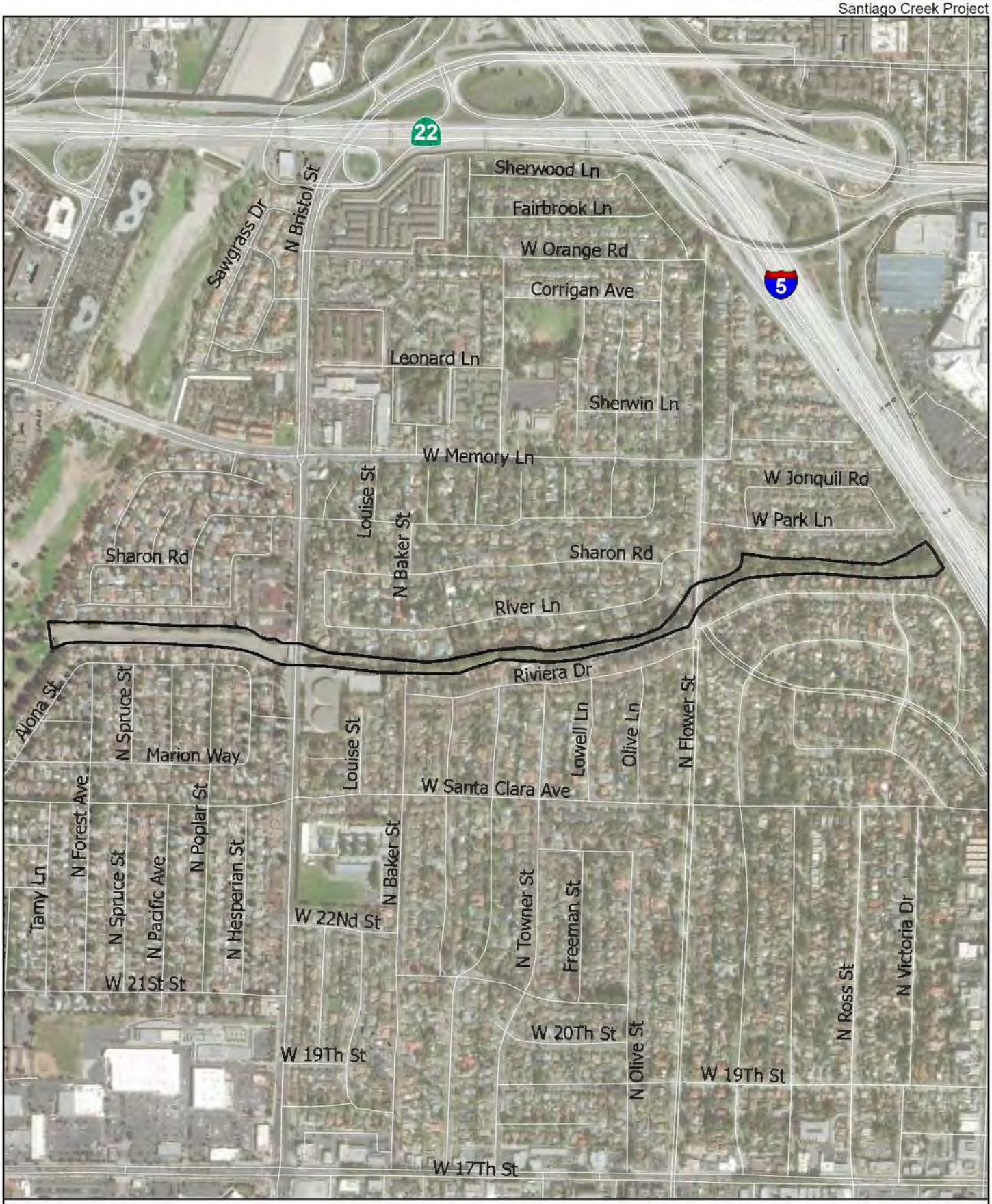


Figure 2b

Project Site
Santiago Creek Channel

August 2022

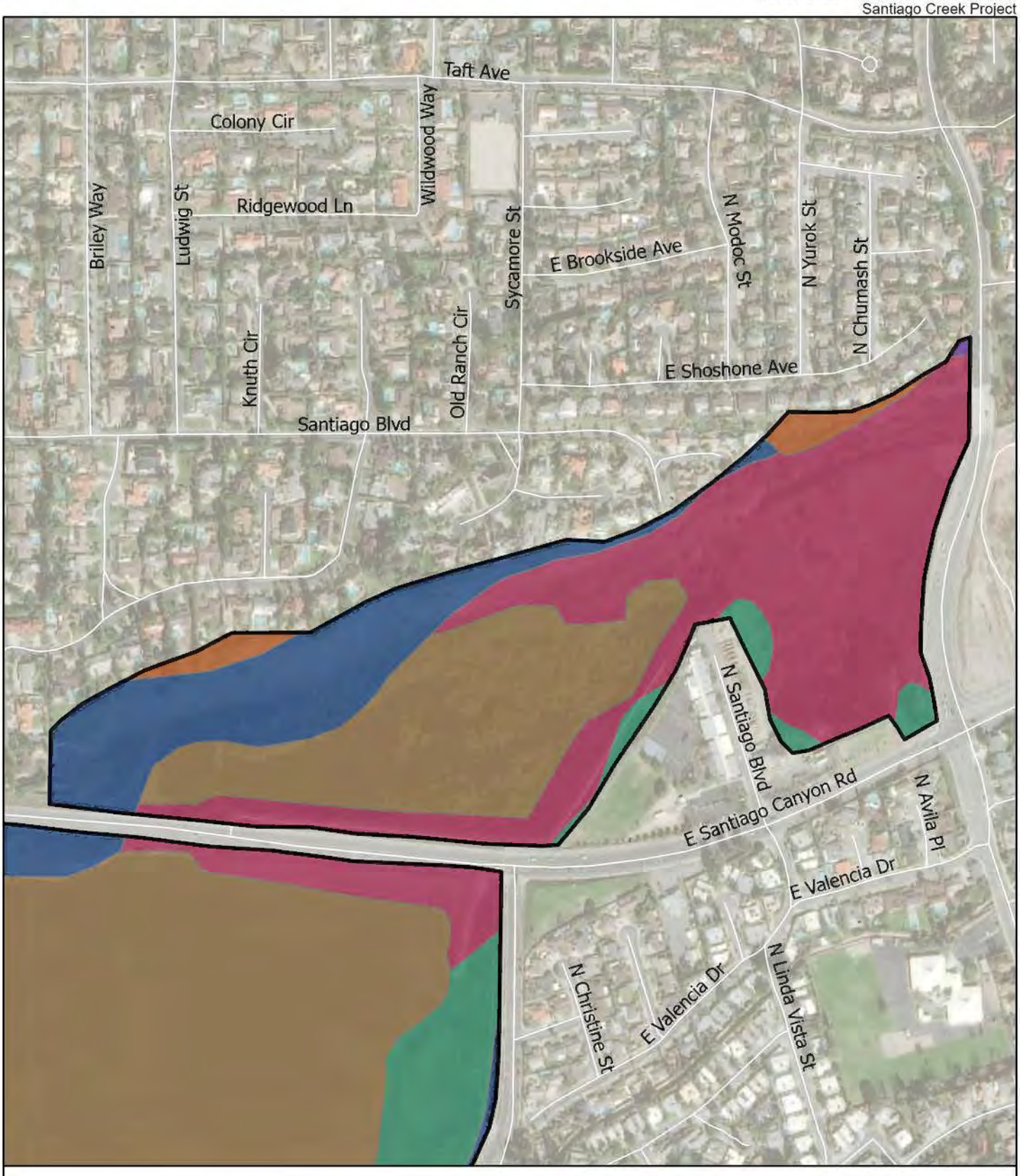


Figure 3a

Soils
Smith Basin

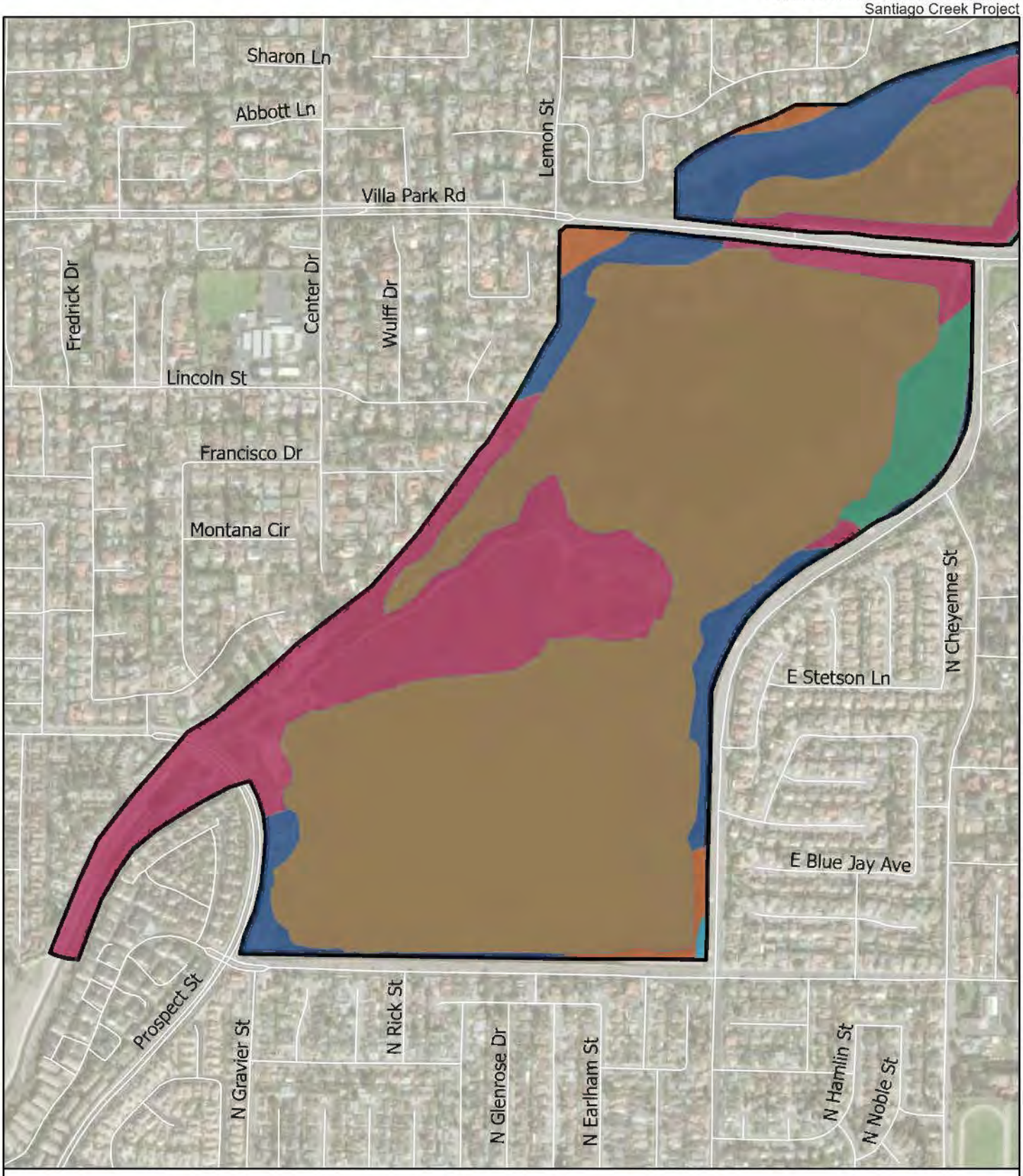


Figure 3b

Soils
Santiago Creek Recharge Basin



Project Site

Soils Type

158: Hueneme fine sandy loam

191: Riverwash

194: San Emigdio fine sandy loam

0 500 1,000 Feet

Figure 3c

Soils
Santiago Creek Channel

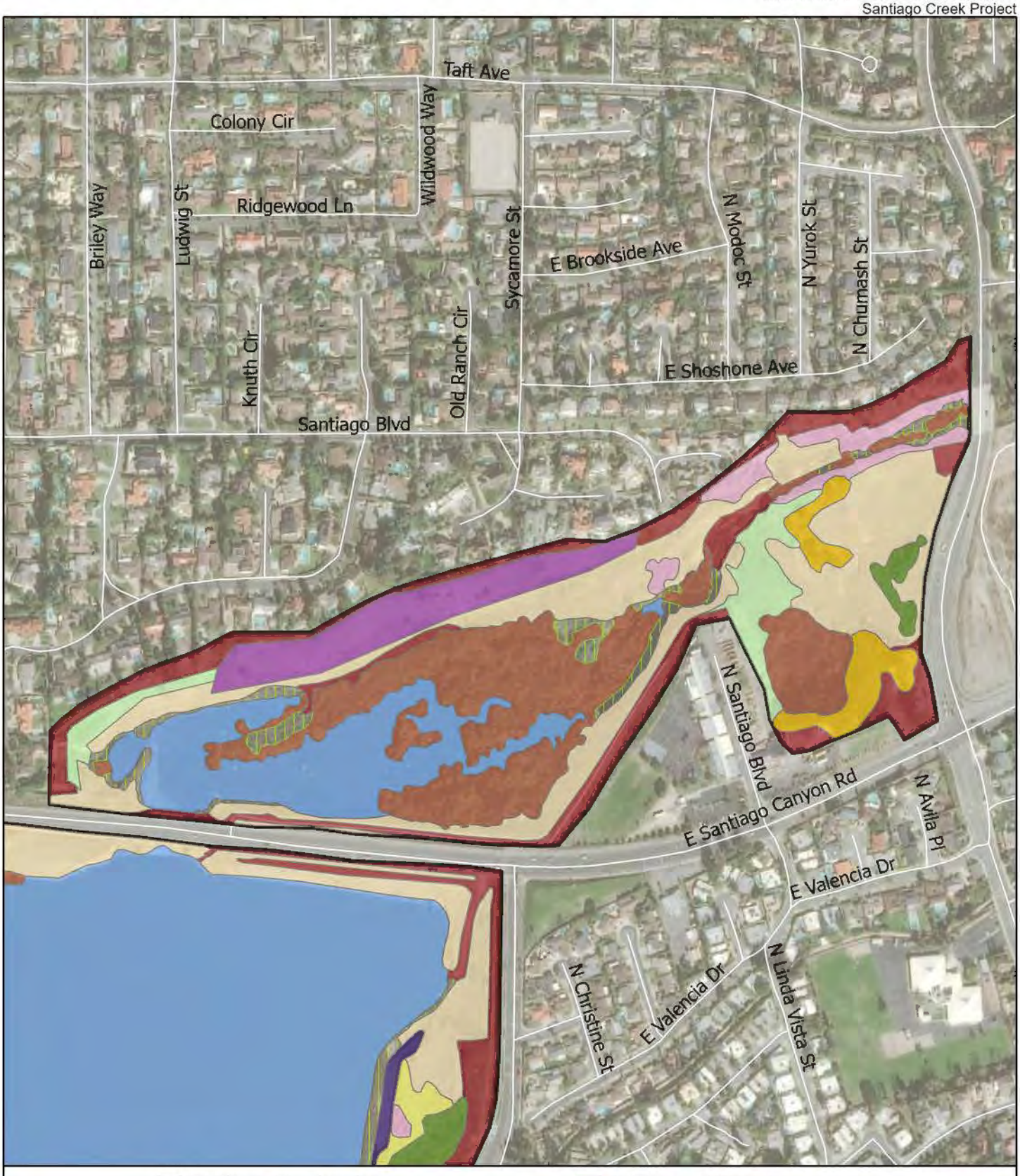


Figure 4a

Vegetation and Land Cover
Smith Basin



Figure 4b

Vegetation and Land Cover
Santiago Creek Recharge



Project Site

Vegetation and Cover Types

- Coast live oak woodland and forest (0.38 acres)
- Developed (37.67 acres)
- Eucalyptus - tree of heaven - black locust groves (8.29 acres)
- Unvegetated channel and slopes (10.43 acres)

N

0 500 1,000 Feet

Figure 4c

Vegetation and Land Cover
Santiago Creek Channel

August 2022



Figure 5a

Aquatic Resources Delineation Map
Smith Basin

August 2022

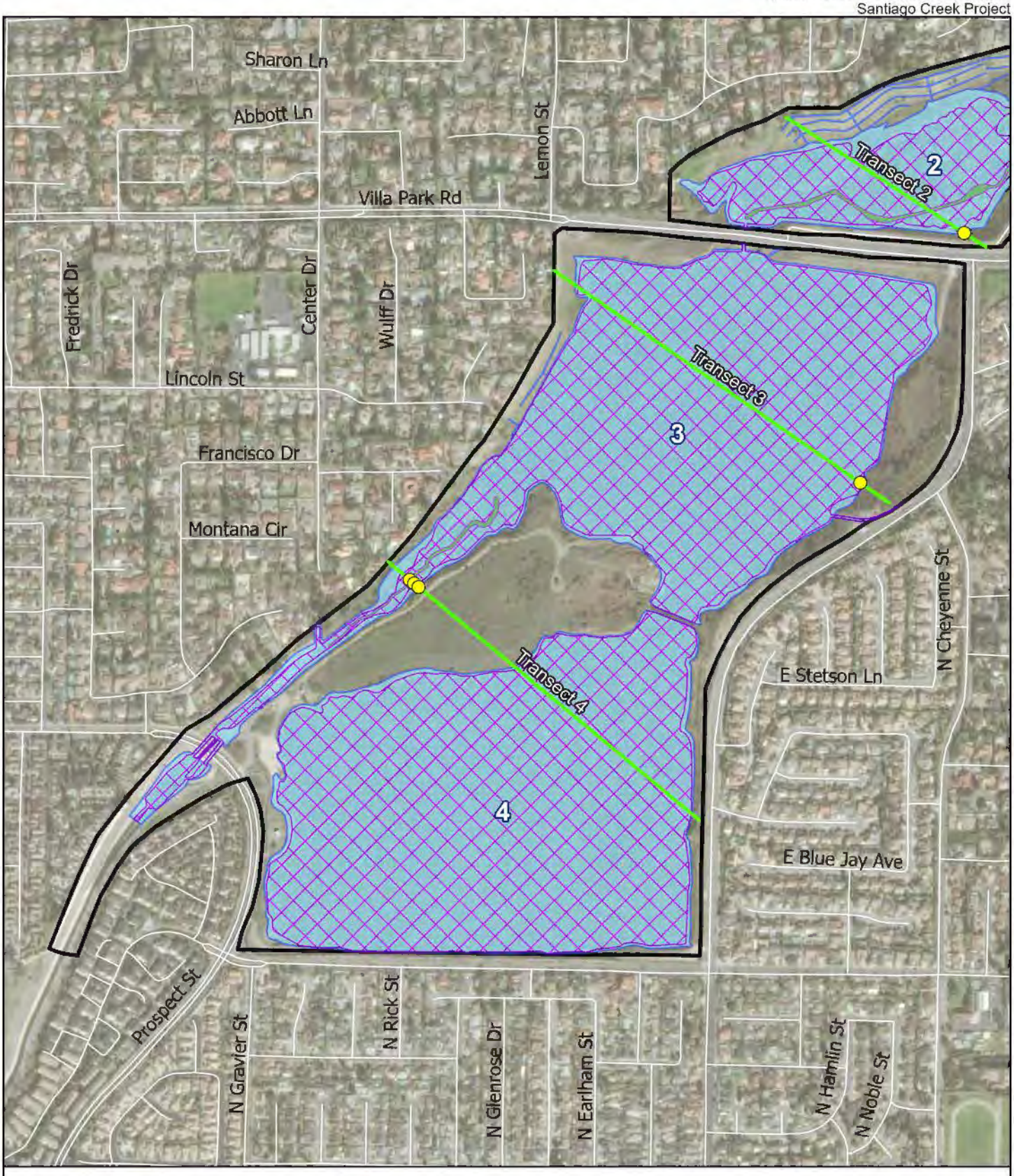


Figure 5b

Aquatic Resources Delineation Map
Santiago Creek Recharge Basin



Figure 5c

Aquatic Resources Delineation Map
Santiago Creek Channel

August 2022

Attachment 2 – Photo Exhibit



Photo 1: Close-up photos of dense riparian vegetation within drainage 1.



Photo 2: Water cascading over bedrock near the central portion of Santiago Creek (drainage 2).



Photo 3: Close-up view of SARWQCB wetlands at the upstream end of Santiago Creek (drainage 2), near Cannon Street.



Photo 4: Rock waterfall near the central portion of Santiago Creek (drainage 2).



Photo 5: Rock pool near the central portion of Santiago Creek (drainage 2).



Photo 6: East-facing overview of Smith Basin (drainage 2).



Photo 7: Close-up view of wetland sample location #1 within Santiago Creek (drainage 2).



Photo 8: Overview of recently constructed land bridge between the Blue Diamond and Bond Pits within Santiago Recharge Basin (drainage 3).



Photo 9: Close-up view of SARWQCB wetlands near the spillway within Santiago Recharge Basin (drainage 3).



Photo 10: Close-up view of SARWQCB wetlands near the spillway within Santiago Recharge Basin (drainage 3).



Photo 11: North-facing view of the existing outlet channel of drainage 3 and the undercrossing of E Collins Ave.



Photo 12: West-facing view of Handy Creek near the northeast corner of Santiago Recharge Basin (drainage 3).



Photo 13: West-facing view of the upstream portion of Santiago Creek Channel (drainage 4).



Photo 14: West-facing view of the downstream portion of Santiago Creek Channel (drainage 4).



Photo 15: East-facing view of the downstream portion of Santiago Creek Channel (drainage 4).



Photo 16: East-facing view of the central portion of Santiago Creek Channel (drainage 4).

Attachment 3 – Federal Non-wetland and Wetland Water Indicator Information

Table 1. Potential Geomorphic Indicators of Ordinary High-Water Marks for the Arid West

(A) Below OHW	(B) At OHW	(C) Above OHW
1. In-stream dunes	1. Valley flat	1. Desert pavement
2. Crested ripples	2. Active floodplain	2. Rock varnish
3. Flaser bedding	3. Benches: low, mid, most prominent	3. Clast weathering
4. Harrow marks	4. Highest surface of channel bars	4. Salt splitting
5. Gravel sheets to rippled sands	5. Top of point bars	5. Carbonate etching
6. Meander bars	6. Break in bank slope	6. Depositional topography
7. Sand tongues	7. Upper limit of sand-sized particles	7. Caliche rubble
8. Muddy point bars	8. Change in particle size distribution	8. Soil development
9. Long gravel bars	9. Staining of rocks	9. Surface color/tone
10. Cobble bars behind obstructions	10. Exposed root hairs below intact soil layer	10. Drainage development
11. Scour holes downstream of obstructions	11. Silt deposits	11. Surface relief
12. Obstacle marks	12. Litter (organic debris, small twigs and leaves)	12. Surface rounding
13. Stepped-bed morphology in gravel	13. Drift (organic debris, larger than twigs)	
14. Narrow berms and levees		
15. Streaming lineations		
16. Desiccation/mud cracks		
17. Armored mud balls		
18. Knick Points		

Table 2. Potential Vegetation Indicators of Ordinary High-Water Marks for the Arid West

	(D) Below OHW	(E) At OHW	(F) Above OHW
Hydroriparian indicators	1. Herbaceous marsh species 2. Pioneer tree seedlings 3. Sparse, low vegetation 4. Annual herbs, hydromesic ruderals 5. Perennial herbs, hydromesic clonals	1. Annual herbs, hydromesic ruderals 2. Perennial herbs, hydromesic clonals 3. Pioneer tree seedlings 4. Pioneer tree saplings	1. Annual herbs, xeric ruderals 2. Perennial herbs, non-clonal 3. Perennial herbs, clonal and non-clonal co-dominant 4. Mature pioneer trees, no young trees 5. Mature pioneer trees w/upland species 6. Late-successional species
Mesoriparian Indicators	6. Pioneer tree seedlings 7. Sparse, low vegetation 8. Pioneer tree saplings 9. Xeroriparian species	5. Sparse, low vegetation annual herbs, hydromesic 6. ruderals 7. Perennial herbs, hydromesic clonals 8. Pioneer tree seedlings 9. Pioneer tree saplings 10. Xeroriparian species 11. Annual herbs, xeric ruderals	7. Xeroriparian species 8. Annual herbs, xeric ruderals 9. Perennial herbs, non-clonal 10. Perennial herbs, clonal and non-clonal codominant 11. Mature pioneer trees, no young trees 12. Mature pioneer trees, xeric understory 13. Mature pioneer trees w/upland species 14. Late-successional species 15. Upland species
Xeroriparian indicators	10. Sparse, low vegetation 11. Xeroriparian species 12. Annual herbs, xeric ruderals	12. Sparse, low vegetation 13. Xeroriparian species 14. Annual herbs, xeric ruderals	16. Annual herbs, xeric ruderals 17. Mature pioneer trees w/upland species 18. Upland species

Table 3. Summary of Wetland Indicator Status

Category		Probability
Obligate Wetland	OBL	Almost always occur in wetlands (estimated probability >99%)
Facultative Wetland	FACW	Usually occur in wetlands (estimated probability of 67–99%)
Facultative	FAC	Equally likely to occur in wetlands/non-wetlands (estimated probability of 34–66%)
Facultative Upland	FACU	Usually occur in non-wetlands (estimated probability 67–99%)
Obligate Upland	UPL	Almost always occur in non-wetlands (estimated probability >99%)
Non-Indicator	NI	No indicator status has been assigned

Source: Reed, 1988

Table 4. Wetland Hydrology Indicators*

Primary Indicators	Secondary Indicators
Watermarks	Oxidized Rhizospheres Associated with Living Roots
Water-Borne Sediment Deposits	FAC-Neutral Test
Drift Lines	Water-Stained Leaves
Drainage Patterns Within Wetlands	Local Soil Survey Data

*Table adapted from 1987 USACE Manual and Related Guidance Documents.

Table 5. Wetland Hydrology Indicators for the Arid West*

	Primary Indicator (any one indicator is sufficient to determine that wetland hydrology is present)	Secondary Indicator (two or more indicators are required to determine that wetland hydrology is present)
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface Water	X	
A2 – High Water Table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water Marks	**X** (Non-riverine)	**X** (Riverine)
B2 – Sediment Deposits	**X** (Non-riverine)	**X** (Riverine)
B3 – Drift Deposits	**X** (Non-riverine)	**X** (Riverine)
B6 – Surface Soil Cracks	X	
B7 – Inundation Visible on Aerial Imagery	X	
B9 –Water-Stained Leaves	X	
B10 – Drainage	X	X
B11 – Salt Crust	X	
B12 – Biotic Crust	X	
B13 – Aquatic Invertebrates	X	
Group C – Evidence of Current or Recent Soil Saturation		
C1 – Hydrogen Sulfide Odor	X	
C2 – Dry-Season Water Table		X
C3 – Oxidized Rhizospheres along Living Roots	X	
C4 – Presence of Reduced Iron	X	
C6 – Recent Iron Reduction in Tilled Soils	X	

Table 5. Wetland Hydrology Indicators for the Arid West*

	Primary Indicator (any one indicator is sufficient to determine that wetland hydrology is present)	Secondary Indicator (two or more indicators are required to determine that wetland hydrology is present)
C7 – Thin Muck Surface	X	
C8 – Crayfish Burrows		X
C9 – Saturation Visible on Aerial Imagery		X
Group D – Evidence from other Site Conditions or Data		
D3 – Shallow Aquitard		X
D5 – FAC-Neutral Test		X

*Table adapted from Regional Supplement to the USACE of Engineers Wetland Delineation Manual: Arid West Region, Version 2.0.

Table 6. Field Indicators of Hydric Soil Conditions*

1. Indicators of Historical Hydric Soil Conditions	2. Indicators of Current Hydric Soil Conditions
a. Histosols b. Histic epipedons; c. Soil colors (e.g., gleyed or low-chroma colors, soils with bright mottles (Redoximorphic features) and/or depleted soil matrix d. High organic content in surface of sandy soils e. Organic streaking in sandy soils f. Iron and manganese concretions g. Soil listed on county hydric soils list	a. Aquic or peraquic moisture regime (inundation and/or soil saturation for *7 continuous days) b. Reducing soil conditions (inundation and/or soil saturation for *7 continuous days) c. Sulfidic material (rotten egg smell)

*Table adapted from 1987 USACE Manual and Related Guidance Documents.

Table 7. Hydric Soil Indicators for the Arid West*

Hydric Soil Indicators			Hydric Soil Indicators for Problem Soils**
All Soils	Sandy Soils	Loamy and Clay Soils	
A1 – Histosol	S1 – Sandy Mucky Mineral	F1 – Loamy Mucky Mineral	A9 – 1 cm Muck
A2 – Histic Epipedon	S4 – Sandy Gleyed Matrix	F2 – Loamy Gleyed Matrix	A10 – 2 cm Muck
A3 – Black Histic	S5 – Sandy Redox	F3 – Depleted Matrix	F18 – Reduced Verti
A4 – Hydrogen Sulfide	S6 – Stripped Matrix	F6 – Redox Dark Surface	TF2 – Red Parent Material
A5 – Stratified Layers	—	F7 – Depleted Dark Surface	Other (See Section 5 of Regional Supplement, Version 2.0)
A9 – 1 cm Muck	—	F8 – Redox Depressions	—
A11 – Depleted Below Dark Surface	—	F9 – Vernal Pools	—
A12 – Thick Dark Surface	—	—	—

* Table adapted from Regional Supplement to the USACE of Engineers Wetland Delineation Manual: Arid West Region, Version 2.0.

** Indicators of hydrophytic vegetation and wetland hydrology must be present

Attachment 4 – Arid West OHWM and Wetland Determination Data Sheets

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Santiago Creek City/County: Orange/Orange County Sampling Date: 1/26/2022

Applicant/Owner: U.S. Army Corps of Engineers State: CA Sampling Point: Wetland #1

Investigator(s): Justin Wood, Jacob Aragon Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Canyon Local relief (concave, convex, none): Concave Slope (%): 8

Subregion (LRR): Mediterranean California Lat: 33.813282 Long: -117.798409 Datum: WGS84

Soil Map Unit Name: Pits NWI classification: Riverine

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil ✔, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks:

Bedrock is preventing hydric soil development, clear indicators of wetlands present.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m x 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 5m x 1m)			
1. Baccharis salicifolia	30	Yes	FAC
2. Salix gooddingii	12	Yes	FACW
3.			
4.			
5.			
	42 = Total Cover		
Herb Stratum (Plot size: 1m x 1m)			
1. Pulicaria paludosa	30	Yes	FAC
2. Typha latifolia	15	Yes	OBL
3. Nasturtium officinale	5	No	OBL
4. Foniculum vulgare	5	No	NL
5.			
6.			
7.			
8.			
	55 = Total Cover		
Woody Vine Stratum (Plot size: 5m x 1m)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 85 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	12	x 2 =	24
FAC species	60	x 3 =	180
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	92 (A)		224 (B)

Prevalence Index = B/A = 2.43

Hydrophytic Vegetation Indicators:

✔ Dominance Test is >50%

✔ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks:

Extenisve bedrock, vegetation growing on small soil accumulations.

SOIL

Sampling Point: Wetland #1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-8	7.5YR 3/1	100					Sandy Loar	Shallow soil over bedrock.

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ✔ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Bedrock

Depth (inches): 8

Hydric Soil Present? Yes ____ No ✔

Remarks:

Bedrock is problemmatic and preventing hydric soil development. All other parameters show strong wetland indicators.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✔ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ✔ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ✔ Sediment Deposits (B2) (**Riverine**)
- ✔ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✔ No ____ Depth (inches): ____

Water Table Present? Yes ____ No ____ Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No ____ Depth (inches): ____

Wetland Hydrology Present? Yes ✔ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETL N ETERMIN TION T FORM – id West Region

Pr ject/Site: Santiago Cr k D City/C unty: Orang /Orang County D Sam pling Date: / 6/ 0

A licant/Owner: U.S. Army Corp o ngin r State: CA Sam pling P int: Wetland #2

Inve tigat r( ): Ju tin Woo , Jacob Aragon D Secti n, T wn hi , Range: N/A

Land rm (hill l e, terrace, etc.): Canyon D L cal relie (c ncave, c nvex, n ne): Concave D Sl e (%): 8

Subregi n (LRR): Mediterranean California D Lat: 33.813257 D L ng: -117.798366 D Datum: WGS84

S il Ma Unit Name: Pits D NWI cla i icati n: Riverine D

Are climatic / hydr l gic c nditi n n the ite ty ical r thi time year? Ye ✔ N _____ (I n , ex lain in Remark .)

Are Vegetati n _____, S il _____, r Hydr l gy _____ igni icantly di turbed? Are "N rmal Circum stance " re ent? Ye ✔ N D_____

Are Vegetati n _____, S il _____, r Hydr l gy _____ naturally r blematic? (I needed, ex lain any an wer in Remark .)

SUMMARY OF FIN INGS – Attach site map showing sampling point locations, transects, important features, etc. D

Hydr hytic Vegetati n Pre ent?	Ye _____	N ✔	**Is the Sampled Area within a Wetland?**	**Yes** _____ **No D** ✔
Hydric S il Pre ent?	Ye _____	N ✔		
Wetland Hydr l gy Pre ent?	Ye _____	N ✔		

Remark :

Adjacent to sample location Wetland #1, approximately three feet beyond surface flows.

VEGETATION – Use scientific names of plants.

Tree Stratum (Pl t ize: 5m x 5m)	Ab lute % C ver	D minant S ecie ?	Indicat r Statu
1. Malosma laurina	5	Yes	NL
2.			
3.			
4. D			
D	_____ = T Dtal C Dver		
Sa Dling/Sh Dub St Dtratum D(Pl DDDze: D 5m x 1 Dm D)			
1. Encelia d Dalifornid D D	70 D	Yes D D	NL DD
2. Bacd Dharis salicifolia D	5 D	No DD	FA DD
3.			
4.			
5. D			
	75 D = T Dtal C Dver		
He Db St Dtratum D(Pl DDDze: D 1m x 1m D)			
1.			
2.			
3.			
4. D			
5.			
6.			
7.			
8. D			
D	_____ = T Dtal C Dver		
Wo Dy V Dne St Dtratum D(Pl DDDze: D 5m x 1m D)			
1.			
2. D			
D D	_____ = T Dtal C Dver		
% Ba DeDr und in D Be Db St Dtratum D 100 D	% C Dver DBi DDDCrD D D D0 D		

ominance Test worksheet:

Number D minant S ecie That Are OBL, FA DCW, r FAC: 1 D (A) D

T tal Nu Dnber DD Dminan Dt S Decie D A D D All D St Ddata: D 2 (B) D

Pe Dcent DD Dminant S Decie D That Are D OBL, FA DDDW, r FA DDDD D 50 D (A/B) D

Pr Dvalence D Index DD Worksh Dt:

T Dtal % C Dver D D Multi lyDby: D

OBL D ecie _____ x 1 = _____

FA DCW D ecie D DD _____ x 2 = _____

FAC D ecie D D _____ x 3 = D _____

FA DDDDD ecie D D _____ x 4 = _____

UP DD D ecie D D _____ x 5 = D _____

C Dlumn T Dtal : DD _____ (A) DD D (B) D

Pr Dvalence I Dndex = B/A = D DD

Hy Dr Dp Dy Dic Ve Dgetation DD Dd Dicators: D

___ D Dminan De Te DDDi s 50% D

___ Pr Dvalence Index i s 3.0[1]

___ M Dr Dp Dy D Dgical Ada Dtati Dn [1] (Pr DDvide Du D rting data in Re Dmark D r D n a e D arate D heet)

___ Pr DDblematic Hy Dr Dphytic Ve Dgetati n D (D plain)

[1]Indicat rDD hydric D l and D ve Dland hydr l Dgy mu t be p e Dent, unle D di t Dbed r D n DDblematic.

Hy Dr Dp Dy Dic Ve Dgetation Pr Dsent? DDD Yes D _____ No DD ✔

Re Dmark D

Qu Dck D ransition to upland vegetation dominated by Encelia california and Malosma laurina, both upland spe Dies. D

SOIL

Sampling Point: Wetland #2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Feature Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	5YR 3/2	100					Sandy loam	Shallow soil over bedrock.

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ✔ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Bedrock

Depth (inches): 3

Hydric Soil Present? Yes ___ No ✔

Remarks

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicator (minimum one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicator (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches):

Water Table Present? Yes ___ No ✔ Depth (inches):

Saturation Present? Yes ___ No ✔ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ___ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Santiago Creek City/County: Orange/Orange County Sampling Date: 1/26/2022

Applicant/Owner: U.S. Army Corps of Engineers State: CA Sampling Point: Wetland #3

Investigator(s): Justin Wood, Jacob Aragon Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Basin Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): Mediterranean California Lat: 33.804804 Long: -117.811527 Datum: WGS84

Soil Map Unit Name: Water NWI classification: Lake

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes ✔	No _____	
Wetland Hydrology Present?	Yes ✔	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m x 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix gooddingii	60	Yes	FAC
2.			
3.			
4.			
	60 = Total Cover		
Sapling/Shrub Stratum (Plot size: 5m x 1m)			
1. Baccharis salicifolia	20	Yes	FAC
2.			
3.			
4.			
5.			
	20 = Total Cover		
Herb Stratum (Plot size: 1m x 1m)			
1. Cyperus eragrostis	5	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 95 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

✔ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks:

SOIL

Sampling Point: Wetland #3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	7.5 YR 3/2						Sandy Loai	
4-12	GLEY 1 4/10BG						Sandy Loai	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ✔ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ✔ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✔ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✔ Surface Water (A1)
- ___ High Water Table (A2)
- ✔ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ✔ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ✔ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✔ No ___ Depth (inches): _____

Water Table Present? Yes ✔ No ___ Depth (inches): 4

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes ✔ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Santiago Creek City/County: Orange/Orange County Sampling Date: 1/26/2022

Applicant/Owner: U.S. Army Corps of Engineers State: CA Sampling Point: Wetland #4

Investigator(s): Justin Wood, Jacob Aragon Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): Basin Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): Mediterranean California Lat: 33.804751 Long: -117.811446 Datum: WGS84

Soil Map Unit Name: Water NWI classification: Lake

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✔	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✔
Hydric Soil Present?	Yes _____	No ✔	
Wetland Hydrology Present?	Yes _____	No ✔	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m x 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix gooddingii	10	Yes	FAC
2.			
3.			
4.			
	10 = Total Cover		
Sapling/Shrub Stratum (Plot size: 5m x 1m)			
1. Baccharis salicifolia	30	Yes	FAC
2.			
3.			
4.			
5.			
	30 = Total Cover		
Herb Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

✔ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✔ No _____

Remarks:

SOIL

Sampling Point: Wetland #4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-11	7.5 YR 3/1						Sandy Loar	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** ✔

Remarks:

Located on elevated lakebed, several feet above the surface water.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Aragon

Date: 1/26/2022 **Time:** 08:30
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
Santiago Creek 1,150 ft. downstream of Cannon St.

Projection: **Datum:** WGS84
Coordinates: 33.813248, -117.798351

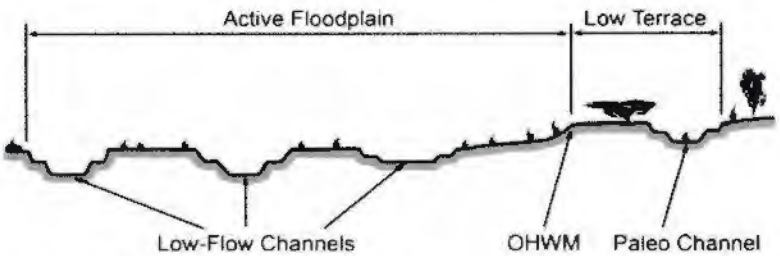
Potential anthropogenic influences on the channel system:
None

Brief site description:
Santiago Creek just downstream of narrow channel as creek tumbles down bedrock before entering Smith Basin.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/85 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

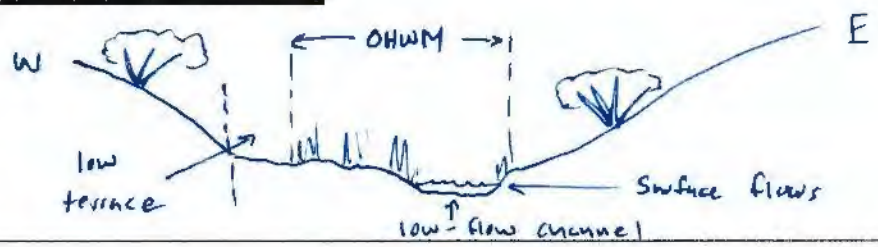


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** #1 **Date:** 1/26/2022 **Time:** 0830

Cross section drawing:



OHWM

GPS point: 33.813248, -117.798351

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Clear change in veg. composition and cover percent.

Floodplain unit: [ ] Low-Flow Channel [x] Active Floodplain [ ] Low Terrace

GPS point: 33.813273, -117.798376

Characteristics of the floodplain unit:

Average sediment texture: Bedrock

Total veg cover: 5 % Tree: 0 % Shrub: 0 % Herb: 5 %

Community successional stage:

- [ ] NA
- [x] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [x] Other: Scoured bedrock
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** # 1 **Date:** 1/26/2022 **Time:** 0830

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 33.813309, -117.798437

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 30 % Tree: 0 % Shrub: 25 % Herb: 5 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☐ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Aragon

Date: 1/26/2022 **Time:** 0930
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y ☐ / N ☐ Do normal circumstances exist on the site?

Y ☐ / N ☐ Is the site significantly disturbed?

Location Details:
Smith Basin upstream of Villa Park Rd.

Projection: **Datum:**
Coordinates: 33.810437, -117.801098

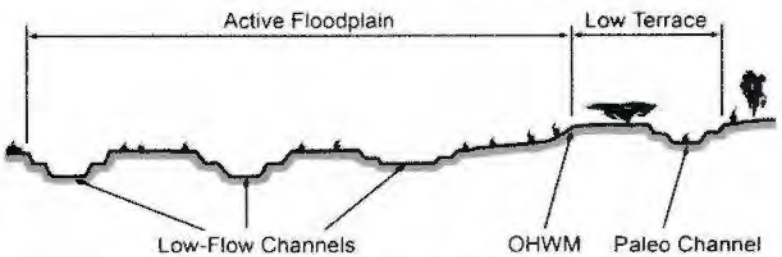
Potential anthropogenic influences on the channel system:
Smith Basin is an anthropogenic feature constructed for flood control. Villa Park Rd. is restricting flows.

Brief site description:
Smith Basin, fed by Santiago Creek and discharges into Santiago Recharge Basin on south side of Villa Park Rd.

Checklist of resources (if available):

- ☒ Aerial photography
  Dates: 12/05 – 3/21
- ☒ Topographic maps
- ☒ Geologic maps
- ☒ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☐ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  Gage number:
  Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

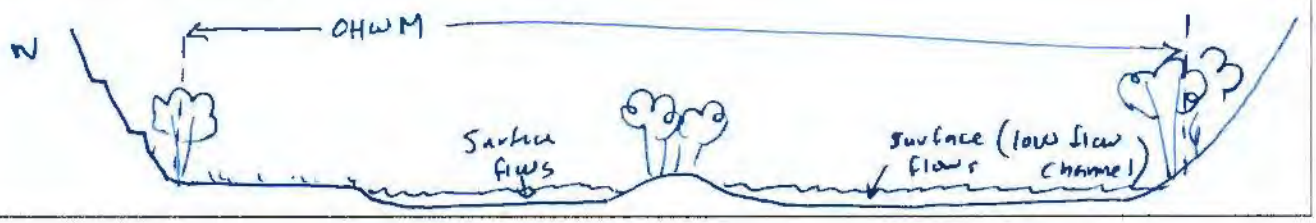


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☒ Digitized on computer
   - ☐ GPS
   - ☐ Other:

Project ID: 3556.001 **Cross section ID:** #2 **Date:** 1/26/22 **Time:** 0930

Cross section drawing:



OHWM

GPS point: 33.810437, -117.801098

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Floodplain unit:

- [ ] Low-Flow Channel
- [x] Active Floodplain
- [ ] Low Terrace

GPS point: 33.810990, -117.802135

Characteristics of the floodplain unit:

Average sediment texture: Silt

Total veg cover: 20 % Tree: 20 % Shrub: 0 % Herb: 0 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [x] Other: Inundated at time of survey
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** #2 **Date:** 1/26/22 **Time:** 0930

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 33.811764, -117.803594

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 50 % Tree: 0 % Shrub: 40 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Arango

Date: 1/26/22 **Time:** 1045
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [X] / N [X] Is the site significantly disturbed?

Location Details:
Santiago Basin, south of Villa Park Rd.

Projection: **Datum:** WGS 84

Coordinates: 33.806475, -117.802989

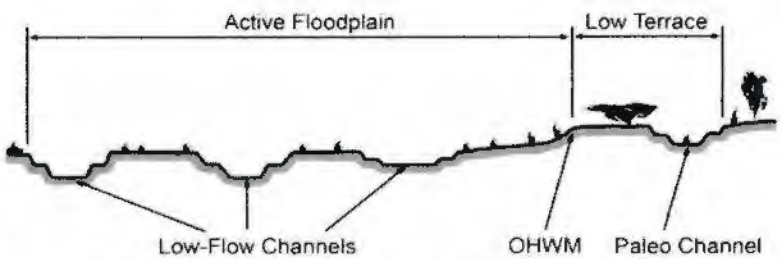
Potential anthropogenic influences on the channel system:
Santiago Basin is old quarry. Extensive modifications to the system have been made.

Brief site description:
Santiago Basin, south of Villa Park Rd., west of Howes St, north of Bond Ave.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/85 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

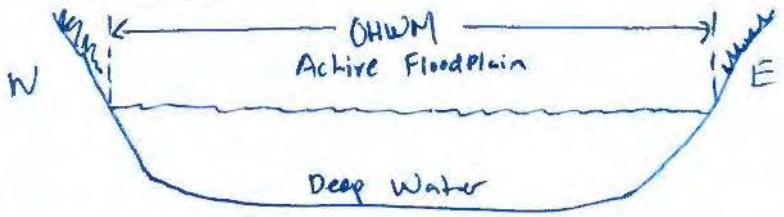


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** # 3 **Date:** 1/26/22 **Time:** 1045

Cross section drawing:



OHWM

GPS point: 33.806475, -117.802989

Indicators:

- ☐ Change in average sediment texture
- ☒ Change in vegetation species
- ☒ Change in vegetation cover
- ☐ Break in bank slope
- ☒ Other: clear line from regular inundation
- ☐ Other: _____

Comments:

Due to the steep walls of the reservoir and difficult access, additional data is not provided for ID # 3.

Floodplain unit:

☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____% Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Aragon

Date: 1/26/2022 **Time:** 1135
Town: Orange **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [X] / N [ ] Is the site significantly disturbed?

Location Details:
Santiago Basin, South of Villa Park Rd.

Projection: **Datum:** WGS84
Coordinates: 33.804703, -117.811349

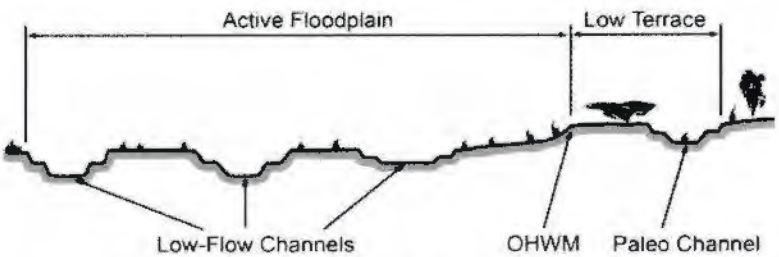
Potential anthropogenic influences on the channel system:
Santiago Basin is an anthropogenic feature. It is routinely maintained and was previously a rock quarry.

Brief site description:
Santiago Basin south of Villa Park Rd., west of Hawes St.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/85 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

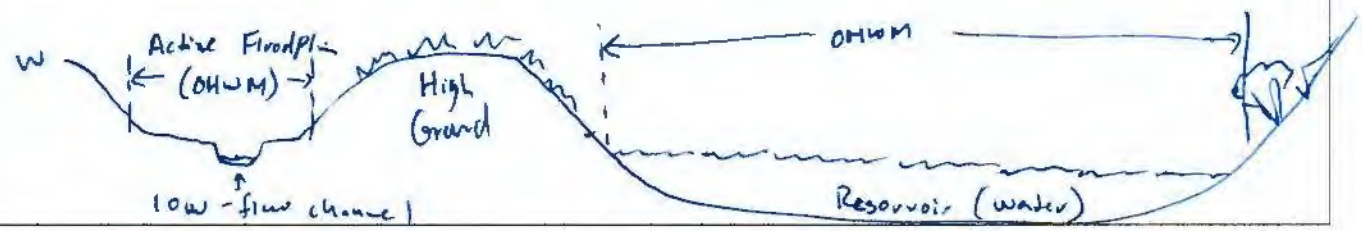


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** #4 **Date:** 1/26/22 **Time:** 1135

Cross section drawing:



OHWM

GPS point: 33.804703, -117.811349

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [x] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

clearly defined OHWM because of frequent inundation.

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: 33.804824, -117.811510

Characteristics of the floodplain unit:

Average sediment texture: Silt

Total veg cover: 80 % Tree: 80 % Shrub: 0 % Herb: 0 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [x] Late (herbaceous, shrubs, mature trees)

Indicators:

- [x] Mudcracks
- [ ] Ripples
- [x] Drift and/or debris
- [x] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** #4 **Date:** 1/26/22 **Time:** 1135

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: 33.804699, -117.811303

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 60 % Tree: 20 % Shrub: 40 % Herb: 0 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s): Justin Wood, Jacob Araya

Date: 1/26/2022 **Time:** 1435
Town: Santa Ana **State:** CA
Photo begin file#: **Photo end file#:**

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
Santiago Creek channel

Projection: **Datum:** WGS 84
Coordinates: 33.771140, -117.874639

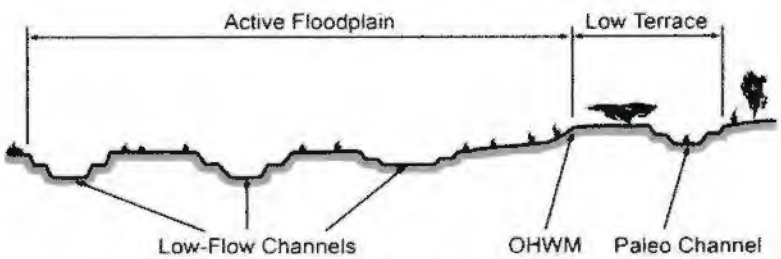
Potential anthropogenic influences on the channel system:
Constructed flood control channel. Altered flow regime and reinforced channel slopes.

Brief site description:
Santiago Creek channel, about 1,200 ft downstream of Interstate 5, just upstream of Flower St.

Checklist of resources (if available):

- [X] Aerial photography
  Dates: 12/85 - 3/21
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [X] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [ ] Global positioning system (GPS)
- [ ] Other studies
- [ ] Stream gage data
  Gage number:
  Period of record:
  - [ ] History of recent effective discharges
  - [ ] Results of flood frequency analysis
  - [ ] Most recent shift-adjusted rating
  - [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

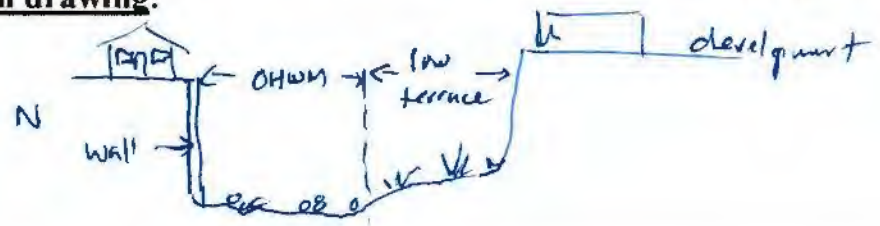


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [ ] GPS
   - [ ] Other:

Project ID: 3556.001 **Cross section ID:** # 5 **Date:** 1/26/22 **Time:** 1435

Cross section drawing:



OHWM

GPS point: 33.771233, -117.874643

Indicators:

- [x] Change in average sediment texture
- [x] Change in vegetation species
- [x] Change in vegetation cover
- [ ] Break in bank slope
- [ ] Other: _____
- [ ] Other: _____

Comments:

Floodplain unit: [x] Low-Flow Channel [ ] Active Floodplain [ ] Low Terrace

GPS point: 33.771260, -117.874637

Characteristics of the floodplain unit:

Average sediment texture: Cobble

Total veg cover: 5 % Tree: 0 % Shrub: 0 % Herb: 5 %

Community successional stage:

- [ ] NA
- [x] Early (herbaceous & seedlings)
- [ ] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [ ] Ripples
- [ ] Drift and/or debris
- [x] Presence of bed and bank
- [ ] Benches
- [ ] Soil development
- [ ] Surface relief
- [x] Other: Coarse Cobbles
- [ ] Other: _____
- [ ] Other: _____

Comments:

Project ID: 3556.001 **Cross section ID:** #5 **Date:** 1/26/22 **Time:** 1435

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☒ Low Terrace

GPS point: 33.771256, -117.874640

Characteristics of the floodplain unit:

Average sediment texture: Sandy loam

Total veg cover: 40 % Tree: 20 % Shrub: 10 % Herb: 10 %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☒ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☒ Presence of bed and bank
- ☒ Benches
- ☒ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Floodplain unit: ☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____ % Tree: _____ % Shrub: _____ % Herb: _____ %

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Santiago Creek
Project Number: 3556.001
Stream: Santiago Creek
Investigator(s):

Date: 1/26/22 **Time:** 1515
Town: Santa Ana **State:** CA
Photo begin file#: **Photo end file#:**

Y ☒ / N ☐ Do normal circumstances exist on the site?

Y ☒ / N ☐ Is the site significantly disturbed?

Location Details:
Santiago Creek Channel

Projection: **Datum:** WGS84
Coordinates: 33.769663, -117.885957

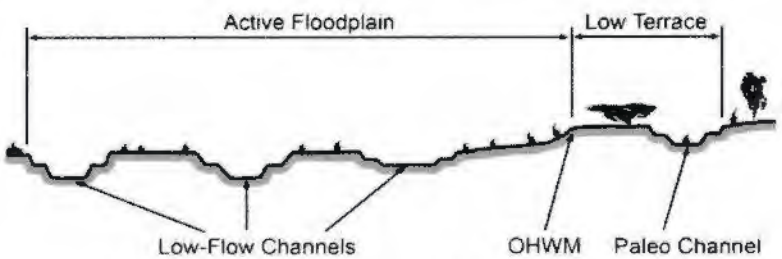
Potential anthropogenic influences on the channel system:
Heavily modified flood control channel. Heavy use by homeless.

Brief site description:
Santiago Creek channel, just downstream of Bristol St.
0.4 miles upstream of Santa Ana River

Checklist of resources (if available):

- ☒ Aerial photography
  Dates: 12/05 - 3/21
- ☒ Topographic maps
- ☒ Geologic maps
- ☒ Vegetation maps
- ☒ Soils maps
- ☐ Rainfall/precipitation maps
- ☐ Existing delineation(s) for site
- ☐ Global positioning system (GPS)
- ☐ Other studies
- ☐ Stream gage data
  Gage number:
  Period of record:
  - ☐ History of recent effective discharges
  - ☐ Results of flood frequency analysis
  - ☐ Most recent shift-adjusted rating
  - ☐ Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

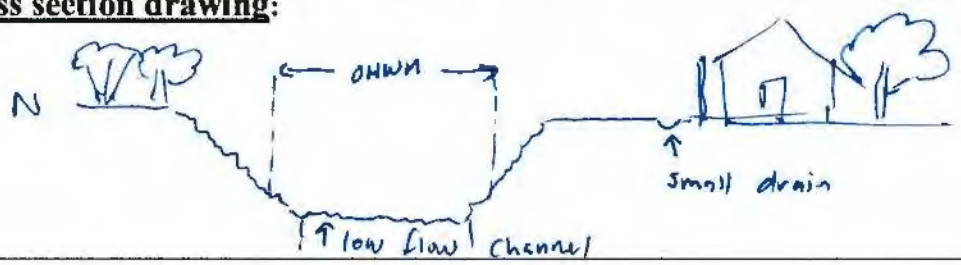


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - ☒ Mapping on aerial photograph
   - ☒ Digitized on computer
   - ☐ GPS
   - ☐ Other:

Project ID: 3556.001 **Cross section ID:** #6 **Date:** 1/26/22 **Time:** 1515

Cross section drawing:



OHWM

GPS point: 33.769661, -117.885957

Indicators:

- ☐ Change in average sediment texture
- ☐ Change in vegetation species
- ☐ Change in vegetation cover
- ☐ Break in bank slope
- ☒ Other: Woody debris on bank.
- ☐ Other: _____

Comments:

Rip-rap lined channel, very little change with the exception of recent wood debris. No additional points collected.

Floodplain unit:

☐ Low-Flow Channel ☐ Active Floodplain ☐ Low Terrace

GPS point: _____

Characteristics of the floodplain unit:

Average sediment texture: _____

Total veg cover: _____% Tree: _____% Shrub: _____% Herb: _____%

Community successional stage:

- ☐ NA
- ☐ Early (herbaceous & seedlings)
- ☐ Mid (herbaceous, shrubs, saplings)
- ☐ Late (herbaceous, shrubs, mature trees)

Indicators:

- ☐ Mudcracks
- ☐ Ripples
- ☐ Drift and/or debris
- ☐ Presence of bed and bank
- ☐ Benches
- ☐ Soil development
- ☐ Surface relief
- ☐ Other: _____
- ☐ Other: _____
- ☐ Other: _____

Comments:

SOIL

Sampling Point: Wetland #4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Feature Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-11	7.5YR 3/1						and Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✔

Remarks:

Located on elevated lakebed, several feet above the surface water.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicator (minimum one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicator (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? Yes _____ No ✔ Depth (inches): _____
(includes capillary fringe)

Wetland Hydrology Present? Yes _____ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Attachment 5 – Observed Plant Species List and Wetland Indicator Status

	Latin Name		Common Name	Wetland Indicator Status[1]
VASCULAR PLANTS				
Dicotyledons				
CUPRESSACEAE		CYPRESS FAMILY		
	Hesperocyparis sp.		Unid. cypress	NI
PINACEAE		PINE FAMILY		
*	*Pinus* sp.		Unid. ornamental	NI
PODOCARPACEAE		PODOCARP FAMILY		
*	*Podocarpus macrophyllus*		Yew plum pine	NI
ADOXACEAE		MUSKROOT FAMILY		
	Sambucus nigra ssp. *cerulea*		Mexican elderberry, blue elderberry	NI
AIZOACEAE		FIG-MARIGOLD or ICEPLANT FAMILY		
*	*Carpobrotus edulis*		Freeway iceplant, hottentot fig	NI
ANACARDIACEAE		SUMAC or CASHEW FAMILY		
	Malosma laurina		Laurel sumac	NI
*	*Pistacia* sp.		Unid. pistachio	NI
	Rhus integrifolia		Lemonade berry	NI
*	*Rhus lanceolata*		Prairie sumac	NI
	Rhus ovata		Sugar bush	NI
*	*Schinus molle*		Peruvian pepper tree	FACU
*	*Schinus terebinthifolius*		Brazilian pepper tree	FACU
	Toxicodendron diversilobum		Western poison oak	FACU
APIACEAE		CELERY FAMILY		
*	*Conium maculatum*		Poison hemlock	FACW
*	*Foeniculum vulgare*		Fennel	NI
APOCYNACEAE		DOGBANE FAMILY		
*	*Nerium oleander*		Common ornamental oleander	NI
*	*Vinca major*		Greater periwinkle, blue periwinkle	NI
ARALIACEAE		GINSENG FAMILY, IVY FAMILY		
*	*Hedera helix*		English ivy	FACU
ASTERACEAE		ASTER FAMILY		
*	*Ageratina adenophora*		Crofton weed, sticky eupatorium	FACU
	Ambrosia psilostachya		Western ragweed	FACU
	Artemisia californica		California sagebrush	NI
	Artemisia douglasiana		Douglas mugwort	FACU
	Artemisia dracunculus		Tarragon	NI
	Baccharis pilularis		Coyote brush	NI
	Baccharis salicifolia		Mule fat	FAC
	Baccharis sarothroides		Broom baccharis	FACU
	Bebbia juncea var. aspera		Sweetbush	NI
	Bidens frondosa		Sticktight	FACW
	Brickellia californica		California brickellbush	FACU
*	*Carduus pycnocephalus*		Italian thistle	NI
*	*Centaurea melitensis*		Tocalote	NI
*	*Cynara cardunculus*		Artichoke thistle, cardoon	NI
*	*Delarea odorata*		German ivy, cape ivy	NI
	Encelia californica		California encelia	NI
	Encelia farinosa		Brittlebush	NI
*	*Erigeron bonariensis*		Flax-leaved horseweed	FACU
*	*Gazania linearis*		Treasure flower, ornamental gazania	NI
*	*Glebionis coronaria*		Garland daisy	NI
*	*Helminthotheca echioides*		Bristly ox-tongue	FAC
	Heterotheca grandiflora		Telegraph weed	NI
	Heterotheca sessiliflora		Sessileflower goldenaster	NI
*	*Hypochaeris glabra*		Smooth cat's-ear	NI
	Laennecia coulteri		Coulter's horseweed	FACW
	Lepidospartum squamatum		Scale-broom	FACU
	Malacothrix saxatilis		Quillwort	NI
	Pluchea odorata		Saltmarsh-fleabane	FACW
	Pseudognaphalium biolettii		Bicolored cudweed	NI
	Pseudognaphalium californicum		California everlasting	NI
	Pseudognaphalium canescens		Wright's cudweed	FACU
*	*Pulicaria paludosa (P. hispanica)*		False flea-bane, Spanish sunflower	FAC
*	*Senecio vulgaris*		Common groundsel	FACU

*	*Sonchus asper*		Prickly sow thistle	FAC
*	*Sonchus oleraceus*		Common sow thistle	UPL
*	*Verbesina encelioides*		Golden crownbeard	NI
	Xanthium strumarium		Cocklebur	FAC
BETULACEAE		BIRCH FAMILY		
	Alnus rhombifolia		White alder	FACW
BIGNONIACEAE		TRUMPET-CREEPER or JACARANDA FAMILY		
*	*Tecoma capensis*		Cape honeysuckle	NI
BORAGINACEAE		BORAGE OR WATERLEAF FAMILY		
	Amsinckia intermedia		Large flower rancher's fiddleneck	NI
	Cryptantha sp.		Unid. annual cryptantha	NI
	Eriodictyon crassifolium		Thick-leaf yerba santa	NI
	Eucrypta chrysanthemifolia		Common eucrypta	NI
	Heliotropium curassavicum		Seaside heliotrope	FACU
	Phacelia ramosissima		Branching phacelia	FACU
BRASSICACEAE		MUSTARD FAMILY		
*	*Brassica nigra*		Black mustard	NI
*	*Brassica rapa*		Field mustard	FACU
*	*Brassica tournefortii*		Sahara mustard, wild turnip	NI
*	*Capsella bursa-pastoris*		Shepherd's purse	FACU
*	*Cardamine hirsuta*		Hairy bitter cress	FACU
*	*Hirschfeldia incana*		Shortpod mustard	NI
*	*Lepidium didymum*		Lesser swine cress, lesser wort-cress	NI
*	*Lobularia maritima*		Sweet alyssum	NI
*	*Sisymbrium irio*		London rocket	NI
*	*Sisymbrium orientale*		Hare's ear cabbage	NI
CACTACEAE		CACTUS FAMILY		
*	*Opuntia ficus-indica*		Mission prickly-pear, Indian fig	NI
	Opuntia oricola		Chaparral pricklypear	NI
CARYOPHYLLACEAE		PINK FAMILY, CARNATION FAMILY		
*	*Cerastium glomeratum*		Sticky mouse-ear chickweed	UPL
CHENOPODIACEAE		GOOSEFOOT FAMILY		
*	*Atriplex semibaccata*		Australian saltbush	FAC
*	*Atriplex suberecta*		Sprawling saltbush, Australian saltbush	FACU
*	*Chenopodium album*		Lamb's quarters, common goosefoot	FACU
*	*Salsola tragus*		Russian thistle	FACU
CONVOLVULACEAE		MORNING-GLORY FAMILY		
	Cuscuta californica		Chaparral dodder, witch's hair	NI
CRASSULACEAE		STONECROP FAMILY		
	Crassula connata		Pygmy-weed	FAC
CUCURBITACEAE		GOURD FAMILY, CUCUMBER FAMILY		
	Cucurbita foetidissima		Calabazilla	NI
	Marah macrocarpa		Chilicothe, wild cucumber	NI
EUPHORBIACEAE		SPURGE FAMILY		
*	*Euphorbia maculata*		Spotted spurge	UPL
*	*Euphorbia peplus*		Petty spurge	NI
*	*Ricinus communis*		Castor bean	FACU
FABACEAE		LEGUME FAMILY, PEA FAMILY		
*	*Acacia* sp.		Unid. escaped ornamental	NI
	Acmispon glaber		Deerweed	NI
	Lupinus succulentus		Arroyo lupine	NI
*	*Medicago polymorpha*		California burclover	FACU
*	*Melilotus albus*		White sweetclover	NI
*	*Melilotus indicus*		Sourclover, India sweetclover	FACU
FAGACEAE		OAK FAMILY		
	Quercus agrifolia		Coast live oak	NI
*	*Quercus ilex*		Holly oak	NI
GERANIACEAE		GERANIUM FAMILY		
*	*Erodium botrys*		Long-beak filaree	FACU
*	*Erodium cicutarium*		Redstem filaree	NI
*	*Erodium moschatum*		Greenstem filaree, white-stemmed filaree	NI
JUGLANDACEAE		WALNUT FAMILY		
**	*Juglans californica*		Southern California black walnut	FACU
LAMIACEAE		MINT FAMILY		

*	*Lamium amplexicaule*		Common henbit	NI
*	*Marrubium vulgare*		Horehound	NI
*	*Rosmarinus officinalis*		Rosemary	NI
	Salvia apiana		White sage	NI
	Salvia mellifera		Black sage	NI
	Trichostema lanatum		Woolly blue curls	NI
MALVACEAE		MALLOW FAMILY		
	Malacothamnus fasciculatus		Chaparral bush-mallow	NI
*	*Malva parviflora*		Cheeseweed	NI
MELIACEAE		MAHOGANY FAMILY		
*	*Melia azedarach*		China berry	UPL
MORACEAE		MULBERRY FAMILY, FIG FAMILY		
*	*Ficus carica*		Common fig, edible fig	FACU
*	*Morus alba*		White mulberry	FACU
MYRTACEAE		MYRTLE FAMILY, EUCALYPTUS FAMILY		
*	*Callistemon citrinus*		Crimson bottlebrush	NI
*	*Eucalyptus sp.*		Ornamental eucalyptus	NI
NYCTAGINACEAE		FOUR O'CLOCK FAMILY		
	Mirabilis laevis (M. californica)		Wishbone bush	NI
OLEACEAE		OLIVE FAMILY		
*	*Fraxinus udhei*		Shamel ash (escaped ornamental)	NI
*	*Olea europaea*		Russian olive	NI
ONAGRACEAE		EVENING-PRIMROSE FAMILY		
	Epilobium canum		California fuchsia	NI
OXALIDACEAE		OXALIS FAMILY		
*	*Oxalis pes-caprae*		Bermuda buttercup	NI
PAPAVERACEAE		POPPY FAMILY		
*	*Fumaria parviflora*		Fine leaved fumitory	NI
**	*Romneya coulteri*		Coulter's matilija poppy	NI
PLANTAGINACEAE		PLANTAIN FAMILY		
	Keckiella cordifolia		Climbing bush-penstemon	NI
*	*Plantago lanceolata*		English plantain, rib-grass	FAC
PLATANACEAE		PLANE-TREE or SYCAMORE FAMILY		
	Platanus racemosa		Western sycamore	FAC
*	*Platanus X acerifolia*		London planetree	NI
POLYGONACEAE		BUCKWHEAT FAMILY		
	Emex spinosa		Devil's thorn	NI
	Eriogonum fasciculatum		California buckwheat	NI
*	*Rumex crispus*		Curly dock	FAC
ROSACEAE		ROSE FAMILY		
	Heteromeles arbutifolia		Toyon, Christmas berry	NI
*	*Pyracantha sp.*		Ornamental pyracantha	NI
	Rosa californica		California wild rose	FAC
RUBIACEAE		MADDER FAMILY, COFFEE FAMILY		
	Galium aparine		Goose grass, stickywilly	FACU
SALICACEAE		WILLOW FAMILY		
	Populus fremontii		Fremont cottonwood	FAC
	Populus trichocarpa		Black cottonwood	FAC
	Salix gooddingii		Goodding's black willow	FACW
	Salix lasiandra		Lance-leaved willow	FACW
	Salix lasiolepis		Arroyo willow	FACW
SAPINDACEAE		SOAPBERRY FAMILY		
*	*Koelreuteria bipinnata*		Goldenrain tree	NI
SCROPHULARIACEAE		FIGWORT FAMILY, SNAPDRAGON FAMILY		
*	*Myoporum laetum*		Myoporum	FACU
SIMAROUBACEAE		QUASSIA or SIMAROUBA FAMILY		
*	*Ailanthus altissima*		Tree of heaven	FACU
SOLANACEAE		NIGHTSHADE FAMILY		
	Datura wrightii (D. meteloides)		Jimsonweed, tolguacha	UPL
*	*Nicotiana glauca*		Tree tobacco	FAC
TAMARICACEAE		TAMARISK FAMILY		
*	*Tamarix ramosissima*		Saltcedar, tamarisk	NI
ULMACEAE		ELM FAMILY		
*	*Ulmus parviflora*		Chinese elm	UPL

URTICACEAE		NETTLE FAMILY		
*	*Urtica urens*		Dwarf nettle	NI
VERBENACEAE		VERVAIN FAMILY		
	Phyla nodiflora		Common lippia	FACW
	Verbena lasiostachys		Western verbena	FAC
VITACEAE		GRAPE FAMILY		
	Vitis girdiana		Wild grape	FAC
Monocotyledons				
AGAVACEAE		CENTURY PLANT FAMILY, AGAVE FAMILY		
*	*Agave sp.*		Escaped ornamental	NI
*	*Yucca aloifolia*		Spanish bayonet (ornamental)	NI
ARECACEAE		PALM FAMILY		
*	*Phoenix canariensis*		Canary Island palm	NI
*	*Washingtonia robusta*		Mexican fan palm, ornamental fan palm	FACW
ASPARAGACEAE		ASPARAGUS FAMILY		
*	*Asparagus asparagoides*		Smilax asparagus	NI
CYPERACEAE		SEDGE FAMILY		
	Cyperus eragrostis		Tall umbrella sedge	FACW
*	*Cyperus involucratus*		Umbrella sedge	FACW
POACEAE		GRASS FAMILY		
*	*Arundo donax*		Giant reed	FACW
*	*Avena barbata*		Slender wild oat	NI
*	*Avena fatua*		Wild oat	NI
*	*Bromus diandrus*		Ripgut brome	NI
*	*Bromus hordeaceus*		Soft chess	FACU
*	*Bromus madritensis* ssp. *rubens*		Red brome	UPL
*	*Cortaderia selloana*		Argentine pampas grass	FACU
*	*Cynodon dactylon*		Bermuda grass	FACU
	Elymus condensatus		Giant wild-rye	FACU
*	*Festuca myuros*		Rattail sixweeks grass	FACU
*	*Hordeum murinum*		Wall barley, hare barley	FACU
*	*Pennisetum setaceum*		Crimson fountain grass, African fountain grass	
*	*Schismus barbatus*		Mediterranean schismus	
*	*Stipa miliacea*		Smilo grass	
TYPHACEAE		CATTAIL FAMILY		
	Typha domingensis		Southern cattail, slender cattail	

* Wetland Indicator Status (WIS):
OBL = occurs in aquatic resources > 99% of time
FACW = occurs in aquatic resources 67-99% of time
FAC = occurs in aquatic resources 34-66% of time
FACU = occurs in aquatic resources 1-33% of time
UPL = occurs in uplands > 99% of time
NI = indicator status not known in this region
~ = unsure as to FAC or FACU

Attachment 6 – Aquatic Resource Table

Waters_Name	State	Cowardin_Code	HGM_Code	Meas_Type	Amount	Units	Waters_Type	Latitude	Longitude	Local_Waterway
DRAINAGE_2	CA	R3SB	RIVERINE	AREA	18.92	ACRES	RPW	33.813222	-117.798453	SANTIAGO_CREEK
DRAINAGE_2	CA	R3UB	RIVERINE	AREA	2.30	ACRES	RPW	33.811501	-117.800303	SANTIAGO_CREEK
DRAINAGE_3	CA	R3UB	LACUSTRINE	AREA	0.44	ACRES	RPW	33.803803	-117.812939	SANTIAGO_CREEK
DRAINAGE_3	CA	L1UB	LACUSTRINE	AREA	82.65	ACRES	RPW	33.807157	-117.805649	SANTIAGO_CREEK
DRAINAGE_4	CA	L1UB	LACUSTRINE	AREA	88.72	ACRES	RPW	33.800890	-117.809333	SANTIAGO_CREEK
DRAINAGE_5	CA	R4SB	RIVERINE	AREA	4.53	ACRES	NRPW	33.770826	-117.875913	SANTIAGO_CREEK

Attachment C: Santiago Creek Biological Resources Report

BIOLOGICAL RESOURCES TECHNICAL REPORT
Santiago Creek Project

Prepared for:

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1.0 Introduction

This report was prepared under contract to the United States Army Corps of Engineers (USACE) to describe biological resources at the Santiago Creek Recharge Basin, Smith Basin, and along the lower reach of Santiago Creek. Throughout this report, "project" refers to the total action proposed by the USACE, while "project site" refers to all areas that may be directly or indirectly impacted by project activities as well as a slightly larger survey area. The USACE is currently designing modifications to Santiago Creek to prevent significant flood damages. The design modifications will be directed toward increasing the flood control capacity and reducing flooding induced erosion along the urbanized areas of Santiago Creek. Reservoir improvements are also proposed at Santiago Recharge Basin which are necessary to accommodate storage and regulation of flood waters released from the upstream dams. Generally, the existing Santiago Recharge Basin would be modified to allow storage of additional flood control volume and to give the basin operators additional flexibility in managing water levels to accommodate both groundwater conservation and flood storage needs.

2.0 Project and Property Description

2.1 Project Description

The USACE proposes to make several modifications to various features within the project site. These features would be directed toward increasing the flood control capacity and reducing flooding induced erosion along the urbanized areas of Santiago Creek. Major elements of the project include reservoir improvements, channel improvements, and recreational improvements as discussed below.

Reservoir Improvements. Reservoir improvements at Santiago Recharge Basin are necessary to accommodate storage and regulation of flood waters released from the upstream dams. Generally, the existing Santiago Recharge Basin would be modified to allow storage of additional flood control volume and to give the basin operators additional flexibility in managing water levels to accommodate both groundwater conservation and flood storage needs. The proposed reservoir improvements include:

- **Reservoir Regulation**. The maximum water elevation of the basins would increase from approximately 285-feet (ft) NAVD88 (North American Vertical Datum of 1988) – the current maximum operating elevation of the basins – to approximately 300.5-ft NAVD88. The increased elevation will increase the reservoir storage volume from approximately 13,500 acre-ft to approximately 16,100 acre-ft, enhancing both the flood control and groundwater conservation capabilities of the site. Approximately 4,620 acre-ft of storage volume is necessary to accommodate flood waters discharged from the Santiago Dam and Villa Park Dam during significant precipitation events. Site operators will release groundwater conservation stored within the basins to make room for incoming flood waters. The volume of water released will be dependent on pool elevations at the upstream dams, pool elevation within the reservoir, and time of year.

- **Outlet Structure**. An outlet structure would be installed in the northwestern corner of the Santiago Recharge Basin. The outlet structure would be a multi-chamber gated water control structure. Radial gates would be installed to allow reservoir operators capability to release conservation water at variable rates in anticipation of incoming flood water. The outlet structure would be configured to discharge conservation water down to an elevation of approximately 270-ft NAVD88 ahead of flood conditions, creating the necessary flood storage volume for the project.

The structure will be constructed of concrete and steel and will be surrounded by an earthen berm and maintenance access roads. The gated outlet structure is approximately 240-ft long, 40-ft wide, and 30-ft tall. The entrance chamber is approximately 45-ft long with a slabbed roof and a trash rack at the upstream end. The gate chamber is approximately 30-ft long and includes two motorized radial gates and a single transferable bulkhead gate. The gate chamber is comprised of two individual 12-ft-tall chambers separated by a divider wall. A 30-ft-long open chamber parabolic transition leads to the 45-ft long stilling basin. The stilling basin has an invert at approximately 262.5-ft NAVD88 and a 17-ft-tall divider wall. The outlet transition is approximately 63-ft long and leads to the triple bay box culvert underneath Prospect Street. The box culvert opens up to a 300-ft-long rectangular and trapezoidal concrete outlet channel that joins with existing Santiago Creek near East Balmoral Drive.

- **Overflow Structure**. The overflow structure is an approximately 600-ft long designated overtopping location consisting of a grouted riprap side-channel weir in the northwestern corner of the Santiago Recharge Basin. The overflow structure provides an overflow weir with a crest set at the reservoir's maximum flood control storage elevation of 300.5-ft NAVD88. The minimum ground elevation at the downstream portion of the reservoir is approximately at elevation 302.5-ft NAVD88 at Prospect Street and Bond Avenue. The overflow structure will be tied into the surrounding grade, including the earthen berms surrounding the overflow structure, at elevation 302.5-ft. The weir is designed to convey 3,500 cfs when the pool is at elevation 302.5-ft NAVD88. During extreme flooding events, the overflow structure provides a stabilized discharge point to prevent overfilling of the reservoir.

- **Slope Stabilization**. The existing slopes of the reservoir require repair. To increase the water elevation in the reservoir and permit rapid drawdown in advance of flood conditions, several locations have been identified along the reservoir which would require stabilization. Stabilization will occur through installation of buttress fill at a slope of approximately 2 Horizontal (H):1 Vertical (V), installation of retaining walls, or installation of armoring.

Channel Improvements. Severe erosion of the channel has occurred during large flood events, compromising adjacent properties. To protect the channel during flood events, the creek must be stabilized. Between the Santa Ana Freeway (Interstate 5) and the Santa Ana River, the project will install buried riprap along the full downstream channel extent between the Santa Ana Freeway and Santa Ana River. Riprap will be buried with native substrate in order to (i) enhance access for ongoing operation and maintenance; (ii) maintain a native, semi-arid ephemeral appearance and function; (iii) anticipate local interests and concerns; (iv) improve recreational opportunities; and (v) enhance the environmental integrity of the stream corridor. The proposed stream stabilization measure includes 6,400-ft of trapezoidal channel armored with buried riprap. The proposed cross section includes a gravel bedding layer, riprap armor layer, and surficial substrate layer. The channel invert width varies from 30-ft to 80-ft, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The riprap size varies from 36-inches to 12-inches, depending on armoring requirements for given reaches. Side slopes are limited to existing right-of-way limitations and will be installed to a slope of 1.75H:1V.

As described above, native substrate harvested from the channel will be placed atop the proposed buried riprap layer. The surficial layer will provide suitable substrate for native vegetation growth, enhancing ecological, aesthetic, and recreational potential of the channel. At least two vegetation species mixes are included, a low-growth mix for the channel invert, and a more diverse mix for the channel banks.

2.2 Project Location

The project site is located in the cities of Orange, Santa Ana, Villa Park, and unincorporated territory within Orange County, California (see Figure 1, Attachment 1). It is within the California United States Geological Survey (USGS) Orange 7.5-minute Quadrangle. The 330-acre project site includes Smith Basin (67 acres) and Santiago Recharge Basin (248 acres) shown in Figure 2a, and Santiago Creek Channel (15 acres) shown in Figure 2b (Attachment 1).

3.0 Methods

3.1 Literature Review

Prior to conducting field surveys, Aspen biologists reviewed available literature to identify special-status biological resources known from the vicinity of the project site. The literature and databases listed below were reviewed.

- U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) for the project site (USFWS 2022).
- CNDDB (CDFW 2022a) for the following 7.5-minute USGS topographic quads: La Habra, Yorba Linda, Prado Dam, Anaheim, Orange, Black Star Canyon, Newport Beach, Tustin, and El Toro.
- CNPS Electronic Inventory of Rare and Endangered Vascular Plants of California (CNPS 2022), for the same topographic quads.
- Santa Ana Watershed Association's Status and Management of the Least Bell's Vireo and Southwestern Willow Flycatcher in the Santa Ana River Watershed, 2021, and Summary Data by Site and Watershed-wide, 2000-2021 (SAWA, 2022).
- Orange County Water District's Least Bell's Vireo and California Gnatcatcher Territories 2021 (OCWD, 2022).

The CNDDB results are listed in Attachment 2 and the IPaC Resource List is provided as Attachment 3. Several special-status species identified during the literature review only occur in specialized native habitats that are absent from the project site or occur at higher or lower elevations. These plants and animals are listed in Attachment 4 but are not addressed further in this report.

3.2 Field Surveys

Aspen biologists Justin Wood, Jacob Aragon, and Nikolai Starzak completed field surveys of the project site on January 12, 26, March 3, and May 2, 2022. During the site visit, the biologists conducted 100 percent coverage biological survey of the project site where safely accessible. Portions of the project site that were not surveyed generally include slopes greater than 50 degrees. During the field surveys, all plant and wildlife species observed were recorded in field notes and sensitive species locations were recorded using hand-held GPS units. All plant and wildlife species observed during the surveys are listed in Attachment 5. Representative site photos were captured during the survey and are included in Attachment 6.

The botanical surveys were conducted in conformance with California Department of Fish and Wildlife (CDFW) guidelines (CDFW 2018). The surveys were (a) conducted during flowering seasons for the special status plants known from the area, (b) floristic in nature, (c) consistent with conservation ethics, (d)

systematically covered all habitat types on the sites, and (e) well documented by this report and by voucher specimens to be deposited at California Botanic Garden (formerly Rancho Santa Ana Botanic Garden) and other herbaria. Plants of uncertain identity were collected and identified later using keys, descriptions, and illustrations in Baldwin et al. (2012).

Vegetation mapping was done by drawing tentative boundaries onto high-resolution aerial images during site visits on January 12 and 26, 2022. These boundaries were then digitized into Geographic Information System (GIS) shapefiles. Vegetation maps were field verified for accuracy on March 3, 2022 (see Attachment 1; Figure 4: Vegetation and Land Cover). Vegetation within the project site is further described below using the names and descriptions in *A Manual of California Vegetation* (Sawyer et al., 2009). Vegetation was mapped digitally using ArcGIS (version 10.7) and one-foot pixel aerial imagery. The smallest mapping unit was approximately 0.05-acre and most mapped vegetation boundaries are accurate to within approximately 5-ft. Any vegetation map is subject to imprecision for several reasons:

1. Vegetation types tend to intergrade on the landscape so that there are no true boundaries in the vegetation itself. In these cases, a mapped boundary represents best professional judgment.
2. Vegetation types as they are named and described tend to intergrade; that is, a given stand of real-world vegetation may not fit into any named type in the classification scheme used. Thus, a mapped and labeled polygon is given the best name available in the classification, but this name does not imply that the vegetation unambiguously matches its mapped name.
3. Vegetation tends to be patchy. Small patches of one named type are often included within mapped polygons of another type. The size of these patches varies, depending on the minimum mapping units and scale of available aerial imagery.

Rainfall: Rainfall is greatest during the months of November through March, with an average annual precipitation total of 13.43 inches (U.S. Climate Data 2022). Rainfall to-date has been below 50 percent of average with approximately 6.15 inches falling in the region since July 2021 (Orange County Public Works 2022).

4.0 General Biological Survey Results

4.1 Vegetation and Cover Types

Vegetation within the project site consists of riparian and wetland vegetation, upland vegetation, and other land cover types. They are described in detail below and acreages of the vegetation and land cover areas are presented in Table 1 and shown in Figures 3a through 3c (Attachment 1).

Table 1. Vegetation and other cover types on the project site (acres)

Vegetation Type	Project Site (Acres)
Blue elderberry thickets	1.84
Brittle bush scrub	16.57
Coast live oak woodland and forest	0.38
California sagebrush - black sage scrub	35.87
Fountain grass swards	5.58
Goodding's willow - red willow riparian woodland and forest	21.73
Laurel sumac scrub	6.10
Mulefat thickets	4.47

Table 1. Vegetation and other cover types on the project site (acres)

Vegetation Type	Project Site (Acres)
Upland mustards or star-thistle fields	1.97
Wild oats and annual brome grasslands	3.78
Eucalyptus - tree of heaven - black locust groves	8.29
Other Cover Types	
Open water	174.91
Unvegetated channels and slopes	10.43
Developed	37.67
Total	329.61

Riparian and Wetland Vegetation Types

Goodding's willow - red willow riparian woodland and forest (*Salix gooddingii – Salix laevigata* Forest & Woodland Alliance). Goodding's willow - red willow riparian woodland and forest are a winter deciduous woodland that are dominated by Goodding's willow (*Salix gooddingii*). Additional species such as Pacific willow (*Salix lasiandra*), red willow (*Salix laevigata*), California sycamore (*Platanus racemosa*), and mulefat (*Baccharis salicifolia*) are also present. Goodding's willow - red willow riparian woodland and forest are present along Santiago Creek in the northern portion of the project site and are the dominant cover type in the seasonally inundated portions of Smith Basin. They are also present in isolated locations around Santiago Recharge Basin and are abundant near the earthen overflow channel. Goodding's willow - red willow riparian woodland and forest have a State rank of S3 and are therefore recognized as a sensitive natural community by CDFW (CDFW 2021).

Mulefat thickets (*Baccharis salicifolia* Shrubland Alliance). Mulefat thickets are a winter deciduous shrubland that are dominated by mulefat. Additional species such as oleander (*Nerium oleander*), coyote brush (*Baccharis pilularis*), and shrubby willows (*Salix* spp.) are also present. Mulefat thickets are present along Santiago Creek in the northern portion of the project site and also around the margins of Smith Basin and Santiago Recharge Basin. Mulefat thickets have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland Vegetation Types

Blue elderberry thickets (*Sambucus nigra* ssp. *caerulea* Provisional Shrubland Alliance). Although not defined as a vegetation type in the current online version of *A Manual of California Vegetation*, blue elderberry thickets are present in the project site. This vegetation is dominated by blue elderberry (*Sambucus nigra* ssp. *caerulea*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species. Within the project site coyote brush and Peruvian pepper tree (*Schinus mole*) are also present. Blue elderberry thickets are present in the uplands near Santiago Creek in the northern portion of the project site and in the upland east of the Santiago Creek Recharge Basin. Blue elderberry thickets do not have a State Rank and therefore is not recognized as a sensitive natural community by CDFW (CDFW 2021).

Brittle bush scrub (*Encelia farinosa* Shrubland Alliance). Brittle bush scrub is a type of coastal sage scrub vegetation that is dominated by brittle bush (*Encelia farinosa*). Additional species such as coastal sage brush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Salvia mellifera*), giant wild rye (*Elymus condensatus*), and Laurel sumac (*Malosma laurina*) are also present in low numbers. Within the project site it appears that all the brittle bush scrub was planted for mitigation.

It is unclear if brittle bush is native to the project site. Brittle bush scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

California sagebrush - black sage scrub (*Artemisia californica* - *Salvia mellifera* Shrubland Alliance). California sagebrush - black sage scrub is a type of coastal sage scrub that is dominated by coastal sage brush. Within the project site, black sage is uncommon, but the vegetation still matches this description the best. Additional species such as sweetbush (*Bebbia juncea*) and California buckwheat are also present. Within the project site it appears that all the California sagebrush - black sage scrub has been planted for mitigation. California sagebrush - black sage scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Coast live oak woodland and forest (*Quercus agrifolia* Forest & Woodland Alliance). Coast live oak woodland and forest are dominated by coast live oaks (*Quercus agrifolia*). Within the project site, the coast live oak woodland and forest is limited to several patches along Santiago Creek Channel, in the vicinity of North Flower Street. The understory vegetation includes non-native ornamental species such as Canary ivy (*Hedera canariensis*). Coast live oak woodland and forest have a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Eucalyptus - tree of heaven - black locust groves (*Eucalyptus* spp. - *Ailanthus altissima* - *Robinia pseudoacacia* Woodland Semi-Natural Alliance). Eucalyptus - tree of heaven - black locust groves are used to map all vegetation dominated by non-native trees within the project site including gum trees (*Eucalyptus* spp.), Peruvian pepper trees, yew plum pine (*Podocarpus macrophyllus*), prairie sumac (*Rhus lanceolata*), and many others. Native tree species such as California sycamore and coast live oak may also be present but generally represent single trees. Eucalyptus - tree of heaven - black locust groves have a State Rank of SNA (Not Applicable) and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Fountain grass swards (*Pennisetum setaceum* - *Pennisetum ciliare* Herbaceous Semi-Natural Alliance). Fountain grass swards are a non-native grassland dominated by crimson fountain grass (*Pennisetum setaceum*), a robust perennial bunchgrass. Other non-native species such as gazania (*Gazania linearis*) and mustard (*Hirschfeldia incana*), are also present as well as scattered natives such as desert wishbone bush (*Mirabilis laevis*). Fountain grass swards are present on the large, landscaped slope to the north of Smith Basin and along the eastern slope of the Santiago Recharge Basin. Fountain grass swards have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Laurel sumac scrub (*Malosma laurina* Shrubland Alliance). Laurel sumac scrub is dominated by Laurel sumac (*Malosma laurina*) which forms short woodland habitat, typically interspersed with native coastal sage scrub species such as coastal sage brush and California buckwheat. Additional species such as tamarisk (*Tamarix* sp.) are also present. Laurel sumac scrub is present in the upland surrounding Santiago Creek, Smith Basin, and the Santiago Recharge Basin. Laurel sumac scrub has a State Rank of S4 and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Upland mustards or star-thistle fields (*Brassica nigra* - *Centaurea* (*solstitialis*, *melitensis*) Herbaceous Semi-Natural Alliance). Upland mustards or star-thistle fields are a non-native plant community and within the project site are dominated by black mustard (*Brassica nigra*). Other non-native species are also present including white horehound (*Marrubium vulgare*), tocalote (*Centaurea melitensis*), fennel (*Foeniculum vulgare*), and others. This vegetation type is present in previously disturbed portion of the updates surrounding the Santiago Recharge Basin. Upland mustards or star-thistle fields have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Wild oats and annual brome grasslands (*Avena* spp. - *Bromus* spp. Herbaceous Semi-Natural Alliance). This grassland vegetation is dominated by a variety of non-native grasses such as wild oat (*Avena* spp.), ripgut brome (*Bromus diandrus*), and red brome (*Bromus rubens*). Non-native herbs are also present including Bermuda buttercup (*Oxalis pes-caprae*), fine leaved fumitory (*Fumaria parviflora*), mustard, and others. Wild oats and annual brome grasslands are present in disturbed sites within the project site, especially around the perimeter of the site adjacent to residential development. Wild oats and annual brome grasslands have a State Rank of SNA and are therefore not recognized as a sensitive natural community by CDFW (CDFW 2021).

Other Land Cover Types

Developed. This cover type includes disturbed and developed areas within the project site including paved roads, unpaved roads, buildings, residential areas, and other unvegetated areas. It also includes a large area in the central portion of Santiago Recharge Basin that was recently impacted by construction activities. Developed is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Open water. Open water is used to map portions of the project site that had surface water present during early 2022. This included Smith Basin and Santiago Recharge Basin. The water depths in these basins' changes throughout the year and most of the open water in these basins will eventually become dry in the late summer and fall. Open water is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

Unvegetated channels and slopes. This cover type includes flood control channels, unvegetated slopes, and other maintained areas within the project site. Vegetation is either absent or very sparse. Unvegetated channels and slopes is not a vegetation type and is therefore not described in *A Manual of California Vegetation* and is also not recognized as a sensitive natural community by CDFW (CDFW 2021).

4.2 Sensitive Natural Communities

Sensitive vegetation communities are defined by CDFW (2018) as, "...communities that are of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects." The literature review identified twelve sensitive vegetation communities recorded near the project site. These included southern dune scrub, southern foredunes, southern interior cypress forest, southern California arroyo chub/Santa Ana sucker stream, southern coastal salt marsh, southern coast live oak riparian forest, southern cottonwood willow riparian forest, southern riparian scrub, southern sycamore alder riparian woodland, southern willow scrub, Riversidean alluvial fan sage scrub, and California walnut woodland (CDFW 2022a). Of these, southern willow scrub closely matches the description of Goodding's willow - red willow riparian woodland and forest, discussed above. This vegetation is recognized by CDFW as a sensitive natural community (CDFW 2022a).

4.3 Wildlife Habitat

The term habitat refers to the environment and ecological conditions where a species is found. Wildlife habitat is often described in terms of vegetation, though a more thorough explanation includes detail such as availability or proximity to water, suitable nesting or denning sites, shade, foraging perches, cover sites to escape from predators, soils that are suitable for burrowing or hiding, proximity of noise and disturbance, and other factors that are unique to each species. For many wildlife species, vegetation reflects important components of habitat, including regional climate, physical structure, and biological

productivity and food resources. Thus, the vegetation descriptions in Section 4.1 are useful overarching descriptors for wildlife habitat.

Wildlife and wildlife sign observed during the field surveys included species common in the region, such as western fence lizard (*Sceloporus occidentalis*), night snake (*Hypsiglena torquata*), lesser goldfinch (*Spinus psaltria*), Bewick's wren (*Thryomanes bewickii*), turkey vulture (*Cathartes aura*), and California ground squirrel (*Otospermophilus beecheyi*). Several active bird nests were observed within the project site including two active red-tailed hawk (*Buteo jamaicensis*) nests. Several special-status wildlife species were observed or otherwise detected during the surveys and are discussed below in Section 5.0.

5.0 Special-Status Species Results

Based on review of the literature and databases listed above, and on local expertise with the flora and fauna of the project site, lists of special-status plants and wildlife with potential to occur on the project site or in the project vicinity were compiled (Table 3). Plant and wildlife taxa were considered to be special-status species if they were classified in one or more of the categories listed in Table 2. All special-status plants and wildlife occurring in the region in habitats similar to those found on the Project site are addressed in Table 3, with brief descriptions of habitat and distribution, conservation status, and probability of occurrence on the site.

Table 2. Definitions of Special-Status Species

Species Designation	Agency	Definition
Federal Endangered	USFWS	A species that is in danger of extinction throughout all or a significant portion of its range.
Federal Threatened	USFWS	A species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Federal Candidate	USFWS	A species the US Fish and Wildlife Service (USFWS) has designated as a candidate for listing under Section 4 of the federal Endangered Species Act (ESA), published in its annual candidate review, and defined as a species that has sufficient information on its biological status and threats to propose it as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.
Federal Proposed	USFWS	A species that the USFWS has proposed for listing under Section 4 of the ESA, by publishing a Proposed Rule in the Federal Register.
Protected under the federal Bald and Golden Eagle Protection Act (BGEPA)	USFWS	Bald and golden eagles are protected from take, including harassment, except as permitted by USFWS.
State Endangered	CDFW	A species that is in serious danger of becoming extinct throughout all or a significant portion of its range due to one or more causes, including loss or change in habitat, overexploitation, predation, competition, or disease.
State Threatened	CDFW	A species that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts.
State Candidate	CDFW	A species that has been officially noticed by the California Fish and Game Commission as being under review by the CDFW for addition to the threatened or endangered species lists. CDFW candidate species are given no extra-legal protection under state laws.

Table 2. Definitions of Special-Status Species

Species Designation	Agency	Definition
Fully Protected	CDFW	Animal species fully protected under the California Fish and Game Code. The CDFW may not issue take authorization except for scientific purposes or as provided under SB 618 (2011).
Species of Special Concern	CDFW	A species, subspecies, or distinct population of an animal native to California that currently satisfies one or more of the following (not necessarily mutually exclusive) criteria: Is extirpated from the state or, in the case of birds, in its primary seasonal or breeding role. Is on the federal, but not state list, of threatened or endangered species. Meets the state definition of threatened or endangered but has not formally been listed. Is experiencing or formerly experienced serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for state threatened or endangered status; or Has naturally small populations exhibiting high susceptibility to risk from any factor(s) that if realized, could lead to declines that would qualify it for state threatened or endangered status. This is an administrative designation and carries no formal legal status. This designation is intended to focus attention on animals at conservation risk, to stimulate research on poorly known species, and to achieve conservation and recovery before these species meet the California Endangered Species Act (CESA) criteria for listing. California Species of Special Concern are considered under the California Environmental Quality Act (CEQA) and require a discussion of impacts and appropriate mitigation to reduce impacts.
Watch List	CDFW	Taxa that were previously Species of Special Concern, but no longer merit that status or which do not meet criteria for designation as Species of Special Concern, but for which there is concern and a need for additional information to clarify status.
Special Animal	CDFW	An animal species that is tracked in the CNDDB but has no other status at the state or federal level.
California Rare Plant Rank (CRPR) 1A	CDFW	Plants presumed to be extinct in California.
CRPR 1B	CDFW	Plants rare or endangered in California and elsewhere.
CRPR 2A	CDFW	Plants presumed extinct in California but more common elsewhere.
CRPR 2B	CDFW	Plants rare or endangered in California but more common elsewhere.
CRPR 3	CDFW	Plants about which more information is needed – a review list.
CRPR 4	CDFW	Plants of limited distribution – a watch list.

Plants or wildlife may be ranked as special-status species due to declining populations, vulnerability to habitat change, or restricted distributions. Certain species have been listed as threatened or endangered under the Federal Endangered Species Act (FESA) or California Endangered Species Act (CESA). Others have not been listed, but declining populations or habitat availability cause concern for their long-term viability. These species of conservation concern appear on lists compiled by resource agencies or private conservation organizations. In this report, "special-status species" includes all plants and wildlife listed as threatened or endangered or included in these other compilations. All special-status plants and wildlife

occurring in the region in habitats similar to those found on the Project site are addressed in Table 3, with brief descriptions of habitat and distribution, conservation status, and probability of occurrence on the site.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
PLANTS				
Astragalus brauntonii Braunton's milk-vetch	Fire adapted plant that requires fire and other disturbances to propagate. Occurs in recently burned or disturbed areas in chaparral, coastal scrub and valley and foothill grasslands, sea level to about 2,000 ft. elev.; Los Angeles, Orange, and Ventura, Cos.	Jan-Aug	Fed: END CA: 1B.1, S2	Low; not observed, marginally suitable habitat is present; known from within 4.5 miles.
Baccharis malibuensis Malibu baccharis	Occurs in chaparral habitats and grassy openings, cismontane woodlands, coastal scrub and riparian; 500-1000 ft. elev.; Los Angeles, Orange, and Ventura, Cos.	Aug	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within 6 miles.
Calochortus catalinae Catalina mariposa lily	Perennial herb (bulb); chaparral, woodlands, coastal sage scrub, and grasslands with heavy soils; 50-2,300 ft. elev., Riverside Co. north to Santa Barbara Co.	Feb - Jun	Fed: None CA: 4.2, S3S4	Moderate; not observed, marginally suitable habitat is present; known from within 1 mile.
Calochortus plummerae Plummer's mariposa-lily	Occurs in chaparral, cismontane woodland, coastal scrub, valley and foothill grassland; 300-5,600 ft. elev.; Ventura and Riverside Cos south to San Diego Co.	May-Jul	Fed: None CA: 4.2, S4	Low; not observed, marginally suitable habitat is present; known from within 7 miles.
Calochortus weedii var. *intermedius* Intermediate mariposa-lily	Occurs on dry, rocky slopes of coastal scrub, chaparral and valley and foothill grasslands; 350-2,800 ft. elev.; Los Angeles, Orange, Riverside, and San Bernardino Cos.	May-Jul	Fed: None CA: 1B.2, S3	Moderate; not observed, suitable habitat is present upstream of Smith Basin; known from within 1.5 miles.
Calystegia felix Lucky morning-glory	Occurs on gentle alluvial slopes with silty loam soils and coastal swamps, riparian, and wetlands; 100-700 ft. elev.; Los Angeles, Riverside, and San Bernardino Cos.	Mar-Sep	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within about 14 miles.
Centromadia parryi ssp. australis Southern tarplant	Occurs is mesic grasslands, vernal pools, are various marsh habitats, sea level to about 1,500 ft. elev.; Santa Barbara Co. south to San Diego Co. and Baja CA.	May-Nov	Fed: None CA: 1B.1, S2	Moderate; not observed, marginally suitable habitat is present, known from within 0.5 miles.
Dudleya multicaulis Many-stemmed dudleya	Occurs in coastal plains, chaparral often in clay soils and sandstone outcrops; 50-2,600 ft. elev.; Los Angeles and San Bernardino Cos. south to San Diego Co.	Apr-Jul	Fed: None CA: 1B.2, S2	Moderate; not observed, suitable habitat is present upstream of Smith Basin; known from within 0.5 miles.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Horkelia cuneata var. *puberula* Mesa horkelia	Dry, sandy, coastal chaparral, and cismontane woodland; 200-2,700 ft. elev.; San Luis Obispo Co. south to San Diego Co.	Feb-Jul (Sep)	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within 7 miles.
Juglans californica Southern California black walnut	Small tree; chaparral, woodlands, coastal scrub, and riparian woodlands; 165-3000 ft. elev.; San Diego Co. north throughout much of coastal California.	Mar-Aug	Fed: none CA: 4.2, S4	Present; two individuals observed upstream of Smith Basin, additional individuals likely present.
Lepidium virginicum var. *robinsonii* Robinson's pepper grass	Chaparral and coastal sage scrub; sea level to about 2,900 ft. elev.; Los Angeles and San Bernardino Cos. south to San Diego Co.	Jan-Jul	Fed: None CA: 4.3, S3	Low; not observed, marginally suitable habitat is present; known from within 4.5 miles.
Nolina cismontana Chaparral nolina	Dry chaparral and coastal sage scrub of coastal mountains; 450-4,200 ft. elev.; Los Angeles, Orange, Riverside, San Diego, and Ventura Cos.	(Mar) May-Jul	Fed: None CA: 1B.2, S3	Low; not observed, marginally suitable habitat is present; known from within 6 miles.
Pentachaeta aurea ssp. *allenii* Allen's pentachaeta	Coastal scrub openings, valley, and foothill grasslands; 250-1,700 ft. elev.; endemic to Orange Co.	Mar-Jun	Fed: None CA: 1B.1, S1	Low; not observed, marginally suitable habitat is present; known from within 8 miles.
Pseudognaphalium leucocephalum White rabbit-tobacco	Chaparral, coastal scrub, and riparian woodlands. Sandy or gravelly beaches, dry stream bottoms, canyon bottoms; sea level to about 7,000 ft. elev.; much of southern CA and east into AZ, NM, and TX.	(Jul)Aug-Nov (Dec)	Fed: None CA: 2B.2, S2	Low; not observed, marginally suitable habitat is present; known from within 6 miles.
Romneya coulteri Coulter's matilija poppy	Chaparral and coastal scrub, often in burned areas, 65-4000 ft. elev.; San Diego Co. north throughout much of coastal southern California.	Mar-Jul	Fed: None CA: 4.2, S4	Present; several individuals planted along Hewes St. along east side of Santiago Recharge Basin.
INVERTEBRATES				
Bombus crotchii Crotch bumble bee	Colonial insect; open grassland and scrub; underground colonies, often in old rodent burrows. Many food plants including *Chaenactis, Lupinus, Phacelia, Salvia*, and *Eriogonum*. Much of southern and central CA, SW Nevada and Baja.	Spring – Summer	Fed: None CA: S1S2	High; not observed, suitable habitat and food plants present; known from within 3 miles.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Danaus plexippus pop. 1 Monarch – California overwintering population	Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby. Closed-cone coniferous forest	Year-round	Fed: CAN CA: S2S3	High; not observed, likely to be present however they are unlikely to overwinter this far inland.
FISH				
Catostomus santaanae Santa Ana sucker	Major cismontane stream systems in S Calif. incl. Santa Ana Riv., formerly below about 3000 ft. elev.; extant populations near Riverside and downstream. Critical habitat is located about 6 miles downstream of the project site.	Year-round	Fed: THR CA: S1, CSC	Low; not observed, only potential in Santiago Creek Channel during periods of heavy flow.
Oncorhynchus mykiss irideus pop. 10 Steelhead - southern California DPS	Federal listing refers to populations from Santa Maria River south to southern extent of range (San Mateo Creek in San Diego County).	Year-round	Fed: END CA: CAN, S1	Low; not observed, only potential in Santiago Creek Channel during periods of heavy flow.
Rhinichthys osculus ssp. 8 Santa Ana speckled dace	Endemic to Santa Ana and San Gabriel Riv. watersheds, historically in Big Tujunga Cyn. Santa Ana Riv. populations in lower San Bernardino Mtn foothills and washes.	Year-round	Fed: None CA: S1, CSC	Moderate; not observed, suitable habitat present upstream of Smith Basin, known from within 10 miles.
REPTILES				
Anniella stebbinsi Southern California legless lizard	Occurs in a variety of habitats, chaparral, coastal scrub generally in moist, loose soil.	Spring – Summer	Fed: None CA: S3, CSC	Low; not observed. marginally suitable habitat in uplands upstream of Smith Basin.
Arizona elegans occidentalis California glossy snake	Generalist occurring in a range of scrub and grassland habitats, often with loose or sandy soils.	Feb-Nov	Fed: None CA: S2, CSC	Low; not observed. marginally suitable habitat in uplands upstream of Smith Basin.
Aspidoscelis hyperythra Orange-throated whiptail	Prefers washes and other sandy areas with patches of brush and rocks. Perennial plants necessary for its major food source; termites.	Year-round	Fed: None CA: S2S3, WL	High; not observed, suitable habitat present, known from within 1 mile.
Aspidoscelis tigris stejnegeri Coastal whiptail	Occurs in deserts and semi-arid areas with sparse vegetation in firm soil, sandy, or rocky soils.	Year-round	Fed: None CA: S3, CSC	High; not observed, suitable habitat present, known from within 1 mile.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Crotalus ruber Red-diamond rattlesnake	Prefers coastal sage scrub, rocky hillsides, and lower woodlands	Spring – Summer	Fed: None CA: S3, CSC	Moderate; not observed, suitable habitat present, known from within 4 miles.
Emys marmorata Western pond turtle	Inhabits permanent or nearly permanent bodies of water in various habitat types; requires basking sites such as partially submerged logs, vegetation mats, or open mud banks.	Spring – Summer	Fed: None CA: S3, CSC	Low; minimally suitable habitat; likely to be present in the vicinity.
Phrynosoma blainvillii Coast horned lizard	Forest, shrubland or grassland; sandy soils; W Calif. from LA Co S through N Baja Calif., below about 6000 ft. elev.	Temp dependent	Fed: None CA: S3S4, CSC	Moderate; not observed, suitable habitat present, known from within 5 miles.
Salvadora hexalepis virgultea Coast patch-nosed snake	Burrows in loose soil in semi-arid bushy areas and chaparral in canyon, rocky hillsides and plains.	Year-round	Fed: None CA: S2S3, CSC	Low; not observed, suitable habitat present, known from within 8 miles.
Thamnophis hammondii Two-striped gartersnake	Riparian and wetland habitat below about 7,000 ft elev.; coastal California from southern San Joaquin Valley to NW Baja California.	Year-round	Fed: None CA: S3S4, CSC	Low; not observed, suitable habitat present, known from within 10 miles.
BIRDS				
Accipiter cooperii Cooper's hawk	Woodland, chiefly of open, interrupted, or marginal type; nest sites mainly in riparian growths of deciduous trees.	Year-round	Fed: None CA: S4, WL	Present; suitable foraging and nesting habitat throughout.
Agelaius tricolor Tricolor blackbird	Highly colonial species; requires open water, protected nesting substrate, and foraging areas with insect prey within a few kilometers of colony.	Year-round	Fed: None CA: THR, S1S2, CSC	Low; not observed, minimally suitable habitat present, known from within 10 miles.
Aimophila ruficeps canescens Southern California rufous-crowned sparrow	Arid and steep rocky areas chaparral and coastal sage scrub including low grasses and shrubs.	Spring – Summer	Fed: None CA: S3, WL	High; not observed, suitable habitat present, known from within 1 mile.
Ammodramus savannarum Grasshopper sparrow	Favors native grasslands with a mix of grasses, forbs and scattered shrubs. Loosely colonial when nesting.	Spring – Summer	Fed: None CA: S3, CSC	Low; not observed, marginally suitable habitat present, known from within 5 miles.
Aquila chrysaetos Golden eagle	Forages in open grasslands, desert scrub and agricultural fields. Nests on ledges on cliff faces, rock outcrops and occasionally in large trees.	Year-round	Fed: BGEPA CA: S3, FP	Minimal (nesting); Moderate (foraging only); no suitable nesting habitat; observed on site in 2011.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Ardea herodias Great blue heron	Rookery sites in close proximity to foraging areas: marshes, lake margins, tide-flats, rivers and streams, wet meadows.	Year-round	Fed: None CA: S4	Moderate (nesting); Present (foraging only); multiple individuals observed foraging, suitable nesting habitat present.
Asio otus Long-eared owl	Riparian bottomlands grown to tall willows and cottonwoods; also, belts of live oak paralleling stream courses.	Year-round	Fed: None CA: S3?, CSC	Minimal (nesting); Low (foraging only); no suitable nesting habitat; marginal foraging habitat, known within 10 miles.
Athene cunicularia Burrowing owl	Nests mainly in rodent burrows, usually in open grassland or shrubland; forages in open habitat; increasingly uncommon in S Calif.; through W US and Mexico.	Year-round	Fed: None CA: S3, CSC	Low (nesting); Moderate (foraging only); limited suitable nesting habitat; marginal foraging habitat, known within 5 miles.
Buteo regalis Ferruginous hawk	Open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon and juniper habitats.	Year-round	Fed: None CA: S3S4, WL	Minimal (nesting); Low (foraging only); not within nesting range, suitable foraging habitat, known within 10 miles.
Buteo swainsoni Swainson's hawk	Grasslands with scattered trees, juniper-sage flats, riparian areas and agricultural lands.	Year-round	Fed: None CA: THR, S3	Minimal (nesting); High (foraging only); not within nesting range, suitable foraging habitat, observed on site in 2011.
Campylorhynchus brunneicapillus sandiegensis Coastal cactus wren	Coastal sage scrub requires tall opuntia cactus for nesting and roosting.	Year-round	Fed: None CA: S3, CSC	High; not observed, suitable habitat present, known from within 1 mile.
Coccyzus americanus occidentalis Western yellow-billed cuckoo	Riparian forest, willows mixed with cottonwoods with a lower story of blackberry, nettles, or wild grape.	Spring – Summer	Fed: THR CA: END, S1	Minimal (nesting); Low (foraging only); no recent nesting in southern California, suitable habitat present.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Elanus leucurus White-tailed kite	Typically nests at lower elevations in riparian trees, including oaks, willows, and cottonwoods; forages over open country. Throughout much of cismontane California.	Spring – Summer	Fed: None CA: S3S4, FP	Low (nesting); Moderate (foraging only); limited suitable nesting habitat; marginal foraging habitat, known within 5 miles.
Empidonax traillii extimus Southwestern willow flycatcher	Riparian woodlands in California.	Spring – Summer	Fed: END CA: END, S1	Minimal (nesting); Low (foraging only); no recent nesting in southern California, suitable habitat present.
Eremophila alpestris actia California horned lark	Open, flat lands incl. sparse sagebrush or grassland, meadows, alkali flats; wide elev. range; breeds in western Calif (San Diego Co through Humboldt Co) and Baja Calif; winters in same range.	Year-round	Fed: None CA: S4, WL	High (seasonal foraging); Low (nesting); Marginally suitable nesting habitat, expected to forage on the project site.
Falco peregrinus anatum American peregrine falcon	Near wetlands, lakes, rivers or other water; on cliffs, banks, dunes, and human-made structures.	Year-round	Fed: DEL CA: DEL, S3S4, FP	Low (nesting); High (foraging only); limited suitable nesting habitat; known within 1 mile.
Haliaeetus leucocephalus Bald eagle	Lower montane, old growth, coniferous forests, near lakes and rivers.	Year-round	Fed: DEL CA: END, S3, FP	Low (nesting); High (foraging only); limited suitable nesting habitat; marginal foraging habitat, observed on site in 2012.
Icteria virens Yellow-breasted chat	Inhabits riparian thickets of willow and other brushy tangles near water courses; nests in low, dense riparian vegetation; nests and forages within 10 feet of ground.	Spring – Summer	Fed: None CA: S3, CSC	High; not observed, assumed to nest on site, known from within 1 mile.
Pandion haliaetus Osprey	Ocean shores, bays, freshwater lakes and large streams.	Year-round	Fed: None CA: S4, WL	Present; 1 individual observed foraging on site, known to nest on site.
Polioptila californica Coastal California gnatcatcher	Permanent resident of coastal sage scrub in arid washes, on mesas and slopes	Year-round	Fed: THR CA: S2, CSC	Present; 12 territories present in 2021, suitable habitat present.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Riparia Bank swallow	Colonial nesters, nests primarily in riparian habitats. Requires vertical banks/cliffs with fine- textured soils.	Spring – Summer	Fed: None CA: THR, S2	Minimal (nesting); Low (foraging only); suitable foraging habitat; known from within 10 miles.
Setophaga petechia Yellow warbler	Riparian vegetation; prefers willows, cottonwoods, aspens, sycamores, and alders for nesting and foraging. Throughout much of southern Calif.	Spring – Summer	Fed: None CA: S3S4, CSC	High; suitable nesting and foraging habitat present, observed onsite in 2008 and 2011.
Vireo bellii pusillus Least Bell's vireo	Summer resident of southern California in low riparian habitats in vicinity of water or dry river bottoms; found below about 2600 ft; nests typically built-in willow, mesquite, *Baccharis*.	Spring – Summer	Fed: END CA: END, S2	Present; 6 territories present in 2021, suitable habitat present.
MAMMALS				
Antrozous pallidus Pallid bat	Desert, grassland, shrubland, woodland, forest; most common in open, dry habitats with rocky areas for roosting.	Spring – Summer	Fed: None CA: S3, CSC	Minimal (roosting); Moderate (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent.
Choeronycteris mexicana Mexican long-tongued bat	Pinyon and juniper woodlands, riparian scrub. Roosts in relatively well-lit caves and in and around buildings.	Spring – Summer	Fed: None CA: S1, CSC	Minimal (roosting); Moderate (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent.
Eumops perotis californicus Western mastiff bat	Lowlands (rare exceptions); cent. and S Calif., S Ariz., NM, SW Tex., N Mexico; roost in deep rock crevices, forage over wide area.	Year-round	Fed: None CA: S3S4, CSC	Minimal (roosting); Moderate (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent
Lasiurus cinereus Hoary bat	Prefers deciduous and coniferous woodlands; primarily roosts in tree foliage.	Spring – Summer	Fed: None CA: S4	Low (roosting); High (foraging). Suitable foraging habitat is present; suitable roosting habitat is limited.
Myotis yumanensis Yuma myotis	Distribution tied to water bodies, optimal habitats are open forests and woodlands.	Spring – Summer	Fed: None CA: S4	Low (roosting); High (foraging). Suitable foraging habitat is present; suitable roosting habitat is limited.

Table 3. Special Species Addressed

Species Name	Habitat Requirements	Flowering or Activity Season	Conservation Status	Potential to Occur
Neotoma lepida intermedia San Diego desert woodrat	Arid shrublands, esp. around rocky outcrops & crevices; cismontane Calif from San Luis Obispo to San Diego Co, and NW Baja Calif.	Year-round	Fed: None CA: S3S4, CSC	Moderate; not observed, suitable habitat present.
Nyctinomops femorosaccus Pocketed free-tailed bat	Deserts and arid lowlands, SW US, Baja Calif., mainland Mexico; Roost mainly in crevices of high cliffs; forage over water and open shrubland.	Year-round	Fed: None CA: S3, CSC	Minimal (roosting); Moderate (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent
Nyctinomops macrotis Big free-tailed bat	Arid lowlands throughout S. Calif., roosts on high cliffs in rocky outcrops. Forages in a variety of habitats and feeds on months.	Spring – Summer	Fed: None CA: S3, CSC	Minimal (roosting); Moderate (foraging). Suitable foraging habitat is present; suitable roosting habitat is absent

General references (botany): Baldwin et al., 2012; CDFW, 2022a; CDFW, 2022b; CNPS, 2022; and CCH, 2022. General references (wildlife): American Ornithologists Union, 1998 (including supplements through 2013); Barbour and Davis, 1969; Ebird.org, 2022; Feldhamer et al., 2003; Garrett and Dunn, 1981; Hall, 1981; Jennings and Hayes, 1994; Stebbins, 2003; Wilson and Ruff, 1999; and Zeiner et al., 1990.

Conservation Status

Federal designations (*Fed*): (federal ESA, USFWS).

- END: Federally listed, endangered.
- THR: Federally listed, threatened.
- Candidate: Sufficient data are available to support federal listing, but not yet listed.
- Proposed: Formally proposed for the federal status shown.
- BGEPA: Bald and Golden Eagle Protection Act
- DEL: Delisted

State designations (*CA*): (CESA, CDFW)

- END: State listed, endangered.
- THR: State listed, threatened.
- CAND. Sufficient data are available to support federal listing, but not yet listed.
- RARE: State listed as rare (applied only to certain plants).
- CSC: California Species of Special Concern. Considered vulnerable to extinction due to declining numbers, limited geographic ranges, or ongoing threats.
- WL: Species that were either previously listed as SC and have not been state listed under CESA; or were previously state or federally listed and now are on neither list; or are on the list of "Fully Protected" species.
- FP: Fully protected. May not be taken or possessed without permit from CDFW.

CDFW Natural Diversity Data Base Designations: Applied to special-status plants and sensitive plant communities; where correct category is uncertain, CDFW uses two categories or question marks.

- S1: Fewer than 6 occurrences or fewer than 1000 individuals or less than 2000 acres.
- S1.1: Very threatened
- S1.2: Threatened
- S1.3: No current threats known
- S2: 6-20 occurrences or 1,000-3,000 individuals or 2,000-10,000 acres (decimal suffixes same as above).
- S3: 21-100 occurrences or 3,000-10,000 individuals or 10,000-50,000 acres (decimal suffixes same as above).
- S4: Apparently secure in California; this rank is clearly lower than S3 but factors exist to cause some concern, i.e., there is some threat or somewhat narrow habitat. No threat rank.
- S5: Demonstrably secure or ineradicable in California. No threat rank.
- SH: All California occurrences historical (i.e., no records in > 20 years).
- SX: Presumed extirpated in California.

California Rare Plant Rank designations. Note: According to the California Native Plant Society (http://www.cnps.org/cnps/rareplants/ranking.php), plants ranked as CRPR 1A, 1B, and 2 meet definitions as threatened or endangered and are eligible for state listing. That interpretation of the state Endangered Species Act is not in general use.

1A: Plants presumed extinct in California.
1B: Plants rare and endangered in California and throughout their range.
2A: Plants presumed extinct in California but more common elsewhere in their range.
2B: Plants rare, threatened or endangered in California but more common elsewhere in their range.
3: Plants about which we need more information; a review list.
4: Plants of limited distribution; a watch list.

California Rare Plant Rank Threat designation extensions:

.1 Seriously endangered in California (over 80% of occurrences threatened / high degree and immediacy of threat)
.2 Fairly endangered in California (20-80% occurrences threatened)
.3 Not very endangered in California (<20% of occurrences threatened or no current threats known)

Definitions of occurrence probability: Estimated occurrence probabilities are based on literature sources cited earlier, field surveys, and habitat analyses reported here.

Present: Observed on the site by qualified biologists.
High: Habitat is a type often utilized by the species and the site is within the known range of the species.
Moderate: Site is within the known range of the species and habitat on the site is a type occasionally used.
Low: Site is within the species' known range but habitat is rarely used, or the species was not found during focused surveys covering less than 100% of potential habitat or completed in marginal seasons.
Minimal: No suitable habitat on the site; or well outside the species' known elevational or geographic ranges; or a focused study covering 100% of all suitable habitat, completed during the appropriate season and during a year of appropriate rainfall, did not detect the species.

5.1 Special-Status Plants

5.1.1 Listed Threatened or Endangered Plants

This section describes plant species reported from the region that are listed as threatened or endangered under the federal ESA or CESA and are present or have a potential to be present on the project site. Several listed plant species were identified during the literature review but none of these species were observed or found to have at least a moderate potential to occur.

5.1.2 Other Special-Status Plants

In addition to the federal and state endangered species regulations noted above, CDFW and CNPS maintain lists of plants of conservation concern. The CDFW compiles these species including CDFW and CNPS rankings as CRPR 1, 2, 3, or 4 in its compendium of "Special Plants" (CDFW 2022b). These plants are treated here as "special-status species." Two additional high-priority special-status plants (i.e., CRPR 1B) have at least a moderate potential to be present (Table 3). Several CRPR 4 species were observed or have a potential to be present and are discussed below.

Southern tarplant (*Centromadia parryi* ssp. *australis*). Southern tarplant has a CRPR of 1B.1 (CDFW, 2022a). It is an annual that grows in mesic native grasslands, vernal pools, seasonal marshes, and coastal marshes (CDFW, 2022a). It is known from 94 occurrences in California, about 46 of which are known from within the last 20 years (CNPS, 2022). These occurrences extend from Santa Barbara County south into San Diego County and Baja California (CDFW, 2022a). Southern tarplant was not observed within the project site but was reported in 2003 less than 0.5 miles upstream of Cannon St. in the vicinity of Santiago Creek 0.5 miles (CCH, 2022). Marginally suitable habitat for southern tarplant is present and there is a moderate potential for this species to be present.

Many stemmed dudleya (*Dudleya multicaulis*). Many stemmed dudleya has a CRPR of 1B.2 (CDFW 2022a). It is an ephemeral perennial that grows on heavy soils and rocky outcrops in coastal sage scrub. It is known from approximately 154 occurrences that stretch from Ventura and Los Angeles Counties south to San Diego County (CDFW 2022a). Many stemmed dudleya was not observed within the project site but

has a moderate potential to be present in the coastal sage scrub habitat upstream of Smith Basin within 0.15 miles of Cannon St.

Intermediate mariposa-lily (*Calochortus weedii* var. *intermedius*). Intermediate mariposa-lily has a CRPR of 1B.2 (CDFW 2022a). It is a perennial bulb that grows on steep slopes and cliffs in coastal sage scrub. It is known from approximately 194 occurrences primarily within Los Angeles, Riverside, and Orange Counties (CDFW 2022a). Intermediate mariposa-lily was not observed within the project site but has a moderate potential to be present on the exposed slopes within the coastal sage scrub habitat upstream of Smith Basin within about 0.2 miles of Cannon St.

California Rare Plant Rank (CRPR) 4 Species. Two CRPR 4 species (i.e., a "watch list," not indicating rarity) were found during biological surveys including southern California black walnut (*Juglans californica*) and Coulter's matilija poppy (*Romneya coulteri*). Two southern California black walnut trees were observed along Santiago Creek upstream of Smith Basin and several planted Coulter's matilija poppy were observed along Hewes St. in ornamental landscaped areas. Several additional planted Coulter's matilija poppy were observed within restored coastal sage scrub habitat near East Bond Ave. and Prospect Ave. One additional CRPR 4 species, Catalina mariposa lily (*Calochortus catalinae*) has a moderate potential to be present in the uplands upstream of Smith Basin.

5.2 Special-Status Wildlife

5.2.1 Listed Threatened or Endangered Wildlife

This section includes species listed as threatened or endangered under CESA or FESA which were detected or have a high potential to be present on the project site. Two listed species were observed on the project site during the survey and several additional species have a potential to be present. No designated critical habitat for federally listed wildlife species is present within the project site but is located nearby and is discussed below.

Least Bell's vireo (*Vireo bellii pusilus*). Least Bell's vireo is listed as endangered under both the FESA and the CESA (CDFW 2022a). It is a small songbird that nests in riparian vegetation throughout much of southern California. Least Bell's vireo were once widespread in southern California, but their range was greatly reduced due to parasitism by brown-headed cowbirds concurrent with development of riparian habitats. Suitable riparian habitat for least Bell's vireo is present in Smith Basin, Santiago Recharge Basin, and along Santiago Creek. Protocol-level surveys were not completed as part of this report however protocol-level surveys were completed in 2021 and six territories were detected (see Figure 4, Attachment 1). Two additional territorial males were detected along Santiago Creek, just downstream of Cannon St., however nesting could not be confirmed at these locations.

Coastal California gnatcatcher (*Polioptila californica californica*). Coastal California gnatcatcher is listed as threatened under the FESA (CDFW 2022a). Its geographic range is primarily coastal southern California from Ventura County, inland to the Santa Clarita area, Banning area, and southward through northwestern Baja California. Its habitat is coastal sage scrub largely composed of California sagebrush, California buckwheat, and other low-growing, drought-deciduous shrubs. Coastal California gnatcatcher are known to nest on the project site and in 2021 up to 12 territories were detected (see Figure 4, Attachment 1). Two additional territorial males were detected in the upland area, upstream of Smith Basin near Cannon St.; however, nesting could not be confirmed at these locations. Continued habitat restoration within the project site by Orange County Water District (OCWD) has undoubtedly favored the coastal California gnatcatcher and caused recent increases in the local population.

Bald eagle (*Haliaeetus leucocephalus*). Bald eagle has been State-listed as endangered in California since 1971 (CDFW 2022a). It was federally listed as endangered in 1978, then down-listed to threatened in 1995, and delisted in 2007 (USFWS, 1978 and 2007b). It is also protected under the Federal Bald and Golden Eagle Protection Act and is a USFWS Bird of Conservation Concern. The USFWS regulates activities that may "take" bald or golden eagles (USFWS 2007a). The bald eagle is an opportunistic, generalized predator and scavenger adapted to hunting and foraging over aquatic habitats. Breeding bald eagles require relatively large bodies of water containing resident populations of suitable-sized fish. Most bald eagles in California breed near reservoirs or lakes. They typically nest in large trees in close proximity to large bodies or water and may occasionally nest on large powerline structures, and steep cliff faces. A single immature bald eagle was reported from the project site in 2012 (ebird.org 2022) and the species has a high potential to forage on the project site in the future. Bald eagle nesting habitat is present in the project site, and they are known to nest approximately 5 miles to the east, near Irvine Lake. Bald eagles have a low potential of nesting at the project site, but a high potential to forage.

Swainson's Hawk (*Buteo swainsoni*). Swainson's hawks are listed as threatened under the CESA (CDFW 2022a). In California, they nest in the San Joaquin Valley, western Antelope Valley, and Owens Valley. They migrate to South America every fall and return to California every spring. Swainson's hawks migrate along the Pacific flyway, and several have been observed in the vicinity of the project site during migration. One was reported from the project site in 2011 (ebird.org 2022). The project site is well outside of the breeding range, but Swainson's hawks may migrate over the area biannually. Swainson's hawks have a high potential to be present during migration.

Monarch (*Danaus plexippus* pop. 1). Overwintering populations of monarch in California are a candidate for federal listing under the ESA. The listing would only protect these overwintering sites and not individual butterflies or their food plants. Monarch and their food plants are widespread in California and although milkweed was not seen on the project site, monarchs have a high potential to be present. Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico and roosts are generally located in wind-protected tree groves. The project site is likely too far inland to support winter roosting habitat.

5.2.2 Species Protected Under the Federal Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668d; BGEPA) prohibits take of bald eagles and golden eagles. The BGEPA defines *take* to include "pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting, and disturbing." The USFWS (2007a) further defines *disturb* as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

Golden eagle (*Aquila chrysaetos*). Golden eagle is a California Fully Protected species and a USFWS Bird of Conservation Concern (CDFW 2022a). Golden eagles are year-around residents throughout most of their range in the western United States. In the Southwest, they are more common during winter months. They breed from late January through August (Pagel et al. 2010). In the Santa Ana Mountains they nest in steep, rugged, remote terrain. Golden eagles are wide-ranging predators, especially outside of the nesting season, when they have no need to return daily to eggs or young at their nests. A single golden eagle was reported from the project site in 2011 (ebird.org 2022) and the species has a moderate potential to forage on the project site in the future. Golden eagle nesting habitat is absent from the project site.

5.2.3 California Wildlife Species of Special Concern

Santa Ana speckled dace (*Rhinichthys osculus* ssp. 8). Santa Ana speckled dace are found in coastal Southern California streams from Los Angeles, Orange, Riverside, and San Bernardino Counties (CDFW, 2022a). They are known to occur in the San Gabriel River and the Santa Ana River but may have been extirpated from the Los Angeles River. Santa Ana speckled dace require cool (<20° C) shaded mountain streams and are typically found in shallow habitats dominated by cobbles and gravels (CDFW, 2022a). Santa Ana speckled dace are known from Santiago Creek approximately 10 miles upstream of the project site and have a high potential to be present within the project site, just upstream of Smith Basin.

Coastal whiptail (*Aspidoscelis tigris stejnegeri*). Coastal whiptail are found in coastal southern California, mostly west of the Peninsular Ranges and south of the Transverse Ranges. There range extends north into Ventura County and south to Baja California. The coastal whiptail occurs in a variety of habitats including various upland and riparian habitats. It is most commonly associated with areas of dense vegetation but is also found around sandy areas along gravelly arroyos or washes (Stebbins 2003). Coastal whiptail were not observed within the project site but have a high potential to be present throughout the project site.

Red-diamond rattlesnake (*Crotalus ruber*). Red-diamond rattlesnake live between sea level and about 5,000 feet elevation throughout most of Orange County and western Riverside County, south through San Diego and Baja California and inland to the Colorado Desert margins. Their habitats include coastal sage scrub, chaparral, and woodlands through most of their geographic range, and desert scrub at the eastern margins of their range. There are numerous records of red diamond rattlesnakes from the Santa Ana Mountains to the east of the project site. The nearest known occurrence is about 0.4 miles to the east. Red diamond rattlesnake have not been reported on the project site, but habitat throughout the site appears suitable and there is a moderate potential to be present.

Coast horned lizard (*Phrynosoma blainvillii*). Coast horned lizard are found throughout much of coastal southern California, inland as far as the southern Mojave Desert and to about 6,000 ft elevation in the mountains. Coast horned lizards occur in sandy soils in a variety of shrubland, grassland, and woodland habitat types. They have been extirpated from much of their historic range by land use changes, but they remain fairly common in natural open space areas where their primary prey (native ants) are found. Coast horned lizard were not observed within the project site but have a moderate potential to be present on the project site, primarily in the upland habitat upstream of Smith Basin.

Burrowing owl (*Athene cunicularia*). Burrowing owl are uncommon throughout much of southern California with the highest densities occurring near agricultural lands in the Imperial Valley. Burrowing owl have been extirpated from portions of Orange County because of development. Burrowing owl are still periodically observed in Orange County and have been observed within about 3 miles of the project site (inaturalist.org 2021). The habitat at the site is marginally suitable for this species, but with a sufficient prey base, and an abundant ground squirrel population (for producing burrows), it is possible that breeding or wintering burrowing owls could persist at the site.

Coastal cactus wren (*Campylorhynchus brunneicapillus sandiegensis*). Coastal cactus wren are found in coastal southern California, from Orange and Riverside Counties south into San Diego County and Baja California. Coastal cactus wren occur in coastal sage scrub habitat, primarily in areas with patches of cactus (*Opuntia* sps.). Coastal cactus wren were not observed within the project site but have a high potential to be present in the upland habitat upstream of Smith Basin.

Yellow-breasted chat (*Icteria virens*). Yellow-breasted chat is a migratory species, occurring in California only during the breeding season which is typically between April and August. In California, it primarily

breeds in the northern portion of the state and is scarce in the central and southern portions. It typically utilizes dense riparian thickets and brushy tangles near watercourses for breeding (CDFW 2022a). Yellow-breasted chat have not been previously detected on the project site but have a high potential to be present during the nesting season.

Yellow warbler (*Setophaga petechia*). Yellow warbler is a migratory species, occurring in California only during the breeding season, which is typically between April and August. In California, it is widespread in riparian habitat throughout much of the state. It typically nests in dense riparian vegetation near watercourses (CDFW 2022a). Yellow warbler were previously detected on the project site in 2008 and 2011 but were not detected during the recent surveys (ebirg.org 2022). Suitable habitat is present throughout the project site, and they are likely to be present during the nesting season.

San Diego desert woodrat (*Neotoma lepida intermedia*). San Diego desert woodrat is known from coastal and desert scrub and rocky outcrops throughout much of southern California (CDFW 2022). It frequently builds large middens (piles of sticks and debris arranged to form a shelter) in rock outcrops or around the bases of shrubs. In some portions of its range, it builds middens primarily at the bases of cactus (*Opuntia* sps.) and yucca (*Yucca* sps.) plants (Feldhamer et al. 2003). Habitat in the project site is suitable for San Diego desert woodrat and it has been documented within about 5 miles of the project site.

Bats. Several special-status bat species have at least a low potential to forage over the Project site: pallid bat (*Antrozous pallidus*), Western mastiff bat (*Eumops perotis californicus*), Mexican long-tongued bat (*Choeronycteris Mexicana*), hoary bat (*Lasiurus cinereus*), Yuma myotis (*Myotis yumanensis*), big free-tailed bat (*Nyctinomops macrotis*), and pocketed free-tailed bat (*Nyctinomops femorosaccus*). The pallid bat and Western mastiff bat forage in open areas over grasslands, agricultural areas, and other shrublands and roost in a variety of habitats including building, rock crevices, and caves. The pocketed free-tailed bat forages over water and open shrublands and roosts in crevices in cliffs. Hoary bats may roost in tree foliage within the project site. The remaining species are unlikely to roost in the project site because of a lack of suitable roosting habitat.

5.2.3 Other Special-Status Wildlife Species

Crotch bumble bee (*Bombus crotchii*). Crotch bumble bee was recently petitioned for listing under the CESA but was determined to not be eligible for protection under CESA. It is currently recognized as a special animal but may be petitioned again in the future based on a recent interpretation of CESA which indicates that some invertebrates may be eligible for protection. Crotch bumble bee is a widespread secretive species that is known from more than two hundred locations over a broad geographic range (CDFW 2022a). It is typically found in openings in grassland and scrub habitats where it burrows into the ground and lives in colonies. It feeds on native plants including milkweed, pincushion, lupine, phacelia, sage, snapdragon, clarkia, bush poppy, and buckwheat. Many of these food plants are present on the project site and suitable burrowing habitat is also present. Crotch bumblebee has a high potential to be present on the site and is known from numerous observations in the region.

Orange-throated whiptail (*Aspidoscelis hyperythra*). Orange-throated whiptail are found in coastal southern California, mostly from Riverside and Orange Counties south into San Diego County and Baja California. The orange-throated whiptail occurs in a variety of habitats including woodlands, coastal sage scrub, and chaparral. It is often found in sandy areas with patches of brush and rocks (CDFW 2022a). Orange-throated whiptail were not observed within the project site but have a high potential to be present throughout the project site.

Raptors. In addition to the raptors discussed above, several other special-status birds of prey including Cooper's hawk (*Accipiter cooperii*), white-tailed kite (*Elanus leucurus*), American peregrine falcon (*Falco peregrinus anatum*), and osprey (*Pandion haliaetus*) were observed on the project site or have at least a moderate potential to be present. These raptors are found seasonally in the region, especially during winter and during migration. Both an individual Cooper's hawk and an individual Osprey were observed flying over the project site in 2022.

Other Special-status Birds. Southern California rufous-crowned sparrow (*Aimophila ruficeps canescens*), great blue heron (*Ardea herodias*), and California horned lark (*Eremophila alpestris actia*) are the only "Watch List" wildlife species with at least a moderate potential to be present on the project site. None of these species are afforded specific protection under either state or federal regulations.

5.3 Designated Critical Habitat

The literature review conducted prior to conducting field surveys determined that the project site is not within federally designated critical habitat for any species. The nearest designated critical habitat is for coastal California gnatcatcher and is located within approximately 0.4 miles east of the project site (USFWS 2007c).

5.4 Native Birds: Migratory Bird Treaty Act (MBTA) / California Fish and Game Code

The federal MBTA prohibits take of any migratory bird, including eggs or active nests, except as permitted by regulation (e.g., licensed hunting of waterfowl or upland game species). Under the MBTA, "migratory bird" is broadly defined as "any species or family of birds that live, reproduce or migrate within or across international borders at some point during their annual life cycle" and thus applies to most native bird species. California Fish and Game Code Section 3503 prohibits take, possession, or needless destruction of bird nests or eggs; Section 3503.5 prohibits take or possession of birds of prey or their eggs; and Section 3513 prohibits take or possession of any migratory nongame bird. With the exception of a few non-native birds, such as European starling, the take of any birds or loss of active bird nests or young is regulated by these statutes. Most of these species have no other special conservation status as defined above.

The project site has many trees, shrubs, and open areas that may provide nesting habitat. Numerous common and special-status birds are known to nest on the project site or have a potential to nest there. During the surveys two active red-tailed hawk nests were observed. Three lesser nighthawk nests were also observed by David McMichael of OCWD.

Many adult birds would flee from equipment during project construction; however, nestlings and eggs would be vulnerable. If project activities include site grading or brush removal during nesting season, then it would likely destroy bird nests, including eggs or nestling birds. For most birds, these impacts can be avoided by scheduling initial clearing and grading outside the nesting season. Or, if initial clearing and grading are undertaken during nesting season, work may be limited only to areas where no nesting birds are present, as documented by pre-construction nest surveys.

Some birds are likely to nest in the project site during construction, even after initial grading and clearing have been completed. Depending on the species, birds may nest on the ground; in adjacent vegetation; or on construction equipment that is left overnight or during a long weekend. The species most likely to nest in the project site during construction are common ravens, house finches, killdeer, and mourning doves, all of which are protected by the MBTA and Fish and Game Code. Due to the high probability that

birds may nest on site during construction, regular monitoring and nest site management may be necessary throughout the breeding season.

5.5 Wildlife Movement

The ability for wildlife to move freely among populations and habitat areas is important to long-term genetic variation and demography. Fragmentation and isolation of natural habitat may cause loss of native species diversity in fragmented habitats. In the short term, wildlife movement may also be important to individual animals' ability to occupy their home ranges, if their ranges extend across a potential movement barrier. These considerations are especially important for rare, threatened, or endangered species, and wide-ranging species such as large mammals, which exist in low population densities.

The California Essential Habitat Connectivity Project was commissioned by the California Department of Transportation (Caltrans) and CDFW to create a statewide assessment of essential habitat connectivity to be used for conservation and infrastructure planning (Caltrans and CDFW 2010). One of its goals was to create the Essential Connectivity Map, which depicts large, relatively natural habitat blocks that support native biodiversity (natural landscape blocks) and areas essential for ecological connectivity between them (essential connectivity areas). This map does not reflect the needs of particular species but is based on overall biological connectivity and ecological integrity. A more detailed analysis is required to assess local and regional needs for connectivity and develop linkage designs based on the requirements of individual species (Caltrans and CDFW 2010). The project site is not located within any identified Essential Habitat Connectivity Areas or Natural Landscape Blocks. The project site is more likely to support more localized movement within the region and some upstream and downstream movement corridors along Santiago Creek.

5.6 Tree Ordinances

As discussed above, the project site is located within the cities of Orange, Santa Ana, and Villa Park and within unincorporated Orange County. Coast live oak tree and other native trees within the project site may be protected by local tree ordinances. The cities of Villa Park and Orange do not have any tree protection ordinances. The city of Santa Ana does have a tree care ordinance, but this would not apply to trees within the project site because it applies to street trees and such. Orange County does not have an adopted tree ordinance however a draft tree ordinance does exist and if adopted before the start of the project, would likely require a permit for removal of native trees within unincorporated portions of Orange County (Orange County, 2016).

6.0. Conclusions

One State and federally listed species, least Bell's vireo is known to nest in the riparian vegetation within the project site. At least six vireo territories were present in 2021. One additional federally listed species, coastal California gnatcatcher, is known to nest in the coastal sage scrub within the project site. At least twelve gnatcatcher territories were present in 2021. Two additional State listed species, bald eagle and Swainson's hawk, were previously documented on the project site and both have a high potential to forage on the project site but with a minimal and low nesting potential, respectively. Bald eagle are known to nest in the region and have a moderate potential to nest on the project site in the future.

Several additional special-status wildlife species were observed or have at least a moderate potential to be present and include Crotch bumble bee, Santa Ana speckled dace, orange-throated whiptail, coastal whiptail, red-diamond rattlesnake, coast horned lizard, burrowing owl, golden eagle, coastal cactus wren,

yellow-breasted chat, yellow warbler, Cooper's hawk, white-tailed kite, American peregrine falcon, osprey, Southern California rufous-crowned sparrow, great blue heron, California horned lark, Mexican long-tongued bat, hoary bat, Yuma myotis, big free-tailed bat, pocketed free-tailed bat, San Diego desert woodrat, pallid bat, and western mastiff bat (refer to Table 3).

In addition to special-status wildlife, two special-status plants including Southern California black walnut and Coulter's matilija poppy were observed on the project site. In addition, several additional special-status species have at least a moderate potential to be present and include many stemmed dudleya, intermediate mariposa-lily, and Catalina mariposa lily.

One sensitive natural community was also present within the project site and includes Goodding's willow - red willow riparian woodland and forest, is present on the project site. The project site is not within any designated wildlife corridors but expected to provide localized wildlife movement along Santiago Creek and within the region. The project site is likely to be used as a forage or dispersal area for wildlife in the immediate vicinity of the project site.

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Attachment 1 – Figures



Figure 1

Project Overview

August 2022



Figure 2a

Project Site
Smith Basin and Santiago Creek Recharge

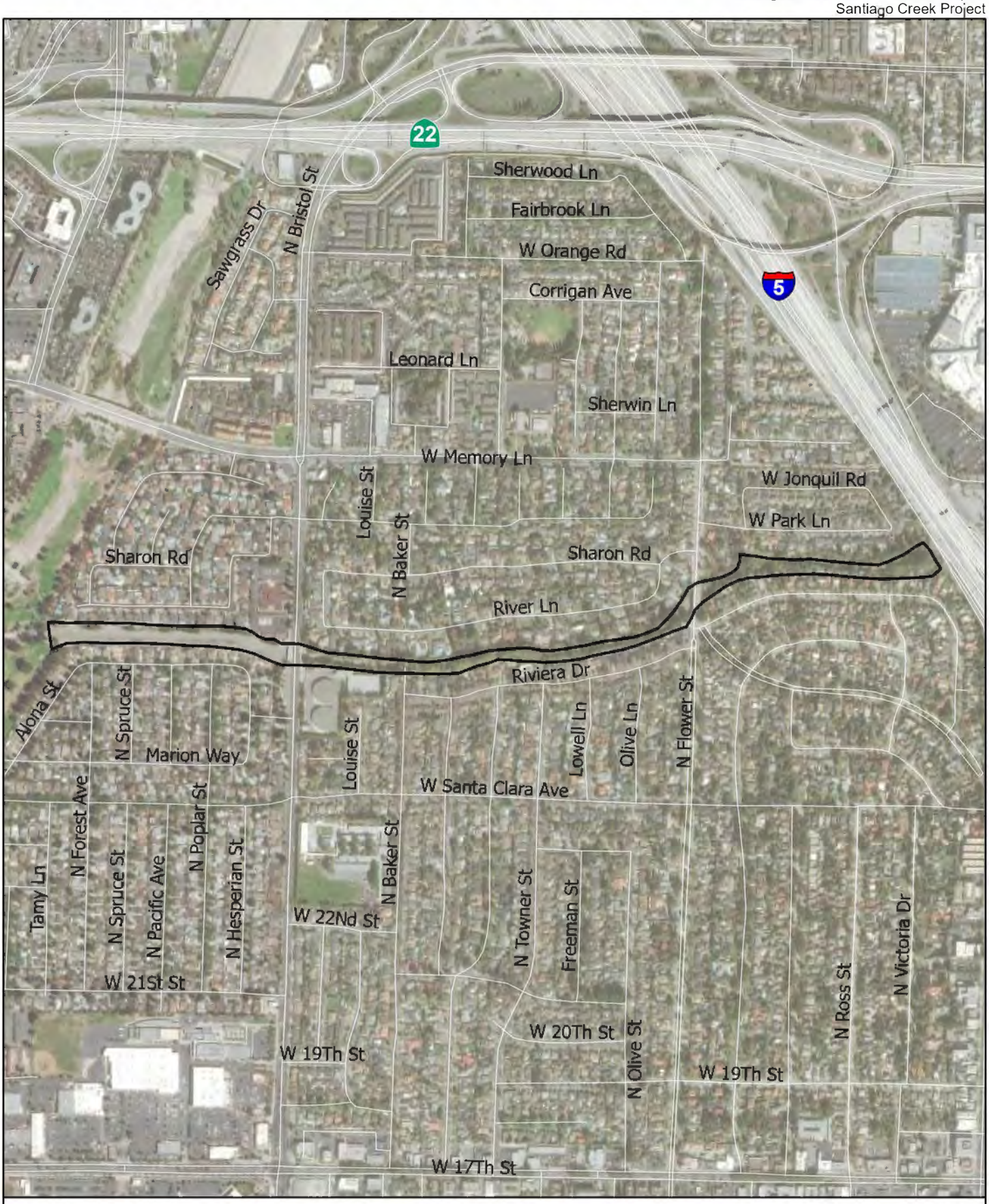


Figure 2b

Project Site
Santiago Creek Channel

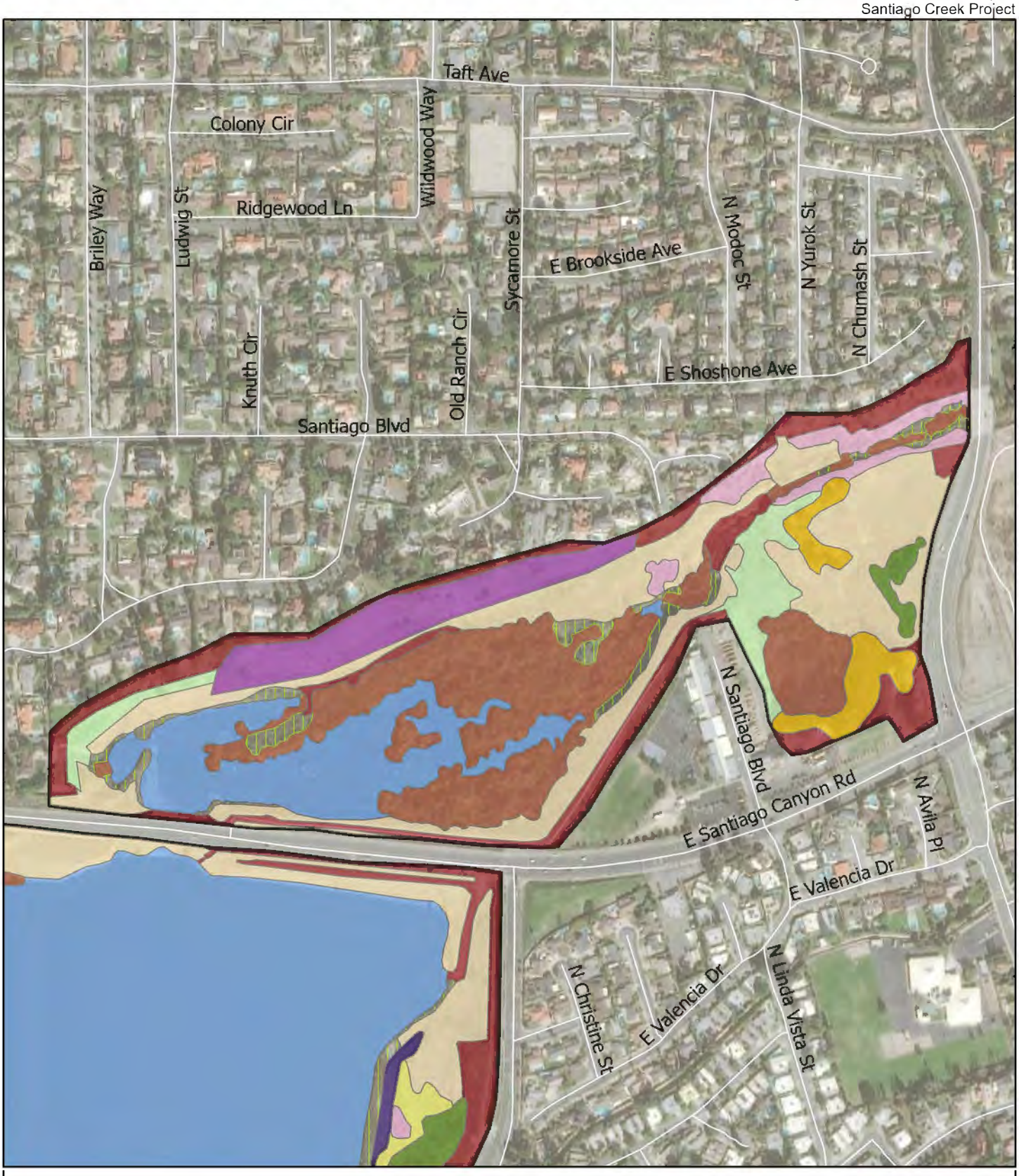


Figure 3a

Vegetation and Land Cover
Smith Basin



Figure 3b

Vegetation and Land Cover
Santiago Creek Recharge

August 2022



Project Site

Vegetation and Cover Types

- Coast live oak woodland and forest (0.38 acres)
- Developed (37.67 acres)
- Eucalyptus - tree of heaven - black locust groves (8.29 acres)
- Unvegetated channel and slopes (10.43 acres)

0 500 1,000 Feet

Figure 3c

Vegetation and Land Cover
Santiago Creek Channel

August 2022



Figure 4
Biological Resources

Attachment 2 – CNDDB Query Results

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (Yorba Linda (3311787) OR Prado Dam (3311786) OR Anaheim (3311778) OR Orange (3311777) OR Black Star Canyon (3311776) OR Newport Beach (3311768) OR Tustin (3311767) OR El Toro (3311766) OR La Habra (3311788))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Abronia villosa var. aurita chaparral sand-verbena	PDNYC010P1	None	None	G5T2?	S2	1B.1
Accipiter cooperii Cooper's hawk	ABNKC12040	None	None	G5	S4	WL
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Threatened	G1G2	S1S2	SSC
Aimophila ruficeps canescens southern California rufous-crowned sparrow	ABPBX91091	None	None	G5T3	S3	WL
Allium marvinii Yucaipa onion	PMLIL02330	None	None	G1	S1	1B.2
Ammodramus savannarum grasshopper sparrow	ABPBXA0020	None	None	G5	S3	SSC
Anaxyrus californicus arroyo toad	AAABB01230	Endangered	None	G2G3	S2S3	SSC
Anniella stebbinsi Southern California legless lizard	ARACC01060	None	None	G3	S3	SSC
Antrozous pallidus pallid bat	AMACC10010	None	None	G4	S3	SSC
Aphanisma blitoides aphanisma	PDCHE02010	None	None	G3G4	S2	1B.2
Aquila chrysaetos golden eagle	ABNKC22010	None	None	G5	S3	FP
Ardea herodias great blue heron	ABNGA04010	None	None	G5	S4	
Arizona elegans occidentalis California glossy snake	ARADB01017	None	None	G5T2	S2	SSC
Asio otus long-eared owl	ABNSB13010	None	None	G5	S3?	SSC
Aspidoscelis hyperythra orange-throated whiptail	ARACJ02060	None	None	G5	S2S3	WL
Aspidoscelis tigris stejnegeri coastal whiptail	ARACJ02143	None	None	G5T5	S3	SSC
Astragalus brauntonii Braunton's milk-vetch	PDFAB0F1G0	Endangered	None	G2	S2	1B.1
Astragalus hornii var. hornii Horn's milk-vetch	PDFAB0F421	None	None	GUT1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Atriplex coulteri Coulter's saltbush	PDCHE040E0	None	None	G3	S1S2	1B.2
Atriplex pacifica south coast saltscale	PDCHE041C0	None	None	G4	S2	1B.2
Atriplex parishii Parish's brittlescale	PDCHE041D0	None	None	G1G2	S1	1B.1
Atriplex serenana var. davidsonii Davidson's saltscale	PDCHE041T1	None	None	G5T1	S1	1B.2
Baccharis malibuensis Malibu baccharis	PDAST0W0W0	None	None	G1	S1	1B.1
Bombus crotchii Crotch bumble bee	IIHYM24480	None	None	G2	S1S2	
Branchinecta sandiegonensis San Diego fairy shrimp	ICBRA03060	Endangered	None	G2	S2	
Brodiaea filifolia thread-leaved brodiaea	PMLIL0C050	Threatened	Endangered	G2	S2	1B.1
Buteo regalis ferruginous hawk	ABNKC19120	None	None	G4	S3S4	WL
Buteo swainsoni Swainson's hawk	ABNKC19070	None	Threatened	G5	S3	
California Walnut Woodland California Walnut Woodland	CTT71210CA	None	None	G2	S2.1	
Calochortus plummerae Plummer's mariposa-lily	PMLIL0D150	None	None	G4	S4	4.2
Calochortus weedii var. intermedius intermediate mariposa-lily	PMLIL0D1J1	None	None	G3G4T3	S3	1B.2
Calystegia felix lucky morning-glory	PDCON040P0	None	None	G1Q	S1	1B.1
Campylorhynchus brunneicapillus sandiegensis coastal cactus wren	ABPBG02095	None	None	G5T3Q	S3	SSC
Catostomus santaanae Santa Ana sucker	AFCJC02190	Threatened	None	G1	S1	
Centromadia parryi ssp. australis southern tarplant	PDAST4R0P4	None	None	G3T2	S2	1B.1
Centromadia pungens ssp. laevis smooth tarplant	PDAST4R0R4	None	None	G3G4T2	S2	1B.1
Chaetodipus fallax fallax northwestern San Diego pocket mouse	AMAFD05031	None	None	G5T3T4	S3S4	SSC
Charadrius nivosus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S2	SSC
Chloropyron maritimum ssp. maritimum salt marsh bird's-beak	PDSCR0J0C2	Endangered	Endangered	G4?T1	S1	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Choeronycteris mexicana Mexican long-tongued bat	AMACB02010	None	None	G3G4	S1	SSC
Chorizanthe parryi var. fernandina San Fernando Valley spineflower	PDPGN040J1	None	Endangered	G2T1	S1	1B.1
Chorizanthe polygonoides var. longispina long-spined spineflower	PDPGN040K1	None	None	G5T3	S3	1B.2
Cicindela hirticollis gravida sandy beach tiger beetle	IICOL02101	None	None	G5T2	S2	
Cicindela latesignata western beach tiger beetle	IICOL02110	None	None	G2G3	S1	
Coccyzus americanus occidentalis western yellow-billed cuckoo	ABNRB02022	Threatened	Endangered	G5T2T3	S1	
Coelus globosus globose dune beetle	IICOL4A010	None	None	G1G2	S1S2	
Coturnicops noveboracensis yellow rail	ABNME01010	None	None	G4	S1S2	SSC
Crotalus ruber red-diamond rattlesnake	ARADE02090	None	None	G4	S3	SSC
Danaus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	Candidate	None	G4T2T3	S2S3	
Dudleya multicaulis many-stemmed dudleya	PDCRA040H0	None	None	G2	S2	1B.2
Elanus leucurus white-tailed kite	ABNKC06010	None	None	G5	S3S4	FP
Empidonax traillii extimus southwestern willow flycatcher	ABPAE33043	Endangered	Endangered	G5T2	S1	
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Eremophila alpestris actia California horned lark	ABPAT02011	None	None	G5T4Q	S4	WL
Eriastrum densifolium ssp. sanctorum Santa Ana River woollystar	PDPLM03035	Endangered	Endangered	G4T1	S1	1B.1
Eryngium aristulatum var. parishii San Diego button-celery	PDAPI0Z042	Endangered	Endangered	G5T1	S1	1B.1
Eumops perotis californicus western mastiff bat	AMACD02011	None	None	G4G5T4	S3S4	SSC
Euphydryas editha quino quino checkerspot butterfly	IILEPK405L	Endangered	None	G5T1T2	S1S2	
Falco peregrinus anatum American peregrine falcon	ABNKD06071	Delisted	Delisted	G4T4	S3S4	FP
Glyptostoma gabrielense San Gabriel chestnut	IMGASB1010	None	None	G2	S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Habroscelimorpha gabbii western tidal-flat tiger beetle	IICOL02080	None	None	G2G4	S1	
Haliaeetus leucocephalus bald eagle	ABNKC10010	Delisted	Endangered	G5	S3	FP
Helianthus nuttallii ssp. parishii Los Angeles sunflower	PDAST4N102	None	None	G5TX	SX	1A
Hesperocyparis forbesii Tecate cypress	PGCUP040C0	None	None	G2	S2	1B.1
Horkelia cuneata var. puberula mesa horkelia	PDROS0W045	None	None	G4T1	S1	1B.1
Icteria virens yellow-breasted chat	ABPBX24010	None	None	G5	S3	SSC
Isocoma menziesii var. decumbens decumbent goldenbush	PDAST57091	None	None	G3G5T2T3	S2	1B.2
Lasiurus cinereus hoary bat	AMACC05030	None	None	G3G4	S4	
Lasthenia glabrata ssp. coulteri Coulter's goldfields	PDAST5L0A1	None	None	G4T2	S2	1B.1
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3T1	S1	FP
Lepechinia cardiophylla heart-leaved pitcher sage	PDLAM0V020	None	None	G3	S2S3	1B.2
Lepidium virginicum var. robinsonii Robinson's pepper-grass	PDBRA1M114	None	None	G5T3	S3	4.3
Monardella australis ssp. jokerstii Jokerst's monardella	PDLAM18112	None	None	G4T1?	S1?	1B.1
Monardella hypoleuca ssp. intermedia intermediate monardella	PDLAM180A4	None	None	G4T2?	S2?	1B.3
Myotis yumanensis Yuma myotis	AMACC01020	None	None	G5	S4	
Nama stenocarpa mud nama	PDHYD0A0H0	None	None	G4G5	S1S2	2B.2
Nasturtium gambelii Gambel's water cress	PDBRA270V0	Endangered	Threatened	G1	S1	1B.1
Navarretia prostrata prostrate vernal pool navarretia	PDPLM0C0Q0	None	None	G2	S2	1B.2
Nemacaulis denudata var. denudata coast woolly-heads	PDPGN0G011	None	None	G3G4T2	S2	1B.2
Neotoma lepida intermedia San Diego desert woodrat	AMAFF08041	None	None	G5T3T4	S3S4	SSC
Nolina cismontana chaparral nolina	PMAGA080E0	None	None	G3	S3	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Nyctinomops femorosaccus pocketed free-tailed bat	AMACD04010	None	None	G5	S3	SSC
Nyctinomops macrotis big free-tailed bat	AMACD04020	None	None	G5	S3	SSC
Oncorhynchus mykiss irideus pop. 10 steelhead - southern California DPS	AFCHA0209J	Endangered	Candidate Endangered	G5T1Q	S1	
Onychomys torridus ramona southern grasshopper mouse	AMAFF06022	None	None	G5T3	S3	SSC
Orcuttia californica California Orcutt grass	PMPOA4G010	Endangered	Endangered	G1	S1	1B.1
Pandion haliaetus osprey	ABNKC01010	None	None	G5	S4	WL
Panoquina errans wandering (=saltmarsh) skipper	IILEP84030	None	None	G4G5	S2	
Passerculus sandwichensis beldingi Belding's savannah sparrow	ABPBX99015	None	Endangered	G5T3	S3	
Penstemon californicus California beardtongue	PDSCR1L110	None	None	G3	S2	1B.2
Pentachaeta aurea ssp. allenii Allen's pentachaeta	PDAST6X021	None	None	G4T1	S1	1B.1
Perognathus longimembris pacificus Pacific pocket mouse	AMAFD01042	Endangered	None	G5T1	S1	SSC
Phrynosoma blainvillii coast horned lizard	ARACF12100	None	None	G3G4	S3S4	SSC
Polioptila californica californica coastal California gnatcatcher	ABPBJ08081	Threatened	None	G4G5T3Q	S2	SSC
Pseudognaphalium leucocephalum white rabbit-tobacco	PDAST440C0	None	None	G4	S2	2B.2
Rallus obsoletus levipes light-footed Ridgway's rail	ABNME05014	Endangered	Endangered	G3T1T2	S1	FP
Rhinichthys osculus ssp. 8 Santa Ana speckled dace	AFCJB3705K	None	None	G5T1	S1	SSC
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
Riversidian Alluvial Fan Sage Scrub Riversidian Alluvial Fan Sage Scrub	CTT32720CA	None	None	G1	S1.1	
Salvadora hexalepis virgultea coast patch-nosed snake	ARADB30033	None	None	G5T4	S2S3	SSC
Senecio aphanactis chaparral ragwort	PDAST8H060	None	None	G3	S2	2B.2
Setophaga petechia yellow warbler	ABPBX03010	None	None	G5	S3S4	SSC

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Sidalcea neomexicana salt spring checkerbloom	PDMAL110J0	None	None	G4	S2	2B.2
Sorex ornatus salicornicus southern California saltmarsh shrew	AMABA01104	None	None	G5T1?	S1	SSC
Southern California Arroyo Chub/Santa Ana Sucker Stream Southern California Arroyo Chub/Santa Ana Sucker Stream	CARE2330CA	None	None	GNR	SNR	
Southern Coast Live Oak Riparian Forest Southern Coast Live Oak Riparian Forest	CTT61310CA	None	None	G4	S4	
Southern Coastal Salt Marsh Southern Coastal Salt Marsh	CTT52120CA	None	None	G2	S2.1	
Southern Cottonwood Willow Riparian Forest Southern Cottonwood Willow Riparian Forest	CTT61330CA	None	None	G3	S3.2	
Southern Dune Scrub Southern Dune Scrub	CTT21330CA	None	None	G1	S1.1	
Southern Foredunes Southern Foredunes	CTT21230CA	None	None	G2	S2.1	
Southern Interior Cypress Forest Southern Interior Cypress Forest	CTT83230CA	None	None	G2	S2.1	
Southern Riparian Scrub Southern Riparian Scrub	CTT63300CA	None	None	G3	S3.2	
Southern Sycamore Alder Riparian Woodland Southern Sycamore Alder Riparian Woodland	CTT62400CA	None	None	G4	S4	
Southern Willow Scrub Southern Willow Scrub	CTT63320CA	None	None	G3	S2.1	
Spea hammondii western spadefoot	AAABF02020	None	None	G2G3	S3	SSC
Sternula antillarum browni California least tern	ABNNM08103	Endangered	Endangered	G4T2T3Q	S2	FP
Streptocephalus woottoni Riverside fairy shrimp	ICBRA07010	Endangered	None	G1G2	S1S2	
Suaeda esteroa estuary seablite	PDCHE0P0D0	None	None	G3	S2	1B.2
Symphyotrichum defoliatum San Bernardino aster	PDASTE80C0	None	None	G2	S2	1B.2
Taricha torosa Coast Range newt	AAAAF02032	None	None	G4	S4	SSC
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Thamnophis hammondii two-striped gartersnake	ARADB36160	None	None	G4	S3S4	SSC
Tryonia imitator mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	G2	S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Vireo bellii pusillus	ABPBW01114	Endangered	Endangered	G5T2	S2	
least Bell's vireo						

Record Count: 125

Attachment 3 – IPaC Resource List

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

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Location

Orange County, California



Local office

Carlsbad Fish And Wildlife Office

(760) 431-9440
(760) 431-5901

2177 Salk Avenue - Suite 250
Carlsbad, CA 92008-7385

http://www.fws.gov/carlsbad/

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Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

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2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Birds

NAME	STATUS
Coastal California Gnatcatcher *Polioptila californica californica* Wherever found There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/8178	Threatened
Least Bell's Vireo *Vireo bellii pusillus* Wherever found There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/5945	Endangered

Fishes

NAME	STATUS
Santa Ana Sucker *Catostomus santaanae* There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/3785	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

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THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern https://www.fws.gov/program/migratory-birds/species
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide conservation measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME

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BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)

Allen's Hummingbird *Selasphorus sasin* — Breeds Feb 1 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9637

Bald Eagle *Haliaeetus leucocephalus* — Breeds Jan 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

Black Skimmer *Rynchops niger* — Breeds May 20 to Sep 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5234

Black-chinned Sparrow *Spizella atrogularis* — Breeds Apr 15 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9447

California Thrasher *Toxostoma redivivum* — Breeds Jan 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Clark's Grebe *Aechmophorus clarkii* — Breeds Jun 1 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

NOT FOR CONSULTATION

Common Yellowthroat Geothlypis trichas sinuosa — Breeds May 20 to Jul 31

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/2084

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Lawrence's Goldfinch Carduelis lawrencei — Breeds Mar 20 to Sep 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9464

Long-eared Owl asio otus — Breeds Mar 1 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3631

Marbled Godwit Limosa fedoa — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — Breeds Mar 15 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Olive-sided Flycatcher Contopus cooperi — Breeds May 20 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3914

NOT FOR CONSULTATION

Short-billed Dowitcher Limnodromus griseus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence ( )

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

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3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

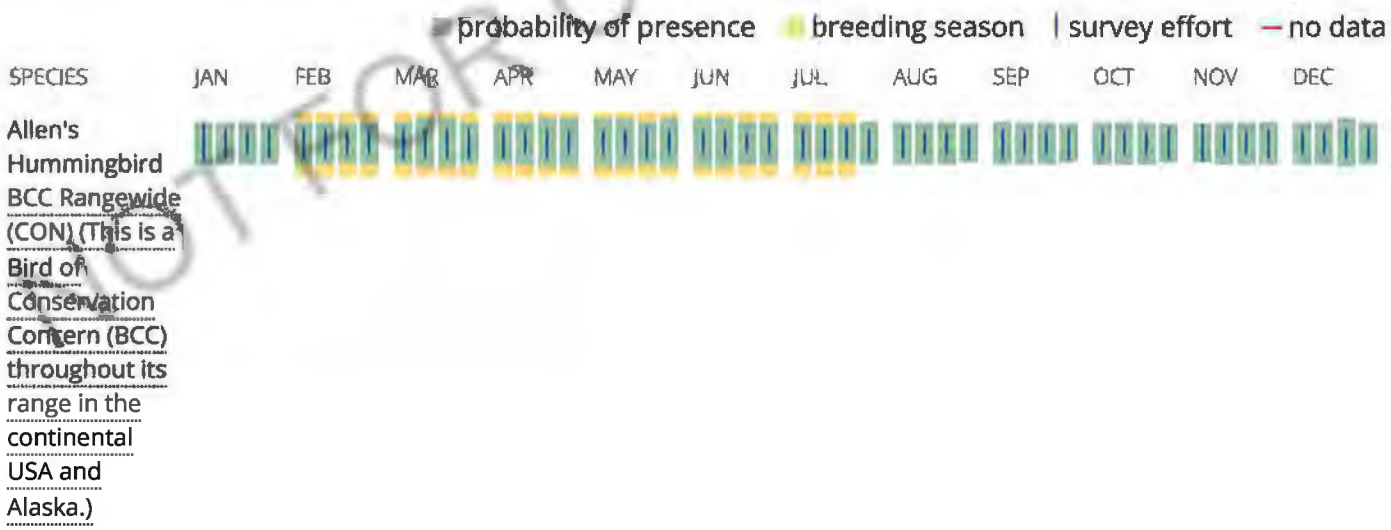
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



NOT FOR CONSULTATION

Bald Eagle Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



Black Skimmer BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Black-chinned Sparrow BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



California Thrasher BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



NOT FOR CONSULTATION

Clark's Grebe BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



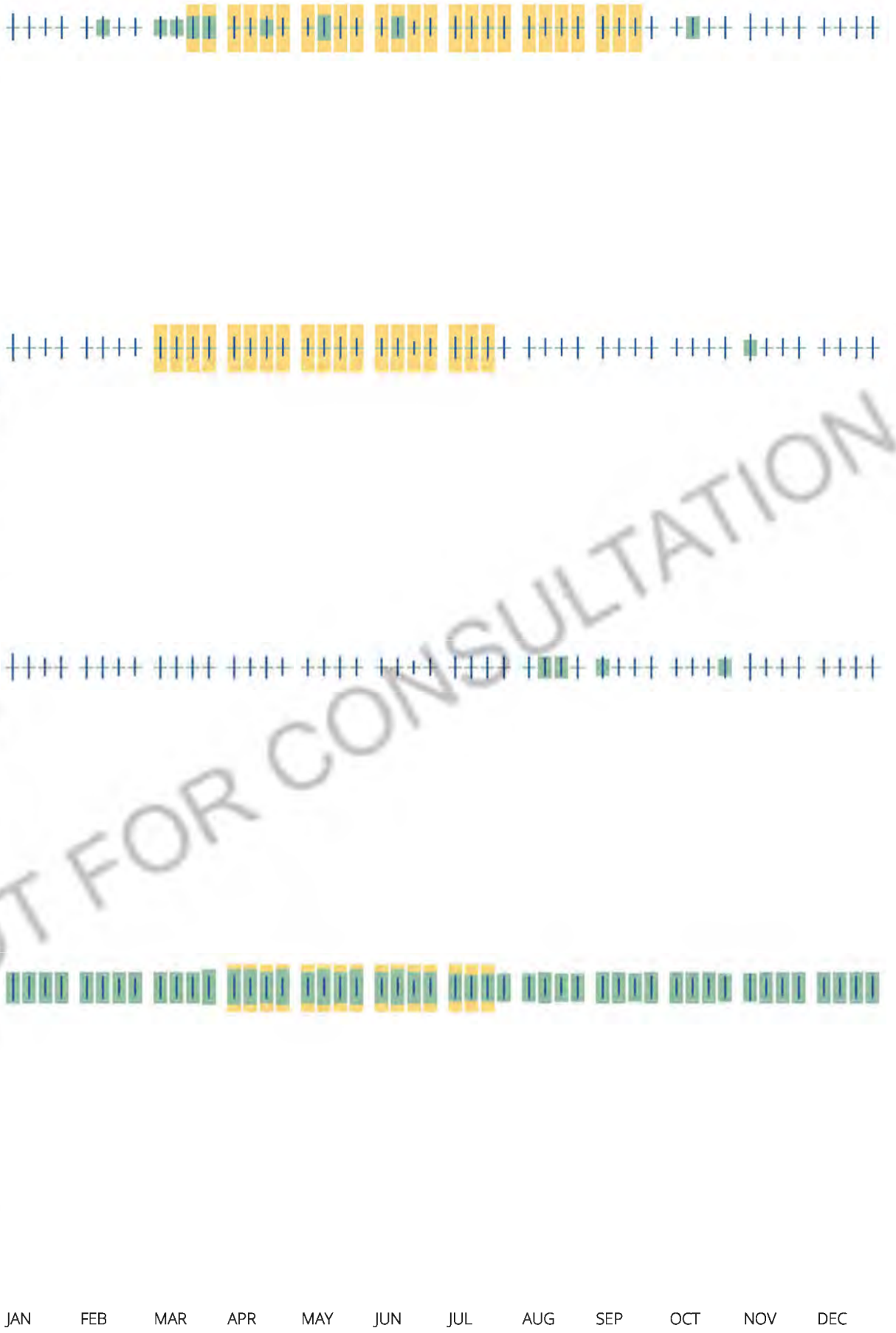
Common Yellowthroat BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Golden Eagle Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

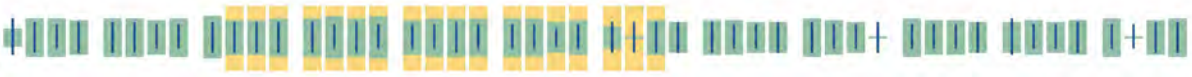


NOT FOR CONSULTATION

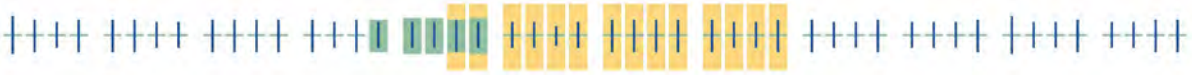


NOT FOR CONSULTATION

Oak Titmouse BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Olive-sided Flycatcher BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Short-billed Dowitcher BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

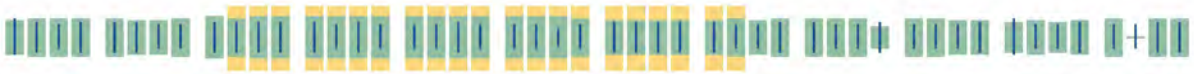


Willet BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



NOT FOR CONSULTATION

Wrentit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

NOT FOR CONSULTATION

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

NOT FOR CONSULTATION

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

WETLAND INFORMATION IS NOT AVAILABLE AT THIS TIME

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION

Attachment 4 – Special-Status Species Not Addressed

Attachment 4. Special-Status Species Not Addressed[1]

Latin Name	Common Name	Reason for Exclusion
PLANTS		
Abronia villosa var. *aurita*	Chaparral sand-verbena	Extirpated from Orange County.
Allium marvinii	Yucaipa onion	No suitable substrate and west of geographic range.
Aphanisma blitoides	Anaphanisma	No coastal bluff or coastal scrub habitat.
Astragalus hornii var. *hornii*	Horn's milk vetch	No alkali playa or saltbush scrub habitat.
Astragalus pycnostachyus var. *lanosissimus*	Ventura marsh milk vetch	No coastal saltmarsh habitat.
Atriplex coulteri	Coulter's saltbush	No alkali playa or saltbush scrub habitat.
Atriplex pacifica	South coast saltscale	No alkali playa or saltbush scrub habitat.
Atriplex parishii	Parish's brittlescale	No alkali playa or saltbush scrub habitat.
Atriplex serenana var. *davidsonii*	Davidson's saltscale	No alkali playa or saltbush scrub habitat.
Brodiaea filifolia	Thread-leaved brodiaea	No suitable clay soils.
Centromedia pungens ssp. *laevis*	Smooth tarplant	No alkali playa or saltbush scrub habitat.
Chloropyron maritimum ssp. *maritimum*	Salt marsh bird's-beak	No coastal saltmarsh habitat.
Chorizanthe parryi var. *fernandina*	San Fernando Valley spineflower	Extirpated from Orange County.
Chorizanthe polygonoides var. *longispina*	Long-spined spineflower	No suitable clay soils.
Eriastrum densifolium ssp. *sanctorum*	Santa Ana River woollystar	Extirpated from Orange County.
Eryngium aristulatum var. *parishii*	San Diego button-celery	No vernal pool habitat.
Helianthus nuttallii ssp. *parishii*	Los Angeles sunflower	Extinct species, no suitable seep or spring habitat.
Hesperocyparis forbesii	Tecate cypress	No suitable forest or chaparral habitat.
Isocoma menziesii var. *decumbens*	Decumbent goldenbush	No coastal saltmarsh habitat.
Lasthenia glabrata ssp. *coulteri*	Coulter's goldfields	No vernal pool or coastal playa habitat.
Lepechinia cardiophylla	Heart-leaved pitcher sage	Well outside of geographic range.
Nama stenocarpa	Mud nama	No vernal pool habitat.
Nasturtium gambelii	Gambel's water cress	Extirpated from Southern California.
Navarretia prostrata	Prostrate vernal pool navarretia	No vernal pool habitat.
Nemacaulis denudata var. *denudata*	Coast woolly-heads	No coastal dune habitat.
Monardella australis ssp. *jokerstii*	Jokerst's monardella	Well below the species elevation range.
Monardella hypoleuca ssp. *intermedia*	Intermediate monardella	Well below the species elevation range.
Orcuttia californica	California Orcutt grass	No vernal pool habitat.
Penstemon californicus	California beardtongue	No suitable habitat, well west of geographic range.
Senecio aphanactis	Chaparral ragwort	No suitable alkali soils present.
Sidalcea neomexicana	Salt spring checkerbloom	No suitable freshwater wetland habitat.
Suaeda esteroa	Estuary seablite	No coastal bluff or coastal scrub habitat.
Symphyotrichum defoliatum	San Bernardino aster	No suitable freshwater wetland habitat.
INVERTEBRATES		
Branchinecta sandiegonensis	San Diego fairy shrimp	No vernal pool habitat
Cicindela hirticollis gravida	Sandy beach tiger beetle	No coastal dune or strand habitat.
Cicindela latesignata	Western beach tiger beetle	No coastal dune or strand habitat.
Coelus globosus	Globose dune beetle	No coastal dune habitat.
Euphydryas editha quino	Quino checkerspot butterfly	Extirpated from Orange County.
Glyptostoma gabrielense	San Gabriel chestnut	Well outside of geographic range.
Habroscelimorpha gabbii	Western tidal-flat tiger beetle	No suitable tidal flats.

Attachment 4. Special-Status Species Not Addressed[1]

Latin Name	Common Name	Reason for Exclusion
Panoquina errans	Wandering (=saltmarsh) skipper	No coastal saltmarsh habitat.
Streptocephalus woottoni	Riverside fairy shrimp	No vernal pool habitat
Tryonia imitator	Mimic tryonia (=California brackishwater snail)	No coastal saltmarsh habitat.
AMPHIBIANS		
Anaxyrus californicus	Arroyo toad	No suitable sandy wash habitat.
Spea hammondii	Western spadefoot	No vernal pool habitat.
Taricha torosa	Coast Range newt	No suitable mesic canyon habitat.
BIRDS		
Charadrius nivosus nivosus	Western snowy plover	No coastal dune or strand habitat.
Coturnicops noveboracensis	Yellow rail	No suitable marsh or wetland habitat.
Laterallus jamaicensis coturniculus	California black rail	No suitable marsh or wetland habitat.
Passerculus sandwichensis beldingi	Belding's savannah sparrow	No coastal saltmarsh habitat.
Rallus obsoletus levipes	Light-footed Ridgeway's rail	No suitable marsh or wetland habitat.
Sternula antillarum browni	California least tern	No coastal dune or strand habitat.
MAMMALS		
Chaetodipus fallax fallax	Northwestern San Diego pocket mouse	Well outside of geographic range.
Onychomys torridus ramona	Southern grasshopper mouse	Well outside of geographic range.
Perognathus longimembris pacificus	Pacific pocket mouse	Well outside of geographic range.
Sorex ornatus salicornicus	Southern California saltmarsh shrew	No coastal saltmarsh habitat.
Taxidea taxus	American badger	Surrounded by development, not adequately sized to support animals.

Note:
[1] Special-status species reported from the region, but not addressed in this report due to habitat or geographic range.

Attachment 5 – Project Species List

Attachment 5. Project Species List	
Latin Name	Common Name
VASCULAR PLANTS	
Dicotyledons	
CUPRESSACEAE	CYPRESS FAMILY
Hesperocyparis sp.	Unid. cypress
PINACEAE	PINE FAMILY
* *Pinus* sp.	Unid. ornamental
PODOCARPACEAE	PODOCARP FAMILY
* *Podocarpus macrophyllus*	Yew plum pine
ADOXACEAE	MUSKROOT FAMILY
Sambucus nigra ssp. *cerulea*	Mexican elderberry, blue elderberry
AIZOACEAE	FIG-MARIGOLD or ICEPLANT FAMILY
* *Carpobrotus edulis*	Freeway iceplant, hottentot fig
ANACARDIACEAE	SUMAC or CASHEW FAMILY
Malosma laurina	Laurel sumac
* *Pistacia* sp.	Unid. pistachio
Rhus integrifolia	Lemonade berry
* *Rhus lanceolata*	Prairie sumac
Rhus ovata	Sugar bush
* *Schinus molle*	Peruvian pepper tree
* *Schinus terebinthifolius*	Brazilian pepper tree
Toxicodendron diversilobum	Western poison oak
APIACEAE	CELERY FAMILY
* *Conium maculatum*	Poison hemlock
* *Foeniculum vulgare*	Fennel
APOCYNACEAE	DOGBANE FAMILY
* *Asclepias curassavica*	Tropical milkweed
* *Nerium oleander*	Common ornamental oleander
* *Vinca major*	Greater periwinkle, blue periwinkle
ARALIACEAE	GINSENG FAMILY, IVY FAMILY
* *Hedera helix*	English ivy
ASTERACEAE	ASTER FAMILY
* *Ageratina adenophora*	Crofton weed, sticky eupatorium
Ambrosia psilostachya	Western ragweed
Artemisia californica	California sagebrush
Artemisia douglasiana	Douglas mugwort
Artemisia dracunculus	Tarragon
Baccharis pilularis	Coyote brush
Baccharis salicifolia	Mule fat
Baccharis sarothroides	Broom baccharis
Bebbia juncea var. *aspera*	Sweetbush
Bidens frondosa	Sticktight
Brickellia californica	California brickellbush
* *Carduus pycnocephalus*	Italian thistle
* *Centaurea melitensis*	Tocalote
* *Cynara cardunculus*	Artichoke thistle, cardoon
* *Delarea odorata*	German ivy, cape ivy

Attachment 5. Project Species List	
Latin Name	Common Name
Encelia californica	California encelia
Encelia farinosa	Brittlebush
* *Erigeron bonariensis*	Flax-leaved horseweed
* *Gazania linearis*	Treasure flower, ornamental gazania
* *Glebionis coronaria*	Garland daisy
* *Helminthotheca echioides*	Bristly ox-tongue
Heterotheca grandiflora	Telegraph weed
Heterotheca sessiliflora	Sessileflower goldenaster
* *Hypochaeris glabra*	Smooth cat's-ear
Laennecia coulteri	Coulter's horseweed
Lepidospartum squamatum	Scale-broom
Malacothrix saxatilis	Quillwort
Pluchea odorata	Saltmarsh-fleabane
Pseudognaphalium biolettii	Bicolored cudweed
Pseudognaphalium californicum	California everlasting
Pseudognaphalium canescens	Wright's cudweed
* *Pulicaria paludosa* (*P. hispanica*)	False flea-bane, Spanish sunflower
* *Senecio vulgaris*	Common groundsel
* *Sonchus asper*	Prickly sow thistle
* *Sonchus oleraceus*	Common sow thistle
* *Verbesina encelioides*	Golden crownbeard
Xanthium strumarium	Cocklebur
BETULACEAE	BIRCH FAMILY
Alnus rhombifolia	White alder
BIGNONIACEAE	TRUMPET-CREEPER or JACARANDA FAMILY
* *Tecoma capensis*	Cape honeysuckle
BORAGINACEAE	BORAGE OR WATERLEAF FAMILY
Amsinckia intermedia	Large flower rancher's fiddleneck
Cryptantha sp.	Unid. annual cryptantha
Eriodictyon crassifolium	Thick-leaf yerba santa
Eucrypta chrysanthemifolia	Common eucrypta
Heliotropium curassavicum	Seaside heliotrope
Phacelia ramosissima	Branching phacelia
BRASSICACEAE	MUSTARD FAMILY
* *Brassica nigra*	Black mustard
* *Brassica rapa*	Field mustard
* *Brassica tournefortii*	Sahara mustard, wild turnip
* *Capsella bursa-pastoris*	Shepherd's purse
* *Cardamine hirsuta*	Hairy bitter cress
* *Hirschfeldia incana*	Shortpod mustard
* *Lepidium didymum*	Lesser swine cress, lesser wort-cress
* *Lobularia maritima*	Sweet alyssum
* *Raphanus sativus*	Wild radish
* *Sisymbrium irio*	London rocket
* *Sisymbrium orientale*	Hare's ear cabbage
CACTACEAE	CACTUS FAMILY

Attachment 5. Project Species List	
Latin Name	Common Name
* *Opuntia ficus-indica*	Mission prickly-pear, Indian fig
Opuntia oricola	Chaparral pricklypear
CARYOPHYLLACEAE	PINK FAMILY, CARNATION FAMILY
* *Cerastium glomeratum*	Sticky mouse-ear chickweed
CHENOPODIACEAE	GOOSEFOOT FAMILY
* *Atriplex semibaccata*	Australian saltbush
* *Atriplex suberecta*	Sprawling saltbush, Australian saltbush
* *Chenopodium album*	Lamb's quarters, common goosefoot
* *Salsola tragus*	Russian thistle
CONVOLVULACEAE	MORNING-GLORY FAMILY
Calystegia macrostegia	Morning-glory
Cuscuta californica	Chaparral dodder, witch's hair
CRASSULACEAE	STONECROP FAMILY
Crassula connata	Pygmy-weed
CUCURBITACEAE	GOURD FAMILY, CUCUMBER FAMILY
Cucurbita foetidissima	Calabazilla
Marah macrocarpa	Chilicothe, wild cucumber
EUPHORBIACEAE	SPURGE FAMILY
* *Euphorbia maculata*	Spotted spurge
* *Euphorbia peplus*	Petty spurge
* *Ricinus communis*	Castor bean
FABACEAE	LEGUME FAMILY, PEA FAMILY
* *Acacia* sp.	Unid. escaped ornamental
Acmispon glaber	Deerweed
Lupinus succulentus	Arroyo lupine
* *Medicago polymorpha*	California burclover
* *Melilotus albus*	White sweetclover
* *Melilotus indicus*	Sourclover, India sweetclover
* *Parkinsonia aculeata*	Mexican palo verde (escaped ornamental)
FAGACEAE	OAK FAMILY
Quercus agrifolia	Coast live oak
* *Quercus ilex*	Holly oak
GERANIACEAE	GERANIUM FAMILY
* *Erodium botrys*	Long-beak filaree
* *Erodium cicutarium*	Redstem filaree
* *Erodium moschatum*	Greenstem filaree, white-stemmed filaree
JUGLANDACEAE	WALNUT FAMILY
** *Juglans californica*	Southern California black walnut
LAMIACEAE	MINT FAMILY
* *Lamium amplexicaule*	Common henbit
* *Marrubium vulgare*	Horehound
* *Rosmarinus officinalis*	Rosemary
Salvia apiana	White sage
Salvia mellifera	Black sage
Trichostema lanatum	Woolly blue curls
MALVACEAE	MALLOW FAMILY

Attachment 5. Project Species List	
Latin Name	Common Name
Malacothamnus fasciculatus	Chaparral bush-mallow
* *Malva parviflora*	Cheeseweed
MELIACEAE	MAHOGANY FAMILY
* *Melia azedarach*	China berry
MORACEAE	MULBERRY FAMILY, FIG FAMILY
* *Ficus carica*	Common fig, edible fig
* *Morus alba*	White mulberry
MYRTACEAE	MYRTLE FAMILY, EUCALYPTUS FAMILY
* Callistemon citrinus	Crimson bottlebrush
* *Eucalyptus* sp.	Ornamental eucalyptus
NYCTAGINACEAE	FOUR O'CLOCK FAMILY
Mirabilis laevis (*M. californica*)	Wishbone bush
OLEACEAE	OLIVE FAMILY
* Fraxinus udhei	Shamel ash (escaped ornamental)
* *Olea europaea*	Russian olive
ONAGRACEAE	EVENING-PRIMROSE FAMILY
Epilobium canum	California fuchsia
OXALIDACEAE	OXALIS FAMILY
* *Oxalis pes-caprae*	Bermuda buttercup
PAPAVERACEAE	POPPY FAMILY
* *Fumaria parviflora*	Fine leaved fumitory
** *Romneya coulteri*	Coulter's matilija poppy
PLANTAGINACEAE	PLANTAIN FAMILY
Keckiella cordifolia	Climbing bush-penstemon
* Plantago lanceolata	English plantain, rib-grass
* *Veronica anagallis-aquatica*	Water speedwell
PLATANACEAE	PLANE-TREE or SYCAMORE FAMILY
Platanus racemosa	Western sycamore
* *Platanus X acerifolia*	London planetree
PLUMBAGINACEAE	LEADWORT FAMILY
* *Limonium* sp.	Sea-lavender (escaped ornamental)
POLYGONACEAE	BUCKWHEAT FAMILY
Emex spinosa	Devil's thorn
Eriogonum fasciculatum	California buckwheat
* *Rumex crispus*	Curly dock
PORTULACACEAE	PURSLANE FAMILY
* *Portulaca oleracea*	Common purslane
ROSACEAE	ROSE FAMILY
Heteromeles arbutifolia	Toyon, Christmas berry
* *Pyracantha* sp.	Ornamental pyracantha
Rosa californica	California wild rose
RUBIACEAE	MADDER FAMILY, COFFEE FAMILY
Galium aparine	Goose grass, stickywilly
SALICACEAE	WILLOW FAMILY
Populus fremontii	Fremont cottonwood
Populus trichocarpa	Black cottonwood

Attachment 5. Project Species List	
Latin Name	Common Name
Salix gooddingii	Goodding's black willow
Salix lasiandra	Lance-leaved willow
Salix lasiolepis	Arroyo willow
SAPINDACEAE	SOAPBERRY FAMILY
* *Koelreuteria bipinnata*	Goldenrain tree
SCROPHULARIACEAE	FIGWORT FAMILY, SNAPDRAGON FAMILY
* *Myoporum laetum*	Myoporum
SIMAROUBACEAE	QUASSIA or SIMAROUBA FAMILY
* *Ailanthus altissima*	Tree of heaven
SOLANACEAE	NIGHTSHADE FAMILY
Datura wrightii (*D. meteloides*)	Jimsonweed, tolguacha
* *Nicotiana glauca*	Tree tobacco
Solanum nigrum	Black nightshade
TAMARICACEAE	TAMARISK FAMILY
* *Tamarix ramosissima*	Saltcedar, tamarisk
ULMACEAE	ELM FAMILY
* *Ulmus parviflora*	Chinese elm
URTICACEAE	NETTLE FAMILY
* *Urtica urens*	Dwarf nettle
VERBENACEAE	VERVAIN FAMILY
Phyla nodiflora	Common lippia
Verbena lasiostachys	Western verbena
VITACEAE	GRAPE FAMILY
Vitis girdiana	Wild grape
ZYGOPHYLLACEAE	CALTROP FAMILY
* *Tribulus terrestris*	Puncture vine
Monocotyledons	
AGAVACEAE	CENTURY PLANT FAMILY, AGAVE FAMILY
* *Agave* sp.	Escaped ornamental
* *Yucca aloifolia*	Spanish bayonet (ornamental)
ARECACEAE	PALM FAMILY
* *Phoenix canariensis*	Canary Island palm
* *Washingtonia robusta*	Mexican fan palm, ornamental fan palm
ASPARAGACEAE	ASPARAGUS FAMILY
* *Asparagus asparagoides*	Smilax asparagus
CYPERACEAE	SEDGE FAMILY
Cyperus eragrostis	Tall umbrella sedge
* *Cyperus involucratus*	Umbrella sedge
Eleocharis sp.	Unid. spike-sedge
POACEAE	GRASS FAMILY
* *Arundo donax*	Giant reed
* *Avena barbata*	Slender wild oat
* *Avena fatua*	Wild oat
* *Bromus diandrus*	Ripgut brome
* *Bromus hordeaceus*	Soft chess
* *Bromus madritensis* ssp. *rubens*	Red brome

Attachment 5. Project Species List	
Latin Name	Common Name
* *Cortaderia selloana*	Argentine pampas grass
* *Cynodon dactylon*	Bermuda grass
Elymus condensatus	Giant wild-rye
* *Festuca myuros*	Rattail sixweeks grass
* *Hordeum murinum*	Wall barley, hare barley
* *Pennisetum setaceum*	Crimson fountain grass, African fountain grass
* *Polypogon monspeliensis*	Rabbitfoot grass
* *Schismus barbatus*	Mediterranean schismus
* *Stipa miliacea*	Smilo grass
TYPHACEAE	CATTAIL FAMILY
Typha domingensis	Southern cattail, slender cattail
INVERTEBRATE ANIMALS	
INSECTA	INSECTS
LEPIDOPTERA	BUTTERFLIES AND MOTHS
Nymphalis antiopa	Mourning Cloak
CRUSTACEA	CRUSTACEANS
DECAPODA	DECAPODS
* *Procambarus clarkii*	Red swamp crayfish
VERTEBRATE ANIMALS	
ACTINOPTERYGII	RAY-FINNED FISHES
POECILIDAE	TOOTH CARPS
* *Gambusia affinis*	Western mosquitofish
AMPHIBIA	AMPHIBIANS
HYLIDAE	TREEFROGS
Pseudacris hypochondriaca hypochondriaca	Baja California treefrog
REPTILIA	REPTILES
Sceloporus occidentalis	Western fence lizard
Uta stansburiana	Side-blotched lizard
COLUBRIDAE	COLUBRIDS
Hypsiglena ochrorhyncha klauberi	San Diego nightsnake
VIPERIDAE	VIPERS
Crotalus oreganus helleri	Southern pacific rattlesnake
AVES	BIRDS
PODICIPEDIDAE	GREBES
Aechmophorus occidentalis	Western grebe
PHALACROCORACIDAE	CORMORANTS
Phalacrocorax auritus	Double-crested cormorant
ARDEIDAE	HERONS
** *Ardea herodias*	Great blue heron
Ardea alba	Great egret
Egretta thula	Snowy egret
** *Nycticorax nycticorax*	Black-crowned night heron
ANATIDAE	DUCKS, GEESE AND SWANS
Branta canadensis	Canada goose
Anas platyrhynchos	Mallard
Anas americana	American wigeon

Attachment 5. Project Species List	
Latin Name	Common Name
Oxyura jamaicensis	Ruddy duck
RALLIDAE	RAILS, GALLINULES, COOTS
Fulica americana	American coot
CATHARTIDAE	VULTURES
Cathartes aura	Turkey vulture
ACCIPITRIDAE	HAWKS, EAGLES, HARRIERS
** *Accipiter cooperii*	Cooper's hawk
Buteo jamaicensis	Red-tailed hawk
** *Pandion haliaetus*	Osprey
FALCONIDAE	FALCONS
Falco sparverius	American kestrel
PSITTACIDAE	AFRICAN AND NEW WORLD PARROTS
* *Amazona viridigenalis*	Red-crowned parrot
PHASIANIDAE	GROUSE AND QUAIL
Callipepla californica	California quail
CHARADRIIDAE	PLOVERS
Charadrius vociferus	Killdeer
RECURVIROSTRIDAE	STILTS AND AVOCETS
Himantopus mexicanus	Black-necked stilt
LARIDAE	GULLS AND TERNS
Larus californicus	California gull
Sterna forsteri	Forster's tern
COLUMBIDAE	PIGEONS AND DOVES
Zenaida macroura	Mourning dove
CUCULIDAE	CUCKOOS
Geococcyx californianus	Greater roadrunner
CAMPRIMULGIDAE	NIGHTJARS
Chordeiles acutipennis	Lesser nighthawk
APODIDAE	SWIFTS
Aeronautes saxatalis	White-throated swift
TROCHILIDAE	HUMMINGBIRDS
Calypte anna	Anna's hummingbird
Selasphorus sasin	Allen's hummingbird
ALCEDINIDAE	KINGFISHERS
Ceryle alcyon	Belted kingfisher
PICIDAE	WOODPECKERS
Picoides nuttallii	Nuttall's woodpecker
Colaptes auratus	Northern flicker
TYRANNIDAE	TYRANT FLYCATCHERS
Sayornis nigricans	Black phoebe
Tyrannus vociferans	Cassin's kingbird
Tyrannus verticalis	Western kingbird
HIRUNDINIDAE	SWALLOWS
Tachycineta bicolor	Tree swallow
Hirundo rustica	Barn swallow
CORVIDAE	CROWS AND JAYS

Attachment 5. Project Species List	
Latin Name	Common Name
Aphelocoma californica (*Aphelocoma coerulescens*)	California scrub-jay (Western scrub jay)
Corvus brachyrhynchos	American crow
Corvus corax	Common raven
AEGITHALIDAE	BUSHTITS
Psaltriparus minimus	Bushtit
TROGLODYTIDAE	WRENS
Thryomanes bewickii	Bewick's wren
Troglodytes aedon	House wren
MUSCICAPIDAE	THRUSHES AND ALLIES
Regulus calendula	Ruby-crowned kinglet
** *Polioptila californica*	California gnatcatcher
Sialia mexicana	Western bluebird
Chamaea fasciata	Wrentit
MIMIDAE	MOCKINGBIRDS AND THRASHERS
Mimus polyglottos	Northern mockingbird
Toxostoma redivivum	California thrasher
STURNIDAE	STARLINGS
* *Sturnus vulgaris*	European starling
VIREONIDAE	VIREOS
** *Vireo bellii*	Bell's vireo
EMBERIZIDAE	SPARROWS, WARBLERS, TANAGERS
Setophaga coronata	Yellow-rumped warbler
Geothlypis trichas	Common yellowthroat
Cardellina pusilla	Wilson's warbler
Pipilo maculatus	Spotted towhee
Melozone crissalis	California towhee
Passerculus sandwichensis	Savannah sparrow
Melospiza melodia	Song sparrow
Zonotrichia leucophrys	White-crowned sparrow
Icterus cucullatus	Hooded oriole
FRINGILLIDAE	FINCHES
Haemorhous mexicanus	House finch
Spinus psaltria	Lesser goldfinch
PASSERIDAE	WEAVERS
* *Passer domesticus*	House sparrow
MAMMALIA	MAMMALS
LEPORIDAE	HARES AND RABBITS
Sylvilagus audubonii	Desert cottontail
SCIURIDAE	SQUIRRELS
Otospermophilus beecheyi	Beechey (California) ground squirrel
* *Sciurus niger*	Eastern fox squirrel
CRICETIDAE	RATS AND MICE
Neotoma fuscipes	Dusky-footed wood rat
CANIDAE	FOXES, WOLVES AND COYOTES
Canis latrans	Coyote
PROCYONIDAE	RACCOONS

Attachment 5. Project Species List	
Latin Name	Common Name
Procyon lotor	Raccoon

Notes:

Species introduced to California are indicated by an asterisk. Special-status species are indicated by two asterisks. This list includes only species observed on the site. Invertebrate species observed throughout the site were not included in this list with the exception of Crustaceans. Other species may have been overlooked or unidentifiable due to season (amphibians are active during rains, reptiles during summer, some birds and bats migrate out of the area for summer or winter, some mammals hibernate, many plants are identifiable only in spring). Plants were identified using keys, descriptions, and illustrations in Baldwin et al (2012). Plant taxonomy and nomenclature generally follow Baldwin et al. (2012). Wildlife taxonomy and nomenclature generally follow Stebbins (2003) for amphibians and reptiles, AOU (1998) for birds, and Wilson and Ruff (1999) for mammals.

Attachment 6 – Project Photos



Photo 1: Close-up photos of dense riparian vegetation within Smith Basin.



Photo 2: Close-up of upland vegetation within Smith Basin.



Photo 3: Close-up view of the upstream end of Santiago Creek (Smith Basin), near Cannon Street.



Photo 4: Rock waterfall near the central portion of Santiago Creek (Smith Basin).



Photo 5: Rock pool near the central portion of Santiago Creek (Smith Basin).



Photo 6: East-facing overview of Smith Basin.



Photo 7: Southwest-facing overview of Smith Basin.



Photo 8: Overview of recently constructed land bridge between the Blue Diamond and Bond Pits within Santiago Recharge Basin.



Photo 9: East-facing overview of northern portion of Santiago Recharge Basin.



Photo 10: Overview of upland vegetation on the northeast corner of Santiago Recharge Basin.



Photo 11: Overview of the upland vegetation near the center of Santiago Recharge Basin.



Photo 12: North-facing view of the existing outlet channel of Santiago Recharge Basin, near the undercrossing of E Collins Ave.



Photo 13: West-facing view of the upstream portion of Santiago Creek Channel.



Photo 14: West-facing view of the downstream portion of Santiago Creek Channel.



Photo 15: East-facing view of the downstream portion of Santiago Creek Channel.



Photo 16: East-facing view of the central portion of Santiago Creek Channel.

Appendix 9 – Public Coordination

US Army Corps of Engineers®

CHICAGO DISTRICT

LEADERS IN CUSTOMER CARE

SANTA ANA RIVER MAINSTEM

SANTIAGO CREEK

ORANGE COUNTY, CALIFORNIA

Appendix 9 – Public Coordination

September 2023

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT / INITIAL STUDY
APPENDIX 9 – PUBLIC COORDINATION

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SECTION 1 - INTRODUCTION

The purpose of this appendix is to document the public involvement that has been undertaken in support of the supplemental National Environmental Policy Act and the California Environmental Quality Act (NEPA/CEQA) integrated document for the Santa Ana River Mainstem Flood Risk Management Project, Santiago Creek component. In this appendix, we will highlight scoping, public meetings, and public comments received as part of the ongoing coordination with the public. The following is a summary of the scoping effort:

1 Scoping Letter

Scoping letters were distributed via email on October 6, 2021, to federal, state, and local agencies/governments and tribal nations (refer to the scoping distribution list below). Input on the scoping distribution list was provided by the U.S. Army Corps of Engineers (USACE) Los Angeles District and the non-federal sponsor Orange County Public Works (OCPW). The scoping letter requested feedback on any resources or habitats of concern in the study area, information on ongoing projects in the study area, and feedback on the 1988 authorized project design. Agencies and governments on the scoping distribution list were given until November 12, 2021, to provide comments.

The following in the email letter transmitted to recipients on the scoping distribution list.

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, CHICAGO DISTRICT
231 SOUTH LA SALLE STREET, SUITE 1500
CHICAGO, IL 60604

REPLY TO
ATTENTION OF

October 6, 2021

Planning Branch
Environmental and Cultural Resources Section

To Whom It May Concern:

The U. S. Army Corps of Engineers (USACE) Chicago District is working with USACE Los Angeles District to prepare an Interim Design Documentation Report (DDR) with an integrated National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) environmental document for the Santiago Creek component of the Santa Ana River Mainstem Flood Risk Management project, Orange County, California. The project is in the pre-construction engineering and design (PED) phase. The feasibility phase alternatives analysis was presented within the USACE 1980 Phase 1 General Design Memorandum (GDM) and the recommended plan was later refined as part of the USACE 1988 Phase II GDM. The Interim DDR that is being prepared will present refinements to the 1988 design. The refined design will reflect changes to the project area since the 1988 design and will incorporate modernized USACE design processes.

In compliance with NEPA, CEQA and associated environmental laws and regulations, the USACE will be preparing an environmental document to analyze the potential effects of any updates to the 1988 design. At this time, we request your feedback on any resources or habitats of concern in the study area, information on ongoing projects in the study area, and any feedback you may have on the 1988 design (for additional detail on the 1988 design refer here for the original report: https://apps.dtic.mil/sti/pdfs/ADA211754.pdf).

The Santiago Creek project is authorized in the Water Resources Development Authority (WRDA) 1986, Energy & Water Appropriation Act 1988, WRDA 1990, WRDA 1996, and WRDA 2007. The Santiago Creek project is a single-purpose project for flood risk reduction. The non-Federal sponsor and CEQA lead for this project is Orange County Public Works. Pursuant to compliance with CEQA, an Initial Study will be prepared using Appendix G of the State CEQA Guidelines. Completion of the Initial Study will determine the type of CEQA document that will be prepared.

The 1982 Chief's Report provides the original recommended plan for Santiago Creek, as described by the USACE 1980 Phase I GDM. That plan included improvements and flood plain management on the lower portion of Santiago Creek, including "providing a detention reservoir at existing gravel pits and 9,000 feet of trapezoidal channel along Santiago Creek, and floodplain management from Walnut Avenue to the Santa Ana Freeway", in order to provide "100-year flood protection for the residents in the Santiago

Creek flood plain". Consistent with the authorized plan, the overall design objective for the Interim DDR will be to contain the 1% Annual Chance of Exceedance (ACE) floods, providing flood protection for approximately 75,000 people living in the Santiago Creek project area (2019 population). The construction features necessary for control of the 1% ACE were also identified in the USACE 1988 Phase II GDM. Since the original design documentation, changed conditions at the project site require re-analysis of the engineered features. Additionally, assessment of the change in regulatory and community needs is warranted.

The proposed project area is the lower Santiago Creek between Villa Park Dam and the creek's confluence with the Santa Ana River, approximately 25-miles southeast of downtown Los Angeles. The proposed project area includes two former gravel pits – the Bond and Blue Diamond Pits – as well as an adjacent lowland area named Smith Basin. The proposed project also includes a 1.2-mile segment of Santiago Creek between the I-5 freeway and the confluence with the Santa Ana River. Significant flooding along the proposed project areas has been documented since at least 1897. According to USACE documentation, the largest recorded flooding event by peak flow occurred in 1938 following a series of large storm events. The flooding caused at least $4 million in damages within Orange County alone (1938 price levels). In February 1969, a series of significant storms results in approximately $22 million damages within Orange County (1969 price levels) and resulted in at least twelve deaths. Flooding at Santiago Creek is a continuing concern among local interests; floods are exacerbated due to inadequate size of the channel for conveyance of flood waters. Additionally, in some locations the unprotected banks are subject to erosion which could cause damage to residential and commercial developments along the creek.

The principle flood risk management features of the 1988 Phase II GDM include: (1) flood storage – vertical expansion and operational considerations for the existing groundwater recharge basin; (2) reservoir flow regulation – construction of a gated outlet structure and designated overtopping location at the existing groundwater recharge basin; (3) channel improvements – rehabilitation and erosion protection for portions of Santiago Creek downstream of the existing groundwater recharge basin; and (4) recreational improvements – construction of hiking and bicycle trails.

Please provide your input regarding this Interim DDR by November 12, 2021. If you have any questions on this matter, please feel free to contact Shawna Herleth-King by email at Shawna.S.Herleth-King@usace.army.mil.

Sincerely,

Susanne J. Davis

Susanne J. Davis, P.E.
Chief, Planning Branch
Chicago District



U.S. Army Corps
Of Engineers ®
Chicago District

Legend

- Downstream Channel
- Reservoir
- Villa Park Dam
- Santiago Creek

Santiago Creek
Area Map

For Official Use Only
Chicago District, U.S. Army Corps of Engineers

2 Scoping Distribution List

The following federal, state, and local agencies/governments and tribal nations were provided with the scoping letter.

Agency	Contact	Contact Position	Mailing Address	City	State	Zip Code
Federal Agencies						
U.S. Environmental Protection Agency	Laura Ebbert	Director, Tribal, Intergovernmental and Policy Division	USEPA REGION 9 75 Hawthorne Street	San Francisco	CA	94105
U.S. Environmental Protection Agency	Amy Miller-Bowen	Director, Enforcement and Compliance Assurance Division	USEPA REGION 9 75 Hawthorne Street	San Francisco	CA	94105
U.S. Fish and Wildlife Service	Scott Sobiech	Field Supervisor, Carlsbad and Palm Springs Offices	U.S. Fish and Wildlife Service Carlsbad and Palm Spring Offices 2177 Salk Avenue, Suite 250	Carlsbad	CA	92008
U.S. Fish and Wildlife Service	Chris Medak	Biologist, Carlsbad Fish and Wildlife Office	U.S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office 2177 Salk Avenue, Suite 250	Carlsbad	CA	92008
U.S. Geological Survey Western Ecological Research Center	Robert Fisher	Supervisory Research Biologist	U.S. Geological Survey Western Ecological Research Center 4165 Spruance Road, Suite 200	San Diego	CA	92101
Federal Emergency Management Agency -	Robert J. Fenton, Jr.	Regional Administrator, Region 9	Federal Emergency Management Agency Region 9 1111 Broadway, Suite 1200	Oakland	CA	94607
California Natural Resources Conservation Service	Carlos Suarez	State Conservationist	California NRCS State Office Richard E. Lyng USDA Service Center 430 G Street, #4164	Davis	CA	95616-4164
Advisory Council on Historic Preservation	Jaime Loichinger	Assitant Director	Advisory Council on Historic Preservation 401 F Street NW, Suite 308	Washington	DC	20001
Federal Transit Administration	Ray Tellis	Administrator	Region 9 Office Federal Transit Administration San Francisco Federal Building	San Francisco	CA	94103
Federal Highway Administration	Vincent Mammano	Division Administrator	Federal Highway Administration California Division 650 Capitol Mall, Suite 4-100	Sacramento	CA	95814-4708
Federal Aviation Administration	Raqual Girvin	Regional Administrator	Federal Aviation Administration, Western Pacific Region 777 S. Aviation Blvd., Suite 150	El Segundo	CA	90245

State Agencies						
State Clearinghouse	Scott Morgan	Acting Director	California State Clearinghouse 1400 Tenth Street	Sacramento	CA	95814
California Air Resources Board	Richard Corey	Executive Officer	California Air Resources Board 1001 I Street	Sacramento	CA	95814
Office of Historic Preservation	Julianne Polanco	State Historic Preservation Officer	Office of Historic Preservation 1725 23rd Street, Suite 100	Sacramento	CA	95816
Native American Heritage Commission	Christina Snider	Executive Secretary	California Native American Heritage Commission 1550 Harbor Blvd., Suite 100	West Sacramento	CA	95691
Caltrans, District 12	Ryan Chamberlain	District Director	Caltrans District 12 1750 East 4th Street, Suite 100	Santa Ana	CA	92705
California Department of Conservation	David Shabazian	Director	California Department of Conservation 801 K St, MS 24-01	Sacramento	CA	95814
California Geological Survey			California Department of Conservation California Geological Survey 801 K St, MS 12-30	Sacramento	CA	95814
California Division of Land Resource Protection			California Department of Conservation Division of Land Resource Protection 801 K St, MS 14-15	Sacramento	CA	95814
California Department of Fish and Wildlife, South Coast Region 5	Jennifer Turner	Senior Environmental Scientist (Supervisor)	California Department of Fish and Wildlife, South Coast Region 5 3883 Ruffin Road	San Diego	CA	92123
California Department of Fish and Wildlife, South Coast Region 5	Jennifer Blackhall	Environmental Scientist	California Department of Fish and Wildlife, South Coast Region 5 Lake and Streambed Alteration Agreement Program 3883 Ruffin Road	San Diego	CA	92123
California Department of Toxic Substances Control	Meredith Williams	Director	California Department of Toxic Substances Control Joe Serna Jr. CalEPA Headquarters Bldg. P.O. Box 806	Sacramento	CA	95814

California Public Utilities Commission	Terence Shia	Director, Water Division	California Public Utilities Commission 320 West 4th Street, Suite 500	Los Angeles	CA	90013
Southern California Association of Governments	Jonathan Hughes	Orange County Regional Office POC	Southern California Association of Governments Orange County Regional Office OCTA Building 600 South Main Street, Suite 741	Orange	CA	92868
Southern California Association of Governments	Kome Ajise	Executive Director	Southern California Association of Governments 900 Wilshire Blvd., Suite 1700	Los Angeles	CA	90017
State Water Resources Control Board	E. Joaquin Esquivel	Chair	State Water Resources Control Board P.O. Box 100	Sacramento	CA	95812-0100
California Governor's Office of Emergency Services	Mark Ghilarducci	Director	Cal OES Main Office (Bldg. A, B, & C) 3650 Schriever Ave.	Mather	CA	95655-4203
Department of Resources Recycling and Recovery (Cal Recycle)	Ken DaRosa	Acting Director	Department of Resources Recycling and Recovery (CalRecycle) P.O. Box 4025	Sacramento	CA	95812-4025
California Department of Conservation, Geologic Energy Management Division	Baldev Gill	Southern District Deputy	Southern District Geologic Energy Management Division (CalGEM) 3780 Kilroy Airport Way, Suite 400	Long Beach	CA	90806
California Department of Water Resources - Southern Region Office	Sharon Tapia		California State Department of Water Resources - Southern Region 770 Fairmont Ave., Suite 102	Glendale	CA	91203
California Department of Parks and Recreation	Armando Quintero	Director	California Department of Parks and Recreation P.O. Box 942896	Sacramento	CA	94296
California Geologic Energy Management Division	David Shabazian	Director	California Department of Conservation Geologic Energy Management Division 801 K Street, MS 24-01	Sacramento	CA	95814

County Agencies						
Metropolitan Water District of Southern California	Adel Hagekhalil	General Manager	The Metropolitan Water District of Southern California P.O. Box 54153	Los Angeles	CA	90054-0153
Orange County Parks	Heather Glasgow		Orange County Parks 13042 Old Myford Road	Irvine	CA	92602
Orange County Water District	John Bonsangue	Director of Recharge and Wetland Operations	Orange County Water District 18700 Ward Street	Fountain Valley	CA	92708
Orange County Transportation Authority	Darrell E. Johnson	Chief Executive Officer	Orange County Transportation Authority P.O. Box 14184	Orange	CA	92863-1584
Santa Ana Regional Water Quality Control Board, Region 8	Mark Allen	Engineering Geologist	Santa Ana Regional Water Quality Control Board 3737 Main Street, Suite 500	Riverside	CA	92501-3348
Santa Ana Watershed Project Authority			Santa Ana Watershed Project Authority 11615 Sterling Avenue	Riverside	CA	92503
Santa Ana Watershed Association			Santa Ana Watershed Association 1835 Chicago Ave., Suite C	Riverside	CA	92507
South Coast Air Quality Management District	Wayne Nastri	Executive Officer	South Coast AQMD Headquarters 21865 Copley Drive	Diamond Bar	CA	91765
County of Orange - Departments						
Orange County Clerk-Recorder Department	Hugh Nguyen	Clerk-Recorder	Orange County Clerk-Recorder County Administration South Building 601 N. Ross Street	Santa Ana	CA	92701
County of Orange Development Services	Cindy Salazar Kevin Shannon	Senior Planner Consultant - Environmental Planner	County of Orange Development Services County Administration South Building 601 North Ross Street	Santa Ana	CA	92701
County of Orange Waste and Recycling	Facilities Planning and Management		County of Orange Waste & Recycling 601 N. Ross Street, Suite 500	Santa Ana	CA	92701
Orange County Fire Authority	Lori Zeller	Deputy Chief of Administration and Support	Orange County Fire Authority 1 Fire Authority Road	Irvine	CA	92602
Santiago Oaks Regional Park			Santiago Oaks Regional Park 2145 N. Windes Drive	Orange	CA	92869

City Agencies						
City of Santa Ana	Vicente Sarmiento	Mayor	The City of Santa Ana 20 Civic Center Plaza	Santa Ana	CA	92701
City of Santa Ana	Kristine Ridge	City Manager	The City of Santa Ana 20 Civic Center Plaza	Santa Ana	CA	92701
City of Orange	Mark A. Murphy	Mayor	City of Orange, CA 300 E. Chapman Ave.	Orange	CA	92866
City of Orange	Rick Otto	City Manager	City of Orange, CA 300 E. Chapman Ave.	Orange	CA	92866
City of Villa Park	Crystal Miles	Mayor	City of Villa Park 17855 Santiago Boulevard	Villa Park	CA	92861
City of Villa Park	Steve Franks	City Manager/ City Clerk	City of Villa Park 17855 Santiago Boulevard	Villa Park	CA	92861
City of Santa Ana-- Planning & Building Agency	Minh Thai	Executive Director	The City of Santa Ana Planning and Building Agency 20 Civic Center Plaza Ross Annex, M-20	Santa Ana	CA	92702
City of Orange -- Planning and Zoning	Robert Garcia	Senior Planner	City of Orange, Planning Division 300 E. Chapman Ave.	Orange	CA	92866
City of Orange -- Planning and Zoning	Chad Ortlieb	Senior Planner	City of Orange, Planning Division 300 E. Chapman Ave.	Orange	CA	92866
City of Villa Park-- Planning	Ray Pascua	Planning Manager	City of Villa Park, Planning Department 17855 Santiago Boulevard	Villa Park	CA	92861
Elected Officials						
U.S. House of Representatives	Rep. Katie Porter	CA-45	1117 Longworth HOB	Washington	DC	20515
U.S. House of Representatives	Rep. Lois Correa	CA-46	1039 Longworth HOB	Washington	DC	20515
U.S. Senate	Sen. Alejandro Padilla	CA	112 Hart Senate Office Building	Washington	DC	20510
U.S. Senate	Sen. Dianne Feinstein	CA	331 Hart Senate Office Building	Washington	DC	20510
State of California	Gavin Newsom	Governor	1303 10th Street, Suite 1173	Sacramento	CA	95814
California State Senate	Sen. Thomas J. Umberg	District 34	State Capitol, Room 5097	Sacramento	CA	95814
California State Senate	Sen. Dave Min	District 37	State Capitol, Room 2048	Sacramento	CA	95814
California State Assembly	Assembly Member Tom Daly	District 69	State Capitol P.O. Box 942849	Sacramento	CA	94249-0069
California State Assembly	Assembly Member Steven Choi	District 68	State Capitol, Suite 2016	Sacramento	CA	94249

Organizations						
Santa Ana Unified School District	Dr. Rigo Rodriguez	School Board President	Santa Ana Unified School District 1601 East Chestnut Avenue	Santa Ana	CA	92701-6322
Orange Unified School District	Kathryn A. Moffat	Board of Education President	Orange Unified School District 1401 North Handy Street	Orange	CA	92867
Orange Park Acres	Sherry Panttaja	President				
Southern California Edison	Jeanne M. Beliveau-Dunn	CEO and President	Jeanne M. Beliveau-Dunn c/o Corporate Secretary Southern California Edison 2244 Walnut Grove Ave.	Rosemead	CA	91770
Southern California Gas Company	Scott Drury	CEO	SoCalGas P.O. Box 3150	San Dimas	CA	91773
Friends of Harbors, Beaches & Parks	Michael Wellborn	President	Friends of Harbors, Beaches and Parks P.O. Box 9256	Newport Beach	CA	92658
Orange County Chapter of California Native Plant Society	Celia Kutcher	Conservation Chair	P.O. Box 54891	Irvine	CA	92619
Sierra Club-- Angeles Chapter	Morgan Goodwin	Senior Director	30632 Marilyn Drive	Laguna Beach	CA	92651
Orange County Environmental Justice	Patricia Jovel	Project Director	PO Box 3584	Tustin	CA	92781
California Environmental Justice Alliance	Gladys Limon	Executive Director	6325 Pacific Boulevard, Suite 300	Huntington Park	CA	90255
River View Golf Course			1800 W Santa Clara Avenue	Santa Ana	CA	92706

3 Scoping Comments

The following is a summary of the scoping comments received followed by the individual comment letters.

Comment	Affiliation	Comment Date	Comment Type	Alternatives	Environmental Concerns	Historic/Cultural Concerns	Hydrology	Socioeconomic	HTRW	Misc.	Specific Comments
1	Advisory Council on Historic Preservation (ACHP)	10/21/21	Email							X	The ACHP has no comments as this time. However, should the Chicago District, as part of its responsibilities under Section 106 of the National Historic Preservation Act (NHPA) and the regulations of the ACHP, "Protection of Historic Properties" (36 CFR Part 800), reach a determination of adverse effect, in consultation with the CA SHPO, tribes, and other consulting parties, please invite the ACHP to participate at that time. The ACHP recommends utilizing our Electronic Section 106 Documentation Submittal System (e106) to notify us formally of an adverse effect finding.

Comment	Affiliation	Comment Date	Comment Type	Alternatives	Environmental Concerns	Historic/Cultural Concerns	Hydrology	Socioeconomic	HTRW	Misc.	Specific Comments
										X	The City is currently engaging in design and environmental review for the final leg of our Santiago Creek Multipurpose Trail. This trail is planned from Cannon Street north of Santiago Creek to Santiago Oaks Regional Park, with a trail bridge over the creek to accomodate access to the park. The attached map shows a tentative trail location. The City will provide you with the public release draft of the environmental document upon completion.
2	City of Orange	10/28/21	Letter							X	The City has approved a tract map to subdivide an approximately 15.4-acre site into 22 single family residential lots on approximately 10.9 acres and open space dedication of approximately 4.5 acres along the Santiago Creek corridor, located north of the creek on the south side of Mabury Avenue between Orange Park Boulevard and Cannon Street. Grading or other on-site improvements have not yet occurred. The approved subdivision project relied on an Environmental Impact Report (EIR) for a project known as the Trails at Santiago Creek, which was approved but overturned by a referendum. The Trails at Santiago Creek project area is generally located west of Cannon Street, north of Santiago Canyon Road, south of Santiago Creek, and west of the nearest residential property. The Trails project site is a former gravel mine and several applications have attempted to residentially develop the property, though none were successful due to oppositional efforts. Of particular help to your pre-construction and design stage may be a review sections 3-4, biology, and 3-9 hydrology of the Trails at Santiago Creek EIR.

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										X	West of the Trails at Santiago Creek site and west of Cannon Street, north of Santiago Canyon Road, south of Santiago Creek, and east of the Blue Ribbon Nursery is a site known as the Chandler Pit. The owner of this site intended to backfill the pit left behind from long-ago terminated sand and gravel mining activities. Although backfilling is permitted by-right per the City's zoning regulations, the project requires approval of an environmental document through the lead agency which, in this case, is the Regional Water Quality Control Board because a portion of the project site is in jurisdictional waters. The status of the proposal is unknown.
										X	A 158 senior apartment complex and storage facility is proposed immediately south of Santiago Creek on vacant land between the terminuses of Yorba Street McPherson Road. No environmental document has been created at this time. The application is in early exploration stages. A preliminary grading plan for the project is attached.
										X	Kornerstone Cemetery is proposed east of Santiago Creek and the State Route 55 Freeway, south of Yorba Park, north of Palymyra Avenue, and west of the orange Unified School District Child Development Center. The City will provide a copy of the project environmental document once a public release draft is completed. A site plan is attached.
3	Orange County Fire Authority	10/25/21	Letter							X	We believe this flood control project will not impact our service area and have no specific impacts for the OCFA.

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4	River View Golf	11/10/21	Email							X	We would request that the DDR give full consideration to maintaining the aesthetic integrity of the golf course and to minimizing any impacts on play during construction.
5	Orange County Parks	11/12/21	Email		X						Several special status species utilize the creek or have been found in the vicinity, including great blue heron, coastal California gnatcatcher, American peregrine falcon, least Bell's vireo, orange-throated whiptail, coast horned lizard, orange-throated whiptail, Catalina mariposa-lily, and intermediate mariposa-lily.
										X	OC Parks has trails crossing and adjacent to Santiago Creek as it traverses Santiago Oaks Regional Park, which may be affected by the project.
										X	OC Waste & Recycling has a long-term oak mitigation project adjacent to portions of Santiago Creek within Santiago Oaks Regional Park.
										X	Depending on the scope of the project footprint/impacts, Santiago Oaks Regional Park is enrolled in the County of Orange Central & Coastal Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP). Potential project impacts to habitat will need to be negotiated/coordinated with the wildlife agencies.
										X	The County of Orange, OC Parks, has received a request by the City of Orange to develop a multi-purpose trail at the Maybury Ranch Estates. The trail would connect from the HOA to the Santiago Oaks Regional Park, across the USACE's study area (attached image to email).
										X	OC Parks parcels and Orange County Flood Control District parcels span the study area defining the Santiago Creek from Villa Park Dam to Smith Basin.

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										X	Recommend using South Coast AQMD's CEQA Air Quality Handbook and website as guidance when preparing the air quality and greenhouse gas analyses. Also recommended that the Lead Agency use the CalEEMod land use emissions software, which can estimate pollutant emissions from typical land use development and is the only software model maintained by the California Air Pollution Control Officers Association.
										X	Recommends that the Lead Agency quantify criteria pollutant emissions and compare the emissions to South Coast AQMD's CEQA regional pollutant emissions significant thresholds and localized significance thresholds to determine the Proposed Project's air quality impacts. The localized analysis can be conducted by either using the LST screening tables or performing dispersion modeling.
6	South Coast Air Quality Management District	11/23/21	Letter							X	Lead Agency should identify any potential adverse air quality impacts that could occur from all phases of the Proposed Project and all air pollutant sources related to the Proposed Project. Air quality impacts from both construction (including demolition, if any) and operations should be calculated. Construction-related air quality impacts typically include, but are not limited to, emissions from the use of heavy-duty equiment from grading, earth-loading/unloading, paving, architectural coatings, off-road mobile sources (e.g., heavy duty construction equipment) and on-road mobile sources (e.g., construction worker vehicle trips, material transport trips, and hauling trips). Operation-related air quality impacts may include but are not limited to, emissions from stationary sources (e.g., boilers and air pollution control devices), area sources (e.g., solvents and coatings), and vehicular trips (e.g., on- and off-road tailpipe emissions and entrained dust). Air quality impacts from indirect sources, such as sources that generate or attract vehicular trips, should be includec in the analysis. Furthermore, emissions from the overlapping construction and operational activities should be combined and compared to South Coast AQMD's regional air quality CEQA operational thresholds to determine the level of significance.

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										X	If the Proposed Project generates diesel emissions from long-term construction or attracts diesel-fueled vehicular trips, especially heavy-duty diesel-fueled vehicles, it is recommended that the Lead Agency perform a mobile source health risk assessment.
										X	In the event that implementation of the Proposed Project requires a permit from South Coast AQMD, South Coast AQMD should be identified as a Responsible Agency for the Proposed Project in the CEQA document. The assumption in the air quality analysis in the CEQA document will be the basis for evaluating the permit under CEQA and imposing permit conditions and limits.
										X	In the event that the Proposed Project results in significant adverse air quality impacts, CEQA requires that all feasible mitigation measures that go beyond what is required by law be utilized to minimize these impacts. Any impacts resulting from mitigation measures must also be analyzed.
7	California Department of Fish and Wildlife	11/12/21	Email		X						We have concerns with the project potentially impacting any mitigation sites along Santiago Creek. While we do not have a definite map with all mitigation sites, we would need to take a much closer look to ensure that mitigation sites along Santiago Creek are not impacted by the project.
					X						Another concern that CDFW has is with potential mitigation for the project. The project would entail some permanent impacts to the bed, bank, or channel to the Creek that would warrant mitigaiton in the form of habitat creation. Adequate mitigation sites are difficult to find in Orange County right now, so we would want to ensure that USACE would be able to cover at least a 1:1 creation mitigation for all permanent impacts. If there is high-quality habitat being impacted, a mitigation ratio higher than 1:1 may be warranted. We would prefer that existing mitigation sites are not impacted by project alternatives, but if project activities do impact existing mitigation sites then we may require a much higher mitigation ratio.

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										X	We may be concerned about changing sediment flows from project activities and slope stabilization that we would like further analysis on.
				X							Obsolete plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area, and accommodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.
					X						In response to the first part of the recommended plan summary on page iii and the structural details outlined in pages IV-4 - IV-12, the "Outlet Structure, Entrance Chamber, Gate Chamber, Stilling Basin, Outlet Channel and Overflow Structure" proposed by USACE will negatively impact the Orange County Water District wildlife habitat mitigation site which includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N Prospect St and E Collins Ave, which support protected species including California gnatcatcher and peregrine falcon. There are no existing offsite locations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of Coastal Sage Scrub and the sycamore grove must be preserved.
					X						Page iii, "...and constructing a riprapped channel between the Santa Ana Freeway and the confluence with the Santa Ana River." The 5.5 miles of creek between the outlet structure and channel in the vicinity of Walnut Avenue to the beginning of the riprapped channel south of the Santa Ana Freeway would not be improved and would be managed by the local sponsor in accordance with FEMA guidelines."

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8	citizen	11/11/21	Email	X	X						In response to the second part of the recommended plan summary on page iii and Page II-6, section c, a trapezoidal channel lined with riprap is an obsolete design model that would negatively impact the riparian and woodland habitat that occurs along the 6,400 foot long section of Santiago Creek from the Santa Ana Freeway to the Santa Ana River. It does not take into consideration the modern Natural Stream Channel Design outlined by the Environmental Protection Agency (link provided in email).
										X	Since the USACE is assisting the City of Los Angeles with a large-scale habitat restoration of the Los Angeles River, similar assistance must be provided in the restoration of Santiago Creek from the Santa Ana Mountains through unincorporated Orange County, Orange, Villa Park and Santa Ana to the Santa Ana River.
										X	We are concerned that the USACE did not actively include key stakeholders within the Santiago Creek Watershed in Orange County and the cities of Orange, Villa Park and Santa Ana in the DDR process. Only a minority of individuals received notification of the public input period while the majority of stakeholders did not hear about the opportunity until the deadline of November 12th has almost arrived. The DDR is being prepared in Chicago, away from community members in Orange County, which prevents local experts, specialists and residents from sharing their expertise and being directly involved in the development of the DDR. Considering hundreds of millions of our federal tax dollars will be spent on a projct that is meant to benefit our community and our creek, USACE must improve communications and be willing to collaborate with the majority of stakeholders throughout the watershed before an Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) are circulated under the California Environmental Quality Act (CEQA).
										X	Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the planning and design.

Comment	Affiliation	Comment Date	Comment Type	Alternatives	Environmental Concerns	Historic/Cultural Concerns	Hydrology	Socioeconomic	HTRW	Misc.	Specific Comments
				X							Remove of modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout, salmon, pacific lamprey, smelt, stickleback, arroyo toad, red-legged frog, western pond turtle, least Bell's vireo, southwestern willow flycatcher, and California gnatcatcher along Santiago Creek from the confluence of the Santa Ana River upstream to Irvine Lake (Santiago Reservoir) and from the Santa Ana River downstream to the ocean.
				X							Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or industrial development proposals. Wherever it is cost feasible, acquire properties within the historic floodplain that feature existing residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.
9	citizen	11/11/21	Email							X	Two protected species of birds the peregrine falcon, and gnatcatcher, nest in the Smith, Bond, and Blue Diamond Pits Army Corps. Referenced in the maps you sent. The Orange County Water District acknowledged this, and mitigated 4 acres of restoration, by planting Coastal Sage Scrub and a sycamore grove next to N. Prospect St. and E. Collins Ave. Because this portion of Santiago Creek runs through a suburban development, there is no way to restore or mitigate the loss of habitat. Preserving this habitat needs to be the primary goal, while focusing on slope stabilization.
										X	Request that the engineers implement a "Natural Channel Design". No riprap, concrete, but a soft bottom design.

Comment	Affiliation	Comment Date	Comment Type	Alternatives	Environmental Concerns	Historic/Cultural Concerns	Hydrology	Socioeconomic	HTRW	Misc.	Specific Comments
									X	X	Also the Army corp. of Engineers need to know the City of Orange approved 22 homes to be built in the maps you've identified as a flood zone. Previously zoned open space, probably because it's in a flood zone, and not suitable to build. And there is an illegal landfill upstream, very close to your project. LEA needs to conduct soil samples for contamination. The mess is only 20 yards from the Santiago Creek.
10	citizen	11/11/21	Email							X	Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the Planning and design.
				X	X						Remove or modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout, salmon, pacific lamprey, smelt, stickleback, arroyo toad, red-legged frog, wetsern pond turtle, least Bell's vireo, southwestern willow flycatcher, and California gnatcatcher along Santiago Creek fromt he confluence of the Santa Ana River upstream to Irvine Lake (Santiago Reservoir) and from the Santa Ana River downstream to the ocean.
				X	X						Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or in industrial development proposals. Wherever it is cost feasbile, acquire properties within the historic floodplain that feature existing residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.

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										X	I oppose the proposed modifications of the Santiago Creek, as described in the obsolete plan of 1988. Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, August 1988, is an outdated plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and accomodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.
										X	As described in the first part of the recommended plan summary on page iii and the structural details outlined in pages IV-4 - IV-12, the "Outlet Structure, Entrance Chamber, Gate Chamber, Stilling Basin, Outlet Channel and Overflow Structure" proposed by USACE will negatively impact the Orange County Water District wildlife habitat mitigation site which includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N Prospect St and E Collins Ave which support protected species including California gnatcatcher and peregrine falcon. There are no existing offsite locations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of Coastal Sage Scrub and the sycamore grove must be preserved.
				X							In response to the second part of the recommended plan summary on page iii and Page II-6, section c, a trapezoidal channel lined with riprap is an obsolete design model that would negatively impact the riparian and woodland habitat that occurs along the 6,400 foot long section of Santiago Creek from the Santa Ana Freeway to the Santa Ana River. More modern Natural Stream Channel Design should be considered here.

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11	citizen	11/11/21	Email							X	Since the USACE, in conjunction with the City of Los Angeles approved findings of an environmental study of Alternative 20, which proposes about $1.3 billion to restore 11 miles of the Los Angeles River from approximately Griffith Park to downtown Los Angeles while maintaining existing levels of flood risk management, they should apply the same practices for this project.
										X	We are concerned that the USACE did not actively include key stakeholders within the Santiago Creek Watershed in Orange County and the cities of Orange, Villa Park and Santa Ana in the DDR process. Only a minority of individuals received notification of the public input period while the majority of stakeholders did not hear about the opportunity until the deadline of November 12th had almost arrived. Considering hundreds of millions of our federal tax dollars will be spent on a project that is meant to benefit our community and our creek, USACE must improve communications and be willing to collaborate with the majority of stakeholders throughout the watershed before an Environmental Impact Statement and Environmental Impact Report are circulated under the CEQA.
										X	Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the planning and design.
				X	X						Remove or modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout, salmon, pacific lamprey, smelt, stickleback, arroyo toad, red-legged frog, western pond turtle, least Bell's vireo, southwestern willow flycatcher, and California gnatcatcher along Santiago Creek from the confluence of the Santa Ana River upstream to Irvine Lake (Santiago Reservoir) and from the Santa Ana River downstream to the ocean. Even species such as Pacific lamprey should be considered as a possible returning species to this area.

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				X	X						Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or industrial development proposals. Wherever it is cost feasible, acquire properties within the historic floodplain that feature existing residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.
12	citizen	11/11/21	Email		X					X	Please dump the outdated 1988 plan, and devise a plan that does not destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and does not accomodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.
					X					X	Section a: Work has already commenced in the existing Blue Diamond and Bond Pits to stabilize steep slopes and control water flow. This project threatens an established Orange County Water District wildlife habitat mitigation site that includes 4 acres of restored coastal sage scrub and a sycamore grove next to N. Prospect Street and E. Collins Avenue, which supports protected species, including gnatcatcher and peregrine falcon. There are no existing offsite locations to mitigate for the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of coastal sage scrub and the sycamore grove must be preserved.

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					X						Concerned about the possible loss of valuable sensitive habitat in the Smith Basin. The section titled Biological and Ecological Features and Resources 2-03 on page B-II-1 cites the ponded water and grove of willows that attracts several bird species, including threatened and endangered species. This section also states that due to the sensitivity of this existing habitat, U.S. Fish and Wildlife has placed development restrictions within and adjacent to this area of the pits. Chandler, LLC, owns the adjacent parcel. An application was made by the owner applying as OC Reclamation, LLC to fill the area with demolition construction waste and bring it up to grade, however, the application was denied by the Santa Ana Regional Water Quality Control Board as incomplete as their plan did not sufficiently address the wetland on the property, formally identified as a "water of the State" and home to endangered and threatened species.
										X	Section b: The existing creek bottom should remain with no improvements. No development should be allowed in areas zoned open space.
				X	X						Section c: One of our chief concerns is item c. on page II-6, a plan to build a 6,400-foot-long trapezoidal channel section lined with riprap from the Santa Ana Freeway to the Santa Ana River. We believe a "Natural Channel Design," as promoted by the EPA, is a much healthier approach and will cost less in the long term. Previously, the USACE has used concrete and riprap to move water as quickly as possible to the ocean. There are many unintended consequences of this model. One is the degradation of water quality as it moves quickly to the ocean without plants to filter out impurities, resulting in die offs at the confluence of the river and the ocean. Another is the loss of habitat along the streambed for sensitive riparian species, affecting the biodiversity of plants, birds, animals, and removing a valuable carbon sink, contributing to climate warming. This model also prevents adequate percolation into the soil to replenish groundwater aquifers.

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										X	As we are fortunate to already have existing native habitat in portions of the proposed project's scope, those areas should be preserved and enhanced in the project's design. For the Santiago Creek Project, the emphasis should be habitat restoration rather than riprap to stabilize channel slopes.
13	citizen	11/12/21	Email							X	We support [the Biden Administration executive order issued January 2021 to conserve at least 30 percent of U.S. Lands and oceans by 2030 and California Executive Order N-82-20, issued in October 2020, which established a state goal to conserve at least 30 percent of California's land and coastal waters by 2030] and with keeping our local commitment of no further building on open space lands in the flood plain by the cities of Orange and Santa Ana, thereby lessening hte need for other measures.
										X	Section d. A bicycle and hiking trail are already in place. In the 1990s the east side of Hewes was slated to become a county regional park but over the objections of the neighborhood, it was developed into a housing tract. The loss of this area for water storage and impacts of these areas to the creek needs further study as part of this update.
										X	II-3 2-08 mentions the Santiago Golf Course. That area is now a housing development and significant infrastructure was put into place to allow that development to exist in the watershed. That area needs further study to protect those residents and its impacts to the creek capacity.

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									X		Illegal construction waste dumping has been allowed by the City of Orange for several years upstream from the recharge basins on the former Sully Miller Property south of Santiago Creek. Residents of the area are concerned about toxic dust in the air and toxic runoff being washed into the creek. The clean up of the hazardous waste on the property is currently being negotiated with the owner of the property, the LEA, County of Orange Department of Health, and CalRecycle. This cleanup work should be studied as part of this update.
										X	There is a tentative tract map approved for 22 homes on the former Sully Miller property north of Santiago Creek (East of Cannon). Although zoned for housing, there needs to be consideration for the existing MWD water pipe and potential flooding. Hydrology studies have been deferred. It's not clear if safe setback requirements for Santiago Creek were established before the original rezoning took place in 1993. The channel is narrow in this area due to mining on the property. The area is also a wildlife corridor. The impacts to the creek should be studied as part of this update.
										X	There is a possible residential development proposal for property off North Yorba behind the Chapman Global Medical Center and a "green" cemetery at Yorba and Palmyra (end of this street). Both initial site plans have direct impacts to Santiago Creek. Both areas are designated by the General Plan as "open space" and zoned "open space" and are within the Army Corps' oversight. We believe any development in these areas should be studied as part of this update. There are no development opportunities approved in these two areas, except for the 22 homes north of Santiago Creek east of Cannon.
										X	We believe the Army Corps of Engineers should facilitate a public workshop and ongoing dialogue with the appropriate agency staff (point of contact) and the community on this effort.

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14	citizen	11/12/21	Email							X	We are concerned that those of us whose property connects with the Creek were not more properly notified.
										X	How can we learn more about this project? Will there be public hearings? Were notices sent to those of us who live along the Creek? If so, when? If not, why would that not have happened? We would appreciate hearing more from you and perhaps others before we start hearing any construction noise coming from the Santiago Creek bed.
15	citizen	11/12/21	Email							X	By way of this email I am requesting to be brought up-to-speed on USACE's project plan, specifically in terms of how it may affect APN 002-037-55 and 002-037-56.
16	citizen	11/12/21	Email							X	The outdated plan proposes new structures for the recharge basins that will negatively impact the Orange County Water District wildlife habitat mitigation site which includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N Prospect St. and E Collins Ave, which support protected species including California gnatcatcher and peregrine falcon. There are no existing offsite locations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of coastal sage scrub and the sycamore grove must be preserved.
										X	Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, August 1988, is an obsolete plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and accomodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.
17	citizen	11/12/21	Email							X	I, my family and riparian neighbors on both sides are opposed to construction of a riprapped channel in the Santiago Creek.
										X	We were not timely or adequately notified of this plan and request an extension of time for public comment.
18	citizen	11/13/21	Email							X	I strongly object to the proposal to pave Santiago Creek.

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19	citizen	11/13/21	Email							X	I join my neighbors in asking that our creek NOT be turned into a cement gulch. Please give us time to address this issue.
				X						X	Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, August 1988, is an obsolete plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and accomodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.
										X	In response to the first part of the recommended plan summary on page iii and the structural details outlined in pages IV-4 - IV-12, the "Outlet Structure, Entrance Chamber, Gate Chamber, Stilling Basin, Outlet Channel and Overflow Structure" proposed by USACE will negatively impact the Orange County Water District wildlife habitat mitigation site which includes 4 acres of restored coastal sage scrub and a sycamore grove next to N Prospect St and E Collins Ave, which support protected species including California gnatcatcher and peregrine falcon. There are no existing offsite lcoations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of coastal sage scrub and the sycamore grove must be preserved.
										X	In response to the second part of the recommended plan summary on page iii and Page II-6, section c, a trapezoidal channel lined with riprap is an obsolete design model that would negatively impact the riparian and woodland habitat that occurs along the 6,400 foot long section of Santiago Creek from the Santa Ana Freeway to the Santa Ana River. It does not take into consideration the modern Natural Stream Channel Design outlined by the EPA (website link provided).

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20	citizen	11/18/21	Email							X	Since the USACE is assisting the City of Los Angeles with a large-scale habitat restoration of the Los Angeles River, similar assistance must be provided in the restoration of Santiago Creek from the Santa Ana Mountains through unincorporated Orange County, Orange, Villa Park and Santa Ana to the Santa Ana River.
										X	We are concerned that the USACE did not actively include key stakeholders within the Santiago Creek Watershed in the cities of Orange, Villa Park and Santa Ana in the DDR process. Only a minority of individuals received notification of the public input period while the majority of stakeholders did not hear about the opportunity until the deadline of November 12th has almost arrived. The DDR is being prepared in Chicago, away from community members in Orange County, which prevents local experts, specialists and residents from sharing their expertise and being directly involved in the development of the DDR. Considering hundreds of millions of our federal tax dollars will be spent on a project that is meant to benefit our community and our creek, USACE must improve communications and be willing to collaborate with the majority of stakeholders throughout the watershed before an Environmental Impact Statement and Environmental Impact Report are circulated under the California Environmental Quality Act.
										X	Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the planning and design.
				X						X	Remove or modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout, salmon, pacific lamprey, smelt, stickleback, arroyo toad, red-legged frog, western pond turtle, least Bell's vireo, southwestern willow flycatcher, and California gnatcatcher along Santiago Creek from the confluence of the Santa Ana River upstream to Irvine Lake and from the Santa Ana River downstream to the ocean.

Comment	Affiliation	Comment Date	Comment Type	Alternatives	Environmental Concerns	Historic/Cultural Concerns	Hydrology	Socioeconomic	HTRW	Misc.	Specific Comments
				X						X	Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or industrial development proposals. Wherever it is cost feasible, acquire properties within the historic floodplain that feature existing residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.

3.1 Scoping Comment C.1

From: Chris Daniel
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Cc: Dalide, Ashley M CIV USARMY CELRC (USA); Padilla, Michael C CIV CELRC CELRD (USA)
Subject: [Non-DoD Source] RE: (External)SCOPING NOTIFICATION: Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project, Orange County, CA
Date: Thursday, October 21, 2021 1:11:10 PM
Attachments: image001.png

Thank you for including the Advisory Council on Historic Preservation (ACHP) on the U.S. Army Corps of Engineers scoping notice for the proposed Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project, Orange County, CA. The ACHP has no comments at this time. However, should the Chicago District, as part of its responsibilities under Section 106 of the National Historic Preservation Act (NHPA) and the regulations of the ACHP, "Protection of Historic Properties" (36 CFR Part 800), reach a determination of adverse effect, in consultation with the CA SHPO, tribes, and other consulting parties, please invite the ACHP to participate at that time, pursuant 36CFR800.6(a)(1). The ACHP recommends utilizing our Electronic Section 106 Documentation Submittal System (e106) to notify us formally of an adverse effect finding. All the information can be found on our site at: https://www.achp.gov/e106-email-form

Sincerely,

Christopher Daniel (he/him/his)
Program Analyst
Advisory Council on Historic Preservation
401 F Street NW, Suite 308, Washington, DC 20001
202.517.0223 (Office & Mobile)
cdaniel@achp.gov

COVID-19 and the ACHP. The ACHP staff is teleworking and available by e-mail and phone. Up to date information on Section 106 and ACHP operations can be found at www.achp.gov/coronavirus.

e106-online section 106 documentation submittal system
https://www.achp.gov/e106-email-form

From: Jaime Loichinger
Sent: Tuesday, October 05, 2021 1:49 PM
To: John Eddins; Chris Daniel
Subject: Fw: (External)SCOPING NOTIFICATION: Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project, Orange County, CA

3.2 Scoping Comment C.2

CITY OF ORANGE

DEPARTMENT OF COMMUNITY DEVELOPMENT — www.cityoforange.org

ADMINISTRATION	PLANNING DIVISION	BUILDING DIVISION	CODE ENFORCEMENT DIVISION
(714) 744-7240	(714) 744-7220	(714) 744-7200	(714) 744-7244
fax: (714) 744-7222	fax: (714) 744-7222	fax: (714) 744-7245	fax: (714) 744-7245

October 28, 2021

VIA ELECTRONIC MAIL: Shawna.S.Herleth-King@usace.army.mil

Department of the Army
U.S. Army Corps of Engineers, Chicago District
Attn: Shawna Herleth-King
231 South La Salle Street, Suite 1500
Chicago, Il 60604

SUBJECT: RESPONSE TO SCOPING NOTIFICATION, SANTIAGO CREEK COMPONENT OF THE SANTA ANA RIVER MAINSTEM FLOOD RISK MANAGEMENT PROJECT, ORANGE COUNTY, CA

Dear Ms. Herleth-King

The City of Orange, California is in receipt of the subject scoping notification and offers information on resources, habitats of concern, and approved or proposed projects within the Santiago Creek study area.

The City is currently engaging in design and environmental review for the final leg of our Santiago Creek Multipurpose Trail. This trail is planned from Cannon Street north of Santiago Creek to Santiago Oaks Regional Park, with a trail bridge over the creek to accommodate access to the park. The attached map shows a tentative trail location. The City will provide you with the public release draft of the environmental document upon completion.

The City has approved a tract map to subdivide an approximately 15.4-acre site into 22 single-family residential lots on approximately 10.9 acres and open space dedication of approximately 4.5 acres along the Santiago Creek corridor, located north of the creek on the south side of Maury Avenue between Orange Park Boulevard and Cannon Street. Grading or other on-site improvements have not yet occurred. The approved subdivision project relied on an Environmental Impact Report (EIR) for a project known as the Trails at Santiago Creek, which was approved but overturned by a referendum. The Trails at Santiago Creek project area is generally located west of Cannon Street, north of Santiago Canyon Road, south of Santiago Creek, and west of the nearest residential property. The Trails project site is a former gravel mine and

several applications have attempted to residentially develop the property, though none were successful due to oppositional efforts. The EIR for the Trails at Santiago Creek may be viewed at the following link:

https://citydocs.cityoforange.org/WebLink/Browse.aspx?id=244057998&dbid=0&repo=CityofOrange

Of particular help to your pre-construction and design stage may be a review sections 3-4, prology, and 3-9 hydrology of the Trails at Santiago Creek EIR.

West of the Trails at Santiago Creek site and west of Cannon Street, north of Santiago Canyon Road, south of Santiago Creek, and east of the Blue Ribbon Nursery is a site known as the Chandler Pit. The owner of this site intended to backfill the pit left behind from long-ago terminated sand and gravel mining activities. Although backfilling is permitted by-right per the City's zoning regulations, the project requires approval of an environmental document through the lead agency which, in this case, is the Regional Water Quality Control Board because a portion of the project site is in jurisdictional waters. The status of the proposal is unknown.

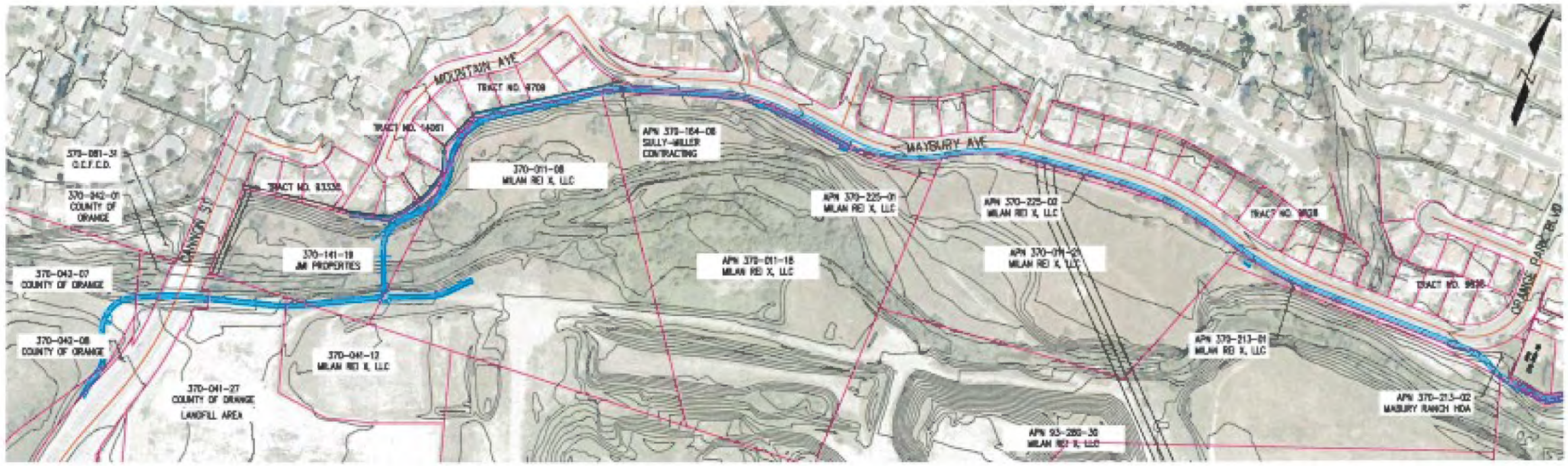
A 158 senior apartment complex and storage facility is proposed immediately south of Santiago Creek on vacant land between the terminuses of Yorba Street McPherson Road. No environmental document has been created at this time. The application is in early exploration stages. A preliminary grading plan for the project is attached.

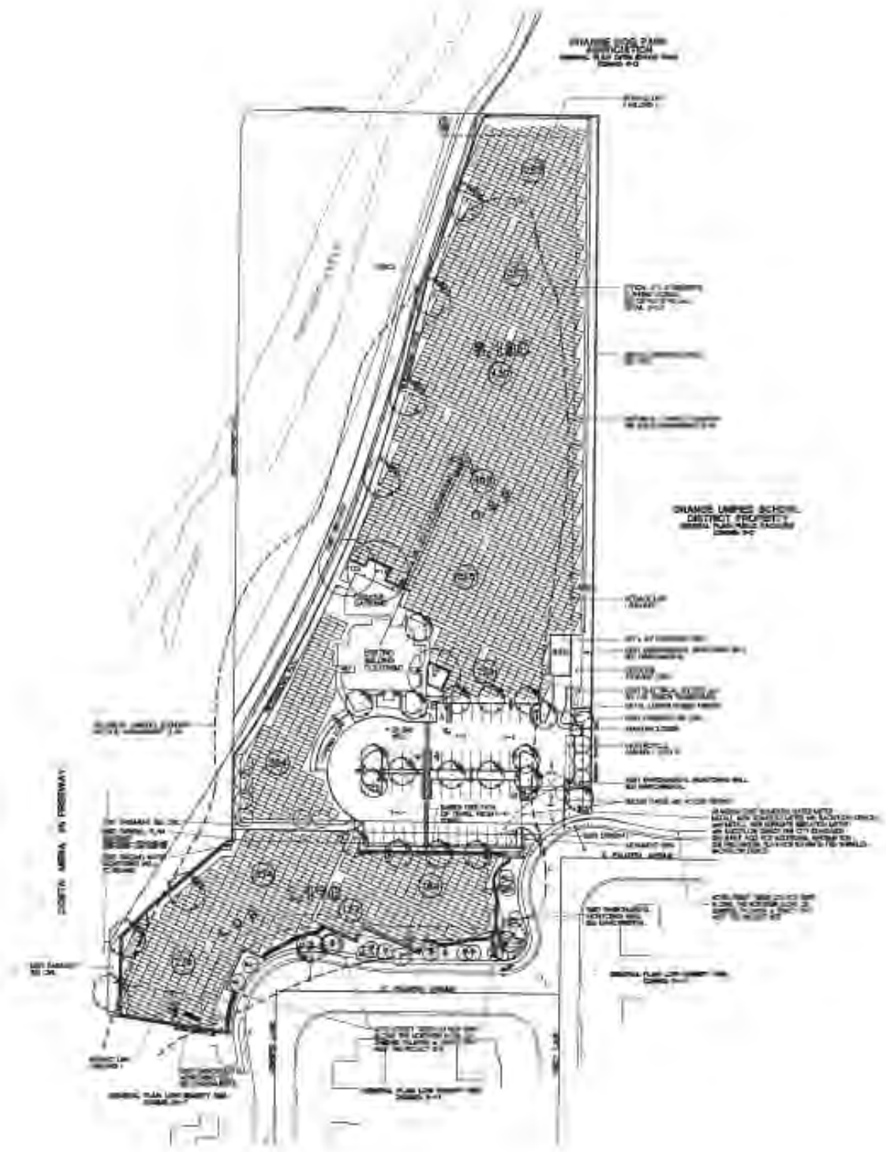
Cornerstone Cemetery is proposed east of Santiago Creek and the State Route 55 Freeway, south of Yorba Park, north of Palmyra Avenue, and west of the Orange Unified School District Child Development Center. The City will provide a copy of the project environmental document once a public release draft is completed. A site plan excerpt is attached.

Thank you for the opportunity to provide input on the Santiago Creek Component at this juncture in the Corps pre-construction engineering and design phase. Please contact me at (714) 744-7237 or cortlieb@cityoforange.org should you have any questions or if I may be of assistance.

Regards,

Chad Ortlieb
Senior Planner
City of Orange


MOUNTAIN AVE
TRACT NO. 9708
TRACT NO. 14051
TRACT NO. 83538
370-081-31
O.C.F.C.D.
370-042-01
COUNTY OF ORANGE
CANYON ST
370-141-19
JM PROPERTIES
370-042-07
COUNTY OF ORANGE
370-042-08
COUNTY OF ORANGE
370-041-12
MILAN REI X, LLC
370-041-27
COUNTY OF ORANGE
LANDFILL AREA
APN 370-164-08
SULLY-MILLER CONTRACTING
370-011-08
MILAN REI X, LLC
APN 370-225-01
MILAN REI X, LLC
APN 370-225-02
MILAN REI X, LLC
APN 370-011-15
MILAN REI X, LLC
APN 370-011-20
MILAN REI X, LLC
MAYBURY AVE
TRACT NO. 9838
TRACT NO. 9838
ORANGE PARK BLVD
APN 379-213-01
MILAN REI X, LLC
APN 379-213-02
MAYBURY RANCH HOA
APN 93-280-30
MILAN REI X, LLC
TRACT NO. 12289
TRACT NO. 9982
MAYBURY RANCH HOA
JOSHUA TREE AVE
ORANGE PARK BLVD
TRACT NO. 9838
TRACT NO. 9319
APN 085-551-86
SERRANO HEIGHTS COMMUNITY ASSOCIATION
APN 83-280-02
O.C.F.C.D
APN 083-280-18
BEN RODRIGUEZ
APN 83-280-32
O.C.F.C.D
APN 083-280-19
BEN RODRIGUEZ
APN 083-280-20
BEN RODRIGUEZ
APN 370-213-02
MAYBURY RANCH HOA
APN 93L-280-31
MILAN REI X, LLC
APN 378-252-01
MAYBURY RANCH HOA
PRELIMINARY ENGINEERING
CITY OF ORANGE
OFFICE OF THE CITY ENGINEER
IMPROVEMENT PLANS
SANTIAGO CREEK BIKE TRAIL NORTH
FROM CANNON STREET TO SANTIAGO OAKS REGIONAL PARK
RIGHT OF WAY BASE MAP
APPROVED:
APPROVED:
SCALE:
SHEET 01 OF 01 SHEETS
SP-4115



STRATOS FORM

PROPOSED CEMTERY FOR
KINDRED MEMORIAL PARK
2205 EAST PALMYRA AVENUE & 200 SOUTH YORBA STREET
ORANGE, CALIFORNIA

A0.1



KEY NOTES

1. ENTRY GATE
2. TRASH ENCLOSURE PER CBSC 5.410.2 (OR BY-OWN)
3. TYPICAL PARKING STALL TYP.
4. ACCESSIBLE PARKING STALL WITH SIGN PER 11B-502.6
5. KNOX BOX - MAIN ENTRY GATE, BY-GATE TO AUTHORIZED, MAIN ENTRY TO EACH BUILDING, FIRE DEPT. TO APPROVE LOCATION
6. 6' HIGH WALL (TYP.)
7. 6' FENCE (TYP.)
8. RETAINING WALL
9. MOTORCYCLE PARKING
10. BICYCLE STORAGE/LOCKER
11. TOP OF SLOPE
12. FIRE TRUCK MANEUVERING PER CFC 503.2.5 (SEE SHEET A-00)
13. TRASH TRUCK MANEUVERING PER CBSC 5.410.2 (SEE SHEET A-00)
14. 6' HIGH FENCE
15. EXISTING CMU WALL
16. METAL CARPORT STRUCTURE. (SEE SHEET A-00)
17. ELECTRIC VEHICLE (EV) CHARGING
18. PROJECT SIGNAGE
19. BUILDING SIGNAGE
20. LOADING ZONE SIGNAGE
21. LADDER TRUCK LOCATION
22. GARAGE

CHAPMAN YORBA VIII

	UNIT MIX (SQ.FT.)	BUILDING 'A'	TAILBONE 'B'	BUILDING 'C'	BUILDING 'D'	TOTAL UNITS	PARKING	PARKING / UNIT	TOTAL STALLS REQ'D	TOTAL AREA (SQ.FT.)	BALC PATIO/ UNIT (SQ.FT.)	TOTAL BALC/PATIO AREA (SQ.FT.)
1BR/1 BATH	726	9	12	5	5	31	1.79	1	27	17,338	120	2,820
2 BED/1 BATH	767	11	6	11	15	43	44%	1	43	32,377	150	7,345
1 BED + DEN/1 BATH	868	5	4	4	5	17	1.29	1	17	14,827	111	1,887
2 BED/2 BATH	1081	20	2	3	5	35	1.89	2	52	37,875	140	4,940
2 BED + DEN/2 BATH	1,125	5	4	1.5	3	13	1.96	2	20	18,857	140	1,300
2 BED/1 BATH	998	0	0	1.5	2	4	1.96	2	8	3,196	106	424
TOTAL/SUM		70	30	29	35	250			215	125,886		18,129
CORRIDOR/STAIRS/LOBBY		10,829	5,082	4,798	4,998					25,197		
LEASING OFFICE		960								960		
COMMUNITY ROOM		1,470								1,470		
FITNESS ROOM		1,284								1,284		
SALEABLE/RATED AREA		8,174	4,267	3,636	3,636					20,713		
TOTAL AREA UNDER ROOF										167,765		
STORAGE FACILITY										112,635		
SITE AREA (8.23 acres)										358,282		
FAR		167,789 sq.ft. + 152,635 sq.ft. / 358,282 sq.ft. =								0.89		
PARKING PROVIDED		215 STALLS + 29 GARAGE						244				
PARKING RATIO		244/158						1.29				
ACCESSIBLE PARKING								10 VAN/12 VAN				
ELECTRIC VEHICLE (EV) CHARGING		9 ALREADY EV PROVIDED W/ CHARGING STATIONS (2%)						PROVIDED 18				

BUILDING CODE AND COMPLIANCES

DISTANCE BETWEEN STRUCTURES PER TABLE 17.28.080	WINDOW WALL TO WINDOW WALL 20'
	WINDOW WALL TO NON WINDOW WALL 20'
	NON WINDOW WALL TO NON WINDOW WALL 10'
PRIVATE OPEN SPACE	60 SQ. FT. MINIMUM
COMMON OPEN SPACE	15% MINIMUM OF THE TOTAL FLOOR AREA OF DWELLING UNITS (MIN. 20' IN DEPTH AND WIDTH)
ALLOWABLE HEIGHT PER ZONE MMU-24 (TABLE 17.28.120)	45 FEET MAXIMUM
ALLOWABLE STORIES PER ZONE MMU-24 (TABLE 17.28.120)	3 STORIES
ZONE	MMU

NOTES

- ALL ITEMS AS CALLED FOR IN CHAPTER 15.32 OF THE ORANGE MUNICIPAL CODE (BUILDING SECURITY ORDINANCE #5-18) AND CONDITIONS RELATED TO CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED) AND ORANGE SECURITY STANDARDS WILL APPLY TO FINAL BUILDING PLANS FOR APPROVAL.
- FENCING, INCLUDING ANY GATES BETWEEN THE GROUND LEVEL APARTMENTS AND THE TRAIL WILL BE OPEN TYPE MATERIAL AND WILL MEET ORANGE SECURITY STANDARDS.
- DARK PARKING LOTS WILL BE PROVIDED WITH ONE FOOT CANDLE LIGHTING DURING DARKNESS AS A MINIMUM AND WILL BE MAINTAINED BY THE OWNER.
- FENCING AS PROPOSED ON THE WEST SIDE WILL BE 6' HIGHER TO PROVIDE BETTER SURVEILLANCE IN ACCORDANCE WITH ORANGE SECURITY STANDARDS.

N

SITE PLAN
FIRST FLOOR PLATE

1" = 40'-0"

CHAPMAN YORBA VIII

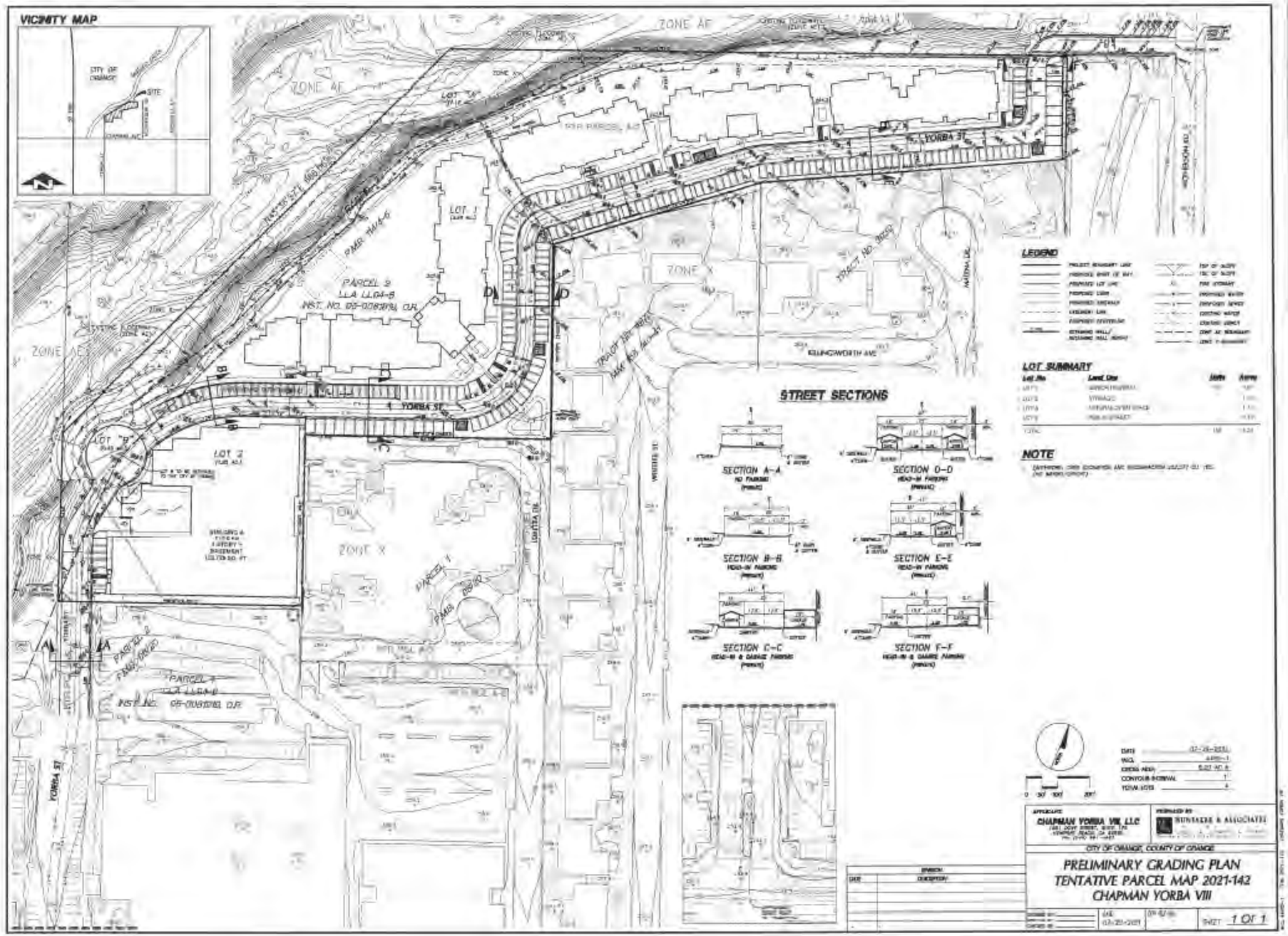
ORANGE, CA

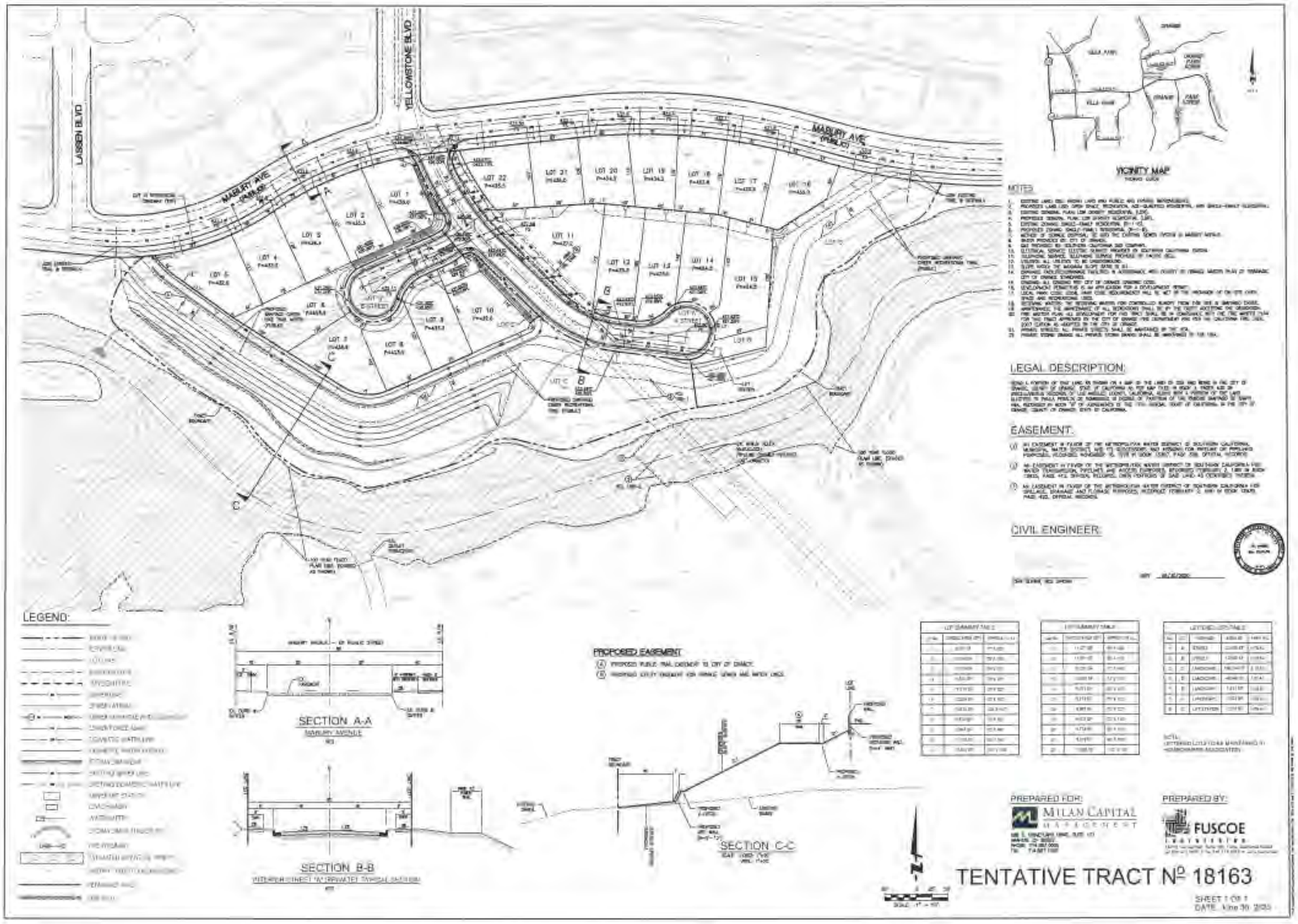
July 28, 2021

IDEArc
ARCHITECTURE + PLANNING

ARCHITECTURAL SITE PLAN

A-01


VICINITY MAP
CITY OF ORANGE
SITE
ZONE AE
ZONE X
PARCEL 2
LLA LL04-8
INST. NO. 05-0083781 O.R.
PARCEL 1
LLA LL04-8
INST. NO. 05-0083781 O.R.
LOT 1
LOT 2
LOT "B"
TRACT NO. 3629
YORBA ST
KELLINGWORTH AVE
HAVENA DR
WOODSIDE RD
WOODSIDE ST
LOUISA DR
PARCEL 1
PMB 269-40
PARCEL 2
PMB 269-40
PMB 144-6
STREET SECTIONS
SECTION A-A
NO PARKING
SECTION B-B
HEAD-IN PARKING
SECTION C-C
HEAD-IN & GARAGE PARKING
SECTION D-D
HEAD-IN PARKING
SECTION E-E
HEAD-IN PARKING
SECTION F-F
HEAD-IN & GARAGE PARKING
LEGEND
LOT SUMMARY
NOTE
CHAPMAN YORBA VIII, LLC
HUNSAKER & ASSOCIATES
CITY OF ORANGE, COUNTY OF ORANGE
PRELIMINARY GRADING PLAN
TENTATIVE PARCEL MAP 2021-142
CHAPMAN YORBA VIII
SHEET 1 OF 1


LASSEN BLVD
YELLOWSTONE BLVD
MABURY AVE
(PUBLIC)
VICINITY MAP
NOTES:
LEGAL DESCRIPTION:
EASEMENT:
CIVIL ENGINEER:
LEGEND:
SECTION A-A
SECTION B-B
SECTION C-C
PROPOSED EASEMENT
PREPARED FOR:
MILAN CAPITAL MANAGEMENT
PREPARED BY:
FUSCOE ENGINEERING
TENTATIVE TRACT Nº 18163
SHEET 1 OF 1

3.3 Scoping Comment C.3

ORANGE COUNTY FIRE AUTHORITY
P. O. Box 57115, Irvine, CA 92619-7115 • 1 Fire Authority Road, Irvine, CA 92602-0125
Brian Fennessy, Fire Chief (714) 573-6000 www.ocfa.org

October 25, 2021

Shawna Herleth-King
LRD Regional Technical Specialist
US Army Corps of Engineers
231 South LaSalle Street, Suite 1500,
Chicago, Illinois 60604
Email: Shawna.S.Herleth-King@usace.army.mil

Subject: Comments to Santiago Creek-Santa Ana River Flood Control Project

Dear Shawna Herleth-King:

Thank you for the opportunity to review the subject document. The Orange County Fire Authority (OCFA) provides fire protection and emergency medical services response to 23 cities in Orange County and all unincorporated areas. The OCFA operates 77 fire stations throughout Orange County. Services include structural fire protection, emergency medical and rescue services, education and hazardous material response. Resources are deployed based upon a regional service delivery system, assigning personnel and equipment to emergency incidents without regard to jurisdictional boundaries. The equipment used by the department has the versatility to respond to both urban and wildland emergency conditions.

We believe this flood control project will not impact our service area and have no specific impacts for the OCFA.

Thank you for providing us with this information. Please contact me at 714-573-6253 if you have any questions.

Sincerely,

Robert J Distaso PE, Fire Safety Engineer, Planning and Development
robertdistaso@ocfa.org
www.ocfa.org

3.4 Scoping Comment C.4

From: Steve Hart
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: RE: [Non-DoD Source] Santiago Creek/Santa Ana Mainstem
Date: Wednesday, November 10, 2021 3:03:04 PM

Hello Shawna,

In response to the request for input dated October 6, 2021 for the Interim Design Documentation Report (DDR) for the Santiago Creek portion of the Santa Ana River Mainstem, we would like to submit the following comments:

River View Golf Course is located at the confluence of the Santiago Creek and the Santa Ana River. River View is a public 18 hole golf course. Approximately 65,000 golfers will play the course in 2021.

A railroad flatcar bridge provides passage over the Santiago Creek for both patrons of River View and course maintenance vehicles. Patrons typically cross the bridge three times during their 18 hole round of golf. Two images of the bridge are attached.

The creek provides a scenic backdrop to our 7th and 10th greens and our 8th and 17th tees. In 1993-94 the side slopes of the creek invert were covered with grouted riprap during construction of the Mainstem. Soil placed over the riprap allowed for vegetation to re-grow which restored the appearance of the creek to near pre-construction conditions. A stabilizer structure was also constructed near the mouth of the creek. Three images taken from the creek bed are attached.

We would request that the DDR give full consideration to maintaining the aesthetic integrity of the golf course and to minimizing any impacts on play during construction. Please let me know if further information is needed. I am generally available Monday through Friday but can meet on site as needed.

Best Regards,

Steve Hart
River View Golf
1800 W. Santa Clara Avenue
Santa Ana, California 92706
714-543-7582 Ext: 102













3.5 Scoping Comment C.5

From: Hull, Eric
To: Hedrick-Klein, Shawna S CTR USARMY CESPL (USA)
Cc: Levin, Shannon
Subject: [Non-DoD Source] Interim GDR for Santiago Creek - OC Parks comments
Date: Friday, November 12, 2021 2:00:36 PM
Attachments: Santiago Creek Scoping Letter 10OCT2021.pdf

Good afternoon Shawna:

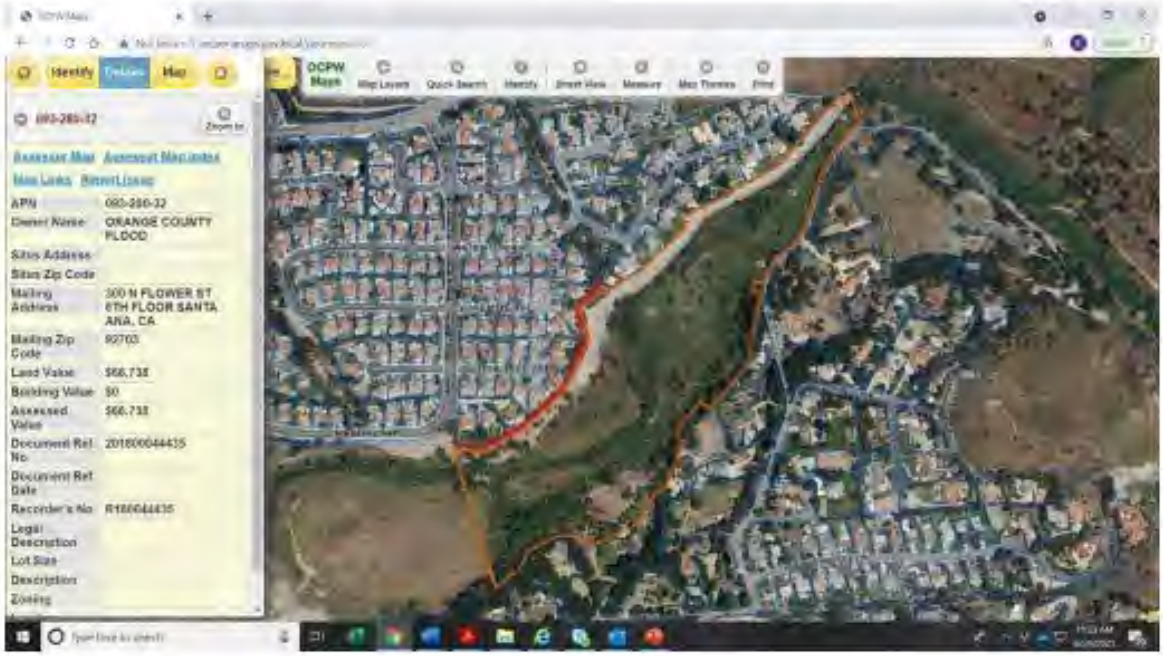
Thank you for the opportunity to respond to the U.S Army Corps of Engineers (USACE) for the Santa Ana River Mainstem Flood Risk Management Project at Santiago Creek.
Please find OC Parks' comments below. We very much appreciate the opportunity to review and comment.

Natural Resources

- Several special status species utilize the creek or have been found in the vicinity, including great blue heron, coastal California gnatcatcher, American peregrine falcon, least Bell's vireo, orange-throated whiptail, coast horned lizard, orange-throated whiptail, Catalina mariposa-lily, and intermediate mariposa-lily.
- OC Parks has trails crossing and adjacent to Santiago Creek as it traverses Santiago Oaks Regional Park, which may be affected by the project.
- OC Waste & Recycling has a long-term oak mitigation project adjacent to portions of Santiago Creek within Santiago Oaks Regional Park.
- Depending on the scope of the project footprint/impacts, Santiago Oaks Regional Park is enrolled in the County of Orange Central & Coastal Natural Community Conservation Plan / Habitat Conservation Plan (NCCP/HCP). Potential project impacts to habitat will need to be negotiated/coordinated with the wildlife agencies.
- With a map of the project study area, Natural Resources may be able to more to specifically describe resources or habitats of concern and ongoing projects within the project footprint.

Future Trail Connection

- The County of Orange, OC Parks, has received a request by the City of Orange to develop a multi-purpose trail at the Mayberry Ranch Estates. The trail would connect from the HOA to the Santiago Oaks Regional Park, across the USACE's study area. Please see image below.



Property Ownership

- OC Parks parcels and Orange County Flood Control District parcels span the study area defining the Santiago Creek from Villa Park Dam to Smith Basin.

We look forward to the opportunity to review the forthcoming environmental documents, and please feel free to contact me at any time with questions or if more information is needed.

Best regards,

Eric E. Hull, AICP
Entitlement Manager
OC Parks
13042 Old Myford Road, Irvine, CA 92602

More about OC Parks: Website, Twitter, Facebook

3.6 Scoping Comment C.6

South Coast
Air Quality Management District
21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 • www.aqmd.gov

SENT VIA E-MAIL:
Shawna.S.Herleth-King@usace.army.mil
Shawna Herleth-King
United States Department of the Army, Army Corps of Engineers
231 South LA Salle Street, Suite 1500
Chicago, Illinois 60604

November 23, 2021

Initial Project Consultation for the
Santiago Creek Project (Proposed Project)

South Coast Air Quality Management District (South Coast AQMD) staff appreciates the opportunity to comment on the above-mentioned document. Our comments are recommendations on the analysis of potential air quality impacts from the Proposed Project that should be included in the CEQA document. Please send a copy of the CEQA document upon its completion and public release directly to South Coast AQMD as copies of the CEQA document submitted to the State Clearinghouse are not forwarded. **In addition, please send all appendices and technical documents related to the air quality, health risk, and greenhouse gas analyses and electronic versions of all emission calculation spreadsheets, and air quality modeling and health risk assessment input and output files (not PDF files). Any delays in providing all supporting documentation for our review will require additional review time beyond the end of the comment period.**

CEQA Air Quality Analysis

Staff recommends that the Lead Agency use South Coast AQMD's CEQA Air Quality Handbook and website[1] as guidance when preparing the air quality and greenhouse gas analyses. It is also recommended that the Lead Agency use the CalEEMod[2] land use emissions software, which can estimate pollutant emissions from typical land use development and is the only software model maintained by the California Air Pollution Control Officers Association.

South Coast AQMD has developed both regional and localized significance thresholds. South Coast AQMD staff recommends that the Lead Agency quantify criteria pollutant emissions and compare the emissions to South Coast AQMD's CEQA regional pollutant emissions significance thresholds[3] and localized significance thresholds (LSTs)[4] to determine the Proposed Project's air quality impacts. The localized analysis can be conducted by either using the LST screening tables or performing dispersion modeling.

The Lead Agency should identify any potential adverse air quality impacts that could occur from all phases of the Proposed Project and all air pollutant sources related to the Proposed Project. Air quality impacts from both construction (including demolition, if any) and operations should be calculated. Construction-related air quality impacts typically include, but are not limited to, emissions from the use of heavy-duty equipment from grading, earth-loading/unloading, paving, architectural coatings, off-road

[1] South Coast AQMD's CEQA Handbook and other resources for preparing air quality analyses can be found at: http://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook.
[2] CalEEMod is available free of charge at: www.caleemod.com.
[3] South Coast AQMD's CEQA regional pollutant emissions significance thresholds can be found at: http://www.aqmd.gov/docs/default-source/ceqa/handbook/scaqmd-air-quality-significance-thresholds.pdf.
[4] South Coast AQMD's guidance for performing a localized air quality analysis can be found at: http://www.aqmd.gov/home/regulations/ceqa/air-quality-analysis-handbook/localized-significance-thresholds.

mobile sources (e.g., heavy-duty construction equipment) and on-road mobile sources (e.g., construction worker vehicle trips, material transport trips, and hauling trips). Operation-related air quality impacts may include, but are not limited to, emissions from stationary sources (e.g., boilers and air pollution control devices), area sources (e.g., solvents and coatings), and vehicular trips (e.g., on- and off-road tailpipe emissions and entrained dust). Air quality impacts from indirect sources, such as sources that generate or attract vehicular trips, should be included in the analysis. Furthermore, emissions from the overlapping construction and operational activities should be combined and compared to South Coast AQMD's regional air quality CEQA *operational* thresholds to determine the level of significance.

If the Proposed Project generates diesel emissions from long-term construction or attracts diesel-fueled vehicular trips, especially heavy-duty diesel-fueled vehicles, it is recommended that the Lead Agency perform a mobile source health risk assessment[5].

In the event that implementation of the Proposed Project requires a permit from South Coast AQMD, South Coast AQMD should be identified as a Responsible Agency for the Proposed Project in the CEQA document. The assumptions in the air quality analysis in the CEQA document will be the basis for evaluating the permit under CEQA and imposing permit conditions and limits. Questions on permits should be directed to South Coast AQMD's Engineering and Permitting staff at (909) 396-3385.

Mitigation Measures

In the event that the Proposed Project results in significant adverse air quality impacts, CEQA requires that all feasible mitigation measures that go beyond what is required by law be utilized to minimize these impacts. Any impacts resulting from mitigation measures must also be analyzed. Several resources to assist the Lead Agency with identifying potential mitigation measures for the Proposed Project include South Coast AQMD's CEQA Air Quality Handbook[1], South Coast AQMD's Mitigation Monitoring and Reporting Plan for the 2016 Air Quality Management Plan[6], and Southern California Association of Government's Mitigation Monitoring and Reporting Plan for the 2020-2045 Regional Transportation Plan/Sustainable Communities Strategy[7].

South Coast AQMD staff is available to work with the Lead Agency to ensure that air quality, greenhouse gas, and health risk impacts from the Proposed Project are accurately evaluated and mitigated where feasible. If you have any questions regarding this letter, please contact me at lsun@aqmd.gov.

Sincerely,

Lijin Sun

Lijin Sun
Program Supervisor, CEQA IGR
Planning, Rule Development & Area Sources

LS
ORC211119-01
Control Number

[5] South Coast AQMD's guidance for performing a mobile source health risk assessment can be found at: http://www.aqmd.gov/home/regulations/ceqa/air-quality-analysis-handbook/mobile-source-toxics-analysis.
[6] South Coast AQMD's 2016 Air Quality Management Plan can be found at: http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2017/2017-mar3-035.pdf (starting on page 86).
[7] Southern California Association of Governments' 2020-2045 RTP/SCS can be found at: https://www.connectsocal.org/Documents/PEIR/certified/Exhibit-A_ConnectSoCal_PEIR.pdf.

3.7 Scoping Comment C.7

From: Blackhall, Jennifer@Wildlife
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Cc: Dallide, Ashley M CIV USARMY CELRC (USA); Padilla, Michael C CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] RE: SCOPING NOTIFICATION: Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project, Orange County, CA
Date: Friday, November 12, 2021 4:45:51 PM

Hi Shawna,

CDFW has a few concerns that we'd like to voice to you:

1. We have concerns with the project potentially impacting any mitigation sites along Santiago Creek. While I do not have a definite map with all mitigation sites (and I believe you asked about this earlier in the year), we would need to take a much closer look to ensure that mitigation sites along Santiago Creek are not impacted by the project.

2. Another concern that CDFW has is with potential mitigation for the project. The project would entail some permanent impacts to the bed, bank, or channel to the Creek that would warrant mitigation in the form of habitat creation. Adequate mitigation sites are difficult to find in Orange County right now, so we would want to ensure that USACE would be able to cover at least a 1:1 creation mitigation for all permanent impacts. If there is high-quality habitat being impacted, a mitigation ratio higher than 1:1 may be warranted. We would prefer that existing mitigation sites are not impacted by project activities, but if project activities do impact existing mitigation sites then we may require a much higher mitigation ratio.

3. We may be concerned about changing sediment flows from project activities and slope stabilization that we would like further analysis on.

Thanks,

Jennifer Blackhall
Environmental Scientist
Lake and Streambed Alteration Agreement Program
California Department of Fish and Wildlife
South Coast Region 5
(858) 354-3285

3.8 Scoping Comment C.8

From: Joel Robinson
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] Public Input Interim DDR Santiago Creek component of the Santa Ana River Mainstem Flood Risk Management project, Orange County, California.
Date: Thursday, November 11, 2021 12:04:09 PM
Attachments: SCWPRP Public Input Interim DDR Santiago Creek 11-11-21.pdf

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Dear Ms. Herleth-King,

Attached is our public input letter. Please reply to this email to confirm that you received our letter. Thank you.

Happy trails!
Joel Robinson
Director & Naturalist
Naturalist For You
www.naturalist-for-you.org
714-798-4392
Office Hours: 8AM-5PM, Wednesday - Sunday

Mission: *Connecting everyone to local wilderness!*
A 501(c)(3) environmental education non-profit & a charitable body, a SCIO registered in Scotland, with registration number SC045993

From: Joel Robinson
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] Public Input Interim DDR Santiago Creek component of the Santa Ana River Mainstem Flood Risk Management project, Orange County, California.
Date: Thursday, November 11, 2021 12:02:23 PM

November 11, 2021

Santiago Creek Preservation and Restoration Project (SCWPRP) is a project of Naturalist For You, a 501(c)(3) environmental education non-profit based in Orange, CA.

Public input for the Interim DDR Santiago Creek component of the Santa Ana River Mainstem Flood Risk Management project, Orange County, California.

PHASE II GDM ON THE SANTA ANA RIVER MAINSTEM including Santiago Creek, August 1988, is an obsolete plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and accommodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.

Page iii, "The recommended plan for Santiago Creek consists of modifying the existing gravel pits for flood control storage, constructing an outlet structure from the gravel pits with a release capacity of 3500 ft /s…"

In response to the first part of the recommended plan summary on page iii and the structural details outlined in pages IV-4 - IV-12, the "Outlet Structure, Entrance Chamber, Gate Chamber, Stilling Basin, Outlet Channel and Overflow Structure" proposed by USACE will negatively impact the Orange County Water District (OCWD) wildlife habitat mitigation site which includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N Prospect St and E Collins Ave, which support protected species including California gnatcatcher (Polioptila californica) and peregrine falcon (Falco peregrinus). There are no existing offsite locations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of Coastal Sage Scrub and the sycamore grove must be preserved.

Page iii, "...and constructing a riprapped channel between the Santa Ana Freeway and the confluence with the Santa Ana River. The 5.5 miles of creek between the outlet structure and channel in the vicinity of Walnut Avenue to the beginning of the riprapped channel south of the Santa Ana Freeway would not be improved and would be managed by the local sponsor in accordance with FEMA guidelines."

Page II-6, section c, "At the downstream side of the Santa Ana Freeway would begin a 6,400 foot long trapezoidal channel section. This section would be lined with riprap. The invert would have riprap thickness which varies from 12 inches to 21 inches and the side slope thickness would vary from12 inches to 36 inches. Also, the channel would be lined with a filter blanket which would vary in thickness from 6 inches to 9 inches depending on the thickness of the riprap. The width of the invert varies from 30 feet to 80 feet. Side

slopes of 1.75 horizontal to1 vertical will be required because of right-of-way limitations. The downstream end of the channel would be at the confluence with the Santa Ana River. A transition at the confluence will consist of an 12-inch-thick, 50-foot-long grouted rock apron placed 10 feet below the design invert of the mainstem."

In response to the second part of the recommended plan summary on page iii and Page II-6, section c, a trapezoidal channel lined with riprap is an obsolete design model that would negatively impact the riparian and woodland habitat that occurs along the 6,400 foot long section of Santiago Creek from the Santa Ana Freeway to the Santa Ana River. It does not take into consideration the modern Natural Stream Channel Design outlined by the Environmental Protection Agency (EPA): https://www.epa.gov/sites/default/files/2015-07/documents/natural_stream_channel_design_techniques_and_review.pdf

According to Michael C Padilla, PMP, US Army Corps of Engineers (USACE), Chicago District, in regards to the Santiago Creek Project, "the budget for this interim design update, referred to as a Design Documentation Report (DDR) is $2,500,000. The current construction cost estimate is $170,000,000. This estimate is just a revision of the 1988 General Design Memorandum 2 costs with updates to the cost of materials and time value of money adjustments. There could be major revisions to the estimate as a result of the DDR efforts."

Based on the current rate of inflation, $170,000,000 in 1988 equals $397,465,173.29 in 2021.

In conjunction with the USACE, the City of Los Angeles approved findings of an environmental study of Alternative 20, which proposes about $1.3 billion to restore 11 miles of the Los Angeles River from approximately Griffith Park to downtown Los Angeles while maintaining existing levels of flood risk management. According to the USACE Los Angeles River Ecosystem Restoration Project PROJECT SUMMARY, "Restoration measures include creation and re-establishment of historic riparian and freshwater marsh habitat to support increased populations of wildlife and enhance habitat connectivity within the study area, as well as to provide opportunities for regional connectivity to ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains. Restoration also includes the re-introduction of ecological and fluvial processes through a more natural hydrologic regime, which reconnects the river to historic floodplains and tributaries, reduces flow velocities, increases infiltration, and improves natural sediment processes. The study also evaluates opportunities for passive recreation that is compatible with the restored environment."

Since the USACE is assisting the City of Los Angeles with a large-scale habitat restoration of the Los Angeles River, similar assistance must be provided in the restoration of Santiago Creek from the Santa Ana Mountains through unincorporated Orange County, Orange, Villa Park and Santa Ana to the Santa Ana River.

However, we are concerned that the USACE did not actively include key stakeholders within the Santiago Creek Watershed in Orange County and the cities of Orange, Villa Park

and Santa Ana in the DDR process. Only a minority of individuals received notification of the public input period while the majority of stakeholders did not hear about the opportunity until the deadline of November 12th had almost arrived. The DDR is being prepared in Chicago, away from community members in Orange County, which prevents local experts, specialists and residents from sharing their expertise and being directly involved in the development of the DDR. Considering hundreds of millions of our federal tax dollars will be spent on a project that is meant to benefit our community and our creek, USACE must improve communications and be willing to collaborate with the majority of stakeholders throughout the watershed before an Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) are circulated under the California Environmental Quality Act (CEQA).

The most cost-effective and environmentally sustainable solution to flood protection is to acquire and protect open spaces, restore wildlife habitat and prevent residential, commercial and/or industrial development within the floodplain along Santiago Creek. Please assist our community in restoring Santiago Creek by following these steps outlined below:

I. Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the planning and design.

II. Remove or modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout (Oncorhynchus mykiss), salmon (Oncorhynchus sp.), pacific lamprey (Entosphenus tridentatus), smelt (Osmeridae), stickleback (Gasterosteidae), arroyo toad (Anaxyrus californicus), red-legged frog (Rana draytonii), western pond turtle (Actinemys marmorata), least Bell's vireo (Vireo bellii pusillus), southwestern willow flycatcher (Empidonax traillii extimus) and California gnatcatcher (Polioptila californica) along Santiago Creek from the confluence of the Santa Ana River upstream to Irvine Lake (Santiago Reservoir) and from the Santa Ana River downstream to the ocean.

III. Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or industrial development proposals. Wherever it is cost feasible, acquire properties within the historic floodplain that feature existing residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.

Recent Data indicates that extirpated species, such as Pacific Lamprey, are capable of recolonizing the watershed, if environmental conditions are improved through habitat restoration. According to Natural Recolonization by Pacific Lampreys in a Southern

California Coastal Drainage: Implications for Their Biology and Conservation by Stewart B. Reid and Damon H. Goodman, "Observations of adult Pacific Lampreys in rivers further south also occurred in 2017 and 2018 (Ventura, Santa Clara, and Santa Ana rivers). In the Santa Ana River, two desiccated adult Pacific Lampreys were found in the dry concrete river channel about 7.3 km upstream of the mouth in January 2017 (C. Martinez and L. Krueger, Orange County Mosquito and Vector Control District, personal communication; OCMVCD 2017), and a desiccated adult female (with eggs) was found in the dry river channel about 18.5 km upstream of the mouth in April 2017 (Robert Fisher, U.S. Geological Survey, personal communication). Depending on natural recolonization can greatly simplify efforts to reestablish populations where passage is attainable, whether it is above modified barrier sites or along unoccu-
pied shorelines. The critical component is to lay the groundwork for recolonization by establishing open pathways for Pacific Lampreys to regain access and successfully complete their life cycle. In some cases, passage improvements can be as simple as retrofitting a weir. In
others, such as over large dams, it can be more challenging but should be explored."

PLEASE CONFIRM THAT YOU RECEIVED MY PUBLIC INPUT BY REPLYING TO THIS LETTER.

Thank you for your consideration.

Joel Robinson
Director, Naturalist For You
PO Box 381
Silverado, CA 92676
714-798-4392 (mobile)
jrobinson@naturalist-for-you.org
www.naturalist-for-you.org

3.9 Scoping Comment C.9

From: Kim Plehn
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] Santiago Creek Project
Date: Thursday, November 11, 2021 9:57:23 AM
Attachments: To The Army Corp.docx

To The Army Corp. of Engineers

Shawna S. Herleth-King

Mike Padilla

Kelly Granberg

This letter is in response to the scoping notification for the Santiago Creek Component of the Santa Ana River Mainstream Flood Risk Management Project Orange County California.

Our community is very involved with the Santiago Creek Corridor, and the natural habitat that surrounds and depends on this creek. There are deer, bobcat, mountain lions, and so many other animals that drink, and raise their young from this water way. Two protected species of birds the peregrine falcon, and gnatcatcher, nest in the Smith, Bond, and Blue Diamond Pits Army Corps. Referenced in the maps you sent. The Orange County Water District acknowledged this, and mitigated 4 acres of restoration, by planting Coastal Sage Scrub and a sycamore grove next to N. Prospect St. and E. Collins Ave. Because this portion of Santiago Creek runs through a suburban development, there is no way to restore or mitigate the loss of habitat. Preserving this habitat needs to be the primary goal, while focusing on slope stabilization.

I understand this channel is being updated, and has not been reviewed since the late 1980's. Preparing for a 100 year flood scenario is a prudent thing to do. I would request that the engineers implement a "Natural Channel Design". No riprap, concrete, but a soft bottom design.

Also the Army corp. of Engineers need to know the City of Orange approved 22 homes to be built in the maps you've identified as a flood zone. Previously zoned open space, probably because it's in a flood zone, and not suitable to build. And there is an illegal landfill upstream, very close to your project. LEA needs to conduct soil samples for contamination. The mess is only 20 yards from the Santiago Creek. Not sure who protects the water...

Virus-free. www.avast.com

To The Army Corp. of Enginneers

Shawna S. Herleth-King

Mike Padilla

Kelly Granberg

This letter is in response to the scoping notification for the Santiago Creek Component of the Santa Ana River Mainstream Flood Risk Management Project Orange County California.

Our community is very involved with the Santiago Creek Corridor, and the natural habitat that surrounds and depends on this creek. There are deer, bobcat, mountain lions, and so many other animals that drink, and raise their young from this water way. Two protected species of birds the peregrine falcon, and gnatcatcher, nest in the Smith, Bond, and Blue Diamond Pits Army Corps. Referenced in the maps you sent. The Orange County Water District acknowledged this, and mitigated 4 acres of restoration, by planting Coastal Sage Scrub and a sycamore grove next to N. Prospect St. and E. Collins Ave. Because this portion of Santiago Creek runs through a suburban development, there is no way to restore or mitigate the loss of habitat. Preserving this habitat needs to be the primary goal, while focusing on slope stabilization.

I understand this channel is being updated, and has not been reviewed since the late 1980's. Preparing for a 100 year flood scenario is a prudent thing to do. I would request that the engineers implement a "Natural Channel Design". No riprap, concrete, but a soft bottom design.

Also the Army corp. of Engineers need to know the City of Orange approved 22 homes to be built in the maps you've identified as a flood zone. Previously zoned open space, probably because it's in a flood zone, and not suitable to build. And there is an illegal landfill upstream, very close to your project. LEA needs to conduct soil samples for contamination. The mess is only 20 yards from the Santiago Creek. Not sure who protects the water...

3.10 Scoping Comment C.10

From: Mary Ann Wettler
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] US Army Corps Outdated Plans to Modify Santiago Creek
Date: Thursday, November 11, 2021 12:43:06 PM

Hello Shawna,

This is is my Public Comment:

The most cost-effective and environmentally sustainable solution to flood protection is to acquire and protect open spaces, restore wildlife habitat and prevent residential, commercial and/or industrial development within the floodplain along Santiago Creek. Please assist our community in restoring Santiago Creek by following these steps outlined below:

- Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the planning and design.
- Remove or modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout (Oncorhynchus mykiss), salmon (Oncorhynchus sp.), pacific lamprey (Entosphenus tridentatus), smelt (Osmeridae), stickleback (Gasterosteidae), arroyo toad (Anaxyrus californicus), red-legged frog (Rana draytonii), western pond turtle (Actinemys marmorata), least Bell's vireo (Vireo bellii pusillus), southwestern willow flycatcher (Empidonax traillii extimus) and California gnatcatcher (Polioptila californica) along Santiago Creek from the confluence of the Santa Ana River upstream to Irvine Lake (Santiago Reservoir) and from the Santa Ana River downstream to the ocean.
- Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or industrial development proposals. Wherever it is cost feasible, acquire properties within the historic floodplain that feature existing residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.

Thank you.
Mary Ann Wettler
Santa Ana, CA

3.11 Scoping Comment C.11

From: Pam Nelson
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] PHASE II GDM ON THE SANTA ANA RIVER MAINSTEM including Santiago Creek
Date: Thursday, November 11, 2021 2:55:49 PM

To whom it may concern,
I oppose the proposed modifications of the Santiago Creek, as described in the obsolete plan of 1988.

PHASE II GDM ON THE SANTA ANA RIVER MAINSTEM including Santiago Creek, August 1988, is an outdated plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and accommodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.

As described in the first part of the recommended plan summary on page iii and the structural details outlined in pages IV-4 - IV-12, the "Outlet Structure, Entrance Chamber, Gate Chamber, Stilling Basin, Outlet Channel and Overflow Structure" proposed by USACE will negatively impact the Orange County Water District (OCWD) wildlife habitat mitigation site which includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N Prospect St and E Collins Ave, which support protected species including California gnatcatcher (Polioptila californica) and peregrine falcon (Falco peregrinus). There are no existing offsite locations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of Coastal Sage Scrub and the sycamore grove must be preserved.

In response to the second part of the recommended plan summary on page iii and Page II-6, section c, a trapezoidal channel lined with riprap is an obsolete design model that would negatively impact the riparian and woodland habitat that occurs along the 6,400 foot long section of Santiago Creek from the Santa Ana Freeway to the Santa Ana River. More modern Natural Stream Channel Design should be considered here.

According to Michael C Padilla, PMP, US Army Corps of Engineers (USACE), Chicago District, in regards to the Santiago Creek Project, "the budget for this interim design update, referred to as a Design Documentation Report (DDR) is $2,500,000, which is likely under-estimated.

Since the USACE, in conjunction with the City of Los Angeles approved findings of an environmental study of Alternative 20, which proposes about $1.3 billion to restore 11 miles of the Los Angeles River from approximately Griffith Park to downtown Los Angeles while maintaining existing levels of flood risk management, they should apply the same practices for this project. According to the USACE Los Angeles River Ecosystem Restoration Project PROJECT SUMMARY, "Restoration measures include creation and re-establishment of historic riparian and freshwater marsh habitat to support increased populations of wildlife and enhance habitat connectivity within the study area, as well as to provide opportunities for regional connectivity to

ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains. Restoration also includes the re-introduction of ecological and fluvial processes through a more natural hydrologic regime, which reconnects the river to historic floodplains and tributaries, reduces flow velocities, increases infiltration, and improves natural sediment processes. The study also evaluates opportunities for passive recreation that is compatible with the restored environment."

However, we are concerned that the USACE did not actively include key stakeholders within the Santiago Creek Watershed in Orange County and the cities of Orange, Villa Park and Santa Ana in the DDR process. Only a minority of individuals received notification of the public input period while the majority of stakeholders did not hear about the opportunity until the deadline of November 12th had almost arrived. Considering hundreds of millions of our federal tax dollars will be spent on a project that is meant to benefit our community and our creek, USACE must improve communications and be willing to collaborate with the majority of stakeholders throughout the watershed before an Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) are circulated under the California Environmental Quality Act (CEQA).

The most cost-effective and environmentally sustainable solution to flood protection is to acquire and protect open spaces, restore wildlife habitat and prevent residential, commercial and/or industrial development within the floodplain along Santiago Creek. Please assist our community in restoring Santiago Creek by following these steps outlined below:

1. Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the planning and design.

2. Remove or modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout (Oncorhynchus mykiss), salmon (Oncorhynchus sp.), pacific lamprey (Entosphenus tridentatus), smelt (Osmeridae), stickleback (Gasterosteidae), arroyo toad (Anaxyrus californicus), red-legged frog (Rana draytonii), western pond turtle (Actinemys marmorata), least Bell's vireo (Vireo bellii pusillus), southwestern willow flycatcher (Empidonax traillii extimus) and California gnatcatcher (Polioptila californica) along Santiago Creek from the confluence of the Santa Ana River upstream to Irvine Lake (Santiago Reservoir) and from the Santa Ana River downstream to the ocean. Even species such as Pacific lamprey should be considered as a possible returning species to this area.

3. Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or industrial development proposals. Wherever it is cost feasible, acquire properties within the historic floodplain that feature existing

residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.

PLEASE CONFIRM THAT YOU RECEIVED MY PUBLIC INPUT BY REPLYING TO THIS LETTER.

Sincerely,
Pam Nelson
chair, Santa Margarita Group/Sierra Club
(commenting as an individual, not representing the Club)

3.12 Scoping Comment C.12

From: Peggy Calvert
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] Revise Outdated Plan
Date: Thursday, November 11, 2021 8:31:50 PM

Please dump the outdated 1988 plan, and devise a plan that does not destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and does not accommodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.

In 1988, we knew comparatively little about maintaining wildlife habitat, protecting water quality and improving environmentally sensitive areas.

We now know more. As we learn more, learn better, we need to do better!

Please act responsibly, updating attitudes, and improving the way we treat this planet.
It is the only one we've got!

Respectfully,
Peggy L Calvert

3.13 Scoping Comment C.13

From: Bonnie Robinson
To: Herleth-King, Shawna S CIV USARMY CELRC (USA); Bonnie Robinson
Subject: [Non-DoD Source] Comments in Response to Interim Design Documentation Report (DDR) for the Santiago Creek Component
Date: Friday, November 12, 2021 6:46:09 PM
Attachments: FinalArmy Corps letter 11.12.2021.pdf

Dear Ms. Herleth-King,

Please see the attached comments regarding the Interim Design Documentation Report (DDR) for the Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project, Orange County, California.

Please confirm that you have received the attached comments.

Thank you for your consideration.

Bonnie Robinson
bonanddon4@gmail.com
714-292-2762

Coalition of County of Orange Residents

League of Women Voters
Central Orange County Area

Orange Park Acres

Naturalist for You

Friends of Harbors, Beaches and Parks

Keep Orange Safe

November 12, 2021

Submitted via email to: *Shawna.S.Herleth-King@usace.army.mil*

Shawna S. Herleth-King
Department of the Army
U.S. Army Corps of Engineers, Chicago District
231 South La Salle Street, Suite 1500
Chicago, IL 60604

Re: Interim Design Documentation Report (DDR) for the Santiago Creek component of the Santa Ana River Mainstem Flood Risk Management project, Orange County, California.

Dear Ms. Herleth-King,

As you know our broad-based bipartisan coalition of Orange citizens is concerned with the Santiago Creek flood plain. Our goal is to advocate for and protect Santiago Creek. These comments are being written in response to the Scoping Notification: Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project, Orange County, CA dated October 6, 2021.

By way of background, the Community Vision for the Santiago Creek Corridor has been in the making for over 60 years. Our mission is to protect and preserve the land along the Santiago Creek Corridor for the health of our entire community and

for future generations to enjoy. Plans for implementing the adopted Santiago Creek Greenbelt Plan have been underway for 50 years. Our goals for this mission include preserving the current open space designated areas and maintaining the corridor that connects our regional and city parks to protect our drinking water, the health of the native flora and fauna to promote biodiversity and protect endangered and threatened species, limit erosion, provide habitat to serve as a carbon sink to counteract global warming, limit damage from flooding, and provide an aesthetic, natural, sustainable environment for recreation and passive use.

Using funds for land acquisition for permanent open space and prohibiting further development encroachment on the watershed, along with strategic habitat restoration, are the healthiest, least expensive and most effective ways to prevent damage and deaths in a 100-year flood event.

Our community has several concerns about the proposed U.S. Army Corps of Engineers Santiago Creek Component of the Santa Ana River Mainstem Flood Risk Management Project that was designed in 1988. The science has changed significantly in recommended approaches to flood control; therefore we have the following comments:

In the section titled ***The Recommended Plan*** on page II-6, we have the following concerns:

Section a: Work has already commenced in the existing Blue Diamond and Bond Pits to stabilize steep slopes and control water flow. This project threatens an established Orange County Water District wildlife habitat mitigation site that includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N. Prospect Street and E. Collins Avenue, which supports protected species, including gnatcatcher and peregrine falcon. There are no existing offsite locations to mitigate for the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of Coastal Sage Scrub and the sycamore grove must be preserved.

We are also concerned about the possible loss of valuable sensitive habitat in the Smith Basin. The section titled ***Biological and Ecological Features and Resources 2-03*** on page B-II-1 cites the ponded water and grove of willows that attracts several bird species, including threatened and endangered species. This section also states that due to the sensitivity of this existing habitat, U.S. Fish and Wildlife has placed development restrictions within and adjacent to this area of the pits. Chandler, LLC, owns the adjacent parcel. An application was made by the owner applying as OC Reclamation, LLC to fill the area with demolition construction waste and bring it up to grade; however, the application was denied by the Santa Ana

Regional Water Quality Control Board as incomplete as their plan did not sufficiently address the wetland on the property, formally identified as a "water of the State" and home to endangered and threatened species.

Section b: The existing creek bottom should remain with no improvements. No development should be allowed in areas zoned open space.

Section c: One of our chief concerns is item c. on page II-6, a plan to build a 6,400-foot-long trapezoidal channel section lined with riprap from the Santa Ana Freeway to the Santa Ana River. We believe a "Natural Channel Design," as promoted by the EPA, is a much healthier approach and will cost less in the long term. Previously, the U.S. Army Corps of Engineers has used concrete and riprap to move water as quickly as possible to the ocean. There are many unintended consequences of this model. One is the degradation of water quality as it moves quickly to the ocean without plants to filter out impurities, resulting in die offs at the confluence of the river and the ocean. Another is the loss of habitat along the streambed for sensitive riparian species, affecting the biodiversity of plants, birds, animals, and removing a valuable carbon sink, contributing to climate warming. This model also prevents adequate percolation into the soil to replenish groundwater aquifers.

The City of Los Angeles, in conjunction with the U.S. Army Corps of Engineers, is now spending hundreds of millions of dollars to remove channel concrete and restore riparian habitat, which requires less maintenance and costs over time. The USACE's Los Angeles River Ecosystem Restoration Project and Aliso Creek Project may be good models for this area. As we are fortunate to already have existing native habitat in portions of the proposed project's scope, those areas should be preserved and enhanced in the project's design. For the Santiago Creek Project, the emphasis should be habitat restoration rather than riprap to stabilize channel slopes.

The Biden Administration issued an executive order in January 2021 to conserve at least 30 percent of U.S. lands and oceans by 2030. In addition, California Executive Order N-82-20, issued in October 2020, establishes a state goal to conserve at least 30 percent of California's land and coastal waters by 2030 in a manner that protects and restores biodiversity. The 30 x 30 order directs relevant state agencies to prepare strategies by February 1, 2022, to achieve this goal. We support this effort and with keeping our local commitment of no further building on open space lands in the flood plain by the cities of Orange and Santa Ana, thereby lessening the need for other measures.

Section d. A bicycle and hiking trail are already in place. In the 1990s the east side of Hewes was slated to become a county regional park but over the objections of the neighborhood, it was developed into a housing tract. The loss of this area for water

storage and impacts of these areas to the creek needs further study as part of this update.

II-3 2-08 mentions the Santiago Golf Course. That area is now a housing development and significant infrastructure was put into place to allow that development to exist in the watershed. That area needs further study to protect those residents and its impacts to the creek capacity.

There are other activities taking place in the Santiago Creek Watershed that should be noted. Illegal construction waste dumping had been allowed by the City of Orange for several years upstream from the recharge basins on the former Sully Miller Property south of Santiago Creek. This property is owned by Milan REI X, LLC. The city approval of a development of 128 homes and a zone change was overturned by the voters through a recent referendum. Residents of the area are concerned about toxic dust in the air and toxic runoff being washed into the creek. The clean up of the hazardous waste on the property is currently being negotiated with the owner of the property, the LEA, County of Orange Department of Health, and CalRecycle. This cleanup work should be studied as part of this update.

There is a tentative tract map approved for 22 homes on the former Sully Miller property north of Santiago Creek (East of Cannon). Although zoned for housing, there needs to be consideration for the existing MWD water pipe and potential flooding. Hydrology studies have been deferred. It's not clear if safe setback requirements for Santiago Creek were established before the original rezoning took place in 1993. The channel is narrow in this area due to mining on the property. The area is also a wildlife corridor. The impacts to the creek should be studied as part of this update.

There is a possible residential development proposal for property off North Yorba behind the Chapman Global Medical Center and a "green" cemetery at Yorba and Palmyra (end of this street). Both initial site plans have direct impacts to Santiago Creek. Both areas are designated by the General Plan as "open space" and zoned "open space" and are within the Army Corps' oversight. We believe any development in these areas should be studied as part of this update. There are no development opportunities approved in these two areas, except for the 22 homes north of Santiago Creek east of Cannon. In fact, all residential development rights along Santiago Creek have been exercised in East Orange.

Once again, the use of federal funds for land acquisition for permanent open space and prohibiting further development encroachment on the watershed, along with strategic habitat restoration, are the healthiest, least expensive, and most effective ways to prevent damage and deaths in a 100-year flood event.

Last, we offer a vitally important comment. We believe the Army Corps of Engineers should facilitate a public workshop and ongoing dialogue with the appropriate agency staff (point of contact) and the community on this effort. Communication and trust from the City of Orange and Santa Ana staff on efforts to protect our creek aren't present and transparency isn't the norm. We want communication to be strong, truthful answers given, and a full partnership achieved. The Army Corps should take the lead on making this happen so the proper stewardship of this waterway is ensured.

Thank you for your consideration of our comments. We are looking forward to reviewing the Army Corps of Engineers "Engineering with Nature Plan."

Sincerely,

Bonnie Robinson
EOGP Resident
Orange, CA

Sherry Panttaja
President
Orange Park Association

Mike Wellborn
President
Friends of Harbors, Beaches and Parks

Joel Robinson
Director & Naturalist
Naturalist For You

Susan Guilford
President
League of Women Voters of
Central Orange County Area

Gisela Meier
Vice President of Voter Services
League of Women Voters of
Central Orange County Area

Laura Thomas
Chair
Keep Orange Safe

Lynne-Marie Frediani
EOGP Resident
Orange, CA

Adrienne Gladson, ACIP
Retired City Planner/
Former Orange Planning Commissioner

David Hillman
Chair
East Orange Loop Trail

Stephanie Lesinski
Construction Industry Consultant

Judy Weissberg-Ortiz
Member of LWV COCA

Soni Rice
Orange resident

The East Orange General Plan *(EOGP) was adopted by the City of Orange in 1976 and is part of the Orange General Plan.*

Orange Park Association *is a non-profit organization, formed in 1960 to protect the rural-equestrian area that was established in 1928 known as Orange Park Acres (OPA). Santiago Creek traverses through OPA. The OPA Plan (1973) is part of the Orange General Plan.*

The League of Women Voters *is a nonpartisan political organization encouraging informed and active participation in government. It influences public policy through education and advocacy.*

Friends of Harbors, Beaches and Parks *(FHBP) is an Orange County non-profit organization working to protect natural lands, waterways, and beaches.*

Naturalist For You *is a 501(c)(3) environmental education non-profit & a charitable body with a mission of connecting everyone to local wilderness!*

Keep Orange Safe *is a grass-roots citizen group dedicated to preserving and protecting the heritage and character of East Orange, with special emphasis on Santiago Creek, for present and future generations.*

Mailing & email list

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bonanddon4@gmail.com

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Orange, CA 92867
judywortiz@gmail.com

3.14 Scoping Comment C.14

From: Murray Finck
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Cc: Rhoda Finck; Murray D Finck
Subject: [Non-DoD Source] Santiago Creek Construction
Date: Friday, November 12, 2021 4:19:54 PM

Dear Shawna, a neighbor came by telling those of us who live along the Santiago Creek bed in Santa Ana, California that the Army Corps of Engineers is going to begin doing a major bit of construction in the Santiago Creek bed. If this is true, we were surprised that we have heard nothing about this, and we are concerned that those of us whose property connects with the Creek were not more properly notified. When we sit in our backyard, instead of a neighbors backyard fence, we see beautiful large trees growing along the banks of the Creek bed. We know and see wildlife in the Creek bed— coyotes, raccoons, opossums, rabbits, squirrels, hawks, owls, and many, many birds. In fact, there are "Bird Sanctuary" signs posted at various places where bridges cross over the Creek.

How can we learn more about this project? Will there be public hearings? Were notices sent to those of us who live along the Creek? If so, when? If not, why would that not have happened? We would appreciate hearing more from you and perhaps others before we start hearing any construction noise coming from the Santiago Creek bed. Please reply at your earliest convenience. Thank you.

Sincerely,

Murray and Rhoda Finck
1106 W. River Lane
Santa Ana, CA 92706
714-345-2791

3.15 Scoping Comment C.15

From: Noah Apodaca
To: Herleth-King, Shawna S CIV USARMY CELRC (USA); S.Herleth-King@usace.army.mil
Cc: Paul Apodaca; Noreen Dratch
Subject: [Non-DoD Source] USACE activity in the Santiago Creek, Santa Ana, CA
Date: Friday, November 12, 2021 6:55:20 PM
Attachments: RS 2014-1068.pdf

Ms. Herleth-King:

My name is Noah Apodaca, and I and my parents, Paul Apodaca, and Noreen A. Dratch (CC'd here) are property owners at 406 W. Park Lane, Santa Ana, CA 92706, which is the address of two lots, identified by the County of Orange Assessors parcel numbers 002-037-55 and 002-037-56 which are along, and extend down, the Northern bank of the Santiago Creek, just West of the 5 Freeway.

These lots are documented and visually described in Book 002, Page 03 of the County of Orange Assessor's records of Potts Borden & Sidwell Tract 1471, Record of Survey RS 89-1033, and Record of Survey RS 2014-1068 (attached here for your reference).

I've previously interacted significantly with Jason P. Lambert and Andrew J. Wendt of the USACE in relation to matters regarding these properties.

I apologize for the formality of this note, but my family has been victimized by overzealous government and community agencies regarding these properties numerous times over the past 28 years. I'm hoping to avert adding another disappointing chapter to that tale.

It has come to my attention that the USACE is in the process of developing new plans for improvements in this area, and has brought those plans to discussion with select property owners in this area. Neither I nor my parents have been contacted about how these improvements may impact our privately-owned residential real estate.

It has also come to my attention that certain activist groups from neighboring areas are encouraging citizens to submit materials and responses to you about these plans.

I state here formally that the "Naturalist For You" organization, its Director Joel Robinson, any other individuals they may enlist, any City, County, or State agencies, proxies or assigns, any private firms or companies, and any community groups (formal or informal) do not have authority to represent me or my parents, or our interests, in terms of actions or activities related to our privately-owned residential real estate at APN 002-037-55 and 002-037-56. Matters affecting and concerning these lots must be addressed with us directly.

By way of this email I am also requesting to be brought up-to-speed on USACE's

project plan, specifically in terms of how it may affect APN 002-037-55 and 002-037-56. I'm available for in-person, computer teleconference, or phone meeting at your convenience.

I look forward to hearing from you and establishing a productive and collaborative relationship.

Noah Apodaca
406 W. Park Ln.
Santa Ana, CA 92706
noah.apodaca@yahoo.com
714-558-7626

3.16 Scoping Comment C.16

From: Rachel Whitt
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] US Army Corps Outdated Plans to Modify Santiago Creek
Date: Friday, November 12, 2021 1:01:02 PM

I used to live in Villa Park and walked along Santiago Creek by Collins and Prospect very often.

Currently, this section of Santiago Creek features riparian (stream side) and woodland vegetation that supports sensitive wildlife species. Please do not consider disrupting that.

The outdated plan proposes new structures for the recharge basins that will negatively impact the Orange County Water District (OCWD) wildlife habitat mitigation site which includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N Prospect St and E Collins Ave, which support protected species including California gnatcatcher (Polioptila californica) and peregrine falcon (Falco peregrinus). There are no existing offsite locations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of Coastal Sage Scrub and the sycamore grove must be preserved.

PHASE II GDM ON THE SANTA ANA RIVER MAINSTEM including Santiago Creek, August 1988, is an obsolete plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and accommodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.

This is an outdated plan that would provide minimal benefit to the communities, municipalities, and organizations involved. The environmental costs in loss of habitat and visual loss of creekside aesthetics are extreme.

Thank you,

Rachel Whitt
Rachel Whitt
PO Box 514
San Clemente, CA 92674

3.17 Scoping Comment C.17

From: ted endres
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Cc: jrobinson@naturalist-for-you.org
Subject: [Non-DoD Source] Santiago Creek channel and riprap from Santa Ana freeway to Santa Ana River
Date: Friday, November 12, 2021 3:23:45 PM

Yesterday, I learned of the above referenced plans. I, my family and riparian neighbors on both sides are opposed to construction of a riprapped channel in the Santiago Creek. We were not timely or adequately notified of this plan and request an extension of time for public comment. Please respond immediately.
Thank you,
Ted Endres
Riparian Homeowner
1010 W. River Lane
Santa Ana, CA 92706

3.18 Scoping Comment C.18

From: Lawrence Budner
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] Paving the creek
Date: Saturday, November 13, 2021 5:28:17 PM

Dear Ms. Herleth-King:

As a resident of Jack Fisher Park for over 30 years, I strongly object to the proposal to pave Santiago Creek. As you can see from the sign at the Baker Street footbridge, the creek is a bird sanctuary and an important stretch of natural parkland. For environmental as well as aesthetic reasons, the creek should be left in its natural state.

Sincerely,

Lawrence J. Budner, M.D.
1222 W. River Lane
Santa Ana, CA 92706
(714) 981-4338

Sent from my iPad

3.19 Scoping Comment C.19

From: Teri Budner
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] Santiago Creek Santa Ana, CA
Date: Saturday, November 13, 2021 5:38:27 PM

I join my neighbors in asking that our creek NOT be turned into a cement gulch. Please give us the time to address this issue.

Teri Wright Budner, Ph.D.

Sent from my iPhone

3.20 Scoping Comment C.20

From: Ryan Leemon
To: Herleth-King, Shawna S CIV USARMY CELRC (USA)
Subject: [Non-DoD Source] Santiago Creek Plan
Date: Thursday, November 18, 2021 10:04:30 PM

Hello,

I wanted to comment on the Santiago Creek Plan:

Santiago Creek Preservation and Restoration Project (SCWPRP) is a project of Naturalist For You, a 501(c)(3) environmental education non-profit based in Orange, CA.

Public input for the Interim DDR Santiago Creek component of the Santa Ana River Mainstem Flood Risk Management project, Orange County, California.

PHASE II GDM ON THE SANTA ANA RIVER MAINSTEM including Santiago Creek, August 1988, is an obsolete plan that proposes modifications to Santiago Creek that will destroy wildlife habitat, decrease water quality, negatively impact the marine ecosystem, cause beach erosion, degrade the recreational and aesthetic value of the area and accommodate inappropriate housing developments that are proposed within the floodplain of Santiago Creek.

Page iii, "The recommended plan for Santiago Creek consists of modifying the existing gravel pits for flood control storage, constructing an outlet structure from the gravel pits with a release capacity of 3500 ft /s…"

In response to the first part of the recommended plan summary on page iii and the structural details outlined in pages IV-4 - IV-12, the "Outlet Structure, Entrance Chamber, Gate Chamber, Stilling Basin, Outlet Channel and Overflow Structure" proposed by USACE will negatively impact the Orange County Water District (OCWD) wildlife habitat mitigation site which includes 4 acres of restored Coastal Sage Scrub and a sycamore grove next to N Prospect St and E Collins Ave, which support protected species including California gnatcatcher (Polioptila californica) and peregrine falcon (Falco peregrinus). There are no existing offsite locations to mitigate the loss of established wildlife habitat that is already serving as a mitigation site. Therefore, the 4 acres of Coastal Sage Scrub and the sycamore grove must be preserved.

Page iii, "...and constructing a riprapped channel between the Santa Ana Freeway and the confluence with the Santa Ana River. The 5.5 miles of creek between the outlet structure and channel in the vicinity of Walnut Avenue to the beginning of the riprapped channel south of

the Santa Ana Freeway would not be improved and would be managed by the local sponsor in accordance with FEMA guidelines."

Page II-6, section c, "At the downstream side of the Santa Ana Freeway would begin a 6,400 foot long trapezoidal channel section. This section would be lined with riprap. The invert would have riprap thickness which varies from 12 inches to 21 inches and the side slope thickness would vary from12 inches to 36 inches. Also, the channel would be lined with a filter blanket which would vary in thickness from 6 inches to 9 inches depending on the thickness of the riprap. The width of the invert varies from 30 feet to 80 feet. Side slopes of 1.75 horizontal to1 vertical will be required because of right-of-way limitations. The downstream end of the channel would be at the confluence with the Santa Ana River. A transition at the confluence will consist of an 12-inch-thick, 50-foot-long grouted rock apron placed 10 feet below the design invert of the mainstem."

In response to the second part of the recommended plan summary on page iii and Page II-6, section c, a trapezoidal channel lined with riprap is an obsolete design model that would negatively impact the riparian and woodland habitat that occurs along the 6,400 foot long section of Santiago Creek from the Santa Ana Freeway to the Santa Ana River. It does not take into consideration the modern Natural Stream Channel Design outlined by the Environmental Protection Agency (EPA): https://www.epa.gov/sites/default/files/2015-07/documents/natural_stream_channel_design_techniques_and_review.pdf

According to Michael C Padilla, PMP, US Army Corps of Engineers (USACE), Chicago District, in regards to the Santiago Creek Project, "the budget for this interim design update, referred to as a Design Documentation Report (DDR) is $2,500,000. The current construction cost estimate is $170,000,000. This estimate is just a revision of the 1988 General Design Memorandum 2 costs with updates to the cost of materials and time value of money adjustments. There could be major revisions to the estimate as a result of the DDR efforts."

Based on the current rate of inflation, $170,000,000 in 1988 equals $397,465,173.29 in 2021.

In conjunction with the USACE, the City of Los Angeles approved findings of an environmental study of Alternative 20, which proposes about $1.3 billion to restore 11 miles of the Los Angeles River from approximately Griffith Park to downtown Los Angeles while maintaining existing levels of flood risk management. According to the USACE Los Angeles River Ecosystem Restoration Project PROJECT SUMMARY, "Restoration measures include creation and re-establishment of historic riparian and freshwater marsh habitat to support increased populations of wildlife and enhance habitat connectivity within the study area, as well as to provide opportunities for regional connectivity to ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains. Restoration also

includes the re-introduction of ecological and fluvial processes through a more natural hydrologic regime, which reconnects the river to historic floodplains and tributaries, reduces flow velocities, increases infiltration, and improves natural sediment processes. The study also evaluates opportunities for passive recreation that is compatible with the restored environment."

Since the USACE is assisting the City of Los Angeles with a large-scale habitat restoration of the Los Angeles River, similar assistance must be provided in the restoration of Santiago Creek from the Santa Ana Mountains through unincorporated Orange County, Orange, Villa Park and Santa Ana to the Santa Ana River.

However, we are concerned that the USACE did not actively include key stakeholders within the Santiago Creek Watershed in Orange County and the cities of Orange, Villa Park and Santa Ana in the DDR process. Only a minority of individuals received notification of the public input period while the majority of stakeholders did not hear about the opportunity until the deadline of November 12th had almost arrived. The DDR is being prepared in Chicago, away from community members in Orange County, which prevents local experts, specialists and residents from sharing their expertise and being directly involved in the development of the DDR. Considering hundreds of millions of our federal tax dollars will be spent on a project that is meant to benefit our community and our creek, USACE must improve communications and be willing to collaborate with the majority of stakeholders throughout the watershed before an Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) are circulated under the California Environmental Quality Act (CEQA).

The most cost-effective and environmentally sustainable solution to flood protection is to acquire and protect open spaces, restore wildlife habitat and prevent residential, commercial and/or industrial development within the floodplain along Santiago Creek. Please assist our community in restoring Santiago Creek by following these steps outlined below:

Involve the majority of stakeholders (residents, local governmental agencies, NGOs, etc.) within the Santiago Creek Watershed in the planning and design.

Remove or modify existing barriers, including dams, drop structures and concrete/riprap lined channels, and restore riparian, wetland and scrub habitat to accommodate federal and state protected wildlife species, including steelhead trout (Oncorhynchus mykiss), salmon (Oncorhynchus sp.), pacific lamprey (Entosphenus tridentatus), smelt (Osmeridae), stickleback (Gasterosteidae), arroyo toad (Anaxyrus californicus), red-legged frog (Rana draytonii), western pond turtle (Actinemys marmorata), least Bell's vireo (Vireo bellii pusillus), southwestern willow flycatcher (Empidonax traillii extimus) and California gnatcatcher (Polioptila californica) along Santiago Creek from the confluence of the Santa Ana River upstream to Irvine Lake (Santiago Reservoir) and from the Santa Ana River downstream to the ocean.

Acquire and restore private properties zoned and/or designated as open space, including Sully-Miller/Rio Santiago, Chandler, Walnut, Chapman Medical Center and YMCA properties, within the floodplain that are threatened by residential, commercial and/or industrial development proposals. Wherever it is cost feasible, acquire properties within the historic floodplain that feature existing residential, commercial and/or industrial structures, which may be negatively impacted by future flood events. Remove structures and restore habitat.

Recent Data indicates that extirpated species, such as Pacific Lamprey, are capable of recolonizing the watershed, if environmental conditions are improved through habitat restoration. According to Natural Recolonization by Pacific Lampreys in a Southern California Coastal Drainage: Implications for Their Biology and Conservation by Stewart B. Reid and Damon H. Goodman, "Observations of adult Pacific Lampreys in rivers further south also occurred in 2017 and 2018 (Ventura, Santa Clara, and Santa Ana rivers). In the Santa Ana River, two desiccated adult Pacific Lampreys were found in the dry concrete river channel about 7.3 km upstream of the mouth in January 2017 (C. Martinez and L. Krueger, Orange County Mosquito and Vector Control District, personal communication; OCMVCD 2017), and a desiccated adult female (with eggs) was found in the dry river channel about 18.5 km upstream of the mouth in April 2017 (Robert Fisher, U.S. Geological Survey, personal communication). Depending on natural recolonization can greatly simplify efforts to reestablish populations where passage is attainable, whether it is above modified barrier sites or along unoccu-

pied shorelines. The critical component is to lay the groundwork for recolonization by establishing open pathways for Pacific Lampreys to regain access and successfully complete their life cycle. In some cases, passage improvements can be as simple as retrofitting a weir. In

others, such as over large dams, it can be more challenging but should be explored."

PLEASE CONFIRM THAT YOU RECEIVED MY PUBLIC INPUT BY REPLYING TO THIS LETTER.

Thank you for your consideration.
Ryan Leemon, resident since 1992

4 Draft Report Distribution List

The following federal, state, and local agencies/governments and tribal nations were provided notification of the Draft Report's release for public review.

Agency	Contact	Contact Position	Mailing Address	City	State	Zip Code
Federal Agencies						
U.S. Environmental Protection Agency	Laura Ebbert	Director, Tribal, Intergovernmental and Policy Division	USEPA REGION 9 75 Hawthorne Street	San Francisco	CA	94105
U.S. Environmental Protection Agency	Amy Miller-Bowen	Director, Enforcement and Compliance Assurance Division	USEPA REGION 9 75 Hawthorne Street	San Francisco	CA	94105
U.S. Fish and Wildlife Service	Scott Sobiech	Field Supervisor, Carlsbad and Palm Springs Offices	U.S. Fish and Wildlife Service Carlsbad and Palm Spring Offices 2177 Salk Avenue, Suite 250	Carlsbad	CA	92008
U.S. Fish and Wildlife Service	Chris Medak	Biologist, Carlsbad Fish and Wildlife Office	U.S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office 2177 Salk Avenue, Suite 250	Carlsbad	CA	92008
U.S. Geological Survey Western Ecological Research Center	Robert Fisher	Supervisory Research Biologist	U.S. Geological Survey Western Ecological Research Center 4165 Spruance Road, Suite 200	San Diego	CA	92101
Federal Emergency Management Agency -	Robert J. Fenton, Jr.	Regional Administrator, Region 9	Federal Emergency Management Agency Region 9 1111 Broadway, Suite 1200	Oakland	CA	94607
Native American Heritage Commission	Reginald Pagaling	Commissioner, NAHC Vie Chairperson	1515 Harbor Boulevard, Suite 100	West Sacramento	CA	95691
California Natural Resources Conservation Service	Carlos Suarez	State Conservationist	California NRCS State Office Richard E. Lyng USDA Service Center 430 G Street, #4164	Davis	CA	95616-4164
Advisory Council on Historic Preservation	Jaime Loichinger	Assitant Director	Advisory Council on Historic Preservation 401 F Street NW, Suite 308	Washington	DC	20001
Federal Transit Administration	Ray Tellis	Administrator	Region 9 Office Federal Transit Administration San Francisco Federal Building	San Francisco	CA	94103
Federal Highway Administration	Vincent Mammano	Division Administrator	Federal Highway Administration California Division 650 Capitol Mall, Suite 4-100	Sacramento	CA	95814-4708
Federal Aviation Administration	Raqual Girvin	Western-Pacific Region Regional Administrator	Federal Aviation Administration, Western Pacific Region 777 S. Aviation Blvd., Suite 150	El Segundo	CA	90245

Agency	Contact	Contact Position	Mailing Address	City	State	Zip Code
State Agencies						
State Clearinghouse	Scott Morgan	Chief Deputy Director	California State Clearinghouse 1400 Tenth Street	Sacramento	CA	95814
California Air Resources Board	Dr. Steven Cliff	Executive Officer	California Air Resources Board 1001 I Street	Sacramento	CA	95814
Office of Historic Preservation	Julianne Polanco	State Historic Preservation Officer	Office of Historic Preservation 1725 23rd Street, Suite 100	Sacramento	CA	95816
Native American Heritage Commission	Raymond C. Hitchcock	Executive Secretary	California Native American Heritage Commission 1550 Harbor Blvd., Suite 100	West Sacramento	CA	95691
Caltrans, District 12	Ryan Chamberlain	District Director	Caltrans District 12 1750 East 4th Street, Suite 100	Santa Ana	CA	92705
Caltrans, Office of Encroachment Permits	Jacob Mathew		Caltrans Office of Encroachment Permits 464 West 4th Street, Basement, MS 619	San Bernardino	CA	95899-7377
California Department of Conservation	David Shabazian	Director	California Department of Conservation 715 P Street, MS 1900	Sacramento	CA	95814
California Geological Survey	VACANT	Acting State Geologist	California Department of Conservation California Geological Survey, Southern California Office 320 West 4th St., Suite 850	Los Angeles	CA	90013
California Division of Land Resources	Keali'I Bright	Assistant Director, Division of Land Resources	California Department of Conservation Division of Land Resources 715 P Street, MS 1900	Sacramento	CA	95814
California Department of Resources Recycling and Recovery (CalRecycle)	Rachel Machi Wagoner	Director	Department of Resources Recycling and Recovery (CalRecycle) P.O. Box 4025	Sacramento	CA	95812-4025
California Department of Fish and Wildlife, South Coast Region 5	Frederic "Fritz" Rieman	Senior Environmental Scientist (Supervisor)	California Department of Fish and Wildlife, South Coast Region 5 Lake and Streambed Alteration Agreement Program	San Diego	CA	92123
California Department of Fish and Wildlife, South Coast Region 5	Jennifer Blackhall	Environmental Scientist	California Department of Fish and Wildlife, South Coast Region 5 Lake and Streambed Alteration Agreement Program 3883 Ruffin Road	San Diego	CA	92123

Agency	Contact	Contact Position	Mailing Address	City	State	Zip Code
California Department of Fish and Wildlife, South Coast Region 5	Alexandra Troeller	Environmental Scientist	California Department of Fish and Wildlife, South Coast Region 5 Habitat Conservation 3883 Ruffin Road	San Diego	CA	92123
California Department of Toxic Substances Control	Meredith Williams	Director	California Department of Toxic Substances Control Joe Serna Jr. CalEPA Headquarters Bldg. P.O. Box 806	Sacramento	CA	95814
California Public Utilities Commission	Terence Shia	Director, Water Division	California Public Utilities Commission 320 West 4th Street, Suite 500	Los Angeles	CA	90013
Southern California Association of Governments	Jonathan Hughes	Orange County Regional Office POC	Southern California Association of Governments Orange County Regional Office OCTA Building 600 South Main Street, Suite 741	Orange	CA	92868
Southern California Association of Governments	Kome Ajise	Executive Director	Southern California Association of Governments 900 Wilshire Blvd., Suite 1700	Los Angeles	CA	90017
State Water Resources Control Board	Eileen Sobeck	Executive Director	State Water Resources Control Board Environmental Services Unit 1001 I Street	Sacramento	CA	95814
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Agency	Contact	Contact Position	Mailing Address	City	State	Zip Code
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U.S. Senate	Sen. Alejandro Padilla	CA	112 Hart Senate Office Building	Washington, DC		20510
U.S. Senate	Sen. Dianne Feinstein	CA	331 Hart Senate Office Building	Washington, DC		20510
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California State Senate	Sen. Thomas J. Umberg	District 34	State Capitol, Room 5097	Sacramento	CA	95814
California State Senate	Sen. Dave Min	District 37	State Capitol, Room 2048	Sacramento	CA	95814
California State Assembly	Assembly Member Josh Lowenthal	District 69	1021 O Street, Suite 5130	Sacramento	CA	95814
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	Brent Colasurdo		1418 W. River Lane	Santa Ana	CA	92706
	Randy Musser					

Appendix 10 – Hydrology and Hydraulics

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CHICAGO DISTRICT

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SANTIAGO CREEK

ORANGE COUNTY, CALIFORNIA

Appendix 10 – Hydrology and Hydraulics

September 2023

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VERTICAL GEODETIC DATUM CONVERSION

LOCATION	FT, NGVD29 to FT, NAVD88	EXAMPLE CALCULATION
Santiago Dam	+2.539	790 ft, NGVD29 + 2.539 ft = 792.539 ft, NAVD88
Villa Park Dam	+2.513	510 ft, NGVD29 + 2.513 ft = 512.513 ft, NAVD88
Santiago Recharge Basins	+2.509	278 ft, NGVD29 + 2.509 ft = 280.509 ft, NAVD88
Santiago Creek (I-5)	+2.346	180 ft, NGVD29 + 2.346 ft = 182.346 ft, NAVD88
Santiago Creek (SARM)	+2.258	100 ft, NGVD29 + 2.258 ft = 102.258 ft, NAVD88

Note: Vertical geodetic datum conversion provided for reference purposes. Historical documents utilize vertical datum of ft, NGVD29 for elevation data. All elevation data within this report is converted to ft, NAVD88 unless otherwise noted.

APPENDIX 10 – Hydrology and Hydraulics

1.0 INTRODUCTION

1.1 General

This Engineering Documentation Report (EDR) pertains to the U.S. Army Corps of Engineers (USACE) – Chicago District (CELRC) analysis of flood risk management measures along lower Santiago Creek in Orange County, California. The project is a component of the Santa Ana River Mainstem (SARM). The purpose of the Santiago Creek project is to reduce flood risks for the community within the lower Santiago Creek floodplain, the congressionally authorized design objective is to contain the 1% annual exceedance probability (1% AEP) flows of lower Santiago Creek within the channel and reservoir area.

The project is a pre-construction engineering and design (PED) phase project. The decision-phase alternatives analysis was presented within the General Design Memorandum Phase I (USACE, 1980), and the recommended plan was later refined as part of the General Design Memorandum Phase II (USACE, 1988). CELRC has been tasked with updating the 1988 design and completing an *Interim Design Documentation Report* (DDR). The updated design will reflect changes to the project area since the 1988 design and will incorporate modernized USACE design processes. This updated DDR is necessary for cost refinement, project decision making by the Change Control Board (CCB) and will be used to guide a future detailed design for the Plans and Specification (P&S) phase.

1.2 Project Background

Significant flooding along the Santa Ana River including Santiago Creek within Orange, Riverside, and San Bernardino Counties in California has been documented since at least 1897. According to USACE documentation, the largest recorded flooding event by peak flow occurred in 1938 following a series of large storm events, the flooding caused at least $4M in damages within Orange County alone (1938 price levels) (USACE, 1980, 1988, and 2017). In February 1969, a series of significant storms resulted in approximately $22M damages within Orange County (1969 price levels) and resulted in at least twelve deaths. Flooding at Santiago Creek is a continuing concern among local interests; floods are exacerbated due to inadequate size of the channel for conveyance of flood waters. Additionally, in some locations the unprotected banks are subject to erosion which could cause damage to residential and commercial developments along the creek (USACE, 1988).

In 1964, Congress authorized USACE to study flooding problems along the Santa Ana River including Santiago Creek. Plans for flood control measures along Santiago Creek were first identified in the *Review Report on the Santa Ana River Main Stem* report (USACE, 1975). The 1975 report was prepared to develop a plan for mitigation of serious flood hazards within Orange, Riverside, and San Bernardino Counties in California, including Santiago Creek. The original Santiago Creek plan recommended construction of channel revetment and concrete rectangular channel intermittently between the Garden Grove freeway and the Santiago Creek channel's confluence with the Santa Ana River. In 1977, Orange County released the *Lower Santiago Creek Specific Plan* (OC, 1977) which incorporated findings from the 1975 plan in the development of a more comprehensive flood control plan, including modifications to the Villa Park Dam and improvements to the existing gravel pits to reduce peak flows and provide groundwater recharge. USACE subsequently developed the Phase I General Design Memorandum (GDM) study in 1980 to update the 1975 report, incorporating public concerns with the original plan as well as findings from the 1977 Orange County study. The Phase I GDM recommended providing over two miles of concrete rectangular channel in selected locations in the lower portion of Santiago Creek and utilizing the former gravel pits as a flood detention reservoir. In 1986, the Orange County Water District (OCWD) acquired the

former gravel pits – now known as the Santiago Recharge Basins – for utilization as a groundwater recharge basin.

The recommended improvements outlined in the Phase I GDM were authorized in part by the Water Resource Development Act (WRDA) 1986, Public Law 99-662. Following authorization, USACE developed the Phase II GDM in 1988 in order to refine the Phase I recommendations, assess environmental and economic effects, and update project costs. The principle Santiago Creek features of the 1988 Phase II GDM include:

1. Flood Storage – Vertical expansion and operational considerations for the existing groundwater recharge basin.
2. Reservoir Flow Regulation – Construction of a gated outlet structure and designated overtopping location at the existing groundwater recharge basin
3. Channel Improvements – Rehabilitation and erosion protection for portions of Santiago Creek downstream of the existing groundwater recharge basin
4. Recreational Improvements – Construction of hiking and bicycle trails.

A USACE Design Memorandum (DM-14) was published in 1992 which altered the proposed design of the riprap trapezoidal channel between the Santa Ana River and Freeway. Based on public input, the rip rap trapezoidal channel was changed to a stamped concrete battered wall for aesthetic purposes. Further, a 1998 USACE Design Memorandum (DM-18) was developed to update slope stabilization design along the Santiago Recharge Basins based on updated geotechnical data.

Some project features from the Phase II GDM have already been completed by non-federal interests since the report's development. In approximately 1991, the trapezoidal channel between Prospect St and Walnut Ave was constructed by non-federal interests. Portions of the Santiago Recharge Basin slopes were stabilized in approximately 1998 by OCWD, and additional stabilization measures were constructed along the saddle in Spring 2022. In approximately 2011, the Santiago Creek Trail & Bike Path was completed by the City of Orange, which passes along the southwestern portion of the Santiago Basins and portions of Santiago Creek.

In 1991, the OCPW updated the operation manual at the Villa Park Dam -- which regulates flows into the Santiago Basins and lower Santiago Creek – to increase the (potential) maximum gated outflow release from the dam. The original maximum gated outflow release was utilized to size the gated outflow structure, and the required storage capacity of the reservoir was based on uncontrolled spillway flows. The Santiago Pipeline and Burris Pump Station were constructed to provide OCWD a mechanism for diverting Santa Ana River water to the Santiago Basins for groundwater recharge purposes. In 2002, a submerged pump station was installed within the Santiago Basins, allowing OCWD to also pump water from the basins back to Santa Ana River. In 2011 a floating pump station was constructed to replace the submerged station; according to the OCWD's 2015 Management Plan the floating pump station was constructed "to dewater the Santiago Basins to increase storm flow capture and percolation, to make storage available for winter season use, to provide water to the Santiago Creek for percolation, and to increase operational flexibility by pumping water back to Burris Basin when necessary" (OCWD, 2015). A portion of the lower Santiago Creek channel not included in the Phase II GDM recommendations – a stretch between Cambridge St and Tustin Ave – was improved by the Orange County Flood Control District in 1994.

In 2020, CELRC was tasked with updating the proposed design of the Phase II GDM with current conditions and modern engineering design standards. This Interim DDR will be developed in order to (1) update the design based on changes since the original reports, (2) provide a basis for future construction plans and specification development, (3) assess environmental compliance requirements, (4) update project costs, and (5) determine real

estate needs. The findings of this DDR will be used for project decision making purposes by the CCB.

1.3 Project Authorization

The Santiago Creek project is authorized in the Water Resource Development Authority (WRDA) 1986 (PL-99-662), Energy & Water Appropriation Act, 1988 (San Timoteo), WRDA 1990 (Santa Ana Trails), WRDA 1996 (Prado Dam, SR 71), and WRDA 2007 (SARI Line). The 1982 Chief's Report provides the recommended plan for Santiago Creek, as described by the Phase I GDM. The recommended plan included improvements and flood plain management on the lower portion of Santiago Creek, including "providing a detention reservoir at existing gravel pits and 9,000 feet of trapezoidal channel along Santiago Creek, and floodplain management from Walnut Avenue to the Santa Ana Freeway", in order to provide "1% AEP flood protection for the residents in the Santiago Creek flood plain".

1.4 Project Description

Consistent with the authorized plan, the overall design objective for this project will be to contain the 1% AEP floods, providing flood protection for approximately 75,000 people living in the Santiago Creek project area (2019 population). The construction features necessary for control of the 1% AEP were identified in the Phase II GDM to be consistent with the both the authorized plan and public preference. Since the original design documentation, changed conditions at the project site (as described above) require re-analysis of the engineered features. Additionally, assessment of the changed regulatory and community needs is warranted.

In the initial portion of the design phase for this development of the DDR, the features evaluated included:

1. *Vertical expansion of Santiago Recharge Basins* – The existing basin site was evaluated to store 1% AEP uncontrolled discharges from Villa Park Dam and nearby runoff. The maximum pool elevation of the basins will be increased by approximately 13-feet. Structurally stabilized slopes are necessary in select locations at the reservoir perimeter to accommodate higher operating elevations and variable water levels.
2. *Construction of an Outlet Works at the Santiago Recharge Basins* – In order to effectively manage water levels in the basin and accommodate both water conservation and flood control needs, a gated outlet structure was evaluated to pass controlled discharges from Villa Park dam. An overflow weir was evaluated to provide a designated spillway at the maximum operating elevation, the overflow weir will be designed to provide appropriate overflow capacity and appropriate freeboard to protect surrounding land.
3. *Riprap trapezoidal channel along portions of lower Santiago Creek* – Channel improvements are necessary between Santa Ana Freeway and Santa Ana River to provide additional flow capacity and prevent erosion. Channel improvements between Prospect St and Walnut Ave were proposed in the Phase II GDM, however the recommended improvements were constructed in approximately 1991.
4. *Recreational features* – A trail rest stop will be constructed along the Santiago Recharge Basins. The Phase II GDM included construction of a hiking and bicycle trail, however that feature was constructed in approximately 2011. This feature does not affect the hydrologic condition of the study area, nor does it encroach or impact the hydraulics of the channel.

After initial evaluation, discussion, and coordination within the Product Development Team (PDT), Local Sponsor, and the SPL on the benefits and cost of the vertical expansion of the Santiago Recharge Basins and Outlet Works as later described in this Appendix, the features were modified as below.

1. *Passive Reservoir Storage of Santiago Recharge Basins* – The existing basin site will continue to provide passive storage for the 1% AEP uncontrolled discharges from Villa Park Dam and nearby runoff. Initial conditions at the beginning of rainfall events will vary with the operation of the reservoir but are expected to be below approximately elevation 287.5 ft (NAVD 88), the high point elevation where gravity drainage begins to flow through the Prospect Avenue culverts and downstream.

2. *Construction of an Outlet Works at the Santiago Recharge Basins* – This feature will not be constructed with the passive reservoir design. This will simplify the operation for the reservoir as an advance (forecasted) release from the reservoir prior to an event will not be required. It will also eliminate the risk of drawing down the reservoir and reducing the recharge capacity of the reservoir if a storm does not materialize or does not impact the basin. It also reduces the risk of a mis-operation of the gates that could potentially send a sudden larger release of water into the densely populated lower basin prior to appropriate flood warning. By removal of this feature, the 1% AEP peak flow will be 6,600 cfs rather than the reduced peak flow of 5,300 cfs with the additional storage in the reservoir. With removal of the tainter gates from the recommended design, passive release from the recharge basins will continue through the three large culverts under Prospect Avenue. Construction in the recharge basins will be limited to the slope stabilization described in the Geotechnical Appeni

3. *Riprap trapezoidal channel along portions of lower Santiago Creek* – Channel improvements are necessary between Santa Ana Freeway and Santa Ana River to provide additional flow capacity and prevent erosion. Channel improvements between Prospect St and Walnut Ave were proposed in the Phase II GDM, however the recommended improvements were constructed in approximately 1991. The riprap trapezoidal channel along the power portion of Santiago Creek will still be necessary to reduce flooding at the 1% AEP and prevent active erosion. Without the reservoir improvements, the 1% AEP flood flows will not be reduced from the approximate 6,600 cfs down to 5,300 cfs, so small flood walls will be required to contain flood flows for the 1% AEP with adequate assurance.

4. *Recreational features* – Recreational features will be designed as before. The changes described above will not impact these features.

1.5 Flood History

The largest flood of record for the study area is the great flood of 1862. No specific rainfall amounts are available for the area in or near the Santa Ana River Watershed but accounts at the time tell of at least 18 straight days of rain and a flood that lasted 20 days and brought great destruction and isolation to the region. The storm of February 27 – March 3, 1938, was one of the most severe general storms of record for southern California. Ground conditions were conducive to runoff due to saturated soil conditions resulting from greater than normal precipitation during the month preceding the storm. The heavy precipitation of the March 1-2 period, along with the low precipitation-loss rate, resulted in numerous peak discharges of record on the Santa Ana River. The general storm of January 21-24, 1943 was the most severe of its kind on record in nearly every respect. Because of the less saturated soil conditions, however, runoff produced by this storm was less than that produced by the storm of 1938.The storm of March 3-4, 1943, is described as a local thunderstorm that resulted in short-period precipitation of near record breaking magnitude for the southern California coastal region. The storms of January 18-27, and February 22-25, 1969, brought extremely heavy precipitation to the southern California area. Because ground conditions were more conducive to runoff than during the January 1943 storm, each of the 1969 floods produced peak discharges greater than the January 1943 flood.

1.6 Engineering Studies, Investigations and Design

1.6.1 Previous Studies, Investigations, and Design

A brief overview of previous studies, investigations, and design reports relevant to the Santiago Creek project are presented, below:

Review Report on the Santa Ana River Main Stem (USACE, 1975). In 1975, USACE developed a feasibility study for providing additional flood control, water conservation, and recreation for the Santa Ana River Basin and Orange County, California. The report, referred to as the "Survey Report", analyzed several alternatives for the SARM project, including Santiago Creek, and ultimately recommended the "All River Plan". This recommended plan for Santiago Creek consisted of 2.5 miles of concrete rectangular channel from Grand Avenue to the Santa Ana River.

Lower Santiago Creek Specific Plan (OCEMA, 1977). Orange County developed the *Lower Santiago Creek Specific Plan* to address a broader array of community needs than the USACE 1975 plan. The selected plan included regulation of the Villa Park Dam to increase controlled releases and decrease uncontrolled vegetation, improvements between the dam and Villa Park Road, regulation of the former gravel pits (now known as Santiago Recharge Basins), recreational features, proposed land use restrictions, and various channel improvements along select locations of the Santiago Creek between the basins and Santa Ana River. The recommended channel improvements included turf channels with rip rap reinforced side slopes, rip rap and earthen trapezoidal channels, and concrete rectangular channels.

Phase I General Design Memorandum: Santa Ana River Main Stem including Santiago Creek (USACE, 1980). In 1980, USACE developed the Phase I GDM for the SARM project. The feasibility-level study was a reanalysis of the SARM Survey Report and utilized the Lower Santiago Creek Specific Plan recommended alternative (OCEMA, 1977) for the Santiago Creek component. Public engagement revealed strong public opposition to components of Orange County plan, and the intent of the Phase I GDM was to refine that plan based on public input. Opposition was primarily related to the proposed concrete channelization of the channel, the plan for recreational trails, and providing a level of protection that was greater than desired. The Phase I GDM modified the Orange County plan to develop the "Detention Storage and Minimal Channel Upgrading Plan". This plan consisted of improving the channel between the reservoir and Walnut Avenue and also between to the Santa Ana Freeway and Santa Ana River; channel improvements would consist of a riprap blanketed trapezoidal channel to meet a 1% AEP level of protection and maintain a volumetric flow rate of less than 5,000 cubic feet per second (cfs) at the confluence with Santa Ana River during 1% AEP events. The plan also included reservoir improvements to utilize the former gravel pits for flood storage. Recommended reservoir improvements consisted of an inlet structure underneath Villa Park Road, a gated outlet structure and outlet channel extending underneath Prospect St, and slope improvements. The reservoir improvements would provide approximately 3,300 acres-feet of flood storage capacity.

Phase II General Design Memorandum: Santa Ana River Main Stem including Santiago Creek (USACE, 1988). The Phase II GDM refined the design features of the SARM features outlined in the Phase I GDM, including Santiago Creek. The report, also known as "Design Memorandum No. 1", included relatively minor changes from the authorized plan, including (i) increasing the necessary reservoir capacity by approximately 1,300 acres-feet (to 4,600 acres-feet), (ii) removing the access road at the downstream channel from the plan to provide additional flow capacity, (iii) removing the inlet at the reservoir to reflect changed usage considerations, and (iv) refining the analysis of all design elements. The outlet structure design was refined by iteratively varying individual elements of the Phase I GDM design (e.g., invert and sill elevation, gate types) using the requirements of EM 1110-2-1601 and -1602 (Hydraulic Design of Flood Control Channel and Outlet Works) and selecting the least cost configuration necessary to reach 3,500 cfs outflow. The reservoir improvements consisted of various types of slope stabilization along the Santiago Recharge Basins, as necessary to maintain variable water levels between 274-ft (NGVD29) and 298-ft (NGVD29) for flood storage. The downstream channel design consisted of multiple design cross-sections consisting of variable riprap blanket thicknesses for a graded trapezoidal channel. The Phase II GDM also presented a reservoir regulation plan that considered conditions at Santiago Dam, Villa Park Dam, and weather forecasts to guide reservoir operations.

Santiago Creek Feature Design: Alternate Channel Station 10+15 to 74+75. Santa Ana River Mainstem Project including Santiago Creek: Design Memorandum No. 14 (USACE, 1992). The DM-14 was developed by USACE at the request of local sponsor to address concerns from the community on the aesthetics of the downstream channel feature. The public was concerned that the appearance of the riprap lined channel would not be consistent with a natural creek setting. The revised design included a primarily rectangular channel with terraced, stamped-concrete battered L-walls with a cobble bottom between the Santa Ana River and Santa Ana Freeway. The design added several grouted stone drop structures for grade and energy control. The proposed design was considered a betterment over the original plan, with additional costs to be provided by the local sponsor.

Santiago Creek Feature Design: Santiago Creek Reservoir. Santa Ana River Mainstem Project including Santiago Creek. Design Memorandum No. 18 (USACE, 1998). The DM-18 report replaces the reservoir buttress fill work recommended in the Phase II GDM, taking into consideration percolation requirements of the basins. In lieu of the

buttress fills proposed in the Phase II GDM, it was generally recommended to construct concrete retaining walls from the surface to approximately 290-ft to 308-ft (NGVD) and to excavate and armor slopes on a 2:1 angle below existing grade. Along Bond Avenue and Prospect Street, the plan recommended placement of a concrete retaining wall above elevation 290-ft with excavation at 3:1 slope and placement of gabion retaining walls below elevation 290-ft. Based on recent review, it does not appear that this design incorporates the tie-back wall constructed in 1998 (OCWD, 1998). The geotechnical design uses modified values collected during the geotechnical investigation of the Phase II GDM report. The DM-18 report also includes more refined engineering analysis for the outlet works and for reservoir management.

Economic Reevaluation Report of the Santa Ana River Mainstem including Santiago Creek (USACE, 2013). USACE provided updated economic analysis to the SARM project in 2013. This analysis included an update of the hydraulic and hydrologic analytical models (HEC-RAS, FLO-2D, HEC-HMS) for Santiago Creek. Under without-project conditions, there were two major breakout areas where the 1% AEP event exceeded the channel capacity, both near the Santa Ana River at Bristol Street. Inundation depths varied between 0- and 5-feet. According to the analysis, the 200-year AEP event overtops the Santiago Recharge Basins, as the culverts underneath Prospect Street are limited to approximately 7,000 cfs and uncontrolled spillway discharge from the dam overwhelms the pits and overtops onto Prospect St and Bond Ave. The model results showed that the 1% AEP flows were fully contained within the channel and reservoir under with-project conditions. The model results indicated that the Santiago Recharge Basins would be overtopped during the 200-year AEP events under with-project conditions, however the model did not account for changed operating conditions at the reservoir or additional flow capacity from the proposed outlet channel. The 2013 Economic Reevaluation Report (ERR) represents the most recent hydraulic and hydrologic analysis prior to this DDR.

Project Survey Report. Santiago Creek Project, Orange County, California (USACE, 2018). Johnson-Frank & Associates on behalf of USACE conducted aerial Light Detection and Ranging (LiDAR) topographic surveys of the Santiago Creek project area in 2018. Topographic data was collected between the basin area and the Santa Ana River, and included ground-truthing of results through ground-level total station cross-sections.

1.6.2 Planned Investigations

Survey Reports. CELRC is coordinating collection of additional survey data along the project extents. The 2018 survey (USACE, 2018) did not include topographic or bathymetric survey of the Villa Park Dam impoundment nor the Santiago Dam impoundment. CELRC has collected additional LiDAR in this area or utilizing existing bathymetric data provided by the local sponsor. This data has become available recently and updated stage-storage relationships are presented later in this Appendix. CELRC will coordinate transfer of planimetric data with the local sponsor.

2.0 PROJECT DESCRIPTION

2.1 Site Description

The Santiago Creek is located entirely within Orange County, California. The full watercourse is approximately 30-miles, originating in the Santa Ana Mountains and draining at the Santa Ana River which ultimately discharges to the Pacific Ocean (Figure 1). It is the largest tributary of the Santa Ana River downstream of the Prado Dam. The Santiago Creek watershed is home to approximately 74,000 residents (source: 2017 ERR). Nearly all structures are within the heavily urbanized portion of lower Santiago Creek portion below the Villa Park Dam.

The proposed project area is the lower Santiago Creek between Villa Park Dam and the creek's confluence with the Santa Ana River (Figure 2), approximately 25-miles southeast of downtown Los Angeles. The creek downstream of the Santiago Recharge Basins is an approximately 9-mile long, urbanized, channelized stream. The creek is mainly earthen except in a few areas where it is armored, channelized, and/or paved. The section of the creek downstream of Villa Park Dam is ephemeral and predominantly dry except during brief periods of the rainy season (October through April). Because the creek is typically dry, portions of the channel have other uses during the dry

periods. The creek adjacent to Hart Park and Santiago Park are also used as a parking lot, and the River View Golf Course is located within the river just downstream of the Santiago Creek's confluence with the Santa Ana River.

Villa Park Dam is located at the upstream end of the project area, it is a flood-control dam maintained and operated by the Orange County Flood Control District (OCFCD). The dam can impound approximately 16,000 acres-feet of water, which includes runoff from the adjacent mountainous area as well as discharges from the upstream Santiago Dam. The maximum controlled release from the dam is approximately 6,000 cubic feet per second (cfs) from the gated control structure, with an additional 9,200 cfs from the spillway under certain conditions. The spillway discharge capacity is approximately 29,000 cfs (OCFCD, 1992) The dam mitigates flows to the lower Santiago Creek project area during most precipitation events.

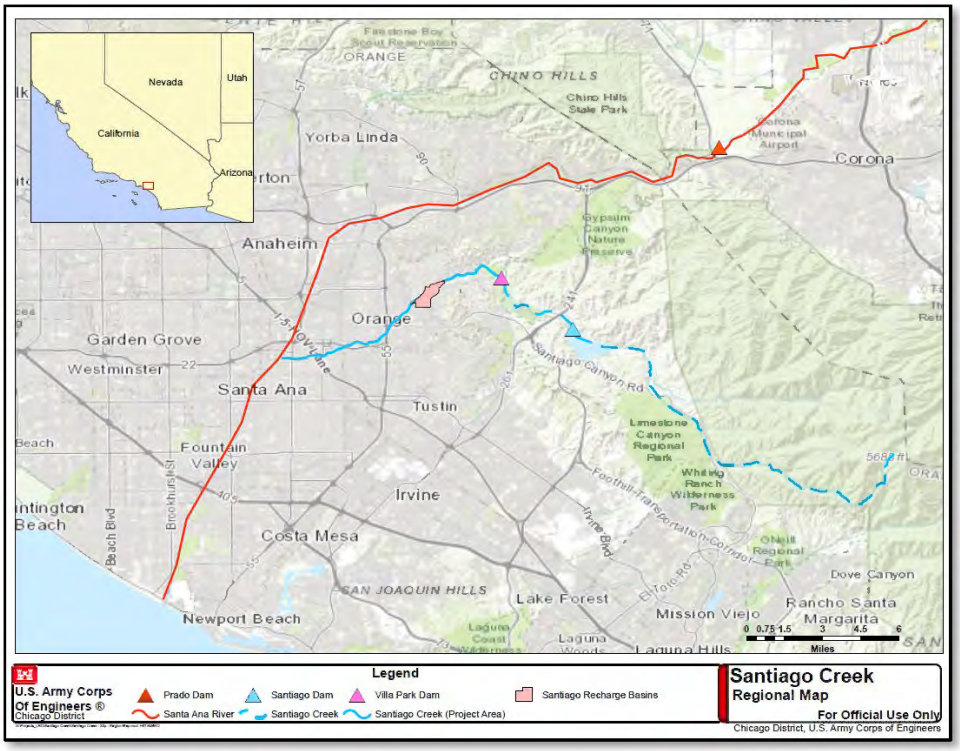


Figure 1: Santiago Creek

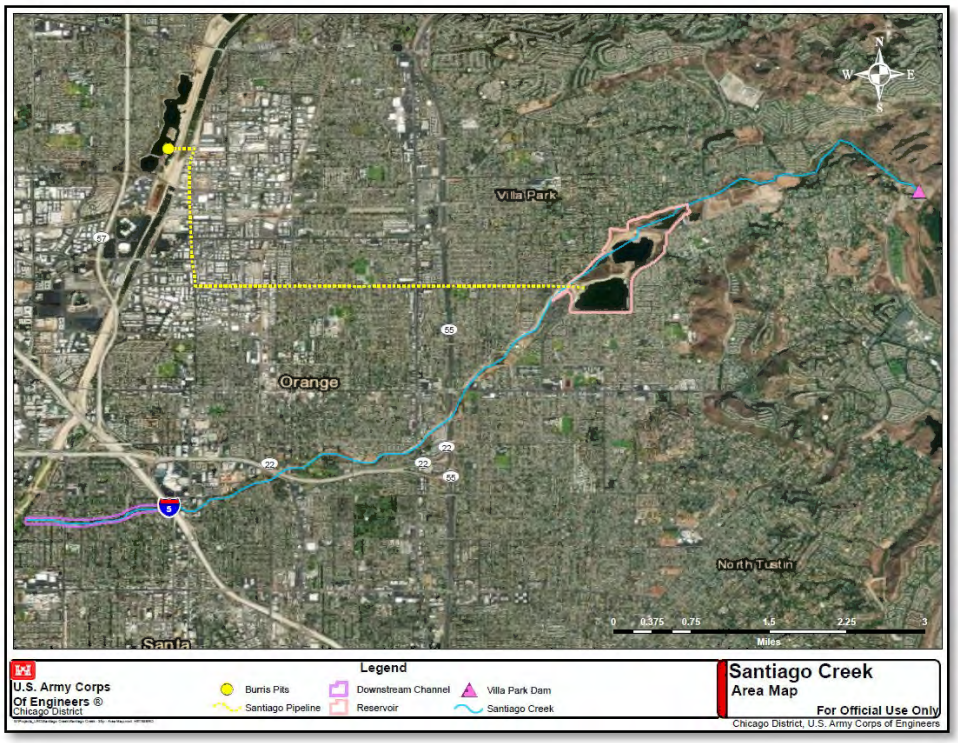


Figure 2: Santiago Creek project area.

Downstream of the dam, the creek passes through three former gravel pits – the Smith, Blue Diamond and Bond Pits (Figure 3). These former gravel pits, along with the Smith Basin immediately upstream, were converted to environmental conservation basins by the Orange County Water District (OCWD) in the early 1990's. The pits, now known as Santiago Recharge Basins, are primarily gravely and cobbley sand which maintain a standing pool of water throughout the year for groundwater recharge. They receive water from the Villa Park Dam, Santiago Pipeline, Handy Creek (via Alameda Drain), and other adjacent runoff and stormwater drains. Water from Villa Park Dam passes across Smith Basin and through a culvert approximately 56-feet below the top of Villa Park Road, discharging to the former gravel pit. The basins are typically used for groundwater recharge, and they maintain a standing pool which does not typically flow downstream under most conditions.

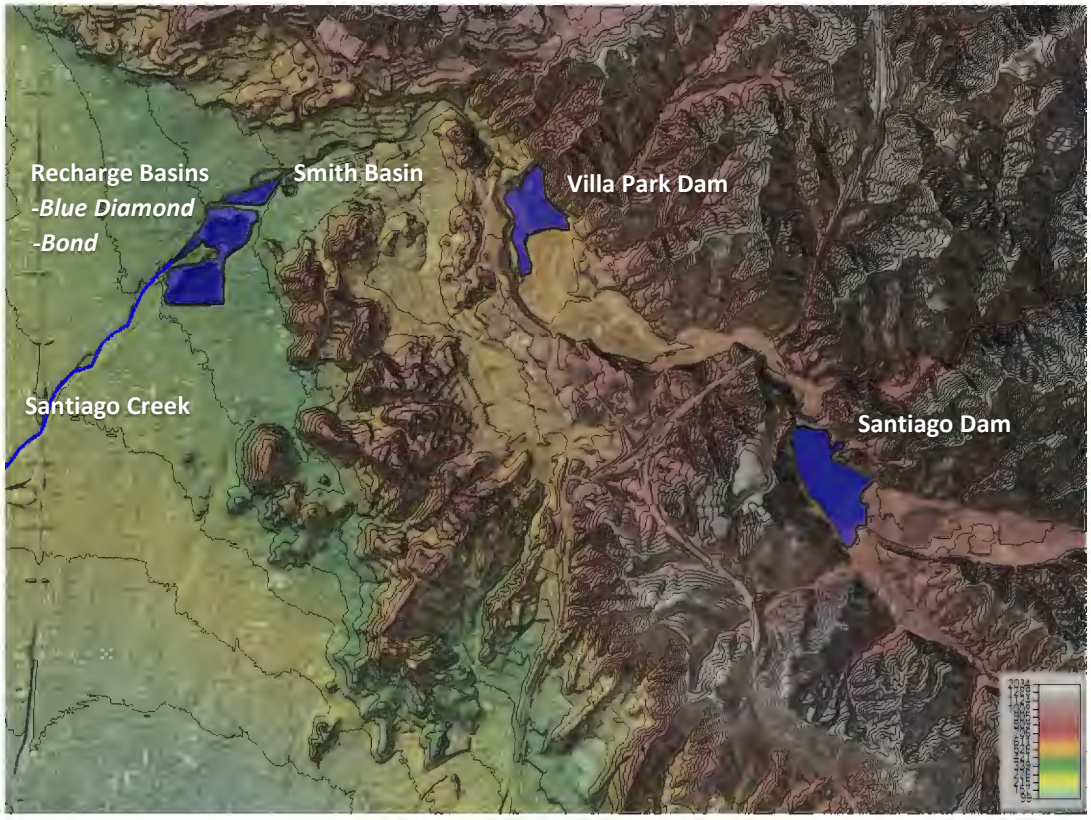


Figure 3: Significant storage features in Santiago Basin.

During normal conditions and minor precipitation events, flow inputs are completely contained within the Santiago Recharge Basins and never reach the downstream channel. During major floods, water will fill the basin and overflow to the downstream channel. Water flowing downstream from the Santiago Recharge Basins passes through a series of arched outlet pipes underneath Prospect St, discharging to the Santiago Creek.

In the spring of 2022, the Orange County Water District completed the construction of a saddle repair between the Blue Diamond and Bond Basins. The repair work was performed to address erosion on the saddle that occurred during a rapid fill event approximately 10 years earlier. The saddle includes a 12-foot box culvert and that connected the basins at elevation 202.5 ft (NAVD 88). The crest of the saddle is 288.5 ft (NAVD 88).

Downstream of the basins, Santiago Creek is an urbanized stream course constrained by encroachments on either side of the channel. The channel is primarily earthen, though some locations have been converted to channelized concrete or stone. Generally, the channel materials are medium dense gravelly sands, silty gravelly sand, and sands with cobbles and boulders near 14-inches in diameter. The Phase II GDM recommended channel improvements to a 1.2-mile segment of Santiago Creek between the I-5 (Santa Ana) Freeway and the confluence with the Santa Ana

River. In this reach, the stream is a compacted earth channel with numerous encroachments, including residential yards, retaining walls, fencing, and vegetation. The study also identified channel improvements for a previously bare earth segment of creek between the Santiago Recharge Basins and Walnut Street. However, a trapezoidal concrete channel was constructed by non-federal interests in the Santiago Recharge Basins to Walnut Street reach in approximately 1991.

To provide additional flood control capacity, the feasibility study also identified improvements to the existing Santiago Recharge Basins area encompassing the former Bond and Blue Diamond Gravel Pits as well as Smith Basin (Figure 3). These gravel pits are a large commercial excavation; the Bond and Blue Diamond pits are joined at the "saddle area" (also referred to as the intertie) which is an earthen groin connecting the two former pits. During a larger filling event, this saddle area was eroded from overtopping. To stabilize the eroded saddle, an armored box culvert was installed within the groin in Spring 2022.

The Smith Basin was also commercially excavated and connects to the Blue Diamond pit via a culvert underneath Villa Park Rd. The Smith Basin is an undeveloped and heavily vegetated low-lying depression immediately north of the Bond and Blue Diamond pits; it is not utilized for groundwater recharge due to limited infiltration potential though the area is periodically inundated by water as the water level in the Santiago Recharge Basins exceeds the invert elevation of the connecting culvert.

2.1.1 Hydrologic and Hydraulic Conditions

The Santiago Creek watershed is approximately 102-square miles in area, it is located primarily in Orange County with a small portion of the headwaters within Riverside County. The watershed is semiarid, with moderate rainfall in the winter months and almost no rainfall the rest of the year. The creek's headwaters originate in the Santa Ana Mountains near Santiago Peak. While the upstream portion of the creek is a relatively undeveloped mountainous region, the downstream segment of the basin is located within a heavily urbanized coastal plain. The entire watershed is a mixture of agricultural, residential, and commercial development. The mountain and foothill areas are scrub, sage, grasses, and scattered trees with large tree stands in the flood plain. The proposed project is located entirely within the downstream valley portion of Santiago Creek where large segments of the valley and coastal plain are cleared of vegetation due to extensive development. The hydrologic and hydraulic setting are briefly summarized below.

2.1.2 Hydrometeorological Characteristics

Most precipitation results from general winter storms associated with extratropical cyclones of the north Pacific and may last four days or more, resulting in precipitation over large areas. Thunderstorms may result in intense precipitation during short periods either in association with general storms or independently. Snowfall occurs in the winter at high elevations within the Santa Ana Mountains, though snowmelt is not a contributing factor to peak runoff values. Nearly all rainfall occurs during the period from November through March. Mean annual rainfall is approximately 18-inches, with an approximate average of 12-inches falling near the Santa Ana River and approximately 28-inches falling in the mountains. Runoff in the basin is erratic with almost no flow for most of the year.

2.1.3 Hydrologic Characteristics

Stream flow is perennial in the canyons though generally ephemeral in the valley segments. The stream is ephemeral within the full project area downstream of Villa Park Dam; this portion of Santiago Creek exhibits little to no stream flow except during and following large precipitation events. Stream flow increases rapidly in response to precipitation, particularly in the urbanized portions of the valley.

The 2013 Economic Reevaluation Report developed hydraulic modeling for existing conditions, utilizing a combination of available as-built drawings (e.g., for the OCEMA Prospect to Walnut section), DM-14, and Phase II GDM data. Under current (2013, without project) conditions, the model showed that there was no flooding with

the 1% AEP upstream of the Santa Ana Freeway. Downstream of Santa Ana Freeway, the modeling indicated floodplain breakout from the channel at two locations during the 1% AEP event, approximately 1,500- and 500-feet upstream of the confluence with SARM. This flooding inundates an approximately 1.5-mile-wide area along Santa Ana River, and some flow is captured by the Oceanview and East Garden Grove Wintersburg channel. Between Santa Ana Freeway and Santa Ana River, flow velocity was approximately 10 fps and stage approximately 10-feet during the 1% AEP event. Under with-project conditions proposed by the Phase II GDM, the model indicated no bank overtopping. The 2022 updated hydraulic model, as later described.

According to previous analysis, the stream is capable of passing 5,000 cfs at the confluence of Santa Ana River without overtopping. This capacity limitation is confirmed with the current analysis. It is worth noting that a significant flooding event occurred in 1969 and reportedly there was significant erosion but no overtopping of the banks. The 1969 flood had a peak discharge of approximately 7,000 cfs and was considered an approximately 250-year (0.4% AEP) storm based on previous analysis performed for the Santa Ana River basin.

Flow from the mountainous headwaters is captured by Santiago Dam (also known as Irvine Dam). Santiago Dam was constructed by the Irvine Company in 1933, and is an earthen dam built for flood control, irrigation, and municipal water use. The dam holds approximately 38,800 acres-feet and has an uncontrolled spillway at elevation 792.5-ft. The Irvine Ranch Water District is currently planning improvements at the dam. This dam effectively captures flood waters from the mountainous region during most storm events.

The Villa Park Dam was constructed in 1963 and is approximately 3.4 miles downstream from Santiago Dam. The dam is an earthen embankment dam constructed at a natural canyon narrow downstream of a widened valley. The impoundment holds approximately 16,000 acres-feet of water at the crest elevation, capturing overflow from Santiago Dam and runoff from an 83.8-mile watershed. Villa Park Dam is classified as an Extremely High Hazard Potential per State of California OAL Emergency Regulatory Action 2017-1009-03E. The dam discharges water through its main 13-ft by 13-ft gated outlet during normal conditions, or via a 200-ft wide reinforced concrete ogee spillway at elevation 568.5-ft (NAVD88) during overtopping conditions. The dam is capable of conveying a design discharge of 29,000 cfs, and the gated outlet capable of discharging 6,000 cfs. According to the 1991 Operation and Maintenance Manual, the gated outlet discharges a maximum of 3,500 cfs but has the capability to discharge up to 6,000 cfs under risk-based and defined conditions.

The Santiago Recharge Basins are located 3-miles downstream from Villa Park Dam. The basins are utilized for groundwater infiltration and flood control storage purposes, and a pond elevation is maintained to the maximum extent practicable for water conservation purposes. During minor floods, upstream flows are completely contained within the basin, and never reach the downstream channel. However, during major floods, water will fill the basin and overflow to the downstream channel. The total capacity of the Santiago Recharge Basins, including the Blue Diamond, Bond, and Smith Pits, is 13,509 acres-feet of water below elevation 287.5-ft NAVD88 based on a 2019 survey effort by USACE. When the pond is above approximately elevation 287.5-ft, water flows from the basin to Santiago Creek via the natural stream path along the southwestern extent of the basins. Water levels in the basins fluctuate throughout the year (Figure 4). Water can be transferred to and from the Burris Pits of the Santa Ana River via the Santiago Pipeline, as necessary. The Santiago Pipeline is typically used to transfer water from the Burris Pits to the basins to enhance groundwater recharge capacity. The basins also accept water from localized runoff, including from stormwater discharge outlets.

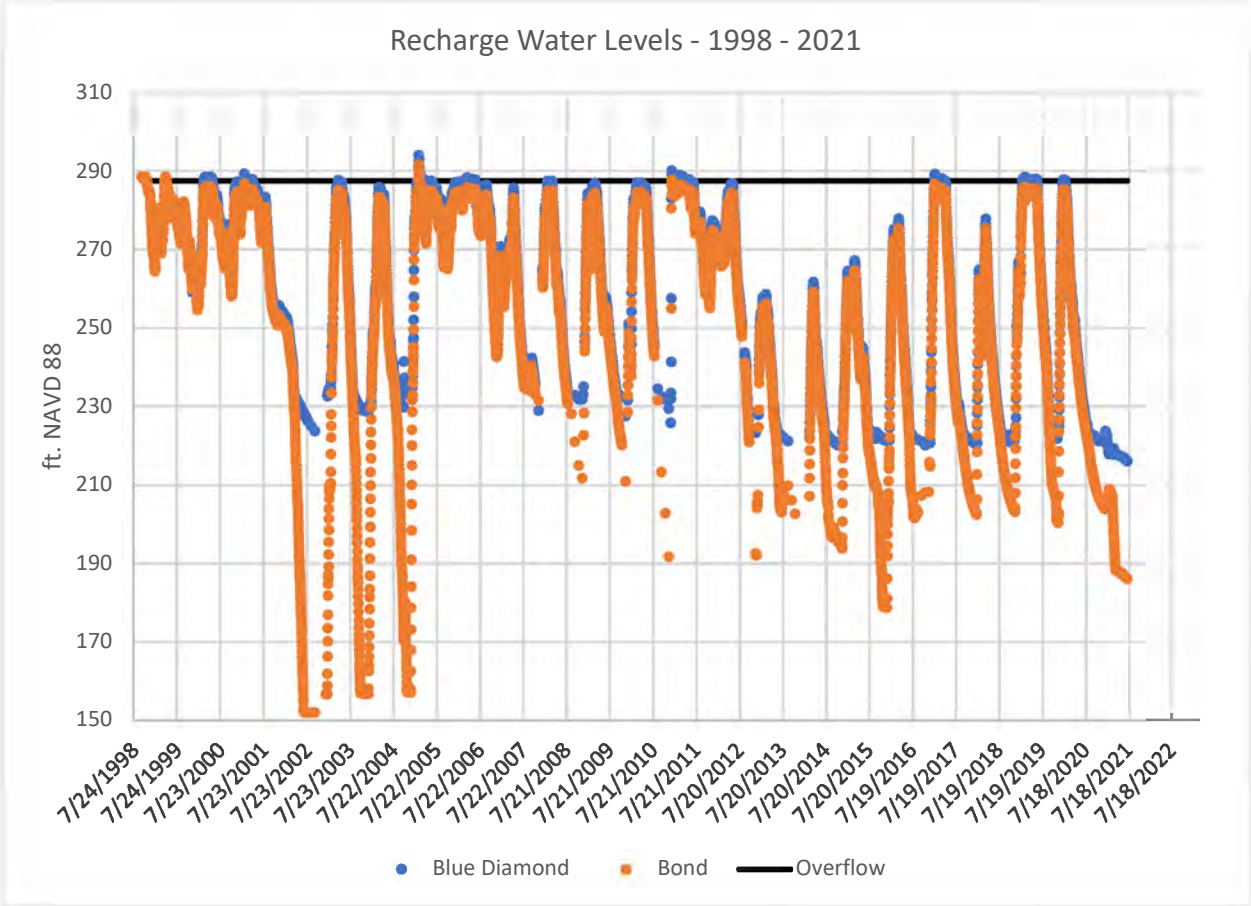


Figure 4: Water levels in the Basins between 1988 and 2021

2.1.4 Hydraulic Characteristics

The channel gradients are approximately 0.06 ft/ft in the mountainous upstream reaches of Santiago Creek, and approximately 0.005 ft/ft in the lower reach and project area. Discharges from Villa Park Dam enter an existing 21-ft culvert underneath Villa Park Rd.

In 1991, the OCEMA constructed a concrete trapezoidal channel between Prospect St and Walnut Ave, as described in more detail below. Between Walnut Ave and Tustin Ave, the streambed opens into an approximately 200-ft wide partially vegetated earthen channel. Rip rap was placed along the northern bank between Chapman Ave and Tustin Ave in the 1990's to protect homes to the north. In 1995, between Tustin Ave and Cambridge St, the creek was channelized with a soil-cement trapezoidal channel by Orange County. Downstream of Cambridge St the creek becomes a natural earthen channel until reaching Shaffer St, in this location the floodway is a concrete parking lot for Hart Park when dry. The floodway also doubles as a parking lot for Santiago Park, placed to Lawson Way. During the 1930's, masonry walls were constructed from the Santa Ana Freeway through Hart Park; the existing walls in this location are considered historic structures.

Proposed channel improvements for the project are between Santa Ana Freeway and the Santa Ana River. Between the freeway and Flower Street, bank protection is currently provided by individual property owners and includes various types of protection including natural bank, vegetation, cobblestone/masonry, or concrete. From Flower St to Bristol St existing channel has 2H:1V side slopes and is protected by wire mesh and heavy vegetation growth. Downstream of Bristol Street, side slopes are protected by various sized gravels, boulder, and broken concrete. During the floods of 1969, the stream experienced significant erosion in this area, and emergency

sandbags and structural debris, including junk motor vehicles, were placed along the banks for protection.

2.2 Project Objective

Consistent with the authorized plan, the overall design objective for this project is to contain the 1% AEP floods downstream of Villa Park Dam within the existing Santiago Creek channel and reservoir, and to prevent erosion threatening adjacent structures.

2.3 Overview of Design components

2.3.1 Reservoir Improvements

In the initial plan formulation, reservoir improvements were considered necessary in order to accommodate the flood storage volume. The Santiago Recharge Basins (reservoir) were intended to fulfill a dual purpose and continue to be operated to fulfill water conservation (i.e., groundwater recharge) purposes while also providing additional flood storage. The objective of the proposed plan was to store and attenuate the 1% AEP flows such that they are contained within the Santiago Creek channel and reservoir.

The Phase II GDM 1% AEP hydrographs were patterned after the 1969 flood hydrographs, balancing and proportioning flows such that the 1% AEP design discharges were routed through Santiago Dam and Villa Park Dam. In order to ensure that the downstream design condition of maximum channel capacity is not exceeded (determined to be 5,000 cfs at the Santa Ana River confluence), discharges from the reservoir were to be attenuated such that this maximum discharge rate was met. Downstream of the reservoir, approximately 1,500 cfs was added to the channel from discharge structures and runoff. In order to maintain the maximum discharge condition at the confluence, flows from the reservoir were to be regulated such that a maximum discharge capacity of 3,500 cfs was maintained during the 1% AEP. The Phase II GDM assumed that the maximum gated spillway capacity of the Villa Park Dam was 3,500 cfs, and a 1% AEP event would result in discharges from the dam's uncontrolled spillway amounting to an additional 2,200 cfs (5,700 cfs total). To attenuate those flows such that the downstream discharge condition was met during the 1% AEP, the required reservoir storage volume was sized to accommodate the uncontrolled spillway volume plus contemporaneous runoff upstream of the reservoir which amounts to 4,618 acres-feet. By providing flood storage for the flood volume in excess of the 3,500 cfs requirement, discharges at Santa Ana River from Santiago Creek would not exceed the 5,000 cfs at the confluence with the Santa Ana River.

The Santiago Recharge Basins are managed to maximize groundwater infiltration. To be consistent with both the water conservation requirements as well as the flood storage requirements, the reservoir had to be capable of storing conservation water during the hydrometeorological wet period. To accommodate these joint uses, the Phase II GDM recommended management of the water levels at the reservoir such that conservation storage could be removed from the reservoir and discharged to Santiago Creek rapidly ahead of any releases from Villa Park Dam. Water would be discharged from the reservoir in a manner that would not create flooding concerns for downstream residents while also freeing up the minimum 4,618 acres-feet capacity for flood control storage.

As established in the Phase II GDM, the minimum 4,618 acres-feet capacity necessary for flood control is available between the elevations of 300.5-ft NAVD88 and 276.5-ft NAVD88. Storage between the elevation of 295.5-ft NAVD88 (dry season) or 293.5-ft NAVD88 (wet season) and the maximum elevation of 300.5-ft is reserved for contemporaneous runoff. Conservation storage between the 295.5-ft (or 293.5-ft) elevation and 276.5-ft elevation would need to be rapidly evacuated and discharged to Santiago Creek to accommodate releases from Villa Park Dam. The stage-storage relationship identified by the Phase II GDM differs somewhat from the recently updated 2019 survey due to changed conditions at the site.

To provide the necessary flow regulation at the Santiago Recharge Basins, a flow regulation structure was considered needed at the reservoir site. To provide the required flood storage capacity and to accommodate the revised operating conditions at the reservoir, structural improvements were considered necessary at the reservoir

site; vertical expansion and reservoir flow regulation. Table 1 contains significant features and elevations related to the reservoir improvements.

Table 1: Significant features and elevations related to the Reservoir Improvements.

Feature / Location	Elevation (ft. NAVD88)	Significance
Invert of 20 ft x 12 ft Radial Gates in Outlet Structure	270.0’	Lowest elevation the pool can be lowered with the outlet structure
Low pool Elevation	276.5’	Drawdown elevation in advance of storm events
Crest of saddle repair embankment between Blue Diamond and Bond Basin	288.5’	Hydraulic connection below the crest is through 12 ft box culvert (EL 202.5 ft NAVD 88). Connection above 288.5 ft is overtopping of the saddle.
High Pool during wet season	293.5’	Maximum pool level for the wet season
High Pool during dry season	295.5’	Maximum pool level for the dry season
Overflow weir connecting Bond Basin to Outlet Channel through Prospect Culverts	300.5’	At this pool level, unregulated flow begins over the grouted riprap bypass weir and through the Prospect Culverts
Top of berm surrounding Outlet Structure	302.5’	Pool levels above this elevation result in overtopping of the Outlet Structure and uncontrolled release through the three 10 x 13 ft box culverts (proposed) under Prospect Avenue
Overtopping location on southwest corner of Bond Basin	302.5’	Pool levels above this elevation result in uncontrolled release of floodwaters into the densely populated area around N. Gravier St. Floodwaters depart from the channel and continue south.
Low elevation of Villa Park Rd (between Smith Basin and Blue Diamond Basin).	305.8’	Above this elevation, Villa Park Rd overtops from Smith Basin to blue Diamond Basin.

2.3.1.1 Vertical Expansion

See Appendix 6 Geotechnical Investigation Report.

2.3.1.1 Reservoir Flow Regulation

Overview

Regulation of water levels within the existing Santiago Recharge Basins would allow the reservoir to be operated to provide 1% AEP flood storage while maintaining its water conservation purpose. To accommodate the recommended storage and operational changes, the Phase II GDM and DM-18 included construction of outlet works at the reservoir. The outlet works consists of the gated flow control structure (outlet structure) for controlled reservoir releases as well as a designated overtopping location (overflow structure).

According to the analysis of the Phase II GDM and DM-18, storage of 4,620 acres-feet within the Santiago Recharge Basins (reservoir) is necessary to limit flows to Santiago Creek’s available capacity during the 1% AEP events. The 1% AEP hydrograph utilized to determine storage requirements was patterned after the 1969 storm, and inflows assumed a Santiago Dam starting elevation of 792.5-ft NAVD88 (spillway crest elevation) and a Villa Park Dam starting elevation of 512.5-ft NAVD88 (debris pool elevation). The 1988 GDMII indicates that flows originating from

Villa Park Dam corresponded to the 1985 operating manual, such that a maximum flow rate of 3,500 cfs is discharged from the gated outlet and a maximum discharge of 5,700 cfs is possible if the uncontrolled spillway elevation is overtopped. However, the Villa Park Dam Operation Manual was updated in 1991 in order to allow an increase in the gated spillway flows from 3,500 cfs to 6,000 cfs under certain conditions (OCEMA, 1991).

Previous analysis indicated that the required storage volume of 4,620 acres-feet was available within the basins between elevations 276.5-feet and 300.5-feet NAVD88. This maximum 300.5-feet elevation provides the minimum 2-foot of freeboard for surrounding grade. The available storage was based upon the stage-storage curve at the time of report development, however changes to the site since 1988 have altered this relationship slightly. Using topographic and bathymetric survey data collected in 2019, the revised stage-storage relationship is provided as indicates 4,665 acres-feet available between elevations 276.5-feet and 300.5-feet NAVD88. Figure 5 shows the stage storage relationship for each of the three basins. Smith Basin is hydraulically connected to Blue Diamond Basin through a 21' diameter culvert and an overtopping location of Villa Park Road at elevation 305.9 ft (NAVD 88). Blue Diamond and Bond are hydraulically connected through a 12' box culvert and an overtopping elevation of the saddle at elevation 288.5 ft (NAVD 88).

While developing the stage storage curves, previous LiDAR data from 2012 and recently collected data was compared to the original stage-storage curves developed back in the 1980s for Villa Park Dam and Santiago Dam and no significant changes were observed, indicating that sedimentation has not likely affected the stage-storage relationships of the reservoir pools.

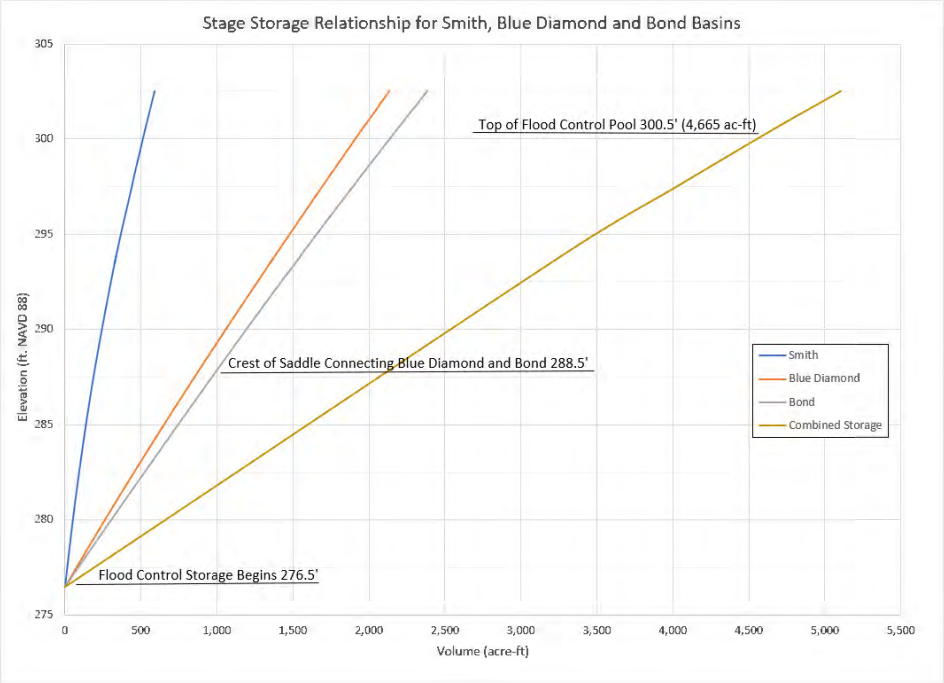


Figure 5: Stage storage relationship for Smith, Blue Diamond and Bond Basins.

The intended purpose of the reservoir was to accommodate both the flood control storage requirements as well as the water conservation purpose of the reservoir. The OCWD stores water from the Burris Pits within the reservoir to maximize groundwater infiltration rates throughout the year. The design intent was to allow the reservoir's water surface elevation to be maintained at the highest level practicable throughout the year, and to release conservation water ahead of a storm event to create capacity for incoming flood waters.

GDM 2 and DM-18 provide reservoir operating conditions which depend on Santiago Dam pool elevation, Villa Park Dam pool elevation, and time of year. GDM 2 and DM-18 describe project formulation that is intended address

flooding from both localized storms that would occur downstream of Villa Park Dam, recognizing that local storms may have the ability to exceed the 5,000 cfs design discharge threshold established as the maximum allowable release from Santiago Creek to the Santa Ana River. It is unclear if this threshold was established considering only the bankfull capacity of Santiago Creek, or if it also includes consideration of how exceeding the 5,000 cfs would affect the system capacity of the greater Santa Ana River project. A secondary consideration would be the joint probability of local storms occurring coincident with an event that would near capacity limits of the Santa River, but this requires consideration of the broader Santa Ana River hydrology.

In the original plan formulation, the upper limit of storage in the Recharge Basins was set at 293.5 ft (NAVD 88) during the wet season (December 1 – March 10) and 295.5 ft (NAVD 88) during the dry season serve as storage for the 1% AEP runoff generated by a local storm upstream of the Recharge Basin. In the conditions that would produce a 1% AEP event on lower Santiago Creek, Villa Park dam and the Recharge Basin could hold releases to reduce the flood peak downstream. The storage between elevation 293.5 ft (NAVD 88) during the wet season and (295.5 ft (NAVD 88) during the dry season) would be used to hold back all of the runoff generated during this 1% AEP event between the outlet works of the Recharge Basin and Villa Park Dam. The contributing drainage for this area is approximately 9.3 square miles. Table 2 is a summary of the storage limits, precipitation volumes and percentages capture for both the wet and dry seasons. The purpose of the table is to more explicitly define the operating limits presented in DM-18 in the context of recent precipitation frequency information.

Table 2: Comparison of rainfall and volume storage between the storage limits and overflow.

Season	Storage Limit (ft NAVD 88)	Overflow (ft NAVD 88)	Storage Volume between limit and overflow (acre-ft)	1% AEP Precipitation (inches)*	Total Precipitation Volume (acre-ft)	% Storage
Wet	293.5’	300.5’	1472	4.8”	2381	62%
Dry	295.5’	300.5’	1062	4.8”	2381	45%

*For local storms, a shorter duration of 12 hours was assumed (NOAA Atlas 14)

Based on expected rainfall runoff volumes relationships, the original assumptions are reasonable, given the uncertainty of antecedent conditions preceding any particular event.

In addition to localized storms, the general storm design was considered in the formulation. As described above, prior to evacuation of conservation water from the reservoir, the maximum conservation water elevation would be 295.5-ft NAVD88 during the dry season (between March 11 and November 30) and 293.5-ft NAVD88 during the wet season (between December 1 to March 10). If the Santiago Dam pool is at an elevation of less than 785.5-ft NAVD88, no releases from the reservoir are necessary. The additional storage behind Santiago Dam allows a delay in the loading of Villa Park.

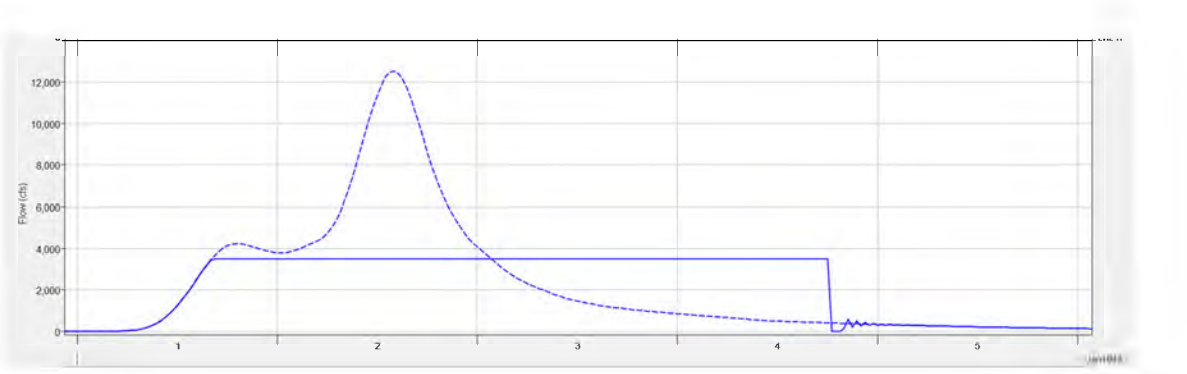


Figure 6: Inflow and outflow from Villa Park Dam comparing Santiago Dam at the crest (top) and lowered by 7 feet at the beginning of the 1% AEP event (bottom).

Figure 6 shows how the additional storage delays the maximum release from Villa Park Dam. Figure 7 and Figure 8 show that both the target water surface elevation in the Recharge Basin and the target flow on lower Santiago Creek are achieved.

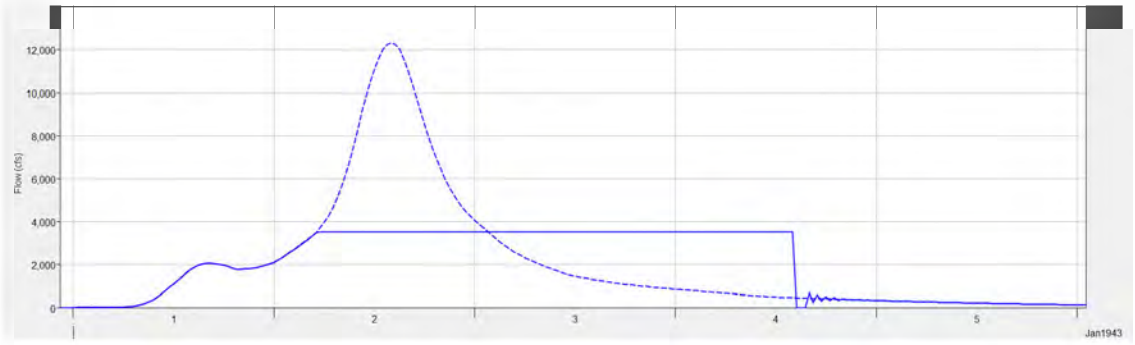


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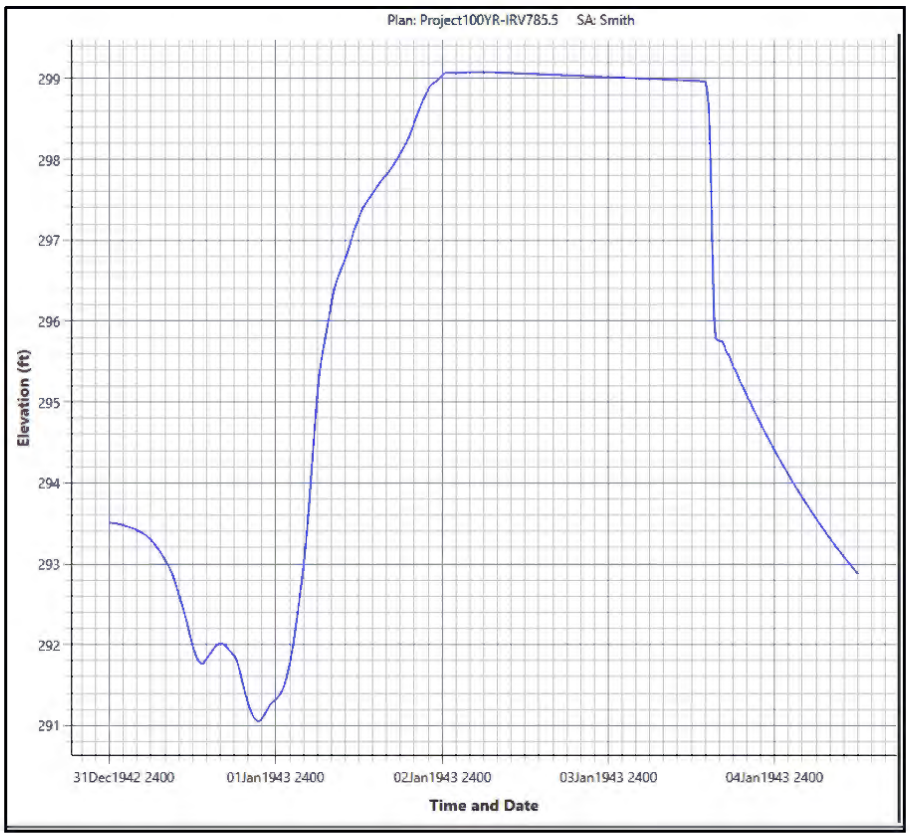


Figure 7: Stage hydrograph for Smith Basin with Santiago Dam starting at elevation 785.5 ft NAVD 88. No advance drawdown in the Recharge Basin is required.

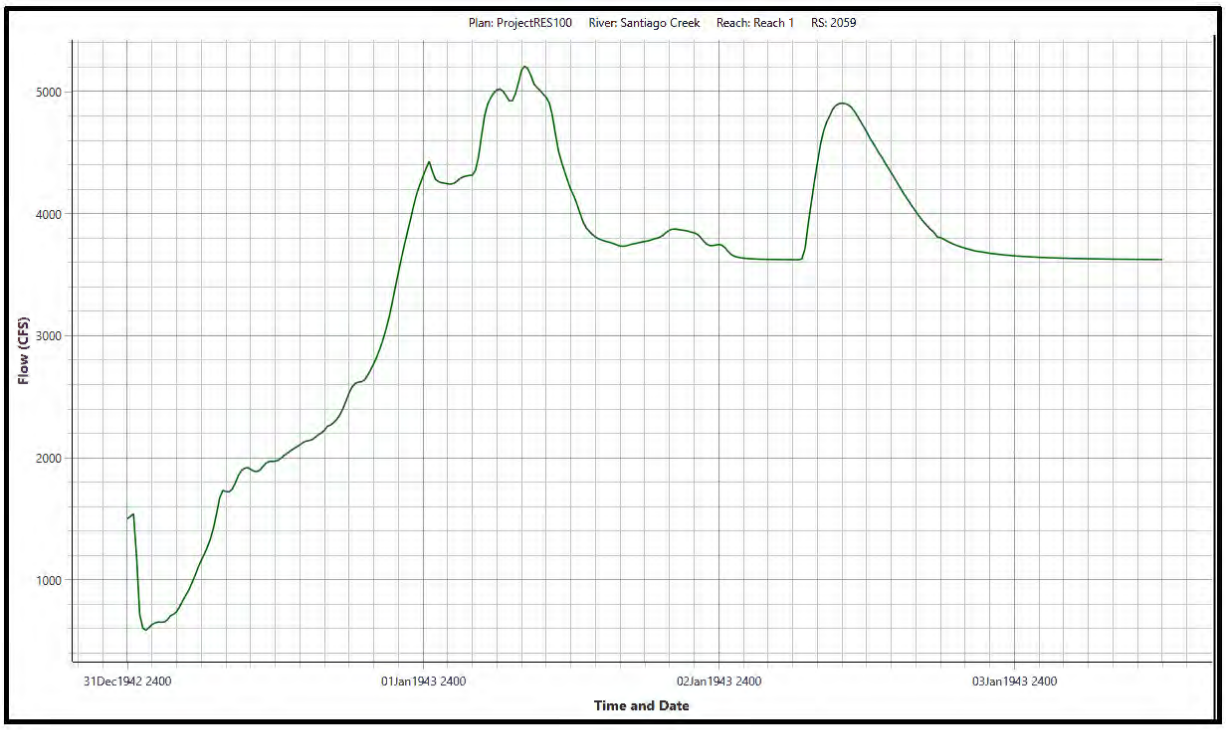


Figure 8: Flow hydrograph on Lower Santiago Creek. Peak discharge just above 5,000 cfs, the target design discharge.

Summary of Updated Results

Updated hydrologic and hydraulic analysis was performed for this DDR and is described in more detail in Sections 3.0 and 5.0, Hydrology and Hydraulics, respectively. To summarize these updated for the purpose of describing the reservoir flow regulation, the update included a reanalysis of the flow frequency of inflows into Villa Park Dam, and updated routing of the flow hydrographs from Villa Park Dam (and contributing areas downstream of Villa Park Dam) through Smith, Blue Diamond and Bond Basins. From review of the analysis performed in 1988, it appears the routing was performed using level pool routing through all three basin lobes. The updated reanalysis routed through each of these three basins. This updated was particularly important since the recent installation of the saddle repairs. The 12-foot box culvert through the saddle is significantly smaller than the 21-foot circular pipe under Villa Park Road. At pool levels above 288.5 ft (NAVD 88) the saddle overtops and allows equalization of the Blue Diamond and Bond Basins, but during the operating range between 276.5 ft (NAVD 88) and 288.5 ft (NAVD 88) the pool level in Bond Basin lags behind the pool level in Blue Diamond Basin making less head available for release through the outlet structure. The reduction in available head (and reduced release from the basins) reduced the effectiveness of the available storage in Bond Basin. A routing comparison between the 'with saddle' and 'without saddle' was performed to determine how this affect pool levels during the design 1% AEP event. The routing used starting pool elevations for Santiago Dam and Villa Park Dam of 792.5 ft (NAVD 88) and 512.5 ft (NAVD 88), respectively.

A comparison was also made between the 1% AEP event volumes between the 1980 flow frequency for inflows into Villa Park Dam and the 1% AEP event volumes based on the updated flow frequency using inflow records to date. The purpose of looking at the previous flow frequency was to evaluate how the project could perform if the drier conditions of recent decades did not continue and the 1980 flow frequency analysis was a better representation of the long-term flood risk in the basin.

These conditions represent Santiago Dam pool level at the spillway crest and Villa Park Dam at the debris pool. The results are presented in Table 3 below. The results show that the 1% AEP event for the most recent flow frequency update show containment below the formulated high pool of 300.5 ft NAVD 88, both and without the saddle, but when evaluated with the older flow frequency analysis 1% AEP volumes, the high pool of 300.5 ft NAVD is exceeded with the saddle condition.

Table 3: Comparison between 1% AEP pool elevations for 'with saddle' and 'without saddle' for the recent flow frequency update for inflows into Villa Park Dam.

Location	Initial (begin routing) Pool (NAVD 88)	Without Saddle Improvements (prior to 2022) Pool (NAVD 88)	With Saddle Improvements (current) Pool (NAVD 88)
Smith Basin	276.5'	296.9'	300.4'
Blue Diamond	276.5'	294.0'	297.4'
Bond Basin	276.5'	294.0'	297.4'
Total Storage Required (acre-ft)		3571	4291

Table 4: Comparison between 1% AEP pool elevations for 'with saddle' and 'without saddle' for the 1980 flow frequency update for inflows into Villa Park Dam.

Location	Initial (begin routing) Pool (NAVD 88)	Without Saddle Improvements (prior to 2022) Pool (NAVD 88)	With Saddle Improvements (current) Pool (NAVD 88)
Smith Basin	276.5'	304.5'	306.7'
Blue Diamond	276.5'	300.6'	301.5'
Bond Basin	276.5'	300.6'	301.5'
Total Storage Required (acre-ft)		4812	5055

There is significant uncertainty in hydrologic analysis related precipitation. The National Oceanic and Atmospheric Administration (NOAA) publishes 90% confidence intervals for annual maximum precipitation frequency estimates. For the Santiago Creek basin, the 95% confidence limit for the 1% AEP precipitation is approximately 20% more in the valley downstream of Villa Park Dam, and approximately 23% more in the mountain region. To determine how this uncertainty affects the risk of the basins exceeding the containment capacity resulting in an uncontrolled release of floodwaters in the neighborhood southwest of Bond Basin near N. Gravier St., an analysis was performed using the 95% confidence interval precipitation assuming an advance drawdown of 576.5 ft (NAVD 88). Table 5 is a comparison of the pool levels for the 50% Atlas 14 precipitation values and the 95% confidence interval values.

Table 5: Comparison between the 1% AEP pool levels for both the 50% and 95% confidence interval NOAA Atlas 14 precipitation.

Location	Initial (begin routing) Pool (NAVD 88)	50% Precipitation Frequency Pool (NAVD 88)	95% Confidence Interval Pool (NAVD 88)
Smith Basin	276.5'	297.4'	307.1'
Blue Diamond	276.5'	297.4'	301.8'
Bond Basin	276.5'	300.4'	301.8'
Total Storage Required (acre-ft)		4291	5490

The previous analysis from 1988 concluded that the level pool storage between the drawdown level (276.5 ft

NAVD 88) and crest of the overflow (300.5 ft NAVD), which generated a total storage of 4,618 acre-ft, would be sufficient for routing of the 1% AEP event. While the 95% confidence interval evaluation shows pool levels exceeding the overflow elevation of 300.5 ft (NAVD 88), it still produces the expected benefit of maintaining flows on Santiago Creek at the confluence with the Santa Ana River to approximately 5,000 cfs, while preventing uncontrolled flooding southwest of Bond Basin. Changes to both conditions (saddle construction) and analysis (recalibration and modified routing) produce different 1% AEP pool elevations, but the reanalysis uphold the drawdown requirement to 276.5 ft (NAVD 88) in advance of storm events to make the necessary storage available.

2.3.1.2 Outlet Structure

With the reservoir improvements, it would be necessary to provide flow regulation at the reservoir to accommodate the release schedule. In addition to providing the initial conservation water pre-storm releases described in the table above, flows from the reservoir would be regulated to attenuate incoming flows from Villa Park Dam as well as contemporaneous runoff. The Phase II GDM established that the maximum channel capacity at Santiago Creek's confluence with the Santa Ana River is 5,000 cfs, and that runoff and side drain inputs deliver approximately 1,500 cfs of flow between the reservoir and the confluence during the 1% AEP event. This downstream boundary condition limits the maximum flow rate from the reservoir to 3,500 cfs.

Construction of a gated outflow structure would have allowed for flow control and reservoir water surface elevation control. The outlet structure was sized to pass a maximum of 3,500 cfs by gravity when the gates are fully open; the gates may be partially opened to throttle flows and maintain constant water surface elevations within the reservoir. During flood events, the outlet structure would be operated such that discharges match reservoir inflows as much as possible.

The DM-18 proposed outlet structure consists of an entrance chamber, gate chamber, approach chute, stilling basin and exit transition. The structure was designed following the guidance of EM 1110-2-1602 – Hydraulic Design of Reservoir Outlet Works and EM 1110-2-2400 – Structural Design and Evaluation of Outlet Works. The structure was to be installed in the southwest corner of the reservoir and would connect to a proposed outlet chamber and channel routed underneath Prospect St. The outlet structure was approximately 240-ft long, 40-ft wide, and 30-ft tall. It would have required excavation into the existing slope such that the entrance chamber invert could be placed at approximately 269.5-ft NAVD88 (approximately 30-ft below existing ground level. The outlet structure is concrete and steel with a slab foundation. Earthen berms would have surrounded the structure and tie into the adjacent overflow structure, and perimeter access roads provide access from Prospect Street.

The entrance chamber was proposed to be approximately 45-feet long with a slabbed roof (to be used as a work platform) and a trash rack at the upstream end. The gate chamber was approximately 30-ft long and includes two motorized radial gates and a single transferable bulkhead gate. The gate chamber was comprised of two individual 12-foot-tall chambers separated by a divider wall. A 30-foot-long open chamber parabolic transition led to the 45-ft long stilling basin with baffles for energy and hydraulic jump control. The stilling basin has an invert at approximately 262.5-ft NAVD88 and a 17-foot-tall divider wall. The outlet transition is approximately 63-ft long and leads to the triple bay box culvert underneath Prospect St. The concrete box culvert opened up to a 300-ft rectangular and trapezoidal concrete outlet channel that joins with existing Santiago Creek near E Balmoral Drive.

The revised hydrologic and hydraulic modeling later described were used to confirm the outlet structure components per the requirements of EM 1110-2-1420 (Hydrologic Engineering Requirements for Reservoirs), EM 1110-2-1602 (Hydraulic Design Requirements for Outlet Works).

2.3.1.3 Overflow Structure

The proposed overflow structure was an approximately 600-ft long designated overtopping location to be constructed of grouted riprap. The reservoir-side of the overflow structure would have provided an overflow weir with a crest set at the reservoir's maximum flood control storage elevation of 300.5-ft NAVD88. The minimum ground elevation at the downstream portion of the reservoir is approximately at elevation 302.5 ft NAVD 88 at Prospect St and Bond Ave. Setting the overflow crest at elevation 300.5-ft provided a minimum 2-ft of freeboard.

The overflow structure would have been tied into this surrounding grade, including the earthen berms surrounding the outflow structure at elevation 302.5-ft. The weir was designed to convey 3,500 cfs when the pool is at elevation 302.5-ft NAVD88.

The structure provides a dedicated channel for the Villa Park Storm Drain (OCFCD Facility No E08P02) outfall flows at Center Dr. The overflow structure would route reservoir overflow and storm sewer flow along the existing Santiago Creek channel through the existing culverts at Prospect Street.

2.3.2 Channel Improvements

The Phase II GDM included approximately 6,400-feet of channel improvements between the Santa Ana Freeway and Santiago Creek confluence. According to the Phase I GDM, Phase II GDM, DM-14, ERR 2013, and current analysis the existing channel between Walnut Ave and the Santa Ana Freeway is capable of passing design flows without improvement. However, downstream of the freeway, improvements are necessary to prevent overtopping and to stabilize the channel. Flow velocities within the creek are erosive during large storm events (approximately 9-13 fps during the 1% AEP), potentially compromising adjacent properties along the highly urbanized floodway. In the original project formulation, the strategy was to utilize reservoir improvements to reduce the 1% AEP peak discharge down to 5,000 cfs, but after consideration of risks and costs associated with the reservoir improvements, the PDT and Local Sponsor has agreed that designing conveyance improvements for the lower reach of Santiago Creek to contain the 1% AEP with appropriate assurance is the selected alternative for advancing the design. The channel improvements of previous designs sized the channel to protect banks according to EM-1110-2-1601 – Hydraulic Design Requirements for Channels and other design guidance.

Slope protection along the existing creek is currently inconsistent and largely implemented by individual property owners adjacent to the creek. Along the right-of-way, slopes are predominately gravel filled wire mesh and invasive vegetation, though floodwalls, masonry/cobblestone, rip rap, and other measures are not uncommon. Downstream of Bristol, which experienced the worst erosion during the 1969 flood event, the stream is a stone trapezoidal channel. Large debris was placed along this portion of the stream in 1969 as slope protection including vehicles; it's not clear if the debris remains buried within the slopes.

The Phase II GDM includes 6,400 feet of trapezoidal channel armored with riprap. The invert width varies from 30-ft to 80-ft, depending on location and available right-of-way. The invert slope varies along the channel between 0.0046 and 0.0052. The channel design included the following constraints: no interference with property fencing lines, install to the same elevation for both sides of channel, placed in increments of a minimum of 1-foot above water surface profile, no less than 400-ft increments along the channel (i.e., each design cross section will not be smaller than 400-feet). Rip rap is not to be placed above right-of-way constraints, though it is set to 2-feet above design water surface wherever possible. The rip rap thickness varies from 30-inches to 18-inches, depending on armoring requirements for given reaches. The rip rap layer at the side slopes has a thickness at 18-inches to 30-inches. Side slopes are limited to existing right-of-way limitations and are 1.75H:1V. There may be opportunities in limited sections to reduce the side slopes slightly in some locations depending on available space. This should be explored in further refinement of the design. The downstream end is a 24-inch thick and 50-foot-long grouted rock apron, 10-feet below the design invert of the mainstem. A sheet pile cutoff was also installed just upstream of the grouted riprap apron. The channel has experienced significant erosion since the last major design update in 1988, with scour incising the channel by 1-ft to 2-ft in some locations.

There will be no berm access along the riprap channels due to constraints on existing space and required channel cross-section sizes to prevent flooding during the 1% AEP. The only access for maintenance vehicles will be the riprap channel bottom during periods of non-flow. Due to the heavily urbanized nature of the stream corridor, access points to the channel will be through Hart Park (1.1 miles upstream of the proposed channel), Santiago Park along Memory Lane, Flower Street near the upstream end, or from Bristol Street near at the downstream end. These access points may require that O&M crews travel significant distance across the riprap channel. The Phase II GDM recommended that 18 to 21-inch riprap be utilized for erosion protection along the channel bottom while also recommended that the channel be utilized for access vehicles.

The current design will include buried riprap with the placement of 12 inches of substrate over the riprap. Planting zones were selected in locations where assurance is adequate with existing channel bank elevations and floodwalls are not required. These zones existing between the I-5 and Flower Street, and immediately upstream of the confluence with the Santa Ana River. For the design water surface profiles and risk and uncertainty analysis, channel roughness in the unvegetated zones varied between 0.04 and 0.043 and are based on values computed from EM 1110-2-1601. The currently planned vegetated zones are expected to be relatively sparsely placed alluvial scrub. Manning's n values for these select locations were increased to 0.07 to account for the additional vegetation roughness. As the design progresses and is refined, these values should be checked and modified based on updates to the planting plan.

The Phase II GDM also included construction of a rip rap trapezoidal channel downstream of the reservoir, between Prospect St and Walnut Ave. The USACE design was a rip rap trapezoidal channel with bottom width of 30-ft, depth of 12.5 ft, slope of 0.0024, and side slopes of 2H:1V. The originally proposed design was to provide freeboard of 2.6 to 3.3-feet at design discharges of between 3,700 cfs and 3,900 cfs. However, design and construction of this reach was completed by a land developer in or around 1991. The channel design and construction were completed consistent with a 1990 Memorandum of Understanding (MOU) between USACE, OCFCD, and the private land developer of an adjacent community developer. Nearly 3,700 ft of channel improvements were constructed in this section, including a rip rap trapezoidal channel, concrete trapezoidal channel, culvert enhancement, service road installation, and a cut off wall. The concrete trapezoidal channel is approximately 3,300-ft length, with approximately 10-inch-thick reinforced concrete; the base is 25-feet wide at the invert, side slopes of 2H:1V, approximately 12.5-feet of depth, and invert slope ranging from 0.0015 to 0.005.

2.3.2.1 Interior Drainage

While topography generally appears to drain away from the banks of Santiago Creek in the lower reach, locations where floodwalls are required (between Flower Street and Bristol on the north and south bank, and on the north bank downstream of Bristol) should be further evaluated in future design phases to determine if additional interior drainage facilities are requires to allow adequate drainage where floodwalls may otherwise prevent surface drainage toward the creek. To address drainage blocked by the floodwalls, regrading or drainage pipes and backflow prevent may need to be designed and installed to prevent both obstructed drainage and interior ponding due to river water backing into drainage facilities. This should be addressed in future design phases.

2.3.3 SPF Evaluation of the Modified Channel Improvements

An evaluation of the Standard Project Flood (SPF) was performed to determine if the performance of larger Santa Ana River project would be adversely impacted by the removal of the reservoir improvements. Through coordination with SPL, it was clarified that the SPF hydrology developed for the Santa Ana River project is fixed based on project authorization and is not subject to recalibration based on hydrologic updates. To perform the evaluation, the inflow hydrograph into Villa Park Dam from in GDM II (Figure 9) was routed through both the 'Passive Reservoir with Channel Improvements' alternative and the 'Reservoir Improvements with Channel Improvements' alternative. The simulated hydrographs are displayed in Figure 10. The results show slight decreases in flow for the 'Passive Reservoir with Channel Improvements' alternative.

The results demonstrate that the 'Reservoir Improvements with Channel Improvements' alternative has a slightly reduced (but comparable) peak discharge and has a large initial peak release in the channel related to the advance drawdown, but flows (and stages) will increase quicker, resulting in slightly less warning time before system capacity is exceeded.

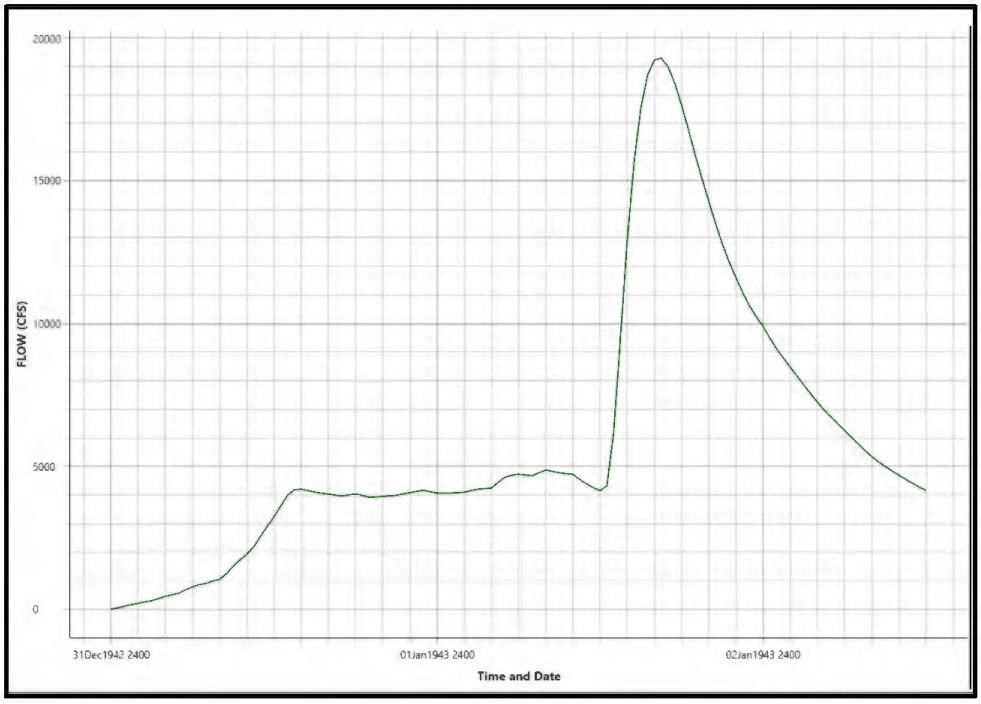


Figure 9: SPF inflow hydrograph for Villa Park Dam.

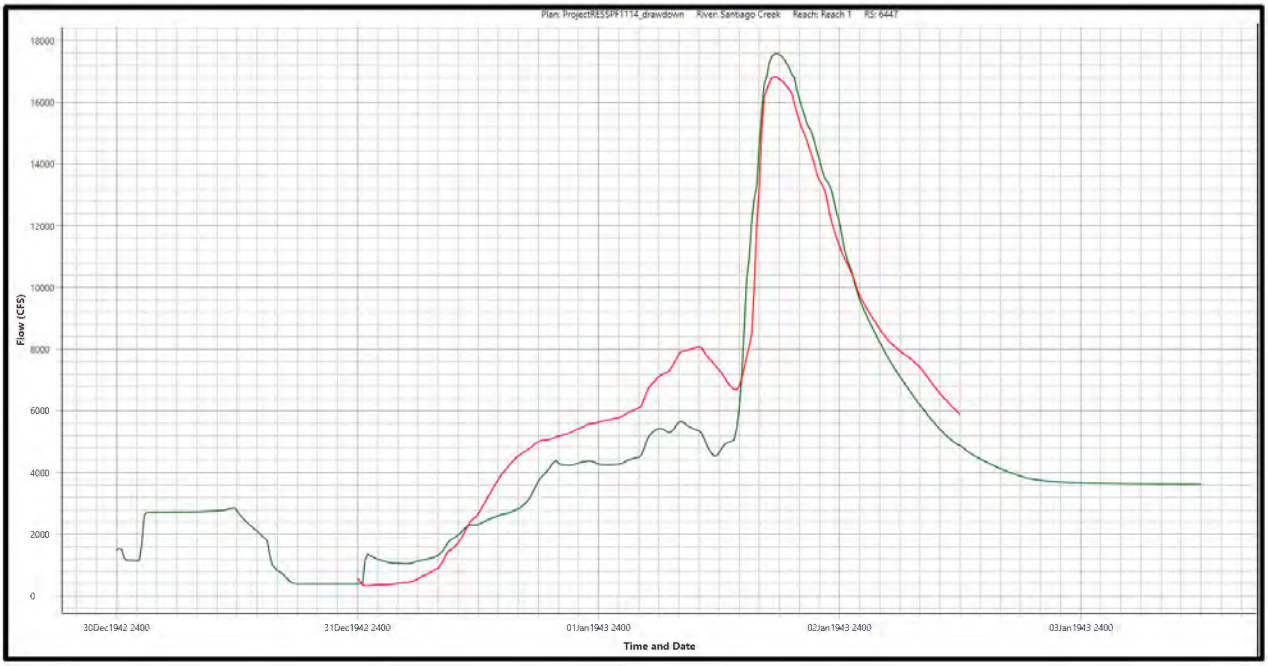


Figure 10: Comparison between the 'Passive Reservoir with Channel Improvements' alternative (red) and the Reservoir Improvements with Channel Improvements' alternative (green) on the lower Reach of Santiago Creek (I-5) for the SPF event.

3.0 HYDROLOGY

3.1 Frequency Analysis

3.1.1 1980 Discharge-Frequency Analysis

The first discharge-frequency analysis for Santiago Creek upstream of Villa Park Dam was presented in the 1980 Phase I GDM. The analysis was reviewed during development of the Phase II GDM but not revised. For the Phase I study, the Santiago Creek near Villa Park stream gage was used to develop a frequency curve for inflow to Villa Park Dam. This gage has a 1921 to 1963 period of record. To reflect the effect of Santiago Dam (drainage area 63.2 square miles) on the inflow to Villa Park Dam, however, only the period after Santiago Dam was constructed (1933) to 1963 (when Villa Park Dam was constructed) was considered. In addition, Villa Park Dam inflow data from 1963 to 1979 was utilized. The peak, 1-day, 2-day, and 3-day discharges for the 1933 to 1979 period were plotted using median plotting positions for n equal to 47. The 1969 inflow was the largest that had occurred during the 1921 to 1979 period, therefore, 1969 was plotted at n = 59. Best fit graphical curves were drawn through each data set. Analytical analysis was not considered due to upstream regulation by Santiago Dam.

The Phase II GDM recommended plan provided protection from the 1% AEP design flood for residents of the Santiago Creek floodplain downstream of Villa Park Dam. The 1% AEP subarea hydrographs downstream of Villa Park Dam were derived from SPF hydrographs reduced by the ratio of 1% AEP peak discharges to SPF peak discharge and the 1% AEP inflow hydrograph at Villa Park Dam was derived from the volume-frequency curves at Villa Park Dam using the balanced hydrograph method. The inflow at Villa Park Dam was routed through the dam to Santiago Recharge Basins and combined with downstream contemporaneous runoff.

3.1.2 Discharge-Frequency Analysis Update for the 2013 Economic Reevaluation Report

Updated peak inflow values through 2007 for Villa Park Dam were readily available from Orange County Public Works and were used to update the inflow frequency curve originally published in the Phase I GDM report. The original analysis was based on data available from 1933 to 1979 and the knowledge that the 1969 event was the largest since 1921. The new data extended the data record 18 years with the 1969 event still the largest event since 1921. At the time, updated 1, 2, and 3-day discharges were not readily available but the upper portion of the volume-frequency curves from the Phase I GDM were graphically updated based on the knowledge that the 1969 event is also the largest volume event since 1921 and on the shape of the update peak discharge frequency curve.

3.1.1 Discharge-Frequency Analysis Update for the 2022 Detailed Project Report

For this design effort, annual peak inflow values between 2008 and 2021 were obtained from Orange County Public Works. The full period of record is contained in Attachment 1. The frequency analysis was updated to include the most recent annual peak releases from Villa Park Dam (Table 6). The updated graphical frequency analysis is displayed in Figure 11, and the comparison between the 2013 analysis and the current analysis is shown in below.

Table 6: Annual peak discharges into Villa Park Dam between the 2013 analysis and 2020.

Year	Annual Maximum Discharge (cfs)
2008	0
2009	0
2010	5,648
2011	371
2012	23
2013	4
2014	1
2015	2
2016	6
2017	399
2018	11
2019	656
2020	19

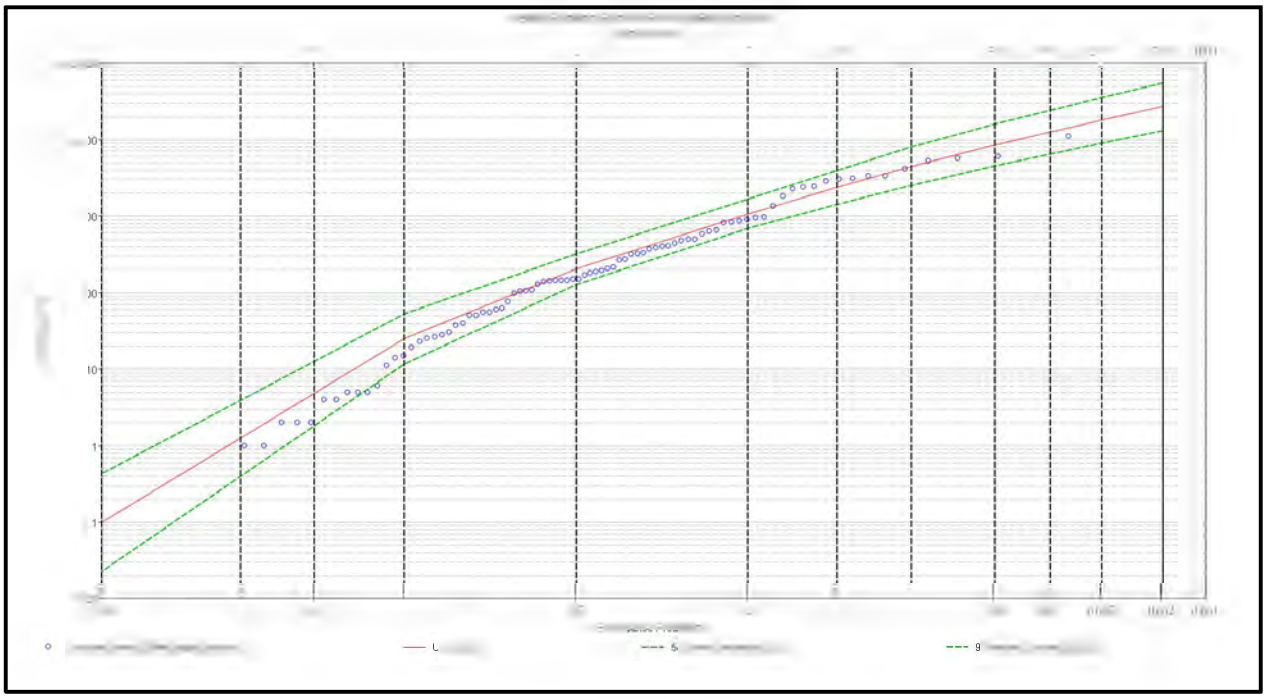


Figure 11: Updated flow frequency analysis for inflows to Villa Park Dam.

Table 7: Flow frequency comparison for Santiago Creek.

% AEP	Return Interval	1980 Analysis				2013 Analysis (through 2007)				Current (through 2020)			
		Peak	1-Day	2-Day	3-Day	Peak	1-Day	2-Day	3-Day	Peak	1-Day	2-Day	3-Day
0.2	500	Not in Report				32,000	19,000	16,000	13,000	27,000	17,000	12,800	9,100
0.5	200					20,000	13,000	9,800	8,000	17,900	11,000	8,000	5,700
1	100	14,500	9,300	8,000	6,000	13,700	8,000	6,200	5,000	12,500	7,200	5,100	3,640
2	50	10,000	5,500	4,600	3,400	8,900	4,900	3,800	3,100	8,500	4,800	3,400	2,400
4	25	6,000	3,100	2,800	1,800	5,400	2,400	2,000	1,600	4,500	3,200	2,300	1,600
10	10	2,500	1,000	850	600	2,400	1,000	820	575	2,400	2,100	1,500	1,000

3.2 HMS Model Development

Hydrologic modeling was completed using Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) v. 4.8. A terrain was created using Orange County's 1 meter LIDAR derivative resampled to a 25-foot resolution. The terrain was reprojected to USA Contiguous Albers Equal Area Conic USGS horizontal datum, allowing the use of gridded precipitation for model calibration.

The purpose of the model development is not only to evaluate the previous design and optimize features where opportunities exist, but also to evaluate the operation of the system.

3.2.1 Model Parameters

3.2.1.1 Subbasin Delineation

The 102 square mile Santiago Creek watershed was divided into 19 subbasins for the hydrologic modeling effort. Terrain manipulation was necessary to address delineated boundaries and available information data. The following changes were made to original terrain to create a hydrologically correct (depressionless) terrain model:

- Streams were burned into the terrain at Santiago Dam, Villa Park Dam, Santiago Recharge Basin, and the bridge/culverts in Santiago Creek to correctly direct the flow over the spillway and or through the outlet works.
- Walls were added to the terrain to force the basin delineation to match the observed basin boundaries. On the lower portion of Santiago Creek (downstream of Santiago Recharge Basins), the area contributing to Santiago Creek is significantly influenced by storm drains.
- After the reconditioned terrain was filled, the 'GIS' tool in HMS v. 4.8 was used to compute flow direction, flow accumulation and stream and basin delineation.
- The 'Parameter Characteristics' tool was used to calculate the longest flowpath, slope, relief and elongation ratio.

The hydrologic parameters can be found in Attachment 2.

3.2.1.1 Routing Method

To route flows between subbasins, 3 reaches are used for routing in the HMS model: upstream of Santiago Dam, between Santiago Dam and Villa Park Dam, and between Villa Park Dam and the Recharge Basins. These routing reaches use the Muskingum method. Parameters from the 2013 model were reused and validated through the calibration process. Routing downstream of the Recharge Basins is performed in the unsteady hydraulic model.

3.2.1.1 Transform Method

The S-Graph method transform method was selected to calculate direct subbasin runoff from HMS. The user defined S-Graphs from the Santa Ana River Phase II GDM (USACE, 1988) were adopted. These S-Graphs are similar to those published in the Orange County Hydrology Manual (Orange County, 1986). The 'Valley' S-Graph was used for subbasins downstream of Villa Park Dam, and 'Santa Margarita' S-Graph was used upstream of Villa Park Dam. Initial lag times were computed using the Kirpich Method, but were adjusted as later described in the calibration section.

3.2.1.2 Loss Method

The 'Initial and Constant method' was selected for the loss method. Initially, loss parameters were set to the parameters established in the 2013 modeling effort but were adjusted through the calibration process, as later described in the calibration section.

3.2.1.1 Precipitation

Precipitation values were obtained from NOAA Atlas 14 for to simulate flood events between the 50% AEP (2 Year) and 0.2% AEP (500 Year) in gridded format. Consistent with previous analysis performed on Santiago Creek, the 2-day duration was used in the analysis.

3.2.1.1 Reservoir Routing

Both Santiago Dam and Villa Park Dam are both routed as reservoirs in the hydrology model. Stage-storage curves from the 2013 modeling effort were carried forward for hydrologic modeling. These stage storage curves appear to be the same curves used for the 1998.

In spring 2022, new LiDAR data was collected in the pools for Villa Park Dam and Santiago Dam and stage storage curves were developed. Curves were also developed using the 2012 Orange County LiDAR data. The results show that for Villa Park Dam, the stage storage curve for all the time periods track very closely. For the Santiago Dam, the stage storage relationship shows an approximate 10% reduction in available storage. To evaluation the sensitivity to this reduction in storage, the curve was updated to represent current conditions for the 1% AEP event. The results show that there was only a 3% reduction in peak discharge in the peak release from Santiago Dam. Since the new LiDAR included some gaps with missing data, the existing stage storage was carried forward in the hydrology model.

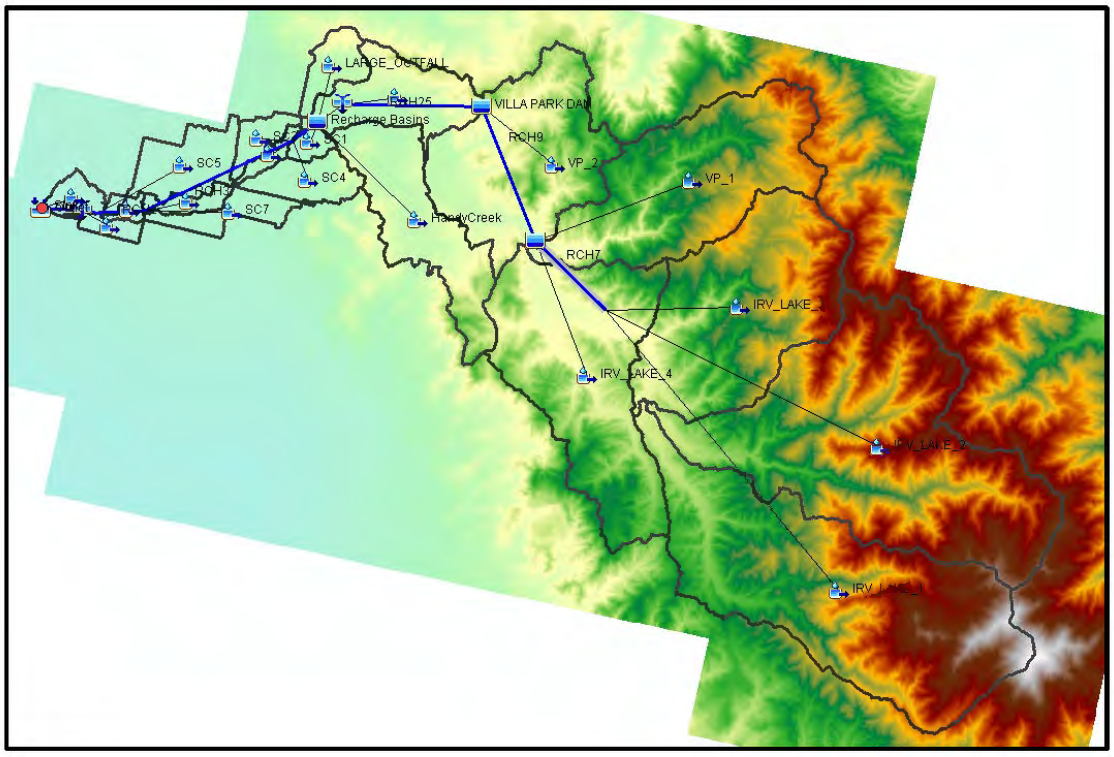


Figure 12: HMS model structure for Santiago Creek.

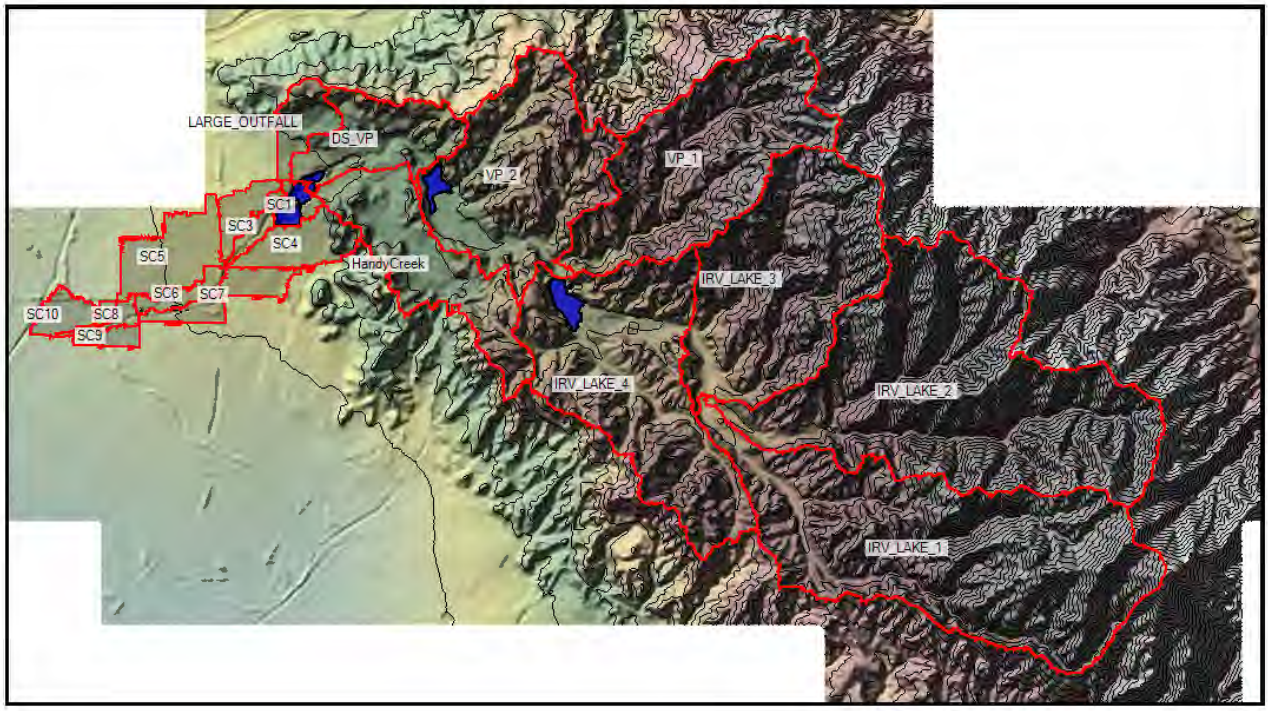


Figure 13: Subbasins for Santiago Creek HMS model.

3.2.2 Model Calibration and Verification

Two events were selected for model calibration and one was selected for verification: December 2010, January 2017 and December 2018. Since the focus on the wet conditions, larger precipitation events were chosen, but available precipitation and water levels were also considered in the decision on which events to include.

3.2.2.1 December 2010

According to data collected by Orange County, rainfall totals of between 5 and 13 inches fell on the basin between December 17 and 23, 2010. The heaviest rainfall occurred in the upper portion of the basin, making this a good event for calibrating parameters upstream of Villa Park Dam. The event resulted in a release of 3001 cfs from Villa Park Dam and quickly filled the downstream Santiago Recharge Basins. Gridded precipitation was not available for this time period, so the nearest Orange County gages were used for each basin.

Figure 14 shows the comparison between the observed and simulated flow at the downstream gage location (Santiago Creek at Santa Ana).Figure 15 shows the comparison between the simulated water levels in Villa Park Dam and the water levels recorded in the operators logs.

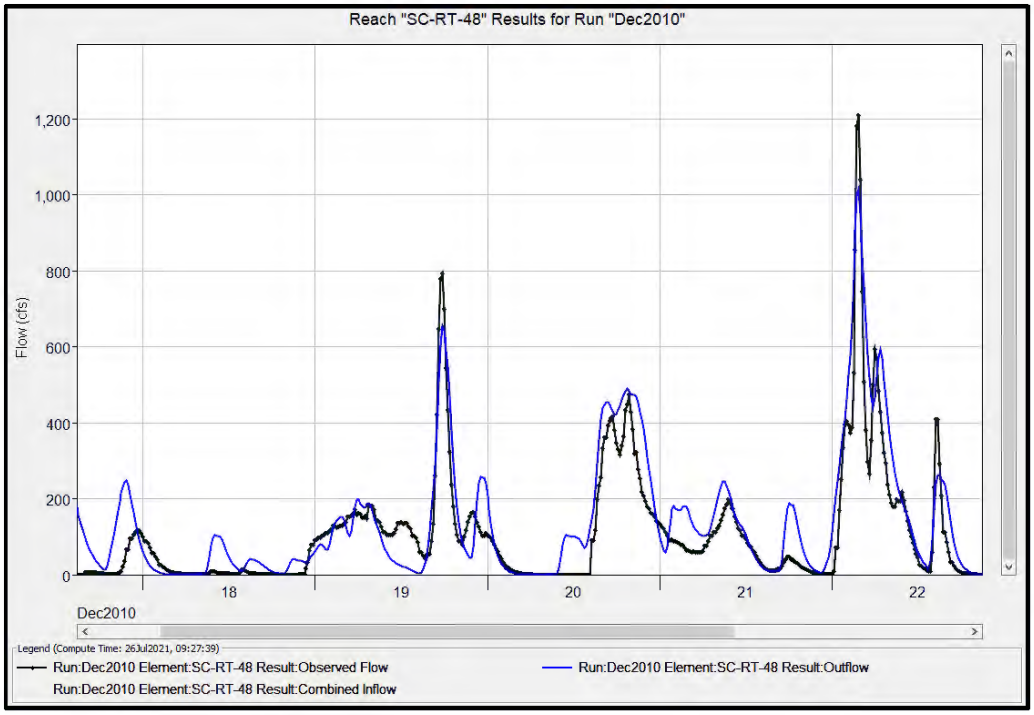


Figure 14. Flow calibration comparison at Santiago Creek at Santa Ana for the December 2010 event.

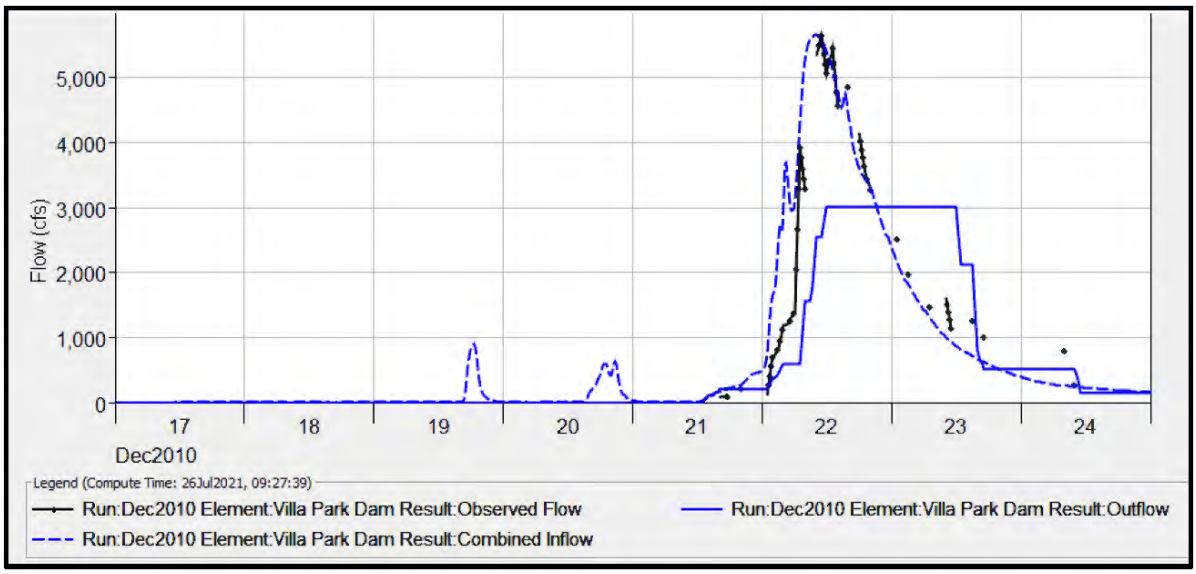


Figure 15. Flow calibration comparison at Villa Park Dam for the December 2010 event.

3.2.2.1 January 2017

The second event selected for calibration was between January 18 and 23, 2017. Gridded precipitation (NEXRAD MPE 3) precipitation was available and was used. This heaviest rainfall during this event occurred on the lower portion of the basin (downstream of Villa Park Dam). Figure 16 shows the comparison between the simulated and observed flow for the event.

In general, the loss rates from the previous hydrology model were reduced to provide a better match between the simulated and observed flows. The lag time also needed to be reduced by 50% from the values computed using then Kirpich Method downstream of the Santiago Recharge Basin to better match the timing of the hydrograph peaks. This area is heavily developed, so storm drain conveyance likely accounts for this reduced lag time. Since this event did not result a fill in Santiago Reservoir or Villa Park dam, there are no comparisons between observed and simulated.

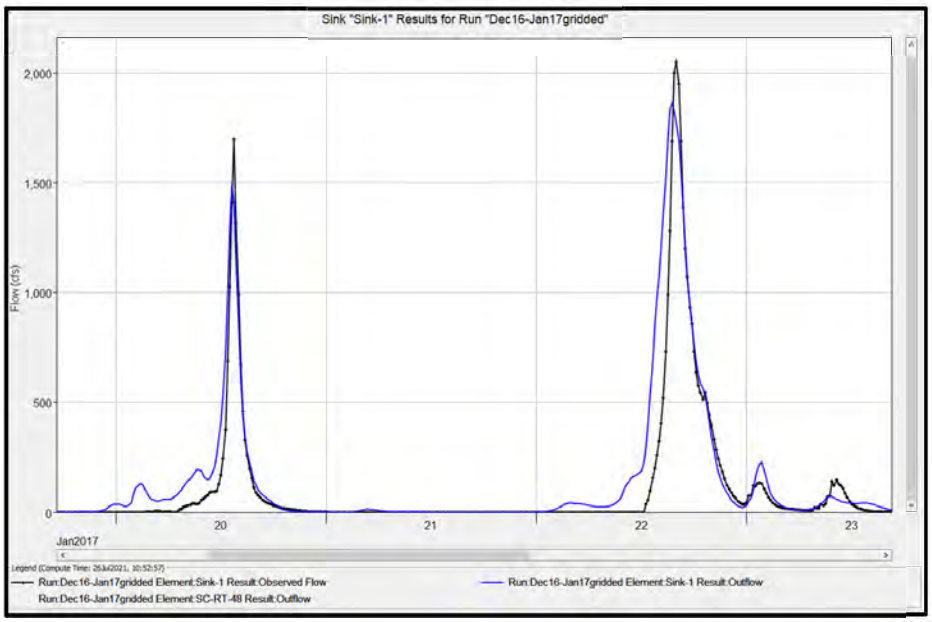


Figure 16. Flow calibration comparison at Santiago Creek at Santa Ana for the December 2017 event.

3.2.2.1 January 2018

The January 2018 event was selected for the verification event. Like the 2017 event, the heaviest precipitation fell on the lower portion of the basin downstream of Santiago Reservoir, Villa Park Dam, and the Recharge Basins. The simulated flows matched the first peaked closely (Figure 16), but the second peak was significantly under simulated. Since the event was driven by precipitation only on the lower portion of the basin (<10 sq. miles), it's possible that the resolution of the gridded precipitation was not adequate to fully capture the spatial variability of the precipitation.

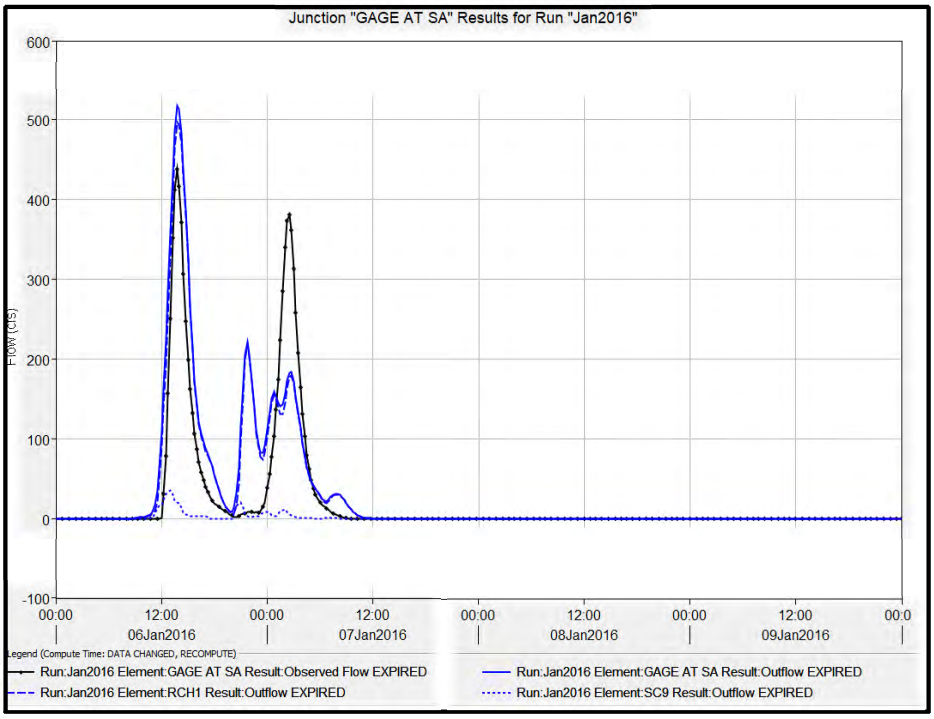


Figure 17: Flow calibration comparison at Santiago Creek at Santa Ana for the January 2018 event.

3.2.1 Adjustments to Match Flow Frequency Curve

Hydrologic parameters upstream of Villa Park Dam Santiago Dam were adjusted slightly upwards to match the updated flow frequency curve described in Section 3.1.1. In addition to the basin hydrology matching the 2021 flow frequency update, a separate basin hydrology was created with decreases to the constant rate losses, effectively increasing runoff to increase inflow rates and volumes to match the 1980 flow frequency analysis. The purpose of development of this basin hydrology was to evaluate how the project could perform if the drier conditions of recent decades did not persist and the 1980 flow frequency analysis was a better representation of the long-term flood risk in the basin.

3.2.2 Existing and Project Conditions

The hydrologic model developed for Santiago Creek is the same for both existing and project conditions. The project components, consisting of a new outlet structure for the Recharge Basin (reservoir improvements) and the channel improvements on Santiago Creek, are represented in the hydraulic model.

4.0 CLIMATE CHANGE

4.1 Inland Hydrology Climate Change

USACE Engineering and Construction Bulletin (ECB) 2018-14 (Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects), “provides guidance for incorporating climate change information in hydrologic analyses in accordance with the USACE overarching climate change adaptation policy. This policy requires consideration of climate change in all current and future studies to reduce vulnerabilities and enhance the resilience of our water resources infrastructure.” The document “helps support a qualitative assessment of potential climate change threats and impacts” related to USACE analyses.

Extreme seasonal conditions of temperature, rainfall and runoff may become more common in some regions.

These conditions may be intensified by future changes in the condition of native vegetation and societal demands for energy and water. Therefore USACE projects, programs, missions, and operations must assess these potential changes to remain reliable in spite of this baseline shift. A qualitative assessment of potential climate change threats and impacts that may be potentially relevant to this study was conducted to address this issue. This qualitative assessment was performed under the guidance of ECB No. 2018-14 (USACE 2018).

The qualitative analysis required by ECB No. 2018-14 should focus on those aspects of climate and hydrology relevant to the project's problems, opportunities, and alternatives, and include consideration of both past (observed) changes as well as projected, future (modeled) changes. At the time of issuance of this ECB, the qualitative analysis is not expected to alter the numerical results of the calculations made for the other, non-climate aspects of the required hydrologic analyses. However, the qualitative analysis can inform the decision process related to future without project conditions, formulation, and evaluation of the performance of alternative plans, and other decisions related to project planning, engineering, operation, and maintenance.

Attachment C to the ECB, titled "Preview of Quantitative Analysis Requirements," highlights the three primary components of the anticipated future quantitative guidance:

- Detection of trends;
- Attribution of these trends to climate change; and
- Projection of future trends.

Climate change is a global-scale concern, but can be particularly important in the western United States where potential impacts on water resources can be significant to supplies for water agencies. Orange County is considering impacts of climate change and has conducted multiple studies regarding the effect on the sustainable and reliable water supply. One such report that Orange County prepared entitled the "Integrated Regional Water Management Plan" (IRWMP) was published in July 2013. Section 12 and Appendix J of the report discuss potential water reliability impacts that may occur as a result of climate change to the region and has proposed solutions (Orange County 2013).

4.1.1 Climate Change Literature Review

USACE is undertaking its climate change preparedness and resilience planning and implementation in consultation with internal and external experts using the best available — and actionable — climate science. As part of this effort, the USACE has developed concise reports summarizing observed and projected climate and hydrological patterns, at a hydrologic unit code (HUC2) Watershed scale cited in reputable peer-reviewed literature and authoritative national and regional reports. The USACE literature review report focused on the California Region was finalized in July 2015 (USACE, 2015). Trends are characterized in terms of climate threats to USACE business lines. The reports also provide context and linkage to other agency resources for climate resilience planning, such as downscaled climate data for sub-regions, and watershed vulnerability assessment tools.

4.1.2 Observed Temperature Trends

A number of studies focusing on observed trends in historical temperatures were reviewed in the recent climate change literature review for the California Region (USACE 2015). These include both national- scale studies inclusive of results relevant to the California Region and regional studies focused more specifically and exclusively on the California Region.

At a national scale, a 2009 study by Wang et al. examined historical climate trends across the continental United States. Gridded (0.5 degrees x 0.5 degrees) mean monthly climate data for the period 1950 – 2000 were used. The focus of this work was on the link between observed seasonality and regionality of trends and sea surface temperature variability. The authors identified positive statistically significant trends in recent observed seasonal mean surface air temperature for most of the U.S. For the California Region, seasonal differences were identified in the historical mean air temperatures. A primarily positive historical warming trend was identified for the California

Region in the winter (December – February) and spring (March – May), and a historical cooling trend was shown for the fall (September – November). Spatial variability in historical temperature trends throughout the California Region is shown in summer (June – August) with some areas showing increasing temperature trends and others showing decreasing temperature trends. The authors do not provide information on statistical significance of the presented observed trends.

An article by MacDonald (2010) evaluated average annual temperatures over 2001 – 2009 compared to 1951 – 1960. In the California Region annual temperatures were up to 1.5 standard deviations above the 20th century average. Details on statistical significance were not provided in the study.

A national study by Tebaldi (2012) evaluated average annual historical decadal changes in temperature. Based on data from 1912 – 2011, temperatures within the state of California (which the California Region is primarily within), increased in temperatures at a rate of 0.16 °F (0.09°C) per decade respectively with a 95% confidence interval.

Similarly, Hoerling et al. (2013) assessed annually averaged daily temperature trends in the Southwest using observed climate and paleoclimate record. In the California Region, a statistically significant (95% C.I.) increase in average annual daily temperature of 0.9 to 4.5 °F (0.5 – 2.5 °C) was identified between 1901 and 2010.

The fourth NCA report (Easterling et al., 2017) presents trends in historical annual average temperatures for the southwestern U.S. For the southwestern U.S., including the California Region, historical data shows a general warming of average annual temperatures in the early part of the 21st century. Details on statistical significance are not provided. When comparing a recent 22-year span (1991 – 2012) to a historical average (1901 – 1960), temperatures have increased throughout the California Region by up to 2 °F (1.11 °C (Walsh et al., 2014) This is consistent with an increasing trend in annual average temperatures within the California Region reported by MacDonald (2010), Tebaldi (2012), and Hoerling et al. (2013).

4.1.3 Projected Temperature Trends

GCMs have been used extensively to project future climate conditions across the country. At a national scale, model projections generally show a significant warming trend throughout the 21st century, with a high level of consensus across models and modeling assumptions. Results of studies inclusive of the California Region typically fall in line with these generalizations.

Elguindi and Grundstein (2013) present results of regional climate modeling of the U.S. focused on the Thornthwaite climate type – a measure of the combination of relative temperature and precipitation projections. For the California Region, results show a shift to a more arid climate by the period 2041 – 2070.

In a regional study, Cayan et al. (2013) investigated projected temperature trends for the southwestern U.S. Several Coupled Model Intercomparison Project 3 (CMIP3) GCMs were used, coupled with dynamically downscaled models and biased correction and spatial downscaling. The A2 (high) and B1 (low) emissions scenarios were evaluated for future projections. An increase in annual average temperature is predicted with high confidence for the southwestern U.S. from 2001 to 2100. Seasonal temperatures trends are projected to increase, with the highest increases in summer temperatures. Within the Klamath Basin in California, historical and projected temperature trends for January and July were evaluated for the A2 (high) and B1 (low) emissions scenarios from 1950 – 2100. Similar to the southwest U.S. as a whole, temperature increases are projected within the California Region for January and July, with the largest potential temperature increases in summer under high emissions scenarios. With the increase in temperatures, the length of the freeze-free season in the California Region is projected to increase by approximately 10 to 45 days, spatially varying, in 2041 – 2070 compared to a baseline period of 1971 – 2000. Specific information on confidence intervals was not provided with the study.

The fourth NCA (Easterling et al., 2017) generally supports the findings presented above. Climate model projections for the southwestern U.S., inclusive of the California Region, presented in this report indicate an

increase in annual average temperature over the next century by up to 8.5 °F (4.7 °C) depending on emissions scenario.

For the California Region specifically, Cayan et al. (2008) evaluated future climate scenarios. Two GCMs were simulated with the B1 (low) and A2 (medium-high) emissions. The study predicted temperature increases of 1.5 ºC (2.7 ºF) to 4.5 ºC (8.1 ºF) by the end of the 21st century, depending on the model and emissions scenario evaluated, with the largest increases occurring in summer months.

Trends in minimum and maximum temperatures across the continental U. S. were the focus of a study by Ashfaq et al. (2010). The study applied a single regional climate model to compare future projections (2071 – 2100) to historical climate (1961 – 1990). They quantified changes in summer and fall daily maximum temperature of up to approximately 5 K (9 ºF or 5 ºC) for the California Region, and spring and winter maximum temperature changes of approximate 3 to 4 K (5.4 to 7.2 ºF or 3 to 4 ºC). Daily minimum temperature changes were also projected to increase by approximately 5 K (9 ºF or 5 ºC) for the summer and fall, and approximately 3.5 K (6.3 ºF or 3.5 ºC) for winter and spring in the California Region.

Daily maximum air temperature projections were investigated by Liu et al. (2013) using a single GCM and assuming an A2 greenhouse gas emissions scenario (worst case) in a national analysis. For the California Region, the results of their study show a projected increase in winter and spring maximum air temperature of 1.5 – 3.0 ºC (2.7 – 5.4 ºF) for a 2055 planning horizon compared to a baseline period of 1971 – 2000. The results of the study project increases in maximum air temperature from 2 to 4 ºC (3.6 –7.2 ºF) for summer and fall temperatures.

Scherer and Diffenbaugh (2014) applied a multi-member ensemble GCM, assuming an A1B (middle of the road) emissions scenario, to the continental U.S. For the southwestern U.S., including the California Region, model projections indicate steadily increasing air temperatures throughout the 21st century for both daily maximum summer and winter minimum temperatures. By 2090, projections show an increase of 4.0 ºC (7.2 ºF) in the summer maximum air temperature and 3.4 ºC (6.1 ºF) in the winter minimum temperature, compared to a 1980 – 2009 baseline period. These results agree well with those described previously for Liu et al. (2013).

Projections of changes in temperature extremes have been the subject of several recent studies. A 2006 study by Tebaldi et al. applied nine GCMs at a global scale focused on extreme precipitation and temperature projections. Model projections of climate at the end of the century (2080 – 2099) were compared to historical data for the period 1980 – 1999. For the general California Region, using an A1B climate scenario, spatial variability in extreme temperature range (annual high minus annual low temperature) is illustrated, with some areas of slight increases and some areas of slight decreases. A statistically significant (indicated by concurrence of at least five out of nine models) increase in a heat wave duration index (increase of 3 to 4.5 days per year that temperatures continuously exceed the historical norm by at least 5 ºC or 9 ºF), and a statistically significant moderate increase in the number of warm nights (6 to 7.5 percent increase in the percentage of times in the year when minimum temperature is above the 90th percentile of the climatological distribution for the given calendar year), compared to the baseline period in the California Region. The number of frost days, (defined as the annual number of days with minimum temperatures below 0 ºC or 32 °F) is predicted to decrease, with statistical significance, by up to 5 days per year in the southwestern U.S., inclusive of the California Region.

In a study by Kunkel et al. (2010), two different downscaled GCMs were applied to the continental U.S., assuming high greenhouse gas emissions scenarios (A2 and A1F), with a focus on summer heat wave occurrence and intensity. For the California Region, projections indicate spatial variability, with up to a 7.5 ºC (13.5 ºF) increase in three-day heat wave temperatures and up to an 80-day increase in the annual number of heat wave days for a 2086 planning horizon compared to a recent historical baseline of 1976. A later study of the southwestern U.S. by Kunkel et al. (2013) showed a statistically significant decrease in the number of days with a minimum temperature less than 32 °F (0 ºC) for the 2041 – 2070 time period compared to the reference period of 1980 – 2000 based on the output from the eight North American Regional Climate Change Assessment Program (NARCCAP)'s Regional Climate Model simulations of the A2 emissions scenario. Similarly, the number of days with maximum temperatures exceeding 95 °F (35 ºC) is projected to increase by up to 30 days per year in 2041 – 2070 compared

to the baseline period of 1980 – 2000.

Another regional study by Dettinger et al. (2012) evaluated trends in annual minimum temperature and annual mean precipitation for the southwestern U.S. using results from National Oceanic and Atmospheric Administration's (NOAA's) Geophysical Fluid Dynamics Laboratory (GFDL) coupled ocean atmospheric GCM model and National Center for Atmospheric Research's Parallel Climate Model (PCM1) simulating the A2 (middle of the road) and B1 (low) emissions scenarios over the 21st century. Results from this analysis show an increasing trend in annual average minimum temperature, up to 6 °C (10.8 °F), for all models and associated emissions scenarios.

Gershunov et al. (2012) studied trends in heat waves in California. The study used four GCMs and an A2 emissions scenario to evaluate heat waves, defined as a group of consecutive days in which maximum or minimum temperatures exceed the 95th percentile threshold. Projected heat wave trends were compared to a baseline period of 1950 – 1999. Heat waves were categorized into two types for the purposes of this study: Type 1 heat waves, which are dry daytime heat waves, and Type II heat waves, which are humid nighttime accentuated events. All four GCMs showed significant increases in heat wave activity of both types. Type II heat waves predicted to increase more intensely than the Type I events. The study predicts that desert heat waves will become less intense in the future, while coastal heat waves are projected to intensify.

The study of the California Region by Cayan et al. (2008), mentioned previously, also evaluated projected changes in the occurrence of extreme daily temperatures between June and September in northern and southern California. The study illustrates a projected increase in the occurrence of 99.9 percentile temperatures, in some cases increasing from 4 days per year during the period of 1961 – 1990 to over 200 occurrences by the end of the 21st century under the high emissions scenario. These projections of increased extreme temperatures are consistent with the projections from other studies.

According to a study by UC Los Angeles, southern California is likely to experience a 4.3 °F average rise in temperatures by the mid-21st century (i.e., 2041-2060), should greenhouse gas emissions continue to increase at comparable rates to those of the past decade. Coastal locations are projected to see roughly two to three times the number of extremely hot days. These temperature effects may be somewhat smaller if emissions begin to decline over the next few decades. By the end of the century, average temperatures across the region are most likely to be 8.2 °F warmer than they were in 1981-2000, if greenhouse gas emissions continue to increase at comparable rates to those of the past decade (UCLA and LARC 2012).

Strong consensus exists in the literature for the study area that the projected mean, minimum, maximum and extreme temperatures show an increasing trend over the next century (USACE 2015).

4.1.4 Observed Precipitation Trends

Multiple authors, evaluating precipitation trends on a national scale, have not identified significant trends in total annual precipitation in recent historical records for the study region. Grundstein (2009) found no statistically significant (95% C.I.) trend in soil moisture index, and no trend in annual precipitation in the California Region based on annual data from 1895 to 2006. Very slight increasing potential evaporation trends with statistical significance were identified in two locations within the California Region. Soil moisture is a function of both supply (precipitation) and demand (ET), and therefore is an effective proxy for both precipitation and ET.

A similar study by Wang et al. (2009) also focused on historical climate trends across the continental U.S. using gridded climate data and a shorter period of record (1950 – 2000). The authors identified generally positive significant trends in annual precipitation for most of the U.S. For the California Region, large spatial variability was found in historical precipitation trends. Increasing trends were seen throughout the region in the spring. However, winter, summer, and fall trends show areas of increasing precipitation trends and areas of decreasing trends. The authors do not provide information on statistical significance of the presented observed trends.

A 2011 study by McRoberts and Nielsen-Gammon (Figure 18) used a new continuous and homogenous dataset to

perform precipitation trend analyses for sub-basins across the United States. The extended data period used for the analysis was 1895 – 2009. Linear positive trends in annual precipitation were identified for most of the U.S. For the California Region, results indicate no change or slight increases (up to 10 percent change per century) for the majority of the region, with a small section of northeastern California displaying slight decreases (up to -5 percent change per century) in precipitation. The authors do not provide information on statistical significance of the presented observed trends.

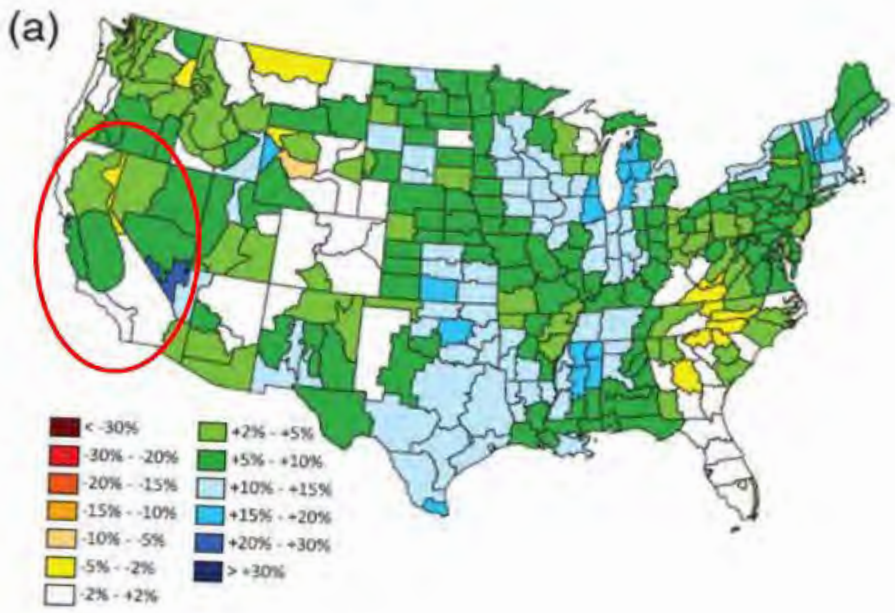


Figure 18. Linear trends in annual precipitation, 1895 – 2009, percent change per century. The California Region is within the red oval (McRoberts and Nielsen-Gammon, 2011).

Similarly, a study by MacDonald (2010) evaluated national precipitation from 2001 – 2009 standardized relative to data from 1895 – 2000. These results show a decrease in precipitation within the California Region.

Palecki et al. (2005) examined historical precipitation data from across the continental U.S. They quantified trends in precipitation for the period 1972 to 2002 using NCDC 15-minute rainfall data. A predominant decreasing trend in storm precipitation totals are projected for the California Region, with some areas showing statistically significant decreases (95% C.I.) in winter and fall precipitation storm totals, and statistically significant decreases (90% C.I.) in some areas during spring months. Across all seasons, storm durations have decreased and storm intensity has increased throughout the majority of the California Region.

According to the fourth NCA, Easterling et al. (2017) climate models project an increase in the frequency of heavy downpours, especially through atmospheric rivers, which are narrow bands of highly concentrated storms that move in from the Pacific Ocean. A series of strong atmospheric rivers caused extreme flooding in California in 2016 and 2017. Under the higher scenario (RCP8.5), models project increases in the frequency and intensity of atmospheric rivers. Climate models also project an increase in daily extreme summer precipitation in the Southwest region, based on projected increases in water vapor resulting from higher temperatures. Projections of summer total precipitation are uncertain, with average projected totals not differing substantially from what would be expected due to natural variations in climate.

A number of recent studies have focused more specifically on southwestern U.S., including the California Region. Kunkel et al. (2013) found no statistically significant trends in historical annual, seasonal, or extreme precipitation from 1895 – 2011 for the Southwest. No trends in the frequency of extreme precipitation events were found either.

Lavers et al. (2015) evaluated the contribution of atmospheric rivers to precipitation in Europe and the United States. Atmospheric rivers are concentrated near-surface water vapor that form about one mile up in the atmosphere and can extend for thousands of miles. (Dettinger et al., 2013). California's largest storms are generally fueled by landfalling atmospheric rivers and may contribute 20 to 50 percent of the precipitation and streamflow in California. (Dettinger et al., 2011). Lavers studied the percent of precipitation which was caused by atmospheric rivers from 1979 to 2012 using data from the European Centre for Medium-Range Weather Forecasts ERA- Interim reanalysis. These results illustrate that atmospheric rivers have the largest influence on precipitation from October to February in the California Region. Precipitation in the western U.S., and the California Region, in particular, is heavily influenced by atmospheric rivers due to the hills and mountains which cause orographic enhancement of precipitation. A zero-inflated beta regression model was used to examine changes in the contribution of atmospheric rivers to precipitation during the study period, and found an increasing trend in the probability of zero-atmospheric river contribution to cold season rainfall in the California Region and the southwestern U.S. (Lavers et al., 2015).

No consistent trend has been identified in the region's historic precipitation data, and there is little consensus across the literature (USACE, 2015).

Climate change is additionally expected to result in more severe drought events (UCS 2014). The southern California region has recently experienced five consecutive below normal rainfall seasons. Although droughts are often started by lower-than-usual levels of precipitation, there have been many periods of low precipitation in California's recent and distant past; the current drought may also be affected by rising temperatures which contribute to drought's severity, by increasing evaporation and decreasing soil moisture (UCLA and LARC 2014b).

4.1.5 Projected Precipitation Trends

In line with projections for the rest of the country, projections of future changes in precipitation in the California Region are variable with topography and latitudinal changes throughout the region. From a global analysis using three GCM projections, Hagemann et al. (2013) projects spatial variability in annual precipitation changes, with a range from -20 mm per year in south California to up to 200 mm per year in the northern parts of the region.

The Liu et al. (2013) study of the continental U.S., mentioned in Section 3.1, quantified spatial and seasonal variability in projected precipitation trends within the California Region. The study projects spatial variability in all seasons, with the largest increases and decreases in winter, with increases in southern California and decreases in northern California for a 2041 – 2070 planning horizon, relative to a recent historical baseline (1971 – 2000, centered around 1985) in the California Region. Decreasing precipitation trends for this time period are projected in summer and spring, with pockets of slight increases in southern California projected for summer, and areas of larger decreases projected in the mountainous areas of the region in spring. Fall precipitation trends are projected to primarily increase, with the largest increases occurring in southern California and the mountainous areas of northern California.

In a study of the western U.S. by Gutzler and Robbins (2010), the middle of the road (A1B) ensemble of projections show spatial variability in precipitation trends throughout the California Region. Areas of southern California exhibit decreasing trends or no change, while northern areas of the California Region exhibit no change or slight increasing trends in annual average precipitation for the last quarter of the 21 century compared to the last quarter of the 20th century. The authors also project an increase in future drought indices for the region, as a function of changing climate, that indicate reduced soil moisture and more drought-prone conditions.

Several regional studies have been performed on precipitation trends in the southwestern U.S., inclusive of the California Region. In support of the fourth NCA, Easterling et al. (20137) prepared a report that summarizes the most recent understanding of projected climates in the southwest United States. These authors calculated the median of sixteen downscaled simulations for three future time horizons: 2021 – 2050, 2041 – 2070, and 2070 – 2099. For the California Region, Cayan et al. (2013) found that under a high-emissions scenario, annual average precipitation is projected to be 80 – 100 percent of the historical average by the end of the 21st century, with

decreases mainly in southern and central California.

A study by Seager and Vecchi (2010) projected seasonal climate trends in southwestern North America based on 24 climate models used as part of the Intergovernmental Panel on Climate Change (IPCC) Assessment Report Four (IPCC AR4). Results of the analysis indicate a drop in precipitation in the winter and summer seasons across the 21st century, and an increase in winter evaporation. In summer, evaporation decreases in parallel with precipitation, reflecting decreases in moisture available for evaporation.

A study by Dettinger (2012) simulated projected trends in annual mean precipitation over the 21st century based on two regionally downscaled model results with two emissions scenarios for the southwestern U.S. For the California Region specifically, the projections primarily indicate decreasing precipitation trends for the 21st century.

In addition to the study's evaluation of the southwestern U.S., Cayan et al. (2013) also evaluated future precipitation trends at a watershed scale for three regions, one of which was the California Region. The study noted large spatial and temporal variability in historical and projected precipitation trends. This study found, with medium-low confidence, a decrease in precipitation in the southern portion of the southwestern U.S. and no change or an increase in precipitation in the northern portions of the southwestern U.S. Little change in precipitation volume was projected for the California Region.

Wang and Zhang (2008) also used downscaled GCMs to look at potential future changes in extreme precipitation events across North America. The GCMs were forced with the IPCC high emissions scenario (A2) to quantify a significant increase in the recurrence (1 to 2 times) of the current 20-year 24- hour storm event for their future planning horizon (2050 – 2099) in the California Region. They found a greater increase in extreme precipitation event risk in southern California than in areas to the north.

Precipitation in the California Region is often related to landfalling atmospheric rivers. Atmospheric rivers are long streams of concentrated, near-surface water vapor above the Pacific Ocean which deliver masses of warm, moist air to the California Region. They were the focus of several studies related to precipitation and streamflow trends throughout the region. Understanding the behavior of atmospheric rivers can help in identifying precipitation trends in the California Region. Atmospheric rivers have been identified as being responsible for 20 – 50 percent of precipitation and streamflow in the California Region (Dettinger et al., 2011). Dettinger (2011) studied changes in the frequency of days from December through February when atmospheric rivers most likely occur using a seven model ensemble of historical climate and projected future climate simulations. Using an A2 emissions scenario, this study projected an increase in the number of atmospheric rivers and a lengthening of the peak season of atmospheric river occurrence. Dettinger (2013) reports that six out of the seven climate models predict that the average rain and snow delivered to California by future atmospheric rivers will increase by an average of about 10 percent by the year 2100. The historical average of nine atmospheric rivers that impact the California coast each year is projected to rise to 11 by the end of the century. Atmospheric river landfalls in the mountains and hills in California often cause heavy precipitation and extreme streamflow events (Kim, 2013).

A study by Warner et al. (2015) also investigated extreme precipitation events that occur along the west coast of North America associated with winter atmospheric river events. The study used phase 5 of the Coupled Model Intercomparison Project (CMIP5) to evaluate changes in precipitation trends from 2070 – 2099 compared to the baseline period of 1970 – 1999. The study found an increase of 11 – 18 percent in winter average precipitation along the west coast of the U.S. In addition, the frequency of days with vertically integrated water vapor transport is projected to increase as much as 290 percent by the end of the century.

It is anticipated that southern California will experience roughly the same amount of total precipitation throughout the 21st century as it received in the last few decades of the 20th century. However, while the amount of precipitation is expected to remain nearly the same, more will fall as rain instead of snow. Precipitation as rainfall shortens the chance to capture water compared to snow stored in mountains, and increases in rainfall precipitation may therefore exacerbate flood risks (UCLA and LARC 2014a).

Large variability exists, spatially, and across model projections, for future precipitation trends within the California Region. There is little consensus across the literature as to how precipitation trends will change, although many studies recognize this variability. Despite the low consensus in precipitation trends, extreme precipitation events are projected to increase in intensity and/or frequency with high consensus throughout the literature for the California Region (USACE, 2015).

4.1.6 Observed Hydrology Trends

In 2013, Xu et al. investigated trends in streamflow for approximately five stations in the California Region. This study used the Model Parameter Estimation Experiment (MOPEX) dataset for the period 1950 – 2000. Gages within the California Region primarily reported no statistically significant (at 95% C.I.) trend in streamflow.

A study by Sangarika et al. (2014) evaluated data from 240 unimpaired streamflow stations throughout the U.S. from 1951 – 2010. Similar to Xu et al., no statistically significant (90% C.I.) trend was found within the California Region.

Kalra et al. (2008) performed a study using recorded streamflow data from 639 unimpaired stations to assess trends and step changes in streamflow between 1951 and 2002. Kalra et al. reported no significant (95% C.I.) trend in streamflow within the California Region.

Hoerling et al. (2013) used observed climate records to analyze the last 100 years of climate variability in the southwestern U.S. The authors compared the basin-mean daily streamflow of 2001 – 2010 to 1931 – 2000 for the Sacramento-San Joaquin Rivers, located within the California Region, and found the rivers had 37 percent less mean flow from 2001 – 2010 compared to the 1931 – 2000 time period. In addition, these authors evaluated the timing of streamflow by comparing the date at which half of the annual streamflow had been discharged. For the California Region, spatial variability of streamflow timing was observed, with streamflow timing occurring earlier by up to 10 days in some areas, and with streamflow timing occurring later by about 10 days in other areas. Streamflow timing observations were reported with 90 to 95% confidence.

Literature on observed streamflow trends in the California Region have very low consensus. The majority of studies suggest that no statistically significant trends have been identified in the region's streamflow data for the latter half of the 20th century.

4.1.7 Projected Hydrology Trends

A number of global and national scale studies have attempted to project future changes in hydrology, relying primarily on a combination of GCMs and macro-scale hydrologic models. The results presented by Thomson et al. (2005), described above, highlight the significant uncertainties associated with global climate modeling, particularly with respect to hydrologic parameters. Additional uncertainty is generated when these climate models are combined with hydrologic models that carry their own uncertainty. This comparison and quantification of uncertainty is the subject of a 2013 study by Hagemann et al. In this study, the authors apply three GCMs, across two emission scenarios to seed eight different hydrologic models for projecting precipitation, ET, and runoff on a global scale. Their findings, in agreement with CDM Smith (2012), indicate that the uncertainty associated with macro-scale hydrologic modeling is as great, or greater, than that associated with the selection of climate models. Study projections from Hagemann et al. (2013), for the California Region, show spatial variability, with some areas showing a decrease in runoff of up to 40 mm per year, and an increase of up to 20 mm per year for their future planning horizon (2071 – 2100) compared to the recent historical baseline (1971 – 2000), assuming an A2 emissions scenario. Changes in seasonal runoff are similar, showing a trend in runoff between -20 to +10 mm, with changes during the fall seasons showing a potential sight increase in runoff and other seasons primarily projecting a decrease in runoff.

A regional study by Cayan et al. (2013) evaluated projected changes in annual runoff based on sixteen simulations of a variable infiltration capacity (VIC) hydrologic model for the high emissions scenarios, comparing future

conditions (2041 – 2070) to historical conditions (1971 – 2000). Projected annual median runoff is spatially and temporally variable within the California Region. In general, the mid and southwestern area of the California Region show a decreasing trend in annual median runoff, while increases in annual mean runoff are observed in the southeastern and northern portions of the California Region. The author did not provide specific information on confidence levels for the parameters in this study.

Because atmospheric rivers are responsible for almost all major historical floods in California, understanding how they are likely to change in the future is critical for flood risk mitigation, particularly for the Central Valley. Dettinger (2011) used a seven-model ensemble of historical- climate and projected future climate simulations to evaluate changes to the frequency and intensity of atmospheric rivers under climate change. Under the A2 scenario by 2100, there is an increase in the number of years with multiple atmospheric river events, an increase in the number of atmospheric rivers with higher-than-historical water- vapor transport rates, and an increase in atmospheric river storm temperatures. In addition, the study showed a lengthening of the peak season of atmospheric river occurrence, with the potential to lengthen the flood- hazard season.

Little consensus exists in the literature with regard to projected trends in streamflow and runoff in the California Region (USACE, 2015).

4.1.8 Observed Climate Findings

Evidence has been presented in the recent literature of increases in both annual average, and minimum and maximum temperature in the California Region over the past century. High consensus exists in the literature supporting these general observed temperature trends. However, seasonal variability and spatial variability exists in many temperature trends within the region.

Increases in annual average temperatures appear to be greatest along the coast and in southern California with less warming evident in the mountainous areas of the region. Seasonally, less consensus exists regarding the variability in temperature changes. Trends in maximum temperatures have generally illustrated the largest increases occurring in southern and central California. Minimum temperatures are also projected to decrease slightly in the mountainous areas of northern and central California with increases in minimum temperatures in the central and southern California at lower elevations within the California Region.

Trends in annual precipitation totals have been variable within the California Region in the 20th century. For the California Region as a whole, changes in annual precipitation totals are spatially variable.

Observed precipitation trends may be influenced by the topographic diversity of the region or possibly the beginning and end dates over which each study was evaluated thus, making it difficult to develop general trends for the entire California Region.

Similarly, variability has been observed in historical streamflow trends and other hydrologic data for the California Region with relatively low consensus across the literature. The majority of the studies report no statistically significant trends in historical streamflows over the second half of the 20th century.

4.1.9 Future Climate Projection Summary

There is strong consensus in the literature that air temperatures will increase in the study basin, and throughout the country, over the next century. The studies reviewed here generally agree on an increase in mean annual air temperature of up to 8 ºF (4.5 ºC), with extreme temperature projections increasing by the latter half of the 21st century for the California Region. The largest increases are generally projected for the summer months with temperature increases generally projected to be higher in inland areas compared to the coast. High consensus is also seen in the literature with respect to projected increases in both frequency and severity of extreme high temperature events compared to the recent past. Decreases in frequency of extreme cold temperatures are projected, with largest frequency decreases in the mountainous areas of the California Region, including northern

California.

Projections of precipitation in the study basin are less certain than those associated with air temperature. Results of some studies conflict with one another. In addition, they show seasonal and spatial variability in projected precipitation results throughout the California Region, which may be related to topographic or latitudinal variations. This variability may also be attributed to differences in time period over which the precipitation studies were conducted. The dominant trend appears to suggest an increase in precipitation in the northern areas of the region and a decrease in precipitation in the southern areas of the California Region. Moderate consensus among the reviewed studies was found regarding extreme precipitation events. Future storm events in the California Region are predicted to increase in frequency and intensity compared to the recent past.

Hydrologic projections, such as streamflow and runoff are harder to compare, with seasonal variabilities, model variabilities, and spatial variabilities in results. Hydrologic models are generally consistent with projections of future precipitation in that the northern areas are that runoff increases, if they occur, are primarily modeled for northern areas (and in the southeast, possibly related to an enhanced summer monsoon).

The trends and literary consensus of observed and projected as noted above are summarized for reference and comparison in Figure 19. California Region 18 - Summary matrix of observed and projected climate trends and literary consensus. (USACE, 2015).

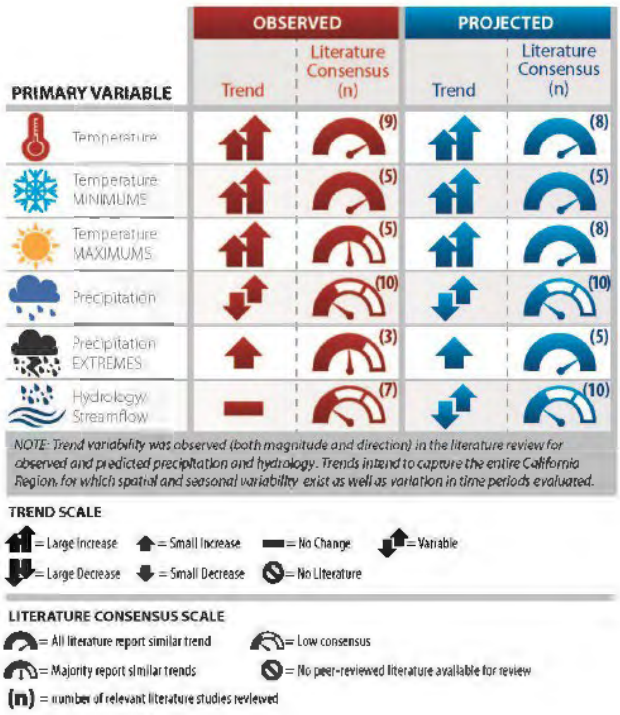


Figure 19. California Region 18 - Summary matrix of observed and projected climate trends and literary consensus. (USACE, 2015)

4.1.10 Project Specific Meteorological Trends

4.1.10.1 Temperature Trends

For this study, daily maximum high temperature data was accessed from the National Climate Data Center for a 59 year span (1960 – 2018) for a station located at the Santa Ana Fire Station. The station is located 5 miles west of the study area. A trend analysis was performed on the maximum daily high temperatures for the 59 years of record. The trend analysis shows a statistically significant (p-value < 0.0001) increase in temperature (Figure 20).

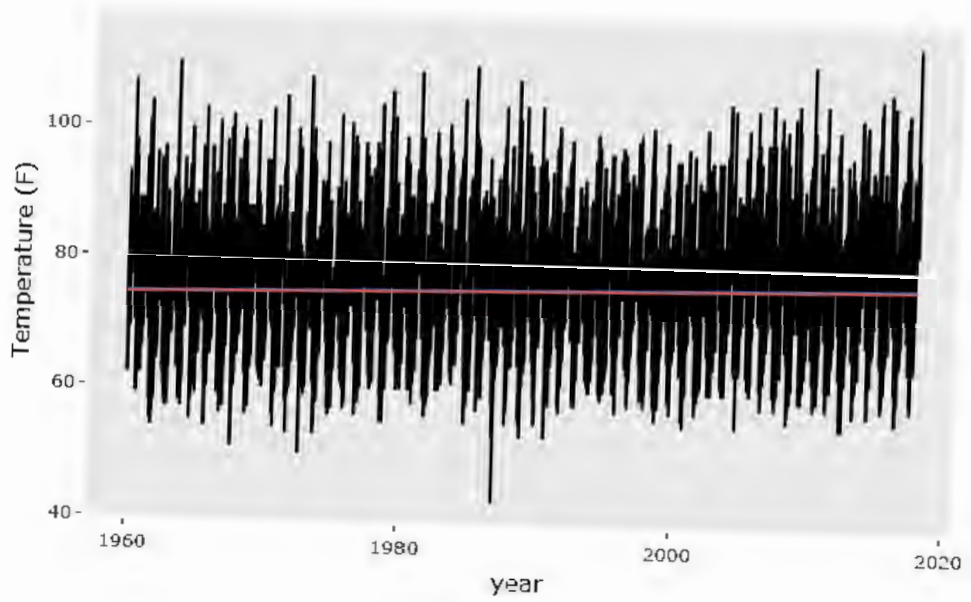


Figure 20. Increasing Maximum Daily Temperature Trend at the weather station located at Santa Ana Fire Station (NOAA ID GHCND:USC00047888)

4.1.10.2 Precipitation Trends

For this study, a trend analysis was performed on daily precipitation data from the National Climate Data Center for a 70 year span (1949 – 2018) for Station USW00023129. The station is located 5 miles west of the study area. While it is not located specifically in the project area, it located at the same approximate elevation and provides a rainfall record representative of the project location. The trend analysis shows no statistically significant increase in precipitation. (Figure 21).

A nonstationarity analysis was completed for the same annual 24 hour peak rainfall events. Figure 22 reflects the results of applying 10 different nonstationarity detection methods on the data set. The results shows no nonstationarity detected on the four mean-based tests, two variance-based tests, or the four distribution-based tests.

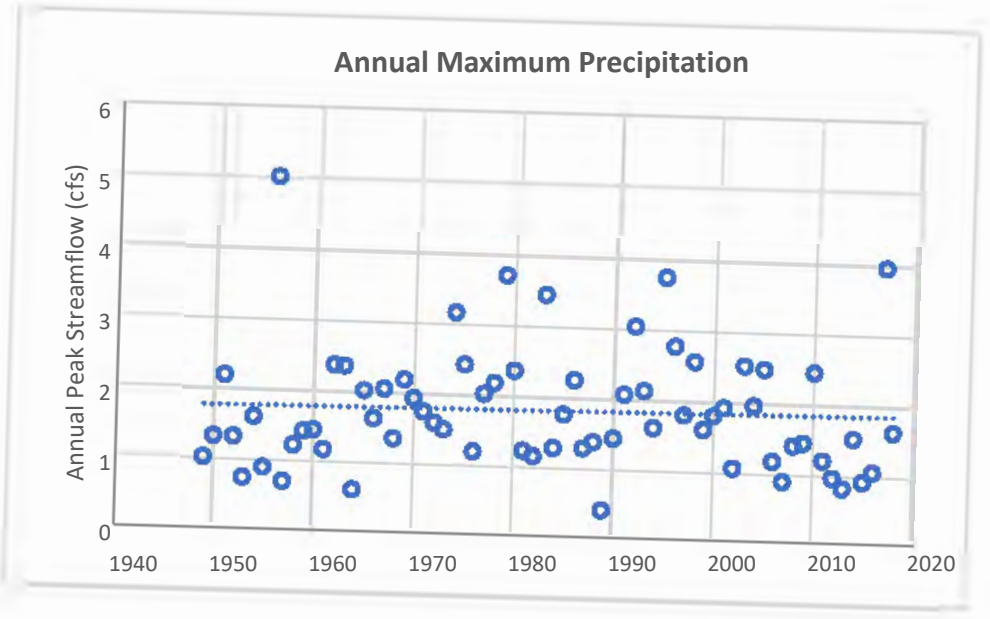


Figure 21. Trend Analysis, Station USW00023129 (p value of 0.81)

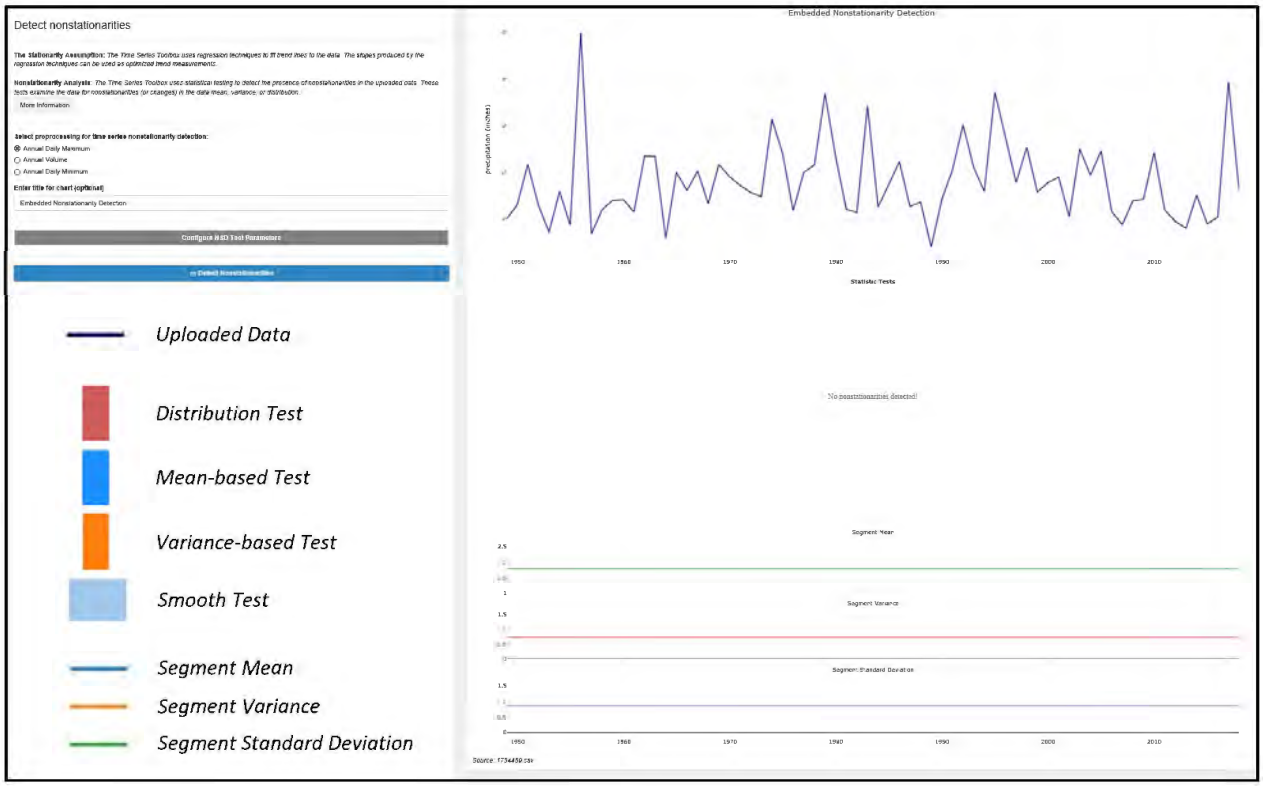


Figure 22. Nonstationarity Analysis, Station USW00023129

4.1.10.3 Streamflow Trends

Figure 23 displays the projected annual, maximum monthly trends from the USACE Climate Hydrology Assessment Tool (CMIP-5 data, downscaled to HUC-4 level via BCSD Method, based on 93 combinations of GCM/RCP model projections for HUC 1807-Southern California Coastal). As expected for this type of analysis, there is a considerable, but consistent spread in the projected annual maximum monthly flows. This spread is indicative of the uncertainty associated with climate changed hydrology. The trend, shown in Figure 24, found within the mean projected annual maximum monthly streamflow, indicates that there is no statistically significant increase in peakflows over time (p-value of 0.34).

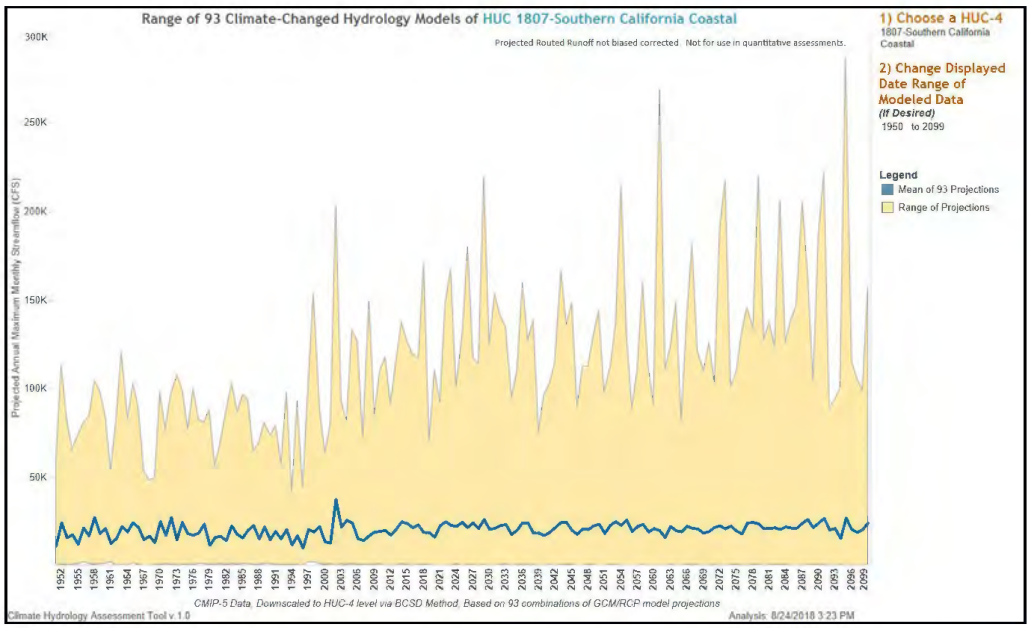


Figure 23. Project Annual Maximum Monthly Streamflow for HUC 1807 – Southern California Coastal

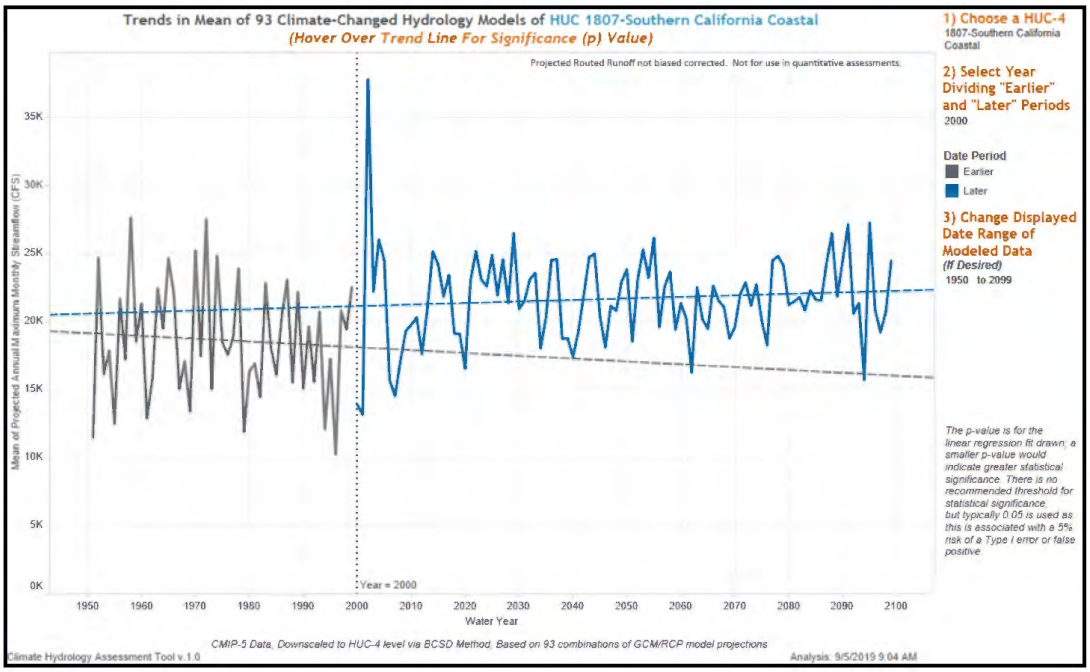


Figure 24. Mean Projected Annual Maximum Monthly Flow HUC 1807 – Southern California Coastal (p value of 0.34)

4.1.11 Vulnerability Assessment Tool

The USACE Vulnerability Assessment Tool was applied for the 1807-Southern California Coastal HUC- 4 to assess the project's vulnerability to climate change impacts relative to the other 201 HUC-4 Watersheds within the continental United States. The USACE Watershed Climate Vulnerability Assessment (VA) Tool facilitates a screening level, comparative assessment of the vulnerability of a given HUC 04 Watershed to the impacts of climate change relative to a maximum of 201 (depending on which business line is specified) HUC04 Watersheds within the continental United States (CONUS).

Assessments using this tool identify and characterize specific climate threats and sensitivities or vulnerabilities, at least in a relative sense, across regions and business lines. Flood risk management is the primary business line being assessed as part of this Feasibility Study.

The Watershed Vulnerability tool uses the Weighted Order Weighted Average (WOWA) method to represent a composite index of how vulnerable (vulnerability score) a given HUC04 Watershed is to climate change specific to a given business line by using a set of specific indicator variables which relate to a particular business line. The HUC04 Watersheds with the top 20% of WOWA scores are flagged as vulnerable. All vulnerability assessment analyses were performed using the National Standard Settings.

Indicators considered within the WOWA score for Flood Risk Reduction include: the acres of urban area within the floodplain, the coefficient of variation in cumulative annual flow, runoff elasticity (ratio of streamflow runoff to precipitation), and two indicators of flood magnification factor (indicator of how much high flows are projected to change over time). Additional information about each of these indicator variables and how they are used to determine a WOWA score is described in the Vulnerability Assessment Tool User Manual.

The USACE Climate Vulnerability Assessment Tool makes an assessment for two 30-year epochs centered at 2050 and 2085 to judge future risk due to climate change. These two epochs are selected to be consistent with many other national and international analyses related to climate. The Vulnerability tool assesses climate change vulnerability for a given business line using climate changed hydrology based on a combination of projected climate outputs from the general circulation models (GCM) and representative concentration pathway (RCPs) of greenhouse gas emissions resulting in 100 traces per watershed per time period. The top 50% of the traces is called "wet" and the bottom 50% of traces is called "dry." Meteorological data projected by the GCMs is translated into runoff using the Variable Infiltration Capacity (VIC) macroscale hydrologic model. The VIC model applied to generate the results used by the Vulnerability Assessment Tool was developed by the U.S. Bureau of Reclamation and is configured to model unregulated basin conditions.

While there is a great deal of uncertainty with the climate changed hydrology given by the vulnerability assessment tool, it does allow a qualitative analysis of watershed-scale vulnerability for USACE business lines and for individual contributing indicator variables. Each of the inputs to the vulnerability assessment tool has uncertainty associated with it. The vulnerability tool relies on projected, climate changed hydrology. The uncertainty associated with projected hydrologic data includes error in temporal downscaling, error in spatial downscaling, errors in the hydrologic modeling, errors associated with emissions scenarios, and errors associated with GCMs. Some of the uncertainty associated with the tool can be visualized because the tool separates results for each of the scenarios (wet versus dry) and epochs (2050 versus 2085) combinations rather than presenting a single, aggregate result (USACE, 2016b). The analysis also incorporates uncertainty inherent in the level of risk aversion selected (ORness factor) and the importance weights applied. Some users may elect to use a higher level of risk aversion while others may not.

For the Flood Risk Reduction business line, the project was determined to be relatively vulnerable to climate change for the Dry and Wet scenarios within the Southern California Coastal HUC-4 region as shown in Figure 25 below, with increasing vulnerability over time for both wetter and dryer future conditions. The main indicator variables contributing to the WOWA score include Flood Magnification Factor as well as the total number acreage included in the 500-year floodplain, particularly for the dry traces. In addition, for the dry scenario there was a +15.2% change and the wet scenario a +19.31% change in the WOWA scores computed for 2050 and 2085 for the HUC-1807 Region with a Flood Risk Reduction business line as shown in Figure 26 and Figure 27.

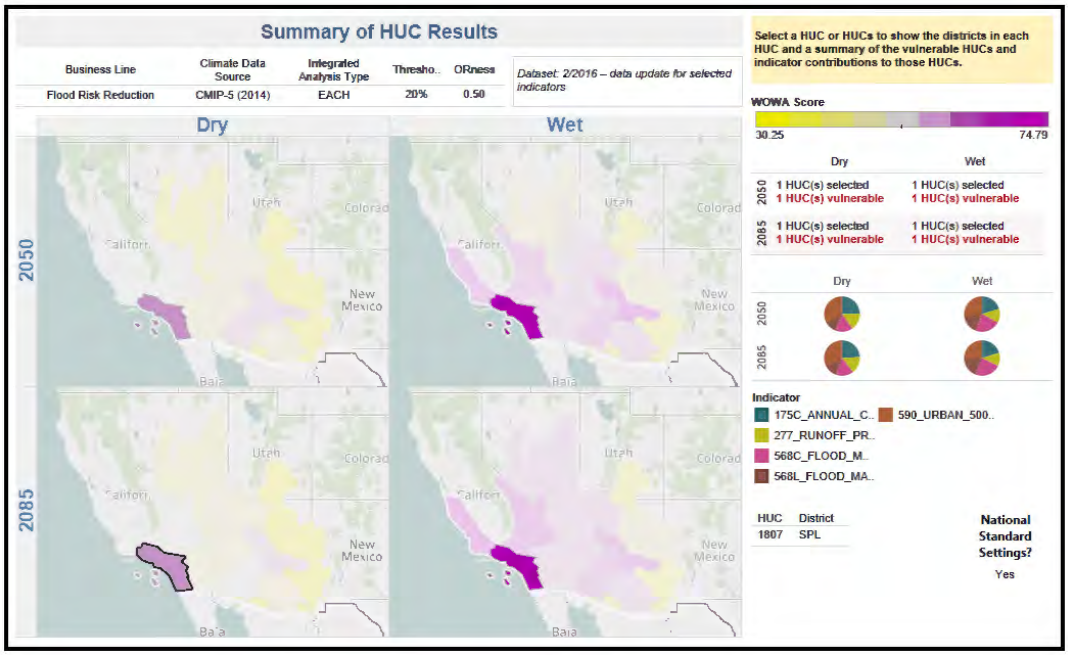


Figure 25. Vulnerability Assessment Tool HUC-4:1807 – Southern California Coastal

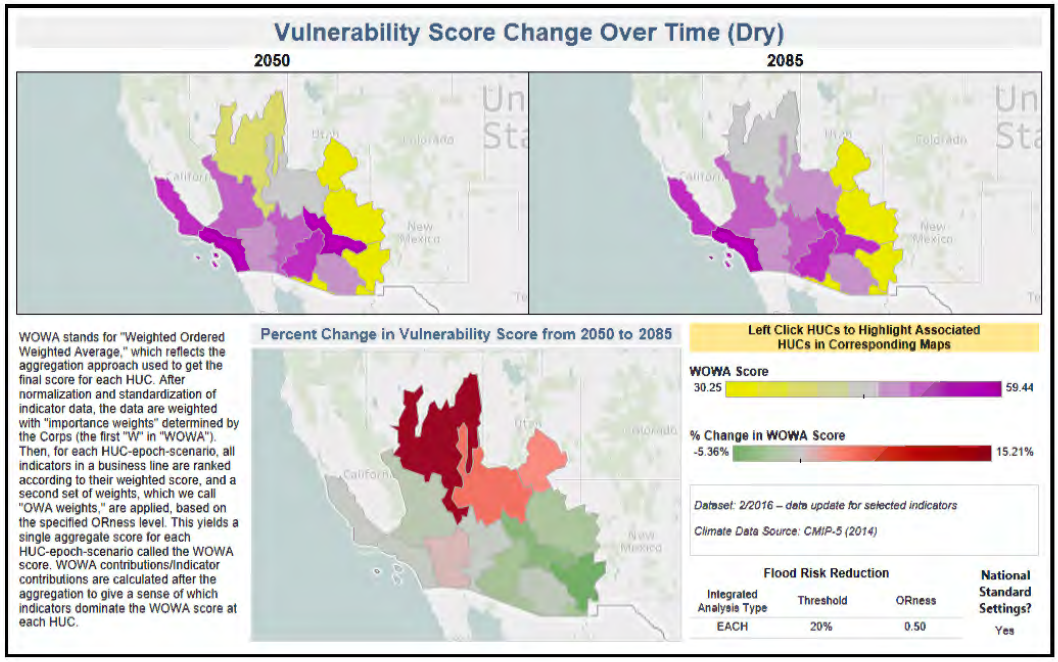


Figure 26. Vulnerability Score, Dry Scenario HUC-4:1807 – Southern California Coastal

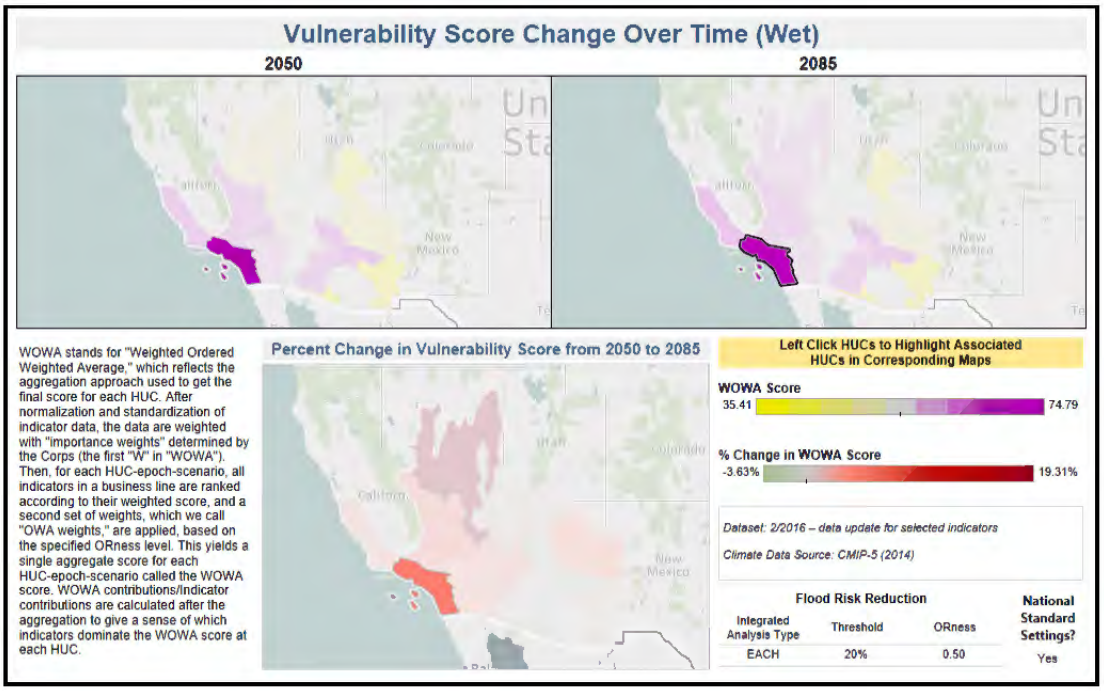


Figure 27. Vulnerability Score, Wet Scenario HUC-4:1807 – Southern California Coastal

4.2 Relative Sea Level Change

San Diego Creek outlets to Santa Ana River, which is connected to the Pacific Ocean. Santiago Creek is over 11 miles upstream of from the ocean outlet, so relative sea level change is on a factor in the project design.

4.3 Summary of Results

Climate change is anticipated to affect sea level rise, temperatures, precipitation, and droughts in southern California. Based upon the literature review, evidence in observed precipitation records suggests increases in both annual average, and minimum and maximum temperature in the California Region over the past century. Trends in observed annual precipitation totals have been variable within the California Region in the 20th century. Similarly, variability has been observed in historical streamflow trends and other hydrologic data for the California Region with relatively low consensus across the literature. The majority of the studies report no statistically significant trends in historical streamflows over the second half of the 20th century. There is strong consensus in the literature that air temperatures will increase in the study basin, and throughout the country, over the next century. Projections of precipitation in the study basin are less certain than those associated with air temperature. The dominant trend appears to suggest an increase in precipitation in the northern areas of the region and a decrease in precipitation in the southern areas of the California Region. Future storm events in the California Region are predicted to increase in frequency and intensity compared to the recent past. Hydrologic projections, such as streamflow and runoff are harder to compare, with seasonal variabilities, model variabilities, and spatial variabilities in results.

Within the study area, a first order statistical analysis was performed to characterize trends in observed temperature, precipitation and streamflow records. It was found that there is a statistically, significant increasing trend in maximum daily temperature. No statistically significant trend was found in precipitation data within the study area. Trends in annual, peak streamflow were analyzed for three locations within and in the vicinity of the study area. There is some evidence of an increasing trend in peak streamflow, but it is difficult to discern whether this trend is due to climate change or the significant land use changes that have occurred in the basin. An evaluation of unregulated, projected climate changed hydrology for the HUC04 watershed which encompasses the study area indicates that projected streamflow is not anticipated to increase overtime.

The USACE Vulnerability Assessment Tool was applied for the 1807-Southern California Coastal HUC-4 to assess the study area's vulnerability to climate change impacts relative to the other 201 HUC-4 Watersheds within the continental United States. For the flood risk reduction business line, the study area was determined to be relatively vulnerable to climate change.

4.4 Alternatives and Climate Change Considerations

The proposed project is expected to reduce losses due to flooding, however, residual risks, including those resulting from changing climate conditions, exist within the watershed. While climate changes were considered during the plan formulation process, uncertainty with those projections exist and risk still remains. For example, there is little consensus on future precipitation projections, but some studies like the fourth NCA, Easterling et al. (2017) project an increase in the frequency of heavy downpours, especially through atmospheric rivers, which are narrow bands of highly concentrated storms that move in from the Pacific Ocean.

5.0 HYDRAULICS

5.1 Hydraulic Model Development

The hydraulic model was initially created in HEC-RAS v. 5.0.7 but was completed in v. 6.3.0. The upstream portion of the model begins at Smith Basin and Recharge basins and extends down to the confluence with the Santa Ana River.

5.2 Model Parameters

The hydraulic model consists of Smith Basin and the Recharge Basins represented as a storage area, cross-sections representing the channel, lateral structures connecting the channel to the two-dimensions flow areas in the overbank and boundary conditions. The physical characteristics and boundary conditions used for each of the is further described in the following paragraphs.

5.2.1 Cross-Section Geometry

Cross-section geometry and reach lengths were obtained from field surveys and LIDAR data collected in 2019. The 2019 LIDAR, which covered Smith Basin, Recharge Basin, and Santiago Creek downstream to the Santa Ana River, was merged with a larger County-wide data set to provide full coverage of the overbank areas.

5.2.1 River Reaches

The existing condition model consists of just one reach Santiago Creek (5.7 miles). The project condition model includes the same Santiago Creek reach, but also includes a 930 ft channel that connects the Recharge Basins with the Santiago Creek though an inline structure representing the two twenty-foot wide tainter gates.

5.2.1 Channel Roughness

Santiago Creek channel varies from small grain material and variable diameter cobble to concrete-lined, so

manning's n values vary considerably. Channel Manning's n values vary from 0.018 up to 0.054. The overbank areas are primarily represented with the two-dimensional flow areas.

5.2.1 Bridges and Culverts

Twenty bridges and one system of culverts are included in the hydraulic model. For low flow computations, the energy method was used, except where piers are present. In these locations, the momentum balance method was used.

5.2.1 Lateral Structures

The one-dimensional representation of Santiago Creek is connected to the two-dimensional flow area on the left and right overbank with 34 lateral structures. Since the connection is not an elevated levee or embankment, a weir coefficient of 0.5 is used to represent the connection.

5.2.1 Two-Dimensional Flow Areas

Two-dimensional flow areas are used to represent inundation when the capacity of the Santiago Creek channel is exceeded, or when there is overflow from Recharge Basins. Unlike typical valley floodplains, after water leaves the banks of Santiago Creek it does not return to the channel but moves in a southern direction parallel to the Santa Ana River. Since inundation can be expansive during the low frequency events, the two-dimensional areas are currently truncated to limit the extent of inundation. A normal depth boundary condition is used to prevent 'pooling' of the water at the edge of the two-dimensional boundary. The default Manning's n value of 0.06 is currently used in the both the left and right overbank two-dimensional flow areas. This composite value is considered reasonable give the highly mixed land cover of building (high roughness) and streets (low roughness).

5.2.2 Boundary Conditions

5.2.2.1 Inflows

Appropriately placed boundary conditions were added along the channel from the results of the HEC-HMS model. Table 8 contains the inflow boundary conditions in the HEC-RAS model. Downstream boundary conditions for Santiago Creek are taken from the 2013 analysis and represent the river level on the Santa Ana River.

Table 8: Boundary conditions for the HEC-RAS model.

Location	Boundary Condition
RS 23,414.5	SC2, SC3, SC4
RS 12,537.4	SC6, SC7
RS 8,126.7	SC5, SC8
RS 4,544.9	SC9
Rs 1,642	SC10
RS 1,055	Downstream BC (See 5.2.2.1)
Recharge Basin	US_BASINS, SC1, HANDCREEK, LARGE_OUTFALL*

**For project condition, the large outfall was added to the upstream channel to reflect the project condition.*

5.2.2.1 Joint Probability of Peaking – Santa Ana River and Santiago Creek

Downstream flows and water levels on the Santa Ana River can influence stages on Santiago Creek. While current,

previous hydrologic and hydraulic modeling and the period of record demonstrates that flooding is relatively minor on Santiago Creek, channel capacity is most limited on the lower end of Santiago Creek closest to the Santa Ana River where the influence is the greatest. As described in EM 1110-2-1413, the degree of dependence is determined based on inspection of the available record available and judgements with regard to the meteorological and physiographic origins of the interior and exterior events.

From the period of record, data was gathered for the largest events recorded at the gage on Lower Santiago Creek (USGS 11077500 – Santiago Creek at Santa Ana) and the nearest gage on the Santa Ana River (USGS 11078000 – Santa Ana at Santa Ana), located a little more than 1.5 miles downstream of the confluence of Santiago Creek and the Santa Ana River. In addition, a flow frequency analysis was performed using graphical methods on annual peak discharges on the Santa Ana gage (*Figure 28*). Annual peak discharges were used from between 1965 and present day. Earlier records were not used because they pre-date the construction of the Villa Park Dam (completed in 1963), which provides flood storage on Santiago Creek and would affect the peak discharges and timing of flood peaks at the confluence.

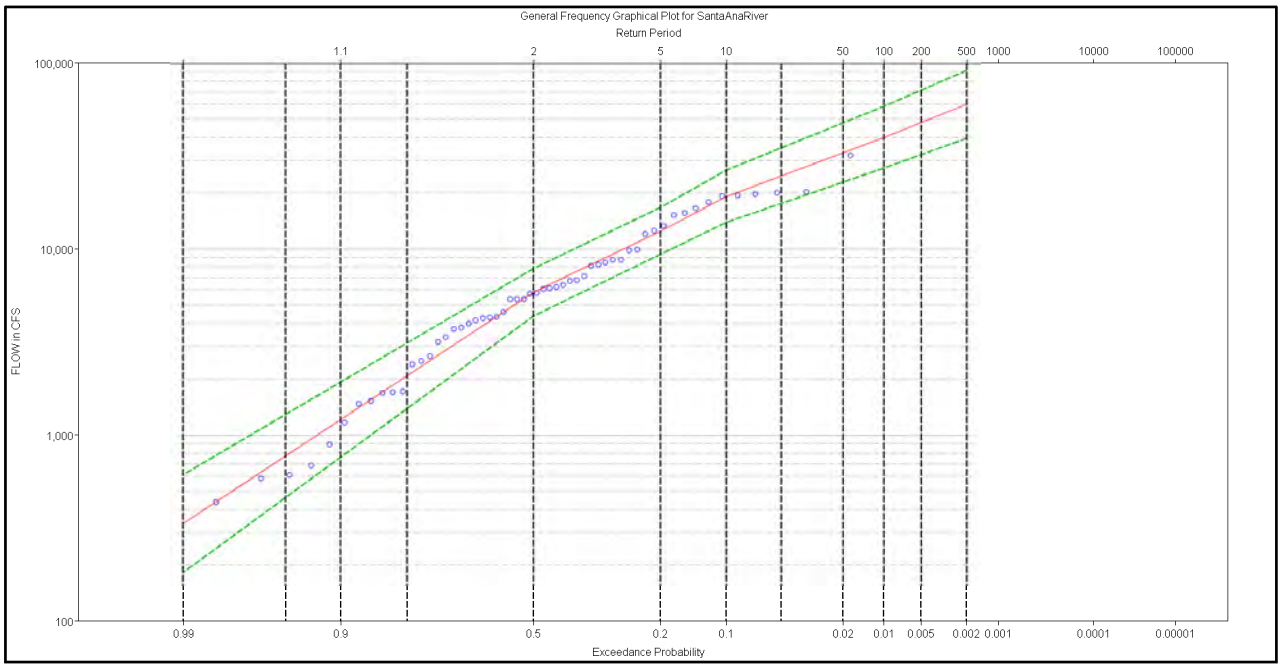


Figure 28: Flow frequency analysis for Santa Ana River at Santa Ana.

According to the Santa Ana Volume 7 - Hydrology Appendix Plate 7-67 (USACE 1988), the present 1% AEP discharge is 46,000 cfs, and an alternative curve labeled 'With Seven Oaks Dam and SAR Project Dam' the 1% AEP discharge is 40,000 cfs. The analysis in 1988 used mean plotting positions for 44 years between 1941 and 1984. According to discussions with Hydraulics in SPL, the accepted 1% AEP discharge is 46,000 cfs and the hydrologic analysis for the Santa Ana River basin have not been updated since 1998.

The updated flow frequency analysis was compared to the previous flow frequency analysis performed in 1988 and the period of record. Table 9 shows a comparison of the largest peak discharges on Santiago Creek and the associated frequency with both Santiago Creek and the Santa Ana River during at the time of the peak with Santiago Creek for annual peak events between 1965 and present.

Table 9: Comparison of annual and peak discharges on Santiago Creek and corresponding flow rates and frequencies on the Santa Ana River near the confluence.

Santiago Creek				Santa Ana River			
Rank	Date	Peak Discharge (cfs)	AEP (Existing / Project)	Rank	Date	Peak Discharge (cfs)	% AEP
1	2/25/1969	6,600	~0.5%	6	2/25/1969	19,100	2.5%
2	10/20/2004	4,450	2% / 2%	*	10/20/2004	10,900	11%
3	2/24/1998	3,300	5% / 5%	10	2/24/1998	15,200	5.3%
4	2/19/1993	3,080	5% / 5%	*	2/19/1993	13,300	5.6%
5	1/4/1995	2,470	20%	1	1/4/1995	31,700	1.1%

**Not an annual peak*

The period of record representing hydrologic conditions similar to today shows that relatively large events do occur at the same time on both Santiago Creek and the Santa Ana River but use of a coincident 1% AEP peak is likely conservative. It is worth noting that the period of record for similar hydrologic conditions is relatively short, resulting in uncertainty in characterizing the likelihood both Santiago Creek and the Santa Ana River peaking at the same time.

To determine the sensitivity of downstream boundary conditions for Santiago Creek and effects of assumed water levels on the Santa Ana River, varied boundary conditions were tested to determine how they would impact the water surface profile on the Santa Ana River. A starting water surface elevation of 109.3 ft NAVD 88, which is the elevation corresponding to the 1% AEP discharge from the Santa Ana Volume 7 - Hydrology Appendix (USACE 1988), was used as the initial downstream boundary condition. This would represent a conservative condition of peaking of the Santiago Creek and Santa Ana River at the same time. Figure 29 and Figure 30 show the results of the boundary condition sensitivity analysis with the boundary condition at 109.3 ft NAVD 88 and 106.3 ft NAVD 88. This three-foot reduction represents the uncertainty in the expected outlet condition on the Santa Ana River during the 1% AEP event for both the existing and project condition (reservoir improvements and channel improvements) between the I-5 and Santa Ana confluence. Figure 30 shows the results with only the channel improvements.

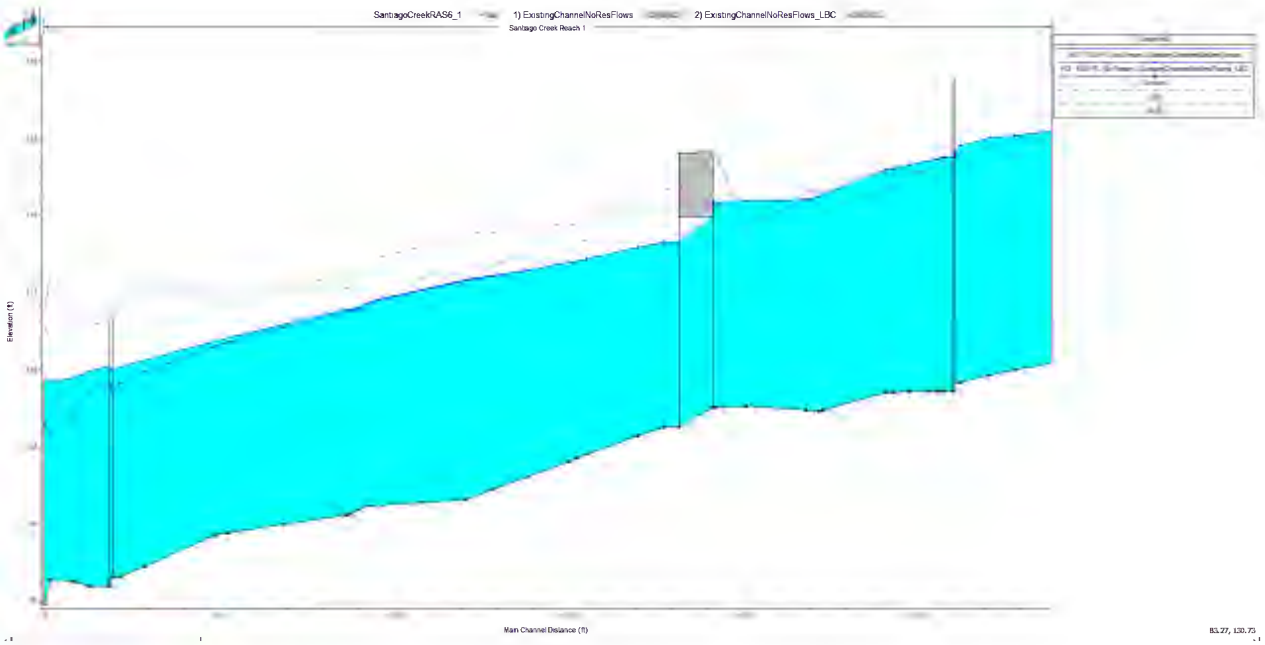


Figure 29: Existing water surface profiles for the 1% AEP on Santiago Creek between the confluence with the Santa Ana River and approximately 3000 feet upstream. Discharges at the confluence are without the reservoir improvements (Q = 6800 cfs)

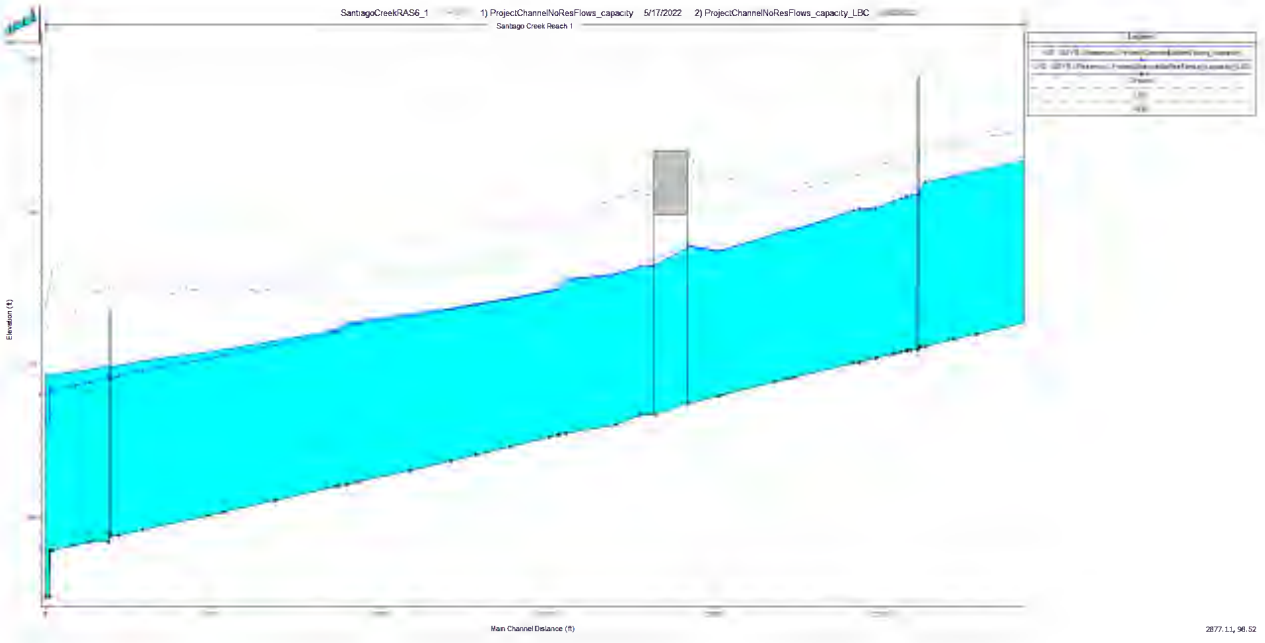


Figure 30: Project condition water surface profiles for the 1% AEP on Santiago Creek between the confluence with the Santa Ana River and approximately 3000 feet upstream. Discharges at the confluence are with the reservoir improvements (Q = 5300 cfs)

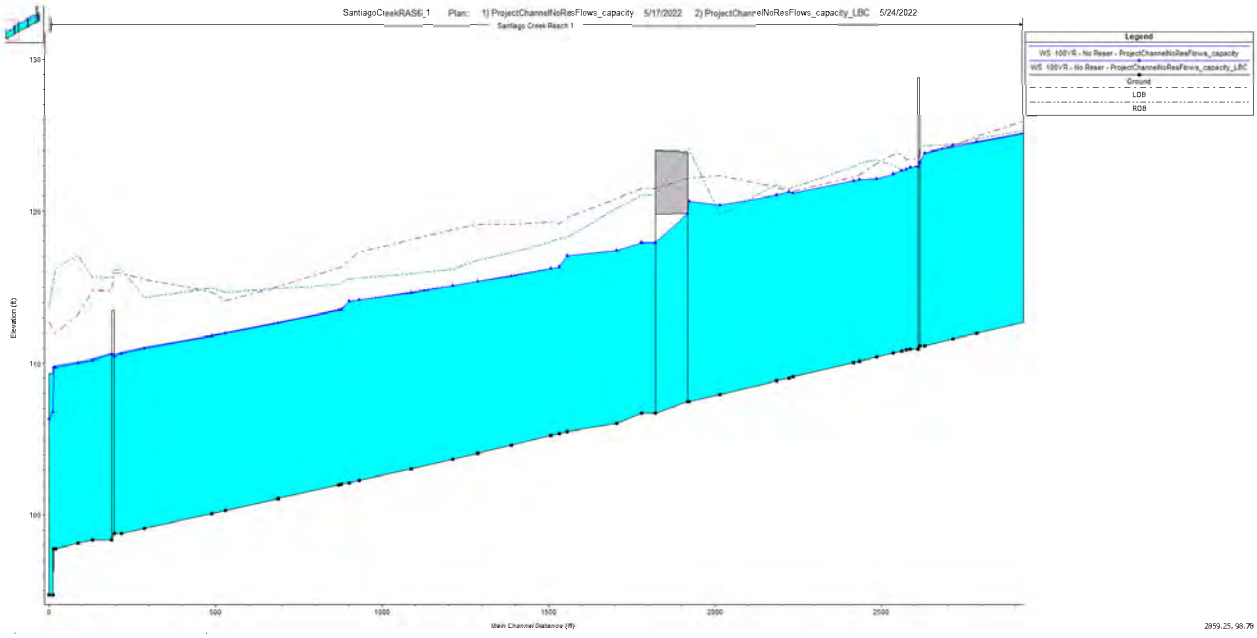


Figure 31: Project condition water surface profiles for the 1% AEP on Santiago Creek between the confluence with the Santa Ana River and approximately 3000 feet upstream. Discharges at the confluence are without the reservoir improvements (Q = 6800 cfs)

5.2.3 Risk and Uncertainty Analysis

A risk analysis was performed on the lower reach of Santiago Creek between I-5 and the confluence with the Santa Ana River. The following conditions were evaluated: Existing Conditions, Channel Improvements without Reservoir Improvements, and Channel Improvements with Reservoir Improvement. The risk and uncertainty analysis was performed using HEC-FDA v 1.4.1.

5.2.3.1 Existing Conditions

For existing conditions, the uncertainty related to the stage-discharge function was determined by establishing lower limit for manning's n, an upper limit for manning' n, and included 2 feet of debris on both sides of bridge piers. The mean stage difference for this range of conditions at the overtopping location is 2.6 ft. Using equation 5—7 in EM 1110-2-1619, the standard deviation was computed to be 0.65 feet.

For the uncertainty of the exceedance probability function, water surface profiles for 8 frequencies (50% AEP – 0.2% AEP) were used, along with an equivalent record length of 58 years, representing the record length for inflows into Villa Park Dam. Three representative locations were selected: between I-5 and Flower Street (RS 7,000.0), between Flower Street and Bristol (3,350.0), and between Bristol and the confluence with the Santa Ana River. While this varies slightly by reach, the mean stage of 2.6 ft was considered representative of all three reaches. Target locations represent the existing banks in those locations.

Table 10: Results of risk and uncertainty analysis for the existing conditions.

		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Location	Target Stage	10	30	50	10%	4%	2%	1%	.4%	.2%
7,000.0	140.7	0.0005	0.0052	0.0259	1.0	1.0	0.9991	0.9879	0.9759	0.9561
3,350.0	121.6	0.2173	0.5206	0.7063	1.0	0.8118	0.6541	0.4908	0.0575	0.0167
2,200.0	115.40	0.1442	0.3731	0.5409	0.9887	0.9234	0.7872	0.5776	0.0948	0.0208

Table 10 shows the results from the risk analysis. In this location for existing conditions. The target stage There is slightly less than 50% chance of containment during the 1% AEP event (assurance) in the reach between Flower Street and Bristol, and a little more than 50% chance of containment of the 1% AEP in the reach between Bristol and the confluence. These two areas represent the greatest risk of breakout flooding.

5.2.3.1 Channel improvements (no floodwalls) with Reservoir Improvements

For the 'channel improvements (no floodwall) with reservoir improvements' condition, the uncertainty related to the stage-discharge function was determined by using the velocity and conveyance manning's n values from the hydraulic design of the channel design and included 2 feet of debris on each side of bridge piers. The mean stage difference for this range of conditions at the overtopping location is 2.6 ft. The mean stage difference was similar to existing conditions as flows are only slightly reduced and channel characteristics are similar. Using equation 5—7 in EM 1110-2-1619, the standard deviation was computed to be 0.65 feet.

Similar to existing conditions, water surface profiles for 8 frequencies (50% AEP – 0.2% AEP) were used, along with an equivalent record length of 58 years, representing the record length for inflows into Villa Park Dam.

Table 11: Results of risk and uncertainty analysis for reservoir and channel improvements (no floodwalls).

		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Location	Target Stage	10	30	50	10%	4%	2%	1%	.4%	.2%
7,000.0	140.7	0.0483	0.1380	0.2192	1.0	1.0	1.0	0.9990	0.2924	0.0119
3,350.0	121.6	0.0726	0.2025	0.3141	0.9995	0.9988	0.9928	0.8906	0.0916	0.0267
2,200.0	115.40	0.0866	0.2380	0.3643	0.9920	0.9871	0.9693	0.8634	0.1196	0.0462

The result of the analysis in Table 11 show that the risk of exceeding the overbank elevations in the lower section of Santiago Creek is an acceptable level without floodwalls, but improvements to the reservoir, including the construction operation of the outlet works to release large volumes of water with peak discharges that will substantially fill the channel in advance of storm events, presents other risks to maintaining the conservation pool and providing flood warning to the public.

5.2.3.1 Channel improvements (no floodwalls) with Passive Reservoir

For the 'channel improvements (no floodwall) with passive reservoir' condition, the uncertainty related to the stage-discharge function was determined by using the velocity and conveyance manning's n values from the hydraulic design of the channel design and included 2 feet of debris on each side of bridge piers. The mean stage difference for this range of conditions at the overtopping location is 2.6 ft. The mean stage difference was similar to existing conditions as channel characteristics are similar. Using equation 5—7 in EM 1110-2-1619, the standard deviation was computed to be 0.65 feet.

Similar to existing conditions, water surface profiles for 8 frequencies (50% AEP – 0.2% AEP) were used, along with an equivalent record length of 58 years, representing the record length for inflows into Villa Park Dam.

Table 12: Results of risk and uncertainty analysis for channel improvements with passive reservoir management without floodwalls.

		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Location	Target Stage	10	30	50	10%	4%	2%	1%	.4%	.2%
7,000.0	140.7	0.0005	0.0052	0.0259	1.0	1.0	0.9991	0.9879	0.9759	0.9561
3,350.0	121.6	0.01876	0.4638	0.6461	0.9503	0.8555	0.7480	0.6292	0.2542	0.1866
2,200.0	115.4	0.150	0.3859	0.5563	0.9766	0.8943	0.7844	0.6441	0.2355	0.0210

The results in Table 12 demonstrate that for the 1% AEP, without the reservoir improvements the assurance is not acceptable to adequately contain computed water surface profile.

5.2.3.1 Channel improvements (with floodwalls) with Passive Reservoir

For the 'channel improvements (with floodwall) with passive reservoir' condition, the uncertainty related to the stage-discharge function was determined by using the velocity and conveyance manning's n values from the hydraulic design of the channel design and including 2 feet of debris on each side of bridge piers. The mean stage difference for this range of conditions at the overtopping location is 2.6 ft. The mean stage difference was similar to existing conditions as channel characteristics are similar. Using equation 5—7 in EM 1110-2-1619, the standard deviation was computed to be 0.65 feet.

Similar to existing conditions, water surface profiles for 8 frequencies (50% AEP – 0.2% AEP) were used, along with an equivalent record length of 58 years, representing the record length for inflows into Villa Park Dam.

Table 13: Results of risk and uncertainty analysis for channel improvements with passive reservoir management with floodwalls.

		Long Term Risk (years)			Conditional Non-Exceedance Probability by Events					
Location	Target Stage	10	30	50	10%	4%	2%	1%	.4%	.2%
7,000.0	140.7	0.0005	0.0052	0.0259	1.0	1.0	0.9991	0.9879	0.9759	0.9561
3,350.0	123.43	0.0587	0.1660	0.2611	0.9959	0.9755	0.8689	0.8689	0.5765	0.4977
2,200.0	117.0	0.0288	0.0840	0.1360	0.9997	0.9965	0.9852	0.9484	0.7322	0.6106

The results in Table 13 show that adequate assurance can be achieved with the installation of short floodwalls (<3 ft) in the reach between Flower Street and Bristol (both sides of the creek) and downstream of Bristol Street (north side of the creek). More details can be found in the table of results.

5.2.1 Channel Improvements between I-5 and the Confluence

Rock Lined Channel

The Riprap Calculator in HEC-RAS v. 6.3 was used to calculator and verify the riprap GDM II design for the lower 6400 feet of channel on Santiago Creek. The calculator currently is only enabled for steady flow, so the lower reach of Santiago Creek (below I-5) was converted to steady flow for the purpose of stone sizing.

Table 14: Flows used in the steady flow analysis.

Station	Location	1% AEP Flow (cfs) -with Reservoir Improvements	1% AEP Flow (cfs) – Passive Resevoir
7417.9	I-5	5,100	6,600
3300.0	US Bristol	5,170	6,680
1329.0	US Pedestrian Bridge	5,300	6,780

In accordance with design guidance in EM 1110-2-1601, manning's n values were computed for both the velocity and conveyance. The hydraulic design parameters for the channel design are found in Table 15. A secondary design was developed for consideration of the passive storage alternative (no outlet structure). Since the design 1% AEP discharges for the passive storage alternative are approximately 22% higher, velocities are slightly higher, resulting in some reaches requiring slightly larger stone sizes. The design parameters for the passive reservoir management alternative are found in Table 15.

At the conclusion of the development of this DDR, Orange County Public Works submitted a comment stating that in 1962, 18 inch thick riprap (unknown gradation) was placed in the lower reach of Santiago Creek and this stone failed during the 1969 flood event. In light of this information, future design efforts should investigate if there is historical information to support increase the stone size in the reach between Bristol Street and the Santa Ana River. The floodwalls on the north bank of Santiago Creek, where the most devastating erosion occurred were designed to perform without soil and stone material creekside to incorporate redundancy and resilience to the design.

Table 15: Design parameters for rock lined channel design with passive reservoir management alternative.

Station	Bed D_{100} / Thickness (in)	Sideslope D_{100} / Thickness (in)	Sideslopes	Bottom Width (ft)	Invert (ft.) NAVD 88	Slope (ft/ft)	Manning's n (vel)	Manning's n (cap)	Q (cfs)	1 % AEP WSE NAVD 88	Min. Protection Level NAVD 88
7611	I-5 Bridge										
7417.9	18.0	18.0	1.75:1	56.00	128.16	0.004566	0.035	0.04	6600	140.9	142.0
7200	18.0	18.0	1.75:1	56.00	127.16	0.004566	0.035	0.07*	6600	140.3	141.4
7134.8	18.0	18.0	1.75:1	56.00	126.87	0.004566	0.035	0.07*	6600	140.0	141.1
7030	18.0	18.0	1.75:1	56.00	126.39	0.004566	0.035	0.07*	6600	139.6	140.7
7000	18.0	18.0	1.75:1	50.00	126.25	0.004566	0.035	0.07*	6600	139.4	140.5
6900	18.0	18.0	1.75:1	50.00	125.79	0.004566	0.035	0.07*	6600	138.9	140.0
6812	24.0	24.0	1.75:1	30.00	125.39	0.004566	0.035	0.07*	6600	138.6	139.7
6800	24.0	24.0	1.75:1	30.00	125.34	0.004566	0.035	0.07*	6600	138.5	139.6
6700	24.0	24.0	1.75:1	30.00	124.88	0.004566	0.035	0.07*	6600	138.1	139.2
6634.9	24.0	24.0	1.75:1	30.00	124.58	0.004566	0.037	0.07*	6600	137.7	138.8
6500	24.0	24.0	1.75:1	30.00	123.97	0.004566	0.037	0.07*	6600	136.6	137.7
6339.4	24.0	24.0	1.75:1	30.00	123.23	0.004566	0.037	0.042	6600	135.3	136.4
6300	30.0	30.0	1.75:1	30.00	123.05	0.004566	0.037	0.043	6600	134.8	135.9
6259	24.0	24.0	1.75:1	30.00	122.87	0.004566	0.035	0.042	6600	134.7	135.8
6208	18.0	18.0	1.75:1	40.00	122.63	0.004566	0.035	0.04	6600	134.8	135.9
6175	18.0	18.0	1.75:1	40.00	122.48	0.004566	0.035	0.04	6600	134.6	135.7
6048.1	18.0	18.0	1.75:1	40.00	121.90	0.004566	0.035	0.04	6600	134.1	135.2
5913	18.0	18.0	1.75:1	40.00	121.29	0.004566	0.035	0.07*	6600	134.2	135.3
5824.3	18.0	18.0	1.75:1	80.00	120.88	0.004566	0.035	0.04	6600	134.3	135.4
5773.1	Flower Street Bridge										
5724.1	18.0	18.0	1.75:1	80.00	120.43	0.004566	0.035	0.04	6600	134.2	136.2[R]
5684.1	18.0	18.0	1.75:1	80.00	120.24	0.004566	0.035	0.04	6600	133.7	135.7[R]
5593	18.0	18.0	1.75:1	30.00	119.83	0.004566	0.035	0.04	6600	133.4	135.4[R,L]
5500	18.0	30.0	1.75:1	30.00	119.40	0.004566	0.037	0.043	6600	132.4	134.4[R]
5354	18.0	30.0	1.75:1	30.00	118.74	0.004566	0.037	0.043	6600	131.8	133.8[R,L]
5300	18.0	30.0	1.75:1	30.00	118.49	0.004566	0.037	0.043	6600	131.5	133.5[R,L]
5100	18.0	24.0	1.75:1	30.00	117.58	0.004566	0.036	0.042	6600	130.7	132.7[R,L]
4932.3	24.0	24.0	1.75:1	30.00	116.81	0.004566	0.036	0.042	6600	129.7	131.7[R,L]
4900	24.0	24.0	1.75:1	30.00	116.66	0.004566	0.036	0.042	6600	129.6	131.6[R,L]
4700	24.0	24.0	1.75:1	30.00	115.75	0.004566	0.036	0.042	6600	128.7	130.7[R,L]
4544.9	24.0	24.0	1.75:1	30.00	115.04	0.004566	0.036	0.042	6600	127.9	129.9[R,L]
4500	24.0	24.0	1.75:1	30.00	114.84	0.004566	0.036	0.042	6600	127.7	129.7[R,L]
4300	24.0	24.0	1.75:1	30.00	113.92	0.004566	0.037	0.042	6600	126.6	128.6[R,L]
4293.5	24.0	24.0	1.75:1	30.00	113.89	0.005230	0.037	0.042	6600	126.6	128.6[R,L]
4252.5	24.0	24.0	1.75:1	30.00	113.68	0.005230	0.037	0.042	6600	126.4	128.4[R,L]
4150	24.0	24.0	1.75:1	30.00	113.14	0.005230	0.037	0.042	6600	125.8	127.8[R,L]
3900	24.0	24.0	1.75:1	30.00	111.83	0.005230	0.037	0.042	6600	124.7	126.7[R,L]
3829.2	18.0	18.0	1.75:1	30.00	111.46	0.005230	0.035	0.04	6600	124.3	126.3[R,L]
3745	18.0	18.0	1.75:1	30.00	111.02	0.005230	0.035	0.04	6600	124.0	126.0[R,L]
3730.7	Pedestrian Bridge										
3702	24.0	24.0	1.75:1	30.00	110.80	0.005230	0.037	0.042	6600	123.1	125.1[R,L]
3690	24.0	24.0	1.75:1	30.00	110.81	0.005230	0.037	0.042	6600	122.9	124.9[R,L]
3675	24.0	24.0	1.75:1	30.00	110.73	0.005230	0.037	0.042	6600	122.8	124.8[R,L]
3650	30.0	30.0	1.75:1	30.00	110.60	0.005230	0.037	0.043	6600	122.7	124.7[R,L]
3600	30.0	30.0	1.75:1	30.00	110.34	0.005230	0.037	0.043	6600	122.2	124.2[R,L]
3550	24.0	24.0	1.75:1	33.75	110.08	0.005230	0.037	0.042	6600	122.2	124.2[R,L]
3532.2	24.0	24.0	1.75:1	33.75	109.99	0.005230	0.037	0.042	6600	122.1	124.1[R,L]
3350	24.0	24.0	1.75:1	33.75	109.03	0.005230	0.037	0.042	6600	121.4	123.4[R,L]
3337.4	24.0	24.0	1.75:1	37.50	108.97	0.005230	0.037	0.042	6680	121.4	123.4[R,L]
3300	24.0	24.0	1.75:1	37.50	108.77	0.005230	0.037	0.042	6680	121.2	123.2[R,L]
3130	24.0	24.0	1.75:1	37.50	107.88	0.005230	0.037	0.042	6680	120.9	122.9[R,L]
3036.6	24.0	24.0	1.75:1	60.00	107.40	0.005230	0.037	0.042	6680	120.9	122.9[R,L]
2980	Bristol Ave Bridge										
2893	18.0	18.0	1.75:1	60.00	106.65	0.005230	0.035	0.04	6680	118.2	120.2
2818	18.0	18.0	1.75:1	50.00	106.26	0.005230	0.035	0.04	6680	117.8	119.8
2670	18.0	18.0	1.75:1	50.00	105.48	0.005230	0.035	0.04	6680	117.4	119.4[R]
2644	18.0	18.0	1.75:1	40.00	105.35	0.005230	0.035	0.04	6680	116.8	118.8[R]
2620	18.0	18.0	1.75:1	40.00	105.22	0.005230	0.035	0.04	6680	116.7	118.7[R]
2500	18.0	18.0	1.75:1	40.00	104.59	0.005230	0.035	0.04	6680	116.3	118.3[R]
2400	18.0	18.0	1.75:1	40.00	104.07	0.005230	0.035	0.04	6680	115.9	117.9[R]
2324.1	18.0	18.0	1.75:1	40.00	103.67	0.005230	0.035	0.04	6680	115.7	117.8[R]
2200	18.0	18.0	1.75:1	40.00	103.03	0.004891	0.035	0.04	6680	115.3	117.3[R]
2044.3	18.0	18.0	1.75:1	40.00	102.26	0.004891	0.035	0.04	6680	114.9	116.9[R]
2015	24.0	24.0	1.75:1	40.00	102.12	0.004891	0.035	0.042	6680	114.8	116.8[R]
1990	24.0	24.0	1.75:1	35.00	102.00	0.004891	0.035	0.042	6680	114.4	116.4[R]
1982	24.0	24.0	1.75:1	35.00	101.96	0.004891	0.035	0.042	6680	114.3	116.5[R]
1800	24.0	24.0	1.75:1	35.00	101.07	0.004891	0.035	0.042	6680	113.6	115.6
1642	18.0	18.0	1.75:1	35.00	100.30	0.004891	0.035	0.04	6680	113.2	115.2
1600	18.0	18.0	1.75:1	35.00	100.09	0.004891	0.035	0.04	6680	113.1	115.1
1400	18.0	18.0	1.75:1	35.00	99.11	0.004891	0.035	0.04	6680	112.6	114.6
1329	18.0	18.0	1.75:1	35.00	98.76	0.004891	0.035	0.07*	6780	112.3	114.3
1275	Pedestrian Bridge										
1242.1	18.0	18.0	1.75:1	35.00	98.34	0.004891	0.035	0.07*	6780	111.1	113.1
1200	18.0	18.0	1.75:1	35.00	98.13	0.004891	0.035	0.07*	6780	110.5	112.5
1132	18.0	18.0	1.75:1	35.00	97.80	0.004891	0.035	0.07*	6780	109.5	111.5

**Increased manning's n value to account for alluvial shrub planting zones*

[R] Floodwall required on right bank

[L] *Floodwall required on left bank*

Substrate Lined Channel

As an alternative to the rock lined channel, the recommended plan is to install surficial substrate over the stone to allow the establishment of vegetation. The substrate would also allow easier access to the channel for maintenance. This concept would carry forward the current stone lined channel design but would lower the invert by one foot to allow the installation substrate 1 foot deep over the stone.

Figure 32 below displays the average channel velocity for the 50% AEP through the 1% AEP event. According to EM-1110-2-1601 (Hydraulic Design of Flood Control Channels) the permissible velocity for fine gravel is 6 ft/s (USACE, 1994). Figure 33 shows the event during the 50% AEP event, velocities exceed this threshold through much of the channel, but particularly in the reach between Bristol and Flower Street. Substrate grain size would need to be larger than this to remain in place. As existing material is intended to be used, it would beneficial to utilize larger material in these higher velocity locations, or movement can be expected.

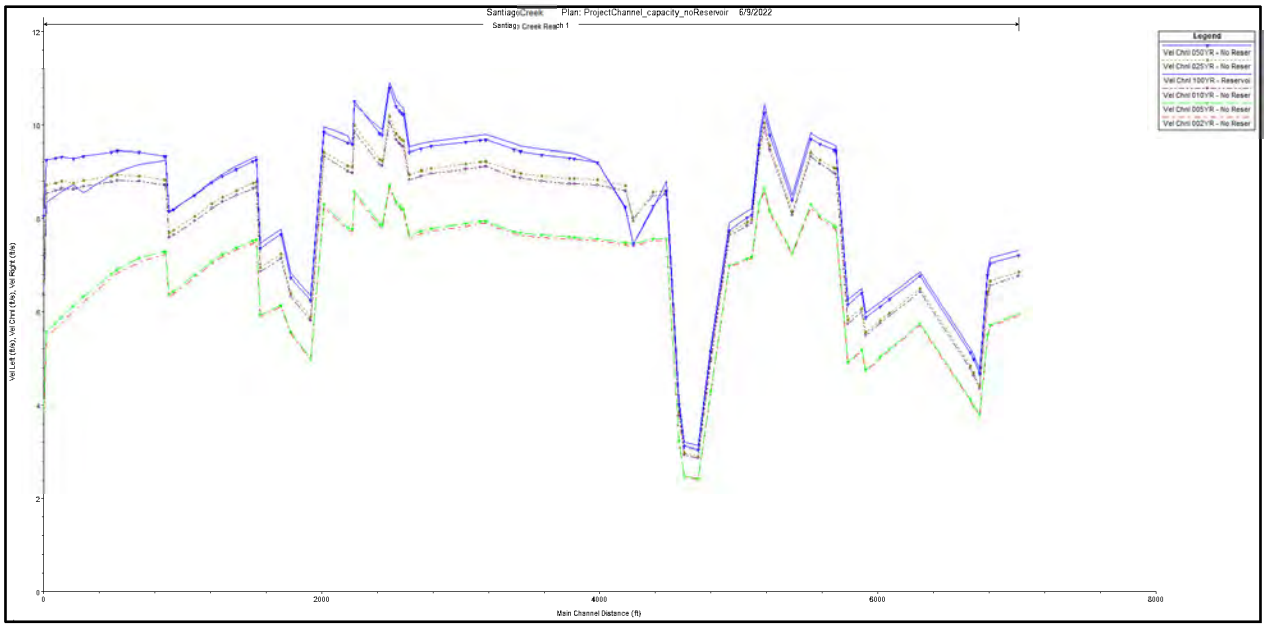


Figure 32: Average channel velocities 50% AEP through the 1% AEP event between I-5 and the confluence with the Santa Ana River.

6.0 RESULTS

6.1 Existing Conditions

Simulated events for the 25-YR (4% AEP) through the 500-YR (0.2% AEP) event were performed for existing conditions and are presented below, along with description of the inundation extents and flooding impacts for each frequency event based on the current modeling. These results do not include overbank flooding contributions from the mainstem Santa Ana River.

Model results for existing conditions assume that the Recharge Basins are full and the starting elevation at the beginning of the event is at 287.5 ft (NAVD 88).

6.1.1 4% AEP through 2% AEP Event

The 4% AEP through 4% AEP event do not show any overbank flooding. All flow is fully contained in the channel (Figure 33). These results are generally consistent with the results described from the 2013 modeling, however, during that effort a small overtopping of the channel is described approximately 850 feet upstream of the confluence with the Santa Ana River. A comparison of the cross-sections from the previous modeling and updated modeling shows a difference of over two feet in the lower reaches of the Santiago Creek, so it is possible that some of this channel incising has resulted in further disconnection between the channel and overbank.

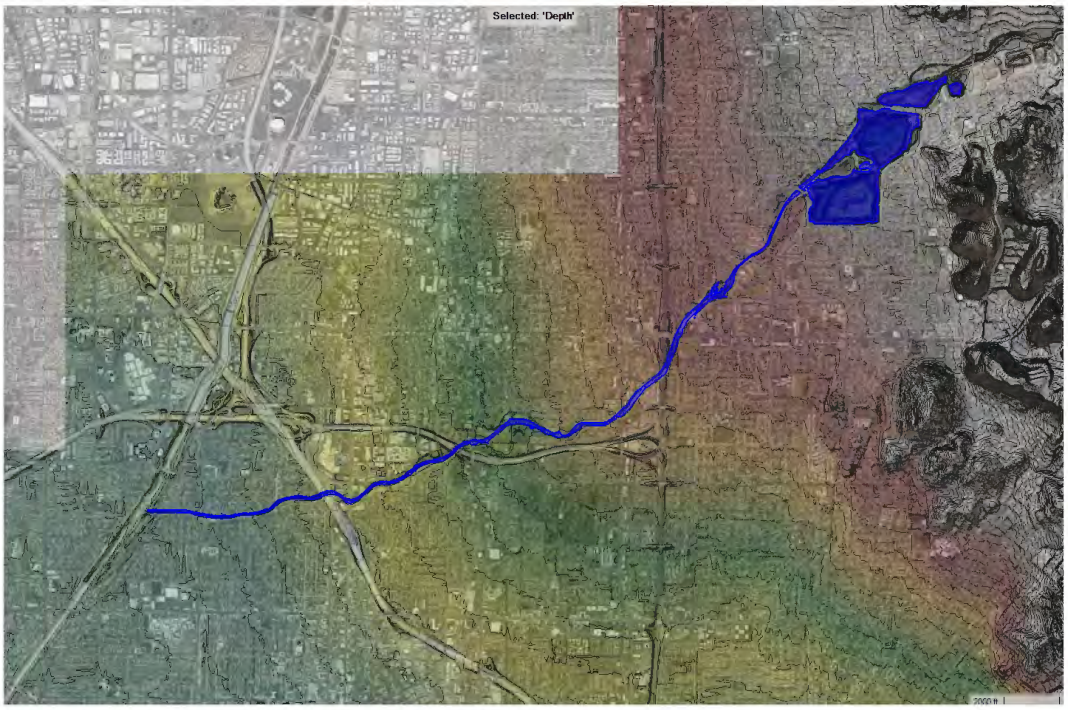


Figure 33: Inundation mapping representing conditions for the 10% AEP through 2% AEP event for existing conditions.

6.1.1 1% AEP Event

The 1% AEP flood event shows some breakout flooding on the north and side of the river just east of Bristol Street (Figure 34). Since overbank flooding generally follows the alluvial fan all the way downs the Pacific Ocean, mapping is truncated just south of the channel and removed from the two-dimensional flow area with a normal depth boundary condition.

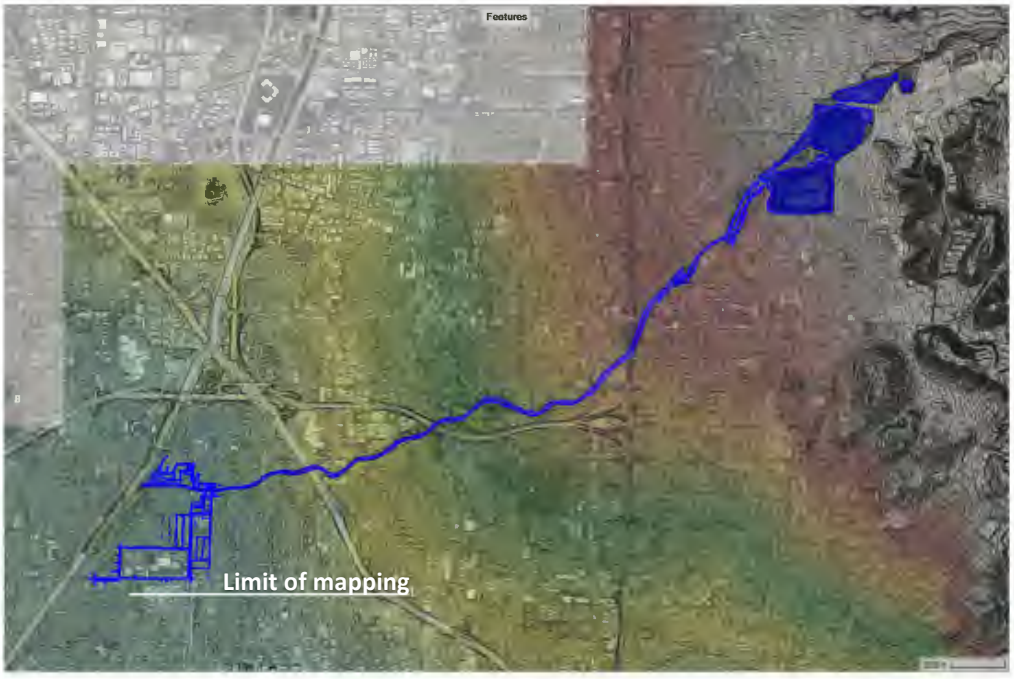


Figure 34: Inundation extents for the 1% AEP event. Mapping is truncated to the south using a normal depth boundary condition.

6.1.1 0.5% AEP Event

The 0.5% AEP event shows additional overbank flooding upstream of the Garden Grove Freeway, along with some additional flooding on the north of the channel east of Bristol and downstream of the Recharge Basins (Figure 35).

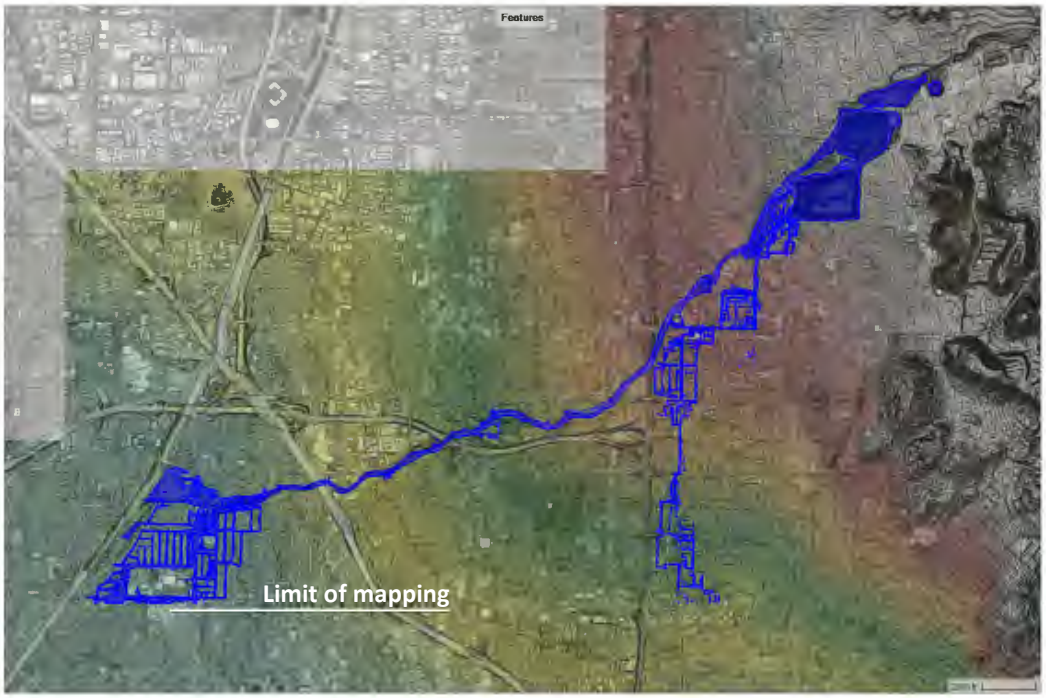


Figure 35: Inundation extents for the 200-year event. Mapping is truncated to the south using a normal depth

boundary condition.

6.1.1 0.2% AEP Event

The 500-year event shows significant flooding throughout the basin (Figure 36). The culverts at Prospect reach a capacity of approximately 7,200 cfs as water levels in the Recharge Basin approach the overflow location on the southwest corner of the but continue to release more up to 9,600 cfs as water levels in the Recharge Basin continues to rise as overflow continues. Model results show that downstream of the overflow, approximately 12,300 cfs returns back to the channel and approximately 1,300 cfs continues downstream to the south.

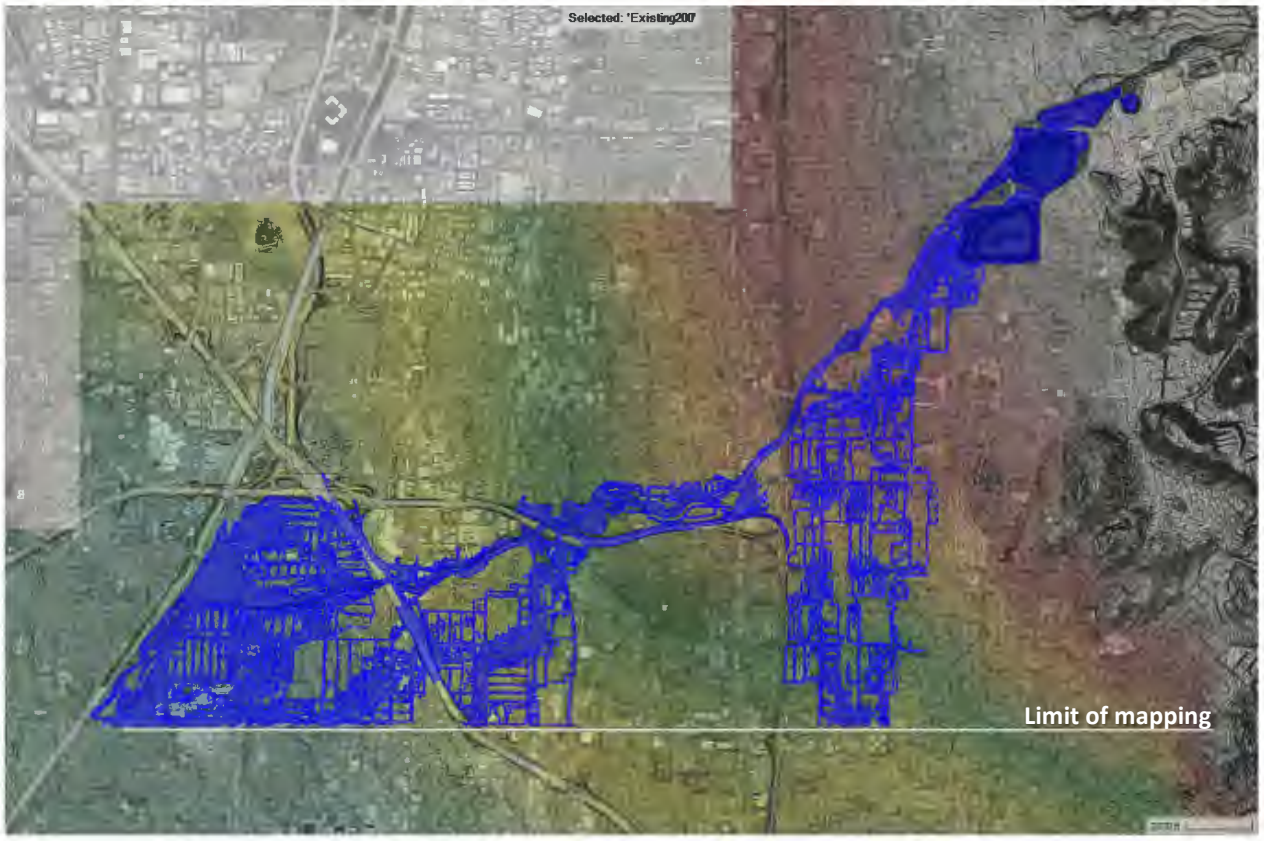


Figure 36: Inundation extents for the 500-year event. Mapping is truncated to the south using a normal depth boundary condition.

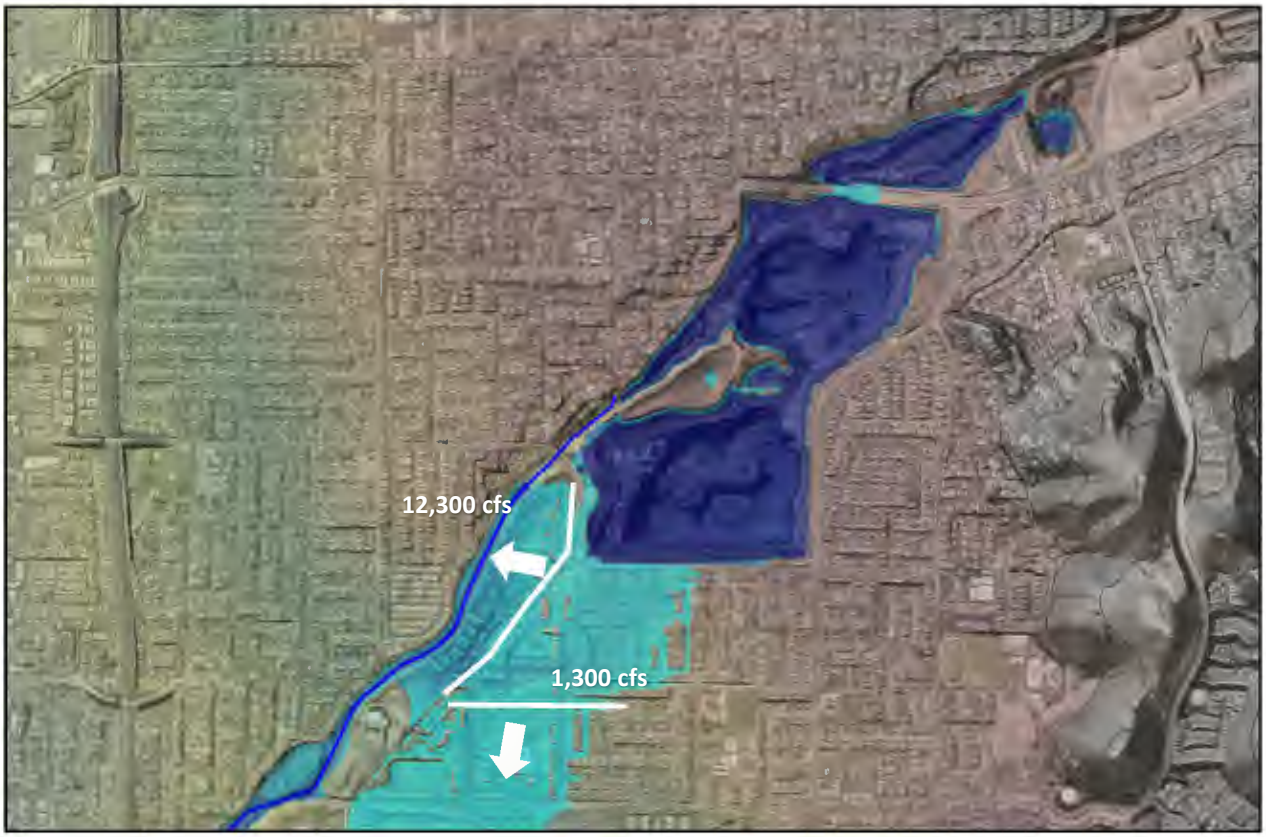


Figure 37: Flow split from the overflow in the southwest corner of the Recharge Basin. Model results shows that approximately 12,300 cfs goes moves the east back to Santiago Creek and approximately 1,300 cfs continues to the south.

Table 16: Summary of discharges for the 4% AEP through 0.2% AEP event for existing conditions.

Source	Location	25-YR	50-YR	100-YR	200-YR	500-YR
hydrology	Villa Park Inflow	9,060	10,320	13,590	14,045	26,245
hydrology	Villa Park Outflow	3,500	3,500	5,550	12,555	24,655
hydraulics	Recharge Basin Outflow (Prospect St.)	5,090	5,375	5,650	8,260	9,600
hydraulics	Recharge Basin Outflow (Overflow)	0	0	0	830	13,600
hydraulics	Chapman Ave.	5,335	5,675	6,015	10,290	23,900*
hydraulics	Garden Grove Freeway	5,355	5,670	6,010	10,285	20,850*
hydraulics	Confluence with Santa Ana	5,905	6,320	6,760	9,310	13,060*

Includes flow returning from the overflow in the southwest corner of the Recharge Basin.

Table 17: Maximum pool levels for the Recharge Basins for existing conditions.

	Elevation (ft. NAVD 88)				
	25-YR	**50-YR**	**100-YR**	**200-YR**	**500-YR**
Smith	302.2	302.9	304.4	309.4	312.3
Blue Diamond	298.3	298.7	299.1	304.1	307.1
Bond	298.3	298.7	299.1	304.1	307.1

6.2 Project Conditions (Passive Reservoir with Floodwalls)

Simulated events for the 25-YR (4% AEP) through the 500-YR (0.2% AEP) event were performed for project conditions and are presented below, along with description of the inundation extents and flooding impacts for each frequency event based on the current modeling. These results do not include overbank flooding contributions from the mainstem Santa Ana River.

Model results for existing conditions assume that the Recharge Basins are full and the starting elevation at the beginning of the event is at 287.5 ft (NAVD 88). Flood inundation is similar to existing conditions, with the exception of the lower reach between I-5 and the confluence with the Santa Ana River, where flooding is contained for the 1% AEP event.

6.2.1 4% AEP through 1% AEP Event

Similar to existing conditions, for the 4% AEP through 2% AEP events, floodwaters are fully contained within the channel along the full length of Santiago Creek between the Recharge Basins and the confluence with the Santa Ana River. For the 1% AEP event, floodwalls along select reaches of the channel banks are utilized to prevent breakout flows.

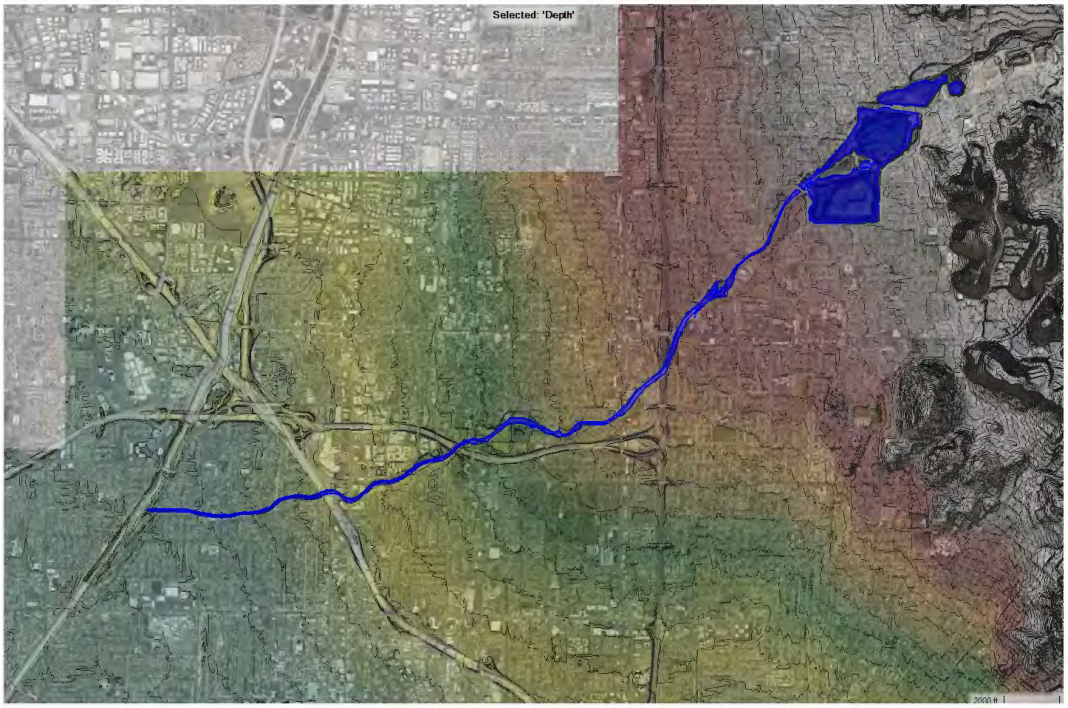


Figure 38: Inundation mapping representing conditions for the 10% AEP through 1% AEP event for project conditions.

6.2.2 0.5% AEP Event

The 0.5% AEP event shows additional overbank flooding upstream of the Garden Grove Freeway, along with some additional flooding on the north of the channel east of Bristol and downstream of the Recharge Basins (Figure 39). There is some overtopping in the lower reach containing floodwalls.



Figure 39: Inundation mapping representing conditions for the 0.5% AEP event for project conditions.

6.2.3 0.2% AEP Event

the 0.2% AEP event shows inundation extents similar to existing conditions (Figure 43). The Recharge Basin overflows into the areas south and west, and the floodwalls in the lower reach between the I-5 and the confluence with the Santa Ana River are overtopped.

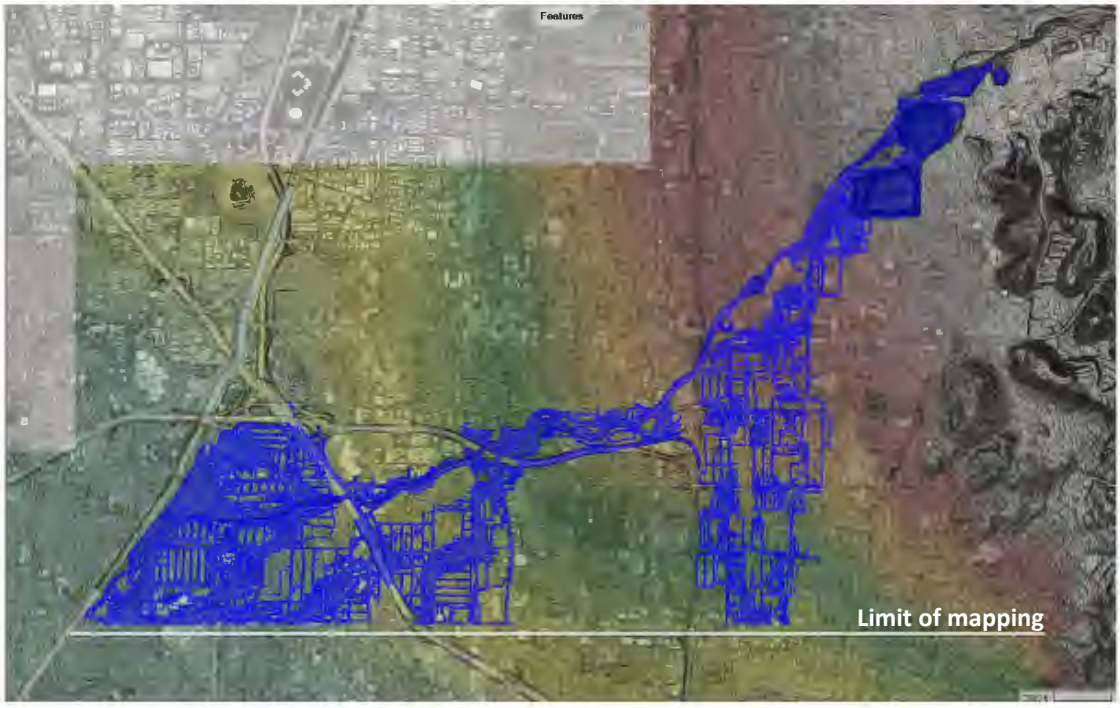


Figure 40: Inundation mapping representing conditions for the 0.2% AEP event for project conditions.

Table 18 presents a summary of peak discharges for project conditions. These results are similar to the results for existing conditions but vary slightly in the lower reach due to the work and floodwalls.

Table 18: Summary of discharges for the 4% AEP through 0.2% AEP event for project conditions.

Source	Location	25-YR	50-YR	100-YR	200-YR	500-YR
hydrology	Villa Park Inflow	9,060	10,320	13,590	14,045	26,245
hydrology	Villa Park Outflow	3,500	3,500	5,550	12,555	24,655
hydraulics	Recharge Basin Outflow (Prospect St.)	5,090	5,375	5,650	8,260	9,600
hydraulics	Recharge Basin Outflow (Overflow)	0	0	0	830	13,600
hydraulics	Chapman Ave.	5,335	5,675	6,015	10,290	23,900*
hydraulics	Garden Grove Freeway	5,355	5,670	6,010	10,285	20,850*
hydraulics	Confluence with Santa Ana	5,905	6,320	6,800	8,855	12,705*

**Includes flow returning from the overflow in the southwest corner of the Recharge Basin.*

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Attachment 1
Peak Inflows to Villa Park Dam

Year	Discharge	Year	Discharge
1933	144	1977	25
1934	271	1978	3,330
1935	194	1979	500
1936	142	1980	2,380
1937	1,360	1981	215
1938	5,200	1982	320
1939	76	1983	4,167
1940	50	1984	480
1941	1,800	1985	180
1942	2	1986	315
1943	2,420	1987	0
1944	3,000	1988	37
1945	330	1989	62
1946	150	1990	5
1947	40	1991	151
1948	1	1992	185
1949	407	1993	3,056
1950	804	1994	60
1951	139	1995	2,850
1952	3,300	1996	55
1953	955	1997	266
1954	494	1998	6,000
1955	104	1999	15
1956	868	2000	2
1957	144	2001	4
1958	825	2002	5
1959	128	2003	145
1960	26	2004	30
1961	388	2005	2,270
1962	98	2006	581
1963	5	2007	0
1964	50	2008	0
1965	55	2009	0
1966	441	2010	5,648
1967	971	2011	371
1968	900	2012	23
1969	10,981	2013	4
1970	28	2014	1
1971	169	2015	2
1972	108	2016	6
1973	625	2016	399
1974	206	2018	11
1975	106	2018	656
1976	14	2020	19

Attachment 2
Hydrologic Parameters

Location	Name	Area (sq.m)	In. loss (in)	con rate (in/hr)	Imperv. %	Lag (hrs)	S-Graph
Upstream of Santiago Dam	IRV_LAKE_2	20.4	0.2	0.25	1	2.9	Santa Margarita
	IRV_LAKE_1	18.8	0.2	0.25	1	3.7	Santa Margarita
	IRV_LAKE_4	11.7	0.2	0.25	1	3.5	Santa Margarita
	IRV_LAKE_3	11.6	0.2	0.25	1	1.9	Santa Margarita
Between Santiago Dam and Villa Park Dam	VP_1	10.5	0.2	0.07	1	5.8	Santa Margarita
	VP_2	9.3	0.2	0.07	2	6.5	Santa Margarita
Downstream of Villa Park Dam	DS_VP	3.4	0	0.2	24	0.6	Valley
Direct Input into Recharge Basins	HandyCreek	5.4	0	0.2	22	1.1	Valley
	LARGE_OUTFALL	1.2	0	0.2	37	0.4	Valley
	SC1	0.5	0.0	0.25	60	0.2	Valley
Santiago Creek	SC4	1.5	0.0	0.25	46	0.2	Valley
	SC2	0.8	0.0	0.25	53	0.4	Valley
	SC3	0.4	0.0	0.25	49	0.3	Valley
	SC7	1.1	0.0	0.25	56	0.6	Valley
	SC6	0.6	0.0	0.25	56	0.3	Valley
	SC5	2.3	0.0	0.25	62	0.6	Valley
	SC8	0.2	0.0	0.25	53	0.2	Valley
	SC9	0.4	0.0	0.25	47	0.3	Valley
	SC10	0.7	0.0	0.25	56	0.4	Valley

Attachment 3
Rules Used to Operate the Tainter Gates

```
'FLOW_IN' = Storage Areas:Total Inflow(Recharge,Value at current time step)
'SIM_TIME_HR' = Time:Hour of Simulation(Beginning of time step)
'RES_LEVEL' = Storage Areas:WS Elevation(Recharge,Value at current time step)
If ('SIM_TIME_HR' >= 6) And ('SIM_TIME_HR' < 24) Then
    If ('RES_LEVEL' > 276.5) Then
        Gate.Flow (Desired)(Gate #1) = 1200
        Gate.Flow (Desired)(Gate #2) = 1200
    Else
        Gate.Opening(Gate #1) = 0
        Gate.Opening(Gate #2) = 0
    End If
ElseIf ('SIM_TIME_HR' >= 24) Then
    If ('FLOW_IN' > 3500) Then
        'FLOW_OUT' = 3500
    ElseIf ('FLOW_IN' <= 3500) Then
        'FLOW_OUT' = 'FLOW_IN'
    End If
    'HALF_FLOW_OUT' = 0.5 * 'FLOW_OUT'
    Gate.Flow (Desired)(Gate #1) = 'HALF_FLOW_OUT'
    Gate.Flow (Desired)(Gate #2) = 'HALF_FLOW_OUT'
End If
```

Hydraulic Design of Outlet Structure (Reservoir Improvement)

The hydraulic design for the outlet structure (trash strut, radial gates, and stilling basin) was performed using and EM-1110-2-1602 and Hydraulic Design Criteria (Sheet 320-3).

Trash Strut

General

The trash strut is designed to trap all debris large enough to damage or clog the outlet, yet still provide minimum resistance to flow. The trash strut will be in the form of a half hexagon in plan view and will consist of vertical concrete beams 1 foot wide and horizontal concrete struts two feet wide. The edge of all members will be streamlined with a semi-circular shape to minimize resistance to flow. The strut will be 32.5 feet high by 300 feet, 2 feet above the maximum pool level. Th strut will provide 48 openings, each 6 feet high by 5.25 feet wide. To facilitate removal of trash, the strut will have a batter of 10 vertical to 1 horizontal.

Design Criteria

Following guidance in EM 110-2-1602, the vertical and horizontal openings of the trash strut were set to be less than two thirds of the gate height and width, respectively (Section 3.5).

Additional hydraulic design calculations can be found in Attachment 4.

Rating Curves – Radial Gates

Rating curves were developed for the two 12 ft x 20 ft radial gates to be used on the outlet structure. The detailed computations can be found in Attachment 4.

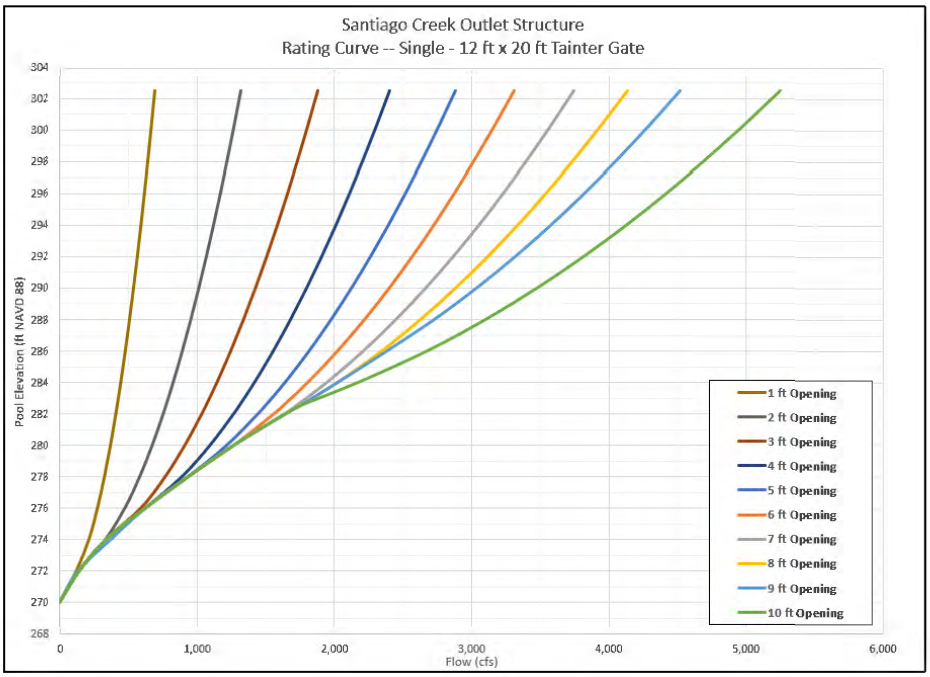


Figure 1: Rating curve for a single 12' x 20' radial gate.

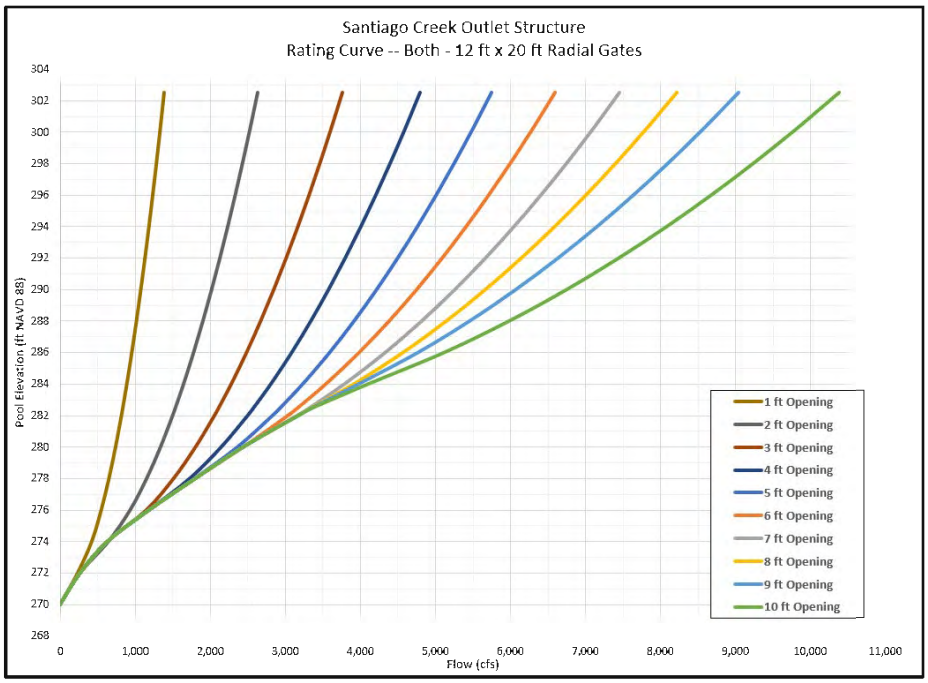


Figure 2: Rating curve for both 12' x 20' radial gates.

Gate Opening: 5 feet

Recharge Basin Pool Level: 284 ft NAVD 88

Head Loss Across Trash Strut

C = 1.1 (Plate C-22, EM 1110-2 1602) --Value is close to C=1.18 used in 1988 design

$h_t = C(\frac{v^2}{2g})$ head loss across trash strut

area of the trash strut

$A = (284\ ft - 270\ ft)(78.5\ ft\ wide)$

$A = 1099\ sq\ ft.$

$A = 1099\ sq\ ft.(0.64)\ adjust\ for\ opening\ ratio$

$A = 703\ sq\ ft.$

$Q = 3231\ cfs\ (determined\ iteratively)$

$$V = \frac{3231\ cfs}{703\ sq.ft}$$

$V = 4.6\frac{ft}{s}$ $V = \frac{9.2ft}{s}\ for\ 50\%\ debris\ load -->\ below\ 15\frac{ft}{s} recommended\ in\ 1602$

$$h_t = 1.1(\frac{4.6\ ft/s^2}{2g})$$

$$h_l = 0.36\ ft$$

Head loss calculations were performed in spreadsheet to iteratively compute discharge/velocity for the final solution

Head Loss Across Entrance Chamber

C = 1.01 (Plate C-22, EM 1110-2 1602 for chamber and 0.01 for gate slots as recommended in EM 1602)

$$A = (20\ ft\ x\ 12\ ft)$$

$$A = 240\ sq\ ft$$

$$Q = 1616\ cfs\ (determined\ iteratively, half\ the\ total\ flow\ through\ both\ gates)$$

$$V = \frac{1616\ cfs}{240\ sq.ft}$$

$$V = 6.7\ ft/s$$

$$h_e = 1.1(\frac{6.7\ ft/s^2}{2g})$$

$$h_e = 1.01(\frac{13.5\ ft/s^2}{2g})$$

$$h_e = 1.01(\frac{13.5\ ft/s^2}{2g})$$

$$h_e = 0.71\ ft$$

Discharge through tainter gate

$Q = CG_oB\sqrt{2gH}$ (HDC 320-3)

C = 0.715 (HDC 320-3)

$$Q = (0.715)(5ft)(20ft)\sqrt{2g(284 - 0.36\ ft - 0.71ft) - (270ft + 5\ ft)}$$

$$Q = 1616\ cfs$$

Parabolic Section on the spillway

$y = -x \tan\theta - \frac{gx^2}{2(1.25Vsm)^2 \cos\theta^2}$ **Equation 5-3 –EM 1110-2-1602**

Gate Opening: 3.0 ft (from rating curve)

Gate width: 20 ft

$V = \frac{Q}{A}$

$V = \frac{(0.5)3500\ cfs}{3.1\ ft\ x\ 20\ ft}$

$V = \frac{1750\ cfs}{3.1\ ft\ x\ 20\ ft}$

$V = 28.2\ ft/s$ **Velocity at exit of gate opening**

Depth at Vena Contracta

Contraction ratio of 0.74 (HDC 320-3)

$V_{sm} = \frac{1750\ cfs}{3.1\ ft\ x\ 20\ ft * 0.74}$

$V_{sm} = \frac{1750\ cfs}{3.1\ ft\ x\ 20\ ft * 0.73}$

$V_{sm} = 38.7\ ft/s$

$v = \frac{q}{y}$

$y = \frac{87.5\ cfs/ft}{38.7\ ft/s}$

$y = 2.3\ ft/s$

$y = -x \tan\theta - \frac{gx^2}{2(1.25Vsm)^2 \cos\theta^2}$

$y = -x\,(0) - \frac{gx^2}{2\left(1.25\left(38.\frac{7ft}{s}\right)\right)^2\,(1)}$

$y = -0.0069x^2$

Velocity at toe of parabolic drop

$V_1 = \sqrt{2g(h+d)}$ **Fluid Mechanics and Hydraulics, Giles**

$V_1 = \sqrt{2g(302.5\ ft - 270\ ft)}$

$V_1 = 45.7\ ft/s$ **velocity at toe of parabolic drop**

$y_{1=}\ \frac{87.5\ cfs/ft}{45.7\ ft/s}$

$y_{1=}\ 1.9\ ft$

Depth at the beginning of the stilling basin (height of jump)

$$y_2 = \frac{-y_1 + \sqrt{y_1^2 + 8qV_1/g)}}{2}$$

$$y_2 = \frac{-1.9ft + \sqrt{3.61ft^2 + 8(87.5cfs/ft)45.7ft/s/g)}}{2}$$

$y_2 = 14.8\ ft$

$v_2 = \frac{q}{y_2}$

$v_2 = \frac{87.5\ cfs/ft}{14.8\ ft}$

$v_2 = 5.9\ ft/s$

Determine elevation difference between the crest and stilling basin floor

$\frac{d_1}{d_2} = 1/2\sqrt{1+8F^2} - 1$

$F = \frac{V}{\sqrt{gd}}$

$$F = \frac{45.7\ ft/s}{\sqrt{g(1.9\ ft)}}$$

$$F = 5.8$$

$$\frac{d_1}{d_2} = 1/2\sqrt{1 + 8F(5.8)^2} - 1$$

$$\frac{d_1}{d_2} = 7.7\ ft \longrightarrow Make\ 7.5\ ft\ as\ designed\ in\ the\ 1988\ preliminary\ design$$

Length of Stilling basin

In EM 1110-2-1602, for Froud number between 3 and 12, a length of 3d is recommended.

$$L = 3y_2$$

$$L = 3(14.8\ ft)$$

$$L = 44.8\ ft --> Length\ of\ 45\ feet\ in\ 1988\ preliminary\ design\ is\ adequate.$$