Carmel Lagoon Ecosystem Protective Barrier, Scenic Road Protection Structure, and Interim Sandbar Management Plan Project



Revised Draft
Environmental Impact Report

SCH#2014071050

January 2024

Prepared For:

County of Monterey

Prepared By:

Denise Duffy & Associates, Inc.

This Page Intentionally Left Blank

Table of Contents

1.0 Introduction 1.0-1

1.1 Background 1.0-1

1.2 Requirements for Recirculation of a Draft EIR 1.0-1

1.3 Changes Requiring Recirculation and Organization of the Revised EIR 1.0-7

1.4 Public Review of the Revised DEIR 1.0-9

1.5 Final EIR 1.0-10

2.0 Summary of the Environmental Impact Report 2.0-1

2.1 Introduction 2.0-1

2.2 Proposed Project Objectives 2.0-1

2.3 Summary of the Proposed Project 2.0-3

2.4 Summary of Impacts and Mitigation Measures 2.0-3

2.5 Alternatives to the Proposed Project 2.0-3

2.6 Areas of Controversy 2.0-4

3.0 Project Description ..... 3.0-1[1]

4.0 Environmental Setting, Impacts and Mitigation Measures 4.0-1

4.1 Aesthetics 4.1-1

4.3 Biological Resources 4.3-1

4.5 Geology, Soils, and Seismicity 4.5-1

4.8 Hydrology and Water Quality 4.8-1

4.12 Transportation 4.12-1

4.13 Energy 4.13-1

5.0 Alternatives 5.0-1

5.1 Introduction and Approach 5.0-1

5.2 Alternatives Considered But Eliminated 5.0-7

5.3 Alternatives Analysis 5.0-20

5.4 Environmentally Superior Alternative 5.0-77

[1] The RDEIR would not result in any changes to the proposed project description or the project footprint. Therefore, **Chapter 3. Project** Description is not included in this document, but available on the County's website: https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/library-current-major-projects/carmel-lagoon-ecosystem-protective-barrier-and-scenic-road-protective-barrier-systems.

6.0 CEQA Considerations 6.0-1

6.1 Growth Inducement 6.0-1

6.2 Cumulative Impacts 6.0-2

6.3 Significant Unavoidable Impacts 6.0-24

6.4 Irreversible Environmental Changes 6.0-24

6.5 Effects Found Not to be Significant 6.0-25

7.0 List of Preparers and Persons Consulted 7.0-1

7.1 Lead Agency 7.0-1

7.2 Environmental Impact Report Consultants 7.0-1

7.3 Persons Consulted 7.0-2

List of Figures

Figure 1-1 Vicinity Map 1.0-3

Figure 1-2 Proposed Project Summary Map 1.0-5

Figure 4.1-1 2016 Site Photos of EPB Project Area 4.1-3

Figure 4.1-2 2016 Site Photos of SRPS Project Area 4.1-5

Figure 4.1-3 Photo Points 4.1-7

Figure 4.1-4 2023 Photos of the Proposed SRPS Project Site 4.1-13

Figure 4.1-5 Visual Simulations of Proposed EPB 4.1-23

Figure 4.1-6 Visual Simulation of Proposed SRPS 4.1-25

Figure 4.3-1 Habitat Map 4.3-7

Figure 4.3-2 CRLF Occurrences Within Biological Study Area 4.3-27

Figure 4.3-3 S-CCC Steelhead Occurrence Within Biological Study Area 4.3-31

Figure 4.3-4 SBB Habitat Within Biological Study Area 4.3-35

Figure 4.3-5 Sensitive Habitats Within Biological Study Area 4.3-39

Figure 4.5-1 Carmel River State Beach and Carmel River 1929 and 2020 ..... 4.5-3

Figure 4.5-2 Geologic Site Plan 4.5-5

Figure 4.5-3 Angles of Wave Incidence at Carmel 4.5-8

Figure 4.5-4 Regional Model Bathymetry and Local Bathymetry 4.5-9

Figure 4.5-5 Bathymetry in Project Area 4.5-11

Figure 4.5-6 Overview of Carmel River State Beach Seasonal Variation and Lagoon Morphology 4.5-13

Figure 4.5-7 Wave Drive Processes Affecting Lagoon Breach Migration 4.5-15

Figure 4.5-8	Overview of Lagoon Closures and Breaches (1991-2021)	4.5-16
Figure 4.5-9	Parameters Governing Lagoon Breaching	4.5-17
Figure 4.5-10	Terminology Used to Describe Astronomical Tides	4.5-18
Figure 4.5-11	Sediment Transport Patterns Associated with Swell Waves	4.5-21
Figure 4.5-12	Sediment Transport Patterns for Northwest Wind-Waves	4.5-22
Figure 4.5-13	Overview of Carmel Littoral Cell	4.5-24
Figure 4.5-14	Wave-Driven Sediment Transport Along the Shore	4.5-25
Figure 4.5-15	Littoral Cell Sediment Sources and Losses	4.5-29
Figure 4.5-16	Shoreline Locations (1929-2020)	4.5-30
Figure 4.5-17	Long-Term Shoreline Recession Rates at Carmel River State Beach	4.5-32
Figure 4.5-18	Soils Map	4.5-39
Figure 4.5-19	Regional Fault Map	4.5-43
Figure 4.8-1	Carmel River Watershed and Carmel Bay Sub-Basin	4.8-3
Figure 4.8-2	Project Location in Relation to Local Waterbodies	4.8-5
Figure 4.8-3	FEMA Flood Hazard Map	4.8-15
Figure 4.12-1	Regional Roadway Network	4.12-3
Figure 4.12-2	Local Roadway Network	4.12-7
Figure 5-1	SRPS Full Height – Secant Pile Wall Alternative: Preliminary Site Plan	5.0-25
Figure 5-2	SRPS Full Height Wall – Scant Pile Wall Alternative: Preliminary Plan Views	5.0-27
Figure 5-3	Example of Type Proposed Garden Wall	5.0-32
Figure 5-4	EPB Garden Wall Alternative	5.0-33
Figure 5-5	Garden Wall Alignment	5.0-35
Figure 5-6	Potential Flow Path – Western Garden Wall Terminus	5.0-36
Figure 5-7	Potential Flow Path – Eastern Garden Wall Terminus	5.0-37
Figure 5-8	Potential Flanking around Intersection of Monte Verde and 16th Ave	5.0-37
Figure 5-9	SRPS MSW Alternative – Site Plan	5.0-43
Figure 5-10	SRPS MSW Alternative – Revetment Plan	5.0-45
Figure 5-11	SRPS MSW Alternative – Revetment Typical Sections	5.0-47
Figure 5-12a	SRPS MSW Alternative – MSW Typical Sections	5.0-49
Figure 5-12b	SRPS MSW Alternative – MSW Typical Sections	5.0-51
Figure 5-13	Aerial View of Lagoon Breach Channel	5.0-56
Figure 5-14	View of Lagoon Breach Channel	5.0-56
Figure 5-15	View of Eroded Beach and Bluff Toe	5.0-57

Figure 5-16 View of Wave-Induce Bluff Erosion 5.0-58
Figure 5-17 Recommended Location and Height of the SRPS MSW Alternative 5.0-59
Figure 5-18 Accretion-Erosion Distribution Waves in December and January 5.0-60
Figure 5-19 Proposed MSW Alternative Visual Simulation of Wall (Winter/Spring) 5.0-61
Figure 5-20 Proposed MSW Alternative Visual Simulation of Wall (Summer/Fall) 5.0-63
Figure 5-21 Proposed MSW Alternative Visual Simulation of Parking Lot Area and Beach Access (Typical Site Condition) 5.0-65
Figure 5-22 Proposed MSW Alternative Visual Simulation of Parking Lot Area and Beach Access (North Lagoon Beach Condition) 5.0-67
Figure 5-23 Proposed MSW Alternative Visual Simulation of Alignment (Winter/Spring) 5.0-69
Figure 5-24 Proposed MSW Alternative Visual Simulation of Alignment (Summer/Fall) 5.0-71
Figure 6-1 Location of Projects Considered for Cumulative Analysis 6.0-5

List of Tables

Table 2-1 Summary of Significant Environmental Impacts and Mitigation Measures 2.0-6
Table 2-2 Summary of Cumulative Impacts and Mitigation Measures 2.0-30
Table 4.0-1 Resource Topics/Sections and Abbreviations Key 4.0-1
Table 4.1-1 Summary of Visual Sensitivity Conditions 4.1-11
Table 4.1-2 Visual Impact Scale for Operational Impact Analysis 4.1-18
Table 4.3-1 Vegetation Types within the Biological Study Area and Proposed Project Components 4.3-9
Table 4.3-2 Potential for Special-Status Wildlife Species Presence within Proposed Project Components 4.3-18
Table 4.3-3 Sensitive Habitats within the Biological Study Area and Proposed Project Components 4.3-40
Table 4.3-4 Potentially Jurisdictional Wetlands and Waters within the Biological Study Area and Proposed Project Components 4.3-42
Table 4.5-1 Water Level Datums at the Proposed Project Site 4.5-19
Table 4.5-2 Aerial Imagery Dates and Color Code 4.5-31
Table 4.5-3 Carmel Littoral Cell Sediment Budget 4.5-34
Table 4.5-4 Sea-Level Rise Projections for Monterey, OPC 4.5-37
Table 4.5-5 Tidal Datums with Sea-Level Rise 4.5-38
Table 4.5-6 Annual Rate of Sea-Level Rise 4.5-38
Table 4.5-7 Regional Faults 4.5-41
Table 4.8-1 Carmel River Monthly Average Flows 4.8-7

Table 4.8-2	Surface Water Quality Objectives for the Carmel River	4.8-12
Table 4.8-3	Overview of Post-Construction Requirements for Stormwater Management	4.8-23
Table 4.12-1	Level of Service Definitions	4.12-9
Table 4.12-2	Highway 1 LOS During Peak Hours, Existing Roadway with Existing (2011-2012) Traffic	4.12-10
Table 5-1	Significant Impacts of Proposed Projects	5.0-5
Table 5-2	Impact Summary for Proposed Project and Alternatives to the Proposed Project	5.0-79
Table 6-1	Projects Considered for Cumulative Impact Analysis	6.0-7

Appendices

E. Biological Resources Report

F. Geotechnical Studies

G. Hydrological Studies

List of Acronyms

AAQS	Ambient Air Quality Standards
Ac	Alviso silty clay loam
ACB	Articulating Concrete Block
AGR	agricultural supply
AMBAG	Association of Monterey Bay Area Government
AQMP	Air Quality Management Plan
ASBS	Area of Biological Significance
ASCE	American Society of Civil Engineers
ASR	Aquifer Storage and Recovery
BFE	Base Flood Elevation
BI	Beneficial Impact
BIOL	preservation of biological habitats of special significance
Bio Memo	Memorandum To Whitson Engineers for Feasibility Report: *Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues*, prepared by H.T. Harvey & Associates (HTH), May 2013
BMPs	Best Management Practices
BSLT	Big Sur Land Trust
Btu	British thermal unit
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CAWD	Carmel Area Wastewater District
CB	Carmel Beach
CBC	California Building Code
CCA	California Coastal Act
CCC	California Coastal Commission
CCoWS	Central Coast Watershed Studies Team
CCR	California Code of Regulations
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CDP	Coastal Development Permit
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second
CIDH	Cast-in-Drilled-Hole
CLSM	Controlled Low Strength Material
Cm	Coastal beaches
CMU	Concrete Masonry Unit
CNDDB	California Natural Diversity Data Base
CNPPA	California Native Plant Protection Act
CNPS	California Native Plant Society
Coastal Analysis	*Carmel River Lagoon Biological Assessment Coastal Engineering Analysis*, prepared by Moffatt & Nichol, August 2013

COLD	cold water habitat
COMM	commercial and sport fishing
County	County of Monterey
County PWFP	County of Monterey Public Works, Facilities, and Parks
CPT	Cone Penetrometer Test
CR	Cultural Resources
CRFREE	Carmel River Floodplain Restoration and Environmental Enhancement Project
CRMB CRLEP	Carmel River Lagoon Enhancement Project
CRLF	California red-legged frog
CRMB	Carmel River Mitigation Bank
CRPR	California Rare Plant Rank
CRSB	Carmel River State Beach
CSLC	California State Lands Commission
CSUMB	California State University Monterey Bay
CWA	Federal Clean Water Act
CZARA	Coastal Zone Reauthorization Amendments
DD&A	Denise Duffy & Associates, Inc.
DEM	Digital Elevation Model
DPS	Distinct Population Segment
Draft EIR	Draft Environmental Impact Report
DSOD	California Division of Safety of Dams
DWA Associates	D.W. ALLEY & Associates
EbC	Elder very fine sandy loam, 2-9% slopes
EIA	Energy Information Administration
EIR	Environmental Impact Report
ENSO	El Nino Southern Oscillation
EPA	United States Environmental Protection Agency
EPB	Ecosystem Protection Barrier
ESA	Federal Endangered Species Act
ESHA	Environmentally Sensitive Habitat Area
EST	estuarine habitat
°F	degrees Fahrenheit
Feasibility Report	*Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report* prepared by Whitson Engineers, May 2013
FEMA	Federal Emergency Management Agency
FHWA	United States Department of Transportation Federal Highway Administration
FHWG	Fisheries Hydroacoustic Working Group
FIMA	Flood Insurance and Mitigation Administration
FIRMS	Flood Insurance Rate Maps
Fisheries Report	Fisheries Analysis for the Carmel River Lagoon Biological Assessment Report prepared by D.W. ALLEY & Associates, March 2014
FMP	Forest Management Plan
FR	Federal Register
FRSH	freshwater replenishment
FRP	fiber reinforced polymer

FYLF	Foothill Yellow-Legged Frog
Geotechnical Report	*Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California*, prepared by Pacific Geotechnical Engineering, May 2013
GHG	Greenhouse Gas
GWR	groundwater recharge
HCD	Housing and Community Development (County)
HCP	Habitat Conservation Plan
HMMP	Habitat Mitigation and Monitoring Plan
HTH	H.T. Harvey & Associates
Hydrology Report	*The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report* prepared by Balance Hydrologics, Inc., January 2014
IND	industrial service supply
IPCC	International Panel on Climate Change
IS/MND	Initial Study/Mitigated Negative Declaration
ISMP	Interim Sandbar Management Plan
IPCC	Intergovernmental Panel on Climate Change
JO	Jeopardy Opinion
kW	Kilowatt
kWh	Kilowatt hour
LAG	Lowest Adjacent Grade
Lagoon	Carmel River Lagoon
LCP	Local Coastal Programs
lf	linear feet
LID	Low Impact Design
LOS	level of service
LS	Less-than-Significant
LSM	Less-than-Significant with Mitigation
M1W	Monterey One Water
MB	Monastery Beach
MBARD	Monterey Bay air Resource District
MBNMS	Monterey Bay National Marine Sanctuary
MBTA	Migratory Bird Treaty Act of 1918
MCC	Monterey County Code
MCWRA	Monterey County Water Resources Agency
MDR/2-D(18)(CZ)	Medium Density Residential in the Coastal Zone
Mf	Metz fine sandy loam
MHHW	mean higher high water
MHW	mean high water
MIGR	migration of aquatic organisms
MLLW	mean lower low water
MLW	mean low water
MMPA	Marine Mammal Protection Act
MMRP	Mitigation Monitoring and Reporting Program
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding

MPWMD	Monterey Peninsula Water Management District
MRSWMP	Monterey Regional Stormwater Management Program
MS4	Municipal Separate Storm Sewer Systems
MST	Monterey Salinas Transit
MSW	Mid Slope Wall
MTL	mean tide level
MUN	municipal and domestic supply
MURP	Model Urban Runoff Program
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NcC	Narlon loamy fine sand, 2-9% slopes
NCCAB	North Central Coast Air Basin
NCCP	Natural Community Conservation Plan
NFIP	National Flood Insurance Program
NGVD29	National Geodetic Vertical Datum 1929
NI	No Impact
NMFS	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
NOP	Notice of Preparation
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
OaD	Oceano loamy sand, 2-15% slopes
Ocean Plan	Water Quality Control Plan for Ocean Waters of California
OHW	Ordinary High Water
OPC	Ocean Protection Council
OPR	Office of Planning and Research
Pa	Pacheco clay loam
PCE(s)	Primary Constituent Element(s)
Pf	Pico fine sandy loam
PG&E	Pacific Gas & Electric
Porter-Cologne	Porter-Cologne Water Quality Control Act of 1969
POTW	Publicly Owned Treatment Works
PRC	Public Resources Code
proposed project	Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project.
P/L	Property Line
RARE	rare, threatened, or endangered species
RDEIR	Revised Draft Environmental Impact Report
REC1	water contact recreation
REC2	non-contact water recreation
RMP	Restoration Management Plan
RPS	Renewables Portfolio Standard
RWD	Reports of Waste Discharge
RWQCB	Regional Water Quality Control Board
SbA	Salinas clay loam, 0-2% slopes

SBB	Smith's blue butterfly
SC	Stillwater Cove
S-CCC steelhead	South-Central California Coast steelhead
SCS	Sustainable Communities Strategy
SDC	Seismic Design Category
SDC A	very small seismic vulnerability
SDC E/F	very high seismic vulnerability and near a major fault
SEL	Sound Exposure Level
SGMA	Sustainable Groundwater Management Act
ShD	Santa Ynez fine sandy loam, 9-15% slopes
SoE	Sheridan coarse sandy loam, 15-30% slopes
SPWN	spawning, reproduction, and/or early development
SRPS	Scenic Road Protection Structure
State Parks	California Department of Parks and Recreation
SU	Significant Unavoidable
SW	Spectral Wave
SWEL	Stillwater Elevation
SWMP	stormwater management plan
SWPPP	stormwater pollution prevention plan
SWRCB	California State Water Resources Control Board
TAMC	Transportation Agency for Monterey County
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
VMT	Vehicle Miles Traveled
W	Water
WARM	warm fresh water habitat
Waters of the U.S.	Waters of the United States
WBB	Western bumble bee
WC	Whalers Cove
WDR	Waste Discharge Requirements
WILD	wildlife habitat
WSE	Water Surface Elevation
Xd	Xerothents, dissect
3CE	Central Coast Community Energy

Chapter 1.0 INTRODUCTION

1.1 BACKGROUND

On December 2, 2016, the County of Monterey (County), as Lead Agency, released the Draft Environmental Impact Report (Draft EIR) for the Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project (proposed project) (County File No. REF120051, State Clearinghouse No. 2014071050). The Draft EIR evaluated the environmental impacts associated with the construction and operation of the three proposed project components: 1) EPB; 2) SRPS; and 3) ISMP, with the primary objective of implementing a solution to improve the functions and values of the ecosystem in and around the Lagoon by restoring the Lagoon's historic hydrologic, pre-management conditions to the extent feasible to protect and improve habitat for fish and wildlife while maintaining flood protection (**Figures 1-1** and **1-2**). The Draft EIR public review period ended on January 31, 2017, which included a 15-day extension to the required 45-day review period. During this time period, public agencies, organizations, and the public had the opportunity to review the Draft EIR and submit comments regarding the Draft EIR and proposed project in accordance with Section 15087 of the California Environmental Quality Act (CEQA) Guidelines.

In accordance with CEQA Guidelines Section 15088, the County reviewed the comments received on the Draft EIR. Several comments requested the discussion and analysis of additional SRPS alternatives to the proposed project, as well as more comprehensive hydrological and geological technical studies of the impacts of the proposed SRPS and alternative SRPS components. Additionally, most of the comments were in opposition to the EPB project component, including State Parks, which owns the property where the EPB would be constructed. In response, the County has prepared this Revised Draft Environmental Impact Report (RDEIR) to discuss and analyze additional SRPS and EPB alternatives and present the results of new technical studies completed for the proposed alternatives.

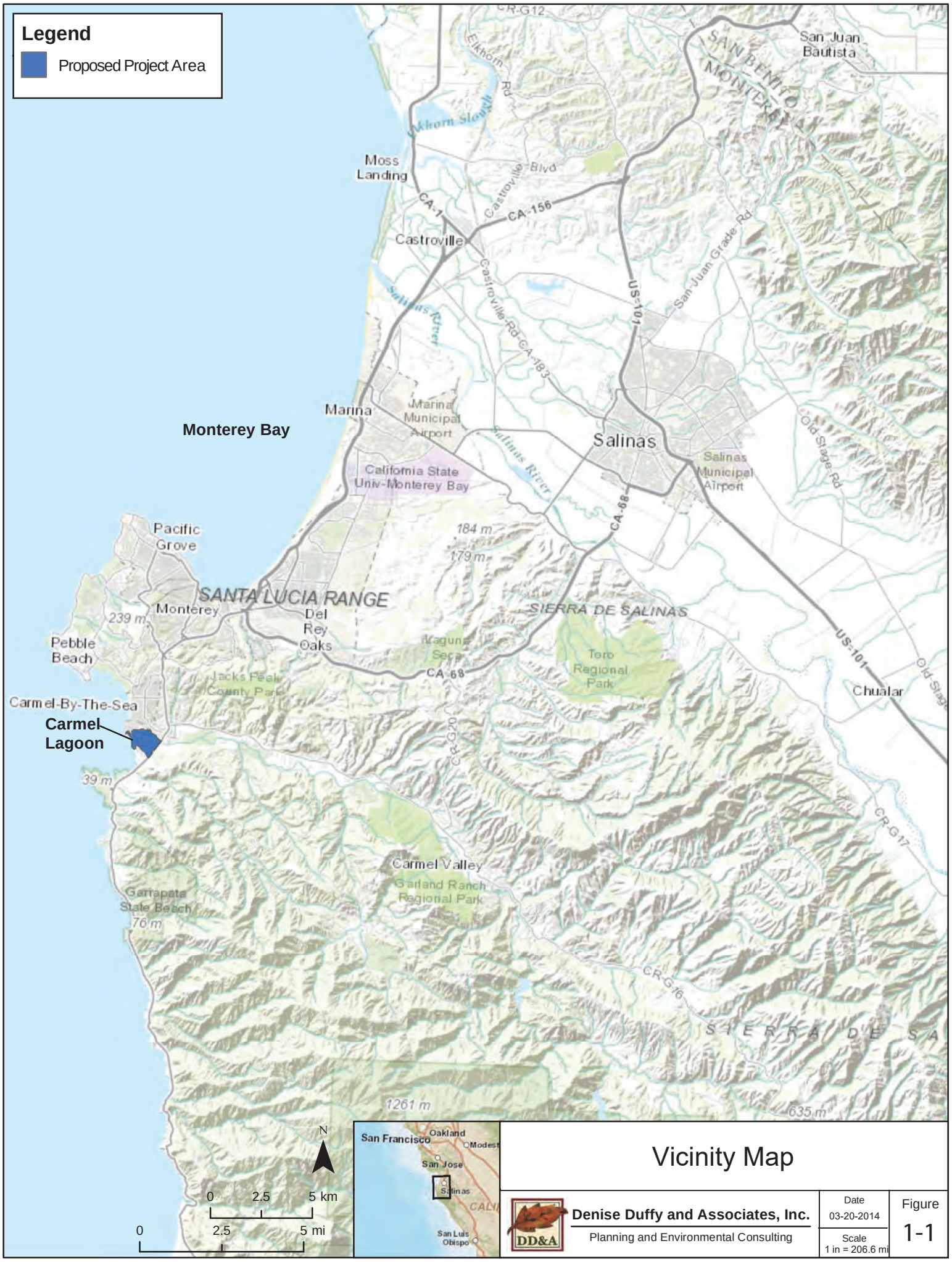
1.2 REQUIREMENTS FOR RECIRCULATION OF A DRAFT EIR

Consistent with Section 15088.5 of the CEQA Guidelines, this recirculated portion of the Draft EIR for the proposed project includes both revised and new sections to account for the inclusion of additional alternatives and CEQA Guidelines.

Pursuant to Section 15088.5 of the CEQA Guidelines, a lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the Draft EIR for public review but before certification. "Recirculation" means the public is provided an opportunity to comment on the new or revised sections of the EIR. As used in this Section, the term "information" can include changes in the project or environmental setting as well as additional data or other information. New information added to an EIR is not "significant" unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect (including feasible project alternatives). "Significant new information" requiring recirculation includes the following:

1. A new significant environmental impact would result from the project or from a new mitigation measure proposed to be implemented.
2. A substantial increase in the severity of an environmental impact would result unless mitigation measures are adopted that reduce the impacts to a level of insignificance.

This Page Intentionally Left Blank



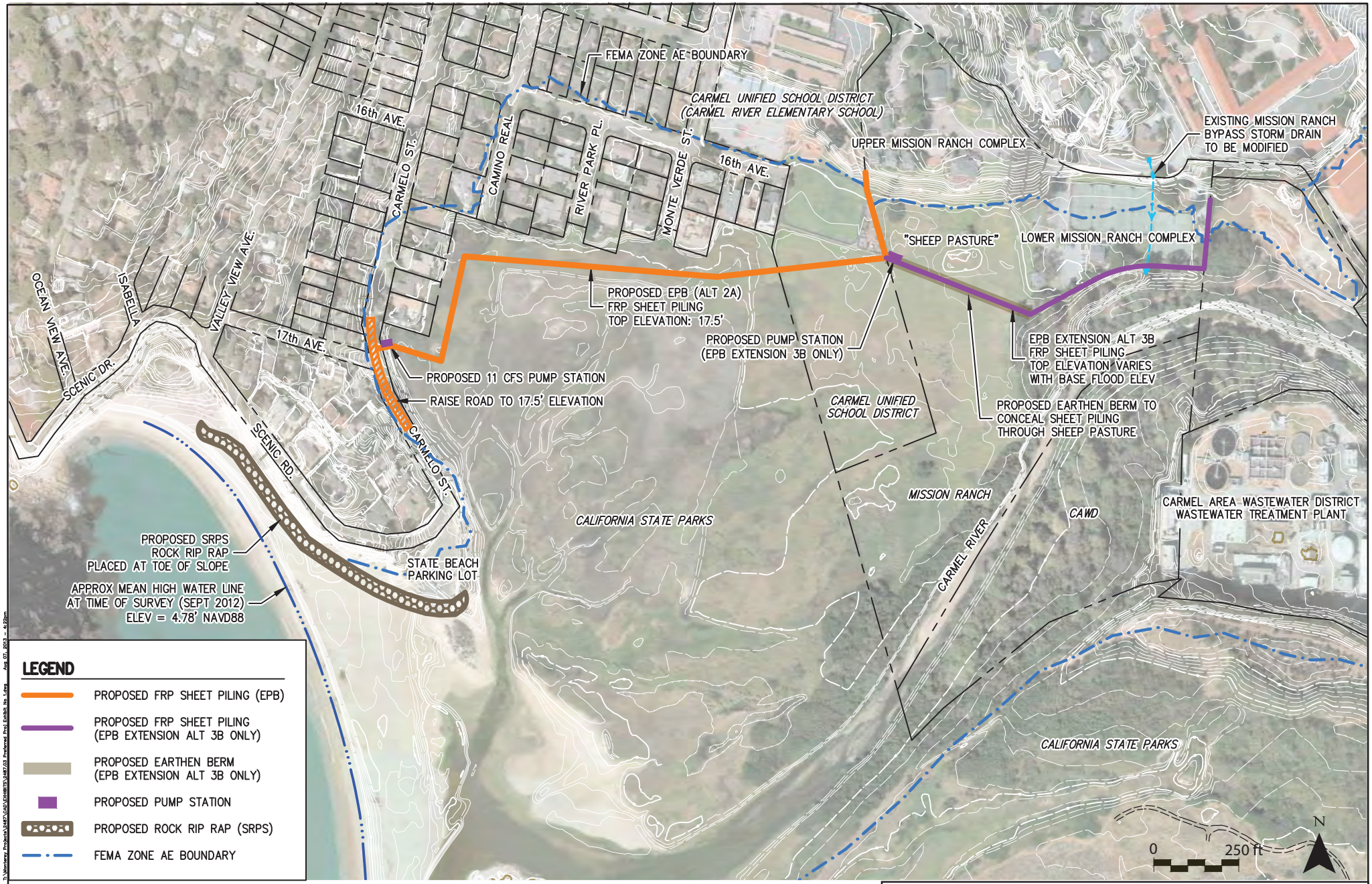
Vicinity Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 03-20-2014
Scale: 1 in = 206.6 mi
Figure: 1-1

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\BA Maps\Action Area Map.mxd

This Page Intentionally Left Blank



Source: Whitson Engineers, Proposed Project Summary Map, August 7, 2013

Proposed Project Summary Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date
03-20-2014

Scale

Figure
1-2

This Page Intentionally Left Blank

3. A feasible project alternative or mitigation measure considerably different from others previously analyzed would clearly lessen the significant environmental impacts of the project, but the project's proponents decline to adopt it.
4. The draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded. (*Mountain Lion Coalition v. Fish and Game Com.* (1989) 214 Cal.App.3d 1043)

In accordance with Public Resources Code (PRC) Section 21092.1 and CEQA Guidelines Section 15088.5, the County is recirculating portions of the Draft EIR in response to new information. The County is recirculating the document to provide the public with a meaningful opportunity to comment on the additional information. The recirculation is "partial" (meaning only chapters or portions of the prior Draft EIR with new information have been revised and reissued) rather than "full" (meaning the entire document has been revised and reissued).

Recirculation of an EIR requires notice pursuant to CEQA Guidelines Section 15087, and consultation pursuant to Section 15086 [see CEQA Guidelines Section 15088.5, subd. (d)]. As stated in the CEQA Guidelines, "if the revision is limited to a few chapters or portions of the EIR, the lead agency need only recirculate the chapters or portions that have been modified." [CEQA Guidelines Section 15088.5, subd.(c)].

1.3 CHANGES REQUIRING RECIRCULATION AND ORGANIZATION OF THE REVISED EIR

As described in **Chapter 2, Summary of the Environmental Impact Report**, in an effort to demonstrate the commitment towards implementation of permanent solutions to reduce or avoid mechanical breaching, the County worked with the United States Army Corps of Engineers (USACE) to develop a Memorandum of Understanding (MOU) that would include the USACE, County, and National Marine Fisheries Service (NMFS) as signatory agencies. The U.S. Fish and Wildlife Service (USFWS) reviewed this document as a consulting agency to the USACE under the federal Endangered Species Act (ESA). The MOU promulgated several items: 1) a long-term plan to balance protection of private property with protection of federally listed species; 2) the negative impacts to fish and wildlife resources from long-term mechanical sandbar breaching of the Lagoon; 3) two long-term solutions as alternative to performing sandbar management: the EPB and SRPS; and 4) the agreement among the MOU parties to allow the ISMP while the County develops and implements the EPB and SRPS projects. The County developed the proposed project and Draft EIR consistent with the expectations of the permitting agencies. The MOU expired on September 30, 2020, after the publication of the Draft EIR in December 2016.

The County received over 40 letters from public agencies, organizations, and the general public, most of which included challenges to and requests for additional technical studies related to the proposed SRPS component of the project and requests to discuss and analyze additional project alternatives. Additionally, the majority of public comments received were in opposition to the EPB for various reasons including potential flood risks, damage to property values and aesthetics, cost, use of public lands for flood protection of private property, and a concern the EPB would not be able to fully provide the flood protection services as proposed. The proposed EPB and SRPS project components would require construction within lands owned by the California Department of Parks and Recreation (State Parks). State Parks submitted comments during the public review period for the Draft EIR, as well as directly to the regulatory agencies, which outlined their opposition to constructing infrastructure within state-owned

lands (including a designated State Natural Preserve) for the protection of private properties from flooding.

The County met with the regulatory agencies, which included representatives from NMFS and State Parks, and other interested stakeholders to discuss the project, its potential alternatives, and the need for further technical studies related to the SRPS between June 2017 and August 2019. Due to the overwhelming lack of support for the EPB from the public, State Parks, and Carmel Area Wastewater District (CAWD), it was clear the EPB was unlikely to be constructed as identified in the MOU. On August 30, 2019, the County informed the USACE and NMFS to proceed with the SRPS, ISMP, and no EPB as the project for the Section 7 consultation process under ESA. NMFS issued an updated Biological Opinion (BO) analyzing only the SRPS and ISMP components on December 2, 2019.

Based on these comments and agency coordination efforts, the County has revised the Draft EIR to respond to public comments and expand upon the analysis in the original Draft EIR. These changes require revision to the EIR chapters: Summary of the Environmental Impact Report; Environmental Setting, Impacts and Mitigation Measures; Alternatives; CEQA Considerations; and List of Preparers, as well as updated discussion and analysis in the following topical issues areas: aesthetics, biological resources, geology and soils, hydrology and water quality, and transportation. These revisions to the Draft EIR would not result in any changes to the proposed project description or the project footprint.

Changes to the EIR to address minor regulatory updates related to issues including air quality, cultural/tribal/paleontological resources, greenhouse gas emissions, hazards and hazardous materials, land use and planning, noise, and public services/recreation/utilities not specifically addressed herein would not result in the need for new analysis or identification of new significant impacts that would require recirculation of these sections of the EIR.

Other important changes since the release of the Draft EIR in 2016 include new regulatory requirements and updated CEQA guidelines, as well as changes to the project-level environmental and cumulative setting in the vicinity of the proposed project. As a result of these changes, additional discussion, and analysis of topics, including transportation impacts from vehicle miles traveled and energy demand, were added to the EIR. Additionally, an updated site visit and records search was conducted to identify the potential biological resources that may be affected by the implementation of the proposed project and alternatives.

The sections and chapters follow the document numbering convention of the original Draft EIR. Updated and supplemental discussion and analysis in the areas of aesthetics, biological resources, geology and soils, hydrology and water quality, and transportation have been added to **Sections 4.1**, **4.3**, **4.5**, **4.8**, and **4.12**, respectively, of the Draft EIR. The cumulative setting and analysis in **Section 6.2**, including **Section 6.2.2., List of Relevant Projects**, has been updated. Additionally, **Section 6.5, Effects Found Not to be Significant**, has been updated to include Wildfire. A new section (**Section 4.13, Energy**) has been added to the RDEIR to analysis energy issues, which was not required under CEQA when the original Draft EIR was published. **Chapter 2, Summary of the Environmental Impact Report**, has been updated to summarize the conclusions of the sections of the RDEIR. **Chapter 4, Environmental Setting, Impacts, and Mitigation Measures**, has been updated to reflect updates to the document as applicable. **Chapter 5, Alternatives**, has been updated to discuss and analyze additional alternatives to the proposed project. **Chapter 7, List of Preparers**, has been updated to include those involved in the preparation of the RDEIR. This RDEIR also includes the relevant appendices as originally contained in the Draft EIR and supplemented, as necessary, to include updated information and new technical studies.

These revisions, new regulatory requirements, and updated CEQA guidelines do not substantially change the information, analysis, or significance conclusions in the remaining sections of the Draft EIR. Therefore, these sections are not included in the RDEIR.

1.4 PUBLIC REVIEW OF THE REVISED DEIR

The RDEIR is available for a 45-day public review period from February 2, 2024, to March 20, 2024. The RDEIR is available on the County's website at https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/library-current-major-projects/carmel-lagoon-ecosystem-protective-barrier-and-scenic-road-protective-barrier-systems/2024-carmel-lagoon-revised-draft-environmental-impact-report.

CEQA Guidelines Section 15088.5(f)(2) establishes that:

> When the EIR is revised only in part and the lead agency is recirculating only the revised chapters or portions of the EIR, the lead agency may request that reviewers limit their comments to the revised chapters or portions of the recirculated EIR. The lead agency need only respond to:
>
> (i) Comments received during the initial circulation period that relate to chapters or portions of the document that were not revised and recirculated, and
>
> (ii) Comments received during the recirculation period that relate to the chapters or portions of the earlier EIR that were revised and recirculated.
>
> The lead agency's request that reviewers limit the scope of their comments shall be included either within the text of the revised EIR or by an attachment to the revised EIR.

Based on this statutory directive, the County requests that commenters limit their written comments to the new information presented in the following chapters and sections of the RDEIR that have been revised or added and recirculated:

- Summary of the Environmental Impact Report
- Environmental Setting, Impacts, and Mitigation Measures
- Section 4.1, Aesthetics
- Section 4.3, Biological Resources
- Section 4.5, Geology and Soils
- Section 4.8, Hydrology and Water Quality
- Section 4.12, Transportation
- Section 4.13, Energy
- Chapter 5, Alternatives
- Chapter 6, CEQA Considerations
- Chapter 7, List of Preparers
- Appendices

Responses will be provided for all comments received on the recirculated portions of the RDEIR during the additional public review period. However, responses will not be provided for additional comments on the remainder of the Draft EIR to which modifications have not been made. **All the comments that were**

submitted to the County in regard to the original Draft EIR have been retained. The comments that pertain to the sections of the original Draft EIR that have not been revised and included in the RDEIR will be responded to in the Final EIR (please refer to Section 1.5, Final EIR, below).

Although not subject to additional comment, the original Draft EIR is available for reference purposes at:

https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/library-current-major-projects/carmel-lagoon-ecosystem-protective-barrier-and-scenic-road-protective-barrier-systems/2024-carmel-lagoon-revised-draft-environmental-impact-report Written comments on the Draft EIR may be submitted to the County of Monterey Housing and Community Development (HCD) at: County of Monterey HCD, ATTN: Melanie Beretti, Acting Chief of Planning, 1441 Shilling Place, South 2nd Floor, Salinas, California, 93901, or emailed to CEQAcomments@co.monterey.ca.us.

1.5 FINAL EIR

When the public comment period for this RDEIR concludes on March 20, 2024, the County will prepare written responses to the comments received on both the original Draft EIR and the RDEIR. The Final EIR will consist of the original Draft EIR, the RDEIR, comments received on both the original Draft EIR and RDEIR, responses to those comments, and any necessary revisions to the original Draft EIR and the RDEIR. After a public hearing on the project, the lead agency decision-making body (i.e., the Board of Supervisors of the Monterey County) will review the Final EIR and any public testimony and decided whether to certify the Final EIR and whether to approve or deny the proposed project.

Chapter 2.0 SUMMARY OF THE ENVIRONMENTAL IMPACT REPORT

2.1 INTRODUCTION

On December 2, 2016, the County, as Lead Agency, released the Draft EIR for the proposed project (County File No. REF120051, State Clearinghouse No. 2014071050). The Draft EIR evaluated the environmental impacts associated with the construction and operation of the three proposed project components: 1) EPB; 2) SRPS; and 3) ISMP, with the primary objective of implementing a solution to improve the functions and values of the ecosystem in and around the Lagoon by restoring the Lagoon's historic hydrologic, pre-management conditions to the extent feasible to protect and improve habitat for fish and wildlife while maintaining flood protection. The Draft EIR public review period ended on January 31, 2017, which included a 15-day extension to the required 45-day review period. During this time period, public agencies, organizations, and the public had the opportunity to review the Draft EIR and submit comments regarding the Draft EIR and proposed project in accordance with Section 15087 of the CEQA Guidelines.

In accordance with CEQA Guidelines Section 15088, the County reviewed the comments received on the Draft EIR. Several comments requested the discussion and analysis of additional SRPS alternatives to the proposed project, as well as more comprehensive hydrological and geological technical studies of the impacts of the proposed SRPS and alternative SRPS components. Additionally, many of the comments were in opposition to the EPB project component, including State Parks, which owns the property where the EPB would be constructed. In response, the County has prepared this RDEIR to discuss and analyze additional SRPS alternatives and present the results of new technical studies completed for the proposed alternatives.

This document has been prepared in accordance with the CEQA statutes and guidelines. The County is the lead agency for this CEQA process. Inquiries about the project and the CEQA process should be directed to:

Melanie Beretti, Acting Chief of Planning
Monterey County, Housing and Community Development
1441 Schilling Place, South 2nd Floor, Salinas, CA 93901
Phone: (831) 755-5025
berettim@co.monterey.ca.us

Comments in hard copy may be submitted to the name and address above. The County also accepts comments via e-mail. To submit your comments by e-mail, please send a complete document including all attachments to: **CEQAcomments@co.monterey.ca.us**.

2.2 PROPOSED PROJECT OBJECTIVES

As described in **Chapter 3, Project Description**, in an effort to demonstrate the commitment to assess towards implementation of permanent solutions to reduce or avoid mechanical breaching, the County worked with the USACE to develop a draft MOU that would include the USACE, County, and National Oceanic and Atmospheric Administration NMFS as signatory agencies. The MOU was reviewed by the USFWS as a consulting agency to the USACE. The MOU promulgated several items: 1) a long-term plan to balance protection of private property with protection of federally listed species; 2) the negative impacts to fish and wildlife resources from long-term mechanical sandbar breaching of the Lagoon;

3) two long-term solutions as alternative to performing sandbar management: the EPB and SRPS; and 4) the agreement among the MOU parties to allow the ISMP while the County develops and implements the EPB and SRPS projects. The MOU was approved by the Monterey County Board of Supervisors on June 11, 2013. The County developed the proposed project and Draft EIR consistent with the expectations of the permitting agencies.

In compliance with the MOU and to avoid a jeopardy opinion (JO)[1] issued by NMFS, the proposed project has been developed as a multi-objective, multi-year, multi-organizational effort to improve habitat for threatened and endangered species in the lower Carmel River and Lagoon, improve natural floodplain function, and protect public infrastructure, while maintaining flood protection to existing developed areas. Consideration for how to restore the natural breaching regime in the Lagoon while maintaining current flood protection to low-lying areas has been a cooperative effort between multiple Federal, State, regional, and local agencies, as well as conservation organizations, for more than a decade, and has included evaluating numerous project alternatives.

Recognizing the challenges associated with the existing development in the low-lying areas that has occurred over the past century adjacent to the Lagoon and the degradation caused by historic farming and breaching activities, the primary objective of the proposed project is to implement a solution to improve the functions and values of the ecosystem in and around the Lagoon by restoring the Lagoon's historic hydrologic, pre-management conditions to the extent feasible to protect and improve habitat for fish and wildlife while maintaining flood protection. In addition, a natural breach in the northerly direction is preferred by the resource agencies to facilitate a longer and more natural flow channel, improving conditions for fish and wildlife within the Lagoon. To accomplish this primary objective, the proposed project would need to meet the following objectives:

- Consistent with the MOU, reduce the necessity for mechanical breaching of the sandbar to the greatest extent practicable;
- Maintain the current level of flood protection for existing public facilities and private structures in the low-lying developed areas located immediately to the north of and within the Lagoon;
- Protect Scenic Road embankment and the State Parks' restroom, interpretive, and parking facilities from scour resulting from a northerly-aligned Lagoon outflow channel that may result from a reduction in mechanical breaching;
- Protect the Scenic Road embankment from the increasing risk of erosion resulting from ocean storm surge and high tides, which could increase in severity due to climate change;
- Allow for interim management of the sandbar while the design and construction of the other project components proceed;
- Design and construct project elements within the timeframe required as outlined in the MOU[2]; and

[1] Under Section 7 of the ESA, if the NMFS or USFWS find that a proposed action may jeopardize listed species or adversely modify critical habitat, then a Biological Opinion is known as a Jeopardy Opinion, or "JO."

[2] As described in **Section 1.3, Changes Requiring Recirculation and Organization of the Revised EIR**, the MOU expired on September 30, 2020. As a result, the sandbar management activities within the Lagoon are subject to the permit conditions required by the USACE, CDFW, RWQCB, and CCC.[2] Therefore, the project objective associated with the MOU is no longer

- Minimize infrastructure that could detract from the function and value of the natural environment.

2.3 SUMMARY OF THE PROPOSED PROJECT

The proposed project area is situated within and adjacent to the Carmel River State Beach and Lagoon, between Highway 1 and the Pacific Ocean in the unincorporated Carmel area of Monterey County, California. The Lagoon is located within the Carmel River Watershed, at the mouth of the Carmel River. Carmel River Beach forms a seasonal barrier between the Lagoon and the Pacific Ocean.

The proposed project involves implementing three project components: 1) EPB; 2) SRPS; and 3) ISMP. The proposed EPB project component would maintain or improve existing flood protection to low-lying homes and public infrastructure along the north edge of the Lagoon, while the frequency of mechanical management of the sandbar is reduced in compliance with regulatory requirements. The proposed SRPS project component would provide protection from erosion along the northern sand cliffs and the undermining of Scenic Road which may result from northerly river flows or large ocean swells. The proposed ISMP project component is intended to provide a short-term (i.e., until the design, environmental review, permitting, and construction of the project is completed) solution to potential flooding issues by implementing select sandbar management actions that allow additional natural function in the Lagoon while still protecting properties and infrastructure, with the understanding that the development of the proposed EPB and SRPS project components would further reduce mechanical management of the sandbar and return the Lagoon, its sandbar, and associated riverine and ocean dynamics to more natural cycles. However, the proposed project recognizes the need for management in the form of breaching activities may be necessary in emergency situations; annual actions do not qualify as an emergency according to the permitting agencies.

2.4 SUMMARY OF IMPACTS AND MITIGATION MEASURES

Table 2-1 summarizes the impacts of the proposed project. A summary of the cumulative impacts and the proposed project contribution to those impacts, as applicable, is presented in **Table 2-2**. For each impact considered to be significant or potentially significant, the table summarizes the recommended mitigations. **Tables 2-1** and **2-2** are intended to provide a summary of the proposed project impacts and mitigation measures that are described in detail in **Chapter 4, Environmental Setting, Impacts, and Mitigation Measures**; please refer to that section for complete discussion.

2.5 ALTERNATIVES TO THE PROPOSED PROJECT

Chapter 5 presents the alternatives analysis for the proposed project. This chapter sets forth the objectives of the proposed project, summarizes its significant impacts, discusses the alternatives considered but eliminated from further analysis, describes the range of alternatives considered, and compares the impacts of the alternatives evaluated to the impacts of the proposed project.

---

applicable to the proposed project. Please refer to **Section 1.3, Changes Requiring Recirculation and Organization of the Revised EIR**, and **Section 5.1.2, Project Objectives** in **Chapter 5, Alternatives**, for more information.

The State CEQA Guidelines, California Code of Regulations (CCR) Section 15126.6(a), state that an EIR must describe and evaluate a reasonable range of alternatives to the proposed project, or to the location of the project, that would feasibly attain most of the project's basic objectives, but that would avoid or substantially lessen any significant adverse effects of the project. An EIR is not required to consider every conceivable alternative to a proposed project. Rather, it must consider a reasonable range of potentially feasible alternatives that will foster informed decision-making and public participation. The CEQA Guidelines further state that the specific alternative of "no project" shall also be evaluated. The EIR must evaluate the comparative merits of the alternatives and include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the impacts of the proposed project. This chapter is organized into the following sections:

Section 5.1, Introduction and Approach, provides an overview of CEQA requirements pertaining to the identification and analysis of alternatives, and the chapter organization. This section also includes the objectives of the proposed project and a summary of significant impacts of the proposed project by topical area (**Table 5-1**). The section concludes with the identification of CEQA alternatives evaluated in this chapter.

Section 5.2, Alternatives Considered but Eliminated*,* discusses the alternatives that were considered, but eliminated from further analysis in this RDEIR. This section is organized into two parts:

5.2.1 Alternative Components of the Proposed Project Considered but Eliminated

5.2.2 Alternative Projects of the Proposed Project Considered but Eliminated

Section 5.3, Alternatives Analysis*,* describes the alternatives to the proposed project, compares the impacts of the alternatives to the impacts of the proposed project, and evaluates the alternatives' ability to accomplish the project objectives. This section is organized into four parts:

5.3.1 No Project Alternative

5.3.2 Alternatives Components to Proposed Project

5.3.3 Alternatives Projects to Proposed Project

Section 5.4, Environmentally Superior Alternative*,* identifies an environmentally superior alternative, as required by CEQA.

2.6 AREAS OF CONTROVERSY

Based on the comments received during the Notice of Preparation scoping periods and comments on the 2016 DEIR, the following key topics and areas of controversy have been identified:

- the proposed EPB project component is not supported by State Parks and the placement of the proposed EPB project component on State Parks property would require legislative action
- alternatives to the proposed project
- impacts to water quality
- technical feasibility of the proposed SRPS and EPB project components
- aesthetic impacts
- flooding impacts on- and off-site
- cultural resources impacts

- wetland and other habitat impacts
- impacts to steelhead
- encroachment into State Parks property
- consistency with applicable planning policies and regulations
- hazardous materials
- public access

Table 2-1 Summary of Significant Environmental Impacts and Mitigation Measures

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
4.1 Aesthetics					
AES-1: Construction Impacts on Scenic Vistas and Visual Quality of the Surrounding Areas. Proposed project construction would not result in substantial adverse effects on scenic vistas or the visual character of the site and surrounding area.	LS	LS	LS	**LS**	No mitigation measures are required.
AES-2: Operation Impacts on Scenic Vistas and Visual Quality of the Surrounding Areas. The proposed project would result in substantial adverse effects on scenic vistas or the visual character of the site and surrounding area.	SU	LS	NI	**SU**	**Mitigation Measure AES-2: Screening of the EPB Project Component (Applies to EPB project component).** The final design of the EPB project component shall include surface treatments with earth-tone colors and natural appearing materials in harmony with the surrounding landscape, including, but not limited to, earth-tone paints and finishes with low reflectivity. Post-construction, native vegetation of the appropriate habitat types shall be planted along both sides of the EPB project component for the purposes of screening. This effort may be implemented in coordination with the restoration required by **Mitigation Measure BIO-1a** and **Mitigation Measure BIO-2**, as determined appropriate.
AES-3: Impacts due to Permanent Light and Glare during Operations. Operation of proposed EPB project component facilities would not result in a substantial new source of light or glare that would adversely affect day or nighttime views in the area.	LS	NI	NI	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
4.2 Air Quality					
AQ-1: Conflict with or Obstruct Implementation of Applicable Air Quality Plans. The construction and operation of the proposed project would not conflict with or obstruct implementation of the applicable air quality plan.	LS	LS	LS	**LS**	No mitigation measures are required.
AQ-2: Violate any Air Quality Standard or Contribute Substantially to an Existing or Projected Air Quality Violation. The construction and operation of the proposed project would not violate any air quality standard or contribute substantially to an existing or projected air quality violation.	LS	LS	LS	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
AQ-3: 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. The construction and operation of the proposed project would not 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, including releasing emissions which exceed quantitative thresholds for ozone precursors.	LS	LS	LS	**LS**	No mitigation measures are required.
AQ-4: Expose Sensitive Receptors to Substantial Pollutant Concentration. The construction and operation of the proposed project would not expose sensitive receptors to substantial pollutant concentrations.	LS	LS	LS	**LS**	No mitigation measures are required.
AQ-5: Create Objectionable Odors Affecting a Substantial Number of People. The construction and operation of the proposed project would not create objectionable odors affecting a substantial number of people.	LS	LS	LS	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
4.3 Biological Resources					
BIO-1: Construction Impacts to Special-Status Species and Habitat. Proposed project construction would not have a substantial effect, either directly or through habitat modification, on special-status wildlife species and their habitat within the Biological Study Area.	LSM	LSM	LSM	**LSM**	**Mitigation Measure BIO-1a: <u>Implement Construction Best Management Practices</u> (Applies to EPB and SRPS project components).** The following BMPs reduce impacts to special-status wildlife species: 1) A qualified biologist will conduct an Employee Education Program for the construction crew prior to any construction activities. 2) Protective fencing will be placed to keep construction equipment and personnel from impacting vegetation outside of work limits. 3) Following construction, disturbed areas will be restored to pre-project contours to the maximum extent possible and revegetated. 4) Activities that involve substantial soil disturbance will be planned and carried out in consultation with a qualified hydrologist, engineer, or erosion control specialist, and will utilize standard erosion control and slope stabilization techniques in satisfaction of Monterey County erosion control guidelines. 5) No firearms or pets on the project site. 6) Removal of trash and construction debris. 7) All excavated, steep-walled holes or trenches more than two feet deep will be covered at the close of each working day and thoroughly inspected before they are filled. 8) Cleaning and refueling of equipment and vehicles shall occur only within designated staging areas. 9) If necessary to work during the nighttime, construction lighting shall be focused and downward directed to preclude night illumination of adjacent habitats. 10) Measures will be implemented to reduce the introduction and spread of non-native, invasive species. **Mitigation Measure BIO-1b: <u>Conduct Pre-Construction Surveys for White-Tailed Kite, Nesting Raptors, and Other Migratory Bird Species</u> (Applies to EPB and SRPS project components).** Construction activities, specifically vegetation and/or tree removal, can be scheduled after September 16 and before January 31. Alternatively,

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
					a qualified biologist will be retained by the project applicant to conduct pre-construction surveys for nesting raptors and other protected avian species within 500 feet of proposed construction activities if construction occurs between February 1 and September 15. **Mitigation Measure BIO-1c: <u>Implement Construction-Phase Monitoring</u> (Applies to EPB and SRPS project components).** The Project Proponent shall retain a qualified biologist to monitor all ground disturbing construction activities. **Mitigation Measure BIO-1d: <u>Avoid and Minimize Impacts to Western Pond Turtle</u> (Applies to EPB project component).** A qualified biologist shall survey suitable habitat no more than 48 hours before the onset of work activities at the EPB project component site for the presence of western pond turtle. **Mitigation Measure BIO-1e: <u>Avoid and Minimize Impacts to FYLF and CRLF</u> (Applies to EPB project component).** Measures for the avoidance and minimization of adverse impacts to FYLF and CRLF during construction of the EPB and SRPS project components are those typically employed for construction activities: 1) Construction activities shall occur within a work window determined in consultation with the USFWS. 2) During ground disturbing and vegetation removal activities, a USFWS-approved biologist shall survey appropriate areas of the construction site daily before the onset of work activities for the presence of FYLF and CRLF. 3) After ground disturbing and vegetation removal activities are complete, the USFWS-approved biologist will designate a person to monitor on-site compliance with all avoidance and minimization measures. **Mitigation Measure BIO-1f: <u>Avoid or Reduce Hydroacoustic Impacts to S-CCC Steelhead</u> (Applies to EPB project component).** Measures for the avoidance and minimization of adverse impacts of hydroacoustic impacts to S-CCC steelhead during construction:

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
					1) A vibratory hammer shall be used for pile driving to the greatest extent feasible. 2) If necessary, an impact hammer may be used. If an impact driver is used, a hydroacoustic impact assessment would need to be conducted. **Mitigation Measure BIO-1g: <u>Avoid and Minimize Impacts to S-CCC Steelhead</u> (Applies to EPB and SRPS project components).** The following measures for avoidance and minimization of adverse impacts to S-CCC steelhead during construction of the EPB and SRPS project components are those typically employed for construction activities. 1) Construction activities shall occur within a work window determined in consultation with the NMFS. 2) Implement all applicable CDFW Avoidance and Minimization Measures **Mitigation Measure BIO-1h: <u>Reduce Impacts to FYLF, CRLF, and S-CCC Steelhead</u> (Applies to ISMP project component).** A monitoring and reporting program will be developed in consultation with the USFWS and NMFS. **Mitigation Measure BIO-1i: <u>Avoid and Minimize Impacts to SBB</u> (Applies to SRPS project component).** The following measures for avoidance and minimization of adverse impacts to SBB during construction of the SRPS project component are those typically employed for construction activities. 1) Dune buckwheat plants that are not scheduled for removal as a result of project activities will be protected by exclusionary fencing. 2) Dune buckwheat plants that will be impacted, as well as the duff and/or soils underneath the plants, will be hand removed prior to disturbance by a USFWS-approved biologist 3) The removal of obligate host plants will be mitigated by replanting disturbed areas upon the completion of construction activities. 4) A qualified biologist or restoration specialist shall monitor the planting areas annually for three years

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
BIO-2: Construction Impacts to Sensitive Habitats. Proposed project construction would not have a substantial adverse effect on sensitive habitats (including riparian, wetlands, and/or other sensitive natural communities) within the Biological Study Area.	LSM	LSM	LS	**LSM**	**Mitigation Measure BIO-1a: Implement Construction Best Management Practices (Applies to EPB and SRPS project components); Mitigation Measure BIO-1b: Conduct Pre-Construction Surveys for White-Tailed Kite, Nesting Raptors, and Other Migratory Bird Species (Applies to EPB and SRPS project components; Mitigation Measure BIO-1c: Implement Construction-Phase Monitoring (Applies to EPB and SRPS project components); Mitigation Measure BIO-1d: Avoid and Minimize Impacts to Western Pond Turtle (Applies to EPB project component); Mitigation Measure BIO-1e: Avoid and Minimize Impacts to FYLF and CRLF (Applies to EPB project component); Mitigation Measure BIO-1g: Avoid and Minimize Impacts to S-CCC Steelhead (Applies to EPB and SRPS project components);** and **Mitigation Measure BIO-1i: Avoid and Minimize Impacts to SBB (Applies to SRPS project component),** summarized above. **Mitigation Measure BIO-2: Avoid and Minimize Impacts to Federal and Coastal Wetlands, Other Waters of the U.S., Waters of the State, Riparian Habitat, and Seasonal Emergent Marsh (Applies to EPB and SRPS project components).** Measures to reduce impacts to Federal and coastal wetlands, other waters of the U.S., waters of the State, riparian habitat, and seasonal emergent marsh: • A 404 permit shall be obtained from the USACE, a 401 permit shall be obtained from the RWQCB, and a coastal development permit (CDP) shall be obtained from the CCC prior to any ground disturbance or other construction activities. • Impacts shall be avoided to the greatest extent possible. • Preparation and implementation of a Habitat Mitigation and Monitoring Plan (HMMP).
BIO-3: Construction Impacts to Movement of Native Wildlife and Native Wildlife Nursery Sites. Proposed project construction would not adversely affect native wildlife corridors and wildlife nursery sites.	LSM	LSM	LS	**LSM**	**Mitigation Measure BIO-1a: Implement Construction Best Management Practices (Applies to EPB and SRPS project components); BIO-1e: Avoid and Minimize Impacts to FYLF and CRLF (Applies to EPB project component); BIO-1g: Avoid and Minimize Impacts to S-CCC Steelhead (Applies to EPB and SRPS project components);** and **Mitigation Measure BIO-2: Avoid and Minimize Impacts to Federal and Coastal Wetlands, Other Waters of the U.S., Waters of the State,**

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
					Riparian Habitat, and Seasonal Emergent Marsh (Applies to EPB and SRPS project components), summarized above.
BIO-4: Operational Impacts to Special-Status Species and Habitat. Proposed project operations would not adversely affect, either directly or through habitat modification, special-status plant and wildlife species and their habitat within the Biological Study Area.	BI	BI	NI	**BI**	No mitigation measures are required.
BIO-5: Operational Impacts to Sensitive Habitats. Proposed project operations would not adversely affect sensitive habitats (including riparian, wetlands, and/or other sensitive natural communities) within and adjacent to the Biological Study Area.	BI	BI	NI	**BI**	No mitigation measures are required.
BIO-6: Operational Impacts to Movement of Native Wildlife and to Native Wildlife Nursery Sites. Proposed project operations would not adversely affect native wildlife corridors and wildlife nursery sites.	BI	BI	NI	**BI**	No mitigation measures are required.
4.4 Cultural Resources					
CR-1: Construction Impacts on Historic Resources (Extant Buildings and Structures). Construction of the proposed EPB and SRPS project components and implementation of	LSM	LS	LS	**LSM**	**Mitigation Measure CR-1: Monitoring EPB Installation (Applies to EPB project component).** The construction of the EPB shall be monitored in accordance with the measures identified. • **Worker Educational Awareness Program (WEAP):** Prior to initiation of any construction-related activities, the County shall implement a WEAP.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
the proposed ISMP project component would not result in a substantial adverse change in the significance of known and/or unknown historic resources as defined in CCR Section 15064.5 of the State CEQA Guidelines or historic properties pursuant to 36 CFR 800.5.					• **Accidental Discovery:** In the event a previously unknown historic resource is uncovered during the course of construction, all work would temporarily cease until such time a qualified professional can evaluate the resource to determine whether the finding is significant. • **Monitoring:** The County shall retain a qualified archaeological professional to monitor ground disturbing activities.
CR-2: Construction Impacts on Historical and/or Archaeological Resources. The construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not result in a substantial adverse change in the significance of known and unknown historical and/or archaeological resources, as defined in CCR Section 15064.5 of the State CEQA Guidelines.	LSM	LSM	LSM	**LSM**	**Mitigation Measure CR-2a: <u>Final Grading Plans</u>. (Applies to EPB and SRPS project components).** The final grading plans for the EPB and SRPS project components shall be prepared in consultation with an archaeologist who meets the Secretary of the Interior's Qualification Standards and a representative of the OCEN. **Mitigation Measure CR-2b: <u>Archaeological Data Recovery</u>. (Applies to EPB and SRPS project components)**. • Prior to the commencement of any construction related activities, the County will retain an archaeological consultant who meets the Secretary of the Interior's Qualifications Standards. • In consultation with the County and a representative of OCEN, the archaeologist shall design and carry out an Archaeological Testing Program to determine the relationship of archaeological deposits to the proposed construction. • The archaeologist shall report on the results of the Program to the County in a draft and a final Archaeological Testing Report (ATR). • Based on the conclusions of the ATR, the archaeologist shall prepare a draft and final Archaeological Research Design and Treatment Plan (ARDTP) for the County to avoid and mitigate potential impacts to archaeological resources. • The archaeologist shall consult with the OCEN representative during the preparation of the ARDTP to ensure to the degree prudent and feasible, and bearing in mind project goals, that the proposed work is in keeping with OCEN traditions and sensibilities.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
					• Once approved by the County, a data-recovery investigation and/or other treatment consistent with the ARDTP shall be conducted by the archaeologist. At the conclusion of the work, the archaeologist shall submit a draft and final Archaeological Data Recovery Report (ADRR) to the County. • All artifacts determined in consultation between the archaeologist and OCEN representative to be neither burial related nor sacred could be curated together with copies of field notes and relevant reports in a suitable archaeological curation facility, preferably within Monterey County, if approved by OCEN and under agreement that all artifacts be returned to OCEN. The final disposition of non-burial related but sacred artifacts (if any) will be determined by the OCEN representative. **Mitigation Measure CR-2c: <u>Archaeological Monitoring</u>. (Applies to the proposed ISMP project component).** A qualified archaeologist shall be on call to quickly assess any potentially significant cultural materials, archaeological resources, or human remains that might be uncovered. **Mitigation Measure CR-2d: <u>Accidental Discovery of Archaeological Resources</u>. (Applies to ISMP project component).** If archaeological resources are unexpectedly discovered during ISMP project component implementation, work shall be halted within 50 meters of the find until it can be evaluated by a qualified professional archaeologist and OCEN monitor.
CR-3: Construction Impacts on Human Remains. The construction of the proposed EPB and SRPS project components and implementation of the ISMP may result in the disturbance of human remains.	LSM	LSM	LSM	**LSM**	**Mitigation Measure CR-2b: <u>Archaeological Data Recovery</u>. (Applies to EPB and SRPS project components)**, summarized above. **Mitigation Measure CR-3: <u>Discovery of Human Remains</u>. (Applies to all project components)**. If human remains are unexpectedly discovered during any construction, work shall be halted within 50 meters and the County Coroner shall be notified in accordance with provisions of PRC Sections 5097.98-99.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
CR-4: Construction Impacts on Tribal Cultural Resources. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not result in a substantial adverse change in the significance of a tribal cultural resource as defined in PRC Section 21074.	LSM	LSM	LSM	**LSM**	**Mitigation Measure CR-1 (Monitoring of EPB Installation); Mitigation Measure CR-2a (Final Grading Plans); Mitigation Measure CR-2b (Archaeological Data Recovery); Mitigation Measure CR-2c (Archaeological Monitoring); Mitigation Measure CR-2d (Accidental Discovery of Archaeological Resources); Mitigation Measure CR-3 (Discovery of Human Remains);** and **Mitigation Measure BIO-2 (Avoid and Minimize Impacts to Federal and Coastal Wetlands, Other Waters of the U.S., Waters of the State, Riparian Habitat, and Seasonal Emergent Marsh)**, summarized above.
4.5 Geology, Soils, & Seismicity					
GS-1: Construction-Related Erosion and Loss of Topsoil. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not result in substantial erosion or loss of topsoil.	LS	LS	LS	**LS**	No mitigation measures are required.
GS-2: Construction-Related Soil Collapse and Soil Constraints. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would be located on geologic units or soils that are unstable, or that may become unstable during project construction, and potentially result in soil instability or collapse; however, this exposure would not result in a substantial risk to people or structures.	LS	LS	LS	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
GS-3: Exposure to Fault Rupture. The proposed EPB and SRPS project components would be located in a seismically active area, and these components may be affected by fault rupture from an earthquake on local faults; however, this exposure would not result in a substantial risk to people or structures.	LS	LS	NI	**LS**	No mitigation measures are required.
GS-4: Exposure to Seismic Ground Shaking and Liquefaction. The proposed EPB and SRPS project components would be located in a seismically active area; however, the proposed project operations would not expose people or structures to a substantial risk of loss, injury, or death involving exposure to seismic groundshaking and liquefaction.	LS	LS	NI	**LS**	No mitigation measures are required.
GS-5: Exposure to Coastal Erosion and Sea Level Rise. The proposed EPB and SRPS project components would not be exposed to substantial soil erosion as a result of sea level rise.	LS	LS	NI	**LS**	No mitigation measures are required.
GS-6: Operation-Related Erosion and Loss of Topsoil/Sand. Operation of the proposed EPB and SRPS project components would not result in substantial erosion or loss of topsoil/sand.	LS	LS	NI	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
4.6 Greenhouse Gases					
GHG-1: Construction Greenhouse Gas Emissions. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would generate GHG emissions, either directly or indirectly, but would not make a considerable contribution to significant cumulative impacts due to GHG emissions and the related global climate change impacts.	LS	LS	LS	**LS**	No mitigation measures are required.
GHG-2: Operational Greenhouse Gas Emissions. Operation of the proposed project would generate GHG emissions, either directly or indirectly. These emissions would not exceed significance thresholds such that they would result in a considerable contribution to significant cumulative impacts of GHG emissions and the related global climate change impacts.	LS	LS	NI	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
4.7 Hazards & Hazardous Materials					
HH-1: Use and Disposal of Hazardous Materials During Construction. Construction of the proposed project would not create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials during construction.	LS	LS	LS	**LS**	No mitigation measures are required.
HH-2: Accidental Release of Hazardous Materials During Construction. Proposed project construction would potentially cause upset and accident conditions involving the release of hazardous materials into the environment.	LS	LS	LS	**LS**	No mitigation measures are required.
HH-3: Use of Hazardous Materials During Construction Within 0.25-Mile of Schools. Proposed project construction would not result in nor create a significant hazard to the public or the environment due to handling of hazardous materials or hazardous emissions within 0.25 mile of a school during construction.	LS	LS	LS	**LS**	No mitigation measures are required.
HH-4: Use and Disposal of Hazardous Materials and Accidental Release or Creation of Safety Hazards During Operation. Operation and maintenance of the proposed EPB and	LS	LS	NI	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
SRPS project components would not create a significant hazard to the public or the environment through the: 1) routine transport, use, or disposal of hazardous materials, 2) accidental release of hazardous materials, or 3) creation of safety hazards during operations					
4.8 Hydrology & Water Quality					
HYD-1: Construction Impacts to Water Quality due to Discharge. Construction activities involving dewatering of shallow groundwater during excavation for the proposed EPB and SRPS project components would generate water requiring disposal. Compliance with existing regulatory requirements would ensure that water disposal during construction would not violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality.	LS	LS	NI	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
HYD-2: Construction Groundwater Supply and Management. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not substantially decrease groundwater supplies nor interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin, nor would the proposed project conflict with or obstruct the implementation of a water quality control plan or sustainable groundwater management plan.	LS	LS	LS	**LS**	No mitigation measures are required.
HYD-3: Construction Impacts to Water Quality due to Earthmoving, Drainage System Alterations, and Use of Hazardous Chemicals. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not violate any water quality standards or waste discharge requirements, would not substantially alter the existing drainage pattern of the site or area causing substantial erosion or siltation on- or off-site, increase the rate or amount of surface	LS	LS	LS	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
runoff resulting in flooding, create runoff that would exceed the capacity of stormwater drainage systems, or impede or redirect flows, and would not otherwise substantially degrade water quality, including marine water quality, due to earthmoving, drainage system alterations, and use of hazardous chemicals.					
HYD-4: Operational Impacts to Water Quality due to Drainage Pattern Alterations and Discharges. Operation of the proposed EPB and SRPS project components would alter existing drainage patterns, but would not: 1) violate any water quality standards or waste discharge requirements, 2) contribute runoff water which would exceed the existing storm drainage capacity or provide substantial additional sources of polluted runoff, or 3) would not otherwise substantially degrade water quality.	LSM	NI	NI	**LSM**	**Mitigation Measure HYD-4: <u>Implementation of Water Quality Treatment BMPs</u> (Applies to EPB project component).** The project shall adhere to the conditions of the NPDES Permit, including the requirements for stormwater discharge treatment measures and appropriate source control and site design measures. To avoid potential long-term impacts to water quality, the EPB project component will be designed to include water quality treatment BMPs to retain and treat stormwater runoff.
HYD-5: Operational Impacts to Groundwater Supply and Management. Operation of the proposed EPB and SRPS project components would not substantially decrease groundwater supplies nor interfere substantially with	LS	LS	NI	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
groundwater recharge such that the project may impede sustainable groundwater management of the basin, nor would the proposed project conflict with or obstruct the implementation of a water quality control plan or sustainable groundwater management plan, or otherwise substantially degrade water quality.					
HYD-6: Operational Drainage Pattern Alterations. The proposed EPB and SRPS project components would alter existing drainage patterns, which would not cause substantial erosion or siltation on- or off-site, but would increase flooding on- or off-site.	SU	LS	NI	**SU**	There are no feasible mitigation measures for impacts to drainage pattern alterations associated with the operation of the proposed EPB project component and, therefore, potential flooding impacts to the CAWD and Mission Ranch properties and groundwater seepage within the CAWD facility are significant and unavoidable.
HYD-7: Operational Risks due to Location within a 100-Year Flood Hazard Area. The proposed EPB and SRPS project components would be located within a 100-year flood hazard area that would impede or redirect flows.	LSM	LS	NI	**LSM**	**Mitigation Measure HYD-7: Avoid and Minimize Impacts to the Validity of Base Level Elevations Cited on the Current, Effective FEMA Flood Insurance Rate Map Panel (Applies to EPB project component).** In order to reduce potential adverse effects associated with possible impacts to the validity of the base flood elevations cited on the currently, effective FEMA Flood Insurance Rate Map Panel for the EPB project component site, the County shall submit design drawings to FEMA showing the existing, pre-developed floodplain conditions and the proposed floodplain conditions after installation of the EPB project component. A FEMA Conditional Letter of Map Revision (CLOMR) is required to be processed prior to construction of the EPB project component to have FEMA review and determine the precise way in which the flood map would be revised. Following the completion of the proposed project, a FEMA Letter of Map Revision (LOMR) request would need to be processed and the flood map officially updated to reflect the revision.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
4.9 Land Use & Planning					
LU-1: Conflict with Plans, Policies, and Regulations during Construction and Operation. During construction, the proposed project would have one or more components that would conflict, or be inconsistent with, applicable land use plans, policies, and regulations without implementation of mitigation measures identified in this EIR. During operation, the proposed project would have one or more components that would potentially conflict, or be inconsistent with, applicable land use plans, policies, and regulations without implementation of mitigation measures identified in this EIR.	LSM	LSM	LSM	**LSM**	Implementation of the mitigation measures identified in this EIR would reduce potential impacts to a less-than-significant level.
4.10 Noise					
NV-1: Construction Ground-Borne Vibration and Noise. Construction of the proposed project would not expose sensitive receptors to excessive ground-borne vibration and noise level.	LSM	LS	LS	**LSM**	**Mitigation Measure NV-1: <u>Ground-Borne Vibration and Noise Reduction Measures</u> (Applies to EPB project component).** To reduce ground vibration impacts associated with sheet pile driving, measures are recommended for construction of the EPB project component. a. Implement **Mitigation Measure NV-2 (Construction Noise Reduction Measures),** summarized below. b. Prior to initiation of pile driving activities, a Construction Vibration Mitigation Plan (CVMP) shall be developed. c. With the permission of property owners, the contractor or designated representative(s) shall conduct pre-construction monitoring surveys for structures located within potentially affected areas that could exceed

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
					applicable thresholds for structural damage. d. Ground-borne vibration levels associated with pile driving activities shall be monitored when pile driving activities occur within 75 feet of existing structures.
NV-2: <u>Construction Noise</u>. Construction activities associated with the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would result in a substantial temporary or periodic (i.e., short-term) increase in ambient noise levels in the vicinity of the proposed project and would exceed noise level standards and/or result in nuisance impacts at sensitive receptors.	SU	LSM	LSM	**SU**	**Mitigation Measure NV-2: <u>Construction Noise Reduction Measures</u>. (Applies to EPB and SRPS project components).** 1) Prior to initiation of construction, a Construction Noise Mitigation Plan (CNMP) shall be prepared and shall include, at a minimum, the following components: • Identification of noise-reduction measures to be implemented with a noise-reduction goal sufficient to achieve the County's instantaneous noise standard of 85 dBA. • A construction noise complaint and response program. • A construction noise monitoring program sufficient to provide verification that resultant noise levels associated with noise-generating construction activities would not exceed the County's daytime intermittent noise standard of 85 dBA. 2) Advance written notification shall be provided to property owners and building occupants that are located adjacent to construction areas. 3) Noise-generating construction activities shall be limited to between the hours of 8:00 a.m. and 6:30 p.m., Monday through Saturday. Noise-generating construction activities shall be prohibited on Sundays and State-recognized holidays. 4) Construction equipment should be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds. 5) Lay-down yards and semi-stationary equipment such as pumps or generators shall be located at the furthest practical distance from noise-sensitive land uses. 6) Quieter equipment shall be selected to the extent locally available.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
NV-3: Operational Noise. Operation of the proposed project would result in a substantial permanent (i.e., long-term) increase in ambient noise levels, and would exceed noise level standards and/or result in nuisance impacts at sensitive receptors**.**	SU	LS	NI	**SU**	**Mitigation Measure NV-3: <u>Conduct Acoustical Analysis for Operational Noise Levels</u>. (Applies to EPB project component).** Prior to construction of the pump station and control building/emergency generator, an acoustical analysis shall be prepared to assess operational noise levels.
4.11 Public Services, Recreation, & Utilities					
PS-1: Construction Public Services Demand. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not result in public service demands for fire and police protection services, schools, or parks that would result in the need for new or physically altered facilities to maintain service capacity or performance objectives.	LS	LS	LS	**LS**	No mitigation measures are required.
PS-2: Construction Landfill Capacity. Construction of the proposed EPB and SRPS project components would result in generation of solid waste; however, the solid waste would be disposed at a landfill with sufficient permitted daily and overall capacity to accommodate the proposed project's solid waste disposal needs.	LS	LS	NI	LS	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
PS-3: Construction Solid Waste Policies and Regulations. Construction of the proposed EPB and SRPS project components would potentially conflict with State and local statutes, policies, and regulations related to solid waste.	LSM	LS	LS	**LSM**	**Mitigation Measure PS-3: <u>Construction Waste Reduction and Recycling Plan (Applies to EPB project component)</u>.** The construction contractor(s) shall prepare and implement a construction waste reduction and recycling plan identifying the types of construction debris the EPB project component will generate and the manner in which those waste streams will be handled.
PS-4: Water Supply During Construction. Construction activities associated with the proposed EPB and SRPS project components would require water, but supply is sufficient and would not require new or expanded entitlements.	LS	LS	NI	**LS**	No mitigation measures are required.
PS-5: Public Services Demand During Operation. Operation of the proposed EPB and SRPS project components would not result in public service demands for fire and police protection services, schools, or parks that would result in the need for new or physically altered facilities to maintain service capacity or performance objectives.	LS	LS	NI	**LS**	No mitigation measures are required.
PS-6: Energy Use During Construction and Operation. The proposed project would not include the wasteful, inefficient, and unnecessary consumption of energy during project construction, operation, and/or maintenance activities that cannot be feasibility mitigated.	LS	LS	LS	**LS**	No mitigation measures are required.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact					
PS-7: Construction or Expansion of Recreational Facilities. The construction of the proposed project and operation of the proposed project component would not require the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment.	NI	LS	LS	**LS**	No mitigation measures are required.
4.12 Traffic & Circulation					
TRA-1: Conflict with a program, plan, ordinance, or policy addressing the circulation systems, including transit, roadway, bicycle, and pedestrian facilities during construction of the proposed project. The construction of the proposed EPB and SRPS project components would temporarily reduce roadway performance and result in temporary traffic delays, potentially affecting transit, bicycle, and pedestrian facilities. Construction of the proposed EPB and SRPS project components could result in potentially significant parking impacts due to temporary increases in parking demand and the displacement of on-street parking. The use of trucks to transport construction equipment and materials could adversely affect road conditions on local roadways.	LSM	LSM	LS	**LSM**	**Mitigation Measure TRA-1a: <u>Traffic Control and Safety Assurance Plan</u> (Applies to EPB and SRPS project components)**. Prior to construction of the EPB and SRPS project components, the County and/or its contractor shall prepare and implement a traffic control plan or plans for the roadways and intersections affected by construction. **Mitigation Measure TRA-1b: <u>Construction Parking Requirements</u> (Applies to EPB and SRPS project components).** Prior to commencing project construction, the construction contractor(s) shall coordinate with the potentially affected jurisdictions to identify designated worker parking areas that would avoid or minimize parking displacement. **Mitigation Measure TRA-1c: <u>Roadway Rehabilitation Program</u> (Applies to EPB and SRPS project components).** Prior to commencing project construction, the County shall detail the preconstruction condition of all local construction access and haul routes proposed for substantial use by project-related construction vehicles. Roads damaged by project-related construction vehicles shall be repaired to a structural condition equal to that which existed prior to construction activities.

Impact Statement	EPB	SRPS	ISMP	Project Overall	Mitigation Measure
KEY To ACRONYMS: *NI – No Impact; LS – Less-than-Significant; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation;* *SU = Significant Unavoidable Impact even with Mitigation; BI = Beneficial Impact*					
TRA-2: Conflict or be inconsistent with CEQA Guidelines Section 15064.3(b). Construction and operation of the proposed project would not result in a significant increase in vehicle miles traveled or conflict or be inconsistent with CEQA Guidelines Section 15064.3(b).	LS	LS	LS	**LS**	No mitigation measures are required.
TRA-3: Result in Inadequate Emergency Access. Construction of the proposed EPB and SRPS project components would result in an increase in traffic and delays, which may affect emergency access in the project area.	LSM	LSM	LS	**LSM**	**Mitigation Measure TRA-1a: Traffic Control and Safety Assurance Plan (Applies to EPB and SRPS project components)**.
4.13 Energy					
ENG-1: Result in Wasteful, Inefficient, or Unnecessary Consumption of Energy or Conflict with a state or local plan for renewable energy or energy efficiency. Construction and operation activities associated with the proposed project would require the use of energy, but these activities would not result in wasteful, inefficient, or unnecessary consumption of energy, nor would they conflict with state or local plans for renewable energy or energy efficiency.	LS	LS	LS	**LS**	No mitigation measures are required.

Table 2-2 Summary of Cumulative Impacts and Mitigation Measures

#	Topical Section/Cumulative Impact Issue		Determination of Significance and Discussion of Contribution of the Proposed Project to Cumulative Impacts (if applicable)	Mitigation Measures
4.1	Aesthetics		SU: The proposed project would result in significant cumulative aesthetic impacts due to operation of the proposed EPB project component, and no mitigation measures are available to reduce those impacts to a less-than-significant level. However, it would not contribute to any significant cumulative aesthetic impacts due to lack of impacts from any other cumulative projects.	No mitigation measures are available to reduce the impacts to a less-than-significant level.
4.2	Air Quality	Cumulative Projects Contributing to Localized Impacts	LS: Localized air pollutant emissions from cumulative projects may potentially impact sensitive receptors if intense construction activities (i.e., those activities with high air pollutant emissions) from two or more construction projects would occur in close proximity to each other (i.e., within 1 mile). The exact sequence of other projects' construction are outside the control of the County; but as currently envisioned, the construction periods may potentially overlap.	No mitigation measures are required.
		Proposed Project Localized Air Pollutants Impacts	LS: The proposed project would not make a considerable contribution to significant cumulative construction or operational impacts due to localized air pollutant exposures or odors.	
		Cumulative Regional, Criteria Air Pollutant Emissions	LS: The proposed project would not make a considerable contribution to significant cumulative regional emissions of PM_{10}.	
4.3	Biological Resources		LS: The proposed project would not make a considerable contribution to significant cumulative impacts to biological resources.	No mitigation measures are required.
4.4	Cultural Resources	Construction Impacts	LS: Construction of the proposed project would not contribute to cumulative impacts related to cultural resources.	No mitigation measures are required.
4.5	Geology, Soils, and Seismicity		LS: The proposed project would not make a considerable contribution to significant cumulative geologic, soil, or seismicity impacts.	No mitigation measures are required.

#	Topical Section/Cumulative Impact Issue		Determination of Significance and Discussion of Contribution of the Proposed Project to Cumulative Impacts (if applicable)	Mitigation Measures
4.6	Greenhouse Gases		LS: The proposed project would not make a considerable contribution to significant cumulative construction or operational impacts due to greenhouse gas emissions.	No mitigation measures are required.
4.7	Hazards & Hazardous Materials		LS: The proposed project would not make a considerable contribution to significant cumulative construction or operational impacts related to hazards or hazardous waste.	No mitigation measures are required.
4.8	Hydrology & Water Quality	Combined Groundwater Construction and Operation Impacts	LS: The proposed project would not make a considerable contribution to significant cumulative construction or operational impacts related groundwater	No mitigation measures are required.
		Combined Surface Water Construction Impacts	LS: The proposed project would not make a considerable contribution to significant cumulative construction impacts related surface water.	No mitigation measures are required.
		Combined Surface Water Operation Impacts	SU: The proposed project would potentially make a considerable contribution to significant cumulative operational impacts to hydrology and surface water quality due Discharges (HYD-4) and Risks due to Location within 100-Year Flood Area (HYD-7); however, with implementation of Mitigation Measure HYD-4 and HYD-7, the impact would be reduced to less than significant and the proposed project would not make a considerable contribution to a significant cumulative impact. There would not be significant cumulative construction flooding impacts to which the proposed project would contribute. However, construction and operation of the EPB project component would result in significant and unavoidable flooding impacts and no mitigation measures are available to reduce those impacts to a less-than-significant level. Therefore, this impact would also be cumulatively significant and unavoidable.	No mitigation measures are required.
4.9	Land Use & Planning		LSM: The proposed project would result in less-than-significant cumulative land use impacts with implementation of the mitigation measures identified in this EIR.	No mitigation measures are required.

#	Topical Section/Cumulative Impact Issue	Determination of Significance and Discussion of Contribution of the Proposed Project to Cumulative Impacts (if applicable)	Mitigation Measures
4.10	Noise	SU: The proposed project would result in significant cumulative noise and vibration impacts due to construction and operation of the proposed EPB project component, and no mitigation measures are available to reduce those impacts to a less-than-significant level.	No mitigation measures are available to reduce the impacts to a less-than-significant level.
4.11	Public Services, Recreation and Utilities	LS: The proposed project would not contribute to any cumulative impacts related to schools, parks, and recreational facilities. The proposed project's contribution to other public services and utilities (fire and police protection, solid waste) would not be cumulatively considerable.	No mitigation measures are required.
4.12	Traffic & Circulation	LS: There would be no significant cumulative construction-related traffic and transportation impacts. The proposed project would not make a considerable contribution to significant cumulative traffic and transportation impacts due to cumulative development.	No mitigation measures are required.
4.13	Energy	LS: There would be no significant cumulative energy-related impacts. The proposed project would not make a considerable contribution wasteful, inefficient, or unnecessary consumption of energy or conflict with a state or local plan for renewable energy or energy efficiency due to cumulative development.	No mitigation measures are required.

Chapter 4.0 ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES

4.1 INTRODUCTION

This chapter provides a project-level analysis of the physical environmental effects of implementing the Lagoon EPB, SRPS, and ISMP project. This chapter describes the environmental setting, assesses impacts, and identifies mitigation measures for significant impacts.

4.1.1 Scope of Analysis

The RDEIR analyzes the potential effects of the proposed project on the environment under the applicable environmental resource topics listed in the CEQA Initial Study Checklist in Appendix G of the State CEQA Guidelines. The checklist includes the environmental resource topics identified in **Table 4.0-1** below.

Table 4.0-1 Resource Topics/Sections and Abbreviations Key

Resource Topics (Section Number)	Abbreviations
Aesthetics (see **Section 4.1**)	AES
Air Quality (see **Section 4.2**)	AQ
Biological Resources (see **Section 4.3**)	BIO
Cultural Resources (see **Section 4.4**)	CR
Geology, Soils, and Seismicity (see **Section 4.5**)	GS
Greenhouse Gas Emissions (see **Section 4.6**)	GHG
Hazards and Hazardous Materials (see **Section 4.7**)	HH
Hydrology/Water Quality (see **Section 4.8**)	HYD
Land Use/Planning (see **Section 4.9**)	LU
Noise (see **Section 4.10**)	NV
Public Services, Recreation, and Utilities (see **Section 4.11**)	PS
Transportation (see **Section 4.12**)	TRA
Energy (see **Section 4.13**)	ENG

Each environmental resource section includes a discussion of the environmental setting, applicable regulations pertaining to the resource area, impact assessment, and mitigation measures where applicable. Each section of **Chapter 4** contains the following elements:

Environmental Setting. This subsection presents a description of the existing physical environmental conditions in the vicinity of the proposed project with respect to each resource area at an appropriate level of detail to understand the impact analysis.

Regulatory Framework. This subsection provides a brief discussion of federal, state, and local regulations and policies applicable to the resource topic and the proposed project.

Impacts and Mitigation Measures. This subsection evaluates the potential for the proposed project to affect the physical environment. The analysis section identifies the significance criteria for evaluation of environmental impacts, including an explanation of how the significance criteria are used in the evaluation of impacts for the proposed project. This subsection includes a discussion of the approach to the analysis, including identification of the significance criteria not applicable to the proposed project. Potential impacts are identified and characterized. When required and feasible, this section identifies mitigation measures to avoid or reduce identified significant impacts to a less-than-significant level.

The **Impacts and Mitigation Measures** section in each resource chapter includes an impact statement followed by the evaluation of the impact for each of the relevant proposed project components, and a conclusion regarding the combined impact for the whole proposed project. For instance, if some of the components evaluated under a particular impact statement were deemed to have a less-than-significant or no impact and one component was determined to have a significant impact that could be reduced with mitigation, the significance determination shown in parentheses in the impact statement would be less-than-significant with mitigation because the combined impact of all components would include a significant impact. The evaluation includes and applies mitigation to the relevant components as indicated in the text of the mitigation measures.

The proposed project involves multiple components and sites in the same geographic area, which may cause, or exacerbate, overlapping environmental impacts due to concurrent construction periods of more than one component. The **Approach to Analysis** section in the resource chapter identifies issues of overlapping environmental impacts due to concurrent construction.

The term "construction impacts" identifies short-term impacts that may result from construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component. The implementation of the proposed ISMP project component would not involve the construction of any permanent structures requiring operation and maintenance. The implementation of the proposed ISMP project component would involve activities similar to short-term construction activities, primarily ground-disturbing activities required to breach the Lagoon and would not be required once the proposed EPB and SRPS project components are constructed. Therefore, the construction impact analysis examines potential impacts associated with the implementation of the proposed ISMP project component. However, this component is not analyzed for long-term, operational analysis.

4.1.2 Significance Determinations

In accordance with the CEQA, specifically, PRC Section 21068, a "significant effect on the environment" means a substantial, or potentially substantial, adverse change in the environment. As noted above, **Chapter 4** presents the significance criteria used for each environmental resource topic following the setting and before the discussion of impacts. For the impact analyses, one of the following significance determinations will be assigned:

No Impact (NI). This determination is made if there is no potential that the proposed project could affect the resource at issue.

Less-than-Significant (LS). This determination applies if there is a potential for a limited impact on a resource, but the impact is not significant in accordance with the significance criterion.

Less-than-Significant with Mitigation (LSM). This determination applies if there is the potential for a significant, adverse effect in accordance with the significance criterion, but mitigation is available to reduce the impact to a less-than-significant level.

Significant Unavoidable (SU). This determination applies to impacts that are significant, but for which there is no feasible mitigation available to substantially reduce the impact.

In addition, the RDEIR may identify **Beneficial Impacts (BI)** of the proposed project, if evidence exists to substantiate the anticipated benefit(s).

A separate Mitigation Monitoring and Reporting Plan (MMRP) (as required by PRC Section 21081.6) will be developed in conjunction with the Final EIR. The Final EIR would outline the mitigation measures and the monitoring and reporting methods that would be employed. The MMRP will be considered for adoption by the Monterey County Board of Supervisors. If the Final EIR is certified and the MMRP is adopted by the County in its capacity as the lead agency, the proposed project will be considered through the County's Capital Improvement Projects process. The County would also seek permitting from responsible agencies for the project before construction can begin.

This Page Intentionally Left Blank

4.1 AESTHETICS

This section assesses the existing visual quality of the proposed project site and potential changes to the visual and aesthetic environment that would result from the proposed project. The visual analysis is based on field surveys conducted by Denise Duffy & Associates, Inc. (DD&A), photos of the proposed project site from various vantage points, and aerial photographs of the site and its surroundings). A field survey captured aerial photographs, studied maps, and noted areas of special interest or potential scenic value for assessment prior to the site visit (see **Section 4.1.1.3** below). Photographs were taken from points that illustrate the existing visual character of the proposed project area. **Figures 4.1-1** and **4.1-2** contain representative site photographs of the property and surrounding area. The locations of the photos are depicted in **Figure 4.1-3.** This section has been updated to include a discussion and photos of the emergency repair of Scenic Road, which occurred in February 2023 because of storm damage.

Public and agency comments related to aesthetic quality were received during the public scoping period, and are summarized below:

- Evaluate potential reduction in scenic value to the Carmel River State Beach and the Lagoon;
- Analyze all potentially significant effects on sensitive visual resources and identify mitigation measures;
- Evaluate potential impact to views; and
- Evaluate potential visual impacts to the proposed project area.

To the extent that issues identified in public comments involve potentially significant effects on the environment according to the CEQA and/or are raised by responsible agencies, they are identified and addressed within this RDEIR. For a complete list of public comments received during the public scoping period, refer to **Appendix A**, **NOP, and Public Comment Letters** of the Draft EIR.

4.1.1 Environmental Setting

4.1.1.1 Regional Overview

The proposed project area is situated within and adjacent to the Carmel River State Beach and Lagoon, between Highway 1 and the Pacific Ocean in the unincorporated Carmel area of Monterey County, California. The proposed project site is surrounded by residential housing to the north and south and bounded by Highway 1 to the east. Highway 1 is a State designated Scenic Highway and a federally designated Scenic Byway.

The coastal landscape of northern Monterey County is aesthetically rich and visually diverse, and some areas, such as the Monterey Peninsula and Carmel Bay, are widely recognized and highly regarded for their aesthetic quality. The proposed project components are sited in primarily coastal strand and emergent marsh habitats. The coastal strand habitat is characterized by long stretches of unvegetated beach. The emergent marsh habitat is characterized by wetlands which are dominated by California bulrush as well as other wetland plant species.

This Page Intentionally Left Blank



A.) View of EPB site from terminus of Camino Real south towards Carmelo Street.



B.) View of EPB site from Carmel Meadows looking north towards terminus of Camino Real.



C.) View of EPB site from Carmelo Street looking northeast towards terminus of River Park Place.



D.) View of EPB site from terminus of Monte Verde Street looking south towards Carmel Meadows.

2016 Site Photos of EPB Project Area

DD&A	**Denise Duffy and Associates, Inc.** Planning and Environmental Consulting	Date 2-24-16 Scale N/A	Figure 4.1-1

This Page Intentionally Left Blank



A.) View of SRPS site from Carmel River Beach looking north towards Scenic Road.



B.) View of SRPS site from Scenic Road looking south towards Carmel River Beach.

2016 Site Photos of SRPS Project Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 2-24-16

Scale N/A

Figure 4.1-2

This Page Intentionally Left Blank

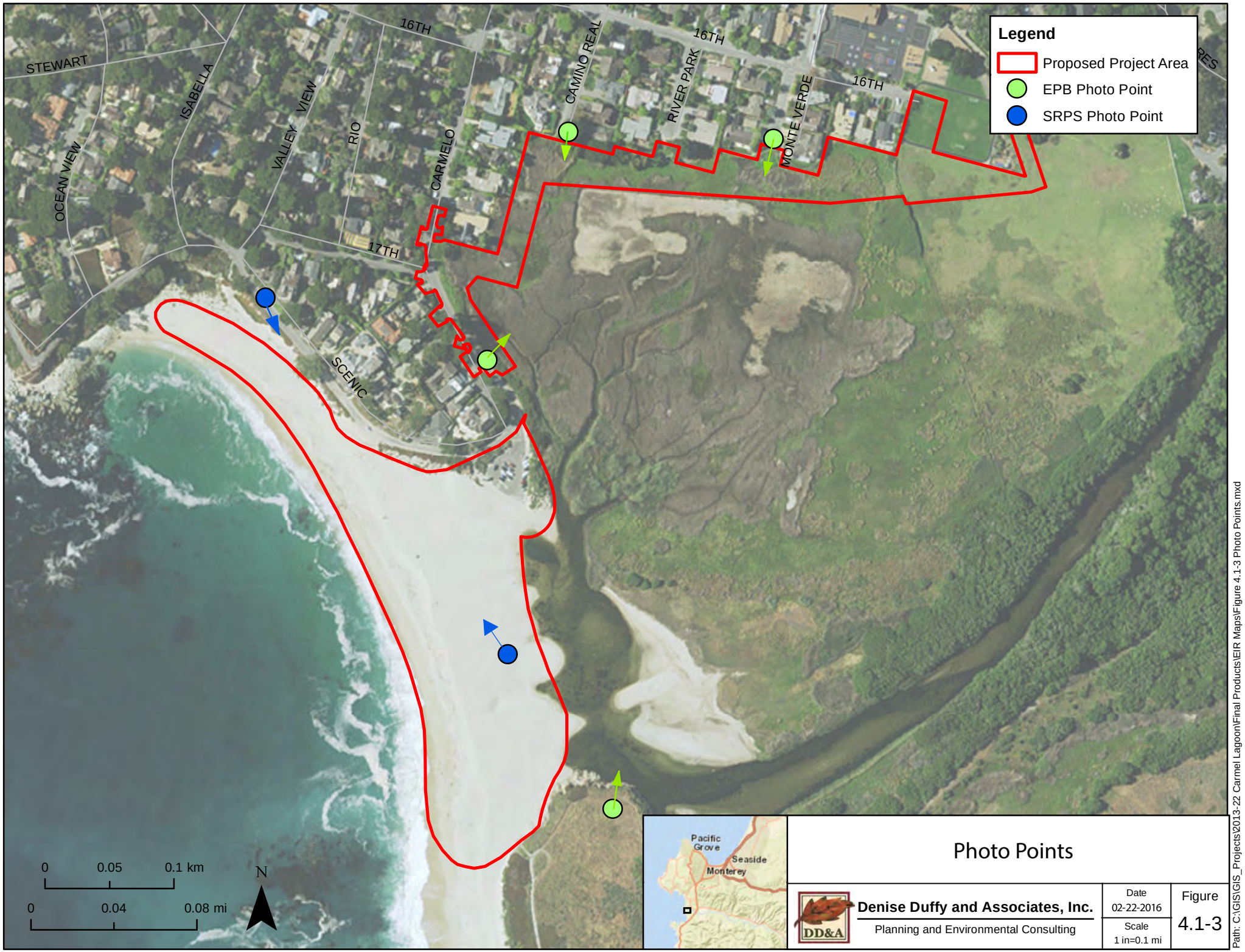


Photo Points

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 02-22-2016
Scale: 1 in=0.1 mi
Figure: 4.1-3

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.1-3 Photo Points.mxd

This Page Intentionally Left Blank

4.1.1.2 Concepts and Terminology

Visual or aesthetic resources are defined as both the natural and built features of the landscape that contribute to the public's experience and appreciation of the environment. Depending on the extent to which a project's presence would alter the visual character and quality of the environment, a visual or aesthetic impact may occur. Visual quality, visual character, affected viewers and exposure sensitivity, and visual sensitivity are the terms used throughout the analysis, and are defined below.

VISUAL QUALITY

Visual quality is defined as the overall visual impression or attractiveness of a site or locale as determined by its aesthetic qualities (such as color, variety, vividness, coherence, uniqueness, harmony, and pattern). Natural and built features combine to form perspectives with varying degrees of visual quality, which are rated in this analysis as low, moderate, and high, as follows:

- **Low.** The location is lacking in natural or cultural visual resource amenities typical of the region. A site with low visual quality will have aesthetic elements that are unappealing and perceptibly uncharacteristic of the surrounding area.
- **Moderate.** The location is typical or characteristic of the region's natural or cultural visual amenities. A site with moderate visual quality maintains the visual character of the surrounding area, with aesthetic elements that do not stand out as either contributing to, or detracting from, the visual character of an area.
- **High.** The location has visual resources that are unique or exemplary of the region's natural or cultural scenic amenities. A site with high visual quality is likely to stand out as particularly appealing and makes a notable positive contribution to the visual character of an area.

VISUAL CHARACTER

Visual character is a general description of the visual attributes of a particular land use setting and the unique set of landscape features. The purpose of defining the visual character of an area is to provide the context within which the visual quality of a particular site or locale is most likely to be perceived by the viewing public. For natural and open space settings, visual character is commonly described in terms of areas with common landscape attributes (such as landform, vegetation, or water features).

AFFECTED VIEWERS AND EXPOSURE SENSITIVITY

Affected viewers and exposure sensitivity conditions address variables that affect viewers and their visual exposure to the proposed project component sites. The identification of viewer types and volumes describes the type and quantity of potentially affected viewers within the visual study area. Land uses that derive value from the quality of their settings are considered potentially sensitive to changes in visual conditions. Sensitive viewers are those who would have a strong stake or interest in the quality of the landscape when viewing a site from a public vantage point. Examples of viewers with elevated concern for visual quality include travelers on designated scenic routes, park visitors, and other recreationists in public recreational areas.

Viewer exposure considers some or all of the following factors: landscape visibility (the ability to see the landscape); viewing distance (the proximity of viewers to the component sites); viewing angle (whether the component sites would be viewed from a superior, inferior, or level line of sight); extent of visibility (whether the line of sight is open and panoramic to the facility sites or restricted by terrain, vegetation,

and/or structures); and duration of view. Viewer sensitivity relates to the level of interest or concern the public has for a particular aesthetic resource.

VISUAL SENSITIVITY

Visual sensitivity is the overall measure of a site's susceptibility to adverse visual changes. Visual sensitivity is rated as high, moderate, or low and is determined based on the combined factors of visual quality, viewer types and volumes, and visual exposure to the proposed project as described above. A setting's overall visual sensitivity is the measure of its susceptibility to significant visual impacts because of project-caused visual change.

4.1.1.3 Site Characteristics

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

The proposed EPB project component would be in the Carmel River State Beach State Park unit, on State Park's land, south of the City of Carmel, in unincorporated Monterey County. The proposed EPB project component would be constructed along the property lines separating State Park's land from adjacent private properties north of the site. The western termination of the proposed EPB project component would be near the intersection of Carmelo Street and 17th Avenue, or at a subtle topographic high point east of Carmelo Street and several tens of feet north of the Carmel River State Beach parking lot. The eastern proposed EPB project component termination would terminate near Carmel River Elementary School property near the end of 16th Street, or at an existing topographic high point south of Mission Ranch.

The existing visual character of the proposed EPB project component site consists of undeveloped wetland and riparian habitat associated with the Carmel River.

The proposed EPB project component site is visible from private residences within the immediate proposed project area. Residences north of the proposed project site along Monte Verde Street, River Park Place, Camino Real, and Carmelo Street, backing up to the site, have the most direct views of the site. The site is also visible to residences south of the proposed project site along Calle La Cruz and many residences along Ribera Road. The locations described below were selected as representative viewpoints of the surrounding proposed project area and locations of special importance are shown in **Figure 4.1-1.**

Camino Real: The proposed EPB project component would be highly visible from the south terminus of Camino Real.

Carmelo Street: The proposed EPB project component would be visible from Carmelo Street when traveling north towards 17th Avenue.

Carmel Meadows: The proposed EPB project component would be highly visible from the open space on the north side of the Carmel Meadows development.

Monte Verde Street: The proposed EPB project component would be highly visible from the south terminus of Monte Verde Street.

The visual quality of this site is high, as the Lagoon is a unique and natural scenic resource and makes a positive contribution to the visual character of the surrounding region. Additionally, the exposure sensitivity of the site is also classified as high, as the Lagoon can be seen from great distances and is the visual centerpiece of the local area. Due to the high visual quality and exposure of the site, visual sensitivity is considered high. **Table 4.1-1**, **Summary of Visual Sensitivity Conditions** provides a summary of these findings.

Table 4.1-1 Summary of Visual Sensitivity Conditions

Proposed Project Component	Visual Quality	Affected Viewers and Exposure Conditions	Visual Sensitivity
EPB	*High*	*High*	*High*
SRPS	*High*	*High*	*High*
ISMP	*High*	*High*	*High*

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The proposed SRPS project component alignment would be located on Carmel River State Beach. The proposed SRPS project component would parallel the outboard shoulder of Scenic Road, from near the northern end of Stewart's Cove, southbound to near the southern tip of the State Beach parking lot. The transition between the proposed EPB and SRPS project components would be located near the Carmel River State Beach parking lot where the transition from lagoon to coastal setting occurs. The proposed SRPS project component would skirt the southern edge of the Carmel River State Beach parking lot or terminate against the edge-of-road prism near the restrooms.

In January 2023, atmospheric storm events and high wave action significantly undermined a section of Scenic Road located on State Parks property, west of the CRSB parking lot and restrooms, exposing and damaging water, sewer, and other underground infrastructure making residences inaccessible (**Figure 4.1-4**). County of Monterey Public Works, Facilities, and Parks (County PWFP) coordinated with the regulatory agencies and other stakeholders, along with specialized engineering consultants, to plan an emergency repair that would restore the carrying capacity of the road and protect it from storm runoff erosion, scouring of ocean waves, and potential wind erosion. Additionally, the emergency repair needed to provide a platform to restore sewer service, water service, and other underground utility service, and restore access to the residences along Scenic Road. In February 2023, the County PWFP installed a 200-foot, soil-nail, shotcrete wall, which involved driving 15' to 30' nails into the soil to anchor and hold a mesh cover to contain the sand and material under the roadway. As a result, the road reopened in early-April 2023.

The SRPS project component site is visible from private residences within the immediate proposed project area. The component area is visible from residences along Scenic Road, north of the proposed project site and along Calle La Cruz and Ribera Road, south of the proposed project site. Portions of the Santa Lucia Mountains and Point Lobos State Reserve can be viewed looking east and south; views looking west consist of the Pacific Ocean; and views looking north consist primarily of private residences. The locations described below were selected as representative viewpoints of the surrounding proposed project area and locations of special importance and are shown in **Figure 4.1-2.**

Scenic Road: The proposed SRPS project component would be highly visible from the segment of Scenic Road east to where it becomes Carmelo Street.

Carmel River Beach: The proposed SRPS project component would be most visible from Carmel River Beach looking towards Scenic Road and the residential area to the north.

The visual quality of this site is high, as the Carmel River Beach is a natural scenic resource, and contributes positively to the visual character of the surrounding area. The exposure sensitivity of the site is also considered high due to the considerable number of visitors and the visibility of Scenic Road. Due to the high visual quality and exposure of the site, visual sensitivity is considered high. **Table 4.1-1**, **Summary of Visual Sensitivity Conditions** provides a summary of these findings.

This Page Intentionally Left Blank



A.) View west of damage and undermining of Scenic Road (January 2023).



B.) View of SRPS site from CRSB looking north towards Scenic Road.



C.) View of SRPS site from Scenic Road looking south towards CRSB.



D.) View of September 2023 conditions after emergency repair of Scenic Road.

2023 Photos of the Proposed SRPS Project Site

Denise Duffy and Associates, Inc. Planning and Environmental Consulting	Date 9/19/2023 Scale N/A	Figure 4.1-4

This Page Intentionally Left Blank

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

Implementation of the proposed ISMP project component would occur in the same locations as the components described above. The Pre-Mobilization Requirements portion of the proposed ISMP project component includes the temporary placement of sandbags along the property boundary of State Parks and homes along the north end of the Carmel Lagoon (Camino Real, River Park Place, Monte Verde Street, and 16th Avenue). Pallets of sandbags would also be placed at the end of the streets and within the right-of-way at the end of streets draining into the Lagoon.

If, and when, the County determines that the Lagoon will be mechanically breached, the channel will be cleared using 1-2 bulldozers (D6 Caterpillar); the bulldozers would be onsite only on a temporary basis while work is being completed. Additional equipment may be present within the proposed project area (sand dunes) as part of the implementation of the Beach/Sand Dune Restoration portion of the proposed ISMP project component.

Site photos are not included for the proposed ISMP project component implementation, as the photos from the previously described components cover the same location, and implementation would be intermittent and temporary in nature.

The proposed ISMP project component shares the same proposed project area as the proposed EPB and SRPS project components, and therefore is considered to have high visual quality and high exposure sensitivity. Due to the high visual quality and exposure of the site, visual sensitivity is considered high. **Table 4.1-1**, **Summary of Visual Sensitivity Conditions** provides a summary of these findings.

4.1.2 Regulatory Environment

4.1.2.1 Federal

NATIONAL SCENIC BYWAYS PROGRAM

Highway 1 from Carmel south to Big Sur (and beyond) is designated as an "All American Road" under the Federal Highway Administration's National Scenic Byways Program. All roads nationally designated are considered part of America's Byways collection and must possess at least one of these six intrinsic qualities: historic, cultural, natural, scenic, recreational, and/or archaeological. To receive an All-American Road designation, a road must possess multiple intrinsic qualities that are nationally significant and contain one-of-a-kind features that do not exist elsewhere. The road must also be considered a "destination unto itself," and must provide an exceptional travel experience.

4.1.2.2 State

CALIFORNIA STATE SCENIC HIGHWAY PROGRAM

In 1963, the Legislature created the California State Scenic Highway program. The program's purpose is to preserve and protect scenic highway corridors from change that would otherwise diminish the aesthetic value of lands adjacent to highways. The program includes a list of highways that are either designated or eligible for designation as a Scenic Highway. State laws governing the Scenic Highway Program are found in the Streets and Highways Code, Sections 260 through 263. A highway may be designated scenic depending upon how much of the natural landscape can be seen by travelers, the scenic quality of the landscape, and the extent to which development intrudes upon the traveler's enjoyment of the view. Portions of Highway 1 along the California coastline are either designated as a State Scenic Highway or eligible for State Scenic Highway's designation (Caltrans, 2023). The section of Highway 1

adjacent to the proposed project site is a designated State Scenic Highway. This section of Highway 1 traverses a series of hills, offering views of the City of Carmel, Carmel Valley, Point Lobos, and the Pacific Ocean.

CALIFORNIA COASTAL ACT

In 1976, the State Legislature enacted the California Coastal Act (CCA) to provide long-term protection of the State's 1,100-mile coastline for the benefit of current and future generations. Development activities, which are broadly defined by the CCA to include (among others) construction of buildings, divisions of land, and activities that change the intensity of use of land or public access to coastal waters, require a coastal permit from either the California Coastal Commission (CCC) or the local government. The CCA includes specific policies (see Division 20 of the PRC) that address issues such as shoreline public access and recreation, lower cost visitor accommodations, terrestrial and marine habitat protection, visual resources, landform alteration, agricultural lands, commercial fisheries, industrial uses, water quality, offshore oil and gas development, transportation, development design, power plants, ports, and public works. Development within the Coastal Zone requires a Coastal Development Permit (CDP). The following portion of the CCA is pertinent to scenic and visual resources:

> **Section 30251**. The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alternation of natural land forms, to be visually compatible with the character of surrounding areas, and where feasible, to restore and enhance visual quality in visually degraded areas. New development in highly scenic areas such as those designated in the California Coastline Preservation and Recreation Plan prepared by the Department of Parks and Recreation and by local government shall be subordinate to the character of its setting.

4.1.2.3 Regional/Local

RELEVANT PLANNING DOCUMENTS

The 1982 Monterey County General Plan, Carmel Area Land Use Plan, Carmel Area Coastal Implementation Plan, Point Lobos State Reserve and Carmel River State Beach General Plan, CCA, and California PRC contain a variety of policies related to preservation and protection of scenic resources. Please refer to **Section 3.5, Required Permits and Approvals** for a list of permits and project approvals, **Section 4.9, Land Use and Planning** for a description of these regulations and plans, and **Appendix C, Applicable Land Use Plans, Policies, and Regulations Consistency Analysis for the Carmel Lagoon Project** for a list of relevant policies and the consistency analysis.

4.1.3 Impacts and Mitigation

4.1.3.1 Thresholds of Significance

Based on Appendix G of the State CEQA Guidelines, the proposed project would have a significant impact on 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 view from a State Scenic Highway;

c. In nonurbanized areas, substantially degrade the existing visual character or quality of the site and its surroundings, or;

d. Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area.

A change to a few private views in a project's immediate vicinity is not generally regarded as a significant environmental impact under CEQA.

4.1.3.2 Impact Analysis Overview

APPROACH TO ANALYSIS

The following impact analysis addresses the short-term (construction-related) and long-term (siting, operations, and maintenance-related) impacts on scenic resources, scenic vistas, and the visual character of the proposed project component sites and surroundings. Construction-related impacts on aesthetics could occur at construction sites and construction staging areas. Operational impacts on aesthetics could result from the permanent placement of above-ground facilities that are visible to the public.

The visual impact analysis is based on field observations of the proposed project component sites and surrounding viewsheds conducted in July and August 2014, August 2023, site and aerial photographs, a visual simulation, computer-aided street-view tours (Google Earth), and review of relevant planning documents.

Construction Impacts

The evaluation of temporary visual impacts during construction considers whether construction activities would substantially degrade the existing visual character or quality of the site or surrounding area and the duration over which this change would occur. Being temporary in nature, construction-related effects of this type of proposed project on visual quality are considered to have a less-than-significant impact unless there are unusual construction features or duration.

Operational Impacts

Permanent visual impacts from component siting and operation are assessed based on the proposed project's potential to have a substantial adverse effect on scenic vistas, substantially damage scenic resources, substantially degrade the existing visual character, or quality of the site and its surroundings. The evaluation of permanent visual impacts of the operation and maintenance of the proposed project relative to the proposed EPB and SRPS project components sites' overall visual sensitivity is presented below. **Table 4.1-2**, **Visual Impact Scale for Operational Analysis**, highlights a scale of three levels (i.e., high, moderate, and low) using the concepts and terminology discussed in **Section 4.1.1.2**, **Concepts and Terminology**, for determining the level of impact for each of the above significance criteria on both construction-related, and siting and operational impacts.

Table 4.1-2 Visual Impact Scale for Operational Impact Analysis

		Overall Visual Sensitivity		
		High	**Moderate**	**Low**
Visual Contrast/Change	**High**	Significant	Significant	Less-than-Significant
	Moderate	Significant	Less-than-Significant	Less-than-Significant
	Low	Less-than-Significant	Less-than-Significant	Less-than-Significant
	No Change/Effect	No Impact	No Impact	No Impact

Table 4.1-2 considers the overall visual sensitivity of each site and its surroundings, as well as the visual change or contrast the proposed project may cause. "Overall Visual Sensitivity" brings together the factors discussed in **Section 4.1.1.2**, **Concepts and Terminology**, into a single consolidated measure: visual quality; affected viewers and exposure conditions; and visual sensitivity, as discussed for each proposed project component site in **Section 4.1.1.3, Site Characteristics** and summarized on **Table 4.1-1.** Visual Contrast/Change refers to the transformation or modification of the appearance of the proposed project (i.e., at each component site) and/or its surroundings. As seen in the table, each of these measures are rated high, moderate, and low, with the significance dependent on how the proposed project impact would compare with both measures.

AREAS OF NO IMPACT

Some of the significance criteria outlined above are not applicable to the proposed project or the proposed project would not result in impacts related to these criteria, as explained below.

(b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within view from a State Scenic Highway (No impact during construction or operations). The proposed project site is not visible from Highway 1, which is a State Scenic Highway. Therefore, no aesthetic impacts related to construction or operation of these components would occur. Thus, significance criterion "b" is not applicable to the proposed project and is not discussed further.

(d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area (No impact during construction). Construction of all proposed project components would occur during daytime hours, and, therefore, would not create a temporary source of nighttime light or glare.

4.1.3.3 Impacts and Mitigation Measures

Impact AES-1: Construction Impacts on Scenic Vistas and Visual Quality of the Surrounding Areas. Proposed project construction would not result in substantial adverse effects on scenic vistas or the visual character of the site and surrounding area. (Criteria a and c) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

Proposed project construction activities could result in temporary changes to the visual character in the vicinity of construction sites due to presence of construction vehicles, equipment and materials, stockpiles, and exposed soils. Construction activities would be temporarily visible from multiple public vantage points to varying degrees at all three sites. As previously indicated, the evaluation of temporary visual impacts during construction considers whether those construction activities would substantially

degrade the existing visual character or quality of the site or surrounding area given the duration of the construction period and degree of visibility of the site.

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

The proposed EPB project component alignment and proposed construction and staging areas are not adjacent to a designated scenic road or highway but are located within designated scenic vista areas and sensitive viewshed. Temporary grading and vegetation removal would be required to construct the proposed EPB project component structure, pump station, outfall structure(s), and improvements to Carmelo Street. Temporary construction easements are anticipated to be required for up to 14 residential parcels for the proposed EPB project component.

Construction of the proposed EPB project component would be temporarily visible from the adjacent streets and properties. Views of the Lagoon, a scenic vista, would be temporarily obstructed by construction equipment and building materials during proposed project construction, which is estimated to require three months for completion. However, the entire viewshed would not be obstructed, as the construction of the proposed EPB project component structure and associated facilities would be phased out throughout the three-month period. Views would be temporarily obstructed but views would be available from other adjacent vantage points. Given the limited construction period, phasing of construction activities, and availability of views from adjacent vantage points, the visual character of the surrounding area would not be substantially degraded during construction and this component's construction would have a less-than-significant effect on scenic vistas.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The proposed SRPS project component alignment and proposed construction and staging areas are not adjacent to a designated scenic road or highway but are located within designated scenic vista areas and sensitive viewshed. Construction of this component would include excavation, rock placement, and backfill using heavy construction equipment along Carmel River State Beach and Scenic Road. The amount of visible rock will depend on the degree of erosion occurring on the excavated material, which is dependent upon the wave climate during construction.

Construction of the proposed SRPS project component would be temporarily visible from Scenic Road and the Carmel River State Beach for approximately two months. However, construction would not obstruct views of the ocean and other portions of the beach from Scenic Road. Views would also be available from other adjacent vantage points. Given the limited construction period, no views would be obstructed, and availability of views from adjacent vantage points, the visual character of the surrounding area would not be substantially degraded during construction and this component's construction would have a less-than-significant effect on scenic vistas.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

The proposed ISMP project component area is not adjacent to a designated scenic road or highway but is located within designated scenic vista areas and sensitive viewsheds. The implementation of the proposed ISMP project component would require heavy equipment and ground-disturbing activities in the Carmel River State Beach and Lagoon, which are areas of high aesthetic quality, for a maximum period of three days. The implementation of the proposed ISMP project component would be temporarily visible to the surrounding area; however, the activities would not obstruct views and would be highly short-term in nature. Therefore, the visual character of the surrounding area would not be substantially degraded during proposed ISMP project component implementation and the implementation of the proposed ISMP project component would have a less-than-significant effect on scenic vistas.

Impact Conclusion

The proposed project construction would not result in substantial adverse impacts to a scenic vista at any of the component sites. Construction activities would be temporarily visible from multiple public vantage points to varying degrees at all construction sites. Although the proposed project areas would be intermittently visible to motorists, bicyclists, pedestrians, and other observers such as nearby residents, these construction activities would be temporary and would not significantly change or disrupt the visual character of the surrounding areas. Therefore, construction-related impacts related to degradation of the visual character of surrounding areas would be less-than-significant. No mitigation measures are required.

Impact AES-2: <u>Operation Impacts on Scenic Vistas and Visual Quality of the Surrounding Areas</u>. The proposed project would result in substantial adverse effects on scenic vistas or the visual character of the site and surrounding area. (Criteria a and c) (EPB: Significant and Unavoidable) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Significant and Unavoidable)

Permanent visual impacts from proposed project siting are assessed based on their potential to have a substantial adverse effect on the existing visual character or quality of the site and its surroundings. The evaluation of permanent visual impacts of the proposed EPB and SRPS project components relative to each relevant site's overall visual sensitivity is presented. As previously discussed in **Section 4.1.3.2, Table 4.1-2**, **Visual Impact Scale for Operational Analysis** presents a scale of three levels (high, moderate, and low) using the concepts and terminology discussed earlier in this section. This scale is used for determining the level of impact for each of the above significance criteria for both construction-related and siting and operational impacts.

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

The proposed EPB project component consists of a sheet pile wall along an alignment ranging from 38 to 120 feet from the property lines to the north of State Parks property with a top of wall elevation of 17.5 feet. The proposed EPB project component would consist of approximately 2,000 linear-feet (lf) of sheet pile wall and the reconstruction of 400 lf of Carmelo Street to a 17.5-foot elevation. The proposed barrier would be constructed of Fiber Reinforced Polymer (FRP) sheet pile. Other materials which may be used during construction consist of steel sheet pile, concrete pile, concrete stem on sheet pile foundation, or concrete stem wall on spread footing. The drainage system component of the proposed EPB project component would also require a pump station. The proposed EPB project component would run along the property line between Carmel River Elementary School and Mission Ranch. For these reasons, the visual contrast and change resulting from the installation of the proposed EPB project component is considered high.

As discussed in **Section 4.1.1.3**, **Site Characteristics**, the proposed EPB project component is considered to have a high visual sensitivity due to the high visual quality and exposure sensitivity of the site. As shown in the visual simulations (**Figure 4.1-5**), the proposed EPB project component would partially obstruct existing views of the Lagoon and alter the existing visual character of the open space. Using the methodology explained above in **Table 4.1-2**, **Visual Impact Scale for Operational Impacts**, the operation of the proposed EPB project component would result in a significant impact to the visual character of the site and would partially obstruct scenic vistas and sensitive viewsheds. The proposed EPB project component would be partially screened by Lagoon vegetation; however, the visual character would remain degraded and the scenic views partially obstructed. **Mitigation Measure AES-2** would require

planting of native vegetation for screening and using natural materials and colors for the proposed EPB project component to further screen the wall and blend with the surrounding landscape.

Implementation of **Mitigation Measure AES-2** would reduce the visual impacts of the proposed EPB project component but would not reduce the impact to a less-than-significant level. Therefore, operational aesthetic impacts associated with the proposed EPB project component would remain significant and unavoidable even with implementation of the identified mitigation measure. This is a significant and unavoidable impact.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The proposed SRPS project component consists of rock slope protection, also known as rock riprap or revetment, placed at the toe of the road embankment. The placement of armor rock would be determined through analyses and final design to extend above existing grade as needed to protect Scenic Road from river scour and would extend below the anticipated outlet channel scour elevation. The outer rock layer would be sized to withstand extreme ocean wave and river current forces (e.g., 1- to 2-ton sized rock) with a layer of smaller rock and/or geotextile fabric underneath to prevent underlying soils from being eroding through the revetment. Above the top of the revetment, the slope would be permanently planted and maintained to control erosion. Burying revetment at the toe of the slope and extending the revetment up the slope only far enough to protect against river scour and wave erosion minimizes the visual impact. It is anticipated that the top of revetment would be low enough to be reburied naturally when the river scours out the sand in front of it as the result of a northern breach. Please refer to **Section 4.5, Geology, Soils, and Seismicity**, and **Appendix F** for discussion and analysis of sediment transport. The proposed SRPS project component would be constructed of riprap, which provides the most natural material, and the structure would be covered with sand when the Carmel River has not breached to the north, and when large waves have not removed the sand during significant winter storms, and during most of the summer months. For these reasons, the visual contrast and change of the SRPS is considered moderate.

As perceived from Scenic Road looking west, the proposed project site provides an unobstructed view of Carmel River State Beach. Development of the proposed SRPS project component would result in the construction of a bluff protection structure. **Figure 4.1-6** provides a visual simulation of the proposed SRPS project component. The proposed SRPS project component structure would be visible only during the rainy season and would not obstruct the view to Carmel River State Beach. The introduction of the structure onto the site would seasonally and temporarily transform and degrade the existing visual character of the site and degrade views from the Scenic Road corridor looking west.

As discussed in **Section 4.1.1.3**, **Site Characteristics**, the proposed SRPS project component is considered to have a high visual sensitivity due to the high visual quality and exposure sensitivity of the site. Using the methodology explained above in **Table 4.1-2**, **Visual Impact Scale for Operational Impact Analysis**, the operation of the proposed SRPS project component would result in a moderate impact to the visual character of the site. Sand would cover the riprap during most of the year and would be visible as a temporary visual degradation of the site and surrounding area. Therefore, this is a less-than-significant impact.

This Page Intentionally Left Blank



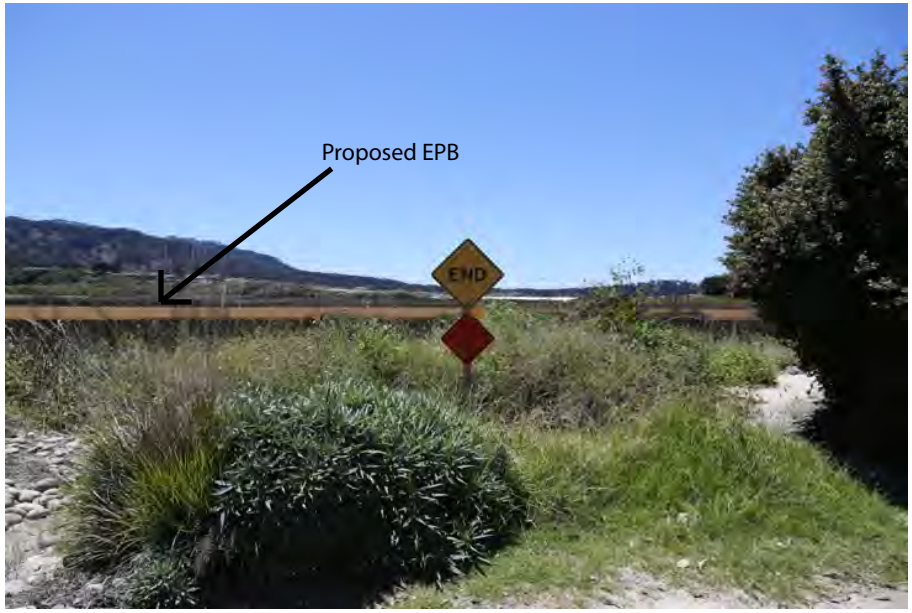
A.) Photo-simulation of EPB when viewing from terminus of Camino Real.



B.) Photo-simulation of EPB when viewing from Carmel Meadows.



C.) Photo-simulation of EPB when viewing from Carmelo Street.



D.) Photo-simulation of EPB when viewing from terminus of Monte Verde Street.

See **Figure 4.1-1, Site Photos of EPB,** for comparison of visual photo-simulation to No Project conditions.

Visual Simulations of Proposed EPB

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 2-25-16

Scale N/A

Figure 4.1-5

This Page Intentionally Left Blank



A.) Photo simulation of proposed SRPS of view from Scenic Road (winter conditions) when the sandbar has been breached and a channel formed to the north.



B.) No Project conditions (summer conditions).

Visual Simulation of Proposed SRPS

Denise Duffy and Associates, Inc. Planning and Environmental Consulting		Date 2-24-16 Scale N/A	Figure 4.1-6

This Page Intentionally Left Blank

Impact Conclusion

The operation of the proposed EPB project component would place development within a scenic vista and sensitive viewshed and partially obstruct public views, permanently degrading the visual character of the site and the surrounding area. **Mitigation Measure AES-2** would reduce the visual impacts of the proposed EPB project component but would not reduce the impact to a less-than-significant level. Therefore, operational aesthetic impacts associated with the proposed EPB project component would remain significant and unavoidable even with implementation of the identified mitigation measure. Therefore, the operation of the proposed EPB project component would result in significant, unavoidable impacts to scenic vistas and viewsheds and the visual character of the site and surrounding area. Sand would cover the riprap associated with the proposed SRPS project component most of the year, and this structure would be temporarily visible; however, it would not obstruct public views. Therefore, the impacts to scenic vistas and viewsheds and visual character of the area from the operation of the proposed SRPS project component are less-than-significant.

Mitigation Measure

Mitigation Measure AES-2: Screening of the EPB Project Component (Applies to EPB project component). The final design of the EPB project component shall include surface treatments with earth-tone colors and natural appearing materials in harmony with the surrounding landscape, including, but not limited to, earth-tone paints and finishes with low reflectivity. Post-construction, native vegetation of the appropriate habitat types shall be planted along both sides of the EPB project component for the purposes of screening. This effort may be implemented in coordination with the restoration required by **Mitigation Measure BIO-1a** and **Mitigation Measure BIO-2**, as determined appropriate.

Impact AES-3: Impacts due to Permanent Light and Glare during Operations. Operation of the proposed EPB proposed project facilities would not result in a substantial new source of light or glare that would adversely affect day or nighttime views in the area. (Criterion d) (EPB: Less-than-Significant) (SRPS: No Impact) (ISMP: No Impact) (Project Overall: Less-than-Significant)

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

The proposed EPB project component would include new exterior security lighting at the pump stations. The nighttime lighting design for the proposed facilities would be consistent with current practices to control fugitive light and glare while maintaining safety and compliance with applicable standards. Lighting would be low intensity and, where possible, directed downward, shielded, and oriented away from surrounding residential areas. The proposed EPB project component would not create a new source of substantial light or glare that would adversely affect views in the area. The proposed EPB component does not require mitigation because impacts related to lighting and glare are less-than-significant.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The operation of the proposed SRPS project component would not require any nighttime lighting that would cause glare.

Impact Conclusion

The proposed EPB project component would result in the development of new structures/facilities with exterior lighting. Nighttime lighting of the proposed facilities would be designed consistent with current practices to control fugitive light and glare while maintaining safety and compliance with applicable standards. Lighting would be low intensity and, where possible, directed downward, shielded, and oriented away from surrounding residential areas. Therefore, permanent exterior lighting for the proposed EPB project component would not result in a substantial new source of offsite lighting or glare. Impacts due to operational nighttime lighting at the proposed EPB project component facilities would be less-than-significant. The proposed SRPS project component would have no impact. No mitigation measures are required.

4.1.4 References

[Caltrans] California Department of Transportation. 2023. California State Scenic Highways. Available online at: https://dot.ca.gov/programs/design/lap-landscape-architecture-and-community-livability/lap-liv-i-scenic-highways.

[County] Monterey County. 1999. Carmel Area Land Use Plan.

[County] Monterey County. 1982. General Plan.

4.3 BIOLOGICAL RESOURCES

In 2016, DD&A prepared a Biological Resources Report for the proposed project, which was included in **Appendix E** of the Draft EIR. This section summarizes the biological resources present in the vicinity of the proposed project site, as described in the Biological Resources Report, and evaluates the potential effects of construction and operation of the proposed project on these resources. These resources include plant communities, wildlife habitats, potentially occurring special-status plant and wildlife species, and natural communities within and adjacent to the proposed project site. DD&A performed an updated records search and reconnaissance survey on July 28 and August 14, 2023, respectively, to determine whether the analysis needed to include any new biological resources and confirm site conditions have not significantly changed since the preparation of the Biological Resources Report. This section and the updated records search and special-status species table have been updated accordingly. The updated records search and special-status species table are provided in **Appendix E** of this RDEIR; the 2016 Biological Resources Report is also included in **Appendix E** for ease of reference.

Public and agency comments related to biological resources were received during the public scoping period, and are summarized below:

- Potential need for Federal agency consultation under the Endangered Species Act;
- Analyze all potentially significant effects on sensitive species and habitats and identify mitigation measures;
- Evaluate potential impacts to plant communities and wetlands;
- Evaluate potential to encourage the establishment or proliferation of aquatic invasive species or other non-indigenous species;
- Evaluate potential impacts to wildlife movement and habitat; and
- Analyze all potentially significant effects on Lagoon and ecological function of Lagoon.

To the extent that issues identified in public comments involve potentially significant effects on the environment according to the CEQA and/or are raised by responsible agencies, they are identified and addressed within this EIR. For a complete list of public comments received during the public scoping period, refer to **Appendix A**, **NOP, and Public Comment Letters** of the Draft EIR.

4.3.1 Environmental Setting

4.3.1.1 Regional Overview

The Carmel River drains approximately 246 square miles of the Santa Lucia and Sierra de Salinas Mountains into the Carmel Bay. Historically, the Carmel River meandered along the floor of the valley resulting in a dynamic riparian corridor the spanned much of the valley floor. Development of the valley has confined the river and isolated portions of the historic riparian corridor both physically and hydrologically. Golf courses, agricultural fields, and residential developments dominate the landscape, although some areas of natural vegetation still exist, particularly within the Carmel River Riparian Corridor and the Lagoon.

The Lagoon ecosystem has also been altered by development and hydrologic manipulation. Early in the 20th century, wetlands on the north side of the Lagoon were partially filled, first for use as pasture, then for residential development. The fill was in place by 1939; however, few houses were built until the 1950s.

The floodplain north and east of the Lagoon was also leveed for commercial and residential development, and the floodplain south and east of the Lagoon (the former Odello property) was leveed and graded for agricultural use. Other hydrologic alterations to the Lagoon ecosystem include upstream development, and diversion of water from the Carmel River for municipal and agricultural use.

Significant restoration efforts have been conducted within the proposed project site in the past 20 years. Farming on approximately 43-acres of the former Odello West property (purchased by State Parks in 1974) was discontinued following flooding and damage to the fields in 1995, and State Parks entered into a Cooperative Agreement with California Department of Transportation (Caltrans) to restore and enhance the area as a mitigation bank for unavoidable impacts to wetland and riparian habitats associated with future transportation projects in the Monterey Area (State Parks, 2002a). Farming of the remaining portion of the former Odello West property was discontinued following flooding in 1998. In 2004, State Parks implemented the Carmel River Lagoon Enhancement Project (CRLEP) to restore the natural landforms and plant communities within this area. Restoration efforts within the Carmel River Mitigation Bank (CRMB) and CRLEP included levee removal, excavation of the South Arm of the Lagoon, significant grading to modify drainage on the site and lower the elevation of the areas adjacent to the recreated South Arm, and planting with native riparian and wetland species (MPWMD, 2005). The monitoring and maintenance of these areas by State Parks is ongoing.

In addition, the Carmel River Floodplain and Enhancement Project (CRFREE), a collaborative project between the County and Big Sur Land Trust (BSLT), has been approved and recently initiated construction of the proposed causeway and floodplain restoration efforts. The floodplain restoration consists of: 1) removing a portion of the non-structural earthen levees on the south side of the river channel; 2) grading to restore the site's ecological function as a floodplain by creating the hydrogeomorphic characteristics necessary to support floodplain restoration activities; 3) grading to elevate approximately 23 acres of existing farmland above the 100-year floodplain elevation to create an agricultural preserve; and 4) implementation of a Restoration Management Plan (RMP). The RMP includes restoration of a mosaic of native habitats, and maintenance, monitoring, and reporting protocols to ensure the success of the revegetation specific to compensatory mitigation requirements. The causeway component consists of replacing a portion of the State Route 1 roadway embankment with a causeway section to accommodate flood flows that enter the south overbank area as a function of the removal of portions of the levees as described above and to restore hydrologic connectivity between the project site and the Carmel Lagoon.

4.3.1.2 Biological Study Area

The Biological Study Area consists of all areas that have the potential to be impacted by the proposed project, including the construction areas for the proposed EPB and SRPS project components, the implementation area of the proposed ISMP project component, and portions of the Lagoon that may be affected by indirect, permanent changes in water surface elevation.

4.3.1.3 Data Sources

TECHNICAL DOCUMENTS

Several technical documents were prepared for the proposed project as part of the planning process or in support of the Biological Resources Report. These documents are utilized throughout the Biological Resources Report to the greatest extent feasible, with much of the language and technical information provided in the Biological Resources Report and this EIR coming directly from the following documents:

- *Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report* prepared by Whitson Engineers, May 2013 (Feasibility Report);
- *Memorandum of Understanding Between County of Monterey, U.S. Army Corps of Engineers, And National Marine Fisheries Service, Regarding Flood Prevention and Habitat Protection At The Carmel Lagoon*, June 2013, including Exhibit A: *Interim Plan And Criteria For Flood Control And Summer Management Of The Carmel River Lagoon* (ISMP);
- Memorandum To Whitson Engineers for Feasibility Report: *Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues*, prepared by H.T. Harvey & Associates (HTH), May 2013 (Bio Memo);
- *Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California*, Pacific Geotechnical Engineering, May 2013 (Geotechnical Report);
- *Carmel River Lagoon Biological Assessment Coastal Engineering Analysis*, prepared by Moffatt & Nichol, August 2013 (Coastal Analysis);
- *The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report* prepared by Balance Hydrologics, Inc, January 2014 (Hydrology Report); and
- *Fisheries Analysis for the Carmel River Lagoon Biological Assessment Report* prepared by D.W. ALLEY & Associates (DWA Associates), March 2014 (Fisheries Report).

Additional literature and data sources include: current agency status information from the USFWS and California Department of Fish and Wildlife (CDFW) for species listed, proposed for listing, or candidates for listing as threatened or endangered under ESA or the California Endangered Species Act (CESA), or CDFW "species of special concern" (USFWS, 2023b; CDFW, 2023c); California Natural Diversity Data Base (CNDDB) occurrence reports (CDFW, 2023b); several documents prepared by the California State University Monterey Bay (CSUMB) Watershed Institute for the Carmel Lagoon; the Draft and Final Initial Study/Mitigated Negative Declaration (IS/MND) and Monitoring Reports prepared by State Parks for the CRLEP (State Parks, 2002a, 2002b, 2007, 2008a, and 2009); and the Draft and Final IS/MND prepared by State Parks for the Carmel River State Beach Lagoon Water Level Management Project (State Parks, 2008b and 2008c). The CNDDB RareFind occurrence reports were reviewed from the Monterey quadrangle and the surrounding quadrangles (Marina, Mt. Carmel, Seaside, and Soberanes Point) (CDFW, 2023b).

BOTANY

The following materials were reviewed to determine if special-status plant species have the potential to occur within the Biological Study Area: HTH's Bio Memo, two IS/MNDs prepared by State Parks (State Parks, 2002a and 2008b), the California Native Plant Society (CNPS) *Inventory of Rare and Endangered Vascular Plants of California* (CNPS, 2015), and CNDDB occurrences (CDFW, 2023b). In addition, to classify habitats within the Biological Study Area, descriptions in Casagrande's *Wetland Habitat Types of the Carmel River Lagoon* (2006) and HTH's Bio Memo were reviewed. The final classification and characterization of the vegetation within the Biological Study Area is based on field observations. Vegetation types identified in *A Manual of California Vegetation* (Sawyer et al., 2009) were utilized to determine if vegetation types identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a) are present within the Biological Study Area. Scientific nomenclature for plant species identified

within this document follows *The Jepson Manual: Vascular Plants of California, Edition 2* (Baldwin et al., 2012).

The Biological Study Area was surveyed for botanical resources following the applicable guidelines outlined in: *Guidelines for Conducting and Reporting Botanical Inventories for Federally listed, Proposed and Candidate Plants* (USFWS, 2000), *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFW, 2009), *CNPS Botanical Survey Guidelines* (CNPS, 2001), and recommendations for conducting botanical surveys during drought years (Deborah Hillyard, Senior Environmental Scientist, CDFW, personal communication, email: March, 11, 2014).

WILDLIFE

A focused review of literature and data sources was conducted in order to determine which special-status wildlife species have the potential to occur within the Biological Study Area. In addition, occurrence information and potential proposed project effects for listed wildlife species included in the Bio Memo were utilized to a great extent. Information regarding South-Central California Coast Steelhead (S-CCC steelhead) occurrences, proposed project effects, etc. was taken directly from the Fisheries Report. In addition, the following literature and data sources were reviewed: *Habitat Characteristics of California Red-Legged Frogs (Rana aurora draytonii) Ecological Differences Between Eggs, Tadpoles, and Adults in a Coastal Brackish and Freshwater System* (Reis, 1999); *Monterey Birds* (Roberson, 2002); CDFW reports on special-status wildlife (Remsen, 1978; Williams, 1986; Jennings and Hayes, 1994; Thelander, 1994); California Wildlife Habitat Relationships Program species-habitat models (CDFW, 2008; Zeiner et al., 1988 and 1990); and general wildlife references (Stebbins, 1985).

4.3.1.4 Survey Methodology

HTH's plant, wildlife, and fish ecologists conducted reconnaissance-level surveys within the construction areas of the proposed EPB and SRPS project components on January 17, 2013, to assess existing vegetation types, identify sensitive habitats, and assess the potential for the site to support special-status plant and animal species. The results of this survey are provided in a biological memorandum to Whitson Engineers (HTH, 2013).

DD&A staff biologists, Matt Johnson and Jami Davis, conducted additional field surveys in June 2014 to confirm, update, and complete the vegetation mapping and descriptions based on current conditions within the entire Biological Study Area. Survey methods included walking the Biological Study Area and using aerial maps to identify general vegetation types and potential sensitive habitats and conducting a focused survey of appropriate habitat for special-status plant species. General vegetation types were mapped using a combination of GPS and hand drawing on aerial maps, which were later digitized using ArcGIS software. Concurrently, a reconnaissance-level wildlife habitat survey was conducted to identify suitable habitat and observe any special-status wildlife species.

A wetland delineation to identify wetlands and waters potentially under the jurisdiction of the USACE and CCC was conducted by DD&A staff biologists, Matt Johnson and Jami Davis, within the Biological Study Area in June 2014; a report was prepared by DD&A under separate cover (Appendix F of the Biological Resources Report[1]; DD&A, 2016).

[1] The Biological Resources Report is contained in **Appendix E** of this EIR.

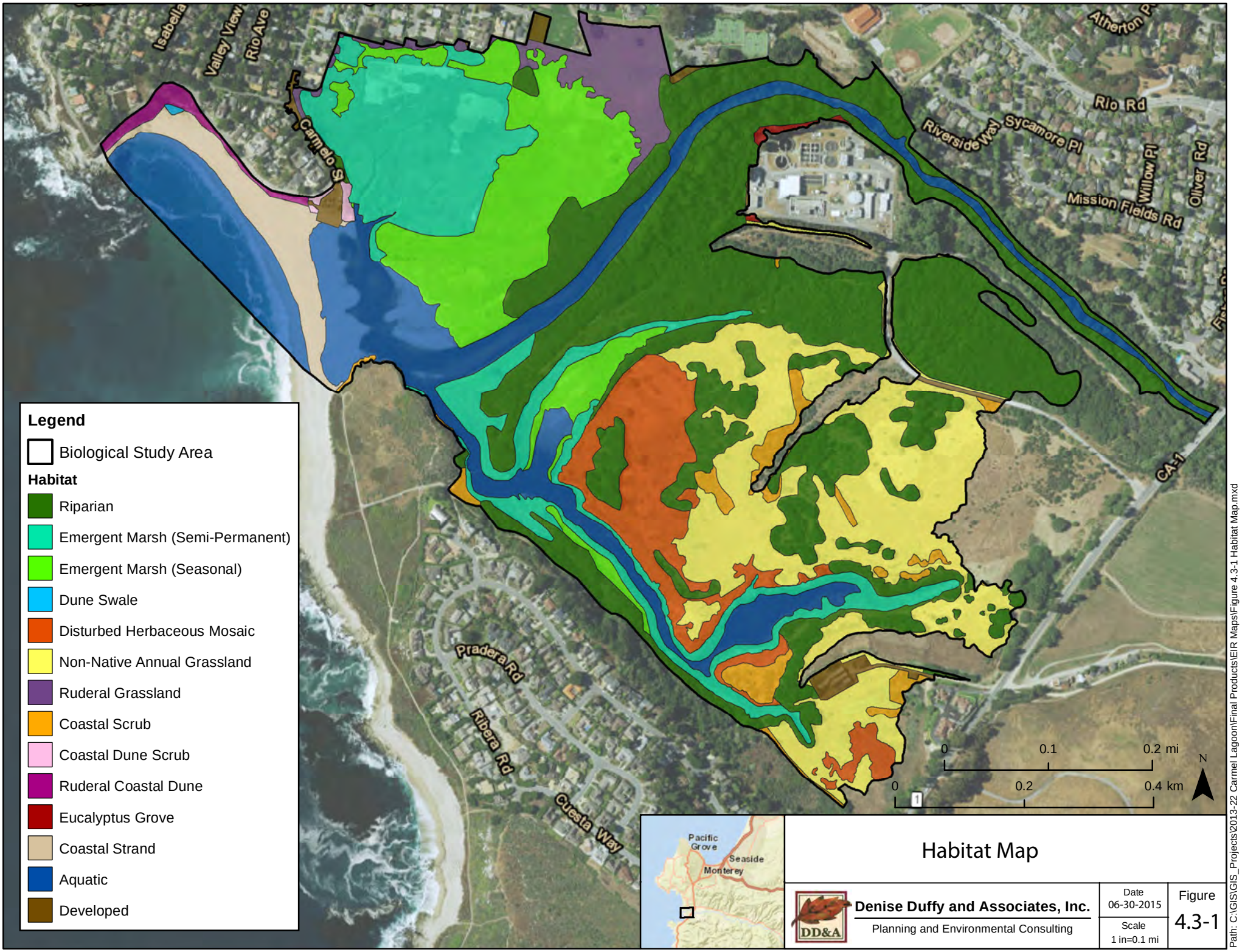
DD&A staff biologists conducted focused surveys for special-status plant species in March, April, and May 2015. Prior to conducting focused botanical surveys, an analysis of special-status plant species known to occur within the vicinity was conducted to determine the potential for their presence within the Biological Study Area based on presence of suitable habitats, soils, elevation range, and currently known geographic range. An effort was made to identify local reference populations for species determined to have the potential to occur within the Biological Study Area, in order to determine the appropriate survey timing (i.e., peak bloom) for these species. A list of all plant species observed during focused surveys is provided in Appendix E of the Biological Resources Report (**Appendix E**; DD&A, 2016). No focused surveys for sensitive wildlife species were conducted as a part of this survey effort.

DD&A biologist, Liz Camilo, conducted a site reconnaissance survey on August 14, 2023, to verify site conditions have not significantly changed since the original analysis. In addition, as referenced above, the current agency status information from the USFWS and CDFW for species listed, proposed for listing, or candidates for listing as threatened or endangered under ESA or the CESA, or CDFW "species of special concern" and CNDDB RareFind occurrence reports were reviewed for updates; this analysis and **Appendix E** of this RDEIR have been updated accordingly.

4.3.1.5 Habitat Types

The survey results include mapping and quantification of the acreage of 11 vegetation types within the Biological Study Area: riparian, semi-permanent emergent marsh, seasonal emergent marsh, dune swale wetland, non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, coastal scrub, coastal dune scrub, ruderal coastal dune, and eucalyptus grove (**Figure 4.3-1**). In addition, three unvegetated areas are present: coastal strand, aquatic, and developed. As identified above, vegetation types present within portions of the Biological Study Area were described by HTH (2013) and Casagrande (2006), and additional field surveys were conducted by DD&A staff biologists to confirm, update, and complete the vegetation mapping and descriptions. A brief description of each of these vegetation types can be found below along with a statement of the presence or potential presence of special-status species within each vegetation type and if it is a sensitive habitat. A generalized nomenclature for vegetation types is used within this document for ease of reference; however, each habitat type description also lists the *Manual of California Vegetation* (Sawyer et al., 2009) vegetation type(s) to provide a crosswalk to the *Natural Communities List* (CDFW, 2023a). **Table 4.3-1** provides the acreages of these vegetation types within the Biological Study Area and within each proposed project component.

This Page Intentionally Left Blank


Legend
Biological Study Area
Habitat
Riparian
Emergent Marsh (Semi-Permanent)
Emergent Marsh (Seasonal)
Dune Swale
Disturbed Herbaceous Mosaic
Non-Native Annual Grassland
Ruderal Grassland
Coastal Scrub
Coastal Dune Scrub
Ruderal Coastal Dune
Eucalyptus Grove
Coastal Strand
Aquatic
Developed
Isabella
Valley View
Rio Ave
Carmelo St
Atherton P
Rio Rd
Riverside Way
Sycamore Pl
Willow Pl
Oliver Rd
Mission Fields Rd
CA-1
Pradera Rd
Ribera Rd
Cuesta Way
0
0.1
0.2 mi
0
0.2
0.4 km
1
N
Pacific Grove
Seaside
Monterey
Habitat Map
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date
06-30-2015
Scale
1 in=0.1 mi
Figure
4.3-1
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.3-1 Habitat Map.mxd

This Page Intentionally Left Blank

Table 4.3-1. Vegetation Types within the Biological Study Area and Proposed Project Components*

Vegetation Type	Biological Study Area	EPB	SRPS	ISMP**
Riparian	69.1 acres	0.1 acre	-	Not Present
Semi-Permanent Emergent Marsh	28.3 acres	1.4 acres	-	Not Present
Seasonal Emergent Marsh	22.2 acres	1.5 acres	-	Not Present
Dune Swale Wetland	0.1 acre	-	-	Not Present
Disturbed Herbaceous Mosaic	13.4 acres	-	-	Not Present
Non-Native Annual Grassland	32.2 acres	-	-	Not Present
Ruderal Grassland	6.2 acres	1.4 acres	-	Not Present
Coastal Scrub	4.6 acres	-	-	Not Present
Coastal Dune Scrub	0.4 acre	-	0.3 acre	Not Present
Ruderal Coastal Dune	1.5 acres	-	-	Not Present
Eucalyptus Grove	0.4 acres	-	-	Not Present
Coastal Strand	6.0 acres	-	2.0 acres	Present
Aquatic	32.0 acres	-	0.3 acres	Present
Developed	2.7 acres	0.7 acre	0.5 acres	Not Present

* The Biological Study Area consists of all areas that have the potential to be impacted by the proposed project, including portions of the Lagoon that may be affected by indirect, permanent changes in water surface elevation. Proposed project components consist of areas within the Biological Study Area that would be directly affected by the construction and operation of the various proposed project components.

**Due to the dynamic nature of the sandbar and the implementation process of the proposed ISMP project component, the area of vegetation types within the proposed ISMP project component implementation area cannot be calculated. This table does not summarize the quantity of each vegetation type present but identifies vegetation types as present or not within the proposed ISMP project component implementation area.

RIPARIAN

***A Manual of California Vegetation* classification**: Arroyo willow thickets (*Salix lasiolepis* Shrubland Alliance)

Two types of riparian vegetation are supported within the Lagoon. Dense riparian forest is present along the Carmel River, upstream of the main embayment, and is dominated by Arroyo willow (*Salix lasiolepis*) and black cottonwood (*Poplus trichocarpa*) trees with an understory dominated by California blackberry (*Rubus ursinus*). Riparian scrub-shrub is present immediately adjacent to the confluence of the Carmel River and the main embayment, adjacent to the Carmelo Road roadway embankment, and in areas slightly higher in elevation throughout the south arm of the Lagoon. Vegetation within the riparian scrub-shrub consists of Arroyo willow and red willow (*S. laevigata*), and various shrubs and vines, such as California blackberry, often in the form of dense thickets less than 20 feet in height. The total area of riparian vegetation within the Biological Study Area is approximately 69.1-acres (**Figure 4.3-1**).

Riparian areas provide habitat for many wildlife species, particularly birds and herpetofauna. Common species that may be found within the riparian habitat in the Biological Study Area includes Sierran treefrog (*Pseudacris sierra*), Monterey ensatina (*Ensatina eschscholtzii eschscholtzii*), California striped racer (*Coluber lateralis lateralis*), tree swallow (*Tachycineta bicolor*), northern flicker (*Colaptes auratus*), black headed grosbeak (*Pheucticus melanocephalus*), black phoebe (*Sayornis nigricans*), song sparrow (*Melospiza melodia*), Pacific-slope flycatcher (*Empidonax difficilis*), and western screech owl (*Megascops kennicottii*). Additional avian species that may be found within the riparian vegetation are presented in Appendix G of the Biological Resources Report (**Appendix E**).

Several special-status species are known or have the potential to occur within this vegetation type. The Northern California legless lizard (*Anniella pulchra*) is known to occur in the riparian habitat within the

CRMB (State Parks, 2002a) and is assumed to occur throughout the riparian habitat where suitable conditions occur. California red legged frog (CRLF) and western pond turtle (*Emys marmorata*) are assumed present within the riparian habitat as these species are known to occur within the Lagoon. In addition, several woodrat nests were observed throughout the riparian vegetation and Monterey dusky-footed woodrat (*Neotoma macrotis fuscipes*) is assumed present. The riparian vegetation within the Biological Study Area may also provide suitable nesting habitat for foothill yellow-legged frog (*Rana boylii*, FYLF), the tricolored blackbird (*Agelaius tricolor*), raptors, including white-tailed kite (*Elanus leucurus*), and sharp-shinned hawk (*Accipiter striatus*), and other migratory bird species. No special-status plant species were identified within the riparian habitat.

Both types of riparian vegetation within the Biological Study Area support vegetation characteristic of Arroyo willow thickets, as described in the *Manual of California Vegetation* (Sawyer et al., 2009), which is identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). Riparian vegetation is also regulated under Sections 1600-1616 of the Fish and Game Code. In addition, portions of this vegetation type meet the definition of wetlands under the jurisdiction of the USACE, and all of this vegetation type meets the definition of waters of the State under the jurisdiction of the Central Coast Regional Water Quality Control Board (RWQCB). This vegetation type may also be considered an Environmentally Sensitive Habitat Area (ESHA) under the jurisdiction of the CCC. As such, this vegetation type is considered a sensitive habitat.

SEMI-PERMANENT EMERGENT MARSH

***A Manual of California Vegetation* classification**: California bulrush marsh (*Schoenoplectus californicus* Herbaceous Alliance)

Siltation has resulted in a narrowing of the main body of the Lagoon, more pronounced on the north side, where up to 350 feet of the old active channel in now vegetated wetland. Most of these wetlands, while experiencing seasonal fluctuation, remain flooded for significant portions of the year, when the sandbar is closed and stream flow entering the Lagoon is present. These semi-permanent emergent wetlands are dominated by California bulrush (*Schoenoplectus californicus*), with few associated species. Within the Biological Study Area, this vegetation type covers approximately 28.3-acres (**Figure 4.3-1**).

The semi-permanent emergent marsh provides habitat for many avian and amphibian species, including Sierran treefrog, red-winged blackbird (*Agelaius phoeniceus*), mallard (*Anas platyrhynchos*), great blue heron (*Ardea herodias*), pied-billed grebe (*Podilymbus podiceps*), great egret (*Ardea alba*), snowy egret (*Egretta thula*), and American coot (*Fulica americana*).

CRLF are known to occur and breed within the Lagoon and are assumed present within the semi-permanent emergent marsh. In addition, during periods of inundation, these areas provide habitat for S-CCC steelhead. This vegetation type may also provide suitable habitat for the FYLF, western pond turtle, tricolored blackbird, northern harrier (*Circus cyaneus*), yellow rail (*Coturnicops noveboracensis*), and migratory bird species. No special-status plant species were identified within the semi-permanent emergent marsh vegetation type.

All areas of the semi-permanent emergent marsh meet the definition of wetlands under the jurisdiction of the USACE and CCC, and waters of the State under the jurisdiction of the RWQCB. As such, this vegetation type is considered a sensitive habitat.

SEASONAL EMERGENT MARSH

***A Manual of California Vegetation* classification**: Pacific silverweed marsh (*Argentina egedii* [*Potentilla anserina* subsp*. pacifica*] Herbaceous Alliance)

At higher elevations in the Lagoon, where flooding is less frequent, the vegetation shifts from the tall California bulrush to areas dominated by Baltic rush (*Juncus balticus* subsp. *ater*) and Pacific silverweed (*Potentilla anserina* subsp. *pacifica*), intergrading with dotted smartweed (*Persicaria punctata*), brass buttons (*Cotula coronopifolia*), marsh spike-rush (*Eleocharis palustris*), and three-square bulrush (*Schoenoplectus pungens*). Approximately 22.2-acres of seasonal emergent marsh are present within the Biological Study Area (**Figure 4.3-1**).

Common species that occur within the seasonal emergent marsh are similar to those described above for the semi-permanent emergent marsh.

CRLF are known to occur and breed within the Lagoon and are assumed present within the seasonal emergent marsh. In addition, during periods of inundation, portions of this area may provide habitat for S-CCC steelhead. This vegetation type may provide suitable habitat for the FYLF, western pond turtle, northern harrier, yellow rail, and migratory bird species. Special-status avian species may also forage within this vegetation type, including sharp-shinned hawk, ferruginous hawk (*Buteo regalis*), white-tailed kite, merlin (*Falco columbarius*), American peregrine falcon (*F. peregrinis anatum*), and osprey (*Pandion haliaetus*). No special-status plant species were identified within the seasonal emergent marsh habitat.

The seasonal emergent marsh habitat supports vegetation characteristic of Pacific silverweed marsh, as described in the *Manual of California Vegetation* (Sawyer et al., 2009), and is identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). In addition, portions of this vegetation type meet the definition of wetlands under the jurisdiction of the USACE; and all of this vegetation type meets the definition of waters of the State under the jurisdiction of the RWQCB, and wetlands under the jurisdiction of the CCC. As such, this vegetation type is considered a sensitive habitat.

DUNE SWALE WETLAND

***A Manual of California Vegetation* classification**: California bulrush marsh (*Schoenoplectus californicus* Herbaceous Alliance)

An approximately 0.1-acre freshwater coastal dune swale wetland is located at the north end of the coastal strand near the headlands, at the base of the bluff (**Figure 4.3-1**). This wet depression is likely a remnant of past scouring in this region. The water table remains high enough to support wetland plants including California bulrush, common three-square bulrush, and dotted smartweed.

The dune swale wetland may provide habitat for common avian and amphibian species, such as Sierran treefrog, red-winged blackbird, and mallard. Additional avian species that may be found within the dune swale wetland are presented in Appendix G of the Biological Resources Report (**Appendix E**).

Due to its small size and isolated location, this vegetation type is unlikely to support any special-status species; however, migratory bird species may occur. In addition, no special-status plant species were identified within the dune swale wetland habitat.

All areas of the dune swale wetland meet the definition of wetlands under the jurisdiction of the USACE and CCC, and waters of the State under the jurisdiction of the RWQCB. As such, this vegetation type is considered a sensitive habitat.

DISTURBED HERBACEOUS MOSAIC

***A Manual of California Vegetation* classification**: Perennial Rye Grass Fields (*Lolium perenne* Semi-Natural Herbaceous Stands), Gum Plant Patches (*Grindelia stricta* Provisional Herbaceous Alliance)

Approximately 13.4-acres of the Biological Study Area are dominated by a mosaic of native and non-native herbaceous vegetation, where one or two species dominate in patches that cannot be discerned at the scale utilized for this mapping effort (**Figure 4.3-1**). The mosaic nature of this vegetation type is a result of the historic disturbance, the subsequent planting and colonization of native species, and the persistence of non-native species. This vegetation type is present in areas that were historically used for agriculture and were graded in 2004 as a part of the restoration of the south arm of the Lagoon (State Parks, 2008a).

The elevation at which most of this habitat occurs allows the area to be intermittently inundated during periods of high-water surface elevation within the Lagoon. This vegetation type is also present in the southern corner of the Biological Study Area, adjacent to Highway 1, in areas where the water from the culvert under the highway and seepage from the adjacent hillside intermittently inundate the nearly flat landscape. As such, this vegetation type is dominated by plant species adapted to mesic conditions. The dominant species include Pacific gum plant (*Grindelia stricta*), perennial rye grass (*Festuca perennis*), mule fat (*Baccharis salicifolia*), sneeze weed (*Helenium puberulum*), bristly ox-tongue (*Helminthotheca echioides*), cut-leaved plantain (*Plantago coronopus*), tall sedge (*Cyperus eragrostis*), curly dock (*Rumex crispus*), and Santa Barbara sedge (*Carex barbarae*).

Common wildlife species that are likely to occur within the disturbed herbaceous mosaic include coast garter snake (*Thamnophis elegans terrestris*), Sierran treefrog, killdeer (*Charadrius vociferous*), red-winged blackbird, white-crowned sparrow (*Zonotrichia leucophrys*), and American goldfinch (*Spinus tristis*). Raptors, black-tailed deer (*Odocoileus hemionus columbianus*), and wild boar (*Sus scrofa*) are also known to forage in this habitat. Additional avian species that may be found within the disturbed herbaceous mosaic are presented in Appendix G of the Biological Resources Report (**Appendix E**).

CRLF and western pond turtles are known to occur and breed within the Lagoon and are assumed present within this vegetation type. Suitable nesting habitat is present within the disturbed herbaceous mosaic habitat for special-status avian species, including California horned lark (*Eremophila alpestris actia*), tricolored blackbird, northern harrier, and other migratory bird species. Special-status avian species may also forage within this vegetation type, including sharp-shinned hawk, ferruginous hawk, white-tailed kite, merlin, American peregrine falcon, and osprey. No special-status plant species were identified within the disturbed herbaceous mosaic habitat.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). However, this vegetation type meets the definition of wetlands under the jurisdiction of the CCC, and waters of the State under the jurisdiction of the RWQCB.

NON-NATIVE ANNUAL GRASSLAND

***A Manual of California Vegetation* classification**: Wild Oats Grassland (*Avena barbata, fatua* Semi-Natural Herbaceous Stands), Annual Brome Grasslands (*Bromus diandrus, hordeaceus-Brachypodium distachyon* Semi-Natural Herbaceous Stands), Poison Hemlock or Fennel Patches (*Conium maculatum – Foeniculum vulgare* Semi-Natural Herbaceous Stands, Upland mustards (*Brassica nigra* and Other Mustards Semi-Natural Herbaceous Stands)

Approximately 32.2-acres of non-native annual grassland are present within the Biological Study Area (**Figure 4.3-1**). Similar to the disturbed herbaceous mosaic habitat, these areas were historically used for

agriculture and were graded in 2004 as part of the restoration of the south arm of the Lagoon. However, this vegetation type is present at a higher elevation and is not inundated as frequently. Dominant grass species within this vegetation type include slender oat (*Avena barbata*), ripgut brome (*Bromus diandrus*), soft chess (*B. hordeaceus*), and rattail fescue (*Vulpia myuros*). Dense patches of non-native poison hemlock (*Conium maculatum*) and wild radish (*Raphanus sativus*) are also present within this area; however, they are not discernable at the scale utilized for this mapping effort.

Non-native annual grasslands provide habitat to a number of wildlife species, such as the Botta's pocket gopher (*Thomomys bottae*), California ground squirrel (*Spermophilus beecheyi*), northern pacific rattlesnake (*Crotalus oreganus* ssp. *oreganus*), gopher snake (*Pituophis catenifer catenifer*), coast range fence lizard (*Sceloporus occidentalis bocourtii*), California quail (*Callipepla californica*), American robin (*Turdus migratorius*), western meadowlark (*Sturnella neglecta*), and American goldfinch. Raptors and black-tailed deer are also known to forage in this habitat. Additional avian species that may be found within the non-native annual grassland habitat are presented in Appendix G of the Biological Resources Report (**Appendix E**).

Special-status wildlife species that have the potential to occur within the non-native annual grassland include the western burrowing owl (*Athene cunicularia*), California horned lark, and Northern California legless lizard. The Smith's blue butterfly (*Euphilotes enoptes smithi*; SBB) is assumed present within this vegetation type where dune buckwheat (*Eriogonum parvifolium*) is present. The non-native annual grassland may also provide suitable habitat for the western bumble bee (*Bombus occidentalis*) and suitable upland and dispersal habitat for CRLF and western pond turtle. Special-status avian species may also forage within this vegetation type, including white-tailed kite (which was observed hunting during surveys in June 2014), tricolored blackbird, sharp-shinned hawk, ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey. No special-status plant species were identified within the non-native annual grassland habitat.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). This vegetation type is not considered sensitive for the purposes of this analysis.

RUDERAL GRASSLAND

***A Manual of California Vegetation* classification**: Fountain Grass swards (*Pennisetum setaceum* Semi-Natural Stands)

Approximately 6.2-acres of ruderal grassland are present within the Biological Study Area (**Figure 4.3-1**). The field owned by Mission Ranch and the Carmel Unified School District supports a near monoculture of kikuyu grass (*Pennisetum clandestinum*) in areas higher in elevation than the adjacent emergent marsh. This area is currently being grazed by sheep and is highly disturbed. Additionally, between the north/northwestern sides of the Lagoon and the Fourth Addition neighborhood, there is a narrow (up to approximately 15 feet wide) strip dominated by kikuyu grass and weedy herbs, including wild radish and naturalized garden nasturtium (*Tropaeolum majus*). Many landscape trees, including Monterey cypress (*Hesperocyparis macrocarpa*), have also been planted at the development edge.

Common wildlife species which do well in urbanized and disturbed areas can utilize this habitat, such as the American crow (*Corvus brachyrhynchos*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), western scrub jay (*Aphelocoma californica*), European starling (*Sturnus vulgaris*), and rock pigeon (*Columba livia*). Additional avian species that may be found within the ruderal grassland are presented in Appendix G of the Biological Resources Report (**Appendix E**).

Special-status wildlife species that have the potential to occur within the ruderal grassland include the California horned lark and Northern California legless lizard. This vegetation type may also provide upland habitat for CRLF and western pond turtles. Special-status avian species may also forage within this vegetation type, including sharp-shinned hawk, ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey. Additionally, raptors including white-tailed kite and other migratory bird species may nest within the large Monterey cypress and other trees present within this vegetation type. No special-status plant species were identified within the ruderal grassland habitat.

The CCC may consider a small portion of this vegetation type ESHA and sensitive because dune buckwheat plants that provide habitat for federally listed SBB are present. Therefore, a small portion of this vegetation type is considered a sensitive habitat.

COASTAL SCRUB

***A Manual of California Vegetation* classification**: Coyote Brush Scrub (*Baccharis pilularis* Shrubland Alliance)

Approximately 4.6-acres of coastal scrub are present within the Biological Study Area (**Figure 4.3-1**). The slope adjacent to the Carmel Meadows residential development supports dense coyote brush (*Baccharis pilularis*) and poison oak (*Toxicodendron diversilobum*). Coyote brush has also been planted in the upland areas surrounding the south arm of the Lagoon as part of the restoration by State Parks. In these areas, the coyote brush is less dense, and annual grass species indicative of the adjacent non-native annual grassland are present in the understory.

Coastal scrub habitats provide cover and food for several wildlife species, including songbirds, snakes, lizards, rodents, and other small mammals. Common species that may occur within the coastal scrub include California quail, Anna's hummingbird, American robin, western scrub jay, coast range fence lizard, northern pacific rattlesnake, gopher snake, and brush rabbit (*Sylvilagus bachmani*). Additional avian species that may reside within the coastal scrub habitat are presented in Appendix G of the Biological Resources Report (**Appendix E**).

Special-status wildlife species that may occur within this vegetation type include the Northern California legless lizard and Monterey dusky-footed woodrat. Special-status avian species may also forage within this vegetation type including white-tailed kite, sharp-shinned hawk, ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey. The coastal scrub habitat may also provide upland and dispersal habitat for CRLF and western pond turtles. No special-status plant species were identified within the coastal scrub habitat.

While some special-status species may use this habitat, it is not the primary habitat for any given special-status species. Additionally, CDFW's *Natural Communities List* does not identify this vegetation type as sensitive (CDFW, 2023a). This vegetation type is not considered sensitive for the purposes of this analysis.

COASTAL DUNE SCRUB

***A Manual of California Vegetation* classification**: California Sagebrush-California Buckwheat Scrub (*Artemisia californica-Eriogonum fasciculatum* Shrubland Alliance)

The parking lot at Carmel River State Beach has been placed on fill material. The sandy slopes bordering the parking lot are stable enough to support species characteristic of coastal dune scrub in the region. The slope is dominated by the native species California sagebrush (*Artemisia californica*) and coyote brush, with dune buckwheat, seaside woolly sunflower (*Eriophyllum staechadifolium*), and mugwort (*Artemisia douglasiana*). The non-native species wild radish and New Zealand spinach (*Tetragonia tetragonioides*)

are also present. Approximately 0.4-acres of coastal dune scrub is present within the Biological Study Area (**Figure 4.3-1**).

Common species that may occur within the coastal dune scrub habitat include coast range fence lizard, western scrub jay, Anna's hummingbird (*Calypte anna*), and killdeer. Additional avian species that may be found within the California sagebrush scrub are presented in Appendix G of the Biological Resources Report (**Appendix E**).

Special-status wildlife species with the potential to occur within this vegetation type include the Northern California legless lizard. SBB is assumed present within this vegetation type where dune buckwheat is present. No special-status plant species were identified within the coastal dune scrub habitat.

The coastal dune scrub is present within the Coastal Zone and dune buckwheat plants within this vegetation type may provide habitat for the federally listed SBB. Therefore, this vegetation type may be considered ESHA by the CCC and protected by the USFWS under the ESA and is considered a sensitive habitat.

RUDERAL COASTAL DUNE

***A Manual of California Vegetation* classification**: Ice Plant Mats (*Carpobrotus edulis* or Other Ice Plant Semi-Natural Herbaceous Stands)

The bluff bordering Scenic Road is very steep and sandy. Non-native hottentot fig (*Carpobrotus edulis*), a type of iceplant often planted for erosion control on sandy slopes, dominates in a majority of the area; however, at the north end of the bluff, California sagebrush co-occurs with the hottentot fig. Large Monterey cypress trees have also been planted within this area. Large areas of the bluff are also devoid of vegetation, especially near the toe of the slope and where there has been slope failure. This ruderal coastal dune area covers approximately 1.5-acres of the Biological Study Area (**Figure 4.3-1**).

Common species that may occur within the ruderal coastal dune are similar to those described above for the ruderal grassland.

Special-status wildlife species with the potential to occur within this vegetation type include the Northern California legless lizard. Additionally, raptors including white-tailed kite, and other migratory bird species may nest within the large Monterey cypress and other trees present within this vegetation type. No special-status plant species were identified within the ruderal coastal dune habitat.

The ruderal coastal dune is present within the Coastal Zone and may be considered ESHA by the CCC. As such, this vegetation type is considered a sensitive habitat.

EUCALYPTUS GROVE

***A Manual of California Vegetation* classification**: Eucalyptus Grove (*Eucalyptus globulus, camadulensis* Semi-Natural Woodland Stands)

An approximately 0.4-acre grove of eucalyptus trees (*Eucalyptus globulus*) is present within the Biological Study Area (**Figure 4.3-1**). This small grove is present surrounding the CAWD water treatment plant and has a maintained understory. Raptors, including red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), and other migratory bird species may nest within these trees. No special-status plant species were identified within the Eucalyptus grove habitat.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). This vegetation type is not considered sensitive for the purposes of this analysis.

COASTAL STRAND

***A Manual of California Vegetation* classification**: None

A broad unvegetated stretch of beach, referred to as the coastal strand, occurs bordering Scenic Road, at the base of the bluff. The coastal strand area extends from the mouth of the Carmel River north to where the beach abruptly ends at a bedrock headland and south towards Monastery State Beach. Within the Biological Study Area, approximately six acres of coastal strand are present (**Figure 4.3-1**). Coastal strand areas are typically dynamic, responding to seasonal shifts in wind and wave energy and storm events. The coastal strand bordering Scenic Road is subject to extreme seasonal and annual changes in morphology in response to storm frequency and intensity, changes in wind and wave energy, stream flow intensity and duration, and the frequency of sandbar management for flood protection. This highly dynamic system precludes the development of vegetation along the strand.

The coastal strand areas provide little habitat for wildlife species due to the lack of vegetation; however, several shore birds are often found in these areas. Common species that may occur include California gull (*Larus californicus*), western sandpiper (*Calidris mauri*), great blue heron, snowy egret, and great egret.

The western snowy plover (*Charadrius lexandrines nivosus*) is known to occur within the coastal strand within the Biological Study Area; however, this species has not been documented to nest there. The California brown pelican (*Pelecanus occidentalis californicus*) and other migratory bird species may also utilize the coastal strand area. Marine mammals may use the coastal strand area as a haul-out site, including the southern sea otter (*Enhydra lutris nereis*), harbor seal (*Phoca vitulina*), and California sea lion (*Zalophus californianus*). No special-status plant species were identified within the coastal strand habitat.

The coastal strand area is present within the Coastal Zone and may be considered ESHA by the CCC. As such, this area is considered a sensitive habitat.

AQUATIC

***A Manual of California Vegetation* classification**: None

Approximately 32.0-acres of aquatic habitat are present within the Biological Study Area (**Figure 4.3-1**). The South Arm and a small portion of the North Arm are permanently flooded areas of the Lagoon. Portions of the main embayment are also perennial; however, the boundary of the permanent water varies both seasonally and annually with changes in the Lagoon water volume, sediment accumulation, stream flow, and the river's opening to the ocean, which ultimately depend on the timing of the sandbar breaching and closure. When the sandbar is closed, water accumulates in the main embayment of the Lagoon creating semi-permanent open water habitat. When the sandbar is open and the water subsides, mudflats or other open shore habitats are present. The main embayment lacks emergent vegetation; however, portions of the South Arm support beds of submerged pondweed (*Potamogeton* sp.).

Common wildlife using the aquatic area include waterfowl, such as Canada goose (*Branta canadensis*), mallard, American coot, great egret, bufflehead (*Bucephala albeola*), cormorants (*Phalacrocorax* sp.), willet (*Tringa semipalmata*), and spotted sandpiper (*Actitis macularius*), and fish species, such as threespine stickleback (*Gasterosteus aculeatus*), staghorn sculpin (*Leptocottus armatus*), and starry flounder (*Platichthys stellatus*).

The S-CCC steelhead, CRLF, and western pond turtle are known to occur in the Lagoon and Carmel River, and are, therefore, present within the aquatic areas of the Biological Study Area. FYLF and migratory waterfowl and some seabird species, including California brown pelican, may also occur within the aquatic

areas of the Biological Study Area. No special-status plant species were identified within the aquatic habitat areas.

The aquatic areas within the Biological Study Area meet the definition of other waters under the jurisdiction of the USACE and RWQCB. Additionally, the aquatic areas provide habitat for special-status species, including the federally listed CRLF and S-CCC steelhead, and, therefore, may be considered ESHA by the CCC and critical habitat by the USFWS and the National Oceanic and Atmospheric Administration (NOAA) –NMFS. As such, this area is considered a sensitive habitat.

DEVELOPED

***A Manual of California Vegetation* classification**: None

Approximately 2.7-acres of developed area occur within the Biological Study Area (**Figure 4.3-1**). These include the State Parks parking lot and facilities, and the associated access roads. Most of the developed areas within the Biological Study Area are completely devoid of vegetation. However, some areas, such as the area surrounding the State Parks facilities in the southern portion of the Biological Study Area, include vegetation dominated by annual grasses, poison hemlock, and wild radish.

Common species that may occur within the developed areas are similar to those described above for the ruderal grassland. These areas are considered to have low biological value, as very little vegetation is present to provide habitat.

Raptors and other migratory bird species, including white-tailed kite (*Elanus leucurus*), may forage and nest within trees that occur within and adjacent to ruderal areas. No special-status plant species were identified within the ruderal areas.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). This vegetation type is not considered sensitive for the purposes of this analysis.

SPECIAL-STATUS SPECIES

The Biological Study Area was surveyed for the presence or potential presence of a number of special-status species. The special-status species that are known to, or have been determined to, have a moderate or high potential to occur within or immediately adjacent to the proposed project site are discussed below, and in the impacts and mitigation section. **Table 4.3-2**, **Potential for Special-Status Wildlife Species Presence within Proposed Project Components** outlines the presence or potential presence of special-status species within the Biological Study Area and each of the proposed project components. All other species evaluated are unlikely to occur or have a low potential to occur based on the species-specific reasons presented in Appendix C of the Biological Resources Report (**Appendix E** of this RDEIR), and therefore, are unlikely to be impacted by the project and are not discussed further.

Table 4.3-2. Potential for Special-Status Wildlife Species Presence within Proposed Project Components*

Species	Biological Study Area	EPB		SRPS	ISMP
		Construction Area	*Area Affected by water surface elevation*		
Southern sea otter	Moderate	Unlikely	Unlikely	Low	Low
Monterey dusky-footed woodrat	Present	Unlikely	Present	Unlikely	Unlikely
Harbor seal	Moderate	Unlikely	Unlikely	Low	Low
California sea lion	Moderate	Unlikely	Unlikely	Low	Low
Tricolored blackbird	Moderate	Moderate	Moderate	Unlikely	Unlikely
Western burrowing owl	Moderate	Unlikely	Moderate	Unlikely	Unlikely
Western snowy plover	Present	Unlikely	Unlikely	High	High
Yellow rail	Moderate	Moderate	Moderate	Unlikely	Unlikely
California horned lark	Moderate	Unlikely	Moderate	Unlikely	Unlikely
California brown pelican	Present	Unlikely	Unlikely	High	High
Sharp-shinned hawk	Moderate	Low	Low	Unlikely	Unlikely
Ferruginous hawk	Moderate	Low	Moderate	Unlikely	Unlikely
Northern harrier	Moderate	Moderate	Moderate	Unlikely	Unlikely
White-tailed kite	Present	Moderate (Adjacent)	High	Moderate (Adjacent)	Unlikely
Merlin	Moderate	Low	Moderate	Unlikely	Unlikely
American peregrine falcon	Moderate	Low	Moderate	Unlikely	Unlikely
Osprey	Moderate	Low	Moderate	Unlikely	Unlikely
Northern California legless lizard	Present	Unlikely	Present	Present	Unlikely
Western pond turtle	Present	Present	Present	Unlikely	Unlikely
Foothill yellow-legged frog	Moderate	Moderate	Moderate	Unlikely	Unlikely
California red-legged frog	Present	Present	Present	Unlikely	Present
S-CCC steelhead	Present	Present (When Inundated)	Present (When Inundated)	Present (When Inundated)	Present
Western bumble bee	Moderate	Unlikely	Moderate	Unlikely	Unlikely
Smith's blue butterfly	Assumed Present	Not Present	Assumed Present	Assumed Present	Not Present

* The Biological Study Area consists of all areas that have the potential to be impacted by the proposed project, including portions of the Lagoon that may be affected by indirect, permanent changes in water surface elevation. Proposed project components consist of areas within the Biological Study Area that would be directly affected by the construction and operation of the various proposed project components. A species may have the potential to occur in a portion of the Biological Study Area, such as the Lagoon, but may have a lesser potential to occur within or be directly affected by the construction of a proposed project component.

Special-status species are those plants and animals that have been formally listed or proposed for listing as endangered, or threatened, or are candidates for such listing under ESA or CESA. Listed species are afforded legal protection under the ESA and CESA. Species that meet the definition of rare or endangered under the CEQA Guidelines Section 15380 are also considered special-status species. Animals on the CDFW's list of "species of special concern" (most of which are species whose breeding populations in California may face extirpation [local extinction] if current population trends continue) meet this definition and are typically provided management consideration through the CEQA process, although they are not legally protected under the ESA or CESA. Additionally, the CDFW also includes some animal species that are not assigned any of the other status designations in the CNDDB "Special Animals" list. The CDFW considers the taxa (hierarchical divisions of a species) on this list to be those of greatest conservation need, regardless of their legal or protection status.

Plants listed as rare under the California Native Plant Protection Act (CNPPA) or included in CNPS California Rare Plant Ranks ([CRPR]; formerly known as CNPS Lists) 1A, 1B, 2A, and 2B are also treated as special-status species as they meet the definitions of Sections 2062 and 2067 of the CESA and in accordance with CEQA Guidelines Section 15380.[2] In general, the CDFW requires that plant species on CRPR 1A (Plants presumed extirpated in California and either rare or extinct elsewhere), CRPR 1B (Plants rare, threatened, or endangered in California and elsewhere), CRPR 2A (Plants presumed extirpated in California, but more common elsewhere); and CRPR 2B (Plants rare, threatened, or endangered in California, but more common elsewhere) of the CNPS *Inventory of Rare and Endangered Vascular Plants of California* (CNPS, 2015) be fully considered during the preparation of environmental documents relating to CEQA.[3] In addition, species of vascular plants, bryophytes, and lichens listed as having special-status by the CDFW are considered special-status plant species (CDFW, 2023b).

Raptors (e.g., eagles, hawks, and owls) and their nests are protected under both Federal and State laws and regulations. The Federal Migratory Bird Treaty Act (MBTA) of 1918, and California Fish and Game Code Section 3513 prohibit killing, possessing, or trading migratory birds except in accordance with regulation prescribed by the Secretary of the Interior. Birds of prey are protected in California under Fish and Game Code Section 3503.5. Section 3503.5 states that it is "unlawful to take, possess, or destroy the nest or eggs of any such bird except otherwise provided by this code or any regulation adopted pursuant thereto." In addition, fully protected species under the Fish and Game Code Section 3511 (birds), Section 4700 (mammals), Section 5515 (fish), and Section 5050 (reptiles and amphibians) are also considered special-status animal species. Species with no formal special-status designation but thought by experts to be rare or in serious decline are also considered special-status animal species (CDFW, 2023b).

SPECIAL-STATUS WILDLIFE SPECIES

Southern Sea Otter

The southern sea otter is a Federally Threatened species and a California fully protected species. It is the largest member of the weasel family, Mustelidae, and the smallest marine mammal species in North America. Sea otters occupy hard- and soft-sediment marine habitats in the shallow coastal waters, ranging from 0.5 to one mile from shore. They generally forage at depths of less than 80 feet, feeding on

[2] CNPS initially created five CRPR in an effort to categorize degrees of concern; however, in order to better define and categorize rarity in California's flora, the CNPS Rare Plant Program and Rare Plant Program Committee have developed the new CRPR 2A and CRPR 2B.

[3] Species on CRPR 3 (Plants about which we need more information - a review list) and CRPR 4 (Plants of limited distribution - a watch list) may, but generally do not, meet the definitions of Sections 2062 and 2067 of CESA, and are not typically considered in environmental documents relating to CEQA.

invertebrates associated with kelp forests (e.g., abalone, sea urchins, crabs, chitons, mussels, and clams). They utilize kelp forests as a refuge from predation by white sharks and winter storms, and as nursery areas. Sea otters give birth to a single pup each year, mostly occurring from late February to early April.

The main threats to this species are habitat degradation (including oil spills and other environmental contaminants) and human disturbance (including shooting, entanglement in fishing gear, and harassment). Once distributed along the west coast from central Baja California to Alaska, sea otters were hunted nearly to extinction between 1741 and 1911. The estimated number of otters before commercial exploitation ranges from approximately 16,000 to 20,000 individuals; the current population contains about 2,000 individuals. Sea otters have been referred to as "keystone species" (a species that despite low biomass exerts strong effects on the structure of the communities they inhabit) because they can have significant impacts on sea urchin populations, which in turn may affect the kelp forest structure.

The CNDDB does not report any occurrence of southern sea otters within the Biological Study Area. However, southern sea otters are known to occur within Carmel Bay and may use the coastal strand habitat within the Biological Study Area.

Monterey Dusky-Footed Woodrat

The Monterey dusky-footed woodrat is a CDFW species of special concern. This is a subspecies of the dusky-footed woodrat *(Neotoma macrotis)*, which is common to oak woodlands and other forest types throughout California. Dusky-footed woodrats are frequently found in forest habitats with moderate canopy cover and a moderate to dense understory, including riparian forests; however, they may also be found in chaparral communities. Relatively large nests are constructed of grass, leaves, sticks, and feathers and are built in protected spots, such as rocky outcrops or dense brambles of blackberry and/or poison oak. Typical food sources for this species include leaves, flowers, nuts, berries, and truffles. Dusky-footed woodrats may be a significant food source for small- to medium-sized predators. Populations of this species may be limited by the availability of nest material. Within suitable habitat, nests are often found in close proximity to each other.

The CNDDB does not report any occurrences of Monterey dusky-footed woodrat within the five quadrangles reviewed; however, this species is known to occur throughout the County of Monterey. Woodrat nests were observed within the riparian habitat within the Biological Study Area and are assumed present where suitable habitat occurs.

Pinnipeds

Pinnipeds known to occur in Carmel Bay include the California sea lion and harbor seal. This section discusses these species together due to similar habitat requirements. Harbor seals are residents in the bay throughout the year, while California sea lions are most common during fall and spring migrations between southern breeding areas and northern feeding areas. These species come ashore at various locations in Carmel Bay to rest at haul-out sites. These areas are usually isolated locations free from land predators and removed from human harassment, and, thus, haul-out sites are the most important habitats for pinnipeds. The CNDDB does not report any occurrences of these species within the Biological Study Area; however, California sea lions and harbor seals may use the coastal strand habitat within the Biological Study Area as a haul-out or resting site.

Tricolored Blackbird

The tricolored blackbird is a State threatened species also protected under the MBTA. This species is common locally throughout the Central Valley and in coastal districts from Sonoma County south. These birds are summer residents in northeastern California, occurring regularly only at Tule Lake, but found as

far south as Honey Lake in some years. In winter, this species becomes more widespread along the central coast and San Francisco Bay area (Grinnell and Miller, 1944). Tricolored blackbirds breed near fresh water, preferably in emergent wetlands with tall, dense cattails or tules, but also in thickets of willow, blackberry, wild rose, and tall herbs, which also serve as their preferred nesting habitat. Nests are built of mud and plant materials, and this species is highly colonial; the minimum nesting colony size is about 50 pairs (Grinnell and Miller, 1944). Drinking water is probably required, at least when seeds and grains are the major foods.

The CNDDB reports three occurrences of tricolored blackbird within the five quadrangles reviewed, the nearest of which is located approximately eight miles from the Biological Study Area. Roberson (2002) reports that although this species occurs at the Lagoon, breeding has not been documented within the area. Additionally, breeding was not documented at the Lagoon in the 2008 or 2011 statewide survey for tricolored blackbirds (Information Center for the Environment [University of California, Davis], 2016). Suitable habitat for this species is present within the semi-permanent emergent marsh, riparian, and disturbed herbaceous mosaic vegetation types.

Western Burrowing Owl

Western burrowing owls are a CDFW species of special concern and also protected under the MBTA. Burrowing owls are a year-round resident of open, dry grassland and desert vegetation types, and grass, forb and open shrub stages of pinyon-juniper and ponderosa pine vegetation types. Burrowing owls reside in open grasslands and shrublands on perches and within burrows. Burrowing owls use rodent burrows (often California ground squirrel) for roosting and nesting cover. These owls line burrows with excrement, pellets, debris, grass, and feathers (occasionally are unlined). Owls may substitute burrows for pipes, culverts, and nest boxes in areas where burrows are not available. Breeding occurs from March through August, with the peak occurring in April and May. This species is semi-colonial and is the most gregarious owl in North America. Burrowing owls eat mostly insects, but will also consume small mammals, reptiles, birds, and carrion. This species usually hunts from a perch and hovers, hawks, dives, and hops after prey on the ground. Conversion of grassland to agriculture, poisoning of ground squirrels, and other forms of habitat destruction have led to the reduction in their numbers in the recent decades.

The CNDDB reports three occurrences of western burrowing owl within the five quadrangles reviewed, the nearest of which is located approximately four miles from the Biological Study Area. Roberson (2002) reports that this species occurs during the winter on the south side of the Carmel River mouth; however, breeding has not been documented within the area. Suitable habitat for this species is present within the non-native annual grassland habitat.

Western Snowy Plover

The western snowy plover was listed as a Federally Threatened species on March 5, 1993 (58 FR 12864-12874) (USFWS, 1993). Additionally, the western snowy plover is protected under the MBTA. This species is associated with sandy marine and estuarine shores and rarely occurs at salt ponds. Snowy plovers require a flat, sandy, gravelly, or friable soil substrate for nesting. Snowy plover nests are shallow depressions in the sand or soil, sometimes lined with small pebbles, glass fragments, or gravel. Nests are often near objects such as driftwood, rocks, or defoliated bushes, although nests may occur on barren ground with no nearby cover. Nests are typically within 100 meters (328 feet) of water but can be several hundred meters away where no vegetative barrier exists between the nest and water (USFWS, 2007). The breeding season in California typically begins in early March and extends through August. Clutch size is typically two to six eggs and chicks reach fledging age approximately one month after hatching (USFWS, 2007). Snowy plovers glean insects and amphipods from the dry sand of upper beaches along the coast,

occasionally foraging in wet sand for young sand crabs. Gulls, ravens, coyotes, and skunks are predators of adults, eggs, and young. The historical nesting of snowy plovers on sandy marine beaches has brought them into constant contact with humans using these areas for recreation.

The CNDDB reports six occurrences of western snowy plover within the five quadrangles reviewed, the nearest of which is located approximately 4.6 miles from the Biological Study Area. Roberson (2002) reports that this species may winter at the Carmel River State Beach near the mouth of the Lagoon, and surveys conducted during the summer of 2012 reported individual snowy plovers at the beach adjacent to Scenic Road during (HTH, 2013). Suitable habitat is present within the coastal strand area of the Biological Study Area. Although snowy plovers may utilize the beach, surveys have never documented them breeding within this area (Roberson, 2002; HTH, 2013).

Yellow Rail

The yellow rail is a CDFW species of special concern. Yellow rails occur year-round in California, but in two primary seasonal roles: as a very local breeder in the northeastern interior and as a winter visitor (early October to mid-April) on the coast and in the Suisun Marsh region. The life history of this species is poorly known due to its secretive behavior. Yellow rails require sedge marshes and meadows with moist soils or shallow standing water for breeding. Over-wintering habitat for yellow rail includes wet meadows and coastal tidal marshes.

The CNDDB reports two occurrences of the yellow rail within the quadrangles reviewed, both located within seven miles of the Biological Study Area on the Monterey Peninsula. Suitable overwintering habitat for this species is present within emergent marsh areas of the Biological Study Area; however, this species does not breed in the region.

California Horned Lark

The CDFW's CNDDB "Special Animals" list includes the California horned lark which is also protected under the MBTA. California horned larks are a common to abundant resident in a variety of open habitats and are frequently found in grasslands with low, sparse vegetation. This species builds a grass-lined cup nest in a depression on the ground in the open. Breeding occurs between March and July, with peak activity occurring in May. California horned larks often form large flocks which forage and roost gregariously after breeding. This species eats mainly insects, snails, and spiders during the breeding season, and add grass and forb seeds (as well as other plant material) to their diet seasonally.

The CNDDB reports two occurrences of California horned lark within the five quadrangles reviewed, the nearest of which is approximately 13 miles from the Biological Study Area. Suitable foraging and nesting habitat for this species is present within the non-native annual grassland, disturbed herbaceous mosaic, and ruderal grassland vegetation types within the Biological Study Area.

California Brown Pelican

The California brown pelican is protected under the MBTA. This species populates estuarine, marine subtidal, and marine pelagic waters along the California coast. California brown pelicans usually rest on water or on inaccessible rocks (either offshore or on mainland), but also use mudflats, sandy beaches, wharfs, and jetties. Breeding occurs on the Channel Islands and in Mexico from March to early August, after which the brown pelicans disperse along the entire California coast. A few individuals will also visit the Salton Sea and Colorado River reservoirs. California brown pelicans mostly forage in the early morning or late afternoon, or when the tide is rising, and feed almost entirely on fish caught diving from six to 12 meters (20-40 feet) in the air.

The CNDDB reports two occurrences of California brown within the five quadrangles reviewed, the nearest of which is approximately 1.2 miles from the Biological Study Area. This species has been observed at the Lagoon within the aquatic and coastal strand areas (State Parks, 2002b, 2008a); however, suitable nesting and communal roosting habitat is not present within the Biological Study Area.

Nesting Raptors and Other Migratory Bird Species

The Fish and Game Code and MBTA protect raptors and their nests. While the life histories of these species vary, overlapping nesting and foraging similarities (February through August) allow for their concurrent discussion. Most raptors are breeding residents throughout most of the wooded portions of the state. Raptors rely on Stands of live oak, riparian deciduous, or other forest vegetation types, as well as open grasslands, most frequently for nesting. Breeding occurs February through August, with peak activity May through July. Prey for these species includes small birds, small mammals, and some reptiles and amphibians. Many raptor species hunt in open woodland and habitat edges. Various common raptor species (such as red-tailed hawk, red-shouldered hawk, great horned owl, western screech owl, American kestrel, and turkey vulture [*Cathartes aura*]) have a potential to nest within any of the large trees present within and adjacent to the Biological Study Area, which include dense willows and several individuals or small clusters of cypress, Monterey pine, coast live oak, and eucalyptus trees. Several special-status raptor species are known to occur within the Biological Study Area (State Parks, 2002b). White-tailed kite is known to breed within the Biological Study Area and DD&A biologists observed this species foraging over the non-native annual grassland during surveys in June 2014. The sharp-shinned hawk historically bred within the Biological Study Area and suitable nesting and foraging habitat for this species is present. Other special-status raptor species that are known to occur within the Biological Study Area, but do not breed there include: ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey.[4]

Suitable nesting and foraging habitat for several other avian species protected under the MBTA is also present within the Biological Study Area. Migratory bird species known to occur within the Biological Study Area includes, but is not limited to, California brown pelican, common poorwill (*Phalaenoptilus nuttallii*), western meadowlark, Townsend's warbler (*Setophaga townsendii*), black phoebe (*Sayornis nigricans*), white-crowned sparrow, California thrasher (*Toxostoma* redvivum), ash-throated flycatcher (*Myiarchus cinerascens*), American coot, great blue heron, pied-billed grebe, great egret, mallard and tree swallow. Appendix C of the Biological Resources Report (**Appendix E**) presents additional migratory bird species that may occur within the Biological Study Area.

Northern California Legless Lizard

The CDFW has recognized two subspecies of the California legless lizard as species of special concern, the black legless lizard (*Anniella pulchra* ssp. *nigra*) and silvery legless lizard (*A. p.* ssp. *pulchra*). These subspecies are based primarily on phenotypic differences and very limited genetic work. Further, the range of the black legless lizard has historically been classified as "restricted to coastal and interior dune sand other areas of sandy soils in the vicinity of Monterey Bay and the Monterey Peninsula" (USFWS, 1998), while the range of silvery legless lizard has been classified as widespread throughout central California (Parham and Papenfuss, 2008). However, recent genetic studies have revealed five lineages of this species, which correspond with different geographic areas of California (Parham and Papenfuss, 2008). These studies do not, however, identify the legless lizards occurring on the coast of Monterey Bay (i.e., the currently designated black-legless lizard) as a separate lineage. Currently, CDFW identifies both

[4] Please refer to Appendix A of the Biological Resources Report (**Appendix E**) for species-specific discussions and additional information regarding breeding habitat.

subspecies as the Northern California legless lizard and this document, therefore, follows the current regulatory identification.

The Northern California legless lizard is a fossorial (burrowing) species that typically inhabits sandy or loose (friable) soils. Vegetation types known to support this species include (but are not limited to) coastal dunes, valley and foothill grasslands, chaparral, and coastal scrub at elevations from near sea level to approximately 1,800 meters (6,000 feet). The Northern California legless lizard forages on invertebrates, beneath the leaf litter or duff layer, at the base of bushes and trees or under wood, rocks, and slash in appropriate vegetation types. Little is known about the specific habitat requirements for courtship and breeding; however, the mating season for this species is believed to begin late spring or early summer, with one to four live young born between September and November. The diet of this species likely overlaps to some extent with that of juvenile alligator lizards and perhaps some other salamanders. Northern California legless lizards eat insect larvae, small adult insects, and spiders. This species may be preyed upon by alligator lizards, snakes, birds, and small mammals.

The CNDDB reports 28 occurrences of Northern California legless lizard within the five quadrangles reviewed. The CNDDB does not present specific location data for these occurrences; however, non-specific occurrences are documented in three of the five quadrangles reviewed, including the Monterey quadrangle. Additionally, observations taken from the CRMB and within the foredunes at the beach have identified this species (State Parks, 2002b; State Parks, 2007). Suitable habitat for Northern California legless lizard is present throughout the Biological Study Area where appropriate soils and cover conditions occur. Coastal scrub, coastal dune scrub, ruderal coastal dune, and riparian vegetation types provide the most suitable habitat for this species; however, the species may occur also in the non-native annual grassland where suitable soils and cover exist.

Western Pond Turtle

The western pond turtle is a CDFW species of special concern. Western pond turtles are uncommon to common in permanent, or nearly permanent, aquatic resources in a wide variety of habitats throughout California, west of the Sierra-Cascade crest, and are absent from desert regions, except in the Mojave Desert along the Mojave River and its tributaries. The elevation range extends from near sea level to 1,430 meters (4,690 feet). Western pond turtles require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks. The home range of western pond turtles is typically quite restricted; however, ongoing research indicates that in many areas, turtles may leave the watercourse in late fall and move into upland habitats where they burrow into duff and/or soil and overwinter (Holland, 1994). However, western pond turtles remain active year-round and may move several times during overwintering. The time spent in the terrestrial habitat appears highly variable; in southern California, western pond turtles may remain in these sites for only a month or two. In pond and lake habitats, however, some turtles remain in the pond during the winter (Holland, 1994). Additionally, during the spring or early summer, females move overland for up to 325 feet (100 meters) to find suitable sites for egg-laying. Nests are typically excavated in compact, dry soils in areas characterized by sparse vegetation, usually short grasses, or forbs (Holland, 1994). Three to 11 eggs are laid from March to August depending on local conditions (Ernst and Barbour, 1972). The western pond turtle is not known to be territorial, but aggressive encounters, including gesturing and physical combat (Bury and Wolfheim, 1973), are common and may function to maintain spacing on basking sites and to settle disputes over preferred spots. This species is considered omnivorous and food sources include aquatic plant material, beetles, and a wide variety of aquatic invertebrates. Fish, frogs, and carrion have also been reported among their food (Stebbins, 1972).

The CNDDB reports seven occurrences of western pond turtle within the five quadrangles reviewed, including one within the Biological Study Area. Additionally, State Parks (2002a, 2008a) reports occurrences of this species within the south arm of the Lagoon. Suitable habitat for this species includes aquatic areas and the surrounding riparian, emergent marsh, and disturbed herbaceous mosaic vegetation types. Western pond turtles may also utilize the non-native annual grassland habitat as upland or dispersal habitat.

Foothill Yellow-Legged Frog

The FYLF was listed as State Endangered on March 20, 2020, and it is currently under review for federal listing (USFWS, 2023a). The FYLF is a small to medium-sized frog with rough, pebbly skin that is generally mottled gray, olive or brown, and it gets its name from the yellow shading on its belly and underside of the rear legs. It occurs in the Coast Ranges from the Oregon border south to the Transverse Mountains in Los Angeles County, in most of northern California west of the Cascade crest, and along the western flank of the Sierra south to Kern County. Isolated populations are known from the floor of the Central Valley in San Joaquin County and from the mountains of Los Angeles County (CDFW, 2000). Its elevation range extends from near sea level to 1940 meters in the Sierra (Jennings and Hayes, 1994). The FYLF is closely associated with streams and is rarely observed far from the water's edge. Breeding stream habitat is typically shallow, rocky, and at least partially exposed to direct sunlight. It occurs in a wide variety of habitats, but rocky creeks and streams bordered by mixed chaparral and by deciduous and evergreen woodland are the primary habitat for this frog. There have been occurrences of foothill yellow-legged frogs along sandy stream courses, presumably as non-breeding habitat (Jennings and Hayes, 1994).

During the breeding season (typically beginning in late spring, when temperatures increase and river flow rates have declined and stabilized), FYLFs exhibit a lek-style mating system, where males congregate at breeding sites and often establish small calling territories to attract female mates. Female frogs lay one egg mass per year, containing approximately 1,000 to 2,500 eggs, but may range from approximately 100 to more than 4,000 eggs. Tadpoles feed on algae and related freshwater organisms. After metamorphosis, juvenile and adult frogs feed on aquatic and terrestrial invertebrates including snails, moths, flies, water striders, beetles, grasshoppers, hornets, and ants (USFWS, 2023a).

The CNDDB reports seven occurrences of FYLF within the quadrangles evaluated; however, five of these occurrences are possibly extirpated. The nearest presumed extant occurrence was reported in 1968 within the Carmel River approximately 10 miles upstream of the Biological Study Area. Suitable breeding and upland habitat for FYLF is present within the Biological Study Area in the Carmel River and directly adjacent riparian and emergent marsh habitats. However, the lagoon itself is likely too deep and slow-moving to support this species.

California Red-Legged Frog

The CRLF was listed as a Federally Threatened species on June 24, 1996 (61 FR 25813-25833) and is also a CDFW species of special concern. The CRLF is the largest native frog in California (44-131 mm snout-vent length) and was historically widely distributed in the central and southern portions of the State (Jennings & Hayes, 1994). Adults generally inhabit aquatic habitats with riparian vegetation, overhanging banks, or plunge pools for cover, especially during the breeding season (Jennings and Hayes, 1988). They may take refuge in small mammal burrows, leaf litter, or other moist areas during periods of inactivity or to avoid desiccation (Rathbun et al., 1993; Jennings and Hayes, 1994). Radio telemetry data indicates that adults engage in straight-line breeding season movements irrespective of riparian corridors or topography and they may move up to two miles between non-breeding and breeding sites (Bulger et al., 2003). During the non-breeding season, a wider variety of aquatic habitats are used including small pools in coastal streams,

springs, water traps, and other ephemeral water bodies (USFWS, 1996). CRLF may also move up to 300 feet from aquatic habitats into surrounding uplands, especially following rains, where individuals may spend days or weeks (Bulger et al., 2003).

This species requires still or slow-moving water during the breeding season where it can deposit large egg masses, which are most often attached to submergent or emergent vegetation. Breeding typically occurs between December and April, depending on annual environmental conditions and locality. Eggs require six to 12 days to hatch, and metamorphosis generally occurs after 3.5 to seven months, although larvae are also capable of over-wintering. Following metamorphosis, generally between July and September, juveniles are 25-35 mm in size. Juvenile CRLF appear to have different habitat needs than adults. Jennings and Hayes (1988) recorded juvenile frogs mostly from sites with shallow water and limited shoreline or emergent vegetation. Additionally, it was important that there be small one-meter breaks in the vegetation or clearings in the dense riparian cover to allow juveniles to sun themselves and forage, but also to have close escape cover from predators. Jennings and Hayes also noted that tadpoles have different habitat needs and that in addition to vegetation cover, tadpoles use mud. It is speculated that CRLF larvae are algae grazers, however, foraging larval ecology remains unknown (Jennings et al., 1993).

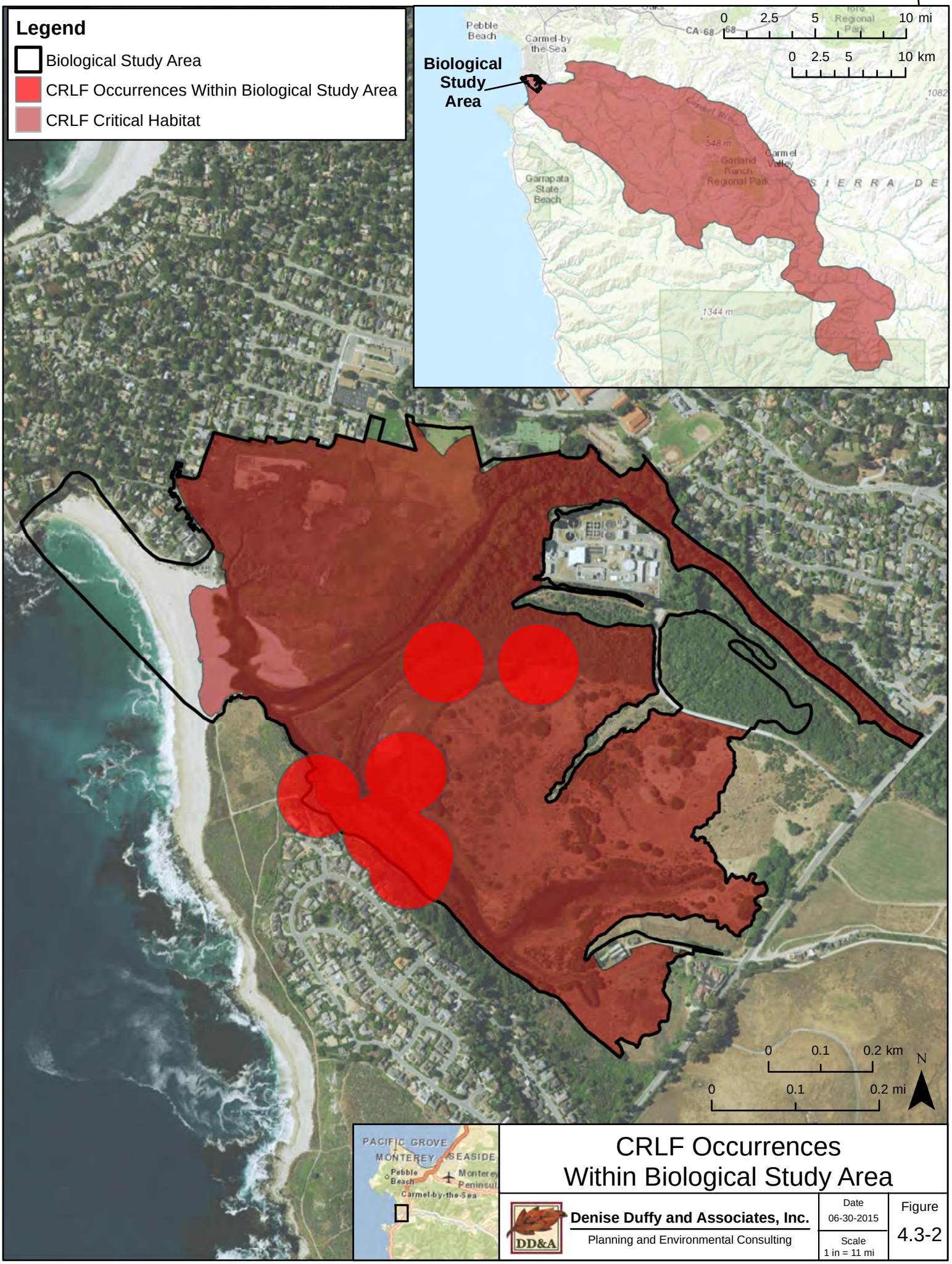
It has been shown that occurrences of CRLF are negatively correlated with presence of non-native bullfrogs (Moyle, 1973; Jennings and Hayes, 1986 and 1988), although both species are able to persist at certain locations, particularly in the coastal zone. It is estimated that CRLF has disappeared from approximately 75% of its former range and has been nearly extirpated from the Sierra Nevada, Central Valley, and much of southern California (USFWS, 1996).

The CNDDB reports 39 occurrences of CRLF within the five quadrangles reviewed, including one occurrence within the Biological Study Area (**Figure 4.3-2**). There are multiple occurrence records of CRLF tadpoles and adults in the south arm of the Lagoon, indicating that reproduction occurs there (HTH, 2013). Suitable aquatic breeding and non-breeding habitat, upland habitat, and dispersal habitat is present within the Biological Study Area. There are no known CRLF records in the Lagoon/wetlands along the north side of the Carmel River.

South-Central California Coast Steelhead

The S-CCC steelhead distinct population segment (DPS) is currently designated as Federally Threatened in all naturally spawned populations (and their progeny) in streams from the Pajaro River (inclusive) located in the County of Santa Cruz, California, to (but not including) the Santa Maria River (71 FR 833-862) in San Luis Obispo County (NMFS, 2006).

In North America, steelheads populate Pacific Ocean drainages from southern California to Alaska. In California, known spawning populations occur in coastal streams from Malibu Creek in the County of Los Angeles to the Smith River near the Oregon border, and in the Sacramento and San Joaquin River systems. The present distribution and abundance of steelhead in California has been greatly reduced from historical levels. In general, steelhead migrate to sea as two-year-old fish, spend two years in the ocean, and then return to fresh water to spawn. Peak spawning for steelhead occurs from December through April in small streams and tributaries. Unlike Pacific salmon, steelhead do not necessarily die after spawning, although repeat spawning rates are generally low and vary considerably among populations. Steelhead have traditionally been grouped into seasonal runs according to their peak migration period; in California there are well-defined winter, spring, and fall runs.



CRLF Occurrences Within Biological Study Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 06-30-2015
Scale: 1 in = 11 mi
Figure: 4.3-2

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.3-2 CRLF Occurrences within BSA.mxd

This Page Intentionally Left Blank

The CNDDB reports two occurrences of S-CCC steelhead within the five quadrangles reviewed, including one occurrence within the Biological Study Area (**Figure 4.3-3**). Additionally, as described in the Fisheries Report (Appendix B of the Biological Resources Report[5]), S-CCC steelhead are known from the Carmel River and Lagoon. Aquatic areas within the Biological Study area provide habitat for this species. Additionally, during times of inundation, the semi-permanent emergent marsh, seasonal emergent marsh, and herbaceous mosaic vegetation types may also provide habitat for S-CCC steelhead.

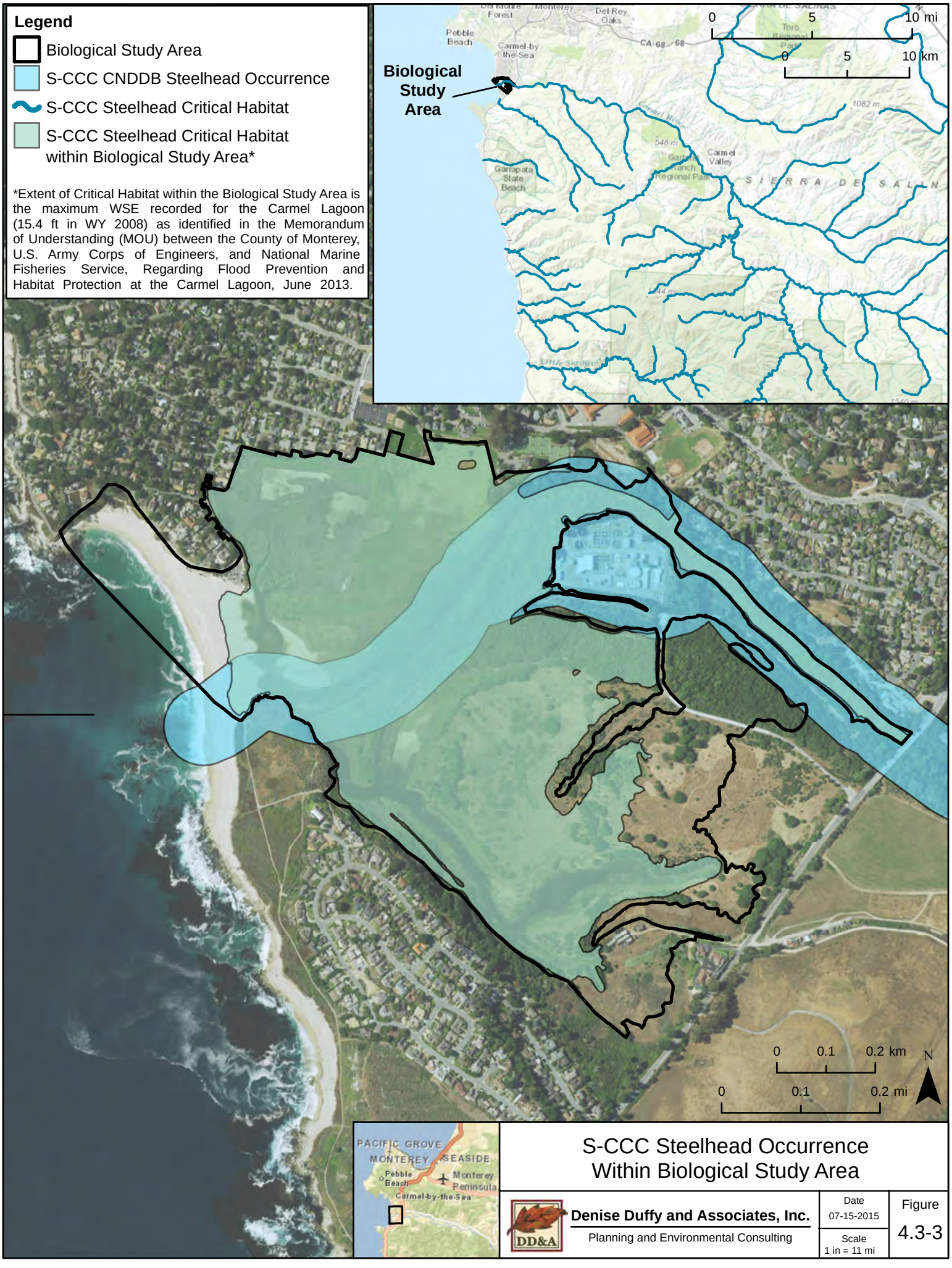
Western Bumble Bee

The western bumble bee (WBB) is a candidate species for listing under CESA. This species was formerly common from the Pacific coast to the Colorado Rocky Mountains; however, populations from central California to southern British Columbia, Canada and west of the Sierra-Cascade Ranges have declined sharply since the late 1990s (Koch et. Al., 2012; Williams et. Al., 2014). Bumble bees are insects that live in colonies made up of one queen, female workers and, near the end of the season, reproductive members of the colony (new queens, or gynes, and males). Unlike their close relative the honeybee, bumble bee colonies do not persist with the same queen for several years. Instead, bumble bee colonies die at the end of each season, and a new colony is founded each year. Mated, overwintered queens emerge from hibernation in the early spring to find a new colony. Once locating a nest site, the queen will construct a wax honeypot for nectar storage and will lay her first clutch of eggs on a mass of pollen moistened with nectar in a small wax cup. After hatching, the larvae feed on the pollen for approximately two weeks before spinning a silk cocoon and pupating for another two weeks. The adult bees that emerge are female worker bees that forage for resources, tend new clutches of eggs and larvae, regulate nest temperature, and defend the nest. The queen will then remain in the nest and lay more eggs, and at some time in the summer the colony will switch over to production of males and new queens. Adult males do not forage for the colony but will leave the nest to feed at flowers and search for mates. Newly emerged queens leave the nest during the day to feed on pollen and nectar to build fat reserves that will carry them through a winter of hibernation. Queens usually mate only once with one male before finding a suitable overwintering site and entering a period of torpor. The new queen having reproduced, the colony declines, and the males, workers, and old queen will die before winter (Williams et. Al., 2014).

Typical habitat types for western bumble bee include open grassy areas, urban parks and gardens, chaparral and shrub areas, and mountain meadows where abundant floral resources are present (Williams et al., 2014; The Xerces Society for Invertebrate Conservation [The Xerces Society] et al., 2018). The western bumble bee requires plants that bloom and provide adequate nectar and pollen throughout the colony's life cycle, which is from early February to late November. The western bumble bee is a generalist forager and has been reported to visit a wide variety of flowering plants; however, this species has a very short tongue that is best suited to open flowers with short corollas. Select food genera include, but is not limited to, *Ceanothus, Geranium, Grindelia, Lupinus, Monardella, Rubus, Solidago, Melilotus, Cirsium, Trifolium, Centaurea, Chrysothamnus, Penstemon,* and *Eriogonum* (Koch et al., 2012; Williams et al., 2014; The Xerces Society et al.). The WBB is also a known "nectar robber" that bites through longer corolla tubes to drink nectar without contacting the anthers or stigma of the flower.

[5] The Biological Resources Report is contained in **Appendix E** of this RDEIR.

This Page Intentionally Left Blank


Legend
Biological Study Area
S-CCC CNDDB Steelhead Occurrence
S-CCC Steelhead Critical Habitat
S-CCC Steelhead Critical Habitat within Biological Study Area*
*Extent of Critical Habitat within the Biological Study Area is the maximum WSE recorded for the Carmel Lagoon (15.4 ft in WY 2008) as identified in the Memorandum of Understanding (MOU) between the County of Monterey, U.S. Army Corps of Engineers, and National Marine Fisheries Service, Regarding Flood Prevention and Habitat Protection at the Carmel Lagoon, June 2013.
Biological Study Area
0 5 10 mi
0 5 10 km
Pebble Beach
Carmel-by-the-Sea
Del Rey Oaks
Monterey
Carmel Valley
Garrapata State Beach
SIERRA DE SALINAS
0 0.1 0.2 km
0 0.1 0.2 mi
N
PACIFIC GROVE
MONTEREY
SEASIDE
Monterey Peninsula
S-CCC Steelhead Occurrence Within Biological Study Area
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date 07-15-2015
Scale 1 in = 11 mi
Figure 4.3-3
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.3-3 Steelhead Occurrences within BSA.mxd

This Page Intentionally Left Blank

Like most other species of bumble bees, WBB typically nests underground. Most reports of WBB nests are from underground cavities, such as old squirrel or other animal nests, and in open west-southwest slopes bordered by trees. A few nests have also been reported from above-ground locations such as in logs among railroad ties or under buildings (Hatfield et. Al,, 2015; The Xerces Society et, al., 2018; Thorpe et. Al., 1983). Very little is known about overwintering sites utilized by most bumble bees, including western bumble bee; however, one report identified that hibernacula was two inches deep "in a steep west slope of the mound of earth" and a closely related European species, the buff-tailed bumble bee (*B. terrestris*), has been reported to hibernate beneath trees (Hatfield et. al., 2015; The Xerces Society et, al., 2018). Additionally, a recent study at the former Fort Ord on the Monterey Peninsula that studied potential overwintering habitat for bumble bees found individuals of two species (*B. melanopygus* and *B. vosnesenskii*) hibernating in the duff below Monterey cypress trees, while none were observed in areas where the groundcover consisted of pine needle duff, grassy meadow, or the invasive iceplant (*Carpobrotus* sp.) (Williams et. Al., 2019).

Suitable habitat for the WBB is present within the project site in annual grassland areas. The presence of flowering annual plants and the abundance of coyote brush within adjacent habitat suggests that sufficient nectar and pollen for the entire life cycle of a western bumble bee colony may be present within the Biological Study Area. The CNDDB reports six occurrences of this species within the quadrangles reviewed, the nearest located approximately seven miles northwest of the Biological Study Area.

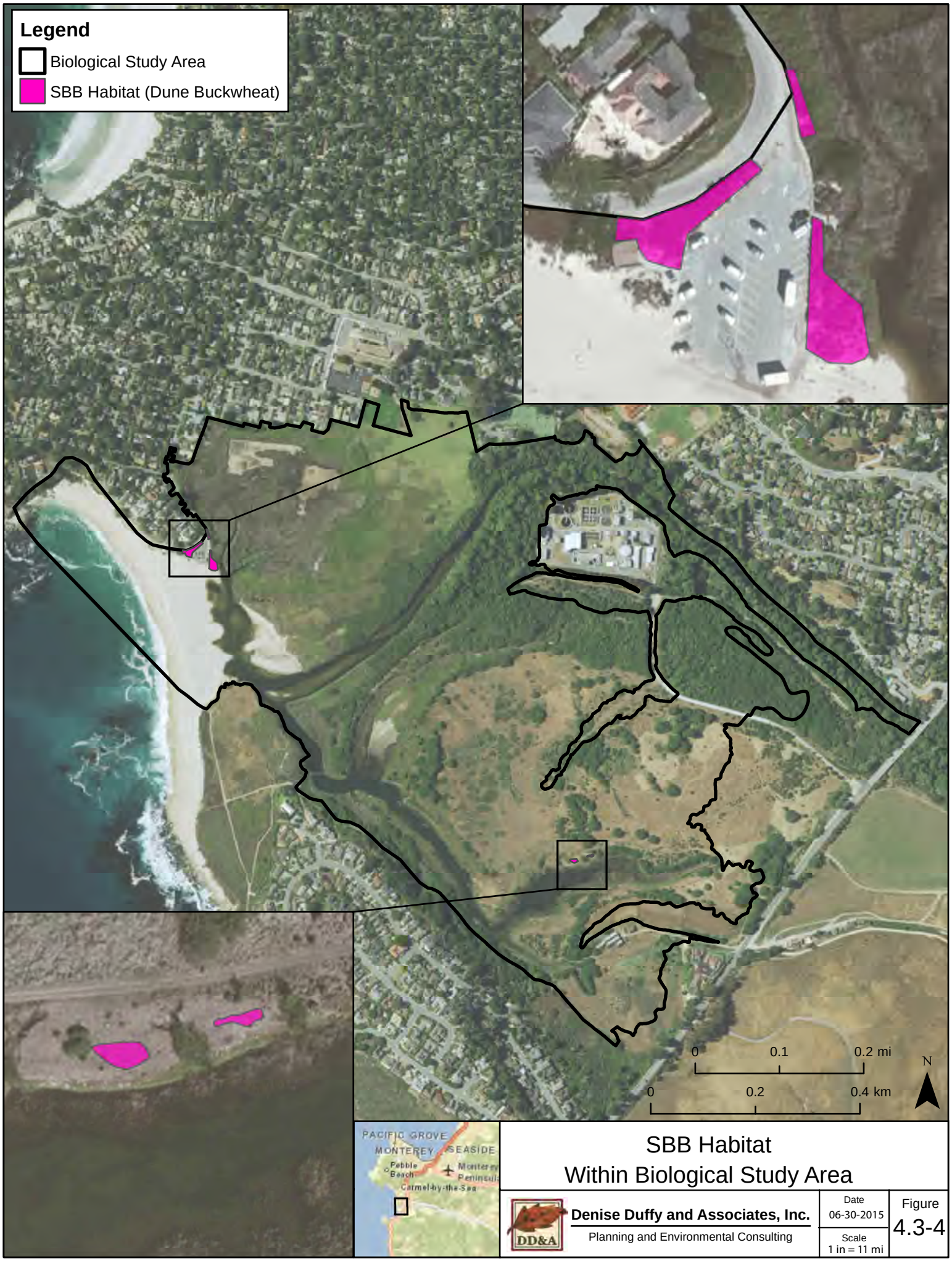
Smith's Blue Butterfly

SBB was listed as a Federally Endangered species on June 1, 1976 (41 FR 22041-22044) (USFWS, 1976). This species historically ranged along the California coast from Monterey Bay south through Big Sur to near Point Gorda, occurring in scattered populations in association with coastal dune, coastal scrub, chaparral, and grassland vegetation types. The primary limiting factor for SBB populations is the occurrence of their host plants, dune buckwheat and coast buckwheat (*Eriogonum latifolium*), in which they are associated for their entire life span. There is also a potential for SBB to use naked buckwheat (*E. nudum*) within a range of the host species (pers. Comm. Dave Dixon, State Parks). However, the presence of the host plant is not always an indication of the occurrence of the SBB, as the host plant distribution is much more extensive than that of the butterfly.

Individual adult males and females live approximately one week. Adult emergence and seasonal activity are synchronized with the blooming period of the particular buckwheat used at a given site. Dispersal data from capture-recapture studies (Arnold, 1983) indicate that most adults are quite sedentary, with home ranges no more than a few acres. SBB has only one generation per year. Females lay single eggs into buckwheat flower heads, which hatch in approximately one week. Caterpillars mature over a span of approximately three to four weeks, feeding on petals and seeds of the buckwheat plant. Chrysalis formation then takes place in the buckwheat flower head, and the chrysalis eventually falls into the leaf litter and topsoil beneath the plant where it remains for approximately 47 weeks until the cycle begins again (Dixon, 1999).

The CNDDB reports 36 occurrences of SBB within the five quadrangles reviewed, the nearest of which is located approximately one mile from the Biological Study Area. However, dune buckwheat plants that may provide habitat for SBB are present within the coastal dune scrub habitat, located directly adjacent to the Carmel River State Beach parking lot next to Scenic Road, and within the non-native annual grassland habitat near the south arm of the Lagoon (**Figure 4.3-4**). The presence of SBB within the Biological Study Area is assumed based on the presence of the host plant and the known occurrences of the species within the vicinity.

This Page Intentionally Left Blank



SBB Habitat Within Biological Study Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 06-30-2015
Scale: 1 in = 11 mi
Figure: 4.3-4

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.3-4 SBB Habitat Map.mxd

This Page Intentionally Left Blank

SPECIAL-STATUS PLANT SPECIES

The Biological Survey Area was evaluated for the presence of a variety of special-status plant species (refer to Appendix A of the Biological Resources Report[6]). Suitable habitat for several species is present within the proposed project site; however, no special-status plant species were identified during focused botanical surveys conducted in 2015.

4.3.1.6 Sensitive Habitats

Sensitive habitats include riparian corridors, wetlands, habitats for legally protected species, areas of high biological diversity, areas supporting rare or special-status wildlife habitat, and unusual or regionally restricted vegetation types. Vegetation types considered sensitive include those listed on the CDFW's *Natural Communities List* (i.e., those habitats that are rare or endangered within the borders of California) (CDFW, 2023a), those that are occupied by species listed under ESA or are critical habitat in accordance with ESA, and those that are defined as ESHA under the CCA. Specific habitats may also be identified as sensitive in city or county general plans or ordinances. Sensitive habitats are regulated under Federal regulations (such as the CWA and Executive Order 11990 – Protection of Wetlands), State regulations (such as CEQA and the CDFW Streambed Alteration Program), or local ordinances or policies (such as city or county tree ordinances and general plan policies).

Several sensitive habitats were identified within the Biological Study Area. **Table 4.3-3** identifies the acreage of sensitive habitats within the Biological Study Area and within each of the proposed project components. The CCA may consider these habitats ESHA as they occur in the Coastal Zone. Additionally, under Section 30107.5 of the CCA, an "environmentally sensitive area" is any area in which plant or animal life, or their habitat are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. Therefore, the CCC may designate additional habitat areas within the Biological Study Area as ESHA if it is determined that it meets this definition.

Table 4.3-3. Sensitive Habitats within the Biological Study Area and Proposed Project Components*

Sensitive Habitat	Biological Study Area	EPB	SRPS	ISMP**
Riparian	69.1 acres	0.1 acres	-	Not Present
Active Beach	7.9 acres	-	2.4 acres	Present
SBB Habitat	0.2 acres	-	0.2 acres	Not Present
CRLF Critical Habitat	186.9 acres	4.3 acres	0.3 acres	Present
S-CCC Steelhead Critical Habitat	154.9 acres	4.3 acres	0.3 acres	Present

* The Biological Study Area consists of all areas that have the potential to be impacted by the proposed project, including portions of the Lagoon that may be affected by indirect, permanent changes in water surface elevation. Proposed project components consist of areas within the Biological Study Area that would be directly affected by the construction and operation of the various proposed project components.

** Due to the dynamic nature of the sandbar and the implementation process of the proposed ISMP project component, the area of vegetation types within the proposed ISMP project component implementation area cannot be calculated. This table does not summarize the quantity of vegetation types present but identifies vegetation types as present or not within the proposed ISMP project component implementation area.

[6] The Biological Resources Report is contained in **Appendix E** of this RDEIR.

RIPARIAN

Approximately 69.1-acres of riparian habitat is present within the Biological Study Area (**Figure 4.3-5**). The riparian habitat within the Biological Study Area supports vegetation characteristic of Arroyo willow thickets, as described in the *Manual of California Vegetation* (Sawyer et al., 2009), which is identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). Riparian habitat is also regulated under Sections 1600-1616 of the Fish and Game Code and may also be considered waters of the State by the RWQCB and ESHA by the CCC. Please refer to the discussion of Wetlands and Other Waters below. Portions of the riparian vegetation within the Biological Study Area are also critical habitat for the federally listed CRLF and S-CCC steelhead. Please refer to the discussion in the Critical Habitat section below.

ACTIVE BEACH

The active beach within the Biological Study Area is present within the Coastal Zone and may be considered ESHA by the CCC. This may include the coastal strand, coastal dune scrub, dune swale wetland, and ruderal coastal dune vegetation types as described in **Section 4.3.1.5**, above. Approximately 7.9-acres of active beach habitat is present within the Biological Study Area (**Figure 4.3-5**).

SMITH'S BLUE BUTTERFLY HABITAT

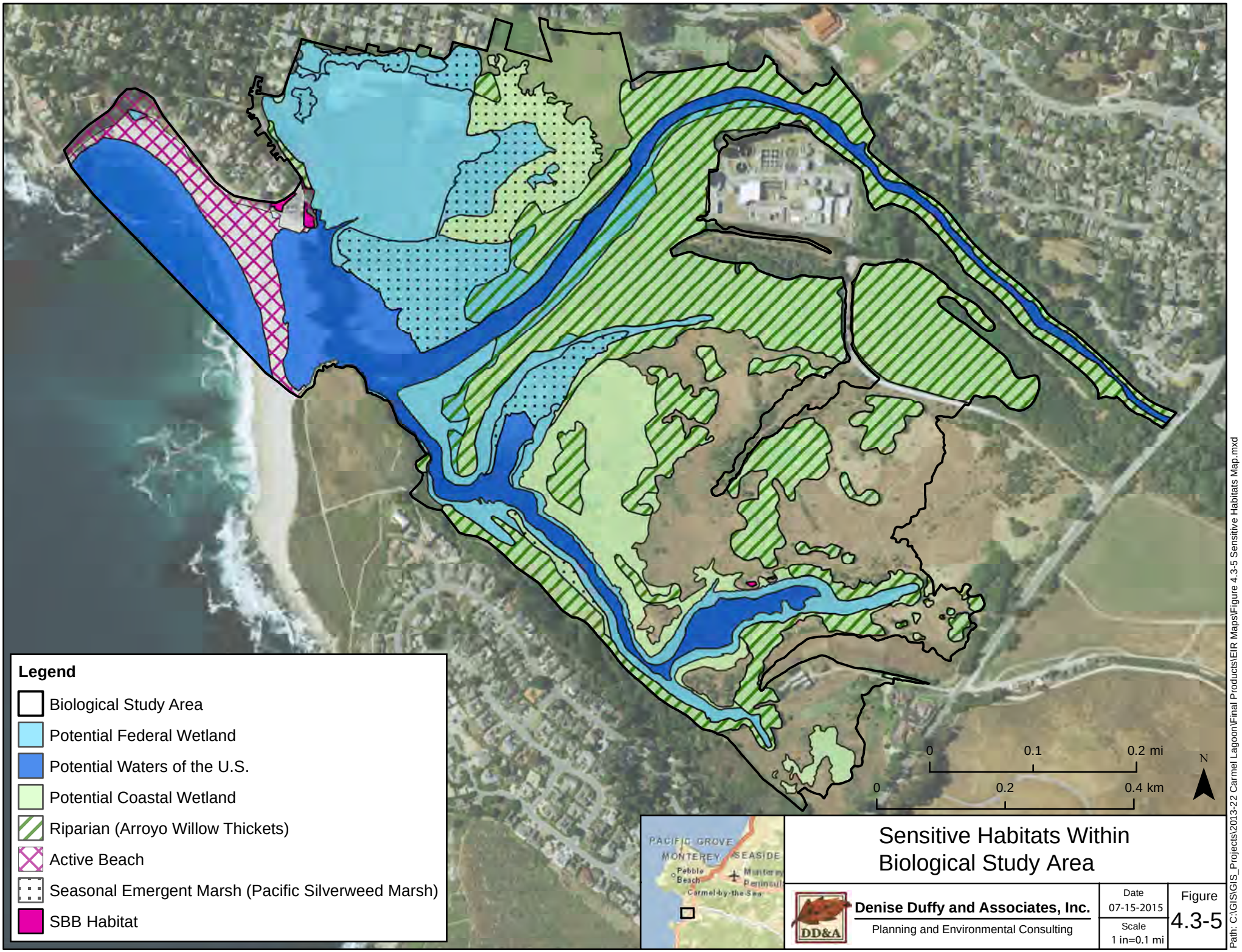
Approximately 0.2 acre of dune buckwheat plants are present within the Biological Study Area (**Figures 4.3-4** and **4.3-5**). These plants may provide habitat for the Federally Endangered SBB. These plants are present within the Coastal Zone and, therefore, this habitat may be considered ESHA by the CCC. This habitat is also protected by the USFWS under ESA.

CRITICAL HABITAT

California Red-Legged Frog

Critical habitat was designated for CRLF on April 13, 2006 (71 FR 19244-19346) (USFWS, 2006) and revised on March 17, 2010 (75 FR 12816-12959) (USFWS, 2010b). The revised critical habitat went into effect on April 16, 2010. The primary constituent elements (PCEs) CRLF critical habitat are:

1. **Aquatic Breeding Habitat:** Standing bodies of fresh water (with salinities less than 7.0 ppt.), including natural and manmade ponds, slow moving streams or pools within streams, and other ephemeral or permanent water bodies that typically become inundated during winter rains and hold water for a minimum of 20 weeks in all but the driest years.
2. **Non-Breeding Aquatic Habitat:** Fresh water habitats, as described above, that may or may not hold water long enough for the subspecies to hatch and complete its aquatic life cycle but that do provide for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLF. Other wetland habitats that would meet these elements include, but are not limited to: plunge pools within intermittent creeks; seeps; quiet water refugia during high water flows; and springs of sufficient flow to withstand the summer dry period.



Sensitive Habitats Within Biological Study Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 07-15-2015
Scale 1 in=0.1 mi
Figure 4.3-5

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.3-5 Sensitive Habitats Map.mxd

This Page Intentionally Left Blank

3. **Upland Habitat:** Upland areas within 200 feet (60 meters) of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat, and comprised of various vegetational series, such as grasslands, woodlands, and/or wetland/riparian plant species that provides the frog shelter, forage, and predator avoidance. Upland features are also essential in that they are needed to maintain the hydrologic, geographic, topographic, ecological, and edaphic features that support and surround the wetland or riparian habitat. These upland features contribute to the filling and drying of the wetland or riparian habitat and are responsible for maintaining suitable periods of pool inundation for larval frogs and their food sources, and provide breeding, non-breeding, feeding, and sheltering habitat for juvenile and adult frogs (e.g., shelter, shade, moisture, cooler temperatures, a prey base, foraging opportunities, and areas for predator avoidance). Upland habitat can include structural features such as boulders, rocks, and organic debris (e.g., downed trees, logs), as well as small mammal burrows and moist leaf litter.
4. **Dispersal Habitat:** Accessible upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mile (1.2 kilometers) of each other that allows for movement between such sites. Dispersal habitat includes various natural habitats and altered habitats such as agricultural fields, which do not contain barriers to dispersal (an example of a barrier to dispersal is a heavily traveled road constructed without bridges or culverts). Dispersal habitat does not include moderate to high density urban or industrial developments with large expanses of asphalt or concrete, nor does it include large reservoirs over 50 acres (20 hectare) in size, or other areas that do not contain those features identified in PCE 1, 2, or 3 as essential to the conservation of the subspecies.

The Biological Study Area is located within CRLF critical habitat mapping unit MNT-2 (**Figure 4.3-2**). The Biological Study Area contains all PCEs. Approximately 186.9 acres of CRLF critical habitat is present within the Biological Study Area (**Figure 4.3-2**). As identified above, CRLF critical habitat includes wetlands and other waters, and portions of the riparian vegetation. Other vegetation types included in the CRLF critical habitat include non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, and coastal scrub.

South-Central California Coast Steelhead

The designation of critical habitat for S-CCC steelhead became effective on September 2, 2005 (70 FR 52487-52627) (NMFS, 2005). The lateral extent of critical habitat for S-CCC steelhead is the width of the stream channel, defined as the ordinary high water (OHW) mark as defined by the USACE in 33 CFR 329.11. In areas for which the OHW mark has not been defined pursuant to 33 CFR 329.11, the width of the stream channel is defined by its bank full elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

The PCEs of S-CCC steelhead critical habitat include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.
2. Freshwater rearing sites with:
    i. Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    ii. Water quality and forage supporting juvenile development; and
    iii. Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
4. Estuarine areas free of obstruction and excessive predation with:
    i. Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;
    ii. Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and
    iii. Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Carmel River and Lagoon is designated critical habitat for S-CCC steelhead. Per the definition of the lateral extent of critical habitat, extreme high water is the extent of the critical habitat within the Lagoon. The maximum water surface elevation recorded for the Lagoon is at 15.4 ft in 2008, as identified in the MOU. Approximately 154.9 acres of S-CCC steelhead critical habitat is present within the Biological Study Area (**Figure 4.3-3**). As identified above, S-CCC steelhead critical habitat includes wetlands and other waters, and portions of the riparian vegetation. Other vegetation types included in the S-CCC steelhead critical habitat include non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, and coastal scrub.

4.3.1.7 Jurisdictional Wetlands

Waters of the U.S. are defined broadly as waters susceptible to use in commerce (including waters subject to tides, interstate waters, and interstate wetlands) and other waters (such as interstate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds) (33 CFR 328.3). Potential wetland areas are identified as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils conditions." The Wetland Delineation Report (DD&A, 2015) was prepared for the proposed project can be found in Appendix F of the Biological Resources Report (**Appendix E**); the results of the delineation are summarized below. **Table 4.3-4** shows the area of potentially jurisdictional wetlands and waters within the Biological Study Area and the proposed project components.

Table 4.3-4. Potentially Jurisdictional Wetlands and Waters within the Biological Study Area and Proposed Project Components*

Habitat	Biological Study Area	EPB	SRPS	ISMP**
Federal Wetlands	49.0 acres	2.7 acres	-	Not Present
Other Waters of the U.S.	32.0 acres	-	0.3 acres	Present
Coastal Wetlands/Waters of the State	133.3 acres	3.0 acres	-	Not Present

* The Biological Study Area consists of all areas that have the potential to be impacted by the proposed project, including portions of the Lagoon that may be affected by indirect, permanent changes in water surface elevation. Proposed project components consist of areas within the Biological Study Area that would be directly affected by the construction and operation of the various proposed project components.

**Due to the dynamic nature of the sandbar and the implementation process of the proposed ISMP project component, the area of vegetation types within the proposed ISMP project component implementation area cannot be calculated. This table does not summarize the quantity of vegetation types present but identifies vegetation types as present or not within the proposed ISMP project component implementation area.

Approximately 49.0 acres of Federal wetlands and 32.0 acres of other waters of the United States (waters of the U.S.) potentially under the jurisdiction of the USACE were identified within the Biological Study Area (**Figure 4.3-5**). The mapping of potential other waters of the U.S. is based on the presence of an OHW mark associated with the un-vegetated bed of the Carmel River and un-vegetated portions of the Lagoon.

Approximately 133.3 acres of coastal wetlands potentially under the jurisdiction of CCC were identified within the Biological Study Area (**Figure 4.3-5**). These coastal wetlands may also be considered waters of the State under the jurisdiction of the RWQCB. This number includes potentially federally jurisdictional wetlands and additional areas that met only one or two parameters. The mapping of coastal wetlands/waters of the State beyond those identified as Federal is based on the distribution of wetland plant species.

A number of vegetation types make up the areas identified as wetland. Areas identified as potential Federal wetlands include the entire semi-permanent emergent marsh and portions of the riparian and seasonal emergent marsh vegetation types. Areas identified as potential coastal wetlands include the entirety of these three vegetation types, as well as the disturbed herbaceous mosaic vegetation type. In addition to protection under the CWA and CCA, the seasonal emergent marsh supports vegetation characteristic of "Pacific silverweed marsh," as described in the *Manual of California Vegetation* (Sawyer et al., 2009), which is identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). Riparian vegetation is also identified as a sensitive habitat on the CDFW's *Natural Communities List*, as described above. As such, approximately 91.3 acres of wetlands (22.2 acres of seasonal emergent marsh and 69.1 acres of riparian) are also considered sensitive and under the jurisdiction of the CDFW.

Wetlands within the Biological Study Area are also critical habitat for the Federally listed CRLF and S-CCC steelhead. Please refer to the discussion in the Critical Habitat section above.

4.3.1.8 Trees

The proposed project would not result in the removal of any native trees.

4.3.2 Regulatory Setting

4.3.2.1 Federal

FEDERAL ENDANGERED SPECIES ACT

Provisions of the ESA of 1973 (16 USC 1532 et seq., as amended) protect Federally listed threatened or endangered species and their habitats from unlawful take. Listed species include those for which proposed and final rules have been published in the Federal Register (FR). The ESA is administered by the USFWS or NMFS. In general, the NMFS is responsible for the protection of ESA-listed marine species and anadromous fish, whereas other listed species are under USFWS jurisdiction.

Section 9 of ESA prohibits the take of any fish or wildlife species listed under ESA as endangered or threatened. Take, as defined by ESA, is "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." Harm is defined as "any act that kills or injures the fish or wildlife…including significant habitat modification or degradation that significantly impairs essential behavioral patterns of fish or wildlife." In addition, Section 9 prohibits removing, digging up, and maliciously damaging or destroying federally listed plants on sites under Federal jurisdiction. Section 9 does not prohibit take of federally listed plants on sites not under Federal jurisdiction. If there is the potential for incidental take of a Federally listed fish or wildlife species, take of listed species can be authorized through either the Section 7 consultation process for Federal actions or a Section 10 incidental

take permit process for non-Federal actions. Federal agency actions include activities that are on Federal land, conducted by a Federal agency, funded by a Federal agency, or authorized by a Federal agency (including issuance of Federal permits).

CRITICAL HABITAT

Critical habitat is a term defined and used in the ESA. It is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. An area is designated as "critical habitat" after the USFWS publishes a proposed Federal regulation in the FR and then public comments are received and considered on the proposal. The final boundaries of the critical habitat area are also published in the FR. Federal agencies are required to consult with the USFWS on actions they carry out, fund, or authorize to ensure that their actions will not destroy or adversely modify critical habitat. In this way, a critical habitat designation protects areas that are necessary for the conservation of the species.

RECOVERY PLANS

The goal of the ESA is the recovery (and subsequent conservation) of endangered and threatened species and the ecosystems on which they depend. A variety of methods and procedures are used to recover listed species, such as protective measures to prevent extinction or further decline, consultation to avoid adverse impacts of Federal activities, habitat acquisition and restoration, and other on-the-ground activities for managing and monitoring endangered and threatened species. The collaborative efforts of the USFWS and its many partners (Federal, State, and local agencies, tribal governments, conservation organizations, the business community, landowners, and other concerned citizens) are critical to the recovery of listed species.

Two recovery plans have been prepared for listed species known or with the potential to occur within the Biological Study Area:

- *Smith's Blue Butterfly Recovery Plan* (USFWS, 1984), and
- *Recovery Plan for the California Red-legged Frog* (USFWS, 2002).

FISH AND WILDLIFE COORDINATION ACT

The Fish and Wildlife Coordination Act (16 USC 651 Et Seq.) requires all Federal agencies to consult with and give strong consideration to the views of the USFWS, the NMFS, and State wildlife agencies regarding the fish and wildlife impacts of projects that propose to impound, divert, channel, or otherwise alter a body of water.

MIGRATORY BIRD TREATY ACT

The MBTA of 1918 prohibits killing, possessing, or trading migratory birds except in accordance with regulation prescribed by the Secretary of the Interior. Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of the MBTA. The USFWS is responsible for overseeing compliance with the MBTA and implements Conventions (treaties) between the United States and four countries for the protection of migratory birds – Canada, Mexico, Japan, and Russia. The USFWS maintains a list of migratory bird species that are protected under the MBTA, which was updated in 2010 to: 1) correct previous mistakes, such as misspellings or removing species no longer known to occur within the United States; 2) add species, as a result of expanding the geographic scope to include Hawaii and U.S. territories and new evidence of occurrence in the United States or U.S. territories; and 3) update name changes based on new taxonomy (USFWS, 2010a).

THE CLEAN WATER ACT

The USACE and EPA regulate discharge of dredged and fill material into waters of the U.S. under Section 404 of the CWA. Waters of the U.S. are defined broadly as waters susceptible to use in commerce (including waters subject to tides, interstate waters, and interstate wetlands) and other waters (such as interstate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds) (33 CFR 328.3). Potential wetland areas are identified as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils conditions."

Under Section 401 of the CWA, any applicant receiving a Section 404 permit from the USACE must also obtain a Section 401 Water Quality Certification from the RWQCB. A Section 401 Water Quality Certification is issued when a project is demonstrated to comply with State water quality standards and other aquatic resource protection requirements.

EXECUTIVE ORDER 11990 - PROTECTION OF WETLANDS

Executive Order 11990 - Protection of Wetlands calls for no net loss of wetlands. For the regulatory process, the USACE and EPA jointly define wetlands as follows:

> "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Federal agencies are required to implement the following procedures for any Federal action that involves wetlands: 1) provide an opportunity for early public involvement; 2) consider alternatives that would avoid wetlands, and avoidance is not possible, measures to minimize harm to wetlands must be included in the action; 3) prepare a "Wetlands Only Practicable Alternative Finding" for actions that require an Environmental Impact Study.

EXECUTIVE ORDER 13112-INVASIVE SPECIES

Executive Order 13112 - Invasive Species requires the prevention of introduction and spread of invasive species. Invasive species are defined as "alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Each Federal agency whose actions may affect the status of invasive species on a project site shall, to the extent practicable and permitted by law, subject to the availability of appropriations, use relevant programs and authorities to: 1) prevent the introduction of invasive species; 2) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; 3) monitor invasive species populations accurately and reliably; 4) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; 5) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and 6) promote public education on invasive species and the means to address them. A national invasive species management plan was prepared by the National Invasive Species Council and the Invasive Species Advisory Committee that recommends objectives and measures to implement the Executive Order.

NATIONAL MARINE SANCTUARY ACT

The National Marine Sanctuaries Act (NMSA) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities as national marine sanctuaries. The primary objective of the NMSA is to protect marine resources, such as

coral reefs, sunken historical vessels, or unique habitats. The NMSA provides several tools for protecting designated national marine sanctuaries. For example,

- The NMSA provides the program with the authority to issue regulations for each sanctuary and the system as a whole. These regulations can, among other things, specify the types of activities that can and cannot occur within the sanctuary (Section 308).
- The NMSA requires the program to prepare and periodically update management plans that guide day-to-day activities at each sanctuary (Sections 304(a) and 304(e)).
- The NMSA authorizes NOAA and the program to assess civil penalties (up to $130,000 per day per violation) for violations of the NMSA or its implementing regulations and damages against people that injure sanctuary resources (Sections 306, 307, and 312).
- The NMSA requires federal agencies whose actions are "likely to destroy, cause the loss of, or injure a sanctuary resources" to consult with the program before taking the action. The program is, in these cases, required to recommend reasonable and prudent alternatives to protect sanctuary resources (Section 304(d)).

Carmel Bay is located in the Monterey Bay National Marine Sanctuary (MBNMS), which was designated as a federally protected area in 1992. The MBNMS is managed by NOAA and includes coastal waters from Marin to Cambria. The MBNMS includes approximately 276 miles of shoreline, extends an average distance of 30 miles from shore, encompasses 6,094 square miles of ocean, and is more than two miles deep at its deepest point. The MBNMS was established for the purpose of research, education, public use, and resource protection. The MBNMS includes a variety of habitats that support extensive marine life (MBNMS, 2021).

4.3.2.2 State

CALIFORNIA ENDANGERED SPECIES ACT

The California Endangered Species Act was enacted in 1984. The CCR (Title 14, §670.5) lists animal species considered endangered or threatened by the State. Section 2090 of CESA requires State agencies to comply with endangered species protection and recovery and to promote conservation of these species. Section 2080 of the Fish and Game Code prohibits "take" of any species that the commission determines to be an endangered species or a threatened species. "Take" is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." A Section 2081 Incidental Take Permit from the CDFW may be obtained to authorize the "take" of any State listed species.

CALIFORNIA FISH AND GAME CODE

Birds

Section 3503 of the Fish and Game Code states that it is "unlawful to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Section 3503.5 prohibits the killing, possession, or destruction of any birds in the orders Falconiformes or Strigiformes (birds-of-prey). Section 3511 prohibits take or possession of fully protected birds. Section 3513 prohibits the take or possession of any migratory nongame birds designated under the Federal MBTA. Section 3800 prohibits take of nongame birds.

Fully Protected Species

The classification of fully protected was the State's initial effort in the 1960's to identify and provide additional protection to those animals that were rare or faced possible extinction. Lists were created for fish (§5515), mammals (§4700), amphibians and reptiles (§5050), and birds (§3511). Most fully protected species have also been listed as threatened or endangered species under the more recent endangered species laws and regulations. On July 10, 2023, Governor Newsom signed Senate Bill 147 (SB 147) allowing for permits to take fully protected species for certain renewable energy and infrastructure projects, which took effect immediately. Fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation of the bird species for the protection of livestock, or if the project is eligible under Senate Bill 147. SB 147 also made a few updates to the list of "fully protected" species. In particular, SB 147 revised the list of fully protected bird species by removing American peregrine falcon and brown pelican from the list; all other previously listed species, including California condor and Golden eagle, remain protected under CESA. SB 147 also removed thicktail chub from the list of fully protected fish. SB 147 did not revise the list of fully protected mammals or reptiles.

Species of Special Concern

As noted above, the CDFW also maintains a list of animal "species of special concern." Although these species have no legal status, the CDFW recommends considering these species during analysis of project impacts to protect declining populations and avoid the need to list them as endangered in the future.

Lake or Streambed Alteration

Sections 1600-1607 of the Fish and Game Code require any agency that proposes a project that will substantially divert or obstruct the natural flow of or substantially change the bed or bank of a river, stream, or lake to notify the CDFW before beginning construction. If the CDFW determines that the project may substantially and adversely affect fish or wildlife resources, a Lake or Streambed Alteration Agreement will be required. The CDFW's jurisdictional limits are usually defined by the tops of the stream or lake banks, or the outer edge of riparian vegetation, whichever is wider.

CALIFORNIA NATIVE PLANT PROTECTION ACT

The CNPPA of 1977 directed the CDFW to carry out the legislature's intent to "preserve, protect and enhance rare and endangered plants in the state." The CNPPA prohibits importing rare and endangered plants into California, taking rare and endangered plants, and selling rare and endangered plants. The CESA and CNPPA authorized the Fish and Game Commission to designate endangered, threatened, and rare species and to regulate the taking of these species (§2050-2098, Fish and Game Code). Plants listed as rare under the CNPPA are not protected under CESA.

PORTER-COLOGNE WATER QUALITY CONTROL ACT

The Porter-Cologne Water Quality Control Act of 1969 (Porter-Cologne) is California's statutory authority for the protection of water quality and applies to surface waters, wetlands, and groundwater, and to both point and nonpoint sources. Under Porter-Cologne, the State Water Resources Control Board (State Water Board) has the ultimate authority over State water rights and water quality policy. However, Porter-Cologne also establishes nine RWQCBs to oversee water quality on a day-to-day basis at the local/regional level. The Biological Study Area is located within Region 3 – Central Coast RWQCB. Porter-Cologne incorporates many provisions of the CWA, such as delegation to the State Board and RWQCBs of the National Pollutant Discharge Elimination System (NPDES) permitting program.

Under Porter-Cologne, the State must adopt water quality policies, plans, and objectives that protect the State's waters for the use and enjoyment of the people. Regional authority for planning, permitting, and enforcement is delegate to the nine RWQCBs. The regional boards are required to formulate and adopt water quality control plans for all areas in the region and establish water quality objectives in the plans. The Porter-Cologne sets forth the obligations of the State Board and RWQCBs to adopt and periodically update water quality control plans (basin plans). The act also requires waste dischargers to notify the RWQCBs of such activities through filing of Reports of Waste Discharge (RWD) and authorizes the State Board and RWQCBs to issue and enforce waste discharge requirements (WDRs), NPDES permits, Section 401 water quality certifications, and other approvals. The RWQCBs also have authority to issue waivers to RWD requirements and WDRs for broad categories of "low threat" discharge activities that have minimal potential for adverse water quality effects, when implemented according to prescribed terms and conditions.

The term "Waters of the State" is defined by Porter-Cologne as "any surface water or groundwater, including saline waters, within the boundaries of the state." The RWQCB protects all waters in its regulatory scope but has special responsibility for wetlands, riparian areas, and headwaters, including isolated wetlands, and waters that many not be regulated by the USACE under Section 404 of the CWA. Waters of the State are regulated by the RWQCB under the State Water Quality Certification Program, which regulates discharges of fill and dredged material under Section 401 of the CWA and the Porter-Cologne.

CALIFORNIA COASTAL ACT

The CCC was established by voter initiative in 1972 (Proposition 20) and later made permanent by the California State Legislature through adoption of the Coastal Act of 1976. The CCC, in partnership with coastal cities and counties, plans and regulates the use of land and water in the coastal zone. California's coastal zone generally extends 1,000 yards inland from the mean high tide line. In significant coastal estuarine habitat and recreational areas, it extends inland to the first major ridgeline or five miles from the mean high tide line, whichever is less. In developed urban areas, the boundary is generally less than 1,000 yards. Development activities, which are broadly defined by the CCA to include (among others) construction of buildings, divisions of land, and activities that change the intensity of use of land or public access to coastal waters, generally require a CDP from either the CCC or the local government if a Local Coastal Program (LCP) has been certified. After certification of a LCP, coastal development permit authority is delegated to the appropriate local government, but the Commission retains original permit jurisdiction over certain specified lands (such as tidelands and public trust lands). The CCC also has appellate authority over development approved by local governments in specified geographic areas as well as certain other developments. A CDP is required in addition to any other permit required from resource agencies.

The CCC or the local government may designate areas of rare or unique biological value, such as wetland and riparian habitat and habitats for special-status species, as ESHA. Section 30107.5 of the CCA defines an "environmentally sensitive area" as any area in which plant or animal life or their habitat are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. Development is restricted within the coastal zone and prohibited within designated ESHA, unless the development is coastal dependent and does not have a significant effect on the resources.

CCA Section 30240(a) states:

> "Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas."

CCA Section30240(b) states,

> "Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas."

The Lagoon is under the original jurisdiction of the CCA and is regulated by the CCC.

4.3.2.3 Regional/Local

RELEVANT PLANNING DOCUMENTS

The 1982 Monterey County General Plan, Carmel Area Land Use Plan, Carmel Area Coastal Implementation Plan, Point Lobos State Reserve and Carmel River State Beach General Plan, CCA, and PRC contain a variety of policies related to the preservation and protection of biological resources including environmentally sensitive areas. Please refer to **Section 4.9, Land Use and Planning** for a description of these regulations and plans, and **Appendix C, Applicable Land Use Plans, Policies, and Regulations Consistency Analysis for the Carmel Lagoon Project** for a list of relevant policies and the consistency analysis.

MONTEREY COUNTY CODE

Title 16, Chapter 16.60, of the Monterey County Code (MCC), provides for the preservation of oaks and other protected tree species within the unincorporated areas of the County. As defined in MCC Section 16.60.040 C, removal of more than three protected trees on a lot in a one-year period requires a Forest Management Plan (FMP) and approval of a Use Permit by the Monterey County Planning Commission. The FMP must be prepared by a qualified forester selected from the County's list of consultants. MCC Section 16.060.040 D requires that the applicant relocate or replace each removed tree on a one-to-one ratio. This ratio may be varied upon showing that such a requirement will create a special hardship in the use of the site, or such a replacement would be detrimental to the long-term health and maintenance of the remaining habitat. The proposed project would not remove any protected trees.

HABITAT CONSERVATION PLANS OR NATURAL COMMUNITY CONSERVATION PLANS

There are no adopted Habitat Conservation Plans (HCP), or Natural Community Conservation Plans (NCCP) associated with the Biological Study Area.

4.3.3 Impacts and Mitigation

4.3.3.1 Thresholds of Significance

In accordance with Appendix G, Section IV. Biological Resources, a project impact would be considered significant if the project would:

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 USFWS; or

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 USFWS; or

c. have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the CWA (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means; or

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; or

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, NCCP, or other approved local, regional, or State habitat conservation plan.

4.3.3.2 Impact Analysis Overview

APPROACH TO ANALYSIS

Breaching dynamics directly affect lagoon stage (water surface elevation), which in turn determines aquatic habitat volume and area, as well as water quality. Artificial breaching has disrupted seasonal flow and sediment dynamics for decades, directly impacting aquatic and terrestrial habitat. Historical, artificial breaching actions have had deleterious effects on the Lagoon habitat conditions, which differ significantly from what would have occurred with a natural opening and closing regime.

The proposed project would eliminate mechanical breaching of the Lagoon sandbar, allowing sandbar management under permitted conditions. Sandbar management would be limited to only true flooding emergencies and allow for improved hydrological and morphological processes to occur, increasing the depth and duration of inundation of the lagoon. In addition, it is anticipated that breaching at the north end of the Lagoon would facilitate a longer and more natural outflow channel, improving conditions for fish and wildlife within the Lagoon by allowing for a perched morphology and avoiding a rapid drawdown.

The Lagoon is a dynamic environment, with the depth and duration of inundation dependent on many contributing factors such as barrier beach height and geomorphology, precipitation, tide, and wind. The exact results of the implementation of the proposed project on biological resources cannot be characterized in the context of annual lagoon dynamics because the combination of factors described above interact in a unique and independent way for any given event; be it flood event or lagoon closure subsequent to the wet season. Rigorous analysis shows that the implementation of the proposed project may have little effect in the context of current conditions in some years (Balance Hydrologics, 2014). However, this analysis also shows that under certain critical circumstances the proposed project would have a significant effect on the Lagoon in reducing the number of emergency breaches, extending the depth and duration of inundation, and reducing the drawdown rate of both natural and emergency breaches. Based on an analysis of the last 20 years for which data exists, the implementation of the proposed project has the potential to increase the depth of the Lagoon by approximately two feet in the fall/early winter when the Lagoon is filling prior to first breach. The duration of this increased water surface elevation would be negligible in most years but may extend a number of days or even weeks under certain conditions (approximately 25% of the years evaluated).

Several special-status species are known or have the potential to occur within the Biological Study Area. This includes four federally listed species: CRLF, S-CCC steelhead, western snowy plover, and SBB; two State listed species: tricolored blackbird and FYLF (also a candidate species for federal listing); one candidate species for State listing: WBB; one fully protected species: white-tailed kite; six California species of special concern: Monterey dusky-footed woodrat, western burrowing owl, northern harrier,

yellow rail, Northern California legless lizard, and western pond turtle; five species on the CDFW's CNDDB "Special Animals" list: California horned lark, sharp-shinned hawk, ferruginous hawk, merlin, and osprey; and three species protected under the Marine Mammal Protection Act (MMPA): southern sea otter, harbor seal, and California sea lion. Additionally, raptors and other avian species protected under the MBTA have the potential to occur within the Biological Study Area. No special-status plant species were identified within the Biological Study Area during focused surveys, and none are expected to occur. Therefore, the proposed project would not result in impacts to special-status plant species.

Several sensitive habitats also occur within the Biological Study Area. This includes riparian habitat; Federal and coastal wetlands and other waters of the U.S. and State; active beach SBB habitat; and critical habitat for CRLF and S-CCC steelhead. The regulatory agencies with potential jurisdiction over these sensitive habitats overlap in many areas and includes the CDFW, USACE, CCC, USFWS, and RWQCB.

Although the special-status species identified above are known to or have the potential to occur within the Biological Study Area, not all species have the potential to be impacted by the proposed project. Suitable foraging habitat for the western snowy plover, yellow rail, ferruginous hawk, merlin, California brown pelican, American peregrine falcon, and osprey is present within the Biological Study Area, as well as suitable habitat for WBB is present within the Biological Study Area. However, these species are not expected to nest within the construction area and the amount of suitable foraging habitat would not be significantly affected by an increase in water surface elevation given the availability of similar habitat in the vicinity. Additionally, southern sea otters, harbor seals, and California sea lions have the potential to use the coastal strand habitat within the Biological Study Area as a haul-out or resting site; however, due to their mobility, the short duration of construction, and the continual disturbance within the area, impacts to these species would be negligible. Therefore, these species will not be discussed further.

The potential for hydroacoustic impacts to S-CCC steelhead from the proposed project was evaluated using the Caltrans *Technical Guidance for Assessment and Mitigation of Hydroacoustic Effects of Pile Driving on Fish* (Caltrans, 2015). Although Caltrans has no jurisdiction associated with the proposed project, this detailed guidance was determined to be the most appropriate to evaluate hydroacoustic impacts as the information was developed by the Fisheries Hydroacoustic Working Group (FHWG). The FHWG is composed of representatives from Caltrans, the departments of transportation in Oregon and Washington, the Northwest and Southwest offices of the NMFS, USFWS, CDFW, and USACE, and is supported by a panel of hydroacoustic and fisheries experts. The goal of the FHWG is to reach agreement on: 1) the nature and extent of knowledge about the current scientific basis for underwater noise effects on fish; 2) interim guidelines for project assessment, mitigation, and monitoring for effects of pile-driving noise on fish species; and; 3) future scientific research needed to satisfactorily resolve uncertainties regarding hydroacoustic impacts on fish species.

Construction

Proposed project construction could impact biological resources. The biological resources analysis evaluates whether the proposed project construction activities would have the potential to adversely impact special-status species, adversely impact riparian or other sensitive natural communities, or interfere with wildlife movement.

Operation

Operational or long-term impacts to biological resources may occur due to the siting of the proposed project components and operation activities. The impact analysis describes if, and to what degree, the proposed project operations would change the existing conditions described in **Section 4.3.1** and how the proposed project would comply with or exceed any regulatory requirements described in **Section 4.3.2**. The significance of an impact is determined using the criteria identified in **Section 4.3.3.1**. The proposed

ISMP project component would not result in any operational impacts as it would be discontinued subsequent to the completion of construction of the proposed EPB and SRPS project components.

AREAS OF NO IMPACT

No adopted HCPs have been developed for the Biological Study Area. Therefore, the proposed project would not conflict with the provisions of an adopted HCP and Appendix G, Section IV., Biological Resources, significance criterion "f" is not applicable to the proposed project and is not discussed further.

4.3.3.3 Impacts and Mitigation Measures

Impact BIO-1: Construction Impacts to Special-Status Species and Habitat. Proposed project construction would not have a substantial adverse effect, either directly or through habitat modification, on special-status wildlife species and their habitat within the Biological Study Area. (Criteria a, b, c, and d) (EPB: Less-than-Significant with Mitigation) (SRPS: Less-than-Significant with Mitigation) (ISMP: Less-than-Significant with Mitigation) (Project Overall: Less-than-Significant with Mitigation)

Construction of the proposed project may result in direct and indirect impacts to special-status wildlife species. Impacts to special-status wildlife species may occur due to use of heavy equipment and other construction activities that could result in the loss of individuals, soil compaction, dust, vegetation removal/loss of habitat, wildlife harassment or mortality, erosion, destruction or disturbance of nests, and introduction and spread of non-native, invasive species. Nighttime construction activities could introduce temporary nighttime lighting at the proposed EPB and SRPS project components construction locations. Most construction activities would occur during the daytime and would not result in new or increased sources of light or glare. However, extended work hours into the night could be necessary during construction of the proposed EPB and SRPS project components.

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

Construction of the proposed EPB project component may result in impacts to tricolored blackbird, northern harrier, white-tailed kite, western pond turtle, FYLF, CRLF, S-CCC steelhead, and nesting raptors and migratory bird species as suitable habitat for these species is present within and adjacent to the proposed EPB project component construction area. Additionally, the footprint of the proposed EPB project component may reduce habitat available to some species and may also result in a reduction in use of approximately 3.1 acres of habitat that would be isolated from the Lagoon by the placement of the proposed EPB project component, which may present a full or partial barrier to some species. The following is a discussion of the potential for impacts to each of these species that may result from construction of the proposed EPB project component.

Tricolored Blackbird and Northern Harrier

Tricolored blackbird and northern harrier have been observed within the Biological Study Area and suitable nesting and foraging habitat is present within the emergent marsh vegetation types within the proposed EPB project component construction area. However, neither species has been documented to nest within the area and, therefore, destruction or disturbance of nests for these species is not expected to occur. If present during the time of construction, temporary disturbance of these species may occur. However, due to the highly mobile nature of these species and the amount of suitable habitat within the Biological Study Area outside of the proposed EPB project component construction area, impacts to these species are less-than-significant.

White-Tailed Kite, Nesting Raptors, and Other Migratory Bird Species

Suitable nesting habitat for white-tailed kite, raptors, and other migratory bird species is present within the trees adjacent to the proposed EPB project component construction area. Suitable nesting habitat for tricolored blackbird and migratory bird species may also be present within the semi-permanent marsh habitat within the proposed EPB project component construction area. Construction activities may result in disturbance and destruction of nests. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a**, **BIO-1b**, and **BIO-1c** identified below.

Western Pond Turtle

Western pond turtles have the potential to occur within the emergent marsh habitat within the proposed EPB project component construction area. Direct mortality of individuals and disturbance of nests may occur as a result of construction activities. Reduced water quality in the summer lagoon, resulting from high turbidity and introduction of hydrogen sulfide from disturbance of decomposing lagoon bottom material, may impact habitat for this species. Additionally, approximately 0.1 acre of habitat for western pond turtle would be permanently removed associated with the footprint of the proposed EPB project component and a reduction in use of approximately 3.1 acres habitat that would be isolated from the Lagoon may result from the placement of the proposed EPB project component, which may present a full or partial barrier to western pond turtles. These are potentially significant impacts that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a**, **BIO-1c**, and **BIO-1d** identified below.

Foothill Yellow-Legged Frog

The proposed EPB project component does not contain suitable aquatic habitat for FYLF, which is only present within the Carmel River, and the potential for this species to use this project component for upland habitat is low because this species is rarely encountered far from the stream's edge. Therefore, direct mortality of FYLF is unlikely to result from construction activities. However, in the unlikely event that individual FYLF uses the EPB project component for upland habitat, implementation of the **Mitigation Measures BIO-1a**, **BIO-1c**, **BIO-1e**, and **BIO-1h** identified below would ensure that potential impacts to this species are avoided or minimized to a less-than-significant level.

California Red-Legged Frog

During periods of inundation, the proposed EPB project component construction area may provide suitable breeding and aquatic non-breeding habitat for CRLF. During dry periods, the proposed EPB project component construction area may provide upland or dispersal habitat for this species. Direct mortality of CRLF may occur associated with construction activities. Additionally, reduced water quality in the summer lagoon, resulting from high turbidity and introduction of hydrogen sulfide from disturbance of decomposing lagoon bottom material, may impact habitat for CRLF. Additionally, approximately 0.1 acre of CRLF habitat would be permanently removed associated with the footprint of the proposed EPB project component and a reduction in use of approximately 3.1 acres of habitat that would be isolated from the Lagoon may result from the placement of the proposed EPB project component, which may present a full or partial barrier to CRLF. These are potentially significant impacts that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a**, **BIO-1c**, **BIO-1e**, and **BIO-1h** identified below.

S-CCC Steelhead

During periods of inundation, the proposed EPB project component construction area may provide suitable habitat for this species. Trapping of juvenile S-CCC steelhead in standing water beyond the

footprint of the proposed EPB project component may occur during construction if the wetted marsh is continuous with the Lagoon within the work area. Additionally, reduced water quality in the summer lagoon, resulting from high turbidity and introduction of hydrogen sulfide from disturbance of decomposing lagoon bottom material, may impact habitat for S-CCC steelhead. Installation of the sheet piling for the proposed EPB project component may result in acoustic impacts to S-CCC steelhead if the thresholds for sound exposure level (SEL) developed by the NMFS are met or exceeded. Although the methodology for pile driving has not been identified at this time, it is likely that either a vibratory hammer or impact driver would be used. There are no established injury criteria for vibration pile driving, and resource agencies in general are not concerned that vibratory pile driving will result in adverse effects on fish (Caltrans, 2015). Therefore, if a vibratory hammer is used, no acoustic impacts to S-CCC steelhead are expected. Impacts to S-CCC steelhead that may result if SELs are met or exceeded from use of an impact hammer include alteration of behavior, auditory tissue damage, temporary hearing loss, swim bladder tear or rupture, capillary rupture in skin, neurotrauma, eye hemorrhage, or death (Caltrans, 2015). Additionally, the proposed EPB project component would result in a loss of approximately 3.1 acres of critical habitat that includes the actual footprint of the proposed EPB project component. While the habitat behind the structure (approximately 0.1 acre) would remain intact with no permanent physical impacts, it would be hydrologically separated from the Lagoon and use of the area by S-CCC steelhead would be precluded. While this area meets the technical definition of critical habitat, it is on the very margin of the Lagoon and only very rarely sees lagoon depth sufficient to be considered preferred S-CCC steelhead habitat (i.e., greater than three feet in depth). These are potentially significant impacts that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a**, **BIO-1c**, **BIO-1f**, and **BIO-1g** identified below.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

Construction of the proposed SRPS project component may result in impacts to Northern California legless lizard, white-tailed kite, as well as nesting raptors and migratory bird species, as suitable habitat for these species is present within the proposed SRPS project component construction area. The proposed SRPS project component construction area may also provide habitat for S-CCC steelhead on the occasions when the sandbar is open, and water is flowing from the Lagoon to the ocean in that area. Additionally, suitable habitat for SBB is present adjacent to the proposed SRPS project component construction area. The following is a discussion of the potential impacts to each of these species that may result from construction of the proposed SRPS project component.

Northern California Legless Lizard

The Northern California legless lizard has the potential to occur within the coastal dune scrub and ruderal coastal dune vegetation types within the proposed SRPS project component construction area. Direct mortality of Northern California legless lizard may occur associated with construction activities. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a, BIO-1c**, and **BIO-1i** identified below.

White-Tailed Kite, Nesting Raptors, and Other Migratory Bird Species

Suitable nesting habitat for white-tailed kite, raptors, and other migratory bird species is present within the trees adjacent to the proposed SRPS project component construction area. Construction activities may result in disturbance or destruction of nests. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a, BIO-1b**, and **BIO-1c** identified below.

South-Central California Coast Steelhead

During the periods that water is flowing from the Lagoon to the ocean, S-CCC steelhead may be present within the proposed SRPS project component construction area. Mortality of individual S-CCC steelhead may result from construction activities if the Lagoon is continuous with the ocean during construction. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a, BIO-1c, BIO-1f**, and **BIO-1g** identified below.

Smith's Blue Butterfly

Loss of SBB habitat and direct mortality of individuals may occur if dune buckwheat plants are damaged or removed during construction. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a, BIO-1c,** and **BIO-1i** identified below.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

The proposed ISMP project component has been designed to reduce impacts to CRLF and S-CCC steelhead. Specific measures in the proposed ISMP project component include:

- Early season coordination with NMFS and the USACE to agree upon sandbar management techniques to be implemented during the upcoming winter months, including the management location, channel configuration, target lagoon water elevations, and access.
- Following an opening action and after high inflows from the river have receded, the Lagoon shall either be allowed to naturally close or remain open with an open outlet channel flowing over the beach in a meandering channel that is designed to mute tidal influence and rapid draining of the Lagoon, which shall be maintained at a minimum six-foot water surface elevation. The river mouth and Lagoon water surface elevation will be monitored during and after the channel has been opened.
- A qualified biological fish monitor will be present during the initial opening or closure of the channel and while an outlet channel remains open and shall monitor the channel twice daily (a.m. and p.m.) to document fish entrainment, strandings, or other occurrences that pose risk to S-CCC steelhead. If stranded S-CCC steelhead are observed, the County shall contact NMFS and the CDFW to coordinate any necessary fish rescues, and regular updates shall be provided to address any action that may be necessary if a 'take' of S-CCC steelhead occurs. The monitor shall also produce a report documenting construction activities and any observation of fish mortalities and/or harm or harassment and submit to the USACE and NMFS following construction.

However, although the proposed ISMP project component reduces impacts, implementation of the proposed ISMP project component may still result in impacts to CRLF and S-CCC steelhead. The following is a discussion of the potential for impacts to each of these species that may result from implementation of the proposed ISMP project component.

California Red-Legged Frog

Direct mortality of CRLF may occur associated with the mechanical sandbar breaching actions resulting from the implementation of the proposed ISMP project component. Mechanical breaching may also result in loss of shallow water areas suitable for CRLF breeding, potential stranding of larvae and eggs, increased predation upon individuals that remain in the shallower estuary, and potential flushing of individuals into the ocean. While the proposed ISMP project component is focused specifically to avoid and minimize, to the greatest extent feasible, potential impacts to CRLF which may occur with its implementation, these

are potentially significant impacts that can be reduced to a less-than-significant level with implementation of the **Mitigation Measure BIO-1e** and **BIO-1h** identified below.

South-Central California Coast Steelhead

Mechanical sandbar breaching may result in loss of juvenile S-CCC steelhead rearing habitat, potential stranding of juveniles, increased predation upon juveniles that remain in the shallower estuary, premature flushing of juvenile into the ocean to cause osmotic stress, and mortality or reduced survival to adulthood due to smaller size. These are potentially significant impacts that can be reduced to a less-than-significant level with implementation of the **Mitigation Measure BIO-1g** and **BIO-1h** identified below.

Impact Conclusion

The proposed project construction/implementation could result in impacts to special-status species due to construction activities at the proposed EPB and SRPS project components construction sites and the proposed ISMP project component implementation area. Impacts to special-status species would be a potentially significant impact. Implementation of **Mitigation Measures BIO-1a** through **BIO-1i**, as specified for each component, would reduce potentially significant impacts to special-status species during construction/implementation to a less-than-significant level.

Mitigation Measures

Mitigation Measure BIO-1a: Implement Construction Best Management Practices (Applies to EPB and SRPS project components). The following BMPs reduce impacts to special-status wildlife species:

1) A qualified biologist will conduct an Employee Education Program for the construction crew prior to any construction activities. A qualified biologist will meet with the construction crew at the onset of construction at the project site to educate the construction crew on the following: 1) the appropriate access route(s) in and out of the construction area and review project boundaries; 2) how a biological monitor will examine the area and agree upon a method which will ensure the safety of the monitor during such activities, 3) the special-status species and sensitive habitats that are known to occur or that may be present, their habitat, and proper identification; 4) the specific mitigation measures that will be incorporated into the construction effort; 5) the general provisions and protections afforded by the USFWS and CDFW; and 6) the proper procedures if a special-status species is encountered within the project site.

2) Protective fencing will be placed prior to and during construction to keep construction equipment and personnel from impacting vegetation outside of work limits. A biological monitor will supervise the installation of protective fencing and monitor at least once per week until construction is complete to ensure that the protective fencing remains intact. Orange cyclone fencing, or other materials that can entrap CRLF and other special-status species, shall not be used.

3) Following construction, disturbed areas will be restored to pre-project contours to the maximum extent possible and revegetated. A Revegetation Plan shall be prepared for the project that shall include, but not be limited to, the following:
   - the use of locally-occurring native species and native erosion control seed mix appropriate for the habitat(s) disturbed, including riparian, wetland, and/or other sensitive natural communities;

- procedures to control non-native species invasion and elimination of existing non-native species within the area of impact;
- provisions to ensure compliance with the requirements of the plan; and
- a monitoring program that describes annual monitoring efforts which incorporate success criteria and contingency plans if success criteria are not met.

4) Grading, excavating, and other activities that involve substantial soil disturbance will be planned and carried out in consultation with a qualified hydrologist, engineer, or erosion control specialist, and will utilize standard erosion control and slope stabilization techniques in satisfaction of Monterey County erosion control guidelines to minimize erosion of slopes and sedimentation to native vegetation and special-status species habitat (pre-, during, and post-construction). If silt fencing is required, only high-quality reinforced silt fencing shall be used and efforts shall be made to install it in a way that does not inhibit movements of special-status species. Openings shall be created approximately every 100 feet.

5) No firearms or pets will be allowed on the project site at any time.

6) All food-related and other trash will be disposed of in closed containers and removed from the project area at least once a week during the construction period, or more often if trash is attracting avian or mammalian predators. Following construction, all trash and construction debris shall be removed from work areas and disposed of properly. Construction personnel will not feed or otherwise attract wildlife to the area.

7) To prevent inadvertent entrapment of special-status wildlife during the proposed project, all excavated, steep-walled holes or trenches more than two feet deep will be covered at the close of each working day with plywood or similar materials. Before such holes or trenches are filled, they will be thoroughly inspected for trapped animals.

8) Cleaning and refueling of equipment and vehicles shall occur only within designated staging areas. No maintenance, cleaning or fueling of equipment shall occur within wetland, riparian, or other sensitive habitat areas and, at a minimum, all equipment and vehicles will be checked and maintained on a daily basis to ensure proper operation and avoid potential leaks or spills. During construction, all construction-related spills of hazardous materials within or adjacent to the construction site will be cleaned up immediately. Spill prevention and clean-up materials shall be onsite at all times during construction. Construction materials/debris will also be stored within the designated staging areas. No debris, soil, silt, sand, oil, petroleum products, cement, concrete, or washings thereof shall be allowed to enter into, or be placed where they may be washed by rainfall or runoff, into wetland, riparian, or other sensitive habitats. A spill response and prevention plan shall be implemented as outlined in the required Storm Water Pollution Prevention Plan (SWPPP). Please refer to the **Impact HYD-3** discussion in **Section 4.8, Hydrology/Water Quality**.

9) If necessary to work during the nighttime, construction lighting shall be focused and downward directed to preclude night illumination of adjacent habitats.

10) The following measures will be implemented to reduce the introduction and spread of non-native, invasive species:
    - Any landscaping or replanting required for the project will not use species listed as noxious by the California Department of Food and Agriculture (CDFA).
    - Bare and disturbed soil will be landscaped with CDFA recommended seed mix or plantings from locally adopted species to preclude the invasion of noxious weeds in the project site.

- Construction equipment will be cleaned of mud or other debris that may contain invasive plants and/or seeds and inspected to reduce the potential of spreading noxious weeds, before mobilizing to arrive at the construction site and before leaving the construction site.
- All non-native, invasive plant species will be removed from disturbed areas prior to replanting.

Mitigation Measure BIO-1b: <u>Conduct Pre-Construction Surveys for White-Tailed Kite, Nesting Raptors, and Other Migratory Bird Species</u> (Applies to EPB and SRPS project components). Construction activities that may directly (e.g., vegetation removal) or indirectly (e.g., noise/ground disturbance) affect protected nesting avian species will be timed to avoid the breeding and nesting season. Specifically, vegetation and/or tree removal can be scheduled after September 16 and before January 31. Alternatively, a qualified biologist will be retained by the project applicant to conduct pre-construction surveys for nesting raptors and other protected avian species within 500 feet of proposed construction activities if construction occurs between February 1 and September 15. Pre-construction surveys will be conducted no more than 14 days prior to the start of construction activities during the early part of the breeding season (February through April) and no more than 30 days prior to the initiation of these activities during the late part of the breeding season (May through August). Because some bird species nest early in spring and others nest later in summer, surveys for nesting birds may be required to continue during construction to address new arrivals, and because some species breed multiple times in a season. The necessity and timing of these continued surveys will be determined by the qualified biologist based on review of the final construction plans and in coordination with the USFWS and CDFW, as needed.

If raptors or other protected avian species nests are identified during the pre-construction surveys, the qualified biologist will notify the project applicant and an appropriate no-disturbance buffer will be imposed within which no construction activities or disturbance should take place (generally 300 feet in all directions for raptors; other avian species may have species-specific requirements) until the young of the year have fledged and are no longer reliant upon the nest or parental care for survival, as determined by a qualified biologist.

Mitigation Measure BIO-1c: <u>Implement Construction-Phase Monitoring</u> (Applies to EPB and SRPS project components). The Project Proponent shall retain a qualified biologist to monitor all ground disturbing construction activities (i.e., vegetation removal, grading, excavation, or similar activities) to protect any special-status species encountered. Any handling and relocation protocols of special-status wildlife species shall be determined in coordination with the CDFW prior to any ground disturbing activities and conducted by a qualified biologist with appropriate scientific collection permit. After ground disturbing project activities are complete, the qualified biologist shall train an individual from the construction crew to act as the on-site construction biological monitor. The construction biological monitor shall be the contact for any special-status wildlife species encounters, shall conduct daily inspections of equipment and materials stored on site and any holes or trenches prior to the commencement of work, and shall ensure that all installed fencing stays in place throughout the construction period. The qualified biologist shall then conduct regular scheduled and unscheduled visits to ensure the construction biological monitor is satisfactorily implementing all appropriate mitigation protocols. Both the qualified biologist and the construction biological monitor shall have the authority to stop and/or redirect project activities to ensure protection of resources and compliance with all environmental permits and conditions of the project. The qualified biologist and the construction monitor shall complete

a daily log summarizing activities and environmental compliance throughout the duration of the project. The log shall also include any special-status wildlife species observed and relocated.

Mitigation Measure BIO-1d: Avoid and Minimize Impacts to Western Pond Turtle (Applies to EPB project component). A qualified biologist shall survey suitable habitat no more than 48 hours before the onset of work activities at the EPB project component site for the presence of western pond turtle. If pond turtles are found and these individuals are likely to be killed or injured by work activities, the biologist shall be allowed sufficient time to move them from the site before work activities begin. The biologist shall relocate the pond turtles the shortest distance possible to a location that contains suitable habitat and would not be affected by activities associated with the project.

Mitigation Measure BIO-1e: Avoid and Minimize Impacts to FYLF and CRLF (Applies to EPB and ISMP project components). The following measures for avoidance and minimization of adverse impacts to FYLF and CRLF during construction of the EPB and ISMP project components are those typically employed for construction activities that may result in short-term impacts to individuals and their habitat. The focus of these measures is on scheduling activities at certain times of year, keeping the disturbance footprint to a minimum, and monitoring.

1) Construction activities shall occur during the dry season within a work window determined in consultation with the CDFW and USFWS. No work shall occur within areas where standing water is present at the time of construction.

2) During ground disturbing and vegetation removal activities, a CDFW- and USFWS-approved biologist shall survey appropriate areas of the construction site daily before the onset of work activities for the presence of FYLF and CRLF. Vegetation shall initially be removed by hand (brush-cutters, weed whackers, and chainsaws). Piles of woody debris shall be cleared by hand. Larger debris will only be moved after being inspected by the CDFW- and USFWS-approved biologist. The CDFW- and USFWS-approved biologist shall remain at the work site until all ground disturbing activities are completed. If any life stage of the FYLF and/or the CRLF is found and these individuals are likely to be killed or injured by work activities, the CDFW- and USFWS-approved biologist shall stop work in that area and relocate the FYLF or CRLF the shortest distance possible to an area that contains suitable habitat and will not be affected by construction activities. The CDFW- and USFWS-approved biologist shall maintain detailed records of any individuals that are moved (e.g., size, coloration, any distinguishing features, photographs [digital preferred]) to assist him or her in determining whether translocated animals are returning to the original point of capture. Only CDFW- and USFWS-approved biologists shall participate in activities associated with the capture, handling, and monitoring of FYLF and CRLF.

3) After ground disturbing and vegetation removal activities are complete, the CDFW- and USFWS-approved biologist will designate a person to monitor on-site compliance with all avoidance and minimization measures. The CDFW- and USFWS-approved biologist shall ensure that this monitor receives sufficient training in the identification of FYLF and CRLF. The monitor or the CDFW- and USFWS-approved biologist is authorized to stop work if the avoidance and/or minimization measures are not being followed. If work is stopped, the CDFW and USFWS shall be notified.

Mitigation Measure BIO-1f: Avoid or Reduce Hydroacoustic Impacts to S-CCC Steelhead (Applies to EPB project component). The following measures for avoidance and minimization of adverse impacts to S-CCC steelhead resulting from noise attenuation during construction of the EPB

project component are those typically employed for construction activities that may result in short-term hydroacoustic impacts to fish.

1) A vibratory hammer shall be used for pile driving to the greatest extent feasible.

2) If necessary, an impact hammer may be used. If an impact driver is used, a hydroacoustic impact assessment would need to be conducted, based on assumptions regarding the number, size, and location of piles along with the number of impact strikes that could occur in a single day, to determine if SELs are met or exceeded that would result in an impact to S-CCC steelhead. The impact assessment shall follow guidance provided in the most current Caltrans *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* and the NMFS Pile Driving Calculations Spreadsheet. If it is determined that pile driving will result in impacts to S-CCC steelhead, an Underwater Noise Monitoring Plan consistent with the most current FHWG template shall be developed and approved by the NMFS prior to the start of construction. The plan will include monitoring and reporting of underwater sound levels in the Lagoon and/or River during the initiation of construction to detect if underwater noise levels meet or exceed established impact thresholds. The plan will also include feasible measures to reduce noise levels below established thresholds if necessary based on the monitoring results.

Mitigation Measure BIO-1g: Avoid and Minimize Impacts to S-CCC Steelhead (Applies to EPB and SRPS project components). The following measures for avoidance and minimization of adverse impacts to S-CCC steelhead during construction of the EPB and SRPS project components are those typically employed for construction activities that may result in short-term impacts to individuals and their habitat. The focus of these measures is on scheduling activities at certain times of year, keeping the disturbance footprint to a minimum, and monitoring.

1) Construction activities shall occur during the dry season within a work window determined in consultation with the NMFS. No work shall occur within areas where standing water is present at the time of construction.

2) All applicable measures outlined in the attached CDFW Avoidance and Minimization Measures (Appendix H of the Biological Resources Report[7]) shall be implemented.

Mitigation Measure BIO-1h: Reduce Impacts to FYLF, CRLF, and S-CCC Steelhead (Applies to ISMP project component). A monitoring and reporting program will be developed in consultation with the USFWS and NMFS prior to the initiation of construction and will be implemented to document the effects of the ISMP project component and inform an adaptive management approach for the duration of the permit. The monitoring program will assess breeding/rearing conditions and relative numbers and distribution of FYLF (if observed within the site), CRLF and S-CCC steelhead, and degree of smoltification of S-CCC steelhead throughout the year and in response to lagoon sandbar management activities.

Mitigation Measure BIO-1i: Avoid and Minimize Impacts to SBB (Applies to SRPS project component). The following measures for avoidance and minimization of adverse impacts to SBB during construction of the SRPS project component are those typically employed for construction activities that may result in impacts to individuals and their habitat. The focus of these measures is on keeping the disturbance footprint to a minimum, restoration, and monitoring.

[7] The Biological Resources Report is contained in **Appendix E** of this RDEIR.

1) Dune buckwheat plants that are not scheduled for removal as a result of project activities will be protected by exclusionary fencing. The fencing shall be installed prior to any grubbing or construction activities associated with the project. No construction activities or equipment will be allowed within the fencing. A qualified biologist shall be onsite during the fence installation. Once these activities are completed for this area, the monitor will visit the site as needed until project completion to ensure that the exclusionary fencing is properly maintained throughout construction activities.
2) Dune buckwheat plants that will be impacted, as well as the duff and/or soils underneath the plants, will be hand removed prior to disturbance by a USFWS-approved biologist and placed as close as possible to, but not on, living dune buckwheat plants within the exclusionary fencing installed around existing plants not scheduled for removal. The number of plants removed shall be counted and the area of disturbance measured.
3) Impacts to SBB that occur as a result of the removal of obligate host plants will be mitigated by replanting disturbed areas upon the completion of construction activities. Following construction, locally sourced seedlings shall be planted at a 2:1 ratio. Planting shall occur in the fall after the first rain.
4) A qualified biologist or restoration specialist shall monitor the planting areas annually for three years. Success criteria for buckwheat plantings are as follows:

    - The percentage of dune buckwheat plants that survive is greater than 75% in the first year and 50% at year three.

    If the criteria are not met, the need for additional planting to achieve success at the end of the three-year monitoring period shall be evaluated.

    After each inspection, a report shall be submitted to the USFWS. The report shall quantify the state of the restoration and shall include photographic documentation, as well as recommendations for further maintenance and management that may be necessary for maintaining the success criteria.

Impact BIO-2: <u>Construction Impacts to Sensitive Habitats.</u> Proposed project construction would not have a substantial adverse effect on sensitive habitats (including riparian, wetlands, and/or other sensitive natural communities) within the Biological Study Area. (Criteria b and c) (EPB: Less-than-Significant with Mitigation) (SRPS: Less-than-Significant with Mitigation) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant with Mitigation)

Several sensitive habitats were identified within the Biological Study Area. Construction of the proposed project may result in direct and indirect impacts to sensitive habitats (defined herein to include any riparian habitat, federally protected wetlands as defined by Section 404 of the CWA, waters of the State protected under the Porter-Cologne Act, critical habitat for federally listed species, sensitive vegetation types on the CDFW's *Natural Communities List* [CDFW, 2023a], or areas potentially considered ESHA by the CCC[8]). Impacts to sensitive habitats may include direct and indirect impacts associated with

[8] Under Section 30107.5 of the Coastal Act, an "environmentally sensitive habitat area" is any area in which plant or animal life or their habitat are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. Therefore, the CCC may designate additional habitat areas within the Biological Study Area as ESHA if the CCC determines that it meets this definition.

construction activities that could result in the direct loss of habitat, soil compaction, root damage, erosion, and introduction and spread of non-native, invasive species. These are potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measures identified below.

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

Wetlands potentially under the jurisdiction of the USACE and CCC are present within the proposed EPB project component construction area. The portions of the wetlands identified as seasonal emergent marsh and riparian support vegetation characteristic of Pacific silverweed marsh and arroyo willow thickets, respectively, as described in the *Manual of California Vegetation* (Sawyer et al., 2009), which are identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). Additionally, portions of the proposed EPB project component construction area are considered Federal critical habitat for CRLF and S-CCC steelhead and may be considered waters of the State by the RWQCB and ESHA by the CCC. Impacts to sensitive habitats may include direct and indirect impacts associated with heavy equipment and construction activities that could result in disturbance of habitat, soil compaction, dust, erosion, and introduction and spread of non-native, invasive species. These sensitive habitats, as well as riparian habitat, are also present adjacent to the proposed EPB project component construction area and may be impacted by erosion and sedimentation that could result from the construction activities. The following identifies the area of potential direct and indirect impacts to each of these sensitive habitats that may result from construction of the proposed EPB project component.[9]

Federal and Coastal Wetlands and Waters of the State

Approximately 2.7 acres of potential Federal wetland and three acres of potential coastal wetland are present within the proposed EPB project component construction area and may be temporarily disturbed during construction activities. Coastal wetlands may also be considered waters of the State. Approximately 1.5 acres of the wetlands within the proposed EPB project component construction area support vegetation characteristic of "Pacific silverweed marsh," which is identified as sensitive on the CDFW's *Natural Communities List* (CDFW, 2023a). Approximately 0.1 acre of wetlands would be permanently removed for the placement of the proposed EPB project component. Additionally, approximately 2.1 acres of wetlands (1.1 acres of which support vegetation characteristic of "Pacific silverweed marsh") would be isolated from the other portions of the Lagoon by the proposed EPB project component. The 2.1 acres of wetland area that would be isolated behind the proposed EPB project component would not be lost because of the proposed project; however, the 2.1 acres of wetlands isolated by the proposed EPB project component may undergo a conversion of wetland type based on a change in hydrologic conditions.

The exact results of this isolation on wetland resources cannot be characterized because the combination of precipitation, runoff, infiltration, evaporation, and other environmental factors above interact in a unique and independent way for any given year. Balance Hydrologics (2015) provided a summary of the estimated hydrologic conditions on the interior side of the proposed EPB project component, which identified that surface and shallow groundwater flows from the upland drainage would be the primary contributor to ponding on the landward side of the proposed EPB project component during the rainy season. The summary estimated that during wetter than average years, water landward of the proposed EPB project component would likely remain at or slightly above the proposed culvert invert and pump trigger elevation of 10.5 feet over extended periods of time (weeks or months); during periods of drought,

[9] Please note that the area of each of these types of sensitive habitat overlaps spatially; however, the acreage of each sensitive habitat type is provided in order to identify the areas potentially under the jurisdiction of each regulatory agency.

water levels may recede below seven feet in elevation, leaving the landward side of the proposed EPB project component completely dry for short periods of time (days or weeks). During the dry season, groundwater would be the primary source of inflow to the landward side of the proposed EPB project component; water levels are anticipated to track very closely to water levels in the Lagoon with a head differential expected to be less than one foot during periods of relatively static water surface elevation. Ponding depths during the dry season are expected to be similar to those during periods of drought during the rainy season, as described above, which is comparable to existing conditions. Therefore, because the proposed EPB project component would impound water on the north side of the wall from precipitation and runoff, it is unlikely that a loss of wetlands would result from the isolation from the Lagoon. However, there may be a habitat type conversion in this area as the water impounded would be freshwater instead of brackish. Additionally, some areas may pond for longer durations, resulting in areas of unvegetated open water.

Although the function of the proposed EPB project component has the potential to increase the depth of the Lagoon by approximately two feet in the fall/early winter when the Lagoon is filling prior to first breach, which may increase and improve the area of wetlands within the Biological Study Area, the impacts identified above are potentially significant. These impacts can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a** identified above and **BIO-2** identified below.

Riparian

Approximately 0.1 acre of riparian habitat is present within the proposed EPB project component construction area and may be temporarily disturbed during construction. Although the function of the proposed EPB project component has the potential to increase the depth of the Lagoon by approximately two feet in the fall/early winter when the Lagoon is filling prior to first breach, which may increase the area of riparian vegetation within the Biological Study Area, this would be a potentially significant impact. This impact can be reduced to a less-than-significant level with implementation of **Mitigation Measures BIO-1a** identified above and **BIO-2** identified below.

California Red-Legged Frog Critical Habitat

Approximately 4.3 acres of CRLF critical habitat is present within the construction area for the proposed EPB project component and may be temporarily disturbed during construction activities. Approximately 0.1 acre of CRLF critical habitat would be permanently removed for the placement of the proposed EPB project component. Additionally, approximately 3.1 acres of CRLF critical habitat would be isolated from the other portions of the Lagoon by the proposed EPB project component, which may result in the loss of CRLF critical habitat. However, the purpose of the proposed EPB project component is to promote improvement in ecological function of the Lagoon, including natural floodplain function and improvement of habitat for federally listed species (including CRLF) associated with the Lagoon, by allowing the Lagoon to breach naturally. As such, the impacts identified above are less-than-significant in light of the overall benefits of the proposed EPB project component.

South-Central California Coast Steelhead Critical Habitat

Approximately 4.3 acres of S-CCC steelhead critical habitat is present within the construction area for the proposed EPB project component and may be temporarily disturbed during construction activities. Approximately 0.1 acre of S-CCC steelhead critical habitat would be permanently removed for the placement of the proposed EPB project component. Additionally, approximately 3.1 acres of S-CCC steelhead critical habitat would be isolated from the other portions of the Lagoon by the proposed EPB project component, which may result in the loss of S-CCC steelhead critical habitat. However, the purpose of the proposed EPB project component is to promote improvement in ecological function of the Lagoon,

including natural floodplain function and improvement of habitat for federally listed species (including S-CCC steelhead) associated with the Lagoon, by allowing the Lagoon to breach naturally. As such, the impacts identified above are less-than-significant in light of the overall benefits of the proposed EPB project component.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

Other waters of the U.S. potentially under the jurisdiction of the USACE and waters of the State potentially under the jurisdiction of the RWQCB are present within the construction area for the proposed SRPS project component. These areas are also considered federal critical habitat for CRLF and S-CCC steelhead. Active beach (which includes coastal strand, coastal dune scrub, dune swale wetland, and ruderal coastal dune areas) area also present within the proposed SRPS project component construction area and may be considered ESHA by the CCC. Additionally, the host plant species (dune buckwheat) for SBB is present within the coastal dune scrub habitat within the proposed SRPS project component construction area. Impacts to these sensitive habitats may include direct and indirect impacts associated with heavy equipment and construction activities that could result in disturbance of habitat, soil compaction, dust, erosion, and introduction and spread of non-native, invasive species. These are potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measures identified below. The following identifies the area of potential direct impact to each of these sensitive habitats that may result from construction of the proposed SRPS project component.

Other Waters of the U.S. & Waters of the State

Approximately 0.3 acres of potential other waters of the U.S. are present within the proposed SRPS project component construction area that may be temporary impacted during construction activities. This area may also be considered waters of the State. Construction of the proposed SRPS project component would not result in permanent loss of potentially other waters of the U.S. or waters of the State; however, indirect impacts associated with erosion may occur. This would be a potentially significant impact that can be reduced to less-than-significant with implementation of **Mitigation Measures BIO-1a** identified above and **BIO-2** identified below.

Active Beach

Approximately 2.4 acres of active beach is present within the proposed SRPS project component construction area and may be temporarily impacted during construction activities. Regions of active beach would return after construction and continue to vary seasonally. This would be a less-than-significant impact.

Smith's Blue Butterfly Habitat

Approximately 0.2 acre of the host plant species (dune buckwheat) for SBB is present within the coastal dune scrub habitat within the proposed SRPS project component construction area. Loss of SBB habitat may occur if dune buckwheat plants are damaged or removed during construction. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a** and **BIO-1i** identified above.

California Red-Legged Frog Critical Habitat

Approximately 0.3 acre of CRLF critical habitat is present within the construction area for the proposed SRPS project component and may be temporarily disturbed during construction activities. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a** and **BIO-1e** identified above.

South-Central California Coast Steelhead Critical Habitat

Approximately 0.3 acre of S-CCC steelhead critical habitat is present within the construction area for the proposed SRPS project component and may be temporarily disturbed during construction activities. This would be a potentially significant impact that can be reduced to a less-than-significant level with implementation of the **Mitigation Measures BIO-1a** and **BIO-1g** identified above.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

Other waters potentially under the jurisdiction of the USACE and RWQCB are present within the implementation area for the proposed ISMP project component. Active beach (which includes coastal strand, coastal dune scrub, dune swale wetland, and ruderal coastal dune areas), which may be considered ESHA by the CCC, and critical habitat for CRLF and S-CCC steelhead is present within the proposed ISMP project component implementation area. Impacts to sensitive habitat may include direct and indirect impacts associated with mechanical sandbar breaching, such as loss of suitable breeding habitat for CRLF and S-CCC steelhead. The proposed ISMP project component is focused specifically to avoid and minimize, to the greatest extent feasible, potential impacts to CRLF and S-CCC steelhead habitat. As such, these impacts are less-than-significant.

Impact Conclusion

The proposed project construction/implementation could result in impacts to sensitive habitats, including riparian, wetlands, and/or other sensitive natural communities, due to construction activities at the proposed EPB and SRPS project components construction sites and the proposed ISMP project component implementation area. Impacts to sensitive habitats is a potentially significant impact. Implementation of **Mitigation Measures BIO-1a** through **BIO-1e, BIO-1g, BIO-1i,** and **BIO-2** would reduce potentially significant impacts to sensitive habitats during construction/implementation to a less-than-significant level.

Mitigation Measure

Mitigation Measure BIO-2: Avoid and Minimize Impacts to Federal and Coastal Wetlands, Other Waters of the U.S., Waters of the State, Riparian Habitat, and Seasonal Emergent Marsh (Applies to EPB and SRPS project components). The following measures reduce impacts to Federal and coastal wetlands, other waters of the U.S., waters of the State, riparian habitat, and seasonal emergent marsh:

A 404 permit shall be obtained from the USACE, a 401 permit shall be obtained from the RWQCB, and a coastal development permit shall be obtained from the CCC prior to any ground disturbance or other construction activities. All requirements of the permits shall be followed. If permit requirements differ or conflict with the mitigation measures in the Final EIR, the permit requirements will take precedence. The project applicant shall comply with all applicable local, State, and Federal regulations related to impacts to the sensitive habitat types of riparian habitat and seasonal emergent marsh, including local tree removal ordinances and/or Section 1602 of California Fish and Game Code. All permits and/or authorizations will be required prior to issuance of a grading permit.

Impacts to Federal and coastal wetlands, other waters of the U.S., waters of the State, riparian habitat, and emergent marsh shall be avoided to the greatest extent possible (e.g., through timing of construction, site design, monitoring). Issuance of the permits identified above typically requires the preparation and implementation of a Habitat Mitigation and Monitoring Plan (HMMP) to mitigate for the impacts to Federal and coastal wetlands and/or other sensitive habitat including riparian and seasonal emergent marsh. The HMMP shall detail

mitigation for temporary and permanent impacts to Federal and coastal wetlands, which are typically replaced at a 3:1 ratio for in-kind, on-site mitigation (e.g., higher mitigation ratios may be required for out-of-kind, off-site mitigation). Impacted riparian habitat would be mitigated at a 1:1 replacement-to-loss ratio. The final mitigation amounts will be determined during the design phase. The HMMP generally includes the following:

- Details of the engineering and hydrological components necessary to maintain and/or recreate wetland function in the designated mitigation area;
- Applicable planting details which include the use of local native plant species and the location and planting size of all planting stock;
- Procedures to control non-native species invasion;
- Provisions to ensure compliance with the requirements of the mitigation plan;
- An irrigation plan, if necessary;
- Description of a 5-year monitoring program, including specific methods of vegetation monitoring, data collection and analysis, restoration goals and objectives, success criteria, adaptive management if the criteria are not met, and a funding mechanism; and
- An outline of the specific content for monitoring reports that will be submitted to the resource agencies annually.

The HMMP will provide sufficient content and information to ensure implementation of restoration measures will reduce identified significant impacts to Federal and coastal wetlands, riparian habitat, and seasonal emergent marsh to a less-than-significant level. The HMMP shall be finalized as part of the regulatory permitting process and must be approved by the USACE, CDFW, CCC, and RWQCB prior to issuance of the grading permit. The HMMP shall be prepared by a qualified biologist and implemented by the project applicant or its contractor(s) under the supervision of a qualified restoration practitioner/biologist. This HMMP could be combined with the revegetation plan included in **Mitigation Measure BIO-1a**, as determined appropriate.

Impact BIO-3: <u>Construction Impacts to Movement of Native Wildlife and Native Wildlife Nursery Sites.</u> Proposed project construction would not adversely affect native wildlife corridors and wildlife nursery sites. (Criterion d) (EPB: Less-than-Significant with Mitigation) (SRPS: Less-than-Significant with Mitigation) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant with Mitigation)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

Direct impacts to S-CCC steelhead and CRLF nursery sites are the same as those identified above in the **Impact BIO-2: Construction Impacts to Sensitive Habitats**. Implementation of **Mitigation Measures BIO-1a, BIO-1e, BIO-1g**, and **BIO-2** would be implemented to reduce impacts to S-CCC steelhead and CRLF movement and nursery sites resulting from construction of the proposed EPB project component.

<u>PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT</u>

Direct impacts to S-CCC steelhead and CRLF nursery sites are the same as those identified above in the **Impact BIO-2: Construction Impacts to Sensitive Habitats**. Implementation of **Mitigation Measures BIO-**

1a, BIO-1e, BIO-1g, and **BIO-2** would be implemented to reduce impacts to S-CCC steelhead and CRLF movement and nursery sites resulting from construction of the proposed SRPS project component.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

Direct impacts to S-CCC steelhead and CRLF nursery sites are the same as those identified above in the **Impact BIO-2: Construction Impacts to Sensitive Habitats**. The proposed ISMP project component would be focused specifically to avoid and minimize, to the greatest extent feasible, potential impacts to CRLF and S-CCC steelhead habitat. As such, these impacts are less-than-significant.

Impact Conclusion

The proposed project construction could result in impacts to movement of native wildlife and native wildlife nursery sites, due to construction activities at the proposed EPB and SRPS project components construction sites and the proposed ISMP project component implementation area. Impacts to movement of native wildlife and native wildlife nursery sites as a result of implementation of the proposed ISMP project component would be less-than-significant. Impacts to movement of native wildlife and native wildlife nursery sites, resulting from construction of the proposed EPB and SRPS project components, is a potentially significant impact. Implementation of **Mitigation Measures BIO-1a, BIO-1e, BIO-1g**, and **BIO-2** would reduce potentially significant impacts to movement of native wildlife and native wildlife nursery sites during construction to a less-than-significant level.

Impact BIO-4: Operational Impacts to Special-Status Species and Habitat. Proposed project operations would not adversely affect, either directly or through habitat modification, special-status plant and wildlife species and their habitat within the Biological Study Area. (Criteria a, b, c, and d) (EPB: Beneficial Impact) (SRPS: Beneficial Impact) (ISMP: No Impact) (Project Overall: Beneficial Impact)

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

The function of the proposed EPB project component is intended to improve and increase habitat for special-status wildlife species known or with the potential to occur in the Biological Study Area. The proposed EPB project component is expected to result in the following impacts:

1) Higher frequency of natural sandbar breaches;
2) a reduction in frequency of mechanical breaching; and
3) increased depth and duration of inundation within the Lagoon.

A more naturally functioning lagoon ecosystem would result in a higher water surface elevation for longer periods within the Lagoon. This may also increase the amount of emergent marsh, riparian, and other sensitive vegetation types influenced by hydrology that provide habitat for many common and special-status species. Special-status species that may occur within areas affected by an increase in water surface elevation include Monterey-dusky-footed woodrat, tricolored blackbird, California horned lark, white-tailed kite, sharp-shinned hawk, nesting raptors and migratory bird species, Northern California legless lizard, western pond turtle, CRLF, S-CCC steelhead, and SBB. Further, the Biological Opinion issued by the USFWS determined that no long-term effects to the overall population, breeding, and reproductive capacity, and recovery of CRLF would occur from the operation of the proposed project (USFWS, 2017). This would be a beneficial impact.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The function of the proposed SRPS project component is intended to improve and increase habitat for special-status wildlife species known or with the potential to occur in the Biological Study Area. The function of the proposed SRPS project component is expected to result in the following:

1) More northerly breaches of the barrier beach during the rainy season than the existing condition would result in relatively long channel alignments and drawdown over a longer period, resulting in a higher water surface elevation that would increase the amount of aquatic habitat and may reduce the potential for lagoon species to be drawn out into the ocean;
2) a more naturally functioning lagoon ecosystem resulting in a higher ratio of fresh water to salt water; and
3) a more naturally functioning lagoon ecosystem.

Further, the Biological Opinion issued by the USFWS determined that no long-term effects to the overall population, breeding, and reproductive capacity, and recovery of CRLF would occur from the operation of the proposed project (USFWS, 2017). In addition, NMFS determined in its Biological Opinion that the proposed SRPS is not likely to jeopardize the continued existence of S-CCC steelhead and is not likely to destroy or adversely modify S-CCC steelhead designated critical habitat (NMFS, 2019). This would be a beneficial impact.

Impact Conclusion

Impacts to special-status species due to operation of the proposed EPB and SRPS project components would be beneficial. No mitigation measures would be required.

Impact BIO-5: Operational Impacts to Sensitive Habitats. Proposed project operations would not adversely affect sensitive habitats (including riparian, wetlands, and/or other sensitive natural communities) within and adjacent to the Biological Study Area. (Criteria b and c) (EPB: Beneficial Impact) (SRPS: Beneficial Impact) (ISMP: No Impact) (Project Overall: Beneficial Impact)

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

The function of the proposed EPB project component is intended to improve and increase sensitive habitats within the Biological Study Area. The proposed EPB project component is expected to result in the following impacts:

1) Higher frequency of natural sandbar breaches.
2) A reduction in frequency of annual mechanical breaching.
3) Increased depth and duration of inundation within the Lagoon.

A more naturally functioning lagoon ecosystem would result in a higher water surface elevation for longer periods of time within the Lagoon. This may also increase the amount of emergent marsh, riparian, habitat for special-status species, and other sensitive habitat types influenced by hydrology. This would be a beneficial impact.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The function of the proposed SRPS project component is intended to improve and increase sensitive habitats within the Biological Study Area. The function of the proposed SRPS project component is expected to result in the following:

1) More northerly breaches of the barrier beach during the rainy season than the existing condition would result in relatively long channel alignments and drawdown over a longer period, resulting in a higher water surface elevation that would increase the amount of aquatic habitat and may reduce the potential for lagoon species to be drawn out into the ocean.
2) A more naturally functioning lagoon ecosystem resulting in a higher ratio of fresh water to salt water.
3) A more naturally functioning lagoon ecosystem.

This would be a beneficial impact.

Impact Conclusion

Impacts to sensitive habitats, including riparian, wetlands, and/or other sensitive natural communities, due to operation of the proposed EPB and SRPS project components would be beneficial. No mitigation measures would be required.

Impact BIO-6: <u>Operational Impacts to Movement of Native Wildlife and to Native Wildlife Nursery Sites.</u> Proposed project operations would not adversely affect native wildlife corridors and wildlife nursery sites. (Criterion d) (EPB: Beneficial Impact) (SRPS: Beneficial Impact) (ISMP: No Impact) (Project Overall: Beneficial Impact)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

Implementation of the proposed EPB project component would improve and increase movement and nursery sites for native wildlife within the Lagoon. This would be a beneficial impact.

The pumps associated with the proposed EPB project component would be located on the landward side of the proposed EPB project component. Pump intakes would be screened in a manner to reduce the risk of sucking species into the pumps. Noise as a result of the operation of the pumps associated with the proposed EPB project component are not expected to have a significant impact on wildlife as the pumps would not be in continuous operation. Pumps would operate when water levels on the landward side of the proposed EPB project component reached a certain depth. Additionally, as the pumps would be submerged and located below grade within a concrete vault, operational noise levels outside of the vault would be reduced. Furthermore, given the mobility of wildlife and the conditions under which the pumps would operate, wildlife would have the ability to move away from the pumps to avoid impacts associated with the noise of the pump operations.

<u>PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT</u>

Function of proposed SRPS project component would improve native wildlife movement and nursery sites. This would be a beneficial impact.

Impact Conclusion

Impacts to movement of native wildlife and to native wildlife nursery sites due to operation of the proposed EPB and SRPS project components would be beneficial. No mitigation measures are required.

4.3.4 References

Arnold, R.A. 1983. Ecological studies of six endangered butterflies (Lepidoptera: Lycaenidae): Island biogeography, patch dynamics, and design of habitat preserves. University of California Publications in Entomology, Vol. 99. Pp. 1-161.

Balance Hydrologics, Inc. 2014. The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report.

Balance Hydrologics, Inc. 2015. Draft Summary of Estimated Interior Side Hydrologic Conditions, EPB Project, County of Monterey, August 2015.

Baldwin, B. G., D.H. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti, and D.H. Wilken (eds.). 2012. The Jepson Manual – Vascular Plants of California, Second Edition, Thoroughly Revised and Expanded. University of California Press. Berkeley, CA. Pp 1600.

Bulger, J.B., N.J. Scott Jr., and R.B. Seymour. 2003. Terrestrial activity and conservation of adult California red-legged frog *Rana aurora draytonii* in coastal forests and grasslands. Biological Conservation, Vol. 110. Pp. 85-95.

Bury, R.B. and J.H. Wolfheim. 1973. Aggression in free-living pond turtles (*Clemmys marmorata*). Bio-Science, Vol. 23. Pp. 659-662.

[CDFW] California Department of Fish and Wildlife. 2008. California Wildlife Relationships System: Life History Accounts. Database Version 8.2.

[CDFW] California Department of Fish and Wildlife. 2009. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities.

[CDFW] California Department of Fish and Wildlife. 2023a. List of California terrestrial natural communities recognized by the Natural Diversity Database.

[CDFW] California Department of Fish and Wildlife. 2023b. California Natural Diversity Database Rare Find 5 Report. Available online at: https://www.wildlife.ca.gov/Data/CNDDB/Maps-and-Data.

[CDFW] California Department of Fish and Wildlife. 2023c. Special Animals List. Available online at: https://www.dfg.ca.gov/wildlife/nongame/list.html.

[State Parks] California Department of Parks and Recreation. 2002a. Draft Initial Study/Mitigated Negative Declaration, Carmel River State Beach Lagoon Restoration Project, June 2002.

[State Parks] California Department of Parks and Recreation. 2002b. Final Initial Study/Mitigated Negative Declaration, Carmel River State Beach Lagoon Restoration Project, October 2002.

[State Parks] California Department of Parks and Recreation. 2007. Riparian Habitat Restoration, Carmel River Lagoon, Wildlife Conservation Board Grand Number – WC-3048SC, Final [monitoring] Report.

[State Parks] California Department of Parks and Recreation. 2008a.Carmel River Lagoon Enhancement Project [monitoring report].

[State Parks] California Department of Parks and Recreation. 2008b. Draft Initial Study/Mitigated Negative Declaration, Carmel River Beach Lagoon Water Level Management Project, July 2008.

[State Parks] California Department of Parks and Recreation. 2008c. Final Initial Study/Mitigated Negative Declaration, Carmel River Beach Lagoon Water Level Management Project, September 2008.

[State Parks] California Department of Parks and Recreation. 2009. Carmel River Enhancement Project Report [monitoring report].

[Caltrans] California Department of Transportation. 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Available online at: http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf

[CNPS] California Native Plant Society. 2001. CNPS Botanical Survey Guidelines.

[CNPS] California Native Plant Society. 2015. Inventory of Rare and Endangered Plants (online edition, v8-02). California Native Plant Society, Sacramento, CA. Available online at: http://www.rareplants.cnps.org/.

Casagrande, J. 2006. Wetland Habitat Types of the Carmel River Lagoon. The Watershed Institute, California State University Monterey Bay, Report No. WI-2006-05. Pp. 15.

[DD&A] Denise Duffy & Associates, Inc. 2015. Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project Draft Delineation of Jurisdictional Wetlands and Other Waters Under Section 404 of the Clean Water Act and the California Coastal Act.

[DD&A] Denise Duffy & Associates, Inc. 2016. Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project Draft Biological Resources Report.

Dixon, Dave. 1999. Dunes Alive-The endangered Smith's blue and marina blue butterflies. A closer look at coastal dune wildlife of south Monterey Bay. Tideline, Vol. 19 (3). Pp. 1-3.

D.W. ALLEY & Associates. 2014. Fisheries Analysis for the Carmel River Lagoon Biological Assessment

Ernst, C.H. and R.W. Barbour. 1972. Turtles of the United States. University Kentucky Press, Lexington, KY, Pp 347.

Grinnell, J and A.H. Miller. 1944. The Distribution of Birds of California. Pacific Coast Avifauna No. 27.

Holland, D. C. 1994. The Western Pond Turtle: Habitat and History. Final Report. Portland, OR: U.S. Department of Energy, Bonneville Power Administration. Available online at: http://www.efw.bpa.gov/Environment/EW/EWP/DOCS/REPORTS/WILDLIFE/W62137-1.pdf

[HTH] H.T. Harvey & Associates. 2013. Memorandum To Whitson Engineers for Feasibility Report: Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues.

[University of California, Davis] Information Center for the Environment. 2016. Tricolored Blackbird Portal. Available online at: http://tricolor.ice.ucdavis.edu/.

Jennings, M.R. and M.P. Hayes. 1986. Decline of ranid frog species in western North America: are bullfrogs (*Rana catesbeiana*) responsible? Journal of Herpetology Vol. 20 (4).Pp. 490-509.

Jennings, M.R. and M.P. Hayes. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana draytonii*) and the foothill yellow-legged frog (*Rana boylii*): implications for management. Proceedings form Management of Amphibians, Reptiles and Small Mammals in North America Symposium 1988.

Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final report to the California Department of Fish and Game, Inland Fisheries Division, Pp 255.

Jennings, M.R. and M.P. Hayes, and D.C. Holland. 1993. A petition to the US Fish and Wildlife Service to place the California red-legged frog and the Western pond turtle (*Clemmys marmorata*) on the list of endangered and threatened wildlife and plants.

Moffatt & Nichol. 2013. Carmel River Lagoon Biological Assessment Coastal Engineering Analysis. August 2013.

[MBNMS] Monterey Bay National Marine Sanctuary.2021. Monterey Bay National Marine Sanctuary Final Management Plan. October 2021. Available online: http://montereybay.noaa.gov/intro/mp/mp.html

[MPWMD] Monterey Peninsula Water Management District. 2005. Technical Memorandum 05-01, Surface Water Dynamics at the Carmel River Lagoon, Water Years 1991 through 2005.

Moyle, P.B. 1973. Effects of introduced bullfrogs, *Rana catesbeiana*, on the native frogs of the San Joaquin Valley, California. Copeia 1973. Pp. 18-22.

[NMFS] National Oceanic and Atmospheric Administration National Marine Fisheries Service. 2005. Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California; Final Rule. Federal Register, Vol. 70(170). Pp. 52487-52627.

[NMFS] National Oceanic and Atmospheric Administration National Marine Fisheries Service. 2006. Endangered and Threatened Species; Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead; Final Rule. Federal Register, Vol. 71(3). Pp. 833-862.

[NMFS] National Oceanic and Atmospheric Administration National Marine Fisheries Service. 2019. Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Carmel Lagoon Scenic Road Protection Structure and Interim Sandbar Management Plan Project.

Pacific Geotechnical Engineering. 2013. Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California. May 2013.

Parham, J.F. and T.J. Papenfuss. 2008. High genetic diversity among fossorial lizard populations (*Anniella pulchra*) in a rapidly developing landscape (Central California). Conservation Genetics, Vol 10. Pp. 169-176.

Rathbun, G.B., M.R. Jennings, T.G. Murphey, and N.R. Siepel. 1993. Status and ecology of sensitive aquatic vertebrates in lower San Simeon and Pico Creeks, San Luis Obispo County, California. Unpublished report, National Ecology Research Center, Piedras Blancas Research Station, San Simeon, California, Pp 103.

Reis, D. 1999. Habitat Characteristics of California Red-Legged Frogs (*Rana aurora draytonii*) Ecological Differences Between Eggs, Tadpoles, and Adults in Coastal Brackish and Freshwater System. A thesis presented to The Faculty of the Department of Biology San Jose State University, Pp. 58.

Remsen, J.V. Jr. 1978. Bird species of special concern in California. California Dept. of Fish and Game, Nongame Wildlife Investigations, Wildlife Management Branch Administrative Report No. 78-1.

Roberson, D. 2002. Monterey Birds. Monterey Peninsula Audubon Society, Monterey, CA, Pp 536.

Sawyer, J.O., T. Keeler-Wolf, and J.M. Evens. 2009. A manual of California vegetation 2nd Edition. California Native Plant Society, Sacramento, CA, Pp 1300.

Stebbins, R.C. 1972. California amphibians and reptiles. University of California Press, Berkeley, CA, Pp 152.

Stebbins, R.C. 1985. Western reptiles and amphibians. Houghton Mifflin Company, Boston, MA, Pp 336.

Thelander, C. (ed.). 1994. Life on the edge: A guide to California's endangered natural resources: wildlife. BioSystems Books, Santa Cruz, CA.

[USFWS] U.S. Fish and Wildlife Service. 1976. Determination That Six Species of Butterflies are Endangered Species; 41 FR 22041 22044 (Lotis blue, *Lycaeides argyrognomon lotis*; El Segundo blue, *Shijimiaeoides battoides allyni*; Smith's blue, *Shijimiaeoides enoptes smithi*; Mission blue, *Icaricia icarioides missionensis*; San Bruno elfin, *Callophrys mossi bayensis*; Lange's metalmark, *Apodemia mormo langei*). Federal Register, Vol. 41(106). Pp. 22041-22044.

[USFWS] U.S. Fish and Wildlife Service. 1984. Smith's Blue Butterfly Recovery Plan. Pp 87.

[USFWS] U.S. Fish and Wildlife Service. 1993. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Pacific Coast Population of the Western Snowy Plover. Federal Register, Vol. 58 (42). Pp. 12864-12874.

[USFWS] U.S. Fish and Wildlife Service. 1996. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the California Red-legged Frog; Final Rule. Federal Register, Vol. 61(101). Pp. 25813-25833.

[USFWS] U.S. Fish and Wildlife Service. 1998. Endangered and Threatened Wildlife and Plants; Withdrawal of Proposed Rule to List the Black Legless Lizard, Proposed Rule. Federal Register, Vol. 69(149). Pp. 47211-47248.

[USFWS] U.S. Fish and Wildlife Service. 2000. Guidelines for Conducting and Reporting Botanical Inventories for Federally listed, Proposed and Candidate Plants.

[USFWS] U.S. Fish and Wildlife Service. 2002. Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii).*

[USFWS] U.S. Fish and Wildlife Service. 2006. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the California Red-legged Frog and Special Rule Exemption Associated with Final Listing for Existing Routine Ranching Activities; Final rule. Federal Register, Vol. 71(71). Pp. 19244-19292.

[USFWS] U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover. Available online at: http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf.

[USFWS] U.S. Fish and Wildlife Service. 2010a. Birds Protected by the Migratory Bird Treaty Act. Available online at: http://www.fws.gov/migratorybirds/RegulationsPolicies/mbta/mbtintro.html.

[USFWS] U.S. Fish and Wildlife Service. 2010b. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the California Red-legged Frog; Final rule. Federal Register, Vol. 75(51). Pp. 12816-12959.

[USFWS] U.S. Fish and Wildlife Service. 2017. Biological Opinion for the Carmel Lagoon Interim Sandbar Management Plan Project and Department of the Army Regional General Permit 5 Issuance. File Number SPN-1996-190890S.

[USFWS] U.S. Fish and Wildlife Service. 2023a. Foothill Yellow-Legged Frog. Available online at: https://www.fws.gov/species/foothill-yellow-legged-frog-rana-boylii.

[USFWS] U.S. Fish and Wildlife Service. 2023b. List of Threatened and Endangered Species with the potential to be affected by the Carmel Lagoon project acquired from the Service's Information, Planning, and Conservation System. Available online at: http://ecos.fws.gov/ipac/.

[USACE] United States Army Corps of Engineers, [County] County of Monterey, and [NMFS] National Oceanic and Atmospheric Administration National Marine Fisheries Service. 2013. Memorandum of Understanding (MOU) regarding Flood Prevention and Habitat Protection at the Carmel Lagoon; including Exhibit A: Interim Plan and Criteria for Flood Control and Summer Management of the Carmel River Lagoon.

Whitson Engineers. 2013. Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report.

Williams, D. 1986. Mammalian species of special concern in California. California Department of Fish and Game Report 86-1, Pp 112.

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White (eds.). 1988. California's wildlife, Volume I: Amphibians and reptiles. California Department of Fish and Game, Sacramento, CA, 272 pp.

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White (eds.). 1990. California's Wildlife, Volume II: Birds. California Department of Fish and Game, Sacramento, CA, 731 pp

4.5 GEOLOGY, SOILS, AND SEISMICITY

This section describes the geology, soils, and seismicity conditions in the vicinity of the proposed project and evaluates the extent to which the proposed project could expose people or structures to potential seismic, liquefaction, landslide, and expansive soil impacts, and the extent to which the project could result in substantial soil erosion or loss of topsoil. This section summarizes the results of the *Feasibility Geotechnical Investigation* prepared for the project by Pacific Geotechnical Engineering (2013), the *Carmel River Lagoon Restoration Scenic Road Protection Options* prepared by Moffatt & Nichol (2013a) and *Coastal Engineering Analysis* prepared by Moffatt & Nichol (2013b), and the *Littoral Processes and River Breachings at Carmel River Beach* prepared by Thornton (2005); each of these reports are contained in **Appendix F** of this RDEIR.

Public and agency comments related to geology, soils, and seismicity conditions were received during the public scoping period, and are summarized below:

- Evaluate scour and erosion impacts because of proposed EPB and SRPS project components structures;
- Evaluate potential impacts to local sand supply; and
- Evaluate potential impacts associated with wave energy.

To the extent that issues identified in public comments involve potentially significant effects on the environment according to the CEQA and/or are raised by responsible agencies, they are identified and addressed within this RDEIR. For a complete list of public comments received during the public scoping period, please refer to **Appendix A**, **NOP, and Public Comment Letters** of the Draft EIR. In addition, several comments received during the public review period of the Draft EIR raised questions about the level of analysis conducted, and requested additional analysis related to the issues above, as well as a more detailed analysis regarding the location and alignment of a natural breach of the Carmel River. Therefore, the County retained Moffatt & Nichol to analyze the natural breach alignment and location and sediment transport and prepare an assessment of potential beach impacts from the SRPS Mid-Slope Wall Alternative. This section describes the results of the additional studies: the *Carmel River Lagoon Natural Breach Alignment and Location* study, *Sediment Transport Study*, and *Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential* study prepared by Moffatt & Nichol (2021a, 2021b, and 2022); each of these reports are contained in **Appendix F** of this RDEIR.

Since the publication of the Draft EIR in December 2016, Appendix G of the CEQA Guidelines was updated, and the threshold related to unique paleontological resources and geologic features moved from the Cultural Resources section to the Geology and Soils section. This threshold is adequately addressed and analyzed in Section 4.4, Cultural Resources, of the original Draft EIR consistent with the revised CEQA Guidelines. Therefore, no revisions related to this threshold are required.

In addition to the updates above, in January 2023, atmospheric storm events and high wave action significantly undermined a section of Scenic Road located on State Parks property, west of the Carmel River State Beach parking lot and restrooms, exposing and damaging the existing water, sewer, and other underground infrastructure and making residences inaccessible (**Figure 4.1-4**). In February 2023, the County PWFP installed a 200-foot, soil-nail, shotcrete wall, which involved driving 15’ to 30’ nails into the soil to anchor and hold a mesh cover to contain the sand and material under the roadway, reopening the road in early-April 2023. This emergency repair was exempt under CEQA and received the necessary permits from the regulatory agencies. This analysis considers this event and the new soil-nail wall as a new existing condition.

4.5.1 Environmental Setting

The geologic structure in central California is primarily the result of tectonic events that have occurred during the past 30 million years. It is widely believed that the numerous faults in this area are related to movements along the boundary between the Pacific and North American tectonic plates. The relative motion between these two tectonic plates is taken up largely along the northwest-trending San Andreas Fault system, which defines the regional boundary between the two plates. Changes in sea level and tectonic uplift resulted in a complicated depositional environment that produced the complex geology of the Monterey Bay region. Faulting and folding have deformed and displaced the geologic units in the region, and the granitic basement and overlying Tertiary deposits have been juxtaposed along many of the northwest/southeast-trending faults. The proposed project site lies within the Coast Ranges Geomorphic Province, a discontinuous series of northwest-southeast trending mountain ranges, ridges and intervening valleys characterized by complex folding and faulting.

4.5.1.1 Regional Geologic Setting

The geologic and soils study area extends from the Lagoon to the beach. The geology of the site vicinity is dominated by two factors: offset across the Cypress Point fault and alluvial sediments of the Carmel River.

The Cypress Point Fault is a northwest-trending normal fault that skirts and parallels the elevated ridge of ground between Scenic Road and Carmelo Street; the fault is mapped just east of and parallel to Carmelo Road. In the project vicinity, this fault is entirely concealed by sediment, and is inferred based on different bedrock types east and west of the fault. The dominant rock type west of the fault (underlying Abalone Point and Stewart's Cove) is granitic. The dominant rock type east of the fault is much younger basaltic andesite. Although the fault is mapped as a single strand, it may be a more complex fault zone. This complexity may have caused some differential offset of the top-of-rock bedrock surface. The Cypress Point Fault is not considered to be active.

The project site is within a crenulate-shaped bay (i.e., having an irregularly wavy or serrate outline), anchored by the rocky Carmel Point headland (south of Stewart's Cove) to the north and a bedrock outcrop to the south. Consistent with typical headland-bay beaches, the shoreline shape is oriented parallel to the wave crests as they refract and diffract around the headland. There is also a wave energy gradient along the beach such that during the winter, when waves are predominantly from the northwest direction, the energy decreases from south to north.

Rocky granodiorite underlying the north and south end of the beach, separated by approximately 600 feet of sand, constrains where the lagoon reaches the beach (MPWMD, 2007). The beach is confined to the north and the south by bedrock outcrops and is comprised of sand. The beach forms a seasonal barrier between the mouth of the Lagoon and the Pacific Ocean. The barrier beach is seasonally breached (either naturally or artificially) when high rainfall events increase the water level in the Lagoon. Because the Carmel River is ephemeral and the beach is subjected to swell for most of the year, wave run-up rebuilds the berm and closes off the barrier beach when river outflows are low or absent.

The beach at Carmel River State Beach is steep, reflective, and composed of coarse sand delivered to the beach by the river. The slope of the beach progressively becomes flatter from the south to the north. Field observations by Professor Ed Thornton of the Naval Postgraduate School show that the beach slope varies from about 8H:1V (12 percent) at the north end of the beach, to about 3.6H:1V (28 percent) at the south end of the beach (Thornton, 2005). Sand grain size, and therefore wave energy, also increases from the north to the south end of the beach. Sand is deposited on the beach berm by wave action, and at high tides, waves overtop the berm depositing sand and debris on the back beach (nearest the Lagoon).

Thornton also determined that the beach is relatively stable and has not significantly migrated over the past 130 years.

The beach topography is seasonally variable and dependent on numerous factors including river flow, wave height, period and direction, tide, mechanical or natural breaching, wind direction and strength, and river sediment deposition. After reviewing the surveys and data, it is evident that the historic management of the beach has significantly altered the beach topography. Historically, mechanically breaching occurred in different locations each year, resulting in the beach to the north, south, and middle of the river mouth to be unnaturally modified and making it difficult to decipher the "natural" beach topography and breaching process.

The Carmel River drains approximately 250 square miles of the Santa Lucia and Sierra de Salinas Mountains into Carmel Bay. The Carmel River watershed has historically experienced large variations in seasonal and yearly discharge rates. There is a complex, dynamic relationship between the Lagoon and Pacific Ocean. During times of low or no river discharge, waves build up the sandbar to form a berm along the Carmel River State Beach shoreline. The sandbar closes off the mouth of the Lagoon, which causes the lagoon to dam up. Some amount of flow from the lagoon to the ocean occurs via groundwater seepage through the beach sand. The lagoon also loses water due to evaporation, primarily during the summer months. When river discharge is minimal, the lagoon water level receded to a base elevation that continues over the dry summer months. When the river discharge increases, the lagoon water level can rise rapidly and potentially reach or exceed the defined flood stage. Therefore, management of the Lagoon water level has been implemented to mitigate flood hazards. This management can occur at any time from late fall to early spring. **Figure 4.5-1** provides closeups of the Lagoon and Carmel River State Beach based on historical aerial imagery from 1929 and present.



Figure 4.5-1. Carmel River State Beach and Carmel River 1929 (left) and 2020 (right). (Moffatt & Nichol, 2021b).

4.5.1.2 Geologic Units

Based on the Geotechnical Report, the geologic units anticipated within the project study area include coastal terrace deposits, coastal dunes, beach sand, floodplain deposits, basin deposits, and earth fill. The

distribution of the various geologic units is shown on the geologic site plan (**Figure 4.5-2**). A summary of these geologic units and characteristics are presented below.

COASTAL TERRACE DEPOSITS

Coastal terrace deposits are deposited across wave-cut platforms that have undergone subsequent uplift. Sediments on these terraces are described as generally "semi-consolidated, moderately well sorted marine sand containing thin, discontinuous gravel-rich layers." The thickness of these deposits is variable, but typically less than about 20 feet. The coastal terrace in the vicinity of the proposed SRPS project component site is mapped as the "Lighthouse terrace."

COASTAL DUNES

Younger (Pleistocene and Holocene) coastal dunes locally lap across and overlie the coastal terrace deposits in the vicinity of the proposed SRPS project component. Dune deposits consist of "unconsolidated, well-sorted fine- to medium-grained sand" up to about 75 feet thick.

BEACH SAND

Beach sand is mapped along the shore of Stewart's Cove,[1] and makes up the seasonal barrier across the mouth of the Carmel River. Texturally, beach sand is typically "unconsolidated, well-sorted, medium- to coarse-grained sand with local layers of pebbles and cobbles and thin discontinuous lenses of silt in back-beach areas."

FLOODPLAIN DEPOSITS

Floodplain deposits occur to the north and south of the Carmel River. The oldest of these floodplain deposits is mapped along a swath a few hundred feet north of, and roughly paralleling, the proposed EPB project component alignment. Texturally, these sediments consist of "unconsolidated, relatively fine-grained, heterogeneous deposits of sand and silt commonly including relatively thin layers of clay." Inset into these older floodplain deposits are younger floodplain deposits, which generally underlie the proposed EPB project component alignment. Texturally, these are very similar to older floodplain deposits with variable gravel content. These younger floodplain deposits are generally less than about 20 feet thick.

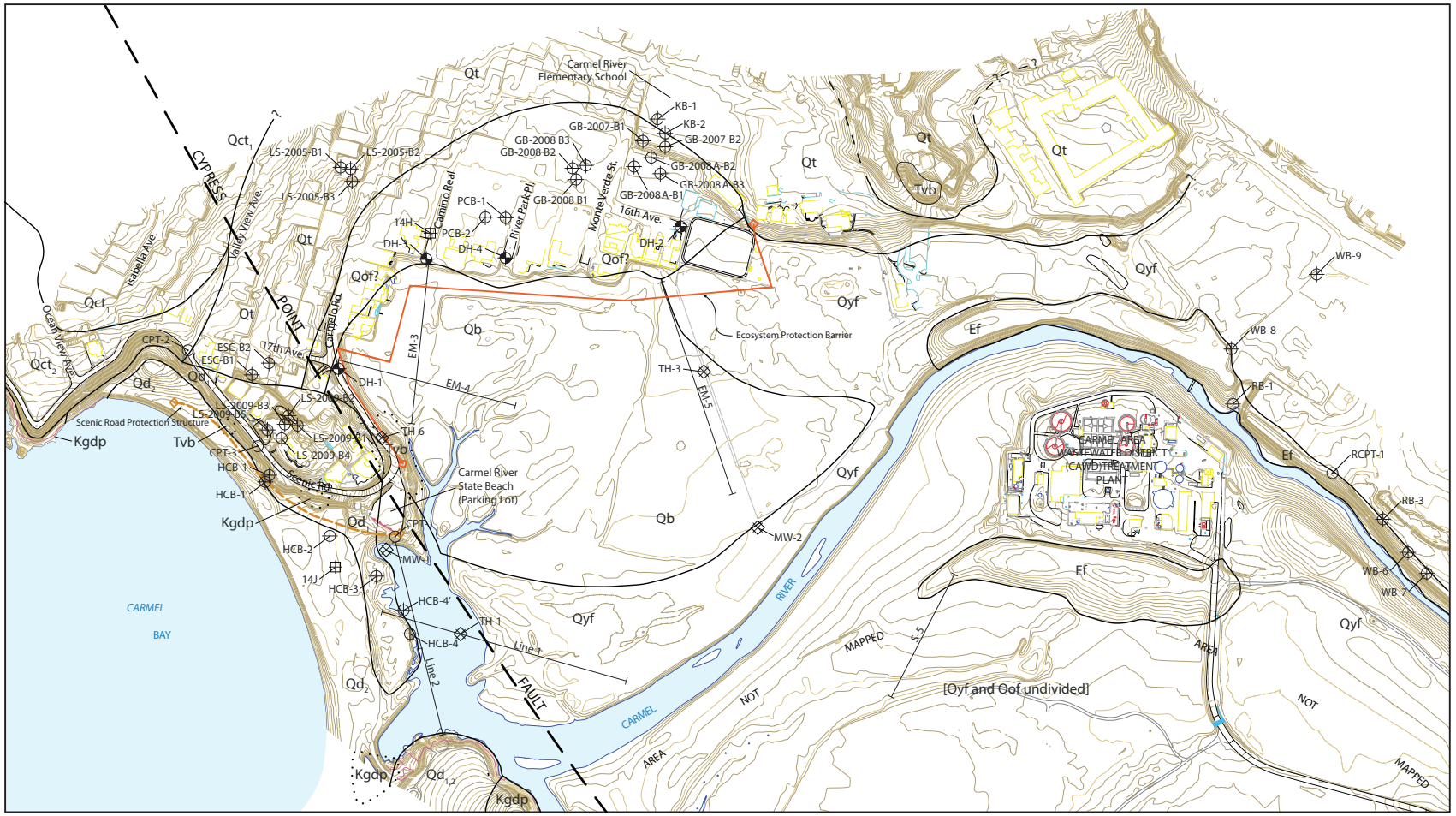
BASIN DEPOSITS

Basin deposits are mapped around the Lagoon. Basin deposits are described as "unconsolidated, plastic clay and silty clay containing much organic materials, and locally containing interbedded thin layers of silt and silty sand."

EARTH FILL

Earth fill is present in many more localities than is shown in **Figure 4.5-2** (for clarity reasons). Developed and graded sites typically have discontinuous fill deposits, particularly at the outboard edges of graded pads on sloping ground, and the outboard shoulders of roads on sloping ground. The southern extent of fill at the interface between developed properties and State Parks land could strongly affect the ease with which any sort of driven floodwall can be constructed, especially if fill contains rubble or larger clasts. The outboard edge of Scenic Road currently consists of a sandy slope that descends to the beach, which is underlain by a prism of riprap and also contains a 200-foot, soil-nail, shotcrete wall.

[1] Stewart's Cove is located west of the proposed SRPS project component; please refer to the map shown in **Figure 3-3**.



EXPLANATION

Earth Materials

- Ef — Earth fill - various textures. Fill prisms along roads not mapped for legibility
- Qd — Dune sand - locally subdivided into Qd_1 (older) and Qd_2 (younger)
- Qb — Basin deposits - plastic clay and silty clay
- Qyf — Younger floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qof — Older floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qt — Alluvial terrace deposits - silt, silty clay, sand and gravel; locally subdivided
- Qct — Coastal terrace deposits - sand with thin, discontinuous gravelly layers
- Tvb — Volcanic rocks - basaltic andesite flows and flow breccia
- Kgdp — Granodiorite (porphyritic granodiorite of Monterey of Ross (1976))

Symbols

- Geologic contact, dashed where approximate, queried where uncertain, dotted where concealed
- Inferred, buried fault
- DH-4 — Exploratory drill hole (this investigation)
- CPT-2 — CPT sounding (this investigation)
- Exploratory drill hole (investigations by others)
  - KB-2 (Kleinfelder, 2011)
  - GB-2008A-B3 (Grice, 2008A)
  - GB-2008 B3 (Grice, 2008B)
  - PCB-2 (Pacific Crest, 2008)
  - LS-2009-B5 (Landset, 2009)
  - LS-2005-B5 (Landset 2005)
  - ESC-B2 (Earth Systems Consultants, 2010)
  - HCB-4 (Hydro-Search, 1981)
  - WB-9 (Wahler, 1989; compiled in Raas [2000])
  - RB-3 (Raas, 2000)
- MW-3 — MW-2 (Staal, Gardner, Dunne, 1989b)
- TH-6 — TH-6 (Staal, Gardner, Dunne, 1989b)
- 14H (Previous borings compiled by Staal, Gardner, Dunne, 1989b)
- RCPT-3 — CPT sounding (Raas, 2000)
- Geophysical transects (Staal, Gardner, Dunne, 1989)
- Proposed Ecosystem Protection Barrier
- Scenic Road Protection Structure

Notes:

1. Base provided by Whitson Engineers
2. Geologic interpretation modified from Clark, Dupre and Rosenberg (1997), with additions
3. Scenic Road Protection Structure preliminary alignment provided by Moffat & Nichol
4. Ecosystem Protection Barrier preliminary alignment provided by Whitson Engineers

N

100 0 100 200
Scale in feet

Source: Pacific Geotechnical Engineers, 2013

Geologic Site Plan

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 02-24-2016
Scale N/A
Figure 4.5-2

Path: P:\DDA Current Projects\2013-22 Carmel Lagoon\EIR EA\Admin Draft EIR EA\Figures\Indesign\ 8.5x11 landscape

This Page Intentionally Left Blank

4.5.1.3 Coastal Processes

WAVE CLIMATE

Wave climate is defined as the distribution of wave height, period, and direction averaged over a period of time for a particular location. In deep water offshore, the wave climate is fairly constant and may be similar over large distances. However, near shore, the wave climate depends on the offshore wave climate caused by prevailing winds and storms and on the bottom topography, which tends to modify the waves. The importance of understanding the wave climate of a region for engineering design calculations is that the wave climate will determine the effect of storms.

Coastal processes in Carmel Bay and at Carmel River State Beach are primarily wave-driven, and include erosion, accretion, cross-shore sediment transport, and longshore sediment transport drive by wind- and swell waves and by wave-induced currents. For the Sediment Transport Study, the Danish Hydraulic Institute MIKE-21 Spectral Wave (SW) model was utilized to develop a regional wave model covering the area of Monterey Bay, Carmel, and Big Sur. The SW model simulates wave transformation of deep-water waves propagating to nearshore areas. Wave transformation effects resolved by the model include wave propagation by speed and direction, wave growth due to wind shear, shoaling and refraction due to variation of the seabed, diffraction and reflection near structures, wave breaking in the surf zone, wave dissipation, and interaction between waves and currents. The SW model area extends approximately 20 miles west of Carmel Bay and 60 miles in the north-south direction.

The modeling results show that the Carmel Submarine Canyon plays a significant role in how waves are transformed as they propagate from offshore waters to the shoreline. The submarine canyon impacts wave transformation in that much of the same effects results irrespective of whether the offshore waves arrive from northwesterly or southwesterly directions. The focus of wave energy occurs along the shoreline between Cypress Point and Pescadero Point is likely the explanation why this portion of the coast is particularly rugged. Conversely, the dispersal of waves coming to the head of the canyon in Carmel Bay and towards Monastery Beach means that the wave climate in these areas is much calmer than further offshore.

Wind-Waves

The Carmel shoreline is exposed to wind-waves generated by local storm systems as well as swell waves originating from distant storms over the Pacific. **Figure 4.5-3** shows the general angles of wave incidence, or waves moving landward. There are four different wave systems that affect Carmel Bay: 1) North Pacific swell waves originating from distant storms over the North Pacific, 2) southern swell originating from distant storms in the South Pacific, 3) northwest wind waves generated by regional wind systems, and 4) local wind waves which can occur from any direction with open water. North Pacific swell waves are generated by extra-tropical storm systems, mid-latitude low-pressure systems, and cold fronts over the North Pacific. Southern swell is generated by storms in the Southern Hemisphere and occurs in the summertime. Swell waves are characterized by long wave periods, typically from eight to 18 seconds. Northwest wind waves are generated by daily sea-breeze conditions and are more pronounced in the spring and early summer months. Wind waves are generated by regional and local wind conditions and produce waves with shorter periods, typically from three to eight seconds. Local storms typically occur from October through April.

Wind-waves are present 79 percent of the time in the Carmel Bay. The remainder of the time, winds are either calm or from overland directions (i.e., north to east-southeast). Although the strongest storms occur over the winter months, the months with the most wind are from May to September. Wind-waves from north-westerly and west-northwesterly directions show a pronounced increase over the summer months from May through September and decrease over the months from October through April.

Approximately 71 percent of wind-waves (out of a total of 79 percent) occur from these directions. Wind-waves from the remaining directions are less frequent or calm over the summer months with a tendency to pick up slightly over the winter months. Data shows that around 84 percent of wind-waves have significant wave heights in the range of four to eight feet, and 97 percent of all waves are within the range from two to 12 feet.

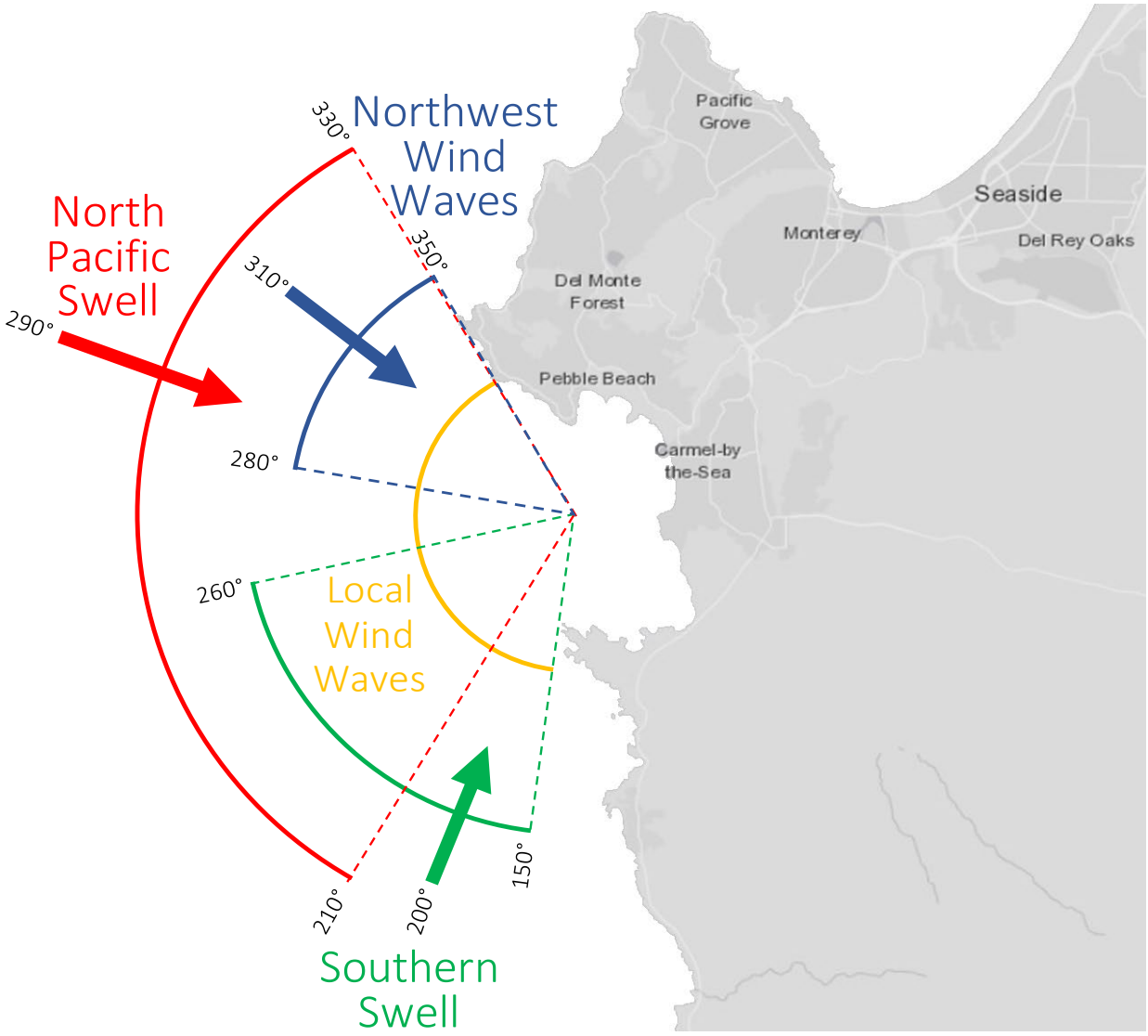


Figure 4.5-3. Angles of wave incidence at Carmel, adopted from United States Geological Survey (USGS) (2006) (Moffatt & Nicol, 2021a).

Swell Waves

Swell waves from the west and west-northwest decrease substantially over the summer months from May through September and become much more prevalent over the months from October through April. Swell waves from the directions of northwest, south, and south-southwest have a pronounced increase over the summer months from May through September and a decrease over the winter months from October through April. Swell waves from the directions south-southeast, southwest, west-southwest, and north-northwest are evenly distributed throughout the year and occur with a constant low-level presence. In summary, there is an even presence of swell waves across all months of the year. This indicates the swell is persistent and occurs at all times of the year. Data shows that around 70 percent of the offshore

waves have significant wave heights in the range from four to 10 feet, and 99 percent of all waves are within the range from two to 16 feet.

LAGOON AND BEACH MORPHOLOGY

The morphology of the Carmel Lagoon and beach has been the subject of extensive studies and field observations. These studies were compiled, reviewed, and described for the natural breaching and sediment transport studies analyses completed by Moffatt & Nichol. The following discussion summarizes the findings of these studies and analyses.

Bathymetry

Bathymetry data for the Sediment Transport Study was obtained from NOAA's 1/3 arc-second (e.g., 10-meter resolution) coastal Digital Elevation Model (DEM) and was originally developed based on multi-agency hydrographic surveys. **Figure 4.5-4** illustrates the regional seabed bathymetry (left) and the bathymetry in the vicinity of Carmel Bay (right). One of the main features of the regional bathymetry is the Monterey Bay Submarine Canyon, which is indicated by the undulating shape of darker blue colors in the figure on the left. Carmel Bay also features a submarine canyon, the Carmel Submarine Canyon, which is a spur off the Monterey Submarine Canyon. Within Carmel Bay, there is a segment of the canyon headed northeast towards Carmel Beach, while another segment is aligned southeast with a canyon head at Carmel River State Beach and another at Monastery Beach. The submarine canyon heads have a major impact on sediment transport processes at Carmel as they effectively trap and remove sediment from the nearshore system.

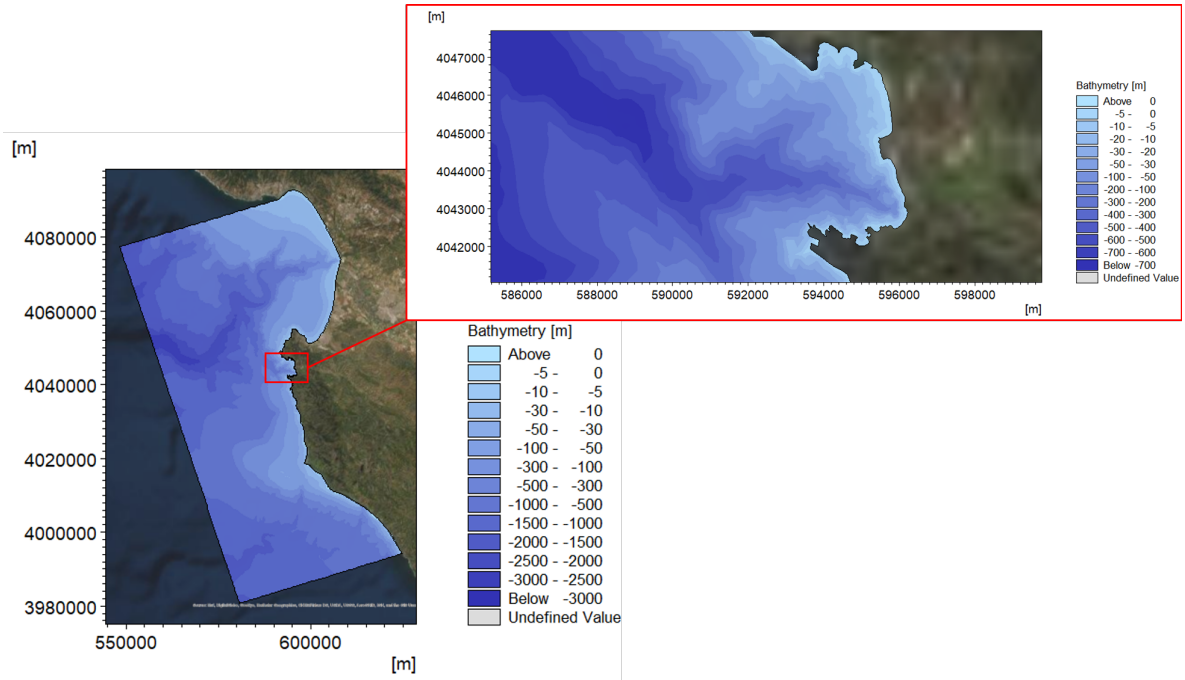
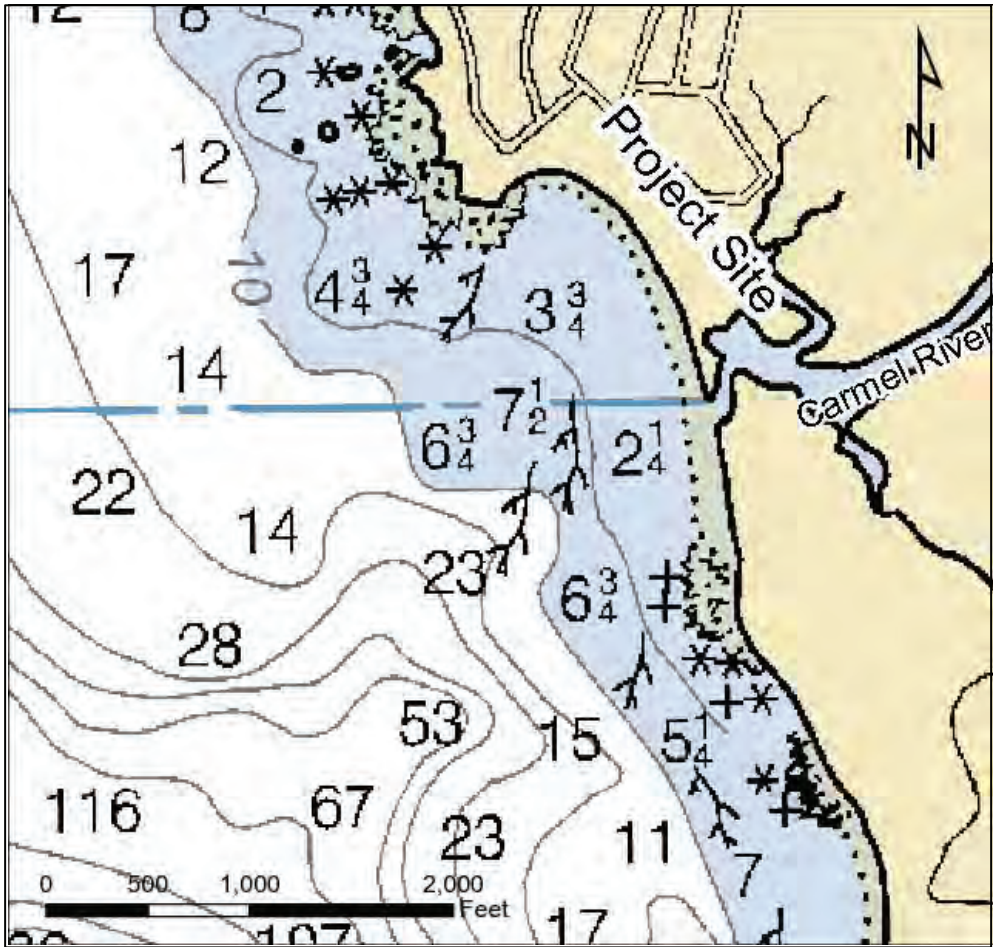


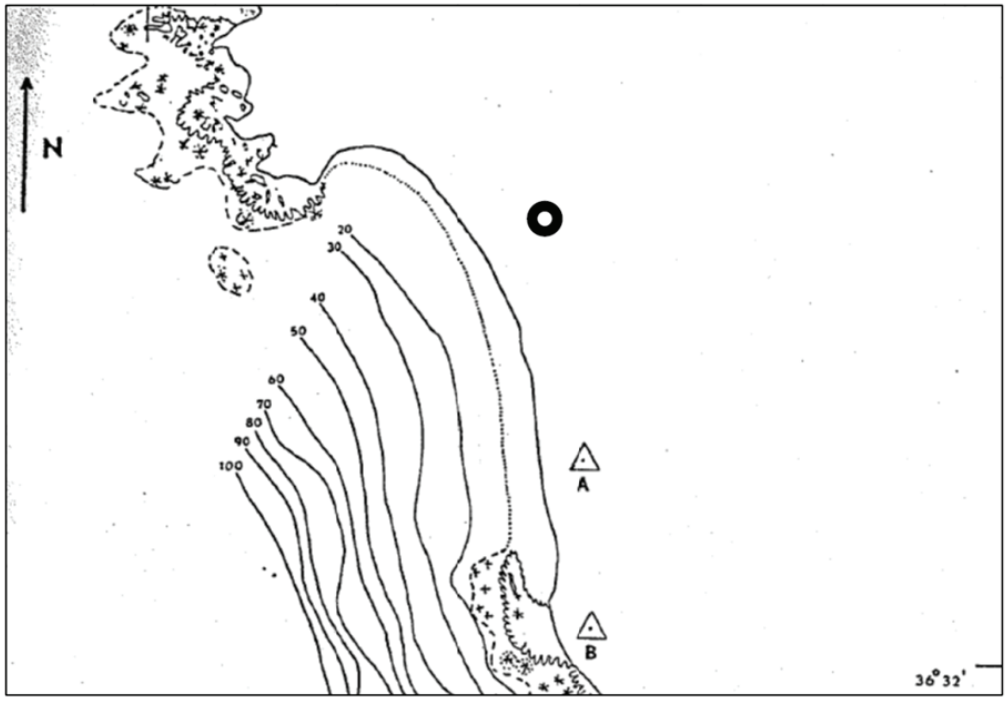
Figure 4.5-4. Regional model bathymetry (left), and local bathymetry (right) (Moffatt & Nicol, 2021b).

The sea floor offshore of the Carmel River State Beach is relatively steep, quickly dropping off to depths greater than 100 feet in the Carmel Submarine Canyon; however, very little detailed information exists on the nearshore bathymetry within the surf zone. **Figure 4.5-5** provides a detail from the NOAA navigation chart of the area, but survey dates are unknown and there is still a lack of detail in the direct project vicinity. **Figure 4.5-5** provides a bathymetric survey performed in the early 1970s, with the locations of 20 to 100 feet depth contours (Howell, 1972). Rock outcroppings at the northern and southern headlands are evident in the figure, with the sea floor between the two headlands reported to be mantled by over five feet of fine to coarse sand.

This Page Intentionally Left Blank



A.) Depths (in fathoms, MLLW) near project site (NOAA Chart)



B.) Nearshore Bathymetry (in ft, MLLW) (Howell, 1972)

Source: Moffatt & Nichol, August 2013

Bathymetry in Project Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 10-12-2016

Scale

Figure 4.5-5

This Page Intentionally Left Blank

Lagoon Morphology

Figure 4.5-6 provides an overview of the processes that shape the Carmel River State Beach and lagoon shape. Incident wave crests and troughs are indicated by the light blue solid and dashed lines. The crenulate shape of the bay and seabed contours cause incident waves to refract and diffract. Refraction causes incident waves to turn or bend so the direction of wave progression and transformation is approximately perpendicular to the seabed contours. Diffraction is the spreading of wave energy and occurs in the lee of the headland (i.e., the side of Carmel Point that faces away from the wind and is sheltered) at the north end of the beach.

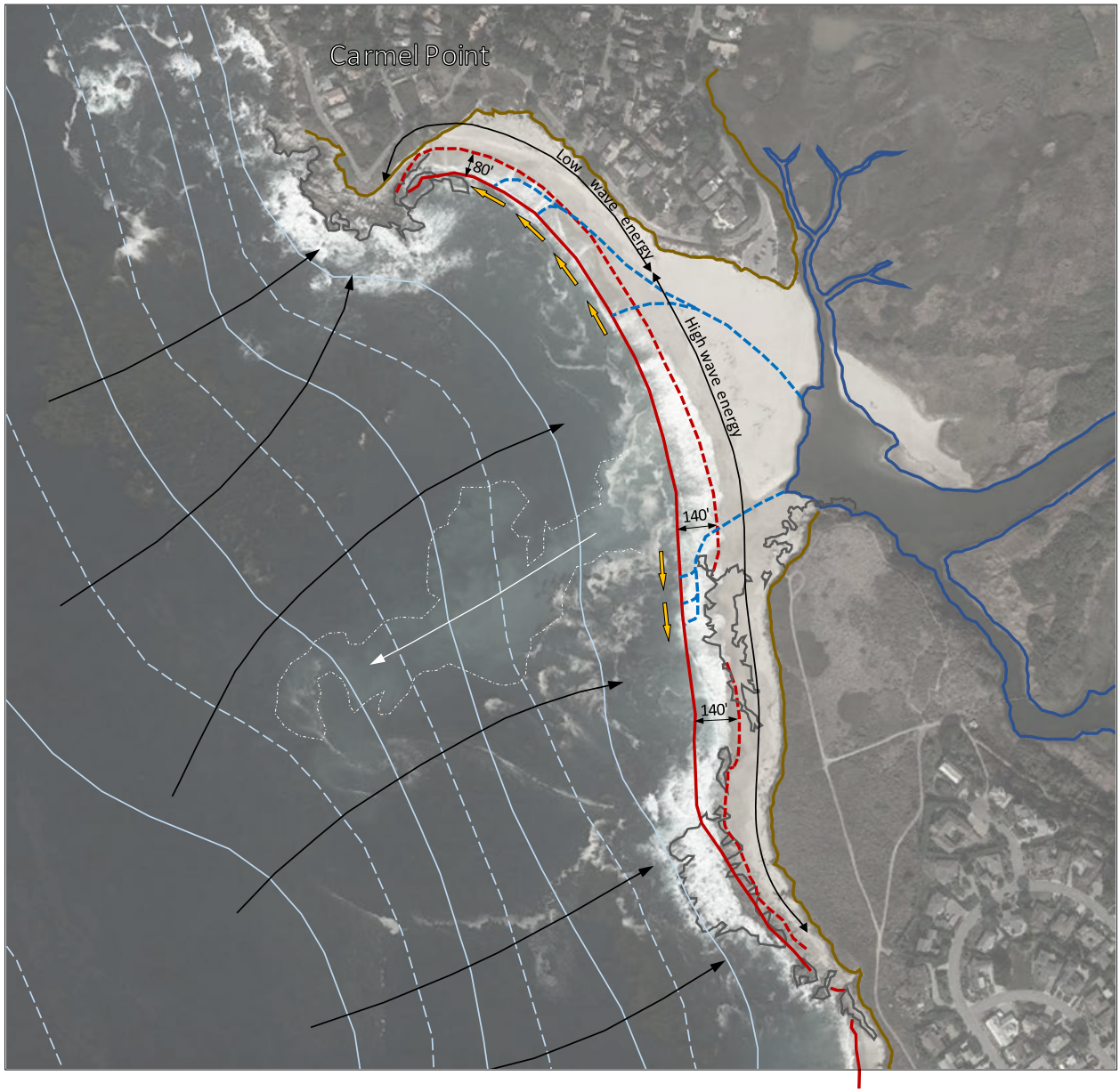


Figure 4.5-6. Overview of Carmel River State Beach seasonal variation and Lagoon morphology (Moffatt & Nichol, 2021b).

Refraction causes the incident waves to converge on the headland at Carmel Point and the rock outcrop located at the south end of Carmel River State Beach at the transition to Ribera Beach (shown as black

arrows in **Figure 4.5-6**). Diffraction occurs primarily in the lee of the headland at Carmel Point. Because of the dispersal of wave energy in the area, the northern portion of Carmel River State Beach is an area of low wave energy compared to the beach to the south, which is an area of relatively high wave energy.

Summer swells tend to build up the beach, while winter storm waves pull sand off the beach into deeper water. The typical summer beach extent is indicated by the solid red line, which the narrower winter beach shape is indicated by the dashed red line. Because of the wave diffraction effects at the north end of the beach and the low wave energy versus high wave energy zones, there is less variation of the beach width at the northern end (on the order of 80 feet) and more variation at the center and south end of the beach (on the order of 140 feet) between the summer and winter.

The general shape of the Carmel River and Lagoon is indicated by the blue solid line. Example paths showing migration of Lagoon breaches are indicated by the dashed blue lines. The breaches can migrate south if the wave-driven littoral transport is southward (yellow arrows) and can migrate north if the direction of littoral transport is to the north. Migration of lagoon breaches occur when there is a significant discharge from the Carmel River, which keeps the breach channel open, while the littoral transport tries to close the beach. Closure of the beach can occur due to littoral transport along the shoreline, and due to vertical buildup of sand deposited with wave runup.

Northward Lagoon migration has historically reached the northern end of the beach where it terminates at the rock outcrop at Carmel Point. Southward migration is limited by the rock outcrops at the south end of the beach. If the beach level is high, these outcrops are typically buried under the sand, but appear when the beach level lowers.

The white plume in **Figure 4.5-6** indicates a rip current, which forms because of wave breaking in the surf zone. The rip current is directed offshore (white arrow) and can transport sand from the shore to deeper water.

The formation of the Lagoon each season is primarily related to the enlargement of the Lagoon as water level rises in response to inflow from the river. This inflow causes the extent of the Lagoon to widen out over the sandbar.

Figure 4.5-7 shows how wave action affects Lagoon breach migration. As waves disseminate towards the shoreline, they are subject to refraction due to their angle of incidence relative to the change in water depth. The process turns, or bends, the incident wave crests so that they are nearly parallel to the shoreline. However, as waves break in the surf zone, the direction of wave motion may still have a small angle relative to the shoreline. This wave break produces a net longshore transport of sediment, indicated by the purple arrow in **Figure 4.5-7**. Wave runup on the beach follows a zig-zag motion as indicated by the orange lines in **Figure 4.5-7**. The process deposits sand on the sandbar with the wave runup and occasional wave overwash. The wave-driven sediment transport process actively builds up the sandbar.

When sufficient outflow from the Lagoon maintains an open breach channel, sediment will be moved within the breach channel. This sediment movement typically occurs as long as discharge from the river is higher than 10 cubic feet per second (cfs). Where the breach channel outflow encounters the active swash zone on the beach, an equilibrium, or balance can develop where the outflow keeps the breach channel open whereas wave action continually tries to close off the breach channel. The result is migration of the breach change, shown right to left in **Figure 4.5-7**. The dashed blue lines indicate preceding breach channels, going from right to left. Recent observations of breach channel migration found that the Lagoon breach channel can migrate north or south by five to 40 feet per day, and, in extreme cases, 150 feet per day.

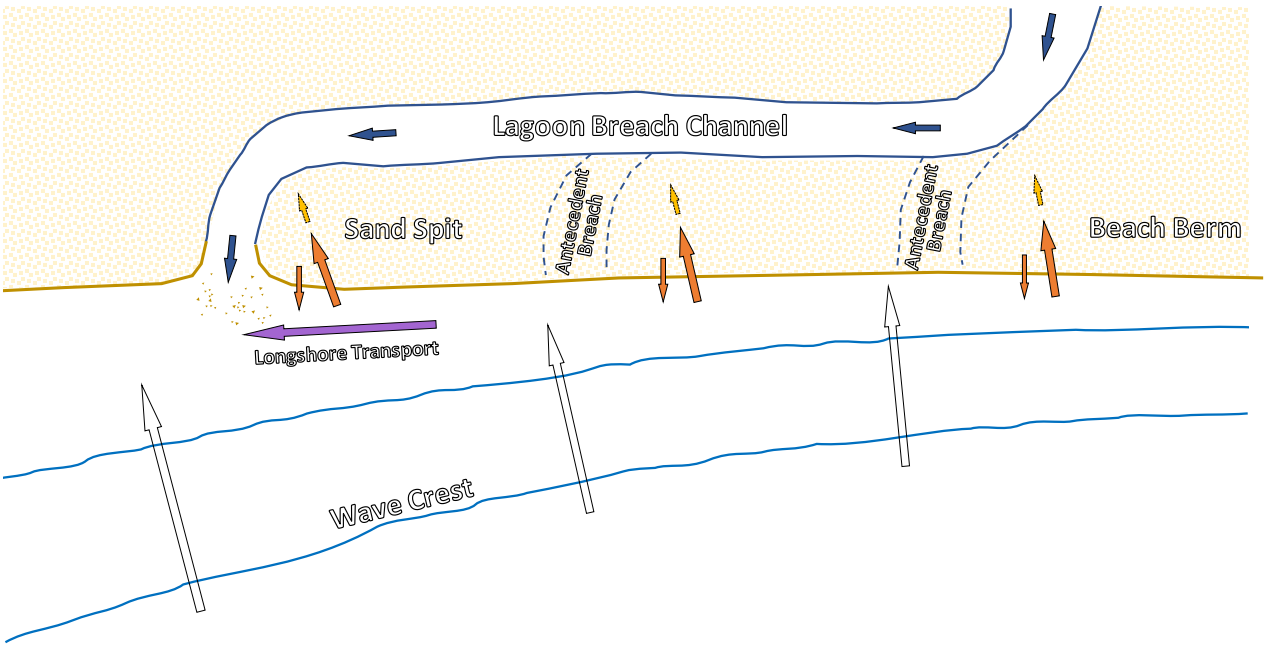


Figure 4.5-7. Wave drive processes affecting lagoon breach migration (Moffatt & Nichol, 2021b).

Beach Morphology

The slope of the beach progressively becomes flatter from the south to the north. Field observations by Professor Thornton of the Naval Postgraduate School show that the beach slope varies from about 12 percent at the north end of the beach to about 28 percent on the south end of the beach (Thornton, 2005). Sand grain size, and therefore wave energy, also increases from the north to the south end of the beach. Sand is deposited on the beach berm by wave action, and at high tides, waves overtop the berm depositing sand and debris on the back beach (nearest the Lagoon) (**Figure 4.5-8**). Thornton also determined the beach is relatively stable and has not significantly migrated over the past 130 years.

The beach topography is seasonally variable and dependent on numerous factors including river flow, wave height, period and direction, tide, mechanical or natural breaching, wind direction and strength, and river sediment deposition. After reviewing the surveys and data, it is evident that the historic management of the beach has significantly altered the beach topography. Historically, mechanically breaching occurred in different locations each year, resulting in the beach to the north, south, and middle of the river mouth to be unnaturally modified and making it difficult to decipher the "natural" beach topography and breaching process.

Figure 4.5-8 provides an overview of Lagoon states (natural and managed) over the period from 1991 to 2021, based on data compiled for the Natural Breach Study. The horizontal yellow bars indicate periods of lagoon closure (i.e., with no outlet to the ocean). This period can start as early as April or May, but typically occurs over the summer months from July through November, and, at time, extending into December and January. Dashed yellow lines indicate years where the start date of sustained Lagoon closure is not accurately known. In these cases, the duration of Lagoon closure was estimated based on historical aerial imagery. The blue squares indicate dates of sandbar management to reduce flood risk. This management action is initiated when the lagoon water level is high or projected to reach flood stage and typically takes place from November through January. The dark green squares indicate dates when naturally formed Lagoon breaches have been observed. The light green squares indicate additional observations of naturally formed lagoon breaches. It should be noted that the natural breach of the Lagoon has not been monitored in detail since 2012. The period and frequency of natural breach events

over the years from 2012 to present should be expected to follow the same pattern as observed by James over the years 1991 to 2005. During the phase of natural breaching of the Lagoon from around January to June/July, the Lagoon will remain open for approximately 85 percent of the time and close intermittently.[2] Per MPWMD (2005), Carmel River inflows to the Lagoon greater than 200 cfs will cause breaches to remain open 100% of the time during this phase. When inflows are between 200 and 20 cfs, the Lagoon may close and breach intermittently. When inflows are below 10 cfs, wave action will typically close the breach.

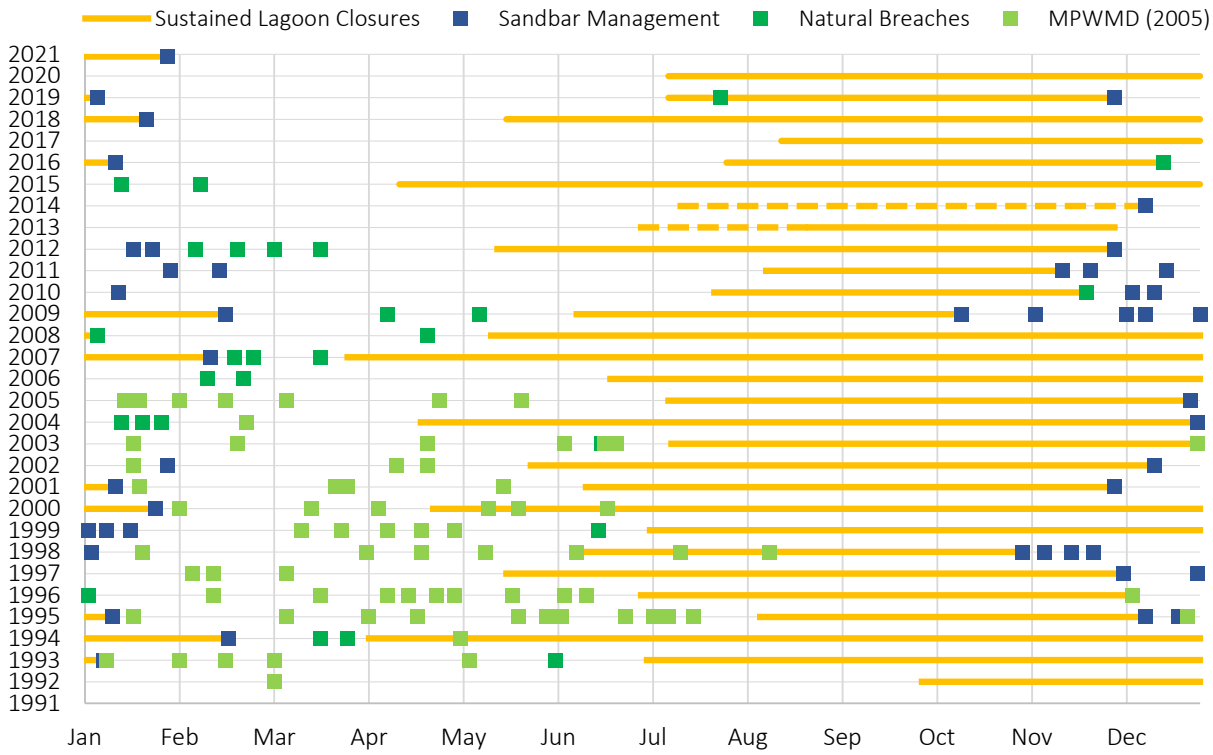


Figure 4.5-8. Overview of Lagoon closures and breaches (1991-2021) (Moffatt & Nichol, 2021a).

Figure 4.5-8 also shows how sandbar management has changed over time. The timing of sandbar management has transitioned from October to February in earlier years to late November to January in recent years. The frequency of sandbar management (dark blue squares) has also decreased. Note several management actions in the years prior to 2012 and typically one action each year thereafter. For example, the high Lagoon water level in October/November of 1998 likely coincided with a period where the sandbar was in a mode of building up. The close spacing of breach events indicates that the Lagoon breach closed off soon after each breach was made. With the practice of excavating a pilot channel, the County has been able to shift sandbar management actions to December and into January, which is the period when natural breach events typically commence each year after the period of sustained Lagoon closure. For example, note there was no sandbar management in December 2016 where breaching occurred naturally.

Figure 4.5-9 shows mechanisms that can lead to breaching of the Lagoon. From the ocean side, wave runup can erode the beach and wave overwash erode the sandbar to a point where the lagoon breaches. This mode of lagoon breaching is not common at Carmel River State Beach, rather wave runup tends to

[2] In wet years, the lagoon was observed to remain open almost 100% of the time. In drought years, approximately 50 percent of the time.

deposit sand and build up the sandbar. There have been a few cases where wave overtopping has filled the Lagoon without breaching it. The most common type of Lagoon breaching is from the lagoon side when the Lagoon water level rises to a point where it overtops the sandbar, or when the hydraulic head (active pressure) overcomes the weight of the sand bar (passive pressure). Close to the point of the Lagoon breaching there is a significant seepage flow through the sandbar. The seepage can produce a couple different effects that can affect when breaching occurs. One effect is the removal of finer grained material over time where fines are winnowed out with the seepage flow. This process is called suffusion. Suffusion means the porosity of the sandbar material can increase slightly over time (fines are removed), which theoretically reduces the resisting force of the sandbar (i.e., space occupied by sand grains are replaced with water). However, washout of the fines also increases the permeability of the sand berm materials so it can accommodate a higher hydraulic head before failing. A second effect of the seepage flow is the pore pressure causes grains to separate at the beach face where the seepage flow enters the surf, which aids wave action in removal of sediment. The wave runup and rundown can have a filtering effect where smaller diameter material is removed and larger diameter material retained and deposited atop the sandbar. The net effect over time can be that the sandbar material transitions to larger diameter material.

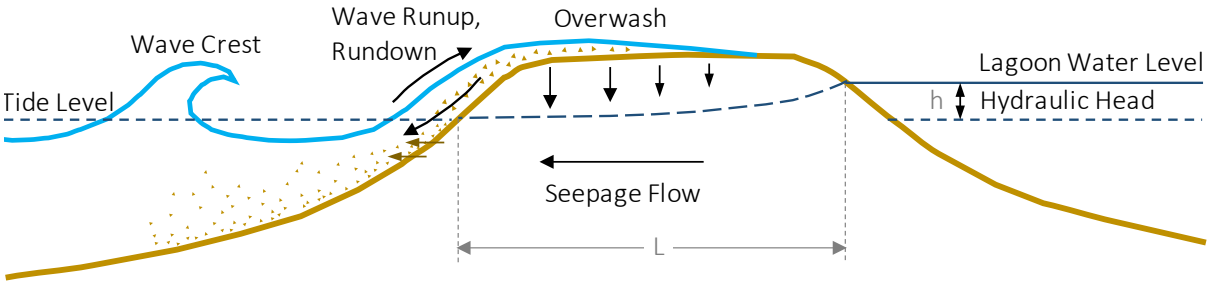


Figure 4.5-9. Parameters governing lagoon breaching (Moffatt & Nichol, 2021b).

The Natural Breach Study found that Lagoon formation is primarily driven by discharge from the Carmel River (i.e., the extent of the Lagoon grows as the volume of water contained within the Lagoon increases). The analysis shows the morphological evolution of the Lagoon is affected by wave-driven processes that can influence whether the Lagoon migrates north, south, or central to the beach in a given year. The ability of wave action to affect the migration of the Lagoon increases the closer the edge of the Lagoon is to the shoreline and dominates once a breach has taken place and a breach channel is formed. In this case, the direction of littoral transport, either north or south along the beach, strongly affects migration of the Lagoon breach channel, which follows the littoral transport direction.

The analysis also found that the is no preordained directionality with respect to whether the Lagoon migrates north, south, or central to the beach each year. Depending on the angle of incidence waves and their duration, wave-drive longshore littoral processes can cause northward or southward migration of the Lagoon. The analysis found that certain wave conditions tend to temporarily stabilize the Lagoon breach channels at the north end of the beach and at the central portion of the beach, while wind-wave events often cause a southward migration of the Lagoon breach channel. These wind conditions are likely the reason behind why many of the Lagoon breach channels are observed to appear in the approximately same areas of the northern, central, and southern portion of the beach. However, it should be noted that these observations are after a breach has occurred and a breach channel has formed. The analysis did not find any indication that there is a preferred location where breach would naturally tend to occur.

While wave-drive processes are found to significantly influence the migration of the breach, it is primarily the inflow to the Lagoon from the Carmel River that controls the breaching and closure of the Lagoon. Field observations have established that following the seasonal initial breach event, the Lagoon will close

temporarily and breach intermittently until its seasonal closure. Closure has been found to occur when discharge from the river decreases to around 10 cfs or lower. At flows of 20-200 cfs, the Lagoon may close and breach intermittently. During inflows higher than 200 cfs, a breach will remain open for as long as the discharge persists.

Because of the random nature of the wind and wave climate and significant variation in precipitation from year to year, Lagoon breaching is highly dynamic and episodic. Irrespective of the ability of waves to close off a breach channel, it is still the discharge from the river that governs when a breach will occur, and when an open breach channel might close and subsequently re-form.

TIDES AND STORM SURGE

Tides occur due to the gravitational pull of the moon and sun, and vary over the cycle of a lunar day, which is approximately 24 hours and 50 minutes. The tidal period is the time between consecutive high tides or low tides. The tidal range is the difference in height between the low tide and the high tide. Tides at Carmel are semi-diurnal, which means that two high tides and two low tides occur each lunar day. **Figure 4.5-10** summarizes the terminology used to describe tides.

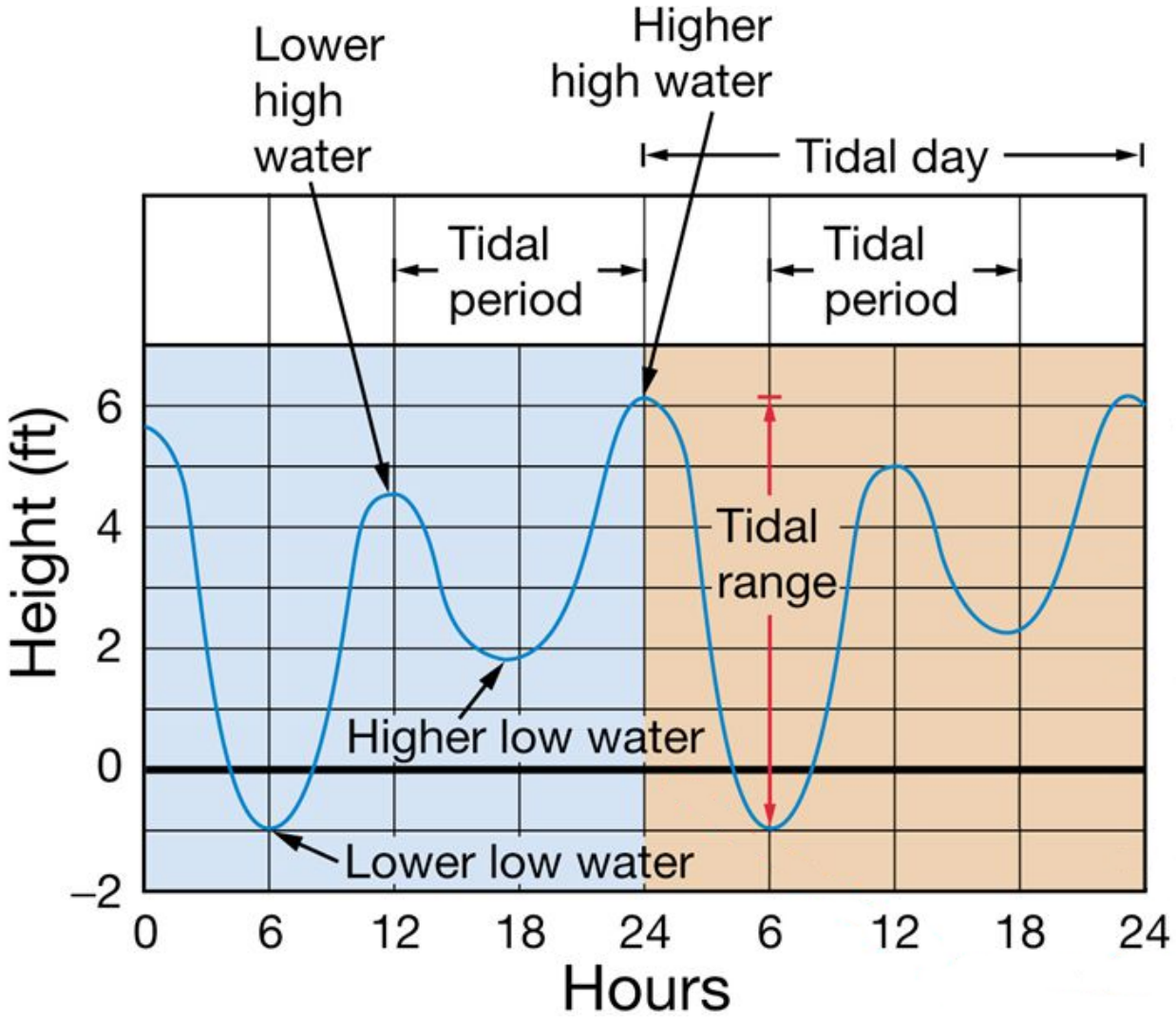


Figure 4.5-10. Terminology used to describe astronomical tides (Moffatt & Nichol, 2021b).

Tides at Carmel are semi-diurnal, which means two high tides and two low tides occur each lunar day. In **Figure 4.5-10**, the higher high tides occur at 24 hours and 24 hours later, and the lower low tides occur at six hours. The highest tides are referred to as "higher high water" while the intermediate high tides are referred to as "lower high water." A similar terminology is used for the low tides, where the lowest tides are referred to as "lower low water" and the intermediate low tides as "higher low water."

Coastal water level datums at the proposed project site are summarized in **Table 4.5-1**. The values in the upper and lower part of the table reflect water level extremes due to a combination of astronomical tide and meteorological effects producing storm surge (positive or negative). The values in the center portion of the table indicate datums for astronomical tides only.

Table 4.5-1. Water Level Datums at the Proposed Project Site (Moffatt & Nicol, 2021b)

Water Level Datum	Elevation (feet)		Description
	MLLW Datum	NAVD88 Datum	
100-yr	+8.08	+8.22	1% annual chance high water level
50-yr	+7.92	+8.06	2% annual chance high water level
10-yr	+7.59	+7.73	10% annual chance high water level
5-yr	+7.42	+7.56	20% annual chance high water level
HAT	+7.04	+7.18	Highest astronomical tide
KT	+6.90	+7.04	King Tide
MHHW	+5.34	+5.48	Mean Higher High Water
MHW	+4.64	+4.78	Mean High Water
MTL	+2.87	+3.01	Mean Tide Level
MSL	+2.83	+2.97	Mean Sea Level
MLW	+1.1	+1.24	Mean Low Water
MLLW	0	+0.14	Mean Lower Low Water
NAVD88	-0.14	0	North American Vertical Datum of 1988
NGVD29	+2.59	+2.73	National Geodetic Vertical Datum of 1929
LAT	-1.91	-1.77	Lowest Astronomical Tide
5-yr	-1.99	-1.85	20% annual chance low water level
10-yr	-2.12	-1.98	10% annual chance low water level
50-yr	-2.29	-2.15	2% annual chance low water level
100-yr	-2.35	-2.21	1% annual chance low water level

LITTORAL TRANSPORT

Littoral transport is the term used for the transport of non-cohesive sediments, primarily sand, along the foreshore and the shoreface due to the action of the breaking waves and the longshore current. Waves breaking in the surf zone causes sediment to be mobilized and brought into suspension. The longshore current, also generated by wave breaking, transports the sediment along the shoreline. Waves and littoral transport patterns associated with waves have been studied in Thorton (2005) and documented in field observations by Greg W. James, MPWMD (2005). The Natural Breaching and Sediment Transport studies compiled and analyzed documentation from Thorton and James' 2005 works, which is now summarized below.

Littoral Transport Driven by Swell Waves

Figure 4.5-11 shows sediment transport patterns associated with swell waves occurring over the months of November through January when initial Lagoon breaching usually takes place. During this time of the year, the swell wave climate is dominated by episodes of North Pacific swell. Swell episodes can last from hours to several days, depending on the magnitude and duration of the storm system of origin. During an episode of swell, the waves with the longest wave period (i.e., the time it takes for two successive wave crests, or one wavelength, to pass a specified point, usually referenced in seconds) will arrive first, followed by waves with progressively shorter periods. For example, initial swell waves with 18 second periods, transitioning to swell with 15 second periods, then 13 second periods, and so forth until the swell front dies down.

Offshore from Carmel Bay, North Pacific swell can arrive from a wide range of directions (**Figure 4.5-6**). In **Figure 4.5-11**, these are grouped into waves arriving from northwesterly directions (dark blue arrows), waves from westerly directions (light blue arrows), and waves from southwesterly directions (red arrows). These offshore directions of wave incidence (i.e., waves moving landward) are indicated by the three arrows on the left side of the figure. The percentage indicates the amount of time incident swell waves arrive from the respective direction. As shown in the figure, most swell waves arrive from westerly and northwesterly directions with a limited amount arriving from southwesterly directions. The size of the arrows used in the figure (large, medium, and small) indicates the magnitude of the littoral transport. The results show that regardless of the offshore angle of wave incidence, the resultant direction of longshore transport is generally southward in the deeper water along the shoreline. Closer to the shoreline, waves from northwesterly and westerly directions can set up a circulation pattern where the direction of sediment transport is northward along the southern part of Carmel River State Beach.

The variation of the seabed and crenulate shape of the bay causes incident waves to undergo a significant amount of refraction. Refraction is the change in direction of a wave as it passes from one medium to another. Refraction, or bending of the path of the wave, is accompanied by a change in speed and wavelength of the wave. At the north end of Carmel River State Beach, where the beach is sheltered behind Carmel Point, the transport direction is to the east-southeast along the beach, which explains why the headland (a narrow piece of land that projects from the coastline into the sea) is rocky and not saturated with sand.

Wave runup over the beach is also able to transport sediment along the shoreline. This occurs when the wave runup is angled slightly with respect to the shoreline. This mode of transport is indicated by the small arrows shown on the beach in **Figure 4.5-11** (also known as the swash zone). For northwesterly waves, the results show that the direction of sediment transport is generally southward along the beach, but there is an area at the center of the beach where the transport can be either northward or southward. For westerly waves, the direction of transport is also generally southward along the beach, but there is an

area of the south end of Carmel River State Beach where the transport can be either northward or southward.

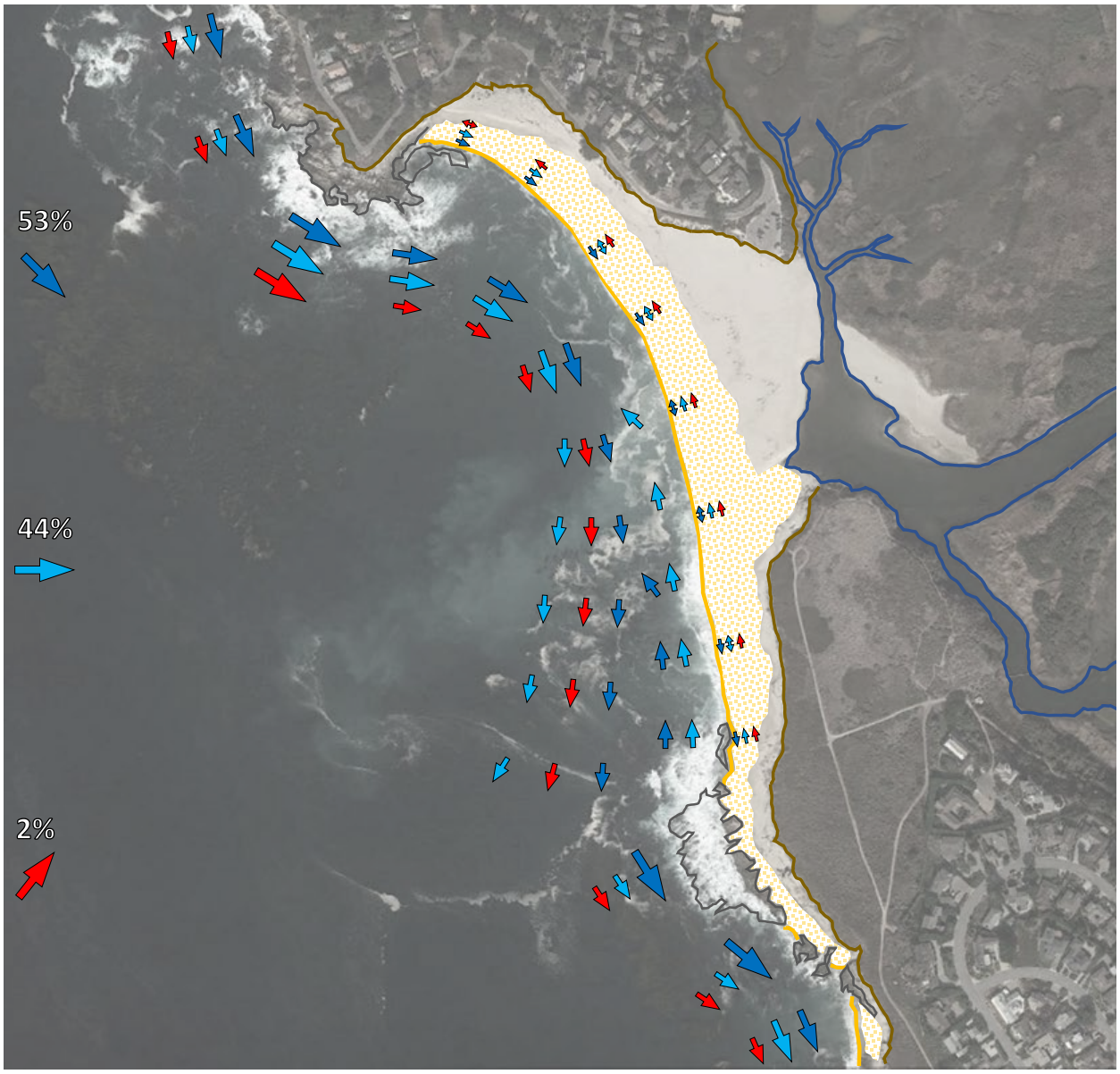


Figure 4.5-11. Sediment transport patterns associated with swell waves (Moffatt & Nicol, 2021a)

For southwesterly waves, the direction of transport is northward nearly all the way to the north end of Carmel River State Beach. The areas of mixed transport directions are locations where open breach channels might tend to congregate. These areas correlate well with where breach channels have been observed in the field (i.e., at the north and south end, and central part of the beach).

Littoral Transport Drive by Wind-Waves

Figure 4.5-12 shows sediment transport patterns associated with wind-waves occurring over the months of November through January for wind-waves from northwesterly, westerly, and southwesterly directions. Because wind-waves have shorter wave periods than swell waves they are not subject to the same degree of wave refraction as swell waves as they spread into Carmel Bay. Therefore, the relationship

between sediment transport direction and wind-wave direction is more obvious. Wind-waves from west-northwesterly and westerly directions produce southward transport both in deeper water and within the swash zone on the beach. Wind-waves from southwesterly directions generally produce northward transport both in deeper water and within the swash zone.

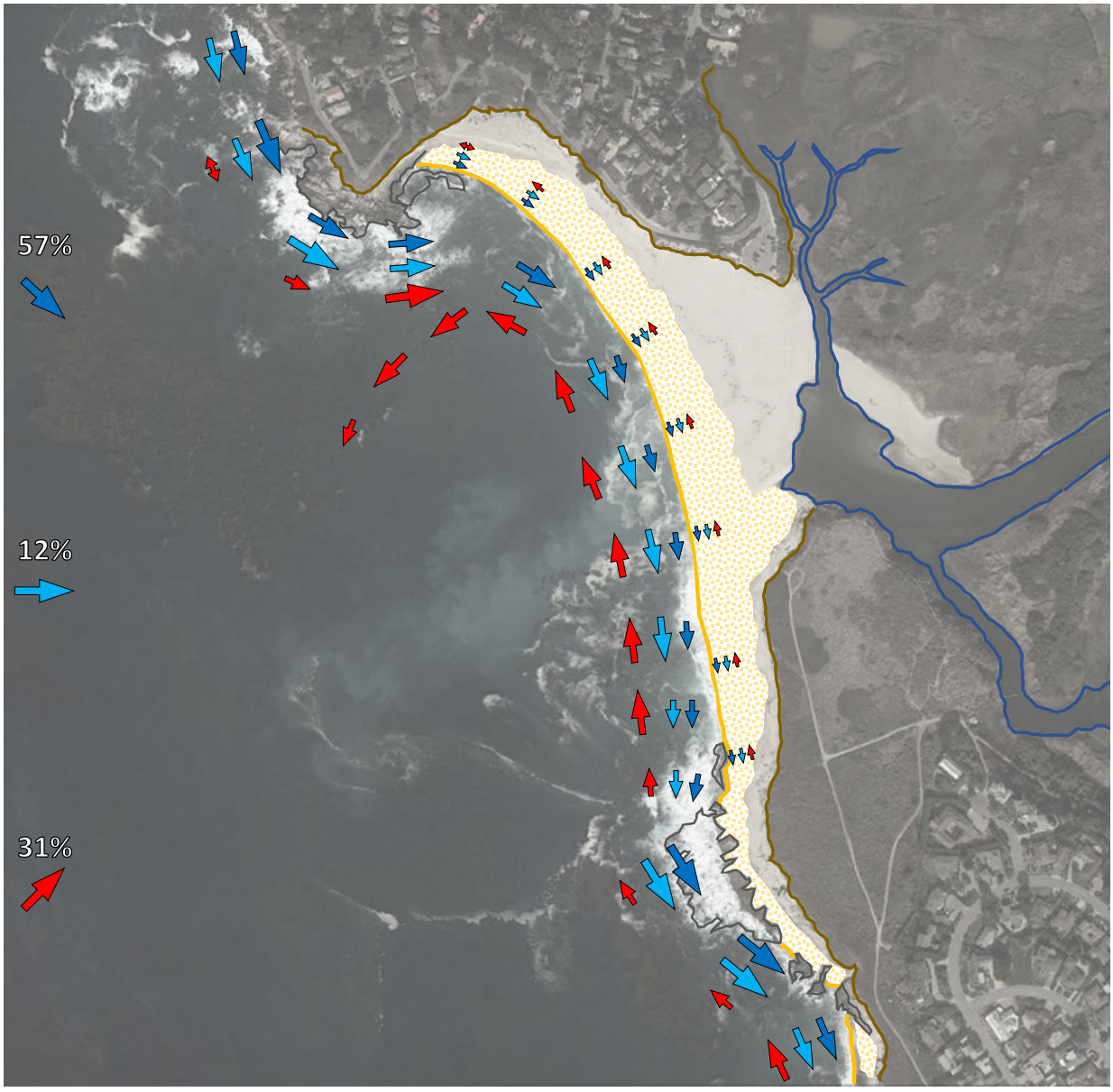


Figure 4.5-12. Sediment transport patterns for northwest wind-waves (Moffatt & Nichol, 2021a).

The percentages noted along the left edge of **Figure 4.5-12** show that most wind-wave events occur from northwesterly directions and from southerly directions. Wind-waves during these events develop during the passage of regional storm systems, and, therefore, are relatively short-lived and occur occasionally and at irregular intervals. **Figure 4.5-12** illustrates that a wave event associated with wind from northwesterly direction can transport significant amounts of sediment from Carmel River State Beach south along the coast. The process removes sediment both along the shoreline and out in deeper water with the net effect being a substantial depletion of sediment from the Carmel River State Beach shoreline and seabed.

Southwesterly wind-wave events will produce a strong northward directed transport along the shoreline and in deeper water. However, in most cases, these events will not bring sand to the area of Carmel River State Beach, but rather shift the sand along the shoreline up to the north end of Carmel River State Beach. The net effect is that the width of the beach decreases along the south end of Carmel River State Beach, while the beach widens at the north end of Carmel River State Beach.

El Niño Southern Oscillation

The El Niño Southern Oscillation (ENSO) is a periodic fluctuation in sea surface temperature and air pressure of the overlying atmosphere across the equatorial Pacific Ocean. The warming phase is termed El Niño while the cooling phase is named La Niña. El Niño and La Niña cycles typically last 9 to 12 months. They often commence in June or August and reach their peak during December through April, and subsequently, decay over May through July of the following year. Their periodicity is irregular, occurring every three to five years on average.

When El Niño conditions are present, ocean wave heights can be larger by one to four feet. Storms associated with El Niño effects typically approach from the west or southwest and may produce local littoral drift to the north, counter to the predominant southerly transport. The warming of the ocean that occurs during El Niño also produces a rise of the mean sea level which can be on the order of 10 to 12 inches. ENSO can therefore be considered as a form of temporary sea-level rise. Shorelines often experience severe erosion during El Niño storms.

During La Niña periods in the winter months, ocean wave heights are larger by 0.3 to 1.3 feet. When La Niña occurs in the summer months, ocean waves are slightly smaller than average.

CARMEL LITTORAL CELL

A littoral cell is a section along the coast where sediment processes are isolated from neighboring shoreline segments. A littoral cell exhibits a complete cycle of sedimentation including sources, losses, and transport paths. The Carmel littoral cell extends from Cypress Point to Point Lobos as illustrated in **Figure 4.5-13**. The net direction of sediment transport within the littoral cells is from north to south. North of Cypress Point, the bluff is oriented approximately perpendicular to the average direction of incident waves. As a result, the material produced due to erosion of the cliffs in this area tends to move north toward Monterey or south into the Carmel littoral cell depending on how the incident waves deviate from the mean wave direction. The Carmel littoral cell terminates at Point Lobos around Monastery Beach, where material is lost to the Carmel submarine canyon. Within the Carmel littoral cell are sub-cells comprised of pocket beaches and crenulate-shaped bays found along the shoreline. These features are located between rocky headlands, which prevents sediment within these cells from moving along the coast. Examples of these are Carmel Beach (CB), Carmel River State Beach (CRSB), Monastery Beach (MB), Stillwater Cove (SC), and Whaler's Cove (WC) (abbreviations shown in **Figure 4.5-13**).

The arrows in **Figure 4.5-13** indicate the predominant direction of littoral transport. Yellow arrows indicate longshore transport, red arrows indicate loss of sediment, and the black arrow indicates storage of sand via dune formation. The blue curves indicate streams that supply sediment to the shoreline areas.

Apart from the Carmel River, which is described in more detail below, sediment transported via streamflow, runoff, and wind comprises a smaller part of the overall system. Wave action is the most significant drive for the movement of sediment within the littoral cell. Wave action contributes to erosion, cross-shore movement of sand onto beaches and movement of sand offshore, and longshore transport along the shoreline due to wave runup and rundown, and in the surf zone via wave-induced currents.

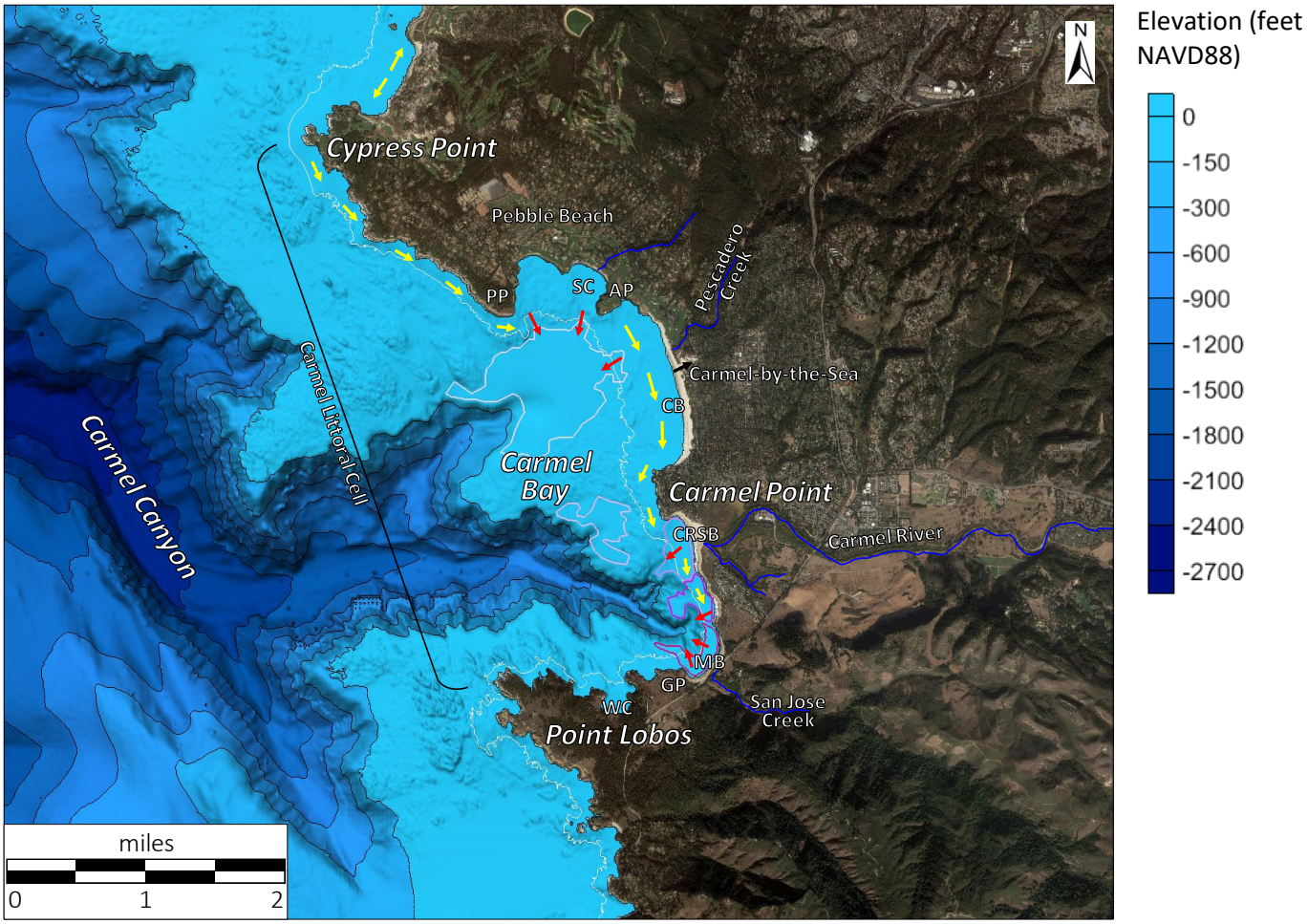


Figure 4.5-13. Overview of Carmel Littoral Cell (Moffatt & Nichol, 2021b)

Figure 4.5-13 illustrates the movement of sand particulate along the shore due to wave-induced processes. In deep water, waves are unable to mobilize sediment on the seafloor; the depth at which this occurs is called closure depth. **Figure 4.5-14** provides a summary of coastal terms and definition of closure depth. At Carmel Bay, the closure depth approximately follows the -45 to -50 feet NAVD88 elevation contour. The predominant zone of wave-induced longshore transport is between this line and the shoreline. Wave-driven sediment transport is limited seaward of the closure depth where water depths are so deep that waves cannot mobilize sediment on the seabed. In areas where the closure depth contour comes close to the shoreline, there is a limited potential for sand movement between adjacent areas. In these areas, sediment exchange is sporadic and typically occurs during significant storm events.

The elements of the Carmel Littoral Cell are described below.

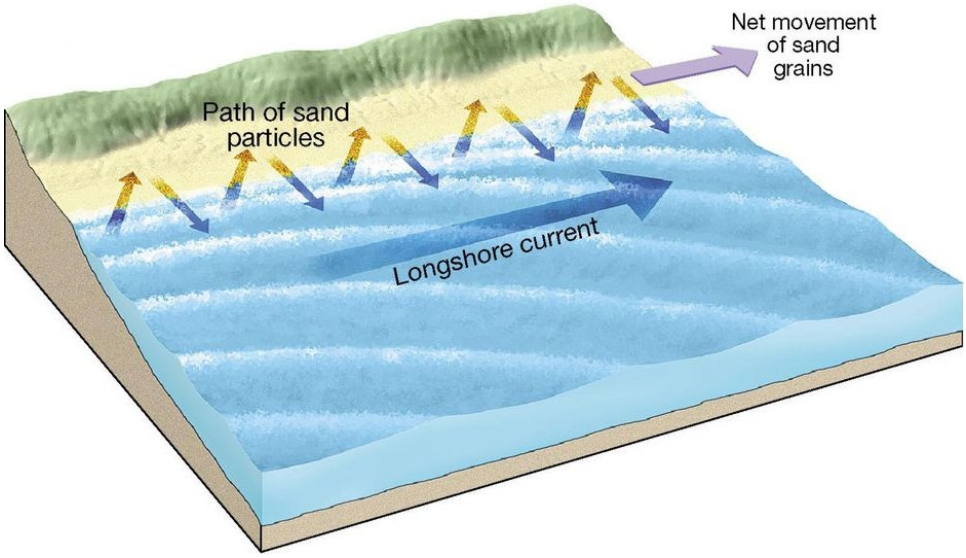


Figure 4.5-14. Wave-driven sediment transport along the shore (Moffatt & Nichol, 2021b).

Coastal Cliffs from Cypress Point to Pescadero Point

This portion of the coast consists of craggy coastal cliffs. There are a limited number of access points to the water and isolated pocket beach areas. Most of the shoreline is rocky and swept free of sand. Due to reflection of long period swell waves as they pass over the Carmel Submarine Canyon, a portion of the incident waves are directed towards the coastal cliffs. This occurs for waves incident from both northwesterly and southerly directions and means the shoreline is continually exposed to wave action. Material dislodged from the cliffs by wave action and natural decomposition of the rock is transported southeast along the cliffs toward Pescadero Point and ultimately provides input of beach sand to Carmel Beach.

Stillwater Cove

Stillwater Cove is a sheltered inlet consisting of two pocket beaches perched between Pescadero Point and Arrowhead Point. Stillwater Cove is the name for the pocket beach to the east, which is sheltered by the Pescadero Rocks fronting the inlet. The pocket beach to the west is open to the bay and receives a higher degree of wave exposure. The shoreline in this area is rocky and consists of sections of steep bluff interspersed by narrow beaches and is aptly named Pebble Beach. The primary source of sediment with Stillwater Cove comes from erosion of the bluff along the golf course. A ravine with a small inland drainage area has an outlet at the beach but does not contribute a significant input of sediment to the beach.

Sediment coming from erosion of the cliffs between Cypress Point and Pescadero Point will tend to move along the bluff towards Stillwater Cove. A fraction of this material may enter the cove, but most of it is probably lost to the deeper portion of the bay at the entrance to the cove (refer to the two red arrows in **Figure 4.5-13**). The deposit of sand offshore from Stillwater Cove can be seen in the figure as a smooth appearance of the seafloor, as opposed to the irregular seabed within the cove which is indicative of a rocky substrate. Sediment lost to the deeper water outside of the cove will tend to migrate downslope towards the north arm of the submarine canyon where it is ultimately lost from the system. In this regard, the submarine canyon acts as a sediment trap, and sediment entering the canyon can be considered as lost from the littoral cell.

Carmel Beach

Carmel Beach is a crenulate-shaped bay suspended between Arrowhead Point and Carmel Point. The beach is approximately 400 feet wide and has an abundance of white sand. The characteristic white color of the sand comes from the source of the material which is the granodiorite rock formations in the bay. Pescadero Creek also has an outlet on the beach via Pescadero Canyon. The drainage area for the creek is estimated to be around 567 acres and the sediment supply to the beach from this drainage area is therefore limited. There is enough sand on Carmel Beach that wind-blown sand transport has created an area of dunes along the beach of approximately 10 acres in size. Wind-blown sediment contributing to growth of the dunes is considered a loss of sediment from the littoral cells. Conversely, sand that is eroded from the dunes provides an input to the system.

The alignment of the beach is generally perpendicular to the average incident wave direction. During significant wave events, the surf zone can extend out past Carmel Point and sediment can be transported from Carmel Beach to the Carmel River State Beach area.

Over the summer months when the wave climate is mild, incident swell waves will transport sand onto the beach which can widen by around 200 feet over this period. Winter waves pull sand away from the beach out into deeper water and the beach can therefore become quite narrow in the winter months.

Carmel River State Beach

Carmel River State Beach features sweeping views of the beach and coastal cliffs. One of the most prominent features of the area is the lagoon formed at the outlet of the Carmel River. The beach extends from the prominent headland at Carmel Point at the north and tapers out along the rocky shoreline to the south. The sand at Carmel River State Beach is variable in color and size. Fine white sand is likely sand originating from Carmel Beach and breakdown of granodiorite formations along the shore. The coarser and more yellow sand is indicative of fluvial deposits coming down the Carmel River. The Carmel River is a significant source of sediment to the littoral cell. Estimates of the sediment output from the river are on the order of 31,851 CY/year on average. The sediment output from the river varies seasonally and from year to year depending on rainfall amounts. As indicated by the red arrow in **Figure 4.5-13**, sand at the Carmel River State Beach may be lost due to downslope migration to the Carmel Submarine Canyon. The north arm of the canyon comes close to shore in this area, in proximity to the closure depth contour. There is evidence that significant wave events and outflow currents cause sediment to be transported into the submarine canyon. The mechanisms that can cause this to happen include:

1. Winter storm wave events, which draw sand away from the beach out into deeper water and over the edges of the submarine canyon.
2. Seepage flows from the Carmel River.
3. Flushing events when the Carmel River Lagoon breaches out into the bay.
4. Rip-currents producing strong outflows away from the beach, which carry sand offshore and into the canyon.

The net sediment transport direction at Carmel River State Beach is from the north to the south. However, incident swell can cause the littoral transport direction to be northerly. Major pulses of sediment move south during storms from northwesterly directions.

Ribera Beach

Ribera Beach is a short stretch of beach between Carmel River State Beach and Monastery Beach. This beach runs along Ribera Road and is also referred to as the Middle Beach. The headlands framing the beach don't protrude as much out from shore and the beach is therefore relatively narrow with rock outcrops. The beach is perched against a narrow 300 ft long shore-parallel granodiorite outcrop on the seafloor. The sand in this area is very coarse.

There is evidence of sand being transported along the shoreline in the form of sand chutes carved into the rock outcrops. These manifest as branching, rounded chutes carved into the rock terrace. The chutes are filled with sand and vary in width from two to three inches up to 10 feet wide. Diver surveys have identified a sand fall in this area, which consists of a river of very coarse sand on the seabed aligned in a southwest direction towards the submarine canyon head. The sand river formation is the result of the longshore littoral transport being diverted seaward by the rock outcrop at the south end of the area, at the transition to Monastery Beach.

Monastery Beach

Monastery Beach is a pocket beach framed between the rocky shoreline to the north and Granite Point at its south end. The orientation of the beach is perpendicular to the average direction of incident waves. A key feature of the area is San Jose Creek, which has a meandering outlet at the beach. The sand at this beach is likely a mix of sand from granodiorite decomposition, sand from the Carmel River transported along the shore, and sediment output from San Jose Creek. The net direction of sediment transport along Monastery Beach is to the north as indicated by the northward migration of San Jose Creek on the beach.

The Carmel Littoral Cell generally terminates at Monastery Beach by Granite Point. Only a very limited amount of sand is transported west past Granite Point. Evidence for this is the fact that Whaler's Cove contains very little sand. Most of the shoreline in Whaler's Cove consists of rocky cliffs with very narrow patches of sandy beach at the back of the cove.

At Monastery Beach, the primary loss of sand is to the south arm of the Carmel Submarine Canyon, which comes close to shore in this area. The mechanisms that can convey sediment from shore out to the submarine canyon include:

1. Winter storm wave events, which draw sand away from the beach out into deeper water and into the canyon.
2. Outflow from San Jose Creek, which may produce turbidity flows out to the canyon.
3. Rip-currents producing strong outflows away from the beach, which carry sand offshore and into the canyon. Rip currents have been observed to achieve enough speed to break through the surf zone. Rip-currents can occur at the rocky headland formations and along the beach. Cusp formations along the beach, which are known to occur at Monastery Beach are often indicative of rip-currents.
4. Sand chutes, consisting of rounded channels carved in the rock terrace have been observed around the canyon head. These have an orientation perpendicular to shore suggesting that these have formed due to abrasion associated with wave-induced oscillation of the coarse sand on the seabed.

Sand falls consisting of rivers of very coarse sand on the seafloor, directed towards the head of the submarine canyon. Sand falls have been identified at the headland features at the north and south end of Monastery Beach.

Carmel Submarine Canyon

The Carmel Submarine Canyon is the end destination of sediment transported out of the Carmel Littoral Cell. Once sediments enter the canyon, they will not reenter the system. Several processes have been identified that document transport of sand from the seabed into the canyon from Carmel River State Beach and Monastery Beach. These include:

1. Tidal circulation patterns, which may drive a net drift of fine sediment into the canyon.
2. Runnels in the bedrock of the seafloor. These are believed to be carved by abrasion from sand particles moving with the orbital motion of incident waves during significant wave events. The downslope grade of the seafloor produces a net flow of sediment towards and into the canyon.
3. Outflow events during Carmel River Lagoon breaching and/or during significant discharges from the Carmel River and San Jose Creek. In these cases, sediment can be flushed out into deeper water via hypopycnal and hyperpycnal flows. Hypopycnal flows occur during smaller outflow events and/or when the transported sediment consists of coarse material, which causes the material to be deposited in the deeper water fronting the beach. The freshwater outflow may initially consist of a lens atop the heavier seawater. Hyperpycnal flows can occur during significant outflow events. In this case, the sediment flows as a turbidity current downslope over the seabed towards the canyon.
4. Mass wasting along the edges of the canyon due to oversteepening of sediment deposits.
5. Seismic activity, which causes submarine landslides into the canyon. Earthquakes can also cause landslides on the seafloor, which subsequently move as turbidity flows downslope towards the canyon.

SEDIMENT BUDGET

Figure 4.5-15 presents an idealized version of the Carmel coast, summarizing sediment input and losses from the littoral cell. The littoral cell can be considered as a control volume along the shoreline. Sediment input to the system is denoted by arrows going into the cell marked with a "+" symbol. Sediment losses are indicated by arrows going out of the cell marked with a "÷" symbol.

The arrow on the left side indicates littoral transport into the cell, which is small to negligible where the littoral cell starts at Cypress Point. Likewise, the littoral transport leaving the system (arrow on the right) is also small where the littoral cell terminates at Point Lobos.

There is longshore littoral transport within the cell which can be to the north and south depending on winter storm and wave patterns, but with a net transport to the south (left to right in the figure).

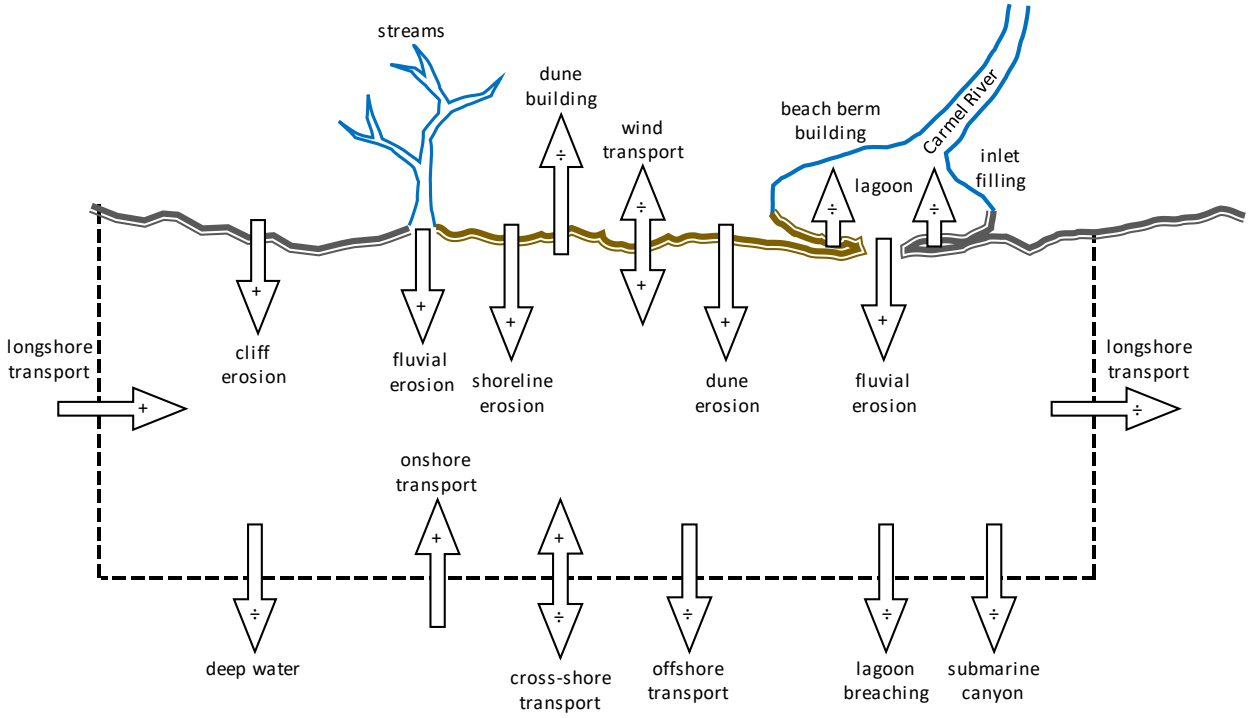


Figure 4.5-15. Littoral cell sediment sources and losses (Moffatt & Nichol, 2021b).

Cliff Retreat Rates

Degradation and erosion of coastal cliffs at Carmel Bay play an important role in the overall sediment budget. Cliff erosion is the second largest contributor of sediment to the littoral cell after the fluvial input from the Carmel River and San Jose Creek. In the region from Cypress Point to Point Lobos, cliff retreat rates are on the order of four to eight inches per year, with the highest rates occurring along the most exposed areas of the coast.

Shoreline Change

Shoreline change is another phenomenon that affects the overall sediment budget at Carmel Bay. While most of the pocket beaches and crenulate-shaped bays are relatively stable, long-term shoreline recession has the effect of adding sand to the overall system. Beaches are subject to a seasonal (cyclical) variation where they tend to build up and widen in the summer and become narrower in the winter. As a result, sediment is added to the littoral cell in the summer and released during the winter. The aggregate effect is a temporary storage of sediment within the littoral cell system. However, long-term shoreline recession will produce a net loss of sediment from the system.

Shoreline change at Carmel River State Beach was evaluated based on historical aerial imagery. **Figure 4.5-16** summarizes the shoreline locations derived from aerial imagery recorded over the year from 1929 to 2020. **Table 4.5-2** lists the years included in the analysis and the color codes used to denote the shoreline locations in **Figure 4.5-16**.



Figure 4.5-16. Shoreline locations (1929-2020) (Moffatt & Nichol, 2021b).

Table 4.5-2. Aerial imagery dates and color code.

Date	Color Code	Source
1929-08-01		UCSB (2020)
1941-11-22		UCSB (2020)
1945-10-24		UCSB (2020)
1961-04-14		UCSB (2020)
1986-09-28		CCRP (2020)
1993-04-19		CCRP (2020)
2001-05-30		UCSB (2020)
2005-10-04		MCPW (2014)
2006-04-18		MCPW (2014)
2016-04-28 [a)]		NOAA (2020c)
2020-05-16		NM (2020)
a) El Nino year.		

The variety of the shoreline locations in **Figure 4.5-16** reflect the seasonal and intra-annual variation of the shoreline as well as the long-term shoreline recession. Fluctuation of the shoreline location is smaller at the north end of the beach than at the south end. The fluctuation of the shoreline varies approximately 45 feet at the north, to 75 feet at the central location of the beach, to 150 feet at the south end. This variation is not surprising as the north end of the beach is more sheltered in the lee of Carmel Point, and, thus, is more stable. The portion of the beach fronting the river mouth is somewhat less sheltered and exposed to larger waves, and, therefore, exhibits more variation in the location of the shoreline. The shoreline segment located south of the river mouth is exposed to more wave action and subject to significantly larger changes in sand volumes as pulses of sand deposited from the river move southward conveyed by the littoral transport.

Figure 4.5-17 summarizes the estimates of long-term shoreline change at Carmel River State Beach, which were developed based on aerial photography dating back to 1929 (see **Table 4.5-2**). The results show that the northern part of the beach appears to be stable over the long-term due to the sheltering of the beach by the promontory at Carmel Point. It is conceivable that the long-term rate of shoreline recession in this area is tied to the cliff recession rate, which is on the order of a few inches per year. Moving south along the beach, the recession rate increases progressively, on the order of 0.4 to 0.5 feet per year at the river mouth to nearly 0.7 feet per year at the transition between Carmel River State Beach and Ribera Beach.

Sediment Input to Carmel Littoral Cell

The primary sources of sediment input to the cell include:

1. Cliff Erosion. Where sediment is created from erosion and weathering of the cliff formations along the coast and on the seabed. The erosive mechanisms include physical breakdown due to wave action, chemical breakdown, and due to biological processes.
2. Fluvial sources. Sediment created from fluvial erosion conveyed to the littoral cell via gullies, streams, and rivers including Pescadero Creek, the Carmel River, and San Jose Creek.

3. Shoreline erosion. Sediment resulting from shoreline erosion is considered input to the littoral cell.

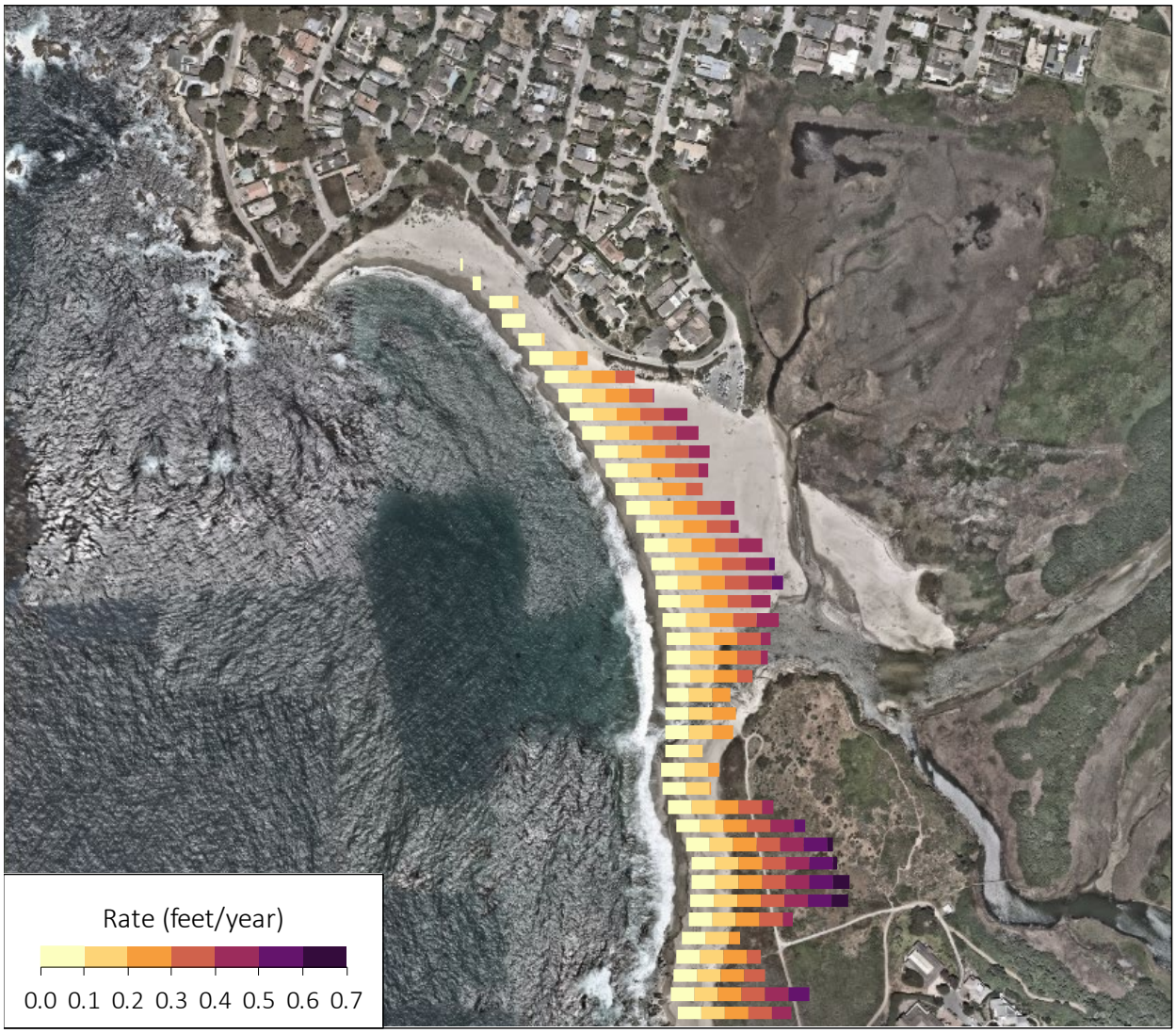


Figure 4.5-17. Long-term shoreline recession rates at Carmel River State Beach (Moffatt & Nichol, 2021b).

The Carmel River and lagoon comprise a separate system of sediment exchange within the littoral cell and a major source of sediment to the system. Sediment carried down the Carmel River provides input of sediment to the system. This source of sediment stems from fluvial erosion along the streambank and upland terrain within the drainage area of the river. The sediment load can vary significantly from year to year depending on several factors. Drought can reduce sediment output from the river, and upper portions of the watershed have historically been dammed off by the Los Padres Dam (1949), the San Clemente Dam (1921), and the Old Carmel River Dam (1880s). The latter two were removed around 2016 as part of the San Clemente Dam Removal Project. Increased sediment output from the Carmel River has been known to occur during wet years and following wildfires within the watershed.

Sediment Losses from Littoral Cell

Loss of sediment from the littoral cell is indicated by arrows pointing out from the cell shown in **Figure 4.5-15**. One form of loss from the littoral cell includes sediment lost to deeper water. This process occurs

when large winter storms draw sediment out from the beach areas into deeper water. Sediment that settles in water depths at the depth of closure may rarely if ever become re-mobilized and can be considered lost from the system. Another effect that contributes to this form of sediment loss is downslope sediment migration, which simply means that when sediment is mobilized, gravity will tend to move the sediment downhill. This effect is noticeable in areas offshore Pebble Beach, Stillwater Cove, Arrowhead Point, and Carmel Point. Refer to the areas outlined in purple in **Figure 4.5-13** seaward of the closure depth contour (white contour line). The smooth appearance of these areas indicates a sandy substrate, as opposed to the irregular features on the seabed seen elsewhere, which are indicative of rocky substrate and/or outcrops of bedrock.

Breaching of the lagoon is another mechanism that can transport sand offshore into deep water past the depth of closure and/or into the submarine canyon. However, this effect is likely limited to the fraction of fine sediment. The sediment on the beach is coarse and probably does not leave the system with each breach.

The ultimate sink in the littoral cell system is the Carmel Submarine Canyon. Once sediment enters the canyon it will not return to the littoral cell.

Table 4.5-3 provides a sediment budget for the Carmel Littoral Cell. For simplicity, the analysis primarily captures major sediment contributions in the form of input from cliff and shoreline recession and streams. Losses account for sediment lost to deep water and lost to the submarine canyon. Temporary storage of sediment and seasonal sediment fluctuations are assumed to be quasi-steady and are not reflected in the breakdown. A cumulative total of sediment input and output is computed for shoreline reaches starting at Cypress Point, moving south along the shoreline to Point Lobos where the littoral cell ends.

Sediment Fluctuations

Wind transport of sand on the beach can contribute to sediment input to the littoral cell as well as loss of sediment from the cell. When wind-blown sand transport contributes to formation of dunes, it is considered a loss from the system. When dunes are eroded due to wind or wave action, it is considered an input to the system. Because the dunes along Carmel Beach are relatively stable and not significantly expanding or eroding, the sediment exchange with the dune system can be considered a form of temporary storage of sediment within the littoral cell.

The Carmel River Lagoon also functions as a form of temporary storage of sediment within the littoral cell. During lagoon formation, seepage provides an input of sediment to the littoral cell. During breaching of the Lagoon, sediment is also released into the system. Sandbar buildup resulting from wave action constitutes a loss of sediment from the system, but because these processes fluctuate, the overall sediment exchange with the Carmel Lagoon can be considered as temporary storage of sediment.

Cross-shore transport is another mechanism that fluctuates significantly seasonally and depending on the incident wave climate. Winter storm events often produce wave conditions that draw sediment out from the beach areas into deeper water. This movement of sediment can be considered as a temporary loss from the system. Swell waves tend to build up the beach profile. This onshore transport can be considered input of sediment to the system. Because these processes of sediment exchange are dynamic and fluctuate seasonally, they can be considered as temporary storage or removal of sediment from the littoral cell.

Table 4.5-3. Carmel Littoral Cell sediment budget (Moffatt & Nichol, 2021b)

Area	Extent (yards)	Recession Rate (ft/yr)	Sediment Sources			Sediment Losses	Total
			Cliff Erosion (CY/yr)	Shoreline Recession (CY/yr)	Fluvial/ Streams (CY/yr)	Deep Water (CY/yr)	Carmel Canyon (CY/yr) / Cumulative Total (CY/yr)
Cypress Pt. to Pescadero Pt.	5,000	0.3	9,194				9,194
Pebble Beach	1,000	0.3	1,275			-17,400	4,669
Stillwater Cove	1,000	0.3	1,755		3 [a)]		627
Arrowhead Point	1,000	1.0	5,499				326
Carmel Beach	2,100	0.7		8,926	14 b)		9,265
Carmel Point	1,200	0.7	3,496			-12,000	761
Carmel River State Beach	1,000	1.0		7,379	31,851 c)	-14,000	25,991
Ribera Beach	800	0.3	1,540			-27,000	531
Monastery Beach	700	2.1		11,012	226 d)	-11,000	769
Granite Point	1,000	0.5	1,835			-1,800	804
Whaler's Cove	1,000	0.3	1,180			-1,200	785
Whaler's Cove to Point Lobos	2,500	0.3	4,519			-4,500	804
Total	**18,300**	**0.5 avg.**	**+30,293**	**+27,317**	**+32,094**	**-36,900**	**-52,000** / **+804**

a) Unnamed ravine/stream into Stillwater Cove.

b) Pescadero Creek.

c) Carmel River, based on simulations by Balance Hydrologics, BH (2021).

d) San Jose Creek, Balance Hydrologics, BH (2014b).

CLIMATE CHANGE AND SEA LEVEL RISE

Climate change can produce several potential impacts on the Carmel Lagoon. Climate change is predicted to produce a higher degree of irregularity in weather patterns with wider extremes. Climate change impacts include higher temperatures, changes in rainfall patterns, higher flow rates leading to increased erosion and flooding, more frequent and more severe droughts, seal level rise, increased coastal erosion, increased coastal inundation, and increased seawater intrusion. In recent years, California has experienced some of the driest years on record, and some of the wettest years as well, impacting the Lagoon system. The increase in number and extent of wildfires in California can also have a potential impact on the Lagoon system because of exposed soil washing down from scorched areas within the watershed causing an increase in the sediment load of the river.

Coastal shoreline retreat is affected by long-term erosion, sea level rise, and storm events, and is forecast to worsen based on some projections of global warming causing the sea level to rise (ESA-PWA, 2014). Sea level rise is a complex and dynamic process ultimately controlled by levels of heat-trapping greenhouse gases in the atmosphere.[3] Globally, sea level rise is driven by two primary factors – global ice melt and thermal expansion of seawater – but locally there are numerous processes that can alter the rate, extent, and duration of changes in sea level. As such, accurately predicting sea level of the coming centuries for specific locations is very challenging.

Sea level rose approximately seven inches over the past century (1900-2005) along most of the California coast. Since 1993, the altimetry, or measure of height or altitude, data suggests that the global mean sea level rise rate has increased from 2 to 3 mm/year, but during this time, data from altimetry and tide gauges show that the mean sea level along the Pacific Coast has been stable due to wind stress. The local tide gauge at Monterey dates to 1973, but even during this short time period, a trend of sea level rise is evident at the rate of approximately 0.05 inches per year. Due to local oceanographic conditions, the sea level in central California has been relatively stable or even declining over the past several decades. However, when the regional climate change patterns that drive local sea level trends shift, the Central Coast will very likely experience a rise in sea level that will correspond to, or may even exceed, the mean global rate of sea level rise.

The *State of California Sea-Level Rise Guidance Document* (CO-CAT, 2013) provides guidance for incorporating sea-level rise projections into planning and projects in California in response to Executive Order S-13-08, issued on November 14, 2008, that directed state agencies to plan for sea level rise and coastal impacts. The guidance was updated in 2018 to ensure that best available science was informing sea level rise planning decisions in California and respond to the needs for guidance that can help cities, counties, and the State prepare for, and adapt to, sea level rise (OPC, 2018). According to this document, sea level rise is projected (using the year 2000 as a baseline, 1-in-200 chance, medium-high risk aversion) as: 0.8 feet in 2030, 1.9 feet in 2050, and 6.9 feet in 2100 (OPC, 2018). Coastal erosion and flooding, ongoing issues in the area, are also expected to increase with accelerating sea level rise.

The best available science and most recent guidance is summarized in State of California Sea-Level Rise Guidance and was adopted for the Sediment Transport Study (California Ocean Protection Council [OPC], 2018). The guidance relies on the best available science to identify a range of sea-level rise scenarios including median, likely, 1-in-20 chance, and 1-in-100 chance projections, considering regional factors such as El Niño and extreme storm events that affect ocean levels, precipitation, and storm surge. This

[3] This discussion on sea level rise has been excerpted from the Monterey Peninsula, Carmel Bay and Southern Monterey Bay Integrated Regional Water Management Plan (Monterey Peninsula Water Management District and DD&A, Inc., 2019) https://www.mpwmd.net/wp-content/uploads/Final-Draft-IRWM-Plan-9-25-19.pdf.

approach allows planners to understand the full range of possible impacts that can be reasonably expected based on the best available science and build an understanding of the overall risk posed by potential future sea-level rise.

Table 4.5-4 summarizes the sea-level rise scenarios from OPC for Monterey, which are applicable to Carmel Bay. The columns outlined in dark blue identify the OPC guidance for risk levels, which include low risk aversion, medium to high risk aversion, and extreme risk aversion.

The sea-level rise analysis in the Sediment Transport Study adopted the 1-in-200 chance sea-level rise projection. This projection reflects a conservative outlook for climate change assuming limited effort to curb emissions world-wide. The Stillwater Elevation (SWEL) in the 1% chance (1-year) Stillwater level without wave action. The Base Flood Elevation (BFE) is the Federal Emergency Management Agency (FEMA) 1% chance coastal base flood elevation including wave runup. **Table 4.5-4**- summarizes select water level datums from **Table 4.5-5** with adjustment for sea-level rise based on **Table 4.5-6**.

Based on **Table 4.5-4**, the rates of sea-level rise were determined projected by year, the amount of sea-level rise, and the underlying rate of sea-level rise as shown in **Table 4.5-5**. The rate is given in feet per year and in inches per year for perspective. The data in **Table 4.5-4** was applied to estimate potential sea-level rise impacts at the Carmel River State Beach, which is summarized in the last three columns in **Table 4.5-5**.

Sea-level rise can result in shoreline erosion and shoreline recession, as described above. The Carmel River State Beach is a crenulate-shaped beach formed due to wave diffraction between the headland (Carmel Point) and rocky downcoast shoreline along Riber Beach (**Figure 4.5-6**). Therefore, shoreline recession at Carmel River State Beach is limited to the rate of cliff erosion, which is on the order of a few inches per year. Instead, the volume of sand needed to compensate for the deficit caused by sea level rise is supplied by the Carmel River. The last three columns in **Table 4.5-6** summarize the estimated annual loss of sediment to the Carmel Submarine Canyon, loss associated with sea-level rise, and the sum of these as total annual loss. However, the sediment supplied by the Carmel River is estimated to be on the order of 61,931 CY annually, which indicates that the Carmel River State Beach can adapt to future sea-level rise. The analysis also found that beach elevation will rise along with sea-level rise because wave runup elevation increases with the rise in ocean level. Therefore, the lagoon is expected to go through a similar transition.

In conclusion, the Carmel River State Beach appears to be resilient to sea-level rise hazards in the near-term as the Carmel River provides sufficient sediment annually to compensate for the sediment deficit caused by sea-level rise. However, it is also evident that the beach is dependent on the Carmel River sediment supply, and, thus, to the extent that climate change alters the supply, the effect on the beach could be substantial.

Table 4.5-4. Sea-Level Rise Projections for Monterey, OPC (2018) (Moffatt & Nichol, 2021b)

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.4	0.3 -	0.5	0.6	0.8	1.0
	2040	0.6	0.4 -	0.8	0.9	1.2	1.7
	2050	0.8	0.5 -	1.1	1.3	1.9	2.7
Low emissions	2060	0.9	0.5 -	1.2	1.5	2.3	
High emissions	2060	1.0	0.7 -	1.4	1.8	2.6	3.8
Low emissions	2070	1.0	0.6 -	1.4	1.9	3.0	
High emissions	2070	1.3	0.9 -	1.8	2.3	3.4	5.1
Low emissions	2080	1.2	0.7 -	1.7	2.3	3.8	
High emissions	2080	1.6	1.1 -	2.3	2.9	4.4	6.6
Low emissions	2090	1.3	0.8 -	2.0	2.7	4.6	
High emissions	2090	2.0	1.3 -	2.8	3.5	5.5	8.2
Low emissions	2100	1.5	0.9 -	2.3	3.1	5.5	
High emissions	2100	2.3	1.5 -	3.3	4.3	6.9	10.1
Low emissions	2110*	1.6	1.0 -	2.4	3.3	6.1	
High emissions	2110*	2.5	1.7 -	3.4	4.4	7.2	11.8
Low emissions	2120	1.7	1.0 -	2.7	3.8	7.3	
High emissions	2120	2.8	2.0 -	4.0	5.2	8.5	14.0
Low emissions	2130	1.9	1.1 -	3.0	4.2	8.3	
High emissions	2130	3.1	2.2 -	4.5	5.9	9.9	16.4
Low emissions	2140	2.0	1.1 -	3.2	4.7	9.5	
High emissions	2140	3.5	2.4 -	5.1	6.7	11.3	18.9
Low emissions	2150	2.1	1.1 -	3.6	5.3	10.8	
High emissions	2150	3.8	2.6 -	5.7	7.6	12.9	21.8

Notes:

- MEDIAN. Mean sea-level rise taken as an average of probabilistic scenarios.
- LIKELY RANGE. Median projection with 66% confidence limits. The upper range (outlined by blue box) is applicable to facilities and infrastructure with a low risk aversion to sea-level rise.
- 1-IN-20 CHANCE. 5% probability that sea-level rise meets or exceeds this projection (1 in 20 chance).
- 1-IN-200 CHANCE. 0.5% probability that sea-level rise meets or exceeds this projection (1 in 200 chance). This projection (outlined by a blue box) is representative of medium to high risk aversion and is applicable to facilities and infrastructure that are vulnerable to sea-level rise impacts.

H++ Scenario. Worst case scenario is representative of rapid ice sheet loss and accelerated sea-level rise. This projection is applicable to facilities with extreme risk aversion to sea-level rise hazards. For example, critical infrastructure or facilities that are extremely sensitive to sea-level rise hazards and unable to adapt to sea-level rise.

Table 4.5-5. Tidal datums with sea-level rise (elevation in feet NAVD88) (Moffatt & Nichol, 2021b)

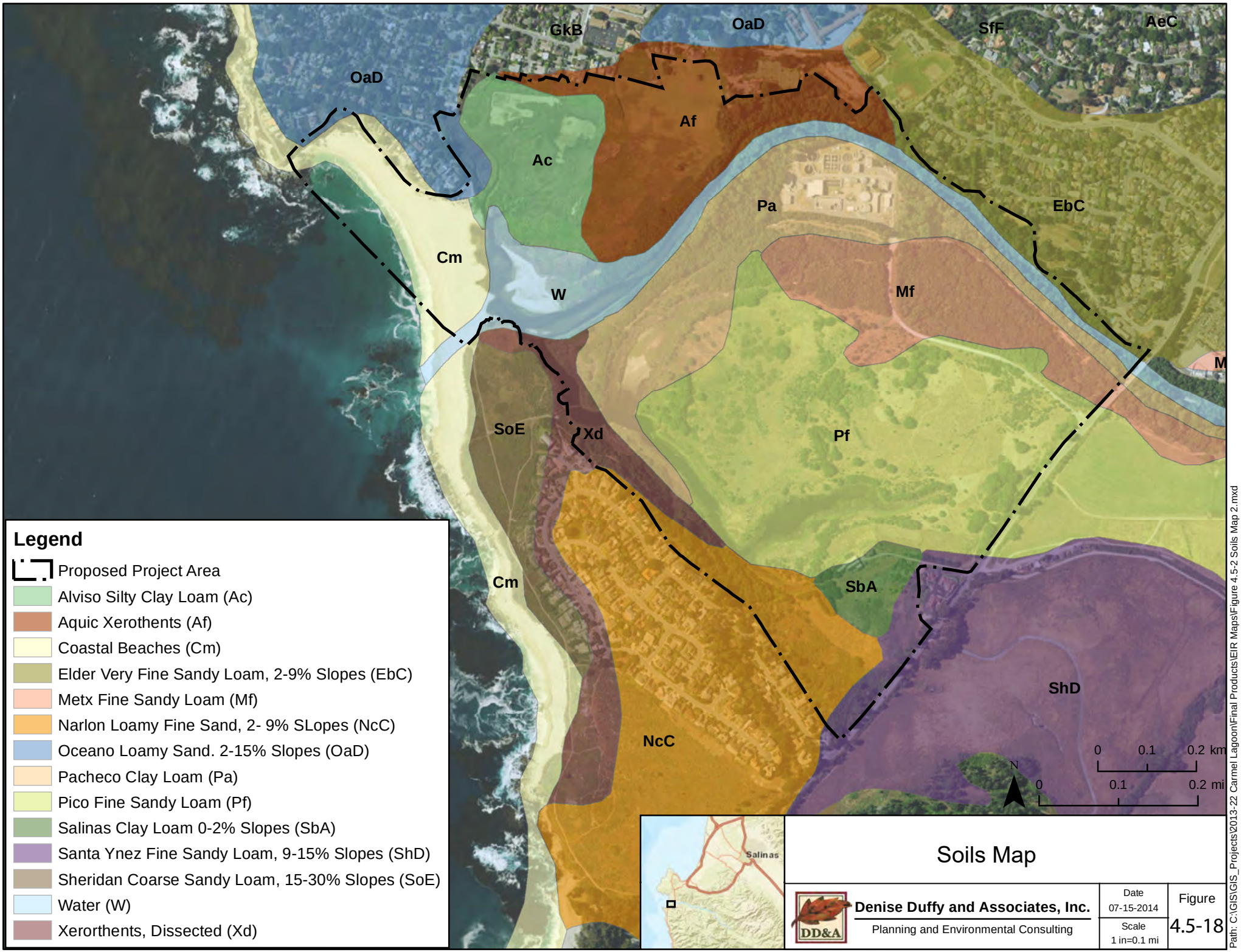
Tidal Plane	Present	1-in-200 Chance Medium to High Risk Aversion Projection*		
		2030 (0.8' SLR)	2050 (1.9' SLR)	2100 (6.9' SLR)
Coastal BFE	+27.0	+27.8	+28.9	+33.9
Coastal SWEL	+8.2	+9.0	+10.1	+15.1
King Tide	+7.0	+7.8	+8.9	+13.9
MHW	+4.8	+5.6	+6.7	+11.7
* With high emissions.				

Table 4.5-6. Annual rate of sea-level rise (Moffatt & Nichol, 2021b)

Year	1-in-200 Chance SLR (feet)	Rate (feet/year)	Rate (inches/year)	Loss (CY/year) to Canyon	Loss (CY/year) due to SLR	Total Loss (CY/year)
2020	0.1	0.01	0.07	23,100	1,600	24,700
2030	0.8	0.05	0.56	23,100	2,200	25,300
2040	1.2	0.06	0.70	23,100	3,000	26,100
2050	1.9	0.07	0.84	23,200	4,000	27,200
2060	2.6	0.08	0.98	23,300	5,000	28,300
2070	3.4	0.09	1.12	23,400	6,300	29,700
2080	4.4	0.11	1.26	23,700	7,700	31,400
2090	5.5	0.12	1.40	23,900	9,400	33,300
2100	6.9	0.13	1.54	24,500	11,400	35,900

4.5.1.4 Soils

On-site soils are classified in the Monterey County Soil Survey (USDA, 1978). Soil is generally defined as the unconsolidated mixture of mineral grains and organic material that covers the land surfaces of the earth. Soils can develop on unconsolidated sediments and weathered bedrock. The soil at the site varies based upon the topography of the site. The soil at the site consists of mostly disturbed soils. Sources of current and historic ground disturbance are due mostly to agricultural activities. As shown on **Figure 4.5-18**, the Web Soil Survey (USDA-NRCS, 2019) identifies 14 map units within the project area: Alviso silty clay loam (Ac), Aquic xerofluvents, Coastal beaches (Cm), Elder very fine sandy loam, 2-9 % slopes (EbC), Metz fine sandy loam (Mf), Narlon loamy fine sand, 2-9% slopes (NcC), Oceano loamy sand, 2-15% slopes (OaD), Pacheco clay loam (Pa), Pico fine sandy loam (Pf), Salinas clay loam, 0-2% slopes (SbA), Santa Ynez fine sandy loam, 9-15% slopes (ShD), Sheridan coarse sandy loam, 15-30% slopes (SoE), Water (W), and Xerothents, dissected (Xd).



Soils Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 07-15-2014
Scale 1 in=0.1 mi
Figure 4.5-18

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.5-2 Soils Map 2.mxd

This Page Intentionally Left Blank

4.5.1.5 Faulting and Seismicity

REGIONAL FAULTS

The greater San Francisco/Monterey Bay Area is seismically dominated by the active San Andreas Fault system, the tectonic boundary between the northward moving Pacific Plate (west of the fault) and the North American Plate (east of the fault). This movement is distributed across a complex system of strike-slip, right-lateral, subparallel faults, as depicted in **Figure 4.5-19**.

Regional faults that have a potential to generate large magnitude earthquakes and significant ground shaking at the site are listed below in **Table 4.5-7**, and selected faults are described in detail in **Appendix F**. Map distances are derived from the USGS Quaternary Fault and Fold database (USGS, 2020).

Table 4.5-7 Regional Faults

Fault	Approximate Distance (miles)	Direction from Project Site to Fault
Monterey Bay/Tularcitos	4.6	Northeast
Reliz	11.7	Northeast
Zayante-Vergeles	26	Northeast
San Andreas	30	Northeast
Sargent	34	Northeast
Calaveras	35	Northeast
Ortigalita	56	Northeast
Hayward	63	North

LOCAL FAULTS

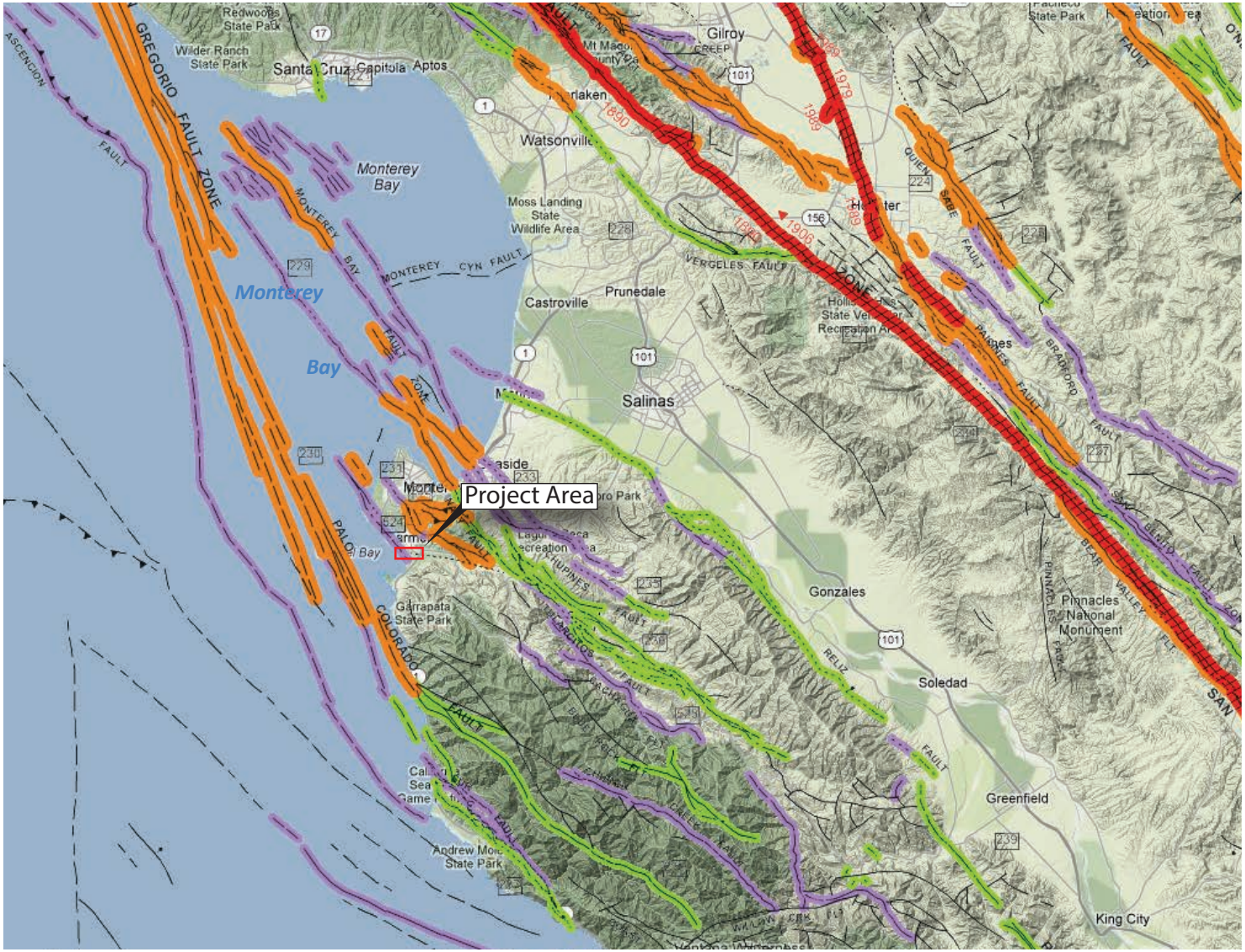
The proposed project vicinity is transected by the Cypress Point Fault, which is not considered active. The proposed project site is not located within an Alquist-Priolo Earthquake Fault Zone and no mapped active faults are known to cross the proposed project site. The nearest fault is the Monterey Bay/Tularcitos Fault approximately 4.6 miles to the northeast. The probability of ground surface rupture at the proposed project site due to displacement is considered low. However, the proposed project site is in a region of high seismicity. It is anticipated that during the useful life of the proposed project, the proposed project area will be subject to strong ground shaking. It is also anticipated that the area will periodically experience small to moderate magnitude earthquakes.

4.5.1.6 Seismic Events and Processes

FAULT RUPTURE

Evaluation of fault rupture hazard is based on the historic activity and recurrence of faulting along existing faults. Faults of known historic activity during the last 200 years, as a class, have a greater probability for future activity than faults classified as Holocene age (last 11,000 years), and a much greater probability of future activity than faults classified as Quaternary age (last 1.6 million years). However, certain faults have recurrent activity measured in tens or hundreds of years whereas other faults may be inactive for thousands of years before being reactivated. The magnitude, sense, and nature of fault rupture also vary for different faults or along different strands of the same fault.

This Page Intentionally Left Blank



Legend

Historic Fault

Holocene Fault

Quaternary Fault

Late Quaternary Fault

Pre-Quaternary Fault

N

0 10 20

Approximate Scale in Miles

Source: Pacific Geotechnical Engineers, 2013

Regional Fault Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 02-24-2016

Scale N/A

Figure 4.5-19

Path: P:\DDA Current Projects\2013-22 Carmel Lagoon\EIR EA\Admin Draft EIR EA\Figures\Indesign\ 8.5x11 landscape

This Page Intentionally Left Blank

As described above, the project vicinity is transected by the Cypress Point Fault, which is not considered active. The proposed project components are in a seismically active region and a number of potentially active and active faults are located within proximity of the site. Current estimates suggest that there is a 62 percent probability of a large magnitude (6.7 or greater) earthquake in the San Francisco Bay Region in the 30-year period ending in 2031. The proposed project site is not, however, located within an Alquist-Priolo Earthquake Fault Zone. No active faults are known to transect the site.

GROUND SHAKING

Strong ground shaking may occur due to earthquake events along active faults nearby or distant to the proposed project site. Disregarding local variations in ground conditions, the intensity of shaking at different locations within the area can generally be expected to decrease with distance away from an earthquake source. Small to moderate earthquakes (magnitude less than 5.0 on the Richter Scale) are common in the County of Monterey. The most significant quakes affecting the County during the last century have included the 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake. Research has shown that areas underlain by layers of unconsolidated, recent alluvium, and unconsolidated soil materials with high ground water have an increased risk of experiencing the damaging effects of ground shaking.

Due to its proximity to several major earthquake faults, it is reasonable to assume that the proposed project site would be exposed to seismically induced ground shaking.

SOIL LIQUEFACTION AND DYNAMIC SETTLEMENT

Liquefaction is the transformation of soil from a solid to a liquid state because of increased pore-water pressures, usually in response to strong ground shaking, such as those generated during a seismic event. Loose, granular soils are most susceptible to these effects while more stable, silty clay and clay materials are generally somewhat less affected. The potential damaging effects of liquefaction include differential settlement, loss of ground support for foundations, ground cracking, heaving, and cracking of structure slabs due to sand boiling, and buckling of deep foundations due to liquefaction-induced ground settlement. Dynamic settlement may also occur in loose, dry sands above the water table. In general, a relatively high potential for liquefaction exists in loose, sandy soils that are within 50 feet of the ground surface and are saturated (below the groundwater table).

The Holocene alluvium has a “high” liquefaction susceptibility, while the older (Pleistocene) alluvium has a “moderate” liquefaction susceptibility. Bedrock and upland areas are mapped has having a “low” liquefaction susceptibility. There are no known historic liquefaction sites from the 1906 and 1989 earthquakes. The proposed EPB alignment lies within zones to have moderate to high liquefaction susceptibility. Hazard mapping is unclear regarding the liquefaction susceptibility of the proposed SRPS project component alignment.

Lateral spreading is horizontal movement of soil toward a free face, such as a creek bank, typically associated with liquefaction. Lateral spreading is a failure within weaker soil material that causes the soil mass to move towards a free face or down a gentle slope. Lateral spreading generally occurs in shallow groundwater areas with unsupported embankments including natural creek banks, fill slopes, levees, etc. Areas that have a potential for lateral spreading within the study area are low-lying areas near river channels, sloughs, or other drainages. Liquefaction-induced lateral spreading can also occur on mild slopes (flatter than five percent) underlain by loose sands and a shallow groundwater table. If liquefaction occurs, the unsaturated overburden soil can slide as intact blocks over the lower, liquefied deposits, creating fissures and scarps.

LANDSLIDES

The occurrence of landslides is influenced by several factors, including slope angle, soil moisture content, vegetative cover, and the physical nature of the underlying strata. Landslides can be triggered by one or more specific events, including development-related construction, seismic activity, soil saturation, and fires. The primary factor in determining landslide potential is an unstable slope condition.

The landslide potential on the project site is low, as indicated by Monterey County's Landslide Hazard Map.

TSUNAMI

Tsunamis are open sea tidal waves generated by earthquakes. Tsunami damage is typically confined to low-lying coastal areas. The proposed project site is located within the mapped tsunami hazard area (California Emergency Management Agency et al., 2021). According to the *Monterey County Operational Area Tsunami Incident Response Plan*, a locally generated tsunami may occur if a large enough earthquake occurs in or near Monterey Bay region (Monterey County Office of Emergency Services, 2007). Such an earthquake could produce a tsunami that reaches shore in a matter of minutes. The plan states that within the County of Monterey there is a low likelihood of experiencing a tsunami. The most likely tsunami cause, though still relatively unlikely compared to other hazards, is a distant event, where there would be more than one hour to respond to a tsunami warning (Monterey County Office of Emergency Services, 2007).

EROSION POTENTIAL

Surface soils tend to erode under the wearing action of flowing water, waves, wind, and gravity. Factors influencing erosion include topography, soil type, precipitation, and other environmental conditions. Erosion is capable of having a large impact on shaping and changing the landscape and may incidentally be accelerated by anthropogenic activities. Non-point sources, including impervious surfaces, construction activities, and road construction, can all accelerate the rate that soils are removed from hillsides. In general, granular soils with relatively low cohesion and soils located on relatively steep topography have relatively high erosion potential.

The proposed project site is identified to have a moderate to high erosion hazard. The sandy bluffs adjacent to the mouth of the Lagoon are at risk of erosion. These bluffs have been developed and erosion of these features threatens homes, roads, and other infrastructure. Severe erosion can undermine stability of natural and man-made slopes, foundations, and roadways. In past years and as exemplified in the atmospheric event in January 2023, erosion has removed the seasonal beach from the water side of Scenic Road, reducing support for the road, surface drainage elements, protected Monterey Cypress trees, and beach access steps (please refer to **Figure 4.1-4** in **Section 4.1**). In February 2023, the County PWFP installed a 200-foot, soil-nail, shotcrete wall, which involved driving 15' to 30' nails into the soil to anchor and hold a mesh cover to contain the sand and material under the roadway, reopening the road in early-April 2023. As discussed above, climate change and sea-level rise can exacerbate the rate of coastal erosion.

EXPANSIVE SOILS

Expansive soils shrink and swell because of moisture changes. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Structures or improvements built atop expansive soils may be subject to damage from soil shrinkage and swelling, associated with wetting, and drying. A soil with a higher plasticity index is generally more prone to shrinkage or swelling in response to seasonal rainfall.

The near-surface soils at the proposed project site are generally low plasticity silts and sand that have low expansion potential.

SOIL COLLAPSE POTENTIAL

Collapsible soil is broadly defined as loose and cemented soil with low moisture content that is susceptible to a large and sudden reduction in volume upon wetting, with no increase in vertical stress. The process of soil collapse upon wetting is referred to as hydro-collapse. Another type of collapse can occur in saturated soil bearing soluble minerals when subjected to continuous leaching. Some common soluble soil minerals include calcium chloride, magnesium chloride, sodium chloride, potassium chloride, gypsum, anhydrite, dolomite, and calcium carbonate. The composition of minerals dissolved in leaching water will affect the soil mineral dissolution rate.

The most common types of collapsible soil include alluvial soils, eolian deposits, and residual soils formed by extensive weathering of parent materials such as granitic rock. Within the proposed project area alluvial materials, and residual soil over granodiorite are present. Settlement may occur where these materials are loose, relatively dry, and subjected to a significant increase in moisture content.

4.5.2 Regulatory Environment

4.5.2.1 Federal

FEDERAL DISASTER MITIGATION ACT

The Federal Disaster Mitigation Act of 2000 (Public Law 106-390), which was adopted by Congress in October 2000, requires state and local governments to develop hazard mitigation plans in order to apply for federal grant assistance for disaster relief. The County, in coordination with all of its incorporated municipalities, prepared a comprehensive update to its Multi-Jurisdictional Hazard Mitigation Plan. The plan, which was initially developed and adopted in 2007, is intended to identify local policies and actions to reduce the risk and future losses from natural hazards such as flooding, severe storms, earthquakes, and wildland fires. The plan also serves to meet key federal planning regulations which require local governments to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for hazard mitigation projects. The County and the cities of Carmel-by-the-Sea, Del Rey Oaks, Gonzales, Greenfield, King City, Marina, Monterey, Pacific Grove, Salinas, Sand City, and Soledad, as well as CAWD, Monterey County Water Resource Agency (MCWRA), Monterey One Water (M1W), ReGen (formerly Monterey Regional Waste Management District), and Moss Landing Harbor District, have each adopted the plan by resolution. The 2022 Multi-Jurisdictional Hazard Mitigation Plan was approved by FEMA on September 14, 2022 (Monterey County Office of Emergency Services, 2022).

NATIONAL MARINE SANCTUARIES ACT

The Office of National Marine Sanctuaries regulations (codified at 15 CFR Part 922) describe and define the boundaries of designated national marine sanctuaries, identify activities that are prohibited in the sanctuaries, and establish a system of permitting and/or authorizations to allow the conduct of certain types of activities that would not otherwise be allowed. The regulations are used by the Office of National Marine Sanctuaries to implement the National Marine Sanctuaries Act and national marine sanctuary management plans. Each sanctuary has its own set of regulations set out in a separate subpart within 15 CFR Part 922. Subpart M contains the regulations specific to MBNMS.

Subpart M sets out general prohibitions against certain activities within MBNMS, including (1) discharging or depositing any material or matter within or into the sanctuary (e.g. pollutants, trash, objects, etc.), or from outside the boundaries if it subsequently enters and injures the sanctuary, and (2) drilling into, dredging, or drilling into, dredging, or otherwise altering the submerged lands of the Sanctuary; or constructing, placing, or abandoning any structure, material, or other matter on or in the submerged lands of the Sanctuary (among other prohibitions). These activities are not allowed in MBNMS unless authorized through a lease, permit, license, approval, or other authorization issued by MBNMS (Section 922.132).

4.5.2.2 State

CALIFORNIA ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT AND SEISMIC HAZARD MAPPING ACT

The Alquist-Priolo Earthquake Fault Zoning Act was enacted in 1972 to minimize hazards from fault rupture by prohibiting structures for human occupancy across the trace of an active fault (within 50 feet). The Act requires delineation of "Earthquake Fault Zones," in which cities and counties cannot issue development permits until geologic investigation shows that development within such zones is not threatened by future faulting. The Seismic Hazards Mapping Act was adopted in 1990 to protect the public from earthquake hazards including ground shaking, liquefaction, seismically induced landslides, and other related ground failure. Maps showing seismic hazard zones, prepared by the California Geological Survey, identify areas susceptible to seismic hazards that may have special requirements, including additional geotechnical analysis (California Geological Survey, 2020).

SEISMIC HAZARDS MAPPING ACT

Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC Sections 2690 to 2699.6) is intended to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong ground shaking, liquefaction, and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act. The State is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards. Cities and counties are required to regulate development within mapped Seismic Hazard Zones.

Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites within Seismic Hazard Zones until appropriate site-specific geologic and/or geotechnical investigations have been conducted and measures to reduce potential damage have been incorporated into the development plans. There are no jurisdictions within the County of Monterey that are included within the State Seismic Hazards Mapping Act.

BUILDING CODES

The California Building Code (CBC), which is codified in CCR Title 24, Part 2, was promulgated to safeguard the public health, safety, and general welfare by establishing minimum standards related to structural strength, egress facilities, and general building stability. The purpose of the CBC is to regulate and control the design, construction, quality of materials, use/occupancy, location, and maintenance of all buildings and structures within its jurisdiction. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. The 2022 CBC is based on the 2006 International Building Code (IBC) published by the International Code Conference. In addition, the CBC contains necessary California amendments that are based on the American Society of Civil Engineers (ASCE) Minimum Design Standards 7-05. ASCE 7-05 provides requirements for general

structural design and includes means for determining earthquake loads, as well as other loads (e.g., flood, snow, wind) for inclusion in building codes. The provisions of the CBC apply to the construction, alteration, movement, replacement, and demolition of every building or structure, or any appurtenances connected or attached to such buildings or structures, throughout California.

The earthquake design requirements consider the occupancy category of the structure, site class, soil classifications, and various seismic coefficients, all of which are used to determine a Seismic Design Category (SDC) for a project. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site and ranges from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are then determined according to the SDC.

STORM WATER POLLUTION PREVENTION PLAN

Construction activity that disturbs one or more acres of soil, or less than one acre but is part of a larger common plan of development that in total disturbs one or more acres, must obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity (State Water Resource Control Board (SWRCB) Order No. 2009-09-DWQ as amended by 2010-0014-DWQ and 2012-006-DWQ). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation but does not include regular maintenance activities performed to restore the original line, grade, or capacity of a facility. The Construction General Permit requires the development and implementation of a SWPPP. The SWPPP includes construction mitigation measures such as desilting basins, silt fences, hydroseeding of slopes, and monitoring and clean-up requirements.

4.5.2.3 Regional/Local

RELEVANT PLANNING DOCUMENTS

The 1982 Monterey County General Plan, Carmel Area Land Use Plan, Carmel Area Coastal Implementation Plan, Point Lobos State Reserve and Carmel River State Beach General Plan, CCA, and California PRC contain a variety of policies related to the protection from geologic and soil hazards. Please refer to **Section 4.9, Land Use and Planning** for a description of these regulations and plans, and **Appendix C, Applicable Land Use Plans, Policies, and Regulations Consistency Analysis for the Carmel Lagoon Project** for a list of relevant policies and the consistency analysis.

MONTEREY COUNTY CODE

Chapter 16.08 of the Monterey County Code identifies rules and regulations to control all grading, including excavations, fills and embankments, and establishes the procedures for the issuance of grading permits. Chapter 16.08 is intended to minimize erosion because of ground disturbing activities.

Chapter 16.12 (Erosion Control) of the Monterey County Code sets forth required provisions for project planning, preparation of erosion control plans, runoff control, land clearing, and winter operations; and establishes procedures for administering those provisions. The code requires that specific design considerations be incorporated into projects to reduce the potential of erosion and that an erosion control plan be approved by the County prior to initiation of grading activities.

Hazardous area development standards identified in the regulations for development in the Carmel Area (Chapter 20.146, Monterey County Coastal Implementation Plan) requires that a geological report be prepared for projects in several cases, including projects located within 50 feet of the face of a cliff or bluff. The report shall be prepared by a registered geologist or engineering geologist, as deemed appropriate by the County. The report shall be consistent with the "Guidelines for Geologic/Seismic

Reports" of the California Division of Mines and Geology, and is required to include specific elements, as applicable to the site and proposed structure.

4.5.3 Impacts and Mitigation

4.5.3.1 Thresholds of Significance

Based on Appendix G of the State CEQA Guidelines, the project would result in significant impacts related to geology, soils, and seismicity if it would:

a. Expose people or structures to 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,
   - Strong seismic ground shaking,
   - Seismic-related ground failure, including liquefaction,
   - 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 or property; or

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.

4.5.3.2 Impact Analysis Overview

APPROACH TO ANALYSIS

The potential for impacts related to geology, soils, and seismicity are evaluated according to the significance criteria identified in **Section 4.5.3.1**. Each proposed project component site has been evaluated with respect to existing published data, mapping and research, and the analysis of project effects is based upon the results of the Geotechnical Report prepared for the project by Pacific Geotechnical Engineering (2013), Coastal Analysis prepared by Moffatt & Nichol (2013b), the Carmel River Lagoon Natural Breach Alignment and Location study, Sediment Transport Study, and Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential study prepared by Moffatt & Nichol (2021a, 2021b, and 2022); each of these reports are contained in **Appendix F** of this RDEIR.

The Geotechnical Report identifies seismic, geologic, and geotechnical hazards and constraints at the project sites and identifies the types of measures and engineering criteria that can be incorporated into project designs to prevent damages to facilities or properties or injury to people. The Geotechnical Report concluded that construction of the proposed EPB and SRPS project components is feasible from a geotechnical perspective provided that appropriate design, engineering, and construction considerations are incorporated into the projects once detailed design plans are developed.

The County would have site-specific geotechnical investigations completed for the proposed EPB and SRPS project components, requiring foundations and specialized soils engineering work, as applicable to each

component. Currently, preliminary (30 percent) design plans have been prepared for both the proposed EPB and SRPS project components. Site-specific geotechnical studies are essential for the final design of the proposed EPB and SRPS project components because they contain the information that informs the structural design of foundations and determines whether the geologic materials underlying the proposed facilities can support the proposed uses without risk of detrimental effects from potential hazards associated with problematic soils, liquefaction, or excessive seismic shaking. Geotechnical investigations are required under the CBC for most structures as well as by the County. Based on field observation and laboratory testing, the geotechnical engineer can assess whether the soils are adequate to support the structure under static (non-earthquake) or seismic conditions. If corrective work is necessary to remedy the problem soils or otherwise unstable ground condition, the geotechnical engineer would recommend approaches to correct the condition. Geotechnical engineering recommendations are typically standard engineering practices that have been proven elsewhere to increase the geotechnical performance of an underlying soil or bedrock material. This impact analysis assumes that the County will incorporate all geotechnical recommendations set forth by the project geotechnical engineer based on more detailed design plans.

PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS GEOTECHNICAL CONSIDERATIONS

The engineering consultants have prepared Preliminary 30 percent Plans for the proposed EPB and SRPS project components. The engineering consultants for the proposed project would incorporate the recommendations from the site-specific geotechnical investigations required by the County into the final design plans and construction plans and specifications. The analysis in this section incorporates the preliminary findings of the Geotechnical Report, as well as other referenced engineering studies, and takes into consideration that the finalized engineering design criteria for the proposed EPB and SRPS project components would be developed during the final stage of geotechnical evaluation.

The Geotechnical Report relied on subsurface data collected and published data available through federal and state agencies and previous local geotechnical investigations. The purpose of the preliminary investigation was to provide a characterization of the geologic, seismic, and subsurface conditions along the proposed component alignments. The preliminary investigation evaluated the potential geologic and seismic hazards as well as geotechnical engineering considerations. The information gathered through the preliminary investigation included geologic setting, subsurface soil and geologic conditions, general groundwater conditions, potential geologic hazards (i.e., ground motion, corrosive soils, and liquefaction), and construction considerations. The findings of the Geotechnical Report did not indicate that site conditions would preclude the construction and operation of the proposed EPB and SRPS project components.

Final geotechnical evaluations of the proposed EPB and SRPS project components would be completed following project approval and prior to obtaining County building permits. The final geotechnical study would build off the previously completed Geotechnical Report and focus on the specific geologic conditions along each alignment. The final study would involve additional soil sampling and soil laboratory analysis, field reconnaissance, and geotechnical engineering analysis to develop the final design criteria for the proposed EPB and SRPS project components. The recommendations developed under the final level of geotechnical study provides designers and construction contractors with necessary engineering details needed for all aspects of the final design such as seismic criteria considerations, maximum allowable displacements for settlement, excavation characteristics, trench stability, temporary shoring, dewatering, backfill requirement, and traffic surcharge loading. The County and project engineers would incorporate the recommendations developed by the final geotechnical study into project design. The recommendations could include soil conditioning, compaction, removal of problematic soils, installation

of foundation piers, and special trench backfilling. These standard engineering practices are applied at construction sites throughout California.

SEISMIC CONSIDERATIONS

In California, an earthquake can cause injury or property damage by: (1) rupturing the ground surface, (2) violently shaking the ground, (3) causing the underlying ground to fail due to liquefaction, or (4) causing enough ground motion to initiate slope failures or landslides, any of which could damage or destroy structures. The checklist items in Appendix G of the State CEQA Guidelines, which provide the basis for most of the significance criteria in **Section 4.5.3.1**, above, reflect the potential for large earthquakes to occur in California and recommend analysis of the susceptibility of the proposed project sites to seismic hazards and the potential for the proposed project to exacerbate the effects of earthquake-induced ground motion at the proposed project sites and surrounding areas. Impacts associated with seismic hazards would be considered significant if the potential effects of an earthquake on a particular site could not be mitigated by an engineered solution. The significance criteria do not require elimination of the potential for structural damage from seismic hazards. Rather, the criteria require an evaluation of whether significant seismic hazards could be minimized through engineering design solutions that would reduce the associated risk of loss, injury, or death.

State and local code requirements ensure buildings and other structures are designed and constructed to withstand major earthquakes, thereby reducing the risk of collapse and the associated risks to human health and safety and private property. The code requirements have been developed through years of study of earthquake response and the observed performance of structures during significant local earthquakes (e.g., the 1989 Loma Prieta Earthquake) and others around the world. As discussed in **Section 4.5.2, Regulatory Environment**, the proposed project would comply with federal, state, and local laws regulating construction. The laws ensure that proposed development sites are adequately investigated and that seismic hazards are evaluated and addressed in the proposed project design and construction. These laws include the Seismic Hazards Mapping Act, the CBC, and County ordinances/codes pertaining to excavation, grading, and site development in geologic hazard zones (described in **Section 4.5.2.3**, above). The California Geological Survey Guidelines for Evaluating and Mitigating Seismic Hazards (Special Publication 117A) (California Geological Survey, 2008) provides guidance for evaluating and mitigating seismic hazards as required by PRC Section 2695(a).

As discussed above, site-specific geotechnical investigations are conducted to determine the presence of problematic soils and identify seismic hazards on a subject site. These investigations identify the geologic and seismic setting of a subject site and provide feasible engineering recommendations to remedy potentially adverse soil and seismic conditions. Site-specific geotechnical investigations also provide the necessary soil information required by structural engineers to ensure structures and buildings are designed appropriately to withstand earthquake ground motion. Grading plans, foundation designs, and structural designs are prepared based on the geotechnical recommendations presented in the site-specific geotechnical investigation and other pertinent requirements of the CBC.

AREAS OF NO IMPACT

Some of the significance criteria outlined above are not applicable to the proposed project or the proposed project would not result in impacts related to these criteria, as explained below.

(a) Expose people or structures to 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,*

- *Strong seismic ground shaking,*
- *Seismic-related ground failure, including liquefaction,*
- *Landslides.*

(No impact during the construction of the proposed project). Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would be temporary and, as such, would not expose people or structures to a substantial risk due to fault rupture, seismic shaking or seismically induced ground failure, liquefaction, or landslides. Operational effects of seismic hazards on people and structures after construction are evaluated below under **Impact GS-2**.

(d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property. (No impact during the construction or operation of the proposed project). The near-surface soils at the proposed project site are generally low plasticity silts and sand that have low expansion potential. Thus, the significance criterion (d) related to expansive soils is not applicable to the proposed project and is not discussed further.

(e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of waste water. (No impact during construction or operation of the proposed project). The proposed project does not include the use of septic tanks or alternative wastewater disposal systems. Thus, the significance criterion (e) related to septic tanks and alternative wastewater disposal systems is not applicable to the proposed project and is not discussed further.

4.5.3.3 Impacts and Mitigation Measures

Impact GS-1: <u>Construction-Related Erosion and Loss of Topsoil</u>. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not result in substantial erosion or loss of topsoil. (Criterion b) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

Construction at the proposed project sites would involve ground disturbance including site preparation, grading, and/or trenching. Most of the proposed project area is identified as being within areas of moderate to high erosion hazard. The potential for erosion or loss of topsoil impacts during construction at each of the proposed project sites is discussed below.

Potential erosion that may result from grading, trenching, and other soil disturbance during construction would generally be controlled during construction with implementation of erosion control plans as required by the County prior to issuance of easements, grading, and building permits. Additionally, standard construction practices to prevent and minimize construction-related erosion would be included in construction documents and SWPPP that are required pursuant to federal and state NPDES regulations and permits for construction on one acre or more (please refer to **Section 4.8, Hydrology and Water Quality** for further explanation of SWPPP requirements). The SWPPP would include BMPs to prevent erosion, such as: the use of silt fences or other physical barriers to prevent erosion and sedimentation into water bodies; use of desilting basins; limitations on work during storm events and control of runoff; and post-construction revegetation and drainage requirements, including low impact development standards.

A 401 Certification under Section 401 of the CWA (please refer to **Section 4.8, Hydrology and Water Quality** for additional information on Section 401 of the CWA) would be required prior to commencing construction. A dewatering or diversion plan as required under Section 401 Certification would be implemented to comply with water quality standards for turbidity and to dissipate the energy of the diverted or dewatering discharge to reduce erosive impacts. Additionally, the 401 Certification would require erosion control management practices, including protection of the excavated material from reentering the ocean or other waters of the state.

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

Excavations and grading activities associated with constructing the proposed EPB project component alignment is not anticipated to be any deeper than a few feet. As such, the proposed EPB project component would not result in substantial erosion or loss of topsoil. Furthermore, a 401 Certification would be required prior to commencing construction and would require the implementation of a dewatering or diversion plan and other measures to minimize impacts associated with erosion. Construction activities on one acre or more are subject to the permitting requirements of the NPDES General Permit for Discharges of Stormwater Runoff Associated with Construction Activity (SWRCB Order No. 2009-09-DWQ as amended by 2010-0014-DWQ and 2012-006-DWQ). Therefore, since the construction site would be greater than one acre in size, implementation of a SWPPP would also be required at this site as part of the General Construction Permit, which would ensure erosion and loss of topsoil impacts would be less than significant.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

As presently planned, construction of the proposed SRPS project component would require excavation of up to about 25 feet for construction of the buried armor rock (i.e., riprap). The excavation would be predominantly in sand with little or no cohesion, with granitic rock anticipated at depth. The bottom portion of the excavations would also be likely under water. The excavations would require shoring or sloping the excavation sidewalls at a safe inclination. Dewatering would also be required to allow construction to proceed in a "dry" condition. A related consideration would also be the protection of excavated areas from ocean swell and waves.

The depth to bedrock along the proposed SRPS project component alignment ranges from approximately 17 to 29 feet. Based on the available information, the top of bedrock throughout this area represents a (buried) wave-cut platform that likely does not have substantial relief. There is a potential for some topographic relief on this surface since the Cypress Point fault is an en-echelon (stepped) fault, which could result in a more complicated top-of-bedrock surface; the site-specific, design-level geotechnical investigation will need to more closely define variability in the top of bedrock elevation. All available information constrains the position of the main Carmel River channel axis since at least Pleistocene time to a location south of the proposed SRPS project component, as indicted by the southward deepening of the top-of-bedrock surface documented in borings.

The proposed SRPS project component alignment would require substantial grading and excavation. A 401 Certification would be required prior to commencing construction and would require the implementation of a dewatering or diversion plan and other measures to minimize impacts associated with erosion. Construction activities on one acre or more are subject to the permitting requirements of the General Construction Permit. Therefore, since the construction site would be greater than one acre in size, implementation of a SWPPP would also be required at this site as part of the General Construction Permit, which would ensure erosion and loss of topsoil impacts would be less than significant.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

Implementation of the proposed ISMP project component would require grading and other ground disturbing activities, when necessary, to manage the breach of the Lagoon in the short-term. The breaching of the Lagoon, naturally or managed, results in erosion and the loss of topsoil in the area. However, annual permits from the resource agencies require the implementation of management criteria that after the opening action and after high inflows from the river have receded, the Lagoon shall either be allowed to naturally close or remain with an open outlet channel flowing over the beach in a meandering channel that is designed to mute tidal influence and rapid draining of the Lagoon. If excessive scouring is observed in the constructed outlet channel, the Lagoon shall immediately be closed by the placement of sand that is free of contaminants. As a result, potential substantial erosion and loss of topsoil impacts are reduced to a less-than-significant level with implementation of the management criteria required by the permits.

Impact Conclusion

The construction of the proposed project could result in soil erosion or loss of topsoil due to ground disturbance and construction at all proposed project sites. However, State requirements for implementation of a SWPPP as well as implementation of measures required by the 401 Certification and General Construction Permit would ensure this impact would be less-than-significant. In addition, implementation of the proposed ISMP project component includes measures to reduce the potential for substantial erosion and loss of topsoil and the impact would be less than significant. No mitigation measures are required.

Impact GS-2: Construction-Related Soil Collapse and Soil Constraints. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would be located on geologic units or soils that are unstable, or that may become unstable during project construction, and potentially result in soil instability or collapse; however, this exposure would not result in a substantial risk to people or structures. (Criterion c) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

Construction of the proposed project components would be located on geologic units or soils that are considered unstable. Liquefaction is a phenomenon in which saturated, cohesion-less soils are subject to a temporary loss of shear strength during seismic shaking. Lateral spreading is a failure within a nearly horizontal soil zone, commonly associated with liquefaction, which causes the overlying soil mass to move towards a free face or down a gentle slope.

The proposed EPB and SRPS project components would be designed in accordance with recommendations of site-specific geotechnical investigations prepared by a California-licensed geotechnical engineer, or engineers. Design-level geotechnical investigation would be prepared for the proposed EPB and SRPS project components to inform final design and construction that address seismic hazards and expansive soils, and the best means for complying with all applicable state and local code requirements and other protective standards. The investigations would include soil sampling and laboratory testing of materials to provide design criteria and recommendations applicable to foundation design, earthwork, backfill, site preparation, trenching, dewatering, tunneling, materials, and other factors related to these proposed project components. All recommendations of the site-specific geotechnical investigations would be incorporated into the final design and construction specifications for each proposed project component and would be implemented as specified by the construction contractors. Project construction would

comply with applicable codes and requirements of the CBC with California additions (CCR Title 24), and applicable County construction and grading ordinances.

Temporary construction slopes may range up to 2:1 or 2.5:1 (horizontal: vertical) inclinations. In accordance with requirements of state and local agencies and professional engineering standards, the contractor would use continuous shoring as necessary to protect existing improvements, where temporary slopes are not feasible. Where flowing sand conditions warrant special excavation and shoring procedures, trench shields and limited open trench conditions would be used to protect adjacent improvements and existing utilities. Given these considerations, the construction of the proposed project components, as described in more detail below, would result in a less-than-significant impact due to soil instability or collapse.

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

Subsurface conditions along the proposed EPB project component alignment consist predominantly of sand and varying relative density and isolated layers of firm to hard clays and silts. The upper sand layers are generally loose to medium dense, whereas the deeper sands are generally dense to very dense. Gravels and cobbles have been reported generally below a depth of about 42 feet except in some areas where gravel-sized granitic fragments were reported as shallow as 13 feet. The presence of gravels and cobbles (especially boulders, if present) must be considered when selecting the type and size of the sheet piles and the driving equipment to be used (which needs to match the pile type). Pre-drilling may be considered to "loosen" the subsurface soils, thereby reducing resistance to pile driving.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The construction of the proposed SRPS project component may require excavations of up to about 25 feet. The excavations would be predominantly in sand with little or no cohesions, with granitic rock anticipated at depth. The bottom portion of the excavations would also likely be under water. The excavations would require shoring or sloping the excavation sidewalls at a safe inclination. Dewatering would also be required to allow construction to proceed in a "dry" condition. A related consideration would also be protection of excavations from ocean waves.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

The implementation of the proposed ISMP project component would occur in the same geologic area described above in the proposed SRPS project component discussions (i.e., sand). However, the implementation of the proposed ISMP project component does not require the construction of any structures that would be adversely affected by unstable soils or other geologic units.

Impact Conclusion

The construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component could result in exposure to unstable soils due to presence of dune sands that may cave continuously in some areas. Construction at these sites may require temporary shoring to protect construction workers from injury due to potential soil collapse. Although there is the potential for soil collapse during trenching and excavation, compliance with the requirements of state and local agencies and professional engineering standards would ensure that this impact would be less-than-significant. No mitigation measures are required.

Impact GS-3: <u>Exposure to Fault Rupture.</u> The proposed EPB and SRPS project components would be in a seismically active area, and these components may be affected by fault rupture from an earthquake on local faults; however, this exposure would not result in a substantial risk to people or structures. (Criterion a) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

The proposed project site is not located within the Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist, and there are no known active faults passing through the property. However, the proposed project is in a region of high seismicity (**Figure 4.5-19**). Based on general knowledge of the local seismicity, it should be anticipated that, during the useful life of the proposed project, the proposed project area would be subject to strong ground shaking. It is also anticipated that the proposed project area would periodically experience small to moderate magnitude earthquakes.

The proposed EPB and SRPS project components would be designed accordingly and would incorporate sound engineering judgment and conform to the CBC requirements, which would minimize potential safety risks associated with seismic hazards to an acceptable and less-than-significant level.

Impact Conclusion

Although in a region of high seismic activity, the operation of the proposed EPB and SRPS project components would not expose people or structures to substantial risk of adverse effects due to fault rupture as the sites are not located on an active fault or within the Alquist-Priolo Earthquake Fault Zoning Map. The proposed EPB and SRPS project components would be designed accordingly and would incorporate sound engineering judgment and conform to the CBC requirements, which would minimize potential safety risks associated with seismic hazards to an acceptable and less-than-significant level. No mitigation measures are required.

Impact GS-4: <u>Exposure to Seismic Ground Shaking and Liquefaction.</u> The proposed EPB and SRPS project components would be in a seismically active area; however, the proposed project operations would not expose people or structures to a substantial risk of loss, injury, or death involving exposure to seismic ground shaking and liquefaction. (Criteria a and c) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

The proposed EPB and SRPS project components would be located within a seismically active region. An earthquake on local or regional faults could result in damage to structures due to seismic shaking and/or liquefaction. The intensity would be dependent on the magnitude of the earthquake and distance of facilities from the earthquake epicenter. The primary effects of ground shaking would be potential damage to the proposed structures, including foundations. Structures would be designed in accordance with requirements of the CBC regarding seismic design criteria, which would help minimize damages and would not result in substantial adverse risks to people or structures.

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

The proposed EPB project component alignment lies within zones considered to have moderate to high liquefaction susceptibility. Effects of liquefaction in the site vicinity because of the 1906 San Francisco or 1989 Loma Prieta earthquakes have not been identified and not anticipated. The results of the liquefaction analysis in the Geotechnical Report suggest that some of the sand layers encountered in the

drill holes and Cone Penetrometer Test (CPT) probes could liquefy when subject to the design peak ground acceleration. In general, the potential for liquefaction-induced lateral spreading along the proposed EPB alignment is low, due to the lack of a nearby free face.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

In general, the potential for liquefaction-induced lateral spreading along the proposed SRPS project component alignment is higher than it is along the proposed EPB project component alignment, due to the drop in elevation as one descends from Scenic Road across the back beach to the surf zone. While the proposed SRPS project component alignment is located where there is potential for liquefaction and ground failure, the proposed SRPS project component alignment would likely have considerable positive effects on slope behavior during seismic events. The proposed SRPS project component alignment would likely protect against loss, injury, or death by stabilizing the Scenic Road and reducing the risk of liquefaction and related hazards.

Prior to the final design of the proposed EPB and SRPS project components, detailed geotechnical evaluations would be performed for specific project sites, with geology and soils hazards identified to develop and incorporate appropriate seismic design parameters into new structural development. Geotechnical evaluation of liquefaction potential and dynamic settlement, including subsurface exploration, would be performed during the design phase for project sites with planned new structural development constructed in accordance with local requirements and the CBC. Appropriate measures to protect structures and other improvements would be developed based on the site-specific geotechnical conditions. Adherence to existing regulations and standards, including the CBC, would minimize harm to people and structures from adverse geologic events and conditions.

Impact Conclusion

Upon completion of construction, the proposed EPB and SRPS project components would be subject to seismic shaking during an earthquake and could be subject to liquefaction and/or lateral spreading. Generally, damage to facilities would be localized and minimized with adherence to local regulations, building codes, and recommendations of site-specific geotechnical reports. The application of proven seismic design criteria as standard engineering practices that are recommended in geotechnical reports would ensure that the facilities would be designed and built to minimize risk of damage. Damage from an earthquake could result in temporary cessation of proposed project operations until repairs are completed, but the effects of seismic ground shaking and liquefaction would not result in a substantial risk of loss, injury, or death resulting in a significant impact. No mitigation measures are required.

Impact GS-5: Exposure to Coastal Erosion and Sea Level Rise. The proposed EPB and SRPS project components would not be exposed to substantial soil erosion because of sea level rise. (Criterion b) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS

Coastal areas are subject to coastal erosion, which may be exacerbated by sea level rise which is predicted to occur throughout the century. It is possible that coastal erosion exacerbated by sea level rise may affect the proposed SRPS project component. The sea level along the central coast is projected to continue to rise over the next several decades, and the coastline is expected to retreat inland due to the rising sea level and the resulting erosion.

The planning and design of the proposed EPB and SRPS project components considered the impacts of sea-level rise. The proposed SRPS project component is located within the landward limit of the 2100 Erosion High Hazard Zone (Pacific Institute, 2009). As a result, there would be a potential for this structure to become undermined and exposed after a significant coastal storm event sometime around 2100. However, the *Carmel River Lagoon Scenic Road Protection Preliminary 30% Design Draft Report* identified using a 2-foot sea level rise, taking into consideration of the results of the NRC report, and assuming a 30-year project life as the basis for design. The preliminary design of the proposed SRPS project component includes the analysis of extreme water levels and events with a 2-foot rise in sea level. The proposed SRPS project component would be reevaluated and either rehabilitated or removed depending on future conditions toward the end of its life in approximately 30 years; this would occur prior to 2100. Therefore, potential impacts from coastal erosion because of sea level rise are less-than-significant.

The proposed EPB project component is located outside the identified coastal erosion hazard area, specifically outside the year 2100 envelope for coastal erosion (Pacific Institute, 2009). The *Feasibility Report* identified the EPB project design life to be 50 years and an increase in ocean levels of 0.5 to 2 feet anticipated over the life of the project. This increase is assumed to translate to an approximately parallel increase in statistical Lagoon levels of 0.5 to 2 feet. Elevation 16 feet is equal to the current FEMA 100-year flood elevation for the Lagoon and is 0.6 feet higher than the highest Lagoon level on record. When considering the elevation of the proposed EPB project component, the anticipated sea-level rise and impacts to the visual character of the area were considered. It was determined that a 1.5-foot freeboard (i.e., an EPB elevation of 17.5 feet) would account for anticipated sea-level rise while reducing visual impacts. Therefore, with the proposed EPB project component elevation at 17.5 feet and the proposed EPB project component located outside of the year 2100 envelope for coastal erosion, potential impacts from coastal erosion because of sea level rise are less-than-significant.

In addition, the Sediment Transport Study analyzed the impacts of sea level rise to the Carmel River State Beach. The study found that the sediment supplied by the Carmel River is estimated to be on the order of 61,931 CY annually, which indicates that the Carmel River State Beach can adapt to future sea-level rise. The analysis also found that beach elevation will rise along with sea-level rise because wave runup elevation increases with the rise in ocean level. Therefore, the Lagoon is expected to go through a similar transition. The study concluded that the Carmel River State Beach appears to be resilient to sea-level rise hazards in the near-term as the Carmel River provides sufficient sediment annually to compensate for the sediment deficit caused by sea-level rise. However, it is also evident that the beach is dependent on the Carmel River sediment supply, and, thus, to the extent that climate change alters the supply, the effect on the beach could be substantial.

Impact Conclusion

The proposed EPB and SRPS project components would be subjected to sea level rise and associated coastal erosion during their 30-year and 50-year life spans, respectively. However, the preliminary design of the proposed EPB and SRPS project components have considered sea level rise, and within the life of the projects. Potential impacts from coastal erosion because of sea level rise are less-than-significant impact.

Impact GS-6: <u>Operation-Related Erosion and Loss of Topsoil/Sand</u>. Operation of the proposed EPB and SRPS project components would not result in substantial erosion or loss of topsoil/sand. (Criterion b) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

The proposed EPB project component would result in a more naturally functioning lagoon ecosystem as the need to artificially breach the Lagoon to prevent flooding of the residential area to the north of the Lagoon would be reduced. The proposed EPB project component would allow an increased depth and duration of inundation within the Lagoon. While structures that constrict or confine river floodplains can induce erosion due to increased flood-flow velocities or through eddying effects at the obstruction, such a response would not be expected under the proposed project scenario. Although the proposed EPB project component would limit the extent of the Carmel River floodplain to some degree at high flows, the magnitude of the constriction is minimal relative to the full width of the floodplain corridor. Flow velocities, even during large floods, are low through the Lagoon, especially along the edges where the proposed EPB project component would be located. Given these conditions, scour effects due to constriction of the channel or because of hardscaping associated with the EPB project component would be unlikely, and, therefore, would have a less-than-significant impact.

<u>PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT</u>

Active Erosion/Scour

Undermining or scouring at the base of a bluff protection structure can be a common cause of structure failure. Scouring of sediment, whether the beach or a river, is the result of water current velocities that are high enough to move or erode the material in any location. Winter waves generate enough energy and have short enough periods that they erode or scour the beach. Longer period and less energetic summer waves move the sand back up the shoreface and rebuild the beach.

As described in **Chapter 3, Project Description**, the purpose of the proposed SRPS project component is to design a rock buttress to prevent erosion of the bluff fronting Scenic Road, and to protect the adjacent public parking lot, if the river breaches in a northerly direction. The proposed SRPS project component would anchor the bluff where it currently exists, preventing erosion that may occur from wave runup. The existing toe of the bluff slope is typically at an elevation of approximately +20 feet. The proposed SRPS project component alignment would extend from the southern tip of the public parking lot toward the northwest. The rock revetment proposed along the parking lot would provide protection from erosion caused by wave run-up. There would be occasional flooding of the parking lot during large coastal storms and flooding would be possible when Lagoon water levels are at or near the base flood elevation. The outer rock layer would be sized to withstand extreme ocean waves and river current forces (e.g., 1 to 2-ton sized rock) with a layer of smaller rock and/or geotextile fabric underneath to prevent underlying soils from being eroded through the revetment. Conservative estimates of rock size and thickness have been utilized in the preliminary design; dimensions were generally selected from Caltrans and the Coastal Engineering Manual.

The northern terminus would be located between stations 5+00 and 6+00, between Valley View Avenue and Isabella Avenue. This terminus was determined based on where the wave energy is low enough (compared to locations further south) such that sand build-up is not a significant concern. The *Feasibility Geotechnical Analysis* indicated that this is the likely location of a natural breach, where river flow would overcome natural beach grades. The end of the rock revetment would be keyed into the slope. The

proposed SRPS project component would be aligned to direct the riverine flow to turn west and breach at approximately station 6+00, which would be the northern limit of river migration. The reasoning for having a northern limit of migration is to ensure that the river does not swing all the way into the cove where Scenic Road turns to the west, where beach erosion could cause significant damage to the unprotected bluff and habitat.

The bottom of the revetment was set to roughly match mean higher high water (MHHW), which is also intended to correspond with the existing marine terrace (which is erosion-resistant). A determination of the marine terrace location and extent would be done as part of the final design; if the elevation of the marine terrace is higher or lower than expected, the rock buttress design would be revised accordingly.

As described above, the proposed SRPS project component has been preliminarily designed to reduce the potential impacts from scour to the structure, bluff, and parking lot if the river breaches to the north end. The engineering consultants would incorporate the recommendations from the site-specific geotechnical investigations as required by the County into final design. Therefore, potential impacts from scours are less-than-significant.

Passive Erosion

Whenever a hard structure, such as riprap or a seawall, is constructed along a shoreline to halt erosion, the shoreline is essentially fixed at that location. Adjacent landforms (e.g., beaches, cliffs, etc.) will continue to retreat landward, creating an artificial headland out of the armored segment of coast. If armor is placed at the base of a cliff that has a beach in front of it, the beach will continue to migrate landward on either side of the armored area, but there will be no beach in front of the armor. This is called passive erosion.

The purpose of the proposed SRPS project component would be to prevent erosion of the bluff below Scenic Road by preventing erosion at the bluff's toe of slope. Above the top of the revetment, the slope would be permanently planted with native species appropriate to the coastal strand and dune habitats and maintained to control erosion. The proposed SRPS project component would be designed to be buried by beach sand under normal conditions, and exposed only during high-flow conditions, after which natural/seasonal beach processes would be allowed to rebury the structure. The northern terminus deflects river flows away from the very innermost (northerly) part of Stewart's Cove. As such, the passive erosion would be reduced as the revetment would not be permanently exposed and subjected to erosion. This is a less-than-significant impact.

Wave Overtopping

Wave overtopping is defined as the transport of significant quantities of ocean water over the top of a seawall, either as greenwater, splash, or spray. Greenwater overtopping occurs when waves break onto or over the shore barrier and the overtopping volume is relatively continuous. Overtopping can cause damage by exerting direct vertical and horizontal forces, and by eroding materials from behind walls.

In most coastal areas, it is not practical or economical to build a protection structure that will not be overtopped during severe storm conditions. Standard run-up calculations for seawalls typically consider only the frequency of overtopping by greenwater. The height of the run-up is usually calculated using empirical or theoretical formulas based on specified water depth, beach slope and grain size, wave height, wave period, maximum expected sea level, and the type of slope of the structure involved. One of the limitations of run-up calculations is that they do not accommodate the local variations in the bluff profile, or the irregularities of the shoreline.

The Preliminary 30 percent Plans are based on protecting Scenic Road and the parking lot from erosion and scour if the river breaches to the north under various extreme ocean and riverine scenarios. As

described above, the proposed SRPS rock buttress structure would anchor the bluff where it currently exists. The bottom of the revetment was set to roughly match MHHW, which is intended to correspond with the existing marine terrace (which is erosion-resistant) and avoid undermining of the structure.

The top of the bluff is already higher than the FEMA base flood elevation, and if the bluff is not allowed to retreat, wave run-up would not reach the top. Based on the available information reviewed for the preliminary design, wave run-up does not seem to pose a significant threat to the upper portions of the slop, and, therefore, the primary focus of the armoring is to protect the base of the bluff. The preliminary design is based on several parameters (please refer to Table 2-1 of the *Preliminary 30% Design Draft Report* in **Appendix G**), and in the run-up analysis, the wave was shown to break prior to reaching the toe of the revetment in each extreme event scenario. Therefore, it is unlikely that waves would overtop the structure and create scour and undermine Scenic Road and the parking lot. Therefore, potential erosion impacts from wave overtopping are less-than-significant.

Reduction in Sand Contribution

The breakdown of rocks and sediments in cliffs, bluffs, and dunes creates sand that constitutes some fraction of the littoral budget. Armoring coastal landforms covers up those erosion-prone surfaces and may, therefore, reduce sand supply. In cases where these reductions occur, they can make downcoast beaches narrower, allowing more wave energy to erode cliffs, bluffs, and dunes downcoast of the armored area. The relative contribution of cliff erosion to sediment budget will vary based on local geology and erosion rates. Thus, understanding the effect of coastal armoring on sand supply needs to be addressed on a littoral cell by littoral cell basis.

Historically and currently, the breach has been managed to avoid flooding of the existing development in the low-lying areas and eroding the bluff under Scenic Road. Damage to Scenic Road by actively managing or allowing a natural breach to the north could result in the loss of access to eight private residences, adverse environmental impacts (such as discharge of raw sewage into the ocean), and impairment to public access to important coastal resources. As a result, the bluff under Scenic Road has not been frequently exposed to riverine or wave erosion and thus, does not significantly contribute to the sand supply or littoral budget in the local or regional area. The proposed SRPS project component would maintain the existing conditions of directing the flow of the river away from the bluff to avoid damage to Scenic Road. Therefore, impacts to sand supply are less-than-significant.

Impact Conclusion

The operation of the proposed EPB and SRPS project components would not result in substantial erosion or loss of topsoil/sand because of active erosion/scour, passive erosion, wave overtopping, or a reduction in sand contribution. Flow velocities, even during large floods, are low through the Lagoon, especially along the edges where the proposed EPB would be located. Given these conditions, scour effects due to constriction of the channel or because of hardscaping associated with the constructed proposed EPB project component would be unlikely, and, therefore, it is a less-than-significant impact. The purpose of the proposed SRPS project component is to prevent erosion of the bluff fronting Scenic Road and parking lot, and the rock buttress has been designed to direct flow away from the bluff and parking lot, avoiding or reducing erosion. The northern terminus of the rock buttress deflects river flows away from the very innermost (northerly) part of Stewart's Cove, reducing passive erosion as the revetment would not be permanently exposed and subjected to erosion. The preliminary design has evaluated wave-up under extreme conditions, and it is unlikely that waves would overtop the structure and create scour and undermine Scenic Road and the parking lot. Therefore, the

proposed SRPS project component would not result in substantial erosion or loss of topsoil. This is a less-than-significant impact.

4.5.4 References

California Geological Survey. 2008. *Guidelines for Evaluating and Mitigating Seismic Hazards in California.* Available online at: https://www.conservation.ca.gov/cgs/Documents/Publications/Special-Publications/SP_117a.pdf.

California Geological Survey. 2022. Online Map of Official Alquist-Priolo Earthquake Fault Zones. Accessed October 2023. Available Online at: https://gis.data.ca.gov/maps/ee92a5f9f4ee4ec5aa731d3245ed9f53/explore?location=37.100176%2C-119.787889%2C6.00.

California Office of Emergency Services, 2021. Tsunami Hazard Area Map, Monterey County; produced by the California Geological Survey and the California Governor's Office of Emergency Services; dated March 23, 2021, mapped at multiple scales. https://www.conservation.ca.gov/cgs/Documents/Publications/Tsunami-Maps/Tsunami_Hazard_Area_Map_Monterey_County_a11y.pdf

[OPC] California Ocean Protection Council. 2018. State of California Sea-Level Rise Guidance 2018 Update. Available online at: https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf.

[CO-CAT] Coastal and Ocean Working Group of the California Climate Action Team. 2010. State of California Sea-Level Rise Interim Guidance Document. Available online at: http://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20110311/12.SLR_Resolution/SLR-Guidance-Document.pdf

[CO-CAT] Coastal and Ocean Working Group of the California Climate Action Team. 2013. State of California Sea-Level Rise Guidance Document. March. Available online at: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/2013_SLR_Guidance_Update_FINAL1.pdf

ESA-PWA. 2014. *Analysis of Historic and Future Coastal Erosion with Sea Level Rise memorandum, Monterey Peninsula Water Supply Project*: dated March 19.

Howell, BF. 1972 Sand Movement Along Camel River State Beach, Carmel, California. Naval Post Graduate School, Monterey, CA. September.

Moffatt & Nichol. 2013a. Carmel River Lagoon Restoration Scenic Road Protection Options. February 2013.

Moffatt & Nichol. 2013b. Carmel River Lagoon Biological Assessment Coastal Engineering Analysis. August 2013.

Moffatt & Nichol. 2021a. Carmel River Lagoon Natural Breach Alignment and Location. December 2021.

Moffatt & Nichol. 2021b. Sediment Transport Study. December 2021.

Moffatt & Nichol. 2022. Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential. December 2022.

[County] Monterey County. 1982. General Plan.

Monterey County Hazard Mitigation Planning Team and AECOM. 2014. Monterey County, Multi-Jurisdictional Hazard Mitigation Plan; Final Draft. September 2014. Available online at: https://www.co.monterey.ca.us/government/departments-a-h/administrative-office/office-of-emergency-services/hazard-mitigation#:~:text=The%20purpose%20of%20the%20Monterey,on%20local%20hazards%20of%20concern.

Monterey County Office of Emergency Services. 2022. Monterey County Multi-Jurisdictional Hazard Mitigation Plan; Final Draft. March 2022. Available online at: https://www.co.monterey.ca.us/home/showpublisheddocument/114305/637961624630700000.

Monterey Peninsula Water Management District and [DD&A] Denise Duffy & Associates, Inc. 2019. Monterey Peninsula, Carmel Bay, and South Monterey Bay Integrated Regional Water Management Plan Update. September 2019. Available online at: https://www.mpwmd.net/wp-content/uploads/Final-Draft-IRWM-Plan-9-25-19.pdf.

[NRC] National Research Council. 2012. Sea-Level Rise for the Coasts of California, Oregon, And Washington: Past, Present, and Future.

[OPC] California Natural Resources Agency, Ocean Protection Council. 2018. State of California Sea-Level Rise Guidance. 2018 Update. Available: https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf.

Pacific Geotechnical Engineering. 2013. Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California. May 2013.

Pacific Institute. 2009. California Flood Risk: Sea Level Rise; Monterey Quadrangle. Available online at: http://www2.pacinst.org/reports/sea_level_rise/hazmaps/Monterey.pdf

Thorton, E.B. 2005. Littoral Processes and River Breachings at Carmel River Beach. Naval Postgraduate School, Monterey, CA.

[USDA] United States Department of Agriculture. 1978. Soil Survey of Monterey County, California.

[USCA-NRCS] United States Department of Agriculture- Natural Resources Conservation District. 2019. Web Soil Survey. Accessed October 2023. Available online at: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

[USGS] United States Geological Survey. 2020. Quaternary fault and fold databases for the Nation. Accessed October 2023. Available online at: https://www.usgs.gov/programs/earthquake-hazards/faults.

4.8 HYDROLOGY AND WATER QUALITY

This section describes the hydrology and water quality conditions related to the proposed project, including a discussion of the existing conditions, and the potential effects of the proposed project on surface and groundwater resources. This section also summarizes the regulations and laws pertinent to water quality. The analyses contained in this section are based primarily on the hydrological technical studies prepared for the proposed project identified below and included as **Appendix H** of this RDEIR and the Feasibility Report (Whitson Engineers, 2013), which is available on the County's website:[1]

- *Carmel River Lagoon EPB-Riverine Flooding Impact Assessment* (Balance Hydrologics, Inc., May 28, 2013);
- *The Geomorphic Role of the Riverine Processed in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon* (Balance Hydrologics, Inc., January 2014);
- *Draft Summary of Estimated Interior Side Hydrologic Conditions, EPB Project* (Balance Hydrologics, Inc., August 7, 2015); and
- *Carmel River Lagoon EPB-Potential Impacts to the CAWD Wastewater Treatment Facility and Mission Ranch* (Balance Hydrologics, Inc., July 29, 2016).

Public and agency comments related to hydrology and water quality were received during the public scoping period, and are summarized below:

- Analyze potentially significant effects from alterations to existing drainage patterns, including impacts associated with flooding;
- Evaluate potential impacts from flooding to CAWD and CAWD operations;
- Evaluate impacts to waterbodies downstream of the proposed project site;
- Evaluate impacts to groundwater;
- Evaluate potential impacts to water quality; and
- Evaluate potential impacts associated with different outflow channel configurations.

To the extent that issues identified in public comments involve potentially significant effects on the environment according to the CEQA and/or are raised by responsible agencies, they are identified and addressed within this RDEIR. For a complete list of public comments received during the public scoping period, please refer to **Appendix A, NOP, and Public Comment Letters** of the Draft EIR.

This section has been updated to include the revised Section IX. Hydrology and Water Quality in Appendix G of the CEQA Guidelines. The revisions to this section were made to streamline, consolidate, and clarify the set of questions in the section. In addition, questions were added to consider impacts to sustainable groundwater management and plans, in accordance with the Sustainable Groundwater Management Act. The thresholds of significance and impact analyses have been updated to be consistent with the revisions to Section IX. Hydrology and Water Quality in Appendix G of the CEQA Guidelines.

[1] Feasibility Report is available online at: https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/library-current-major-projects/carmel-lagoon-ecosystem-protective-barrier-and-scenic-road-protective-barrier-systems

4.8.1 Environmental Setting

4.8.1.1 Regional Setting

The proposed project would be located within and adjacent to the Carmel River State Beach and the Lagoon. The proposed EPB and ISMP project components would be located at the downstream end of the Carmel River, along the perimeter of the Lagoon near its terminus in Carmel Bay, and the proposed SRPS project component would be located adjacent to the Scenic Road bluff on Carmel River State Beach. Carmel Bay is located within the MBNMS and is identified as an Area of Special Biological Significance (ASBS) #34 by the SWRCB.[2] In addition to being an ASBS, Carmel Bay is also a State Marine Conservation Area, as defined in the Marine Managed Areas Improvement Act. The Carmel River represents a relatively large watershed, with a total area of approximately 256 square miles. The proposed project location with respect to the Carmel River Watershed and Carmel Bay sub-basin is depicted in **Figure 4.8-1.** The proposed project components and their relation to the Carmel River, Lagoon, and Carmel Bay are depicted on **Figure 4.8-2**.

4.8.1.2 Climate and Precipitation

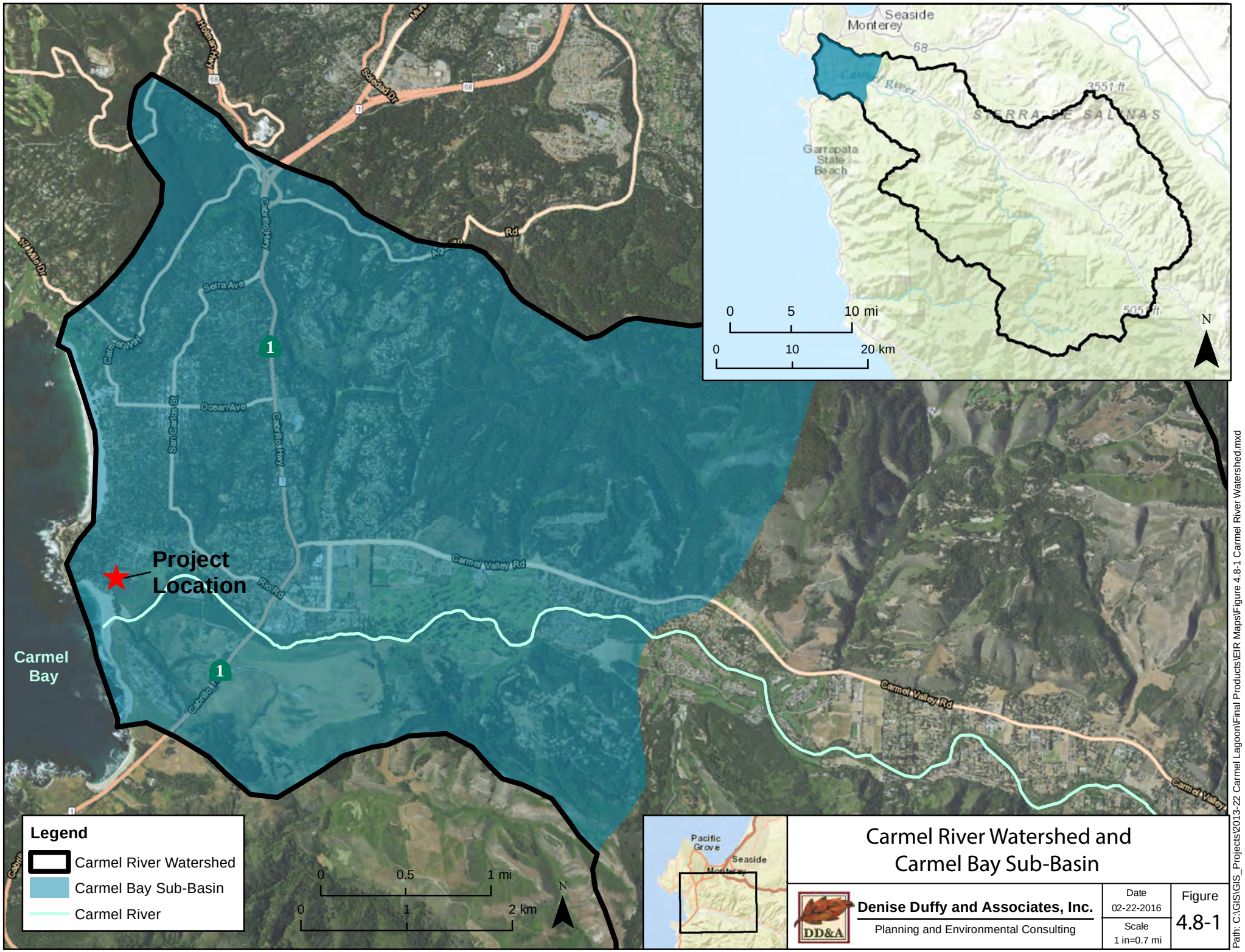
The proposed project area is located along the western margin of the Coast Range and the climate is dominated by the Pacific Ocean. The region is characterized by a moderate coastal climate with mild, wet winters and generally dry summer days, which are often overcast or have coastal fog and cool temperatures. The average temperature is approximately 60 degrees Fahrenheit (°F). Rainfall occurs primarily between November and April.

4.8.1.3 Hydrologic Setting

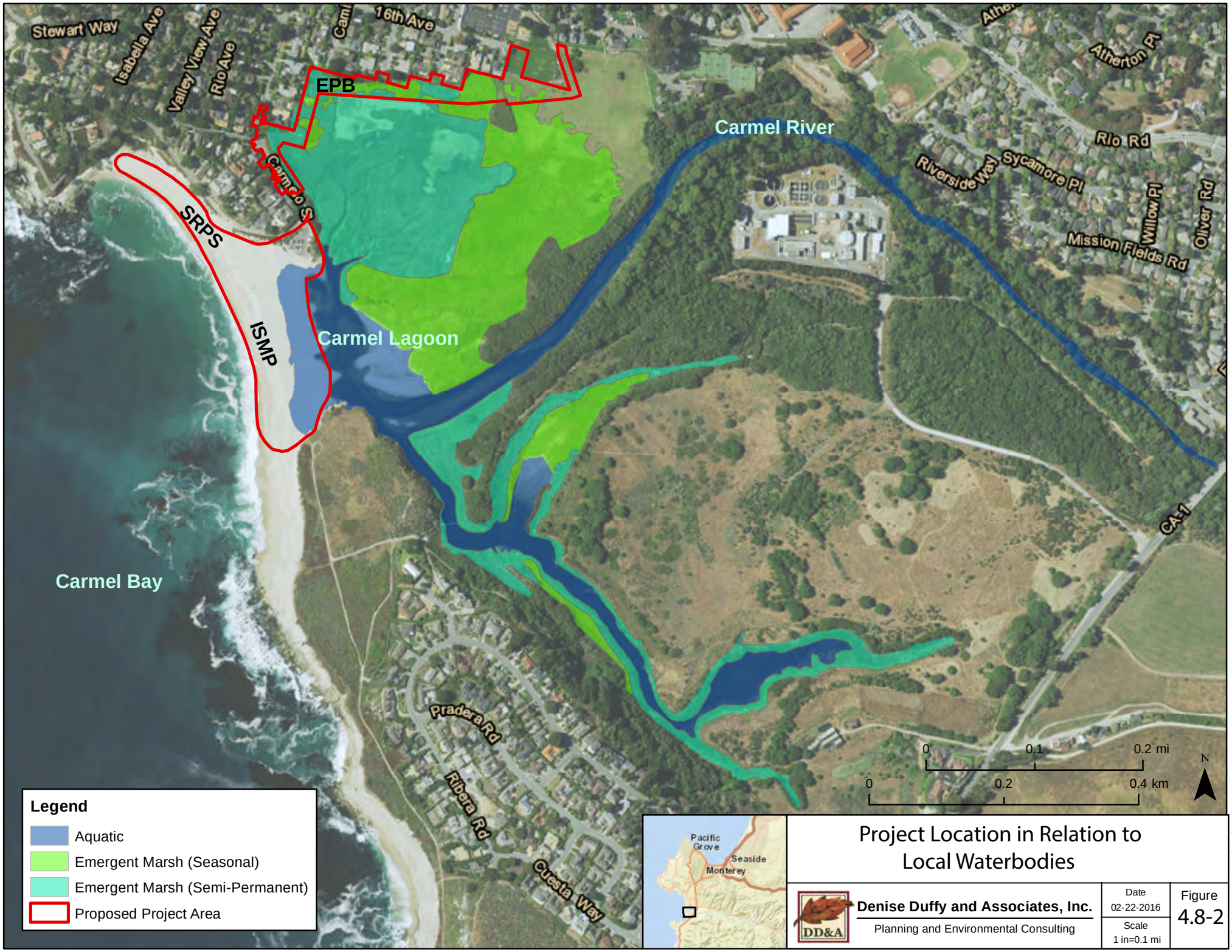
REGIONAL HYDROLOGY

The Carmel River Watershed is located within the California Coast Ranges Geomorphic Province. The entire drainage area of the watershed is located on the western slopes of the Sierra De Salinas. The northwesterly flowing Carmel River originates approximately 35 miles upstream from Carmel Bay at an elevation of 3,500 feet above sea level. In the upper watershed, the river, and its tributaries flow in deep, steep-sided canyons. For its last 15 miles, the river flows across the relatively flat Carmel Valley floor to the Pacific Ocean. The major tributary to the Carmel River is the Tularcitos Creek. Most of the Carmel River watershed (approximately 65 percent) is upstream of the confluence with Tularcitos Creek. Other large tributaries include Garzas Creek, San Clemente Creek, Pine Creek, Danish Creek, Cachagua Creek, and the Miller Fork. The upper reaches of the Carmel River flow northwesterly, generally following the trend of the fault block structure of the Coast Ranges, to a confluence with Tularcitos Creek. The lower reach flows in a more westerly direction through Carmel Valley and into the Pacific Ocean at Carmel Bay.

[2] California PRC Section 36700 (f) "Areas of special biological significance" are a subset of state water quality protection areas, and require special protection as determined by the SWRCB pursuant to the *California Ocean Plan* adopted and reviewed pursuant to Article 4 (commencing with Section 13160) of Chapter 3 of Division 7 of the Water Code, and pursuant to the Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (California Thermal Plan) adopted by the SWRCB.


Seaside
Monterey
68
Carmel River
3551 ft
SIERRA DE SALINAS
Garrapata State Beach
505 ft
0 5 10 mi
0 10 20 km
N
Project Location
Carmel Bay
Carmel Valley Rd
Rio Rd
Ocean Ave
Serra Ave
Carmel Valley
Legend
Carmel River Watershed
Carmel Bay Sub-Basin
Carmel River
0 0.5 1 mi
0 1 2 km
N
Pacific Grove
Seaside
Monterey
Carmel River Watershed and Carmel Bay Sub-Basin
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date 02-22-2016
Scale 1 in=0.7 mi
Figure 4.8-1
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.8-1 Carmel River Watershed.mxd

This Page Intentionally Left Blank


Stewart Way
Isabella Ave
Valley View Ave
Rio Ave
16th Ave
EPB
Carmel River
Rio Rd
Riverside Way
Sycamore Pl
Willow Pl
Oliver Rd
Mission Fields Rd
Atherton Pl
Camino S
SRPS
ISMP
Carmel Lagoon
Carmel Bay
CA-1
Pradera Rd
Ribera Rd
Cuesta Way
0
0.1
0.2 mi
0
0.2
0.4 km
N
Legend
Aquatic
Emergent Marsh (Seasonal)
Emergent Marsh (Semi-Permanent)
Proposed Project Area
Pacific Grove
Seaside
Monterey
Project Location in Relation to Local Waterbodies
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date
02-22-2016
Scale
1 in=0.1 mi
Figure
4.8-2
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.7-2 Project Vicinity.mxd

This Page Intentionally Left Blank

California American Water (CalAm) owned and operated two dams at the headwaters of the Carmel River: the San Clemente Dam and the Los Padres Dam. Until 2015, when the San Clemente Dam was removed, these two dams worked together to regulate winter and summer flows to the lower reaches and retain winter runoff to provide surplus water to accommodate summer demand. The Los Padres Dam will continue to perform these functions at a significantly reduced capacity.[3]

According to the Monterey Peninsula Water Management District (MPWMD), average annual runoff (from 1962 to 2006) is 78,190 acre-feet. Streamflow in the Carmel River is directly attributed to rainfall; average annual precipitation is 18 to 20 inches. Accordingly, river flows are subject to large seasonal and annual variation in terms of total volume and peak discharge. Climate plays an important role in the watershed and can result in significant seasonal variation due to changes in annual precipitation from year to year. The watershed has a typical coastal California wet-dry seasonal pattern that can vary significantly. More than 90 percent of the annual rainfall typically occurs over the watershed during the six-month period between November and April (DWR and USACE, 2008).

Flows in the Carmel River are gaged by the USGS at two locations: Robles Del Rio (RM 14.143) and Near Carmel ("Carmel Gage") at RM 3.24.[4] The MPWMD also maintains a series of monitoring gages within the Carmel River. Monthly average flows taken at the Carmel Gage are shown in **Table 4.8-1.**

Table 4.8-1. Carmel River Monthly Average Flows

Carmel River Monthly Average Flows at USGS Gage: Near Carmel Water Years 1963 – 2023	
Month	**Average Flows (cfs)**
January	245
February	342
March	311
April	172
May	66
June	23
July	6.5
August	1.6
September	0.80
October	2.3
November	7.2
December	63
Source: USGS, 2023.	

CARMEL LAGOON

The proposed project is located along the northern and western perimeters of the Lagoon system and includes effecting water surface elevation within the Lagoon. The Lagoon and associated wetlands, which are located immediately south of the City of Carmel-by-the-Sea, cover an area of approximately 100 acres. The Lagoon is a valuable aesthetic and recreational resource to residents and tourists, and provides rich habitat for juvenile steelhead, birds, and other wildlife.[5] Most of the Lagoon and associated wetlands are

[3] For further information about the Los Padres and San Clemente Dams, see **Section 4.8.1.3, Hydrological Setting,** and **Section 4.8.1.6 Flooding, Seiche, and Ocean-Related Inundation**.

[4] Carmel River flow data for stations 11143200 (Robles del Rio) and 11143250 (Carmel).

[5] For additional information concerning wildlife species and habitat present within the project study area, please see **Section 4.3, Biological Resources.**

within the Carmel River Lagoon and Wetlands Natural Preserve, which is part of the Carmel River State Beach. A delineation of jurisdictional wetlands and Other Waters under Section 404 of the CWA and the CCA of the entire proposed project footprint was completed January 2015 by DD&A and is presented in **Appendix E**, as Appendix F of the Biological Resources Report. Impacts to potential federal wetlands and Other Waters of the U.S., coastal wetlands, and Waters of the State are addressed in **Section 4.3, Biological Resources**. There are no drinking water reservoirs within the proposed project area.

The Lagoon, located at the bottom of the watershed, serves as an ecological interface zone between the watershed and the ocean. The Lagoon is generally not connected to the ocean during times of very low or zero streamflow, when ocean waves build a barrier beach (sandbar) across the mouth of the Lagoon and close the outflow channel. When river inflow is relatively low and the Lagoon is not open to the ocean, a dynamic equilibrium is reached between streamflow and groundwater inflows, outflow through the barrier beach, evapotranspiration, and ocean wave overtopping. In summer, this leads to lower water surface elevations and in the fall prior to opening, abrupt increases in water surface elevations can occur due to overtopping. As streamflow increases in the fall and early winter, Lagoon water surface elevations can rise to flood stage depending on precipitation patterns. When flooding does occur, infrastructure along the northern edge of the Lagoon and within the Lagoon floodplain are threatened with flooding before the sandbar would typically open naturally.

The Lagoon is distinguished by several physical factors that provide a unique setting with respect to lagoon dynamics and the interactions between river and ocean forces that drive seasonal and yearly changes. Unlike many other coastal lagoons, a relatively small barrier beach, confined by bedrock, limits the seepage of water from the Lagoon through the sandbar to the ocean.[6] During periods when river flows exceed seepage rates (often during the wet season), the Lagoon may breach the beach and maintain an open connection with the ocean for long periods of time. In other coastal lagoons, sandbar seepage can dominate the outflow process for most of the year; therefore, other systems may not breach every year and when breaching does occur, it may only be for a short period of time. Due to the unique setting of the Lagoon, the system may breach the beach even in critically dry water years for a brief time if there is flow at the Lagoon; however, this is not always the case (Balance Hydrologics, Inc., 2014). Additionally, variation exists between lagoon systems that function naturally and systems that have been modified through human actions.

The hydrology of the Lagoon is dynamic. In the fall and early winter, the Lagoon receives freshwater inflow from the Carmel River and direct runoff from approximately 100 acres of residential development to the north. The barrier sandbar is periodically breached by mechanical means to alleviate flooding in adjacent residential areas, and subsequently, the Lagoon does not attain water levels that it would under natural conditions. Siltation has resulted in a narrowing of the main body of the Lagoon, which is more pronounced on the north side, where up to 350 feet of the old active channel in now vegetated wetland (Williams and PWA, 1992). Most of these wetlands, while experiencing seasonal fluctuation, remain flooded for significant portions of the year, when the sandbar is closed and stream flow entering the Lagoon is present (Casagrande, 2006). While the Lagoon mouth is open, these wetlands are tidally influenced, and if the barrier beach forms late after river flows have nearly ceased, a significant volume of saltwater remains in the Lagoon over the summer. When streamflow ceases, typically during dry summer months, groundwater inflows from the local aquifer become the source of freshwater into the Lagoon system.

[6] For additional information concerning the geological setting of the Lagoon, please refer to **Section 4.5, Geology, Soils, and Seismicity.**

The Lagoon ecosystem has been altered by development and hydrologic manipulation. Early in the 20th century, wetlands on the north side of the Lagoon were partially filled, first for use as pasture, then for residential development. The fill was in place by 1939; however, few houses were built until the 1950s. The floodplain south and east of the Lagoon (the former Odello properties) was also leveed and graded for agricultural use and the floodplain north and east of the Lagoon leveed for commercial and residential development. Other hydrologic alterations to the Lagoon ecosystem include upstream development, and diversion of water from the Carmel River for municipal and agricultural use (Williams and PWA, 1992). These alterations can lead to an impaired lagoon system.

Naturally Functioning Lagoon Systems

In a naturally functioning lagoon system on the California coast, streamflow plays a critical role in the temporal pattern of lagoon openings and closures. Several factors determine how and when a lagoon breaches, including wave action, morphology of the sandbar that separates the lagoon from the ocean, and river discharge. Once the outflow channel through the sandbar is created, tidal flows may enter the lagoon. The shape and elevation of the outflow channel to the ocean are important factors in determining available lagoon habitat. Streamflow, tidal fluctuation, and ocean swells affect the water surface elevation in the lagoon as well as the depth and volume of the lagoon. Conditions under which the lagoon breaches, which is if it is filled to a full volume by low flows before breaching or if the breach is a result of a high flow through the system, will play a role in the evolution of the path of the outflow channel through the sandbar. Summer waves carrying sand to the beach can build up the sand berm and may lead to natural perched lagoon morphology.[7] If the perched lagoon morphology occurs when the lagoon is open, this configuration provides the greatest ratio of freshwater to saltwater in the system under open conditions, and, in addition, provides the highest lagoon water surface elevation upon closure of the outflow channel.

As streamflow decreases through the dry spring and summer months, the riverine processes in the lagoon are less able to overcome ocean forces bringing sand up onto the sandbar. Eventually, the ocean and lagoon are once again separated by a sandbar in a closed configuration. As tidal exchange occurs until a sandbar closes, more saline water is generally present within the lagoon at closing. Saltwater is denser than freshwater and, thus, tends to stratify into the lower layers of a lagoon. Conversion from highly saline conditions to more freshwater conditions occurs when freshwater river discharge forces saltwater against the inland side of the closed sandbar (Coates and Gou, 2003). Because of stratification, a forcing mechanism exists at the boundary between the two layers. The upper wedge of freshwater pushes the saltwater wedge against the porous sandbar. If there is enough freshwater inflow to the lagoon, three processes can occur: 1) entrainment, which carries a mixture of freshwater and saltwater into the ocean if a shallow or intermittent channel remains open to the ocean; 2) mixing, which de-stratifies the lagoon and blends the stratified layers together, moderating salinity values; and 3) seepage of saltwater through the permeable sandbar and out of the lagoon (Smith, 1990; Debler and Imberger, 1996; NMFS, 2008; Zhang et al., 2008). All these processes can play a role in the conversion of a lagoon to freshwater. The conversion can take more than a month after sandbar closure (Smith 1990), and generally depends on continuation of freshwater flows into the lagoon. Within a closed configuration, coastal lagoon water quality and water surface elevation are governed by a balance of outflows (seepage through the bar and evaporation), saltwater inflows, and freshwater inflows (streamflow and groundwater inflows).

An additional element in the complex lagoon system is that of ocean waters entering the lagoon while the sandbar is closed. This occurs primarily through wave overtopping, but also through seepage into the

[7] "Perched lagoon morphology" is when the water surface elevation in a lagoon is above the elevation of the mean high tide. This term can refer to a lagoon under the conditions when the lagoon has an open connection through a sandbar to the ocean or when the lagoon is closed to the ocean by a sandbar.

lagoon through the sandbar—seepage can occur in either direction and is mainly a function of tides (Watson and Casagrande, 2004). Seepage out of the lagoon may happen when tides are out, while seepage into the lagoon may happen when tides bring waves onto the beach and against the sandbar. Overtopping is a function of wave energy. Higher energy waves crash onto a sandbar and overtop it, adding small to large volumetric quantities of saltwater to the lagoon (Thornton, 2005; Moffat and Nichol, 2013). Along the California coast, wave energy decreases in the late spring and summer and increases in the fall and winter. The addition of saltwater into the lagoon in late summer/early fall while the lagoon remains closed increases water surface elevations and salinity values in the lagoon, generally lowering water quality shortly before rains begin to contribute streamflow, which then provide relief with better water quality (Hayes et al., 2011).

Under ideal conditions for freshwater fisheries, the closed lagoon system would be converted to freshwater before streamflow stops in the late spring or summer months. As streamflow dwindles in the dry months, groundwater becomes the source of freshwater to the lagoon and must, at least to some degree, counteract evaporation rates as well as seepage rates through the sandbar to maintain freshwater conditions over the course of lagoon closure. The condition of the groundwater aquifer is dependent on the preceding hydrological conditions of the previous and current years. Please refer to **Section 4.8.1.5, Groundwater Hydrology and Water Quality** below for additional information about groundwater.

Natural functioning lagoons provide several year-round benefits to aquatic and terrestrial wildlife species including habitat diversity, refugia, and food sources. When lagoons are opened by streamflow in the winter full mixing of saltwater and freshwater can provide opportunities for fish to thrive. Additionally, fish species may benefit when a lagoon closes in the beginning of the dry season, when streamflow is still enough to naturally convert the lagoon to freshwater conditions. Studies show that steelhead smolt have higher growth rates, greater survival rates, and larger densities in lagoon systems under freshwater conditions.

Impaired Lagoon Systems

Lagoon ecosystems found along Coastal California have experienced high degrees of modification due to human interactions. Impaired lagoon/estuarine ecosystems are not able to provide the full range of benefits to aquatic and terrestrial species that are required for healthy ecosystem function. Modifications leading to impaired lagoon ecosystem function include alteration of the natural cyclical opening and closure of the lagoon by breaching and closing the sandbar artificially; encroachment onto the lagoon floodplain via infill, built structures, and agricultural uses; channelization of the river; diversions of streamflow; groundwater pumping; and loss of sediment supply via hardening of channel banks and damming. The following discussion will focus on impairment of a lagoon system through alteration of the natural opening and closing cycle of the lagoon.

Artificial barrier bar breaching can adversely affect the health of the lagoon by promoting the formation of a wide and deep outflow channel. This outflow channel configuration can remove large amounts of sand from the barrier beach and prematurely flush freshwater from the lagoon at a rapid rate, resulting in an increase in salinity levels and lower surface water elevations. Where an artificial breach is cut can affect the evolving morphology of the outflow channel and the remaining beach berm. Cutting artificial breaches across a beach directly perpendicular to the river mouth could lead to a situation where the outflow channel is at a low elevation and ocean water tidal flows are able to move freely into and out of the lagoon. Under these conditions, freshwater may form a lens on top of saline waters and be carried out to sea when tides recede resulting in the flushing of the freshwater from the lagoon with each tidal cycle. This flushing occurs because freshwater is less dense than saltwater, so if the outlet elevation is low, the stratified freshwater lens is preferentially removed. Flushing of freshwater from the lagoon could

continue throughout the yearly open cycle. Impacts to water quality resulting from salinity gradients are addressed in **Section 4.8.1.4, Surface Water Quality** below.

Multiple artificial breaches may be required within a single year to promote open conditions when river forces are not able to maintain an open connection as ocean waves continually bring sand onto and from the beach. This recurrent disruption of lagoon water results in large spikes of changing water quality. Eventually, streamflow may be large enough to keep an outlet channel open, yet if the channel has been artificially placed, it is unknown where a natural channel would have formed, where it potentially would have moved to, or what geometry such channels would have had in the case where natural breaching occurred. Artificial breaching at the beginning of the rainy season results in significant habitat losses that can reduce lagoon volume and area. Additionally, if the outflow channel geometry brought about by artificial sandbar breaching is wide and deep, freshwater accumulating in the lagoon is largely flushed with each tidal cycle, precluding the ability of the lagoon to retain high quality aquatic habitat. In all cases where artificial breaching occurs, aquatic habitat conditions are negatively affected.

Artificial breaching of the lagoon may lead to higher salinity levels in the lagoon at closure compared to what natural conditions might provide, as a result conversion of the lagoon to freshwater conditions may not be possible depending on streamflow conditions and how long the flow persists upon closure for that water year. If streamflow is low at lagoon closure, high salinity concentrations can create very poor water quality habitat conditions, resulting in fish die-offs.

4.8.1.4 Surface Water Quality

CARMEL RIVER AND LAGOON

Land use in the proposed project area can affect water quality. Pollutants and sediments are transported via runoff from the watershed into surface water features such as streams, rivers, storm drains, and reservoirs. Local land uses influence the quality of the surface water through point source discharges (discrete discharges such as an outfall) and nonpoint source discharges (e.g., stormwater runoff). Land uses in the Carmel River watershed include industrial, agricultural, rural, and urban.

The Regional Water Quality Control Board (RWQCB) in the Basin Plan (RWQCB, 2019) designates beneficial uses of the Carmel River as the following: municipal and domestic supply (MUN); agricultural supply (AGR); industrial service supply (IND); groundwater recharge (GWR); freshwater replenishment (FRSH); water contact recreation (REC1); non-contact water recreation (REC2); commercial and sport fishing (COMM); warm fresh water habitat (WARM); cold water habitat (COLD); wildlife habitat (WILD); preservation of biological habitats of special significance (BIOL); rare, threatened, or endangered species (RARE); migration of aquatic organisms (MIGR); and spawning, reproduction, and/or early development (SPWN). Beneficial uses of the surface water from the Carmel River Estuary include the following: GWR; REC1; REC 2; COMM; WILD; COLD; MIGR; SPWN; BIOL; RARE; estuarine habitat (EST) (RWQCB, 2016). General water quality objectives exist for each of the beneficial uses identified. Surface water quality objectives have also been identified for the Carmel River (**Table 4.8-2**).

Table 4.8-2. Surface Water Quality Objectives for the Carmel River

Constituent	Objective[1] (mg/L)
Total Dissolved Solids (TDS)	200
Chloride (Cl)	20
Sulfate (SO_4)	50
Boron (B)	0.2
Sodium (Na)	20

[1] These surface water quality objectives are annual mean values characterizing a large area of the water body and may not be directly related to the objective indicated

The Central Coast Watershed Studies Team (CCoWS) monitored water quality in the Lagoon between 2004 and 2007. Salinity, dissolved oxygen, and temperature in the Lagoon vary seasonally and with depth. The topography and lack of mixing in the Lagoon creates a layer of isolated saltwater in the bottom of the south arm of the Lagoon. The lack of mixing can also result in anoxic conditions below the halocline. The depth at which the halocline occurs fluctuates seasonally with changes in freshwater input. The Carmel River near the Lagoon typically ceases to flow during the summer months and a slow input of groundwater provides the only freshwater input to the Lagoon (Perry et al., 2007). The Lagoon does become well mixed on occasion when the Lagoon has breached the sandbar and freshwater input is adequate. Large precipitation events and/or disturbance of sediment on the bottom of the Lagoon can lead to increases in turbidity (Larson et al., 2006).

Salinity gradients can drive other water quality parameters including dissolved oxygen and temperature. Poor water quality, such as low levels of dissolved oxygen, can lead to fish kills as the habitat becomes inhospitable. Additionally, increased levels of salinity may drive fish into shallow waters where survival rates are lower, decreasing productive lagoon habitat. Poor water quality may impair designated beneficial uses of the Lagoon including RARE, SPWN, and WILD.

Water quality in the Lagoon is influenced by freshwater inflow from the Carmel River, tidal levels, and ocean waters over topping the sandbar from the Pacific Ocean. Water quality often declines during the late summer, fall, and early winter months when Carmel River flows are reduced (MPWMD, 2012). Water temperature in the Lagoon can exceed 70°F, which is above Basin Plan guidelines (MPWMD, 2013). Dissolved oxygen levels can also periodically drop below guidelines (not less than 7.0 mg/L), probably due to a combination of increasing water temperature and decomposition of marine organic material washed into the Lagoon by ocean waves (MPWMD, 2012). Water quality conditions in the Lagoon during the summer through early fall were commonly within stressful ranges and likely decrease growth and survival rates of rearing steelhead (MPWMD, 2023). These conditions are mainly caused by a lack of river inflow and variability in tidal influences.

CARMEL BAY AREA OF SPECIAL BIOLOGICAL SIGNIFICANCE

As an ASBS, waste discharges to the Carmel Bay are regulated to ensure that water quality objectives, as identified in the California Ocean Plan, are met and beneficial uses of California's coastal waters are protected. Only waste discharges granted exceptions are allowed to occur within the ASBS to protect the beneficial uses of the area, all other waste discharges are prohibited. ASBSs are considered important elements for a sustainable, resilient coastal environment and economy (County, 2014).

4.8.1.5 Groundwater Hydrology and Water Quality

There are two types of groundwater aquifers in the watershed: the unconfined alluvial aquifer located in the mid and lower reaches of the river within Carmel Valley, and a bedrock aquifer located in the upper hills of the watershed. The unconfined alluvial aquifer underlies the bed, floodplain, and terraces of the

Carmel River and represents the primary source of groundwater along the Carmel River (Logan, 1983; Kapple et al., 1984; Smith et al., 2004). The Carmel Valley Groundwater Basin lies along the downstream portion of the Carmel River located southeast of the Monterey Peninsula.

Beneficial uses of the groundwater from the Carmel River include the following: municipal (MUN), agricultural (AGR), and industrial (IND) (RWQCB, 2016). No groundwater quality objectives have been established for the Carmel River.

As stated previously in **Section 4.8.1.3, Hydrologic Setting** above, groundwater becomes the primary source of freshwater to the Lagoon in dry summer months when streamflow from the Carmel River into the Lagoon has ceased. Groundwater must partially counteract evaporation on seepage rates through the sandbar if freshwater conditions are to be maintained in the Lagoon when streamflow to the Lagoon has ceased. The conditions of the groundwater aquifer are based on the antecedent hydrological conditions of the previous and current year. Factors including groundwater pumping, instream diversions, and aquifer storage capacities can impact groundwater. In the lower section of coastal watersheds, freshwater and saltwater are hydrologically connected. When groundwater aquifers are full of freshwater, the gradient that exists pushes seaward generally keeping saltwater intrusions from encroaching into fresh groundwater supplies. When groundwater pumping rates lead to an overdraft, the gradient is reversed and saltwater moves inland, affecting water quality where saltwater intrusions occur.[8] An uplifted fault block provides some protection against saltwater intrusion into the Carmel River alluvial aquifer by reducing aquifer thickness as the Lagoon approaches the ocean; however, the aquifer is still in hydraulic communication with Carmel Bay (Staal, Gardner & Dunne, Inc., 1989). Depending on local conditions, groundwater pumping can reduce groundwater contributions to the Lagoon system. The water surface elevation present in a Lagoon at the time of closing can have a direct effect on potential groundwater inflow, due to hydraulic gradient conditions at the coast between infiltrating seawater and freshwater aquifer storage. If seawater intrusions occur, there is little chance that fresh groundwater will be able to percolate out of the substrate. An impaired groundwater condition can potentially magnify water quality impacts associated with outflow channel geometry brought about by artificial sandbar breaching.

Groundwater pumping can have negative effects on the overall watershed flow regime and result in the early cessation of streamflow. A consequence may be diminished groundwater gradients, resulting in a reduction in groundwater flow into coastal lagoons if groundwater elevations were impaired by pumping. These considerations show that high water surface elevation in the Lagoon at closure is important because groundwater flows may not be consistent enough or of sufficient volume to help maintain Lagoon water quality through a dry season.

In general, the depth to groundwater within the proposed project area fluctuates depending on tides, water level in the Lagoon, rainfall, pumping in wells, irrigation, and/or other factors.

4.8.1.6 Flooding, Seiche, and Ocean-Related Inundation

FLOODING

Flood hazards are generally considered from three sources: 1) seismically induced waves (tsunami or seiche), 2) dam failure, and 3) long-cycle storm events. The proposed project site is located adjacent to the Pacific Ocean at sea level.

[8] Groundwater overdraft occurs when groundwater used exceeds the amount of recharge into an aquifer, which leads to a decline in groundwater level.

The 100-year flood boundary shown on **Figure 4.8-3,** the FEMA Flood Hazard Map, reflects that the proposed project would lie within the 100-year Flood Hazard Area (areas with a one percent annual chance of flooding). The proposed project site is in an area subject to periodic flooding. Major flood events along the Carmel River have been well-documented. Numerous incidents of flooding have been reported since at least 1911. Major flood events were reported in 1911, 1914, 1922, 1926, 1931, 1937, 1938, 1941, 1943, 1945, 1952, 1955, 1956, 1958, 1962, 1966, 1969, 1973, 1978, 1983, 1995, and 1998. Flood events in 1995 and 1998 produced two of the highest flows on record causing substantial property damage.

River flows in 1995 were among the highest recorded on the Carmel River in the past 60 years. The March 1995 flood event, considered a 30- to 50-year flood event, flooded many of the low-lying areas in the Carmel River Watershed. Numerous commercial and residential properties at the mouth of Carmel Valley were inundated. In addition, a section of Highway 1 was destroyed as a result of flooding. Several flood control projects were implemented after the 1995 event in order to reduce future flood hazards upstream of the proposed project site, in the Mission Fields area, and lower Camel Valley.

The 100-year flood boundary shown on **Figure 4.8-3,** the FEMA Flood Hazard Map, reflects that the proposed project would lie within the 100-year Flood Hazard Area (areas with a one percent annual chance of flooding). The proposed project site is in an area subject to periodic flooding. Major flood events along the Carmel River have been well-documented. Numerous incidents of flooding have been reported since at least 1911. Major flood events were reported in 1911, 1914, 1922, 1926, 1931, 1937, 1938, 1941, 1943, 1945, 1952, 1955, 1956, 1958, 1962, 1966, 1969, 1973, 1978, 1983, 1995, 1998, 2008, 2021, and 2023. Flood events in 1995 and 1998 produced two of the highest flows on record causing substantial property damage.

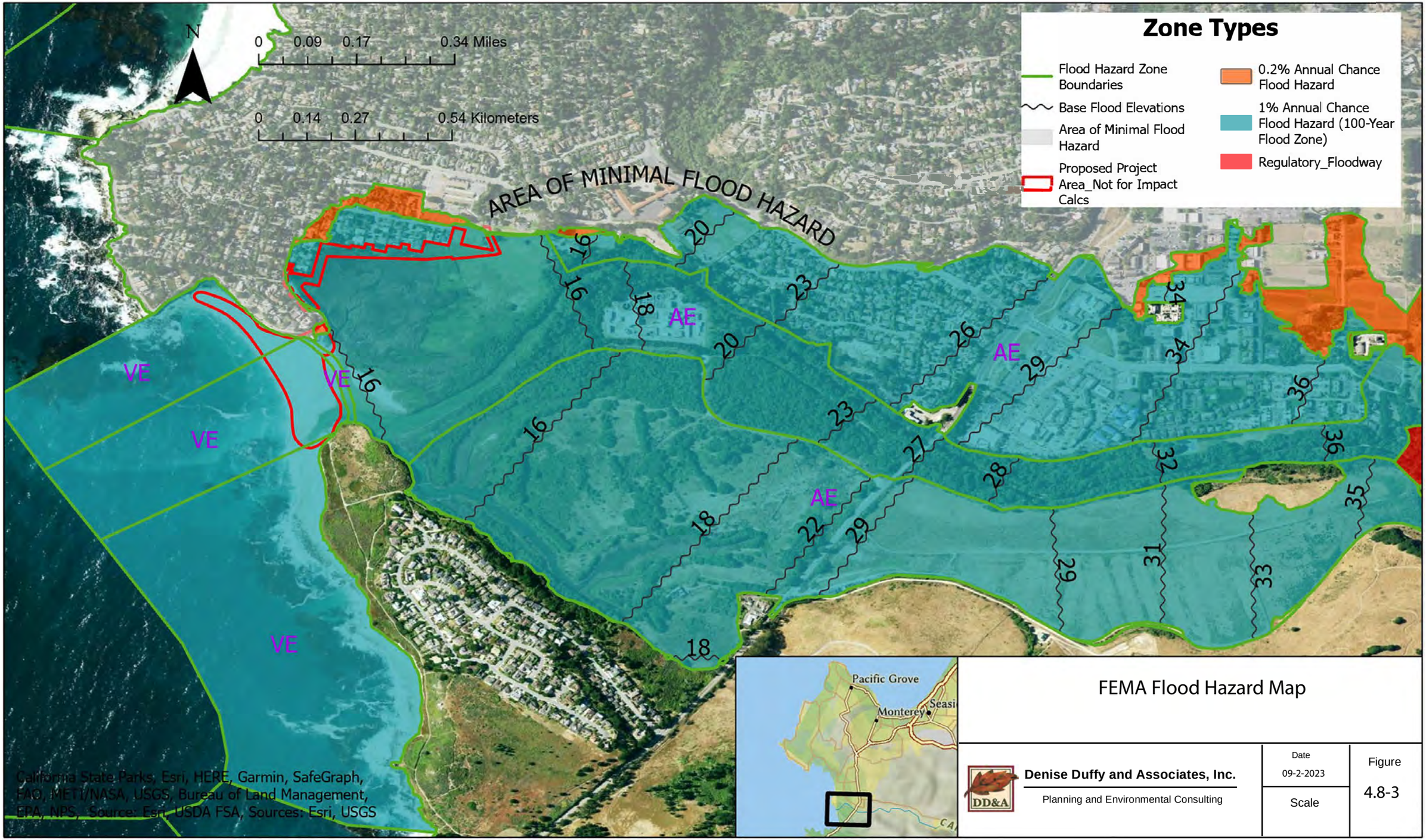
River flows in 1995 were among the highest recorded on the Carmel River in the past 60 years. The March 1995 flood event, considered a 30- to 50-year flood event, flooded many of the low-lying areas in the Carmel River Watershed. Numerous commercial and residential properties at the mouth of Carmel Valley were inundated. In addition, a section of Highway 1 was destroyed because of flooding. Several flood control projects were implemented after the 1995 event in order to reduce future flood hazards upstream of the proposed project site, in the Mission Fields area, and lower Carmel Valley.

One of the most significant floods occurred in 1998 after a series of “El Niño” winter storms hit the County of Monterey. Flow in the Carmel River reached 14,600 cubic feet per second (about a 20-year flood event). Properties five miles upstream of the mouth were significantly impacted by erosion and some flooding.

In 2008, the Lagoon reached its highest recorded level up to that time. The water surface elevation (NAVD 88) was just above the 15.3-ft flood stage. Previously, the highest Lagoon level on record was just under 15 ft. Flooding occurred in the Lagoon due to high surf from the storm. The sandbar breached naturally about four hours after the flood stage was reached. Approximately 30 homes were affected by flooding and nine homes were deemed uninhabitable because of damaged electrical and gas systems.

Serious flooding occurred in The Fourth Addition, the surrounding neighborhood of the Carmel River Lagoon in January of 2021. Overflow from the Carmel River spilled into the lagoon where the water surface elevation eventually exceeded the 15.3-ft flood stage. The water surface elevation continued to rise until the sandbar enclosing the lagoon breached, allowing water to drain. Flooding of the lagoon impacted a dozen homes and inundated the bottom floor of six homes.

In 2023, an atmospheric river storm led to lagoon flooding, triggered by the overflow of the Carmel River and the onslaught of exceptionally massive ocean waves. According to the Monterey Peninsula Water Management District, the Lagoon water surface elevation reached just above 14 ft, which was enough to inundate surrounding neighborhoods such as Carmel Point and The Fourth Addition. Sandbags and pumps were utilized to lower flood levels and protect properties from further damage.



FEMA Flood Hazard Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date
09-2-2023

Scale

Figure
4.8-3

This Page Intentionally Left Blank

Since at least the early 20th Century, whenever water in the Lagoon rose to levels that threatened private property, the sandbar has been mechanically managed (breached) to lower the Lagoon's water level to below flood stage. Since 1973, emergency sandbar management was carried out by the County, Monterey County Water Resource Agency (MCWRA), and State Parks. On average, at least one mechanical breach has occurred annually, with as many as thirteen management actions occurring in one year. When the annual rainy season ends (and depending on whether the sandbar has closed off naturally), the decision is made to close the sandbar before the river inflow subsides to maximize the volume of water in the Lagoon for the dry season. These historic breaching events have directly adversely affected Lagoon water surface elevation, which in turn determines aquatic habitat volume and area, altering habitats as well as water quality.

DAM OR LEVEE FAILURE

The Los Padres Dam is located on the Carmel River, upstream of the proposed project area. Dams are regulated by the design and operational requirements established by the California Division of Safety of Dams (DSOD). California Water Code Section 6000, et seq. and 23 CCR 301, et seq. establish the authority and responsibility of the DSOD, including periodic safety inspections of dams, completion of studies that predict the flood zones created by sudden dam failure, and development of emergency response plans in the advent of pending dam failure, including a program for emergency warning and evacuation. The DSOD requires the determination of a dam inundation area, which is an area downstream of a dam that would be inundated or otherwise affected by the failure of the dam and accompanying large flood flows. As required by California Water Code section 6161. DSOD reviews and approves inundation maps prepared by licensed civil engineers and submitted by dam owners for extremely high, high, and significant hazard dams and their critical appurtenant structures. The Los Padres Dam is an extremely high hazard dam, and the project area is within the dam breach inundation map area (DSOD, 2020).

TSUNAMI, SEICHE, AND MUDFLOWS

Seismic shaking during earthquakes can result in the formation of waves within open bodies of water. The two major types of seismically generated wave are tsunamis and seiches. Tsunamis are waves generated by the displacement of a large volume of water and, therefore, only occur in large water bodies such as oceans, bays, or large lakes. Displacements of water can occur by several mechanisms (including subaqueous landslides or explosions) but are mostly caused by submarine displacements of the earth's crust resulting from earthquakes. A seiche is a wave that oscillates in lakes, bays, or gulfs from a few minutes to a few hours because of seismic or atmospheric disturbances. Small seiches are almost always present on larger lakes, and the frequency of the oscillation is determined by the size of the water body, its depth and contours, and the water temperature. Larger seiches can be caused by nearby or distant earthquakes and occur when the wave signature of the seismic waves is resonant with the natural period (controlled by basin geometry) of the lake.

The proposed project site is located within the mapped tsunami hazard area (California Emergency Management Agency et al., 2021). According to the *Monterey County Operational Area Tsunami Incident Response Plan*, a locally generated tsunami may occur if a large enough earthquake occurs in or near Monterey Bay region (Monterey County Office of Emergency Services, 2007). Such an earthquake could produce a tsunami that reaches shore in a matter of minutes. The plan states that within Monterey County there is a low likelihood of experiencing a tsunami. The most likely tsunami cause, though still relatively unlikely compared to other hazards, is a distant event, where there would be more than one hour to respond to a tsunami warning (Monterey County Office of Emergency Services, 2007).

The proposed project site is in a relatively flat area where a mudslide is unlikely to occur. Additionally, the *Monterey County Multi-Jurisdictional Hazard Mitigation Plan* (Monterey County Office of Emergency Services, 2022) does not identify hazards from seiches or standing waves in enclosed bodies of water.

SEA LEVEL RISE AND COASTAL FLOODING

Sea level rise provides a physical measure of possible oceanic response to climate change. Average global sea level has risen between five to nine inches during the 20th century as reported by the Intergovernmental Panel on Climate Change (IPCC), nearly one-tenth of an inch each year. The rise in global sea level is attributed to the thermal expansion of ocean water and the melting of mountain glaciers and ice sheets around the globe. As sea level rises, higher mean sea level will make it possible for wave run-up to reach coastal dunes more frequently, undercutting at the dune toe and causing increased erosion. A 2012 study by the National Research Council (NRC) provided a sea level rise projection of 15 inches by 2040 and 28 inches by 2060, relative to 2010 for San Francisco (the closest projection to the proposed project). The 2040 and 2060 values were derived by fitting a curve to the "Average of Models, High" projections for 2030, 2050, and 2100 published in the NRC study (ESA and PWA, 2014).

The *State of California Sea-Level Rise Guidance Document* (CO-CAT, 2013) provides guidance for incorporating sea-level rise projections into planning and projects in California in response to Executive Order S-13-08, issued on November 14, 2008, that directed state agencies to plan for sea level rise and coastal impacts. The guidance was updated in 2018 to ensure that best available science was informing sea level rise planning decisions in California and to meet the needs for guidance that can help cities, counties, and the State prepare for, and adapt to, sea level rise (OPC, 2018). According to this document, sea level rise is projected (using the year 2000 as a baseline, 1-in-200 chance, medium-high risk aversion) as: 0.8 feet in 2030, 1.9 feet in 2050, and 6.9 feet in 2100 (OPC, 2018). Coastal erosion and flooding, ongoing issues in the area, are also expected to increase with accelerating sea level rise.

CLIMATE CHANGE AND HYDROLOGICAL RESPONSE

Intensive investigation of climate trends over the last two decades indicates strong evidence that the lower atmosphere has been warming at an unprecedented rate during the last 50 years, and it is expected to further increase at least for the next 100 years. Warming of the climate is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC, 2023). Generally, a warmer air mass implies a higher capacity to hold water vapor and an increased likelihood of an acceleration of the global water cycle. Other factors being equal, warm air holds more water vapor than cool air and potential for increased precipitation as the air is lifted either by winds blowing over a mountain range, by convective activity (thunderstorms), or by a weather system front has the potential for greater precipitation intensity.

Several effects on water resources infrastructure may occur in response to global warming. Potential impacts throughout California could include changes in snowpack accumulation and melting, alteration of precipitation and runoff patterns, increasing sea level, changes in flood frequency and timing, increased droughts, increased potential for wildfires, and increased demand for groundwater (and related decreases in groundwater levels).

It is generally accepted that the observed rise in global sea level is one of the most demonstrable responses to the effects of increased global temperatures. However, sea level rise is neither uniform across the globe nor constant at any given location. Along the California coast, sea level is also affected by changes in Pacific Ocean water temperatures during relatively short-term climatic variations including El Niño/Southern Oscillation cycle (with return periods of three to five years) and the Pacific Decadal Oscillation cycle. Additionally, the rate of sea-level change is relative to significant tectonic movements.

Active uplift has occurred within the study area and would act to decrease the relative rate of sea-level rise.

Some climate change models suggest possible changes in the pattern and characteristics of storms in California. The effect of global warming may be to increase the number of years with many "pineapple express" (also called "atmospheric river") storms, events with the potential to cause flooding in the study area. The potential for increased flood magnitudes can be amplified in areas that lie near sea level by concurrent high sea level stands associated with astronomical tides, storm surges, El Niño influences, and the gradual sea level rise. Potential impacts of sea-level rise in coastal and estuarine zones may result in changes in shoreline erosion, inundation or exposure of low-lying coastal areas, changes in storm and flood damages, shifts in extent and distribution of wetlands and other coastal habitats, changes to groundwater levels, and alterations to salinity intrusion into estuaries and groundwater systems. In addition to potential changes in the characteristics of flooding events, global warming is expected to result in changes in water quality. As sea level rises, the tidal influence will migrate landward, causing a gradual increase in salinity in surface waters and will also generally increase saltwater intrusion into the aquifer.

4.8.2 Regulatory Environment

4.8.2.1 Federal and State

FEMA AND THE NATIONAL FLOOD INSURANCE PROGRAM

The FEMA is tasked with responding to, planning for, recovering from, and mitigating against disasters. FEMA is responsible for determining flood elevations and floodplain boundaries based on the USACE and approved agencies' studies; for coordinating the federal response to floods, earthquakes, hurricanes, and other natural or man-made disasters; and for providing disaster assistance to states, communities, and individuals. FEMA prepares and distributes the Flood Insurance Rate Maps (FIRMs), which are used in the National Flood Insurance Program. These maps identify the locations of special flood hazard areas, including the 100-year flood zone.

The Flood Insurance and Mitigation Administration (FIMA), a component of FEMA, manages the National Flood Insurance Program (NFIP). The NFIP consists of three components: flood insurance; floodplain management; and flood hazard mapping. Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP also identifies and maps the nation's floodplains.

CLEAN WATER ACT

The CWA establishes the basic structure for regulating discharges of pollutants into the Waters of the United States (Waters of the U.S.) and regulating quality standards for surface waters. Its goals are to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Under the CWA, the EPA has implemented pollution control programs and established water quality standards. The NPDES permit program under Section 402 of the CWA and enabling regulations controls water pollution by regulating point sources that discharge pollutants into Waters of the U.S. The EPA has delegated authority of issuing NPDES permits in California to the State Water Board, which has nine RWQCBs. The Central Coast RWQCB regulates water quality in the project area. The NPDES permit program is further described below.

The USACE and EPA regulate discharge of dredged and fill material into Waters of the U.S. under Section 404 of the CWA and its implementing regulations. Waters of the U.S. are defined broadly as waters susceptible to use in commerce (including waters subject to tides, interstate waters, and interstate wetlands) and other waters (such as interstate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds) (33 CFR 328.3, 40 CFR 120.2, 40 CFR 122.2). For regulatory purposes under the CWA, the term "wetlands" mean those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Section 401 of the CWA requires that, prior to the issuance of a federal license or permit for an activity or activities that may result in a discharge of pollutants into navigable waters, the permit applicant must first obtain a certification from the state in which the discharge would originate. A state certification indicates that the proposed activity or activities would not result in a violation of applicable water quality standards established by federal or state law, or that no water quality standards apply to the proposed activity.

Section 401 Water Quality Certifications are issued by the RWQCB to protect water quality and the beneficial uses of water from projects that may result in discharges of dredge and fill. The RWQCB only issues Section 401 Water Quality Certifications for projects that may discharge dredge of fill to waterbodies that are under the jurisdiction of the USACE. The RWQCB may issue other waste discharge requirements (permits) for discharges of dredge or fill to waterbodies not under the jurisdiction of the USACE, but that are Waters of the State as defined by the Porter-Cologne Water Quality Control Act.

Water bodies that may not be covered under USACE jurisdiction may require a Section 401 Water Quality Certification for impact on waters of the state. Placement of structures, fill, or dredged materials into Waters of the State requires Section 401 Water Quality Certification. Activities that require a federal Section 404 permit also require a Section 401 Water Quality Certification. The RWQCB issues Section 401 Water Quality Certifications and waivers.

National Pollution Discharge Elimination System Waste Discharge System

In California, the NPDES program is administered by the State Board through the RWQCBs and requires point sources to obtain NPDES permits (also called Waste Discharge Requirements, or WDRs, in California). Point sources include municipal and industrial wastewater facilities and stormwater. There are two types of NPDES permits: individual permits tailored to an individual facility and general permits that cover multiple facilities within a specific category. Effluent limitations serve as the primary mechanism in NPDES permits for controlling discharges of pollutants to receiving waters. When developing effluent limitations for an NPDES permit, a permit writer must consider limits based on both the technology available to control the pollutants (i.e., technology-based effluent limits) and limits that are protective of the water quality standards of the receiving water (i.e., water quality-based effluent limits if technology-based limits are not sufficient to protect the water body). For inland surface waters and enclosed bays and estuaries, the water-quality-based effluent limitations are based on criteria in the National Toxics Rule and the California Toxics Rule, and objectives and beneficial uses in the Basin Plan. For ocean discharges, the Ocean Plan contains beneficial uses, water quality objectives, and effluent limitations.

National Pollution Discharge Elimination System Construction General Permit

Construction activities on one acre or more or that disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Construction Permit (SWRCB Order No. 2009-09-DWQ as amended by 2010-0014-DWQ and 2012-006-DWQ). The State Board established the General Construction Permit program to reduce

surface water impacts from construction activities. Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation.

The Construction General Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP). The General Construction Permit requires the preparation and implementation of a SWPPP for construction activities. The SWPPP must be prepared before construction begins. The SWPPP must include specifications for Best Management Practices (BMPs) that would need to be implemented during construction. BMPs are measures that are undertaken to control degradation of surface water by preventing soil erosion or the discharge of pollutants from the construction area. Additionally, the SWPPP must describe measures to prevent or control runoff after construction is complete and identify the procedures for inspecting and maintaining facilities and other project elements. The required elements of a SWPPP include:

- Site description addressing the elements and characteristics specific to the site;
- Descriptions of BMPs for erosion and sediment controls;
- BMPs for construction waste handling and disposal;
- Implementation of approved local plans;
- Proposed post-construction controls; and
- Non-stormwater management.

Examples of typical construction BMPs include scheduling or limiting activities to certain times of year, installing sediment barriers such as silt fence and fiber rolls, and maintaining equipment and vehicles used for construction. Non-stormwater management measures include installing specific discharge controls during certain activities, such as paving operations, vehicle and equipment washing, and fueling. The RWQCB has identified BMPs in the *California Stormwater Best Management Practice Handbook* (California Stormwater Quality Association, 2023) to effectively reduce degradation of surface waters to an acceptable level.

NPDES General Permit for Discharges with Low Threat to Water Quality

Construction in areas with shallow groundwater or that are located adjacent to surface water bodies could require dewatering to create a dry area. Discharges of non-stormwater from a trench or excavation that contains sediments or other pollutants to sanitary sewers, storm drain systems, creek beds (even if dry), or receiving waters is prohibited. However, discharges of dewatering effluent are conditionally exempt. The RWQCB requires that the dewatering effluent be tested for possible pollutants; the analytical constituents for these tests are generally determined based on the source of the water, the land use history of the construction site, and the potential for the effluent to impact the quality of the receiving water body.

The *Waste Discharge Requirements and NPDES General Permit for Discharges with Low Threat to Water Quality (Order No. R3-2017-0042, NPDES No. CAG993001, amended)* (RWQCB, 2017) applies to low-threat discharges, which are defined as discharges containing minimal amounts of pollutants and posing little or no threat to water quality and the environment.

For discharges from construction sites smaller than one acre that are part of a larger common plan of development or that may cause significant water quality impacts, the discharge may require coverage under the construction stormwater permit or an individual NPDES permit.

Nonpoint Source Pollution Control Program

In accordance with Section 319 of the CWA and Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, the SWRCB and CCC jointly submitted the Plan for California's Nonpoint Source Pollution Control Program to the EPA and NOAA on February 4, 2000. California's Nonpoint Source Pollution Control Program provides a single unified, coordinated statewide approach to address nonpoint source pollution. A total of 28 state agencies are working collaboratively through the Interagency Coordinating Committee to implement California's Nonpoint Source Pollution Control Program. California's Critical Coastal Areas Program is a non-regulatory planning tool to foster collaboration among local stakeholders and government agencies, to better coordinate resources and focus efforts on coastal-zone watershed areas in critical need of protection from polluted runoff. A coastal area is designated as a Critical Coastal Area if it: has a 1998 303(d)-listed impaired coastal water body that flows into a Marine Managed Areas; flows into a Wildlife Refuge or Waterfront Park/Beach; flows into a marine State Water Quality Protection Area (also known as ASBS);[9] or was on the original 1995 Critical Coastal Areas list, which is comprised of watersheds that flow into an 1994 303(d)-listed impaired bay or estuary. The Critical Coastal Areas (CCAs) in the proposed project area and vicinity include the Carmel Bay and Point Lobos CCAs (CCC, 2019).

NPDES Municipal Stormwater Permit

The NPDES General Permit for WDRs for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s) (Order No. 2013-001-DWQ, NPDES No. CAS000004) regulates stormwater discharges from small MS4s into waters of the U.S. (SWRCB, 2013). An "MS4" is defined as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) designed or used for collecting or conveying stormwater; (ii) which is not a combined sewer; and (iii) which is not part of a Publicly Owned Treatment Works (POTW) as defined at Title 40 of the Code of Federal Regulations Section 122.2.

The Phase II Municipal General Permit requires regulated small MS4s to develop and implement BMPs, measurable goals, and timetables for implementation, designed to reduce the discharge of pollutants to the maximum extent practicable and to protect water quality.[10] The permittees under the small MS4 (Phase II) General Permit[11] in the project area include the County of Monterey and cities therein. Each permittee is required to prepare and implement a stormwater management plan (SWMP) and regulate stormwater runoff from development and redevelopment projects through post-construction stormwater management requirements.

A Memorandum of Agreement for the Monterey Regional Stormwater Pollution Prevention Program (MRSPPP) was prepared and executed by the Monterey One Water (M1W) and by the entities in the southern Monterey Bay area (County of Monterey and cities of Carmel-by-the-Sea, Del Rey Oaks, Monterey, Pacific Grove, Sand City, and Seaside) to form the Monterey Regional Stormwater Management Program (MRSWMP). M1W acts as the administrative agent for the MRSWMP. The purpose of the MRSWMP is to implement and enforce a series of BMPs to reduce the discharge of pollutants from the MS4s to the "maximum extent practicable," to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. The Phase II Program contains six Minimum Control Measures:

[9] The SWRCB monitors and maintains water quality in a total of 34 ASBSs along the California coast.

[10] Phase I stormwater permits provide permit coverage for medium (serving between 100,000 and 250,000 people) and large (serving 250,000 people) municipalities.

[11] Phase II stormwater permits provide permit coverage for smaller municipalities (populations less than 100,000), including non-traditional Small MS4s, which are facilities such as military bases, public campuses, prisons, and hospital complexes.

- Public Education and Outreach;
- Public Participation/Involvement;
- Illicit Discharge Detection and Elimination;
- Construction Site Runoff Control;
- Post-Construction Runoff Control; and
- Pollution Prevention/Good Housekeeping.

The MRSWMP lists BMPs and associated Measurable Goals for the six Minimum Control Measures. The Measurable Goals must include, as appropriate, the months and years for scheduled actions, including interim milestones and frequency of the action. It is through the implementation and evaluation of these BMPs and Measurable Goals that the permittees ensure that the objectives of the Phase II NPDES Program are met.

The Model Urban Runoff Program (MURP)—a water quality program under the Statewide Nonpoint Source program—is a comprehensive guide developed for the local agencies to address polluted runoff in the urban environment. The MURP provides options to help small municipalities develop individual urban runoff programs. Each member or permittee is responsible for complying with the NPDES permit conditions. The local municipalities would require the proposed project to comply with the stormwater control requirements in their individual jurisdictions under the MS4 permit and require implementation of erosion and stormwater control measures to reduce any long-term runoff effects from the facilities.

In July 2013, the RWQCB adopted Resolution No. R3-2013-0032, which prescribes new Post-Construction Requirements for projects that create or replace 2,500 square feet or more of impervious area and receive their first discretionary approval for design elements after March 6, 2014. **Table 4.8-3** summarizes the new post-construction requirements for different categories of projects, which would include the proposed project components.

Table 4.8-3. Overview of Post-Construction Requirements for Stormwater Management

Project Categories	Performance Requirements
Tier 1 Projects Projects that create or replace 2,500 square feet or more of impervious surface.	**Implement One or More Low Impact Design (LID) Measures:** Limit disturbance of natural drainage features. Limit clearing, grading, and soil compaction. Minimize impervious surfaces. Minimize runoff by dispersing runoff to landscape or using permeable pavements.
Tier 2 Projects Projects that create or replace 5,000 square feet or more net impervious surface.	**Tier 1 requirements, plus treat site runoff:** Treat runoff generated by the 85th percentile 24-hour storm event with an approved and appropriately sized LID treatment system prior to discharge from the site.
Tier 3 Projects Projects that create or replace 15,000 square feet or more of impervious surface.	**Tier 2 requirements, plus:** Prevent offsite discharge from events up to the 95th percentile rainfall event using Stormwater Control Measures.

Project Categories	Performance Requirements
Tier 4 Projects Projects that create or replace 22,500 square feet of impervious surface.	**Tier 3 requirements, plus:** Control peak flows to not exceed pre-project flows for the 2-year through 10-year events.
SOURCE: MRSWMP, 2014.	

PORTER-COLOGNE WATER QUALITY CONTROL ACT

The Porter-Cologne Act (Division 7 of the California Water Code) is the principal law governing water quality regulation in California. It establishes a comprehensive program to protect water quality and the beneficial uses of water. The Porter-Cologne Act applies to surface waters, wetlands, and groundwater, and to both point and nonpoint sources of pollution.

The Porter-Cologne Act defines water quality objectives as the limits or levels of water constituents that are established for reasonable protection of beneficial uses. The Porter-Cologne Act allows the State Board to adopt statewide water quality control plans (or "basin plans"), which serve as the legal, technical, and programmatic basis of water quality regulation for a region. The act also authorizes the NPDES program under the CWA, which establishes effluent limitations and water quality requirements for discharges to waters of the state.

The term "Waters of the State" is defined by Porter-Cologne as "any surface water or groundwater, including saline waters, within the boundaries of the state." The RWQCB protects all waters in its regulatory scope but has special responsibility for wetlands, riparian areas, and headwaters, including isolated wetlands, and waters that may not be regulated by the USACE under Section 404 of the CWA. Waters of the State are regulated by the RWQCB under the State Water Quality Certification Program, which regulates discharges of fill and dredged material under Section 401 of the CWA and Porter-Cologne.

WATER QUALITY CONTROL PLAN

The RWQCB updated the Basin Plan in 2019. It is intended to provide guidance on how the quality of the surface water and groundwater in the Central Coast Region should be managed to provide the highest water quality reasonably possible. The Basin Plan serves as a guidance document to the Water Board when reviewing and authorizing projects under their Section 401 authority.

The RWQCB establishes beneficial uses of surface and groundwater resources, as contained in its Water Quality Control Plan for the Central Coast. **Table 4.8-2** summarized beneficial uses identified for surface waters in the project area.

WATER QUALITY CONTROL PLAN FOR OCEAN WATERS OF CALIFORNIA

The *Water Quality Control Plan for Ocean Waters of California* (Ocean Plan) (SWRCB, 2019) establishes water quality objectives and beneficial uses for waters of the Pacific Ocean adjacent to the California Coast outside of estuaries, coastal lagoons, and enclosed bays. The plan establishes effluent quality requirements and management principles for specific waste discharges. The water quality requirements and objectives are incorporated into all NPDES permits. The Ocean Plan objectives relevant to the proposed project include:

- Marine communities, including vertebrate, invertebrate, algae, and plant species shall not be degraded;
- Waste management systems that discharge into the ocean must be designed and operated in a manner that will maintain the indigenous marine life and a healthy and diverse marine community;

- Waste discharged to the ocean must be essentially free of substances that will accumulate to toxic levels in marine waters, sediments, or biota; and
- The Ocean Plan establishes objectives for many bacterial, physical, chemical, biological, and radioactive parameters.

CALIFORNIA STATE LANDS COMMISSION

The California State Lands Commission (CSLC) has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. Per PRC Sections 6301 and 6306, the CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions. At Carmel River State Beach, the Pacific Ocean in this location is currently under lease to the CDFW, Lease No. PRC 5309.9. The lease expires on June 30, 2026. Placement of the proposed EPB project component may require a lease from the CSLC.

ANTI-DEGRADATION POLICIES

California's anti-degradation policies are found in Resolution 68-16, Policy with Respect to Maintaining Higher Quality Waters in California, and Resolution 88-63, Sources of Drinking Water Policy.[12] These resolutions are binding on all State agencies. They apply to both surface waters and groundwaters, protect both existing and potential beneficial uses of surface water and groundwater, and are incorporated into RWQCB Basin Plans.

COASTAL ZONE ACT REAUTHORIZATION AMENDMENTS SECTION 6217

The Coastal Nonpoint Pollution Control Program (Section 6217) addresses nonpoint pollution problems in coastal waters. Section 6217 requires states and territories with approved Coastal Zone Management Programs to develop Coastal Nonpoint Pollution Control Programs. In its program, a state or territory describes how it will implement nonpoint source pollution controls, known as management measures, which conform with those described in Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. This program is administered jointly with NOAA. As of 2023, 34 states and territories participate in this program.

MONTEREY BAY NATIONAL MARINE SANCTUARY

Carmel Bay is in the MBNMS, which was designated as a federally protected area in 1992. The MBNMS is managed by NOAA and includes coastal waters from Marin to Cambria. The MBNMS includes approximately 276 miles of shoreline, extends an average distance of 30 miles from shore, encompasses 6,094 square miles of ocean, and is more than two miles deep at its deepest point. The MBNMS was established for the purpose of research, education, public use, and resource protection. The MBNMS includes a variety of habitats that support extensive marine life (MBNMS, 2021).

NOAA has entered into a Memorandum of Agreement (MOA) with the State of California, Environmental Protection Agency, and the Association of Monterey Bay Area Governments (AMBAG) regarding the MBNMS regulations relating to water quality within state waters within the sanctuary (MBNMS, 2021). The MOA provides for MBNMS review authority for the following permits within the Sanctuary:

[12] See https://www.waterboards.ca.gov/plans_policies/#policies.

- National Pollutant Discharge Elimination System permits issued by the State of California under Section 13377 of the California Water Code; and
- Waste Discharge Requirements issued by the State of California under Section 13263 of the California Water Code.

The MOA specifies how the review process for applications for leases, licenses, permits, approvals, or other authorizations will be administered within State waters within the Sanctuary in coordination with the State permit program.

The MBNMS also implements a separate Water Quality Protection Program for the Sanctuary and tributary waters. The program is a partnership of 20 organizations, including the MOA signatories, which represent federal, state, and local government, non-government organizations, agricultural industry, municipalities, research, and academia (MBNMS, 2021). The program calls for education, funding, monitoring, and development of treatment facilities and assessment programs to protect water quality. The goal of the program is to enhance and protect the chemical, physical, and biological integrity of the Sanctuary.

CALIFORNIA FISH AND GAME CODE

California Fish and Game Code Sections 1600-1607 authorizes the CDFW to enter into streambed alteration agreements with applicants to develop mitigation measures for projects that would obstruct the flow or alter the bed, channel, or bank of a river or stream in which there are fish or wildlife resources, including intermittent and ephemeral streams. The CDFW has the authority to regulate work that will:

- Divert, obstruct, or change the natural flow of a river, stream, or lake;
- Change the bed, channel, or bank of a river, stream, or lake; or
- Use material from a streambed.

The CDFW takes jurisdiction along a river, stream, or creek, usually bounded by the top-of-bank or the outermost edges of riparian vegetation. Typical activities regulated by the CDFW under Section 1600 to Section 1607 authority include installing outfalls, stabilizing banks, restoring creeks, and implementing flood control projects.

CALIFORNIA MARINE PROTECTED AREAS

California's Marine Protected Areas network uses three different marine management classifications as defined by the Marine Managed Areas Improvement Act:

- State Marine Reserves;
- State Marine Conservation Areas; and
- State Marine Recreational Areas.

Carmel Bay is a State Marine Conservation Area. Within the Carmel Bay State Marine Conservation Area, it is unlawful to injure, take, or possess any living, geological, or cultural marine resources for recreational and/or commercial purposes with few exceptions.

SUSTAINABLE GROUNDWATER MANAGEMENT ACT

The Sustainable Groundwater Management Act (SGMA) was adopted in 2014 and became effective January 1, 2015. SGMA gives local agencies the authority to customize groundwater sustainability plans to their regional economic and environmental needs and manage groundwater in a sustainable manner to protect groundwater resources. SGMA establishes a definition of sustainable groundwater

management and a framework for local agencies to develop plans and implement sustainable management strategies to manage groundwater resources, prioritizes basins (ranks as high- and medium-priority) with the greatest problems (i.e., the undesirable results of chronic lowering of groundwater levels indicating significant depletion, and significant and unreasonable reduction of storage, seawater intrusion, degraded water quality, and land subsidence), and sets at 20-year timeline for implementation.

The proposed project is located within the Carmel River Groundwater Basin. However, since the SWRCB issued its Order WR 95-10 in 1995, the aquifer has been subject to surface water rights and jurisdiction of the SWRCB. Thus, DWR determined that the basin is exempt from SGMA and will not require a groundwater sustainability plan. While SGMA does not have a direct impact on the proposed project, this act is included here for background and context as it is new legislation affecting groundwater basins.

4.8.2.2 Regional/Local

MONTEREY COUNTY GENERAL PLAN/CARMEL AREA LAND USE PLAN

The Monterey County General Plan and Carmel Area Land Use Plan contain a variety of policies related to hydrology, water quality, and drainage issues. Please refer to **Section 4.9, Land Use and Planning** and **Appendix C, Applicable Land Use Plans, Policies, and Regulations Consistency Analysis for the Carmel Lagoon Project** for a list of relevant policies and the consistency analysis.

FLOODPLAIN MANAGEMENT PLAN

The Monterey County Floodplain Management Plan was first developed in 2002, and most recently updated in 2014, to identify the flooding sources affecting properties, and to establish an implementation plan to reduce flooding and flood related hazards, and to ensure the natural and beneficial functions of our floodplains are protected. This requires utilization of existing programs and resources, involving those public agencies responsible for regulating development in special flood hazard areas in the planning process, and ensuring that the policies and programs identified in the implementation plan are carried out. The 2014 Floodplain Management Plan update was prepared by the MCWRA under the supervision of the Monterey County Floodplain Administrator. The County of Monterey has been a voluntary participant in the Community Rating System since October 1, 1991. The 2014 Floodplain Management Plan identified 109 Repetitive Loss Properties in the County of Monterey.

MONTEREY COUNTY CODE

Chapter 16.08 of the Monterey County Code (Grading) identifies rules and regulations to control all grading, including excavations, fills and embankments, and establishes the procedures for the issuance of grading permits. Chapter 16.08 is intended to minimize erosion because of ground disturbing activities.

Chapter 16.12 (Erosion Control) of the Monterey County Code sets forth required provisions for project planning, preparation of erosion control plans, runoff control, land clearing, and winter operations; and establishes procedures for administering those provisions. The code requires that specific design considerations be incorporated into projects to reduce the potential of erosion and that an erosion control plan be approved by the County prior to initiation of grading activities.

Chapter 16.16 of the Monterey County Code identifies rules and regulations to control development within the floodplain. Chapter 16.16 is intended to promote public health, safety, and general welfare, and to minimize public and private losses due to flood conditions. Chapter 16.16 consists of regulations to: 1) restrict and/or prohibit uses which are dangerous to health, safety and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities; 2) require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction; 3) control the alteration of natural floodplains, stream

channels, and natural protective barriers, which help accommodate or channel flood waters; 4) control filling, grading, dredging, and other development which may increase flood damage; and 5) prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards in other areas.

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

The MPWMD was formed on June 6, 1978, under the enabling legislation found in West's California Water Code, Appendix Chapters 118-1 to 118-901. The legislative functions of the MPWMD include:

- Augmenting the water supply through integrated management of ground and surface water resources;
- Promoting water conservation (includes rationing, if needed);
- Promoting water reuse and reclamation of storm and wastewater; and
- Fostering the scenic values, environmental qualities, native vegetation, fish and wildlife, and recreation on the Monterey Peninsula and in the Carmel River Basin.

4.8.3 Impacts and Mitigation

The following discussion addresses the potential impacts of the proposed project associated with hydrology and water quality. As identified in **Chapter 3, Project Description**, the proposed project proposes a storm drainage plan to manage runoff from the site.

4.8.3.1 Thresholds of Significance

In accordance with Appendix G of the State CEQA Guidelines, the project would have a significant impact on hydrology and water quality if it would:

a. Violate any water quality standards or waste discharge requirement or otherwise substantially degrade surface or ground water quality.

b. Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede.

c. Sustainable groundwater management of the basin.

d. 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:

   i. result in substantial erosion or siltation on- or off-site;

   ii. substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;

   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

   iv. impede or redirect flows?

e. In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation.

f. Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.

4.8.3.2 Impact Analysis Overview

APPROACH TO ANALYSIS

Construction

Construction of the proposed project could impact local hydrology and water quality. The hydrology and water quality analysis evaluates whether the proposed project construction activities would have the potential to degrade existing water quality, increase erosion, modify existing drainage patterns, exceed capacities of existing drainage facilities, deplete groundwater supplies, or interfere with recharge.

The analyses related to Criteria "a" and "c" are based on existing site conditions, applicable water quality requirements of relevant regulatory programs, including required permits and local ordinances. Construction dewatering and erosion was analyzed for the proposed project by Pacific Geotechnical Engineering in their project-specific *Feasibility Geotechnical Investigation* (2013) (**Appendix F**). Regional data, plans, reports, and maps were reviewed to identify surface water resources that could be directly or indirectly affected by the construction of the proposed project. The impact analysis describes if, and to what degree, the proposed project construction would change the existing water hydrology and water quality conditions described in **Section 4.8.1,** and how the proposed project would comply with or exceed any regulatory requirements described in **Section 4.8.2**. The significance of an impact is determined using the criteria identified in **Section 4.8.3.1**. No construction activities are proposed within Carmel Bay, and, therefore, no direct construction impacts to marine resources would occur. Indirect temporary construction impacts on marine water quality relative to discharges to surface waters that lead to the ocean are also addressed.

During construction, the proposed project would use water for soil compaction and dust control. The amount of water use is quantified, and the sources of construction water are provided to determine if this use would adversely affect groundwater levels. At the component sites, there would be new impervious surfaces constructed that may potentially change local recharge characteristics at each site. In particular, the impact analysis includes a description of how rainfall runoff from new impervious areas is allowed to flow to adjacent pervious areas to recharge the groundwater basins underlying the component sites.

Criterion "d" is not evaluated for construction-related impacts because the temporary construction activities would not result in substantial risks related to inundation. Construction crews and equipment would demobilize in the unlikely event of one of these conditions occurring during the short-term construction periods for the proposed EPB and SRPS project components. Similarly, crews and equipment associated with the implementation of the proposed ISMP project component would demobilize in the unlikely event of one of these conditions occurring during the implementation of the plan. Furthermore, implementation of the proposed ISMP project component is intended to provide a short-term (i.e., until the design, environmental review, permitting, and construction of the proposed project is completed) solution to potential flooding issues by implementing select sandbar management actions that allow additional natural function in the Lagoon while still protecting properties and infrastructure. Thus, this criterion is not discussed further as construction impacts.

Operation

Operational or long-term impacts on surface water bodies and the marine water quality relative to flow quantities and water quality may occur due to siting of the proposed project components, discharges to surface waters and the ocean, and maintenance activities. The impact analysis describes if, and to what

degree, the proposed project operations would change the existing hydrology, water quality, and flooding conditions described in **Section 4.8.1** and how the proposed project would comply with or exceed any regulatory requirements described in **Section 4.8.2**. This section also analyzes whether the proposed project may result in a significant impact related to decreasing groundwater supplies or interfering substantially with groundwater recharge, or conflict with or obstruct the implementation of a water quality control plan or sustainable groundwater management plan. The significance of an impact is determined using the criteria identified in **Section 4.8.3.1**.

Impacts and Mitigation Measures

Impact HYD-1: <u>Construction Impacts to Water Quality due to Discharge</u>. Construction activities involving dewatering of shallow groundwater during excavation for the proposed EPB and SRPS project components would generate water requiring disposal. Compliance with existing regulatory requirements would ensure that water disposal during construction would not violate any water quality standards or waste discharge requirements, or otherwise substantially degrade surface or ground water quality. (Criterion a) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

Subsurface water levels vary throughout the proposed project area and depths of excavation would vary for each proposed project component. The proposed EPB project component is in a low-lying floodplain area, underlain by basin deposits and younger floodplain deposits. Groundwater is anticipated to be approximately ten feet deep or less in these areas. Trench excavations may encounter groundwater, moist to wet soils, and soft ground conditions, and, thus, trench dewatering may be required.

As currently conceived, no substantial excavations are envisioned in association with construction of the proposed EPB project component. Excavation during construction of the proposed EPB project component may intercept shallow or perched groundwater, requiring temporary localized dewatering to facilitate construction. Groundwater encountered during excavation would be pumped and discharged to the local drainage system in accordance with permit requirements. Water from dewatering operations could contain materials used during typical construction activities such as silt, fuel, grease, or other chemicals. Absent regulatory controls, the discharge from construction dewatering could thus contaminate downstream surface water; however, permits and review of the discharge while under permit are required for these activities.

Permits would be required prior to commencing construction including as required by the CWA (Sections 404 and 401) and California Fish and Game Code 1602 (Streambed Alteration Agreements) that require management measures to protect water quality and biological resources.

Most of the dewatering effluent produced during construction and excavation is considered a low threat and can be discharged to the land or local receiving water provided it complies with the *General Waste Discharge Requirements for Discharges with a Low Threat to Water Quality* (Order No. R3-2017-00452, NPDES Permit No. CAG993001) (RWQCB, 2017). To comply with the conditions of these general waste discharge requirements, the construction contractor(s) would be required to control, test, and treat the extracted water as needed to minimize or avoid water quality degradation, erosion, and sedimentation in the receiving waters. To receive coverage under the general waste discharge requirements, the contractor would submit a Notice of Intent along with the following materials to the RWQCB (2017):

- A list of all chemicals (including Safety Data Sheets) added to the water and the concentrations of such additives in the discharged effluent;
- Certified analytical results of the effluent for all priority toxic pollutants listed in Attachment D of the General Waste Discharge Requirements. These analyses would fulfill the requirements set forth in the California Toxics Rule to evaluate the potential for water quality degradation and establish effluent limits, unless the discharge meets all requirements for a conditional exception;
- Certified analytical results of representative samples of the receiving surface water collected 50 feet upstream and 50 feet downstream from the point of discharge, respectively. Alternately, if access is limited, the samples can be collected at the first point upstream and downstream of the discharge, respectively, that is accessible for the following constituents: pH, temperature, color, turbidity, and dissolved oxygen;
- For low-threat discharges from proposed facilities, the Contractor(s) would provide analytical data for discharges from similar existing facilities, or information regarding the anticipated discharge characteristics of the proposed facility based on the specific facility design. As part of facility startup, the operator of each facility would submit all analytical results required in Section A of the General Waste Discharge Requirements; and
- If the concentration of any constituent in the effluent sampled under the second bullet above exceeds the applicable criterion listed in Attachment D of the General Waste Discharge Requirements, the Contractor(s) may submit a Reasonable Potential Analysis consistent with Section 1.3 of the State Implementation Policy or Appendix VI of the Ocean Plan, as applicable.

In certain cases, depending on the site-specific conditions and the construction methods, suspended sediment and/or trace amounts of construction-related chemicals (i.e., fuels, lubricants, cement products) could be present in the dewatering effluent. The dewatering effluent could also contain other chemicals and contaminants present in local soil and groundwater. If the dewatering effluent contains contaminants that do not comply with the requirements of the General Waste Discharge Requirements, the contractor must contain the dewatering effluent in a portable holding tank for appropriate offsite disposal or discharge. The contractor could either dispose of the effluent at a permitted waste management facility or discharge the dewatering effluent, under permit, to a publicly owned treatment works such as the CAWD Wastewater Treatment Facility.

Adherence to the permit requirements and compliance with regulatory requirements as described above would ensure that the proposed EPB project component would not have a significant impact on surface or groundwater quality due to construction dewatering and, therefore, no mitigation measures would be required.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

Subsurface water levels vary throughout the proposed project area and depths of excavation would vary for each proposed project component. It is estimated that as presently planned, the proposed SRPS project component would require excavations of up to about 25 feet for construction of the buried armor rock (riprap). The excavations would be predominantly in sand with little or no cohesion, with granitic rock anticipated at depth. The bottom portion of the excavations would also be likely under water.

The excavations would require shoring or sloping the excavation sidewalls at a safe inclination. Excavation during construction of the proposed SRPS project component would also require temporary localized dewatering to facilitate construction. A related consideration will also be protection of excavations from swell attack. Water from dewatering operations could contain materials used during typical construction

activities such as silt, fuel, grease, or other chemicals. Absent regulatory controls, the discharge from construction dewatering could contaminate downstream surface water.

The proposed SRPS project component is located on dune sand adjacent to a bluff. Groundwater is anticipated to be approximately ten feet deep or less in these areas. Trench excavations may encounter groundwater, moist to wet soils, and soft ground conditions, and, thus, trench dewatering may be required.

Permits would be required prior to commencing construction including as required by the CWA (Sections 404 and 401) that require management measures to protect water quality and biological resources.

As with the proposed EPB project component, most of the dewatering effluent produced during construction and excavation for the proposed SRPS project component is considered a low threat and can be discharged to the land or local receiving water provided it complies with the *General Waste Discharge Requirements for Discharges with a Low Threat to Water Quality* (Order No. R3-2011-0042, NPDES Permit No. CAG993001) (RWQCB, 2017). The requirements would be the same as those described for the proposed EPB project component (please see above). Adherence to the permit requirements and compliance with regulatory requirements would ensure the proposed SRPS project component would not have a significant impact on surface and groundwater quality due to construction dewatering and, therefore, no mitigation measures would be required.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

No dewatering would be required for the implementation of the proposed ISMP project component, and, therefore, no potential water quality impacts from construction dewatering would occur.

Impact Conclusion

Disposal of water produced during general construction dewatering would be conducted in accordance with the NPDES *General Permit for Discharges with Low Threat to Water Quality* (RWQCB Order R3-2011-0042). All discharges of water produced during dewatering of shallow groundwater during construction would occur in compliance with the regulatory requirements that are protective of the receiving water quality. Therefore, the proposed project construction would result in less-than-significant water quality impacts due to dewatering of surface waters and shallow groundwater during excavation for the proposed EPB and SRPS project components. The implementation of the proposed ISMP project component would not require any dewatering, and, therefore, no water quality impacts from water disposal would occur. No mitigation measures would be required.

Impact HYD-2: Construction Impacts to Groundwater Supply and Management. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not substantially decrease groundwater supplies nor interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin, nor would the proposed project conflict with or obstruct the implementation of a water quality control plan or sustainable groundwater management plan. (Criteria b and e) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS

Construction at all proposed project sites would result in a limited, temporary demand for water for construction-related purposes, typically associated with watering surfaces for compaction and dust control. Construction water is typically acquired by the construction contractor, and recycled water may be acquired from the CAWD facility for construction use. The amount of construction water used at the proposed EPB and SRPS project components sites is estimated to be minimal in relation to overall water resources. Some of the water applied at the construction sites may percolate to the aquifer beneath the proposed EPB and SRPS project components sites. This small amount of construction water use would not have a significant adverse impact on groundwater recharge, volume, or levels. This is a less-than-significant impact.

As discussed in **Impacts HYD-1** and **HYD-3**, construction activities associated with the proposed EPB and SRPS project components would be required to adhere to permit requirements and compliance with regulatory requirements, including applicable water quality control plans, as described above. This is a less-than-significant impact. As stated in the regulatory section, SGMA does not apply to the Carmel River Groundwater Basin, and, therefore, the construction of the proposed EPB and SRPS project components would not conflict with or obstruct the implementation of a sustainable groundwater management plan. This is a less-than-significant impact.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

Implementation of the proposed ISMP project component would not require the use of water for construction-related purposes and, therefore, would have no impact on groundwater recharge. Lagoon stage and groundwater levels have been shown to have a strong correlation. Measures included in the proposed ISMP project component state that after opening, the Lagoon shall be maintained at a minimum six-foot water surface elevation. Under the proposed ISMP project component, the County would be required to monitor the river mouth and Lagoon for water levels, both during and after a channel has been opened, regardless of whether it was mechanically or naturally opened, as often as necessary as conditions warrant. Therefore, implementation of the proposed ISMP project component would result in a less-than-significant impact to groundwater supply and recharge.

As discussed in **Impacts HYD-1** and **HYD-3**, construction activities associated with the proposed ISMP project component would be required to adhere to permit requirements and compliance with regulatory requirements, including applicable water quality control plans, as described above. This is a less-than-significant impact. As stated in the regulatory section, SGMA does not apply to the Carmel River Groundwater Basin, and, therefore, the construction of the proposed ISMP project component would not conflict with or obstruct the implementation of a sustainable groundwater management plan. This is a less-than-significant impact.

Impact Conclusion

Impacts associated with the potential decrease in groundwater supply and recharge during the construction of the proposed EPB and SRPS project components would be less-than-significant. During construction of the proposed EPB and SRPS project components, water would be used for soil compaction and dust control. The amount of water used would be minimal in relation to overall water resources. The proposed ISMP project component would not require the use of water for construction-related purposes and measures included in the proposed ISMP project component would reduce any potential impacts to groundwater resources to a less-that-significant level. Construction activities associated with the proposed project components would be required to adhere to permit requirements and compliance with regulatory requirements, including applicable water quality control plans, as described above. Therefore, potential impacts

to groundwater quality because of construction activities would be less than significant. As stated in the regulatory section, SGMA does not apply to the Carmel River Groundwater Basin, and, therefore, the construction of the proposed project would not conflict with or obstruct the implementation of a sustainable groundwater management plan Therefore, the potential construction impacts would be less-than-significant to groundwater resources and water quality, and no mitigation measures would be required.

Impact HYD-3: <u>Construction Impacts to Water Quality due to Earthmoving, Drainage System Alterations, and Use of Hazardous Chemicals</u>. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not violate any water quality standards or waste discharge requirements, would not substantially alter the existing drainage pattern of the site or area causing substantial erosion or siltation on- or off-site, increase the rate or amount of surface runoff resulting in flooding, create runoff that would exceed the capacity of stormwater drainage systems, or impede or redirect flows, and would not otherwise substantially degrade water quality, including marine water quality, due to earthmoving, drainage system alterations, and use of hazardous chemicals. (Criteria a, c(i) and (iii), and d) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS</u>

The construction of the proposed EPB and SRPS project components could degrade surface or groundwater quality, including marine water quality, because of erosion and siltation caused by earthmoving activities during construction or the accidental release of hazardous construction chemicals. In general, water quality impacts would be significant if a water quality standard were to be exceeded or a beneficial use were to be impacted due to changes in water quality caused by erosion and/or siltation or release of hazardous construction chemicals resulting from proposed project earthmoving activities.

Earthmoving activities associated with proposed project construction at the proposed EPB and SRPS project components sites would temporarily alter existing drainage patterns to some degree, including grading, excavation, and soil stockpiling. Exposed soil from excavated areas, stockpiles, and other areas where ground cover would be removed could be inadvertently transported off-site by wind or water. If not properly managed, this could increase sediment loads in surface water bodies, some of which are located on-site (e.g., the Lagoon), and adversely impact the surface water quality, thereby adversely affecting water quality and designated beneficial uses.

Construction activities at all sites could also result in the accidental release of hazardous construction chemicals, such as adhesives, solvents, lubricants, and fuels. If not managed appropriately, these chemicals could adhere to soil particles, become mobilized by rain or runoff, and flow to downstream water bodies, including Carmel Bay/Pacific Ocean, degrading water quality.

Proposed project construction activities would disturb more than one acre of soil, and, therefore, the proposed EPB and SRPS project components would be subject to the NPDES Construction General Permit and the Municipal Stormwater Permit requirements. As required under the Construction General Permit, a SWPPP would be prepared by a Qualified SWPPP Developer and a Qualified SWPPP Practitioner would oversee its implementation. The SWPPP, which would include specific measures and conditions to reduce or eliminate stormwater flow carrying any pollutants or sediment from the earthmoving activities and

related construction activities, would be implemented throughout the duration of construction activities. As discussed in **Section 4.8.2, Regulatory Environment**, the SWPPP is required to include specific elements such as erosion and stormwater control measures that would be implemented onsite. At a minimum, the SWPPP must include the following:

- A description of construction materials, practices, and equipment storage maintenance;
- A list of pollutants likely to contact stormwater and site-specific erosion and sedimentation control practices;
- A list of provisions to eliminate or reduce discharge of materials to stormwater;
- BMPs for fuel and equipment storage;
- Non-stormwater management measures to manage pollutants generated by activities such as paving operations and vehicle and equipment washing and fueling;
- The requirement that the appropriate equipment, materials, and workers be available to respond rapidly to spills and/or emergencies. All corrective maintenance or BMPs must be performed as soon as possible, depending upon worker safety; and
- On-site post-construction controls.

Examples of typical construction BMPs include scheduling or limiting certain activities to dry periods of the year, installing sediment barriers such as silt fencing and fiber rolls, maintaining equipment and vehicles used for construction, and tracking controls such as stabilization of construction access points. The development and implementation of BMPs such as overflow structures designed to capture and contain any materials that are inadvertently released from the storage containers on the construction site is also required. In accordance with the Construction General Permit, a Rain Event Action Plan would be required to ensure that active construction sites have adequate erosion and sediment controls in place prior to the onset of a storm event, even if construction is planned only during the dry season.

The construction contractor(s) would also be required to develop and implement a monitoring program as required under the NPDES Construction General Permit. The contractor would be required to conduct inspections of the construction site prior to anticipated storm events and after the actual storm events. During extended storm events, the inspections would be conducted after every 24-hour period. The inspections would be conducted to identify areas contributing to stormwater discharge; evaluate whether measures to reduce pollutant loadings identified in the SWPPP are adequate, were properly installed, and are functioning in accordance with the Construction General Permit; and determine whether additional control practices or corrective measures are needed.

Earthmoving within Waters of the State (such as trenching or excavation) is considered a discharge and requires permits from the USACE and RWQCB under Sections 404 and 401 of the CWA. If the USACE claims jurisdiction in the subject waterbody where the discharge may occur, the RWQCB also will need to review the action and potential discharge and issue a CWA Section 401 Water Quality Certification. If the RWQCB determines that the action will be protective of water quality and the beneficial uses of water, it can issue the 401 Certification. If the USACE does not take jurisdiction, the RWQCB may issue waste discharge requirements (a permit) for impacts to waters of the state. Please refer to **Impact HYD-1** for a description of waste discharge requirements.

Mandatory compliance with the NPDES Construction General Permit requirements, Sections 404 and 401 of the CWA, and, if required, other Waste Discharge Requirements issued by the RWQCB due to impacts to Waters of the State would prevent significant construction-related impacts to surface water quality

during general construction activities. Therefore, the water quality impacts (including on inland surface waters and marine waters) associated with general construction activities would be less-than-significant.

The proposed EPB and SRPS project components would primarily be constructed on currently unpaved sites. As described above, some water may be used for soil compaction and dust control but not in sufficient quantities to flow or infiltrate into the subsurface in significant quantities or to carry pollutants to the groundwater. In addition, SWPPPs and BMPs are required by permits administered by the RWQCB. The County requires any accidental spills of contaminants or hazardous materials be promptly cleaned to prevent contamination of surface and groundwater. Therefore, the construction of the proposed EPB and SRPS project components would result in a less-than-significant impact related to changes to groundwater quality and no mitigation measures would be required.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

The implementation of the proposed ISMP project component would involve ground-disturbing activities to assist with the breach of the Lagoon. When the outflow channel through the sandbar has been artificially placed, it is unknown where a natural channel would have formed, where it potentially would have moved to, or what geometry such channels would have had in the case where natural breaching occurred. Artificial breaching can adversely affect the health of the Lagoon by promoting the formation of a wide and deep outflow channel. This outflow channel configuration can prematurely flush freshwater from the Lagoon at a rapid rate, resulting in an increase in salinity levels. When artificial breaches are cut across a beach directly perpendicular to the river mouth, this practice could affect any further evolving morphology of the outflow channel and the remaining beach berm. This action could propagate through the year, leading to a situation where the outflow channel is at a low elevation and ocean water tidal flows are able to move freely into and out of the Lagoon. Freshwater that forms a lens on top of saline waters could then be carried out to sea when tides recede. If the outflow channel geometry brought about by artificial sandbar breaching is wide and deep, freshwater accumulating in the Lagoon is largely flushed with each tidal cycle, precluding the ability of the Lagoon to retain high quality aquatic habitat. Impacts to water quality can result from salinity gradients.

Criteria for the proposed ISMP component have been developed to manage the sandbar for flood protection (e.g., channeling). Trigger points include water level within the Lagoon, actual and anticipated river flow rates (in consultation with MPWMD), weather forecasts, and tidal forecasts. Any such work would be performed only when necessary - based on pre-determined triggers and upon consultation with the National Marine Fisheries Service (NMFS) - to prevent flooding of homes and would be implemented in a manner that would minimize impacts to listed species (e.g., S-CCC steelhead). Before management of the sandbar occurs, the County would implement all measures of flood protection (e.g., sandbags) to reduce the flood potential to the surrounding homes and infrastructure to the greatest extent feasible.

After the opening action and after high inflows from the river have receded, the Lagoon shall either be allowed to naturally close or remain with an open outlet channel flowing over the beach in a channel that is designed to mute tidal influence and rapid draining of the Lagoon. The Lagoon shall be maintained at a minimum six-foot water surface elevation. If excessive scour is observed in the constructed outlet channel that was mechanically assisted in its opening, the Lagoon shall immediately be closed by the placement of sand that is free of contaminants.

Measures included as part of the proposed ISMP project component would help reduce potential impacts to water quality in the Lagoon associated with artificial breaching. These measures would also reduce potential impacts to water quality in Carmel Bay, the receiving waterbody into which waters from the Lagoon would flow following a Lagoon breach. No hazardous chemicals would be used as part of actions associated with the proposed ISMP project component. Water quality impacts (including on inland surface

waters and marine waters) associated with the implementation of the proposed ISMP project component would be less-than-significant.

Impact Conclusion

Prior to construction of the proposed EPB and SRPS project components, compliance with NPDES Construction General Permit, CWA Sections 404 and 401, and other waste discharge requirements of the Porter-Cologne Water Quality Control Act, would be required, including implementation of erosion and stormwater quality control measures set forth in a SWPPP that would prevent substantial adverse effects on water quality during construction. Measures included in the proposed ISMP project component would reduce potential impacts associated with the implementation of the plan to a less-than-significant level. In addition, there would be a less-than-significant impact based on the compliance with regulatory requirements that ensure that there would be a lack of substantial pollutants released or disposed at the sites, and the low amount of flow that would carry any pollutants such that no contamination of groundwater resources is expected. The proposed project would have a less-than-significant impact on water quality associated with increased soil erosion and sedimentation, and inadvertent releases of toxic chemicals during general construction activities. No mitigation measures would be required.

Impact HYD-4: <u>Operational Impacts to Water Quality due to Drainage Pattern Alterations and Discharges</u>. Operation of the proposed EPB and SRPS project components would alter existing drainage patterns but would not: 1) violate any water quality standards or waste discharge requirements, 2) contribute runoff water which would exceed the existing storm drainage capacity or provide substantial additional sources of polluted runoff, or 3) would not otherwise substantially degrade water quality. (Criteria a, c(ii) and (iii), and e,) (EPB: Less-than-Significant with Mitigation) (SRPS: No Impact) (ISMP: No Impact) (Project Overall: Less-than-Significant with Mitigation)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

Under existing conditions, stormwater runoff from approximately 100 acres drain from the developed area north of the proposed EPB project component. This stormwater runoff ultimately enters the Lagoon as a surface flow from the ends of Camino Real, River Park Place, and Monte Verde Street. Following the construction of the proposed EPB project component, the urban stormwater runoff from the 100-acre developed area would be detained behind the proposed EPB project component. The entire 100-acre drainage area would continue to surface drain (down street gutters) into the Fourth Addition neighborhood, eventually flowing off the ends of Monte Verde Street, River Park Place, and Camino Real, as it does currently. With the proposed EPB project component in place, this runoff would collect in an area of existing wetland habitat (approximately 2.1 acres) between the proposed EPB project component and the Fourth Addition neighborhood. The proposed EPB project component setback from the property line (i.e., ranging from 38 to 120 feet) would provide approximately 8 acre-feet of stormwater detention volume on the developed (north) side of the proposed EPB project component when the Lagoon stage is above 10 feet and the flap gates on the proposed EPB project component are closed.

Winter Rainy Season

Balance Hydrologics, Inc. (2015) provided a summary of the estimated hydrologic conditions on the interior side of the proposed EPB project component, which identified that surface and shallow groundwater flows from the upland drainage would be the primary contributor to ponding on the

landward side of the proposed EPB project component during the rainy season. Pumps would be used to control the depth of ponding landward of the proposed EPB project component during moderate to large storm events or during times of elevated stages in the Lagoon.

Water ponding on the landward side of the proposed EPB project component would gravity flow to the Lagoon through one or more culverts controlled by flap gates, during times that the Lagoon is sufficiently low. When Lagoon levels are sufficiently high, the flap gates on the culverts would close and rising water levels in the detention area would activate a pump station which would pump the collected stormwater into the Lagoon. The drainage system would require a 20 cfs (9,000 gallon per minute) pump station to accommodate flows from the entire 100-acre developed watershed.

Ponding depths during the winter months are anticipated to be variable and dependent on both the frequency and magnitude of storm events, as well as the stage in the Lagoon.[13] During wetter than average years, it is possible that water levels landward of the proposed EPB project component remain at or slightly above the proposed culvert invert and pump trigger elevation of 10.5 feet over extended periods of time (i.e., weeks or months). During periods of drought, ponding depths would be comparable to dry season conditions (described in more detail below) and it would be possible for the water level to recede below seven feet, leaving the area interior of the proposed EPB project component completely dry for short periods of time (i.e., days or weeks). Peak water elevations landward of the proposed EPB project component could potentially reach as high as 13 feet during large storm events, but would be drawn down rapidly (i.e., hours) due to pumping.

Potential impacts of pollutant loadings to the area landward of the barrier would be limited to winter stormwater runoff. Relative to existing conditions, the proposed EPB project component would slow the rate of flow towards the Lagoon and potentially concentrate pollutants in areas subject to frequent ponding along the barrier. This aggregation of pollutant runoff constitutes a potentially significant impact. Treatment of stormwater runoff from the developed area north of the Lagoon before the water is carried to the Lagoon would improve stormwater quality entering the Lagoon and Carmel Bay ASBS. In addition, stormwater discharge through these facilities would be subject to the post-construction stormwater management requirements of the SWPPP, General Construction Stormwater Permit, conditions of Phase II small MS4 General Permit, and other regulations that require projects to implement post-construction stormwater BMPs (and low impact development measures) into the final site designs and construction. Specifically, the SWPPP includes post-construction BMPs to reduce pollutant loading in stormwater runoff once the site is developed, sets forth the BMP monitoring and maintenance schedule, and identifies responsible entities during the construction and post-construction phases. This potentially significant impact can be reduced to a less-than-significant level with adherence to the permit requirements, compliance with regulatory requirements, and implementation of **Mitigation Measure HYD-4**, below. This measure requires design and implementation of a range of water-quality treatment BMPs (e.g., bioretention basins, vegetated swales, etc.) sited at the ends of the roads that route surface runoff towards the Lagoon.

Summer Dry Season

Balance Hydrologics, Inc. (2015) provided a summary of the estimated hydrologic conditions on the interior side of the proposed EPB project component, which identified that groundwater would be the primary source of inflow to the inside of the proposed EPB project component during the summer dry

[13] Public comments received during the NOP scoping period included concerns regarding potential increases in mosquitos in the area due to ponding landward of the proposed EPB project component; this potential impact in discuss in **Section 4.7, Hazards, and Hazardous Materials**.

season with the groundwater gradient generally conveying flows towards the Lagoon. However, a relatively rapid rise in Lagoon stage during the summer months would have the potential to block seepage flows from uplands areas or even reverse the direction of the groundwater flow from the Lagoon toward the landward side of the proposed EPB project component.

Water levels on the interior side of the proposed EPB project component are anticipated to track very closely to water levels in the Lagoon with a head differential expected to be less than one foot during periods of relatively static water surface elevations.[14] Balance Hydrologics, Inc. reviewed the MPWMD Lagoon stage data, which indicated that water levels in the Lagoon most frequently range between five and nine feet during the summer months. These water levels compared to a low elevation of seven feet along the proposed EPB project component that could remain inundated or desiccated for extended periods of time (i.e., weeks or months) dependent on conditions in the Lagoon. Lagoon levels occasionally rise above eight feet during the summer months, in which case water levels landward of the proposed EPB project component could be expected to occasionally rise as high as the pump trigger elevation of 10.5 feet.

Dry season discharges to the landward side of the proposed EPB project component would predominantly consist of shallow groundwater inflow that would pose minimal risk of contributing pollutants into the system. Discharge through these facilities would be subject to the post-construction stormwater management requirements of the SWPPP, General Construction Stormwater Permit, conditions of Phase II small MS4 General Permit, and other regulations that require projects to implement post-construction stormwater BMPs (and low impact development measures) into the final site designs and construction. With the minimal risk of contributing pollutants into the system and adherence to the permit requirements and compliance with regulatory requirements, potential water quality impacts resulting from discharges during the summer dry season are less-than-significant impact, and, therefore, no mitigation measures would be required. In addition, the implementation of **Mitigation Measure HYD-4** would further reduce this less-than-significant impact.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

While the placement of the proposed revetment would alter the drainage pattern of the river, the operation of the proposed SRPS project component would not contribute runoff water that would exceed the capacity of the existing stormwater drainage system or provide substantial additional sources of polluted stormwater runoff, otherwise substantially degrading water quality. Therefore, no impacts to water quality would occur because of stormwater runoff from the operation of the proposed SRPS project component.

Impact Conclusion

During the rainy season, the operation of the proposed EPB project component could result in concentrated pollutants in the stormwater runoff in the area landward of the barrier. This potentially significant impact could be reduced to a less-than-significant level with adherence to the permit requirements, compliance with regulatory requirements, and implementation of **Mitigation Measure HYD-4**, below. This measure requires the design and implementation of a range of water-quality treatment BMPs (e.g., bioretention basins, vegetated swales, etc.) sited at the ends of the roads that route surface identified below. No discharge or increased stormwater runoff would result from the operation of the proposed SRPS project component and, thus, no

[14] The term "head differential" means the difference measured in feet between the water level in the Lagoon and that of the water on the interior side of the proposed EPB project component.

impact would occur. No mitigation measures are required for the proposed SRPS project component.

Mitigation Measure

Mitigation Measure HYD-4: Implementation of Water Quality Treatment BMPs (Applies to EPB project component). The project shall adhere to the conditions of the NPDES Permit, including the requirements for stormwater discharge treatment measures and appropriate source control and site design measures. To avoid potential long-term impacts to water quality, the EPB project component will be designed to include bioswales or other water quality treatment BMPs to retain and treat stormwater runoff. Treatment BMPs that have been approved for use a treatment by the SWRCB include:

- Biofiltration Strips and Swales,
- Infiltration Basins,
- Detention Devices,
- Traction Sand Traps,
- Dry Weather Flow Diversion,
- Gross Solids Removal Devices,
- Media Filters,
- Multi-Chamber Treatment Trains, and
- Wet Basins.

Water-quality treatment BMPs shall be included in the final design for the EPB project component. One or a combination of the above-mentioned treatment BMPs may be implemented. These treatment BMPs may be sited at the ends of the roads that route surface runoff towards the Lagoon, landward of the EPB project component, or at other locations as determined appropriate by the project engineer and/or contractor during final design and SWPPP preparation.

Impact HYD-5: Operational Impacts to Groundwater Supply and Management. Operation of the proposed EPB and SRPS project components would not substantially decrease groundwater supplies nor interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin, nor would the proposed project conflict with or obstruct the implementation of a water quality control plan or sustainable groundwater management plan, or otherwise substantially degrade water quality. (Criteria b and e) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS

The proposed project operations would significantly impact groundwater resources if project operations were to result in substantial groundwater depletion and reduction in recharge. Substantial reduction would occur if wells were to become incapable of supporting existing land uses or planned uses for which permits have been granted.

The proposed EPB and SRPS project components do not require a long-term water supply, and, therefore, would not deplete groundwater supplies.

The proposed EPB and SRPS project components would involve the construction of new structures in unpaved areas. The proposed EPB project component would include the construction of the sheet pile wall, pump station, generator, and control building. In addition, the proposed EPB project component involves the reconstruction of Carmelo Street, which may result in some new paved areas. However, the total area of new impervious surfaces required for the proposed EPB project component would be minimal. The footprints of the pump station and generator and control building would total approximately 1,600 square feet, while the footprint of the sheet pile wall would comprise approximately 0.5 acre. Approximately 400 linear feet of Carmelo Street is proposed for reconstruction, the majority of which would occur within paved areas and the existing Right-of-way. The surrounding unpaved areas would remain unpaved, providing a route for rainwater falling on these structures to infiltrate into the ground. Therefore, the amount of new impervious surface area resulting from the proposed EPB project component would not substantially interfere with groundwater recharge. This impact is less-than-significant, and no mitigation measures are required.

The revetment (i.e., riprap) and geotextile fabric associated with the proposed SRPS project component would be located within unpaved areas. However, these materials are permeable, allowing rainwater to continue to infiltrate the area. Therefore, no impacts to groundwater resources would occur from the proposed SRPS project component.

The proposed project would be subject to the post-construction stormwater management requirements of the stormwater permit, General Construction Stormwater Permit, and other regulations that require projects to implement post-construction stormwater BMPs (and low impact development measures) into the final site designs and construction. Adherence to the permit requirements and compliance with regulatory requirements would ensure the operation of the proposed EPB and SRPS project components would not have a significant impact on groundwater quality and, therefore, no mitigation measures would be required.

As stated in the regulatory section, SGMA does not apply to the Carmel River Groundwater Basin, and, therefore, the operation of the proposed project would not conflict with or obstruct the implementation of a sustainable groundwater management plan. This impact is less-than-significant.

Impact Conclusion

The proposed EPB and SRPS project components do not require a long-term water supply, and, therefore, would not deplete groundwater supplies. The total area of new impervious structures required for the proposed EPB project component would be minimal and the surrounding unpaved areas would remain unpaved, providing a route for rainwater falling on these structures to infiltrate into the ground. The revetment (i.e., riprap) and geotextile fabric associated with the proposed SRPS project component would be located within unpaved areas. However, these materials are permeable, allowing rainwater to continue to infiltrate the area. Therefore, the proposed EPB and SRPS project components would not substantially interfere with groundwater recharge. Additionally, the proposed project would not conflict with or obstruct the implementation of a sustainable groundwater management plan. This impact is less-than-significant, and no mitigation measures are required.

Impact HYD-6: <u>Operational Drainage Pattern Alterations</u>. The proposed EPB and SRPS project components would alter existing drainage patterns, which would not cause substantial erosion or siltation on- or off-site but would increase flooding on-

or off-site. (Criteria c(i) and (ii)) (EPB: Significant Unavoidable) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Significant Unavoidable.)

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

Erosion On- or Off-Site

While structures that constrict or confine river floodplains can induce erosion due to increased flood-flow velocities or through eddying effects at the obstruction, such a response would not be expected under the proposed EPB project scenario. Although the proposed EPB project component would limit the extent of the Carmel River floodplain to some degree at high flows, the magnitude of the constriction is minimal relative to the full width of the floodplain corridor. Flow velocities, even during large floods, are low through the Lagoon, especially along the edges where the proposed EPB project component would be located. Given these conditions, scour effects due to constriction of the channel or because of hardscaping associated with the constructed proposed EPB project component would be unlikely, and would be a less-than-significant potential impact.

Flooding Landward of the Proposed Ecosystem Protection Barrier Project Component

As described in **Impact HYD-4** above, Balance Hydrologics, Inc. (2015) provided a summary of the estimated hydrologic conditions on the interior side of the proposed EPB project component, which identified surface and shallow groundwater flows from the upland drainage would be the primary contributor to ponding on the landward side of the proposed EPB project component during the rainy season. Pumps would be used to control the depth of ponding landward of the proposed EPB project component during moderate to large storm events or during times of elevated stages in the Lagoon. Water ponding on the landward side of the proposed EPB project component would gravity flow to the Lagoon through one or more culverts controlled by flap gates, during times that the Lagoon is sufficiently low. When Lagoon levels are sufficiently high, the flap gates on the culverts would close and rising water levels in the detention area would activate a pump station which would pump the collected stormwater into the Lagoon. The drainage system would require a 20 cfs (9,000 gallon per minute) pump station to accommodate flows from the entire 100-acre developed watershed.

Peak water elevations landward of the proposed EPB project component could potentially reach as high as 13 feet during large storm events, but would be drawn down rapidly (i.e., hours) due to pumping. The rate of seepage under the proposed EPB project component (through culverts or by pumping) would largely be a function of water levels in the Lagoon, which vary significantly during the winter months.

During the dry season, groundwater would be the primary source of inflow to the inside of the proposed EPB project component. However, a relatively rapid rise in lagoon stage during the summer months would have the potential to block seepage flows from upland areas or even reverse the direction of the groundwater flow from the Lagoon toward the landward side of the proposed EPB project component. Water levels on the interior side of the proposed EPB project component are anticipated to track very closely to water levels in the Lagoon with a head differential expected to be less than one foot during periods of relatively static water surface elevations. Lagoon levels occasionally rise above nine feet during the summer months, in which case water levels landward of the proposed EPB project component could be expected to occasionally rise as high as the pump trigger elevation of 10.5 feet.

The proposed EPB project component structure has been designed with redundant systems (i.e., a generator and backup pump) and an alarm system in case of any equipment failure. The pump system would be tested and maintained, and the County would provide response in emergency situations. With the implementation of the pump system and flap gates, regular testing and maintenance, and emergency response and backup systems in case of equipment failure, potential flooding landward of the proposed

EPB project component would be unlikely. Therefore, potential flooding landward of the proposed EPB project component is a less-than-significant impact.

Carmel Area Wastewater District and Mission Ranch

The proposed EPB project component would result in a more naturally functioning lagoon ecosystem as the need to artificially breach the Lagoon to prevent flooding of the residential area to the north of the Lagoon would diminish. The proposed EPB project component would allow an increased depth and duration of inundation within the Lagoon. Increased depth and duration of inundation may also increase the amount of emergent marsh and riparian habitat for special-status species, and other sensitive habitat types influenced by hydrology. This impact is beneficial.

However, two aspects of the proposed EPB project component have the potential to increase Carmel River and Lagoon surface water elevations and effect low-lying buildings and other facilities adjacent to the Lagoon (i.e., those not protected by the proposed EPB project component). First, the secession of non-emergency management of the barrier beach would allow higher sustained water elevations within the Lagoon, which would increase the area subject to flooding, potentially affecting low-lying buildings and other facilities adjacent to the Lagoon. Second, the proposed EPB project component would constrict flood inundation areas on the north side of the Carmel River and would result in slightly increased flood water surface elevations. To analyze the magnitude and location of these potential increases, Balance Hydrologics, Inc. modeled pre- and post-project conditions under several different scenarios, and prepared a summary of the results (Balance Hydrologics, Inc., 2013). A second analysis was conducted that evaluated potential groundwater effects and assessed the potential impacts related to the uncertified levee surrounding the CAWD facility and structures on the Mission Ranch property (Balance Hydrologics, Inc., 2016).[15] All of the technical information presented below is derived from these two analyses.

Carmel Area Wastewater District

The CAWD wastewater treatment facility is situated west of Highway 1, upstream of the Lagoon, and adjacent to the main channel of the Carmel River, separated from the channel by an uncertified levee, or berm. The implementation of the proposed EPB project component would alter the existing drainage pattern of the lower River and Lagoon which could potentially increase flooding on- or off-site and may result in the exposure of the CAWD facility to an increased risk of flooding and increased groundwater elevations. Theoretically, the CAWD facility could be affected in three separate ways, but specific analysis set forth below identifies only one of these potential impacts would be significant and unavoidable. The first is an increased potential of riverine flooding by overtopping of the existing uncertified levees. The second is an increase in the potential of overtopping of the uncertified levees by the Lagoon if the Lagoon surface water elevation is allowed to rise above the current uncertified levee height. The third is an increase in the surface water elevation of the Lagoon, which would raise the groundwater levels at the CAWD facility and could potentially result in an increase in seepage of water into subsurface facilities and low-lying areas at the CAWD facility.

The proposed EPB project component would not increase the potential for the Carmel River to overtop the existing uncertified levees during a flood event and would have no impact on riverine flooding of the CAWD facility. Operation of the proposed EPB project component would constrict existing flood inundation areas and slightly increase the Carmel River base flood elevation downstream of the CAWD

[15] Levee certification is the process that deals specifically with the design and physical condition of the levee and is the responsibility of the levee owner or community in charge of the levee's operations and maintenance. Certification must be completed for the levee to be eligible for accreditation by FEMA. The areas behind uncertified levees are mapped as high-risk areas.

facility. The changes in the base flood elevation because of the proposed EPB project component are predicted to be small overall (less than an inch). Modeling of the base flood elevation for the 100-year flood indicates that the greatest anticipated increase in base flood elevation (0.02 feet) is at the downstream portion of the CAWD facility, where the uncertified levee is at an elevation sufficient to preclude flooding. Modeling of the base flood elevation indicated that at two locations on the upstream portion of the CAWD facility, the pre-project base flood elevation exceeds the elevation of the uncertified levee. However, the base flood elevation at these locations is not expected to increase because of the implementation of the proposed EPB project component.

The project could result in higher sustained surface water elevation within the Lagoon. The higher surface water elevation of the Lagoon increases the potential for overtopping of the existing uncertified levee and flooding of the CAWD facility. The elevation of the top of the uncertified levee that surrounds the CAWD facility is greater than 16 feet along the full perimeter with some sections 17 to 18 feet. Estimates of the typical water surface elevation in the Lagoon under fully natural beach dynamics and breaching conditions cover a wide range but are likely to typically fall in the range of 13 to 16 feet. Therefore, such an increase in breaching elevation to 16 feet would not cause surface flooding at the CAWD facility. However, there is uncertainty with these estimations, and it may be possible that the surface water elevation exceeds 16 feet in some years. With the implementation of the proposed EPB project component, the water surface elevation in the Lagoon could theoretically reach 17.5 feet (i.e., the height of the proposed EPB project component), overtopping the lowest elevation of the existing uncertified levee at approximately 17 feet. While possible, this outcome is highly unlikely and could only occur in the context of an unforeseen emergency where the barrier beach had built up far beyond what is deemed likely and the County and/or other agencies that would typically act to protect life and property were unable to successfully breach the Lagoon. Therefore, this potential impact is less-than-significant.

CAWD has expressed concern that the increase in sustained water surface elevation because of the proposed EPB project component would limit their use of an eight-acre area on their property between the channel and the uncertified levee west of the facility. Under current conditions, the barrier beach is, when conditions warrant, manually breached when water reaches an elevation of about 13 feet. The proposed changes in management of the barrier beach would allow a more natural breaching regime, which, as stated above, has been estimated to occur at an elevation of about 13 to 16 feet. Therefore, the maximum sustained water surface elevation would be approximately three feet higher along the existing uncertified levee with implementation of the proposed EPB project component. The base of the uncertified levee is at an elevation of approximately 12 to 13 feet, and, therefore, under current sandbar management conditions, the eight-acre area would be inundated during winter conditions. The three-foot increase in water surface elevation would occur along the edge of the berm but would not result in a significant loss of usable area during winter conditions.

However, there is the potential for the eight-acre land area, predominantly between 10 to 12 feet in elevation, to be inundated more frequently (greater number of years) and for longer duration when inundation occurs (on the order of several weeks) if Lagoon inflow continues to exceed Lagoon outflow after the barrier beach closes. This inundation would reduce the availability of the 8-acre area for CAWD operations. This impact is potentially significant.

There are no feasible mitigation measures to reduce this impact to a less-than-significant level. One mitigation option that CAWD has proposed is the installation of a floodwall similar to the proposed EPB project component at the CAWD facility. A floodwall at the CAWD facility would require: 1) additional funding; 2) additional environmental analysis; 3) State Parks and/or CAWD permission, depending on the location; and 4) additional technical studies. A floodwall at the CAWD facility is not a component of the County's proposed project, nor is it a project proposed to be carried out by CAWD. Further, an agreement

between the County, CAWD, and State Parks to construct a floodwall does not currently exist. Given the absence of an agreement between these entities, no feasible mitigation measure is currently available. Therefore, this impact of the proposed EPB project component is significant and unavoidable.

The proposed EPB project component could result in higher sustained surface water elevation within the Lagoon which would raise the groundwater elevations at the CAWD facility. The increased groundwater elevations could result in an increase of water seeping into underground facilities and low-lying areas within the CAWD facility. This impact on the CAWD facility is significant and unavoidable.

Specific information pertaining to the CAWD facility, such as finished floor elevations and current seepage management program, was not available to the project team. In lieu of this information, the County directed Balance Hydrologics, Inc. to conduct an assessment, taking a conservative, worst-case scenario approach of the potential impacts resulting from increased groundwater elevations at the CAWD facility (Balance Hydrologics, Inc., 2016).

Groundwater data from several monitoring wells in the vicinity of the CAWD facility indicate shallow groundwater levels closely track with Lagoon water levels, suggesting higher water levels in the Lagoon would likely result in higher groundwater levels at the CAWD facilities. High groundwater levels in the vicinity of the CAWD facility may result in seepage of water into the CAWD facility and property. CAWD has indicated in a comment letter (Buikema, 2013) that groundwater levels within 20 feet of the surface in and around the CAWD facilities may influence the future construction of the facilities as well as maintenance costs. Existing groundwater data from a monitoring well adjacent to the CAWD facility indicates pre-project groundwater levels already reach an elevation of over 14 feet, less than four feet below ground surface at the location of the well (Balance Hydrologics, Inc., 2016). The groundwater data suggests groundwater currently has the potential to be close to the surface within the CAWD facility, barring any sizable obstruction to groundwater flow in the vertical direction.[16] This data suggests CAWD may already need to dewater to maintain groundwater levels at their stated threshold of 20 feet below ground surface.[17] A comparison of water levels measured at the monitoring well adjacent to the CAWD facilities and water levels in the Lagoon reveal, at higher Lagoon water elevations, there is a one to one relationship between well water elevation and Lagoon water elevation (Balance Hydrologics, Inc., 2016). Based on the relationship indicated in the data, it is expected that the higher sustained Lagoon water surface elevations that would result from the implementation of the proposed EPB project component would correspond directly to the higher groundwater levels at the monitoring well adjacent to the CAWD facilities. Estimates of a typical water surface elevation for fully natural beach dynamics and breaching cover a wide range but would likely fall within the range of 13 to 16 feet. Implementation of the proposed EPB project component would likely result in a maximum sustained Lagoon water elevation as high as 16 feet and would raise groundwater levels adjacent to the CAWD facilities by a similar amount, potentially resulting in seepage where ground surface in locations within the CAWD facilities are below 16 feet (Balance Hydrologics, Inc., 2016).[18] This impact is potentially significant.

There are no feasible mitigation measures to reduce this impact to a less-than-significant level. One option would be for a higher capacity pump to be installed and operated at the CAWD facility. However, CAWD

[16] The compacted fill on which the CAWD facilities were constructed may obstruct groundwater flow in the vertical direction.
[17] No information was available as to whether there is, or is not, an active dewatering program at CAWD.
[18] The analysis by Balance Hydrologics, Inc. (2016) assumed a sustained water elevation of 16 feet in the Lagoon; however, this water surface elevation would likely typically be sustained only for a short period just prior to the barrier beach naturally breaching and could reach greater elevations during emergency flood events. To further clarify, this increase in water level is not an increase of 16 feet in elevation, but a maximum sustained water elevation of 16 feet.

has not thus far agreed to install pumps (Buikema, 2016).[19] Another mitigation option that CAWD has proposed is the installation of a floodwall similar to the proposed EPB at the CAWD facility. A floodwall at the CAWD facility would require: 1) additional funding; 2) additional environmental analysis; 3) State Parks and/or CAWD permission, depending on the location; and 4) additional technical studies, including an analysis to determine whether potential groundwater seepage impacts would be mitigated by the floodwall. A floodwall at the CAWD facility is not a component of the County's proposed project, nor is it a project proposed to be carried out by CAWD. Further, an agreement between the County, CAWD, and State Parks to construct a floodwall does not currently exist. Given the absence of an agreement between these entities, no feasible mitigation measure is currently available. Therefore, this impact of the proposed EPB project component is significant and unavoidable.

Mission Ranch

Portions of Mission Ranch lie within the 100-year floodplain and may be affected by increased flood levels because of floodplain constriction caused by the proposed EPB project component. The implementation of the proposed EPB project component will result in a predicted increase (0.01 feet) in the 100-year flood elevation around Mission Ranch (Balance Hydrologics, Inc., 2013). That impact is confined to the area within the open fields ("sheep field") and does not extend upstream as far as the tennis courts. As such, the slight increase in base flood elevation in that area does not represent a significant impact. The Mission Ranch area could, however, be impacted by sustained higher lagoon water elevation because of the secession of non-emergency breaching. Post-project, sustained lagoon water levels may reach as high as 16 feet. In addition, while highly unlikely, it is possible that higher lagoon water levels could occur for short durations up to 17.5 (i.e., the height of the proposed EPB project component). The ground surface immediately adjacent to some buildings near the tennis courts and parking lot are at 15.9 feet and, thus, may be impacted by higher sustained Lagoon water levels. Higher sustained Lagoon water levels could limit access to portions of the facility. In addition, the sheep field to the west of the Mission Ranch infrastructure is at a lower elevation (about 12.5 to 13.5 feet) and would be inundated more frequently and to a greater extent. Increased inundation in this area, however, would not specifically threaten any built infrastructure. This impact is potentially significant.

There are no feasible mitigation measures to reduce this impact to a less-than-significant level. One option would be to extend the proposed EPB project component onto the Mission Ranch property. The extension of the floodwall would require: 1) additional funding; 2) additional environmental analysis; 3) permission from Mission Ranch owners; and 4) additional technical studies. The floodwall on the Mission Ranch property is not a component of the County's proposed project, nor is it a project proposed to be carried out by Mission Ranch. Further, an agreement between the County and Mission Ranch to construct a floodwall does not currently exist. Given no agreement exists between these entities, there is no feasible mitigation measure available. Therefore, this impact of the proposed EPB project component is significant and unavoidable.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

Without management of the beach, the river would naturally breach and could flow in a northern direction. It is not known how frequently a northern breach would occur due to the years and variations of management, but an elongated channel forms to the north along the beach in half of the years of observation (James, 2005) and either natural breaching or channel migration is expected to tend toward the northern alignment since the antecedent, lowered beach alignment has not recovered to typical berm heights and widths (Thornton, 2005) (please refer to **Section 4.5, Geology, Soils, and Seismicity** for more

[19] A copy of the letter from CAWD (Buikema, 2016) is in **Appendix H** of this EIR.

data on coastal processes). It is also known that under certain conditions, such as during high river flow events, the beach bluff adjacent to Scenic Road is subject to erosion (please refer to **Section 4.1, Aesthetics** for a description of the 2023 event and emergency repair of Scenic Road). The proposed SRPS project component concept was developed to protect public infrastructure along Scenic Road from damage in the event of northerly river flows or from large ocean swells. The proposed SRPS project component would restrict the ability of waves, and any outflow channel from the Lagoon that migrated north along the bluff, to erode this feature and move further inland. The implementation of the proposed SRPS project component would result in alteration of the drainage pattern of the river but would protect existing infrastructure from erosion. Therefore, erosion impacts to the existing drainage pattern from the proposed SRPS project component would be less-than-significant. Please refer to **Impact GS-6** in **Section 4.5, Geology, Soils, and Seismicity** for more information.

The proposed SRPS project component would alter the river flow, but would not result in an increase in flow, constrict the floodplain, or increase sustained water elevations within the Lagoon. The proposed SRPS project component would not avoid or reduce flooding to the State Parks parking lot, which is known to occur under current conditions, but would protect it from scour. Therefore, potential flooding impacts on- or off-site because of the operation of the proposed SRPS project component are less-than-significant.

Impact Conclusion

The proposed EPB project component would alter the existing drainage patterns in the Lagoon, resulting in a beneficial impact to the Lagoon ecosystem. With the implementation of the pump system and flap gates, regular testing and maintenance, and emergency response and backup systems in case of equipment failure, potential flooding landward of the proposed EPB project component would be unlikely and is a less-than-significant impact.

Operation of the proposed EPB project component would constrict existing flood inundation areas resulting in higher sustained water surface elevations and slightly increase the Carmel River base flood elevation downstream of the CAWD facility. However, potential flooding impacts to the CAWD facility resulting from overtopping the existing uncertified levee are less-than-significant as the base flood elevation at the CAWD facility will not increase at the CAWD facility location and an increase in breaching elevation to 16 feet would not cause surface flooding at the CAWD facility. The proposed EPB project component would result in flooding impacts to the CAWD property west of the uncertified levee and the Mission Ranch property in the sheep field. Additionally, the proposed EPB project component could result in higher sustained surface water elevation within the Lagoon, which would raise the groundwater elevations at the CAWD facility. The increased groundwater elevations could result in an increase of water seeping into underground facilities and low-lying areas within the CAWD facility. There are no feasible mitigation measures for these impacts and, therefore, potential flooding impacts to the CAWD and Mission Ranch properties and groundwater seepage within the CAWD facility are significant and unavoidable.

The proposed SRPS project component would alter the existing drainage patterns but is designed to protect existing infrastructure from flooding and erosion; and, therefore, erosion impacts associated with alteration of the drainage pattern would be less-than-significant. The proposed SRPS project component would alter the river flow, but would not result in an increase in flow, constrict the floodplain, or increase sustained water elevations within the Lagoon. Therefore, potential flooding impacts on- or off-site because of the operation of the proposed SRPS project component are less-than-significant.

Impact HYD-7: <u>Operational Risks due to Location within a 100-Year Flood Hazard Area.</u> The proposed EPB and SRPS project components would be located within a 100-year flood hazard area that would impede or redirect flows. (Criterion c(iv)) (EPB: Less-than-Significant with Mitigation) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant with Mitigation)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS</u>

The proposed EPB and SRPS project components would be constructed within the 100-year floodplain. The objectives of the proposed project include, but are not limited to, the following:

- Consistent with the MOU, reduce the necessity for mechanical breaching of the sandbar to the greatest extent practicable;
- Maintain the current level of flood protection for existing public facilities and private structures in the low-lying developed areas located immediately to the north of and within the Lagoon;
- Protect Scenic Road embankment and the State Parks' restroom, interpretive, and parking facilities from scour resulting from a northerly-aligned Lagoon outflow channel that may result from a reduction in mechanical breaching;
- Protect the Scenic Road embankment from the increasing risk of erosion resulting from ocean storm surge and high tides, which could increase in severity due to climate change;
- Allow for interim management of the sandbar while the design and construction of the other project components proceed;
- Design and construct project elements within the required eight-year timeframe of the MOU; and
- Minimize infrastructure that could detract from the function and value of the natural environment.

As a result, the proposed EPB and SRPS project components are necessarily designed to redirect flows. Further, the proposed project would not impede flows, but rather would redirect flows to allow for a more naturally functioning lagoon ecosystem. Please refer to **Impact HYD-6** above. Because the proposed project would not impede flows and the need to artificially breach the Lagoon to prevent flooding of the residential area to the north of the Lagoon would diminish, this impact is considered less-than-significant.

However, the changes in water surface elevations because of the proposed EPB project component could have a potentially adverse effect by impacting the validity of base flood elevations cited on the current, effective FEMA Flood Insurance Rate Map Panel for the proposed project area. The implementation of the proposed EPB project component may result in changes to the area mapped within the 100-year flood zone. As described in **Impact HYD-6**, the changes in base flood elevation because of the proposed EPB project component are predicted to be small overall (less than an inch). Specifically, the maximum increase in main channel base flood elevation is 0.02 feet near the eastern end of the proposed EPB project component. Very minor increases in base flood elevations would extend upstream roughly to the western limit of the CAWD facility. Base flood elevations are not predicted to increase in the north overbank area. Although minor, any new area that would fall within the revised base flood elevation would need to be revised on the FEMA Flood Insurance Rate Map Panel. This impact is considered potentially significant. The potential impact associated with validity of base flood elevations cited on the current, effective FEMA Flood Insurance Rate Map Panel could be reduced to a less-than-significant level through implementation of **Mitigation Measure HYD-7** identified below.

Impact Conclusion

The proposed project would be in a 100-year flood hazard area and result in redirecting flows. However, the proposed project would not result in impeding flows. The proposed project would redirect flows to allow for a more natural breaching regime and reduce the need to mechanically breach the Lagoon. Therefore, this is considered a less-than-significant impact. However, potentially significant impacts associated with changes in base elevations cited on the current, effective FEMA Flood Insurance Rate Map Panel as a result of the proposed EPB project component may occur but would be reduced to a less-than-significant level by implementing **Mitigation Measure HYD-7** identified below.

Mitigation Measure

Mitigation Measure HYD-7: Avoid and Minimize Impacts to the Validity of Base Level Elevations Cited on the Current, Effective FEMA Flood Insurance Rate Map Panel (Applies to EPB project component). In order to reduce potential adverse effects associated with possible impacts to the validity of the base flood elevations cited on the current, effective FEMA Flood Insurance Rate Map Panel for the EPB project component site, the County shall submit design drawings to FEMA showing the existing, pre-developed floodplain conditions and the proposed floodplain conditions after installation of the EPB project component. A FEMA Conditional Letter of Map Revision (CLOMR) is required to be processed prior to construction of the EPB project component to have FEMA review and determine the precise way in which the flood map would be revised. Following the completion of the proposed project, a FEMA Letter of Map Revision LOMR request would need to be processed and the flood map officially updated to reflect the revision.

4.8.4 References

Balance Hydrologics, Inc. 2013. *Carmel River Lagoon EBP-Riverine Flooding Impact Assessment*. May 28.

Balance Hydrologics, Inc. 2014. The Geomorphic Role of the Riverine Processed in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report.

Balance Hydrologics, Inc. 2015. Draft Summary of Estimated Interior Side Hydrologic Conditions, EPB Project, County of Monterey. August 7.

Balance Hydrologics, Inc. 2016. Carmel River Lagoon EPM-Potential Impacts to the CAWD wastewater treatment facility and Mission Ranch. Memorandum dated July 2016.

Buikema, B. 2013. Comment letter to Carl Holm in response to the feasibility discussion of the Carmel Lagoon Ecosystem Protective Barrier. Letter from Barbara Buikema, Carmel Area Wastewater District, dated May 13, 2013, 3p.

Buikema, B. 2016. Letter to Melanie Beretti in response to draft analysis of a hydrologic impact and proposed mitigation measure concerning CAWD. Letter from Barbara Buikema, Carmel Area Wastewater District, dated August 17, 2016, 2p.

[CCC] California Coastal Commission. 2019. *Water Quality Critical Coastal Areas Program Information*. Available at: https://www.coastal.ca.gov/water-quality/critical-coastal-areas/.

[DWR and USACE] California Department of Water Resources and United States Army Corps of Engineers. 2008. San Clemente Dam Seismic Safety Project, Final Environmental Impact Report/Environmental Impact Statement, Volume 2. January 2008.

[DSOC] California Department of Water Resources, Division of Safety of Dams. 2023. Dam Breach Inundation Map. Accessed August 27, 2023, at: https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2.

California Office of Emergency Services, 2021. Tsunami Hazard Area Map, Monterey County; produced by the California Geological Survey and the California Governor's Office of Emergency Services; dated March 23, 2021, mapped at multiple scales. https://www.conservation.ca.gov/cgs/Documents/Publications/Tsunami-Maps/Tsunami_Hazard_Area_Map_Monterey_County_a11y.pdf

[CO-CAT] Coastal and Ocean Working Group of the California Climate Action Team. 2013. State of California Sea-Level Rise Guidance Document. March. Available online at: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/2013_SLR_Guidance_Update_FINAL1.pdf

[RWQCB] California Regional Water Quality Control Board. 2017. *Waste Discharge Requirements NPDES General Permit for Discharges with Low Threat to Water Quality (Order No. R3-2017-0242, NPDES No. CAG993001, amended).*

[RWQCB] California Regional Water Quality Control Board, Central Coast Region. 2019. *Water Quality Control Plan for the Central Coastal Basin*. June 2019. Available online at: https://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs/2019_basin_plan_r3_complete_webaccess.pdf

California Stormwater Quality Association. 2023. Stormwater Best Management Practice Handbook; Construction.

Casagrande, J. 2006. Wetland Habitat Types of the Carmel River Lagoon. Seaside, CA: The Watershed Institute, California State University Monterey Bay. Report No. WI-2006-05.

Coates, M.J. and Y. Guo. 2003. The salt wedge position in a bar-clocked estuary subject to pulsed inflows. *Estuarine, Coastal and Shelf Science*, 58: 187-196. 2003.

Debler, W., and J. Imberger. 1996. Flushing criteria in estuarine and laboratory experiments. In *Journal of Hydraulic Engineering*, Vol. 122, No. 12, p. 728-734. 1996.

ESA PWA. 2014. Analysis of Historic and Future Coastal Erosion with Sea Level Rise memorandum, Monterey Peninsula Water Supply Project. March 19, 2014.

Hayes, S.A., M.H. Bond, C.V. Hanson, A.W. Jones, A.J. Ammann, J.A. Harding, A.L. Collins, J. Perez, and R.B. MacFarlane. 2011. "Down, up, down and 'smolting' twice? Seasonal movement patterns by juvenile steelhead (Oncorhynchus mykiss) in a coastal watershed with a bar closing estuary." *Canadian Journal of Fisheries and Aquatic Sciences*, Vol. 68: pp. 1341-1350.

[IPCC] International Panel on Climate Change. 2014. Climate Change 2014 Synthesis Report Summary for Policymakers. Available at: https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_SPM.pdf.

[IPCC] International Panel on Climate Change. 2023. Climate Change 2023 Synthesis Report Summary for Policymakers. Available at: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

James, G.W. 2005. Monterey Peninsula Water Management District; Technical Memorandum 05-01; Surface Water Dynamics at the Carmel River Lagoon Water Years 1991 Through 2005.

Kapple, G.W., H.T. Mitten, T.J. Durbin, and M.J. Johnson. 1984. Analysis of the Carmel Valley Alluvial Ground-Water Basin, Monterey County, California. Sacramento: Monterey Peninsula Water Management District. Report 83-4280 (pp. 45).

Larson J., F. Watson, J. Casagrande, and B. Pierce. 2006. Carmel River Lagoon Enhancement Project: water quality and aquatic wildlife monitoring, 2005-6. Available online at: http://ccows.csumb.edu/pubs/reports/CCoWS_StateParks_CRLEP_Monitoring_2005-6_080229_fw.pdf.

Logan, J. 1983. DRAFT-The Carmel Valley Alluvial Aquifer: Bedrock geometry, hydraulic parameters, and storage. Carmel: Monterey Peninsula Water Management District, p. 21.

Moffatt & Nichol. 2013. Monterey County Water Resources Agency: Carmel River Lagoon Biological Assessment, Coastal Engineering Analysis. Progress Draft. August 2, 2013.

[County] Monterey County. 2010. Monterey County Dam Inundation Map. January 22, 2010.

[County] Monterey County. 2014. Carmel Bay Area of Special Biological Significance (ASBS); Draft Compliance Plan. September 20, 2014.

Monterey County Office of Emergency Services. 2022. Monterey County Multi-Jurisdictional Hazard Mitigation Plan; Final Draft. March 2022. Available online at:

https://www.co.monterey.ca.us/home/showpublisheddocument/114305/637961624630700000.

Monterey County Office of Emergency Services. 2007. *Monterey County Operational Area Tsunami Incident Response Plan*. Accessed February 22, 2016. Available online at: https://www.co.monterey.ca.us/government/departments-a-h/administrative-office/office-of-emergency-services/hazard-mitigation/2022-mjhmp.

Monterey County Water Resources Agency. 2014. Floodplain Management Plan, Monterey County, CA, 2014 Update. Available: https://www.co.monterey.ca.us/home/showpublisheddocument/78317/636963847692200000.

[MBNMS] Monterey Bay National Marine Sanctuary. 2021. Monterey Bay National Marine Sanctuary Final Management Plan. October 2021. Available online: http://montereybay.noaa.gov/intro/mp/mp.html

[MPWMD] Monterey Peninsula Water Management District. 2012. "2010-2011 Annual Report (July 1, 2010 – June 30, 2011) for the MPWMD Mitigation Program." March.

[MPWMD] Monterey Peninsula Water Management District. 2013. "2011-2012 Annual Report (July 1, 2011 – June 30, 2012) for the MPWMD Mitigation Program." April 2013.

[MRSWMP] Monterey Regional Stormwater Management Program. 2014. *Post-Construction Requirements At A Glance*. Available online: http://www.montereysea.org/resources_developers.php.

[MPWMD] Monterey Peninsula Water Management District. 2023. "2021-2022 Annual Report (July 1, 2021 – June 30, 2022) for the MPWMD Mitigation Program." April 2023.

[NMFS] National Marine Fisheries Service. 2008. Biological Opinion for water supply, flood control operations, and channel maintenance. Conducted by the US Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservations Improvement District in the Russian River watershed, F/SWR/2006/07316, pp. 386.

[OPC] California Natural Resources Agency, Ocean Protection Council. 2018. State of California Sea-Level Rise Guidance. 2018 Update. Available: https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf.

Pacific Geotechnical Engineering. 2013. Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California. May 2013.

Perry, W., F. Watson, J. Casagrande, and C. Hanley. 2007. Carmel River Lagoon Enhancement Project: water quality and aquatic wildlife monitoring, 2006-7. Available online at: http://ccows.csumb.edu/crlep/reports/CRLEP_Final_070815.pdf.

Smith, D.P., W.B. Newman, F.G.R. Watson, and J. Hameister. 2004. Physical and hydrologic assessment of the Carmel River Watershed, California. The Watershed Institute, California State University Monterey Bay. Publication No. WI – 2004-05/2.

Smith, J.J. 1990. The effects of sandbar formation and inflows on aquatic habitat and fish utilization in Pescadero, San Gregorio, Waddell and Pomponio Creek estuary/lagoon systems, 1985-1989. Report prepared under Interagency Agreement 84-04-324, between Trustees for California State University and the California Department of Parks and Recreation, pp. 47.

Staal, Gardner & Dunne, Inc. Hydrogeological investigation Carmel River Aquifer Coastal Portion, Monterey County California. May 1989.

[SWRCB] State Water Resources Control Board. 2013. *Waste Discharge Requirements for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) General Permit, Water Quality Order No. 2013-001-DWQ, NPDES General Permit No. CAS000004*. Available online at: http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/phsii2012_5th/wqo2013_0001_dwq.pdf.

[SWRCB] State Water Resources Control Board. 2019. *Water Quality Control Plan - Ocean Waters of California (Ocean Plan)*. Available online at: https://www.waterboards.ca.gov/water_issues/programs/ocean/docs/oceanplan2019.pdf.

Thornton, E. B. 2005. Littoral Processes and River Breachings at Carmel River Beach. Naval Postgraduate School, Monterey, CA.

[USGS] United States Geological Survey. 2014. Carmel River flow data downloaded from USGS National Water System Web Interface for station 11143250 (Carmel). Accessed: July 21, 2014. Available online at: http://waterdata.usgs.gov/nwis/gw.

Watson, F and J. Casagrande. 2004. Potential Effects of Groundwater Extractions on Carmel Lagoon. Report to California-American Water Company. The Watershed Institute, California State University Monterey Bay, Rep. No. WI-2004-09 (pp. 93). Available online at: http://ccows.csumb.edu/pubs/reports/CCoWS_CalAmLagoonGW_041217_fw.pdf.

Whitson Engineers. "Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report." WE # 2487.01 and 2487.02. May 29, 2013.

Williams, J. and [PWA] Philip Williams & Associates, Ltd. 1992. Carmel River Lagoon Enhancement Plan. Prepared for Carmel River Steelhead Association, California State Coastal Conservancy, Monterey County Water Resources Agency, and Monterey Peninsula Water Management District, in cooperation with California Department of Parks and Recreation. PWA #509.

Zhang, J., Y. Guo, Y. Shen, and L. Zhang. 2008. Numerical simulation of flushing of trapped slat water from a bar-blocked estuary. Journal of Hydraulic Engineering, 134:11(1671), DOI: 10.1061/(ASCE)0733-9429.

This Page Intentionally Left Blank

4.12 TRANSPORTATION

This section provides an overview of existing conditions within the proposed project area, including existing roadway networks, traffic conditions, bicycle and pedestrian networks, and public transit, as well as an overview of relevant Federal, State, and local transportation regulations. The impact section evaluates construction, operational, and cumulative impacts with mitigation measures, as necessary.

Since publication of the Draft EIR in December 2016, CEQA guidelines incorporated the California Code of Regulations (CCR) Section 15064.3 which requires a transportation impact analysis be based on Vehicles Miles Traveled (VMT), instead of a congestion matrix (such as level of service, or [LOS]). Additionally, a project's effect on automobile delay no longer constitutes a significant environmental impact, as previously required. However, the proposed project is subject to the programs and policies of the 1982 Monterey County General Plan. Policy 37.2.1 requires the transportation demands of the proposed development shall not exceed an acceptable LOS for existing transportation facilities unless appropriate increases in capacities necessary. As required by CEQA and the 1982 General Plan, this section updates the LOS impact analysis from the December 2016 Draft EIR and includes a VMT analysis.

The CEQA Guidelines also removed the threshold related to changes in air traffic patterns from the Transportation section of Appendix G. The CEQA Guidelines consolidated thresholds of significance related to airports and associated safety risks into the Hazards and Hazardous Materials and Noise sections of Appendix G. **Section 4.7, Hazards, and Hazardous Materials** (criteria e and f) and **Section 4.10, Noise** (criteria e and f) in the original Draft EIR adequately address and analyze the safety and noise impacts from airport land use consistent with the revised CEQA Guidelines. Therefore, no revisions to those Draft EIR sections are necessary.

This analysis is based on estimates of workers and vehicles associated with construction and operation of the various components of the proposed project; Caltrans data on State highway traffic volumes; Transportation Agency for Monterey County (TAMC) data on local roadway traffic volumes; field reconnaissance; and review of available maps of transit routes and recreational paths.

Public and agency comments related to traffic and circulation were received during the public scoping period, and are summarized below:

- Evaluate potential impacts associated with construction traffic.

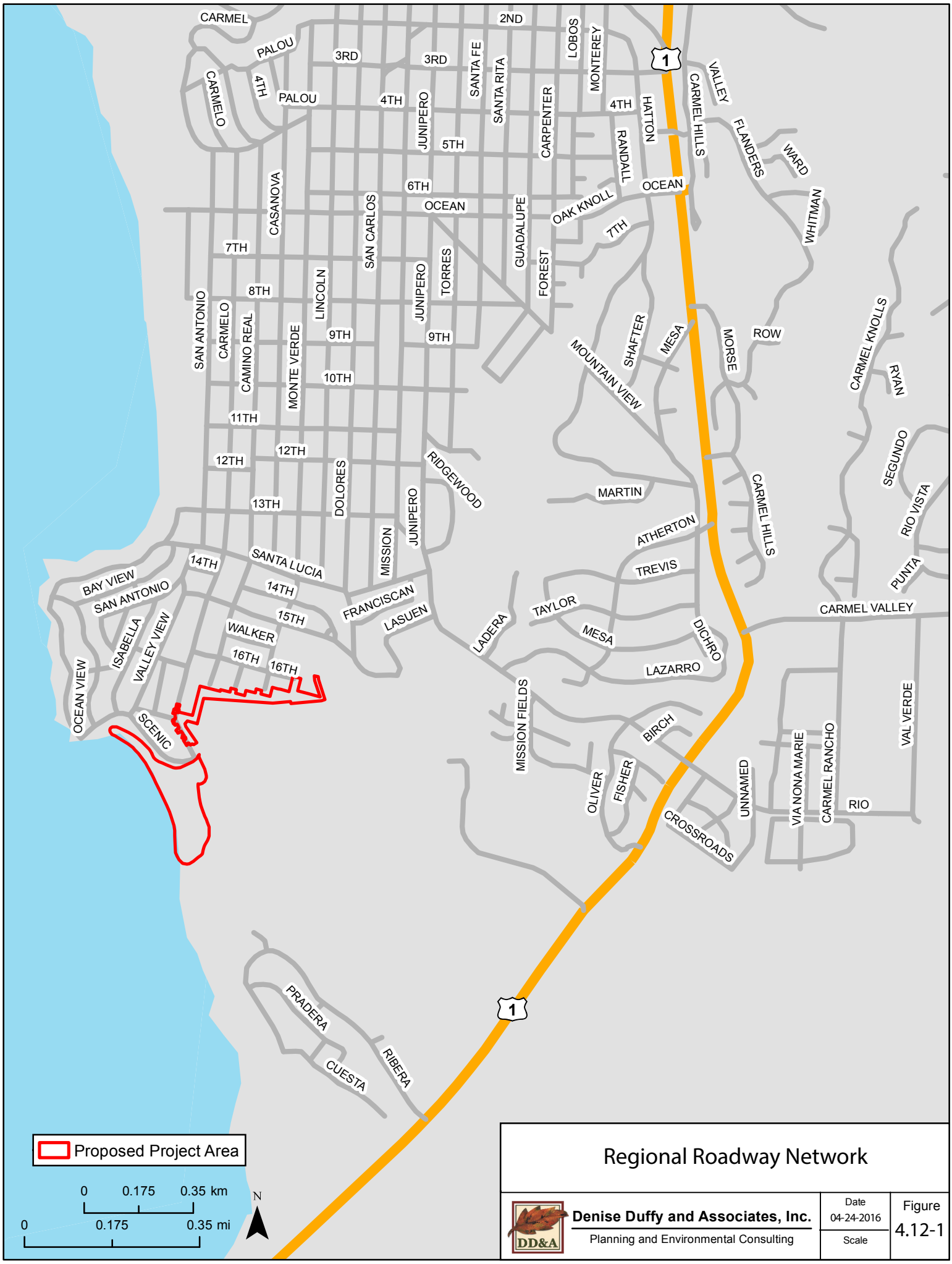
To the extent that issues identified in public comments involve potentially significant effects on the environment according to the CEQA and/or are raised by responsible agencies, they are identified and addressed within this EIR. For a complete list of public comments received during the public scoping period, refer to **Appendix A**, **NOP, and Public Comment Letters** of the Draft EIR.

4.12.1 Environmental Setting

4.12.1.1 Regional Overview

The proposed project is in the unincorporated area of Monterey County, south of the City of Carmel-by-the-Sea. **Figure 4.12-1, Regional Roadway Network,** presents the regional roadway network in the proposed project area.

This Page Intentionally Left Blank


CARMEL
PALOU
3RD
3RD
2ND
LOBOS
MONTEREY
SANTA FE
SANTA RITA
CARPENTER
1
VALLEY
CARMEL HILLS
FLANDERS
WARD
WHITMAN
CARMELO
4TH
PALOU
4TH
JUNIPERO
5TH
4TH
HATTON
RANDALL
OCEAN
6TH
OCEAN
OAK KNOLL
7TH
CASANOVA
SAN CARLOS
GUADALUPE
FOREST
7TH
8TH
LINCOLN
JUNIPERO
TORRES
SAN ANTONIO
CARMELO
CAMINO REAL
MONTE VERDE
9TH
9TH
10TH
MOUNTAIN VIEW
SHAFTER
MESA
MORSE
ROW
CARMEL KNOLLS
RYAN
11TH
12TH
12TH
DOLORES
RIDGEWOOD
SEGUNDO
13TH
MARTIN
CARMEL HILLS
RIO VISTA
ATHERTON
MISSION
JUNIPERO
14TH
SANTA LUCIA
TREVIS
PUNTA
BAY VIEW
SAN ANTONIO
14TH
FRANCISCAN
15TH
LASUEN
TAYLOR
CARMEL VALLEY
WALKER
LADERA
MESA
DICHRO
ISABELLA
VALLEY VIEW
16TH
16TH
LAZARRO
OCEAN VIEW
SCENIC
MISSION FIELDS
BIRCH
VAL VERDE
OLIVER
FISHER
UNNAMED
VIA NONA MARIE
CARMEL RANCHO
RIO
CROSSROADS
PRADERA
1
CUESTA
RIBERA
Proposed Project Area
0
0.175
0.35 km
0
0.175
0.35 mi
N
Regional Roadway Network
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date
04-24-2016
Scale
Figure
4.12-1
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.12-1 Roadways Template.mxd

This Page Intentionally Left Blank

4.12.1.2 Existing Roadway Network

The proposed project area has a network of roads that serve various purposes: arterial streets designed to carry the traffic of local and collector streets to and from freeways and other major streets; collector streets designed to move traffic between arterials to local roadways; and local roads that provide direct access to residential land uses. The roadways that would be most affected by proposed project construction activities (and, to a lesser extent, proposed project operations) are primarily two-lane roads through a residential neighborhood.

The location of the proposed project allows for limited ingress and egress to the proposed project area. Roads that are appropriate for heavy construction equipment travel are further limited. All three of the proposed project components are accessible by Rio Road via Highway 1. Alternately, the only access route to the proposed project area besides Rio Road is to use Highway 1 to Ocean Avenue, through the City of Carmel.

The following is a summary of the local roadway network within and around the proposed project vicinity (**Figure 4.12-2, Local Roadway Network**).

Highway 1 is designated as a State Scenic Highway from the City of Carmel south to Big Sur, including the highway segment to the west of the proposed project site. Highway 1 has four travel lanes (two lanes in each direction) north of Ocean Avenue, before the City of Carmel. South of Ocean Avenue, southbound Highway 1 transitions to one travel lane. The posted speed limit is 65 miles per hour (mph) north of Carpenter Street and 40 mph south of Carpenter Street.

Highway 1 has 12-foot travel lanes with four-foot shoulders; these shoulder widths are less than Caltrans' standard of eight feet. Average Annual Daily Traffic (ADT) for the year 2020 was 16,500 at the intersection of Highway 1 and Rio Road. Rio Road represents the major ingress/egress to the proposed project area. The County's General Plan identifies Highway 1 as an emergency access route.

Rio Road, which intersects with Highway 1, is approximately 1.3 miles in length and is a two-lane surface street that extends to Junipero Street (its eastern terminus). Segments of Rio Road are four-lane, separated by a median, including the section that passes by a medium density residential neighborhood known as Carmel Point. Rio Road has marked public bus stops along its length.

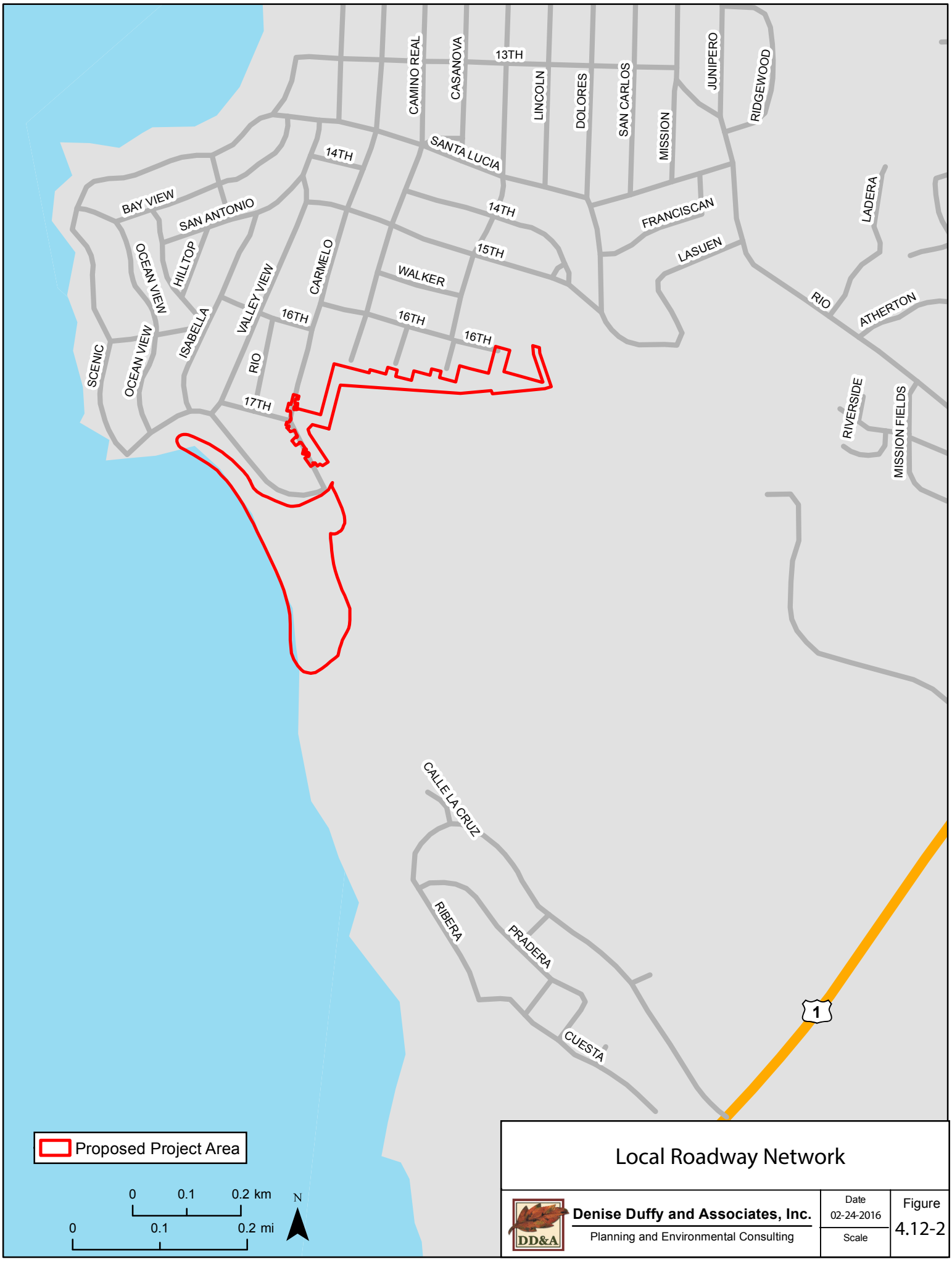
Scenic Road is a local street that follows the shoreline of Carmel Point, originating at Ocean Avenue to the north and terminating at the Carmel River State Beach where it becomes Carmelo Street. No parking is permitted at any time along Scenic Road adjacent to the proposed project site. Signs at the intersection of Scenic Road and Ocean View Avenue to the north of the proposed project site make note of the truck and bus route splitting off onto Ocean View Avenue, heading east.

Lasuen Drive is a two-lane street with room for parking along the side of the road that adjoins Rio Road and Dolores Street's southern terminus. It runs by the Carmel Mission Basilica and the Junipero Serra School.

Santa Lucia Avenue is a local street that has marked public bus stops as well as room for parking on the sides of the street. It spans the distance east to west between Rio Road and Scenic Road. It runs parallel to and just to the north of 14th Avenue.

Monte Verde Street is a local street with marked public bus stops originating near Toyon Heights to the north. The posted speed limit on Monte Verde Street is 25 mph. Its termination to the south abuts the proposed project site. It runs parallel and to the east of Camino Real.

This Page Intentionally Left Blank



Local Roadway Network

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 02-24-2016
Scale:
Figure: 4.12-2

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 4.12-2 Roadways Template.mxd

This Page Intentionally Left Blank

16th Avenue is a local street running east to west that extends from Carmelo Street to its termination to the east, just past Monte Verde Street. It has room for parking along both sides of the road.

Carmelo Street, similar to Monte Verde Street, is a local street with marked public bus stops. The street originates at 4th Avenue to the north, ending to the south at the proposed project site where it becomes Scenic Road. There is room for parking along both sides of the road.

17th Avenue is a local street that extends east to west between and perpendicular to Valley View Avenue and Carmelo Street. Similar to 16th Avenue, there is room for parking on the sides of the street.

Valley View Avenue extends from Scenic Road to the south to San Antonio Avenue to the north and is a local street with minimal room for on-street parking.

Camino Real is a local street that extends between 2nd Avenue to the north and the proposed project site to the south. It is parallel to Carmelo Street and Monte Verde Street and has room for parking on either side of the street.

River Park Place is a small, local street extending perpendicularly from 16th Avenue just above the proposed project site and running south to the proposed project site itself. It has minimal room for on-street parking.

Dolores Street runs parallel to Monte Verde Street to the west, joining with Camino Del Monte to the north and connecting with Lasuen Drive to the south near the Junipero Serra School. It is a local street with sections having a posted speed limit of 20 mph.

4.12.1.3 Traffic Operating Conditions on Roadways

LOS is used to identify the magnitude of traffic congestion and delay at intersections along highways and roadways in some jurisdictions. The LOS is based on several factors, including traffic volumes, number of lanes, type of intersection control, speed and travel time, traffic interruptions, driving comfort and convenience, and is expressed qualitatively on a six-level range of conditions, represented as LOS A (best) to LOS F (worst). LOS A through D represent traffic volumes at less-than roadway capacity, while LOS E represents at capacity conditions, and LOS F represents over capacity or forced flow conditions; see **Table 4.12-1**.

Table 4.12-1 Level of Service Definitions

Level of Service	Description
A	Relatively free flow. No restrictions to vehicle maneuverability or speed. Very slight delay.
B	Stable flow. Some slight reduction in maneuverability and speed. Vehicle platoons form. This is a suitable level of operation for rural design. Slight delay.
C	Stable flow or operation. Higher volumes. More restrictions on maneuverability and speed. This level of operation is suitable for urban planning purposes. Acceptable delay.
D	Approaching unstable flow or operation. Queues develop. Little freedom to maneuver. Tolerable delays for short periods.
E	Unstable flow or operations. Low operating speed; momentary stoppages. This condition is common in peak hours. Congestion; intolerable delay.
F	Forced flow or operation. Many stoppages; jammed conditions.
Source: Transportation Research Board, 2000	

The TAMC 2010 Regional Transportation Plan evaluated the segment of Highway 1 from Carpenter Street to Rio Road in Carmel. This segment was operating at LOS F during peak periods, and it was determined

that Highway 1 will continue to operate at LOS F in 2030 without capacity improvements to the existing alignment. The Draft 2014 TAMC Regional Transportation Plan Project List outlined Regionally Significant Projects in Monterey County, including constructing one new northbound climbing lane between Rio Road and Carmel Valley Road, modifying intersections, and enhance turn movements. These improvements were completed in 2019. This segment of northbound Highway 1 was operating at an arterial LOS E during the weekday morning and evening peak hours and at LOS F during peak weekend hours. In the southbound direction, the segment of Highway 1 between Carmel Valley Road and Rio Road was operating at an arterial LOS D in peak hours. **Table 4.12-2** shows the LOS for roads in the proposed project region.[1]

Table 4.12-2 Highway 1 LOS During Peak Hours, Existing Roadway with Existing (2011-2012) Traffic

Highway 1 Segment and Direction	Weekday Morning Peak Hour	Weekday Evening Peak Hour	Weekend Evening Peak Hour
South of Rio Road, Northbound	E	E	F
Rio Road to Carmel Valley Road, Northbound	E	E	E
North of Carmel Valley Road, Southbound	B	B	B
Rio Road to Carmel Valley Road, Southbound	D	D	D
Source: Traffic Operations Technical Memorandum (April 2004) and Addendum (August 2010)			

City and County jurisdictions, within the County of Monterey, have adopted designated truck routes to reduce problems associated with increased congestion during peak hours and to direct trucks away from certain streets not designed to accommodate the excess weight. Modern trucks accommodate a larger and heavier cargo load and require special geometric designs for roads. A locally designated truck route in the vicinity of the proposed project includes Highway 1 from Rio Road to the Santa Cruz County Line.

Per the County's 1982 General Plan, the acceptable level of service for County roads and intersections is LOS C except in specified situations.

4.12.1.4 Vehicles Miles Traveled

Senate Bill (SB) 743, codified in California PRC Section 21099, required changes to the CEQA Guidelines regarding the analysis of transportation impacts. Pursuant to PRC Section 21099, the criteria for determining the significance of transportation impacts must "promote the reduction of greenhouse gas emissions, the development of multimodal transportation networks, and a diversity of land uses." As a result, the Governor's Office of Planning and Research (OPR) proposed changes to the CEQA Guidelines that identify VMT as the most appropriate metric to evaluate a project's transportation impacts. VMT refers to the amount and distance of automobile travel attributable to a project.

In 2018, OPR released a technical advisory containing the recommendations regarding the assessment of VMT. The technical advisory provides recommendations for assessing VMT and significance thresholds for residential, office, retail, and transportation projects. It does not provide guidance on assessing VMT or recommend significance thresholds associated with public infrastructure projects similar to the proposed

[1] Due to the change in approach and methodology in analyzing traffic impacts from LOS to VMT, there is no current data on the LOS in the project vicinity. Therefore, the RDEIR relies on the best LOS data available, which was published in the original Draft EIR.

project. As noted in the advisory, agencies are directed to choose metrics that are appropriate for their jurisdiction to evaluate the potential impacts of a project in terms of VMT. Updates to the CEQA Guidelines on December 28, 2018, formally adopted the change to VMT. The deadline for adopting policies to implement SB 743 and the provisions of CEQA Guidelines Section 15064.3(b) was July 1, 2020.

The technical advisory also discusses potential screening thresholds for land use projects. Many agencies use "screening thresholds" to quickly identify when a project should be expected to cause a less-than-significant impact without conducting a detailed study (CEQA Guidelines 15063(c)(3)(C), 15128, and Appendix G). The technical advisory suggests that lead agencies may screen out VMT impacts using project size, maps, and transit availability. Specifically, the advisory states that, absent substantial evidence indicating that a project would generate a potentially significant level of VMT or would be inconsistent with a Sustainable Communities Strategy (SCS) or general plan, projects that generate or attract fewer than 110 trips per day generally may be assumed to cause a less-than-significant transportation impact.

4.12.1.5 Transit Service

The Monterey-Salinas Transit (MST) and Greyhound Lines are the main providers of public transit services. MST is a public transportation agency that provides bus service to the greater Monterey and Salinas areas, plus routes to Carmel Valley and North County. Greyhound provides intercity passenger service between Monterey Peninsula cities, Salinas, Salinas Valley cities, as well as intra- and inter-State service (County, 2010).

There is one bus route that runs near the proposed project vicinity: Route 5 from Monterey to Carmel Rancho along Highway 1 and within the City of Carmel. There is an existing bus stop on Carmel Rancho Boulevard east of Highway 1.

4.12.1.6 Bicycle/Pedestrian Facilities

The County of Monterey has approximately 246 miles of maintained bikeways on State, county, and local roads. Bikeways in the County are classified as Class I, II, and III. These classifications follow design standards established by Caltrans:

- Class I (bike path) - a separate right-of-way designed for the exclusive use of cyclists and pedestrians.
- Class II (bike lane) - a lane on a roadway separated from motorists by paint striping; designated for the exclusive use or semi-exclusive use of bicycles.
- Class III (bike route) - allows for shared use of the roadway with motorists; designated by signs or permanent marking.

Near the proposed project, Highway 1 is a designated bicycle route (road with bicycle lane). Existing paved shoulders are five feet wide at some locations, too narrow to meet Caltrans standards.

The Carmel Hills Trail was built in September 2010 and extends from the north bank of the Carmel River, northward in the State Park's property, to the east of Highway 1. It crosses Rio Road at-grade and passes under Carmel Valley Road in a concrete box tunnel. The Carmel Hills Trail is now the main north-south bicycle route in the proposed project area (rather than the shoulder of Highway 1). There are no existing sidewalks on either side of Rio Road to the west of Highway 1 nor throughout the Carmel Point residential neighborhood. Bicycling along Highway 1 with its narrow lanes, blind curves, and heavy traffic is hazardous. Congested traffic conditions combined with steep grades and strong winds are factors that discourage bicycling along the coast.

4.12.2 Regulatory Environment

4.12.2.1 Federal and State

United States Department of Transportation Federal Highway Administration (FHWA) supports State and local governments in the design, construction, and maintenance of the nation's highway system. Caltrans implements Federal interstate highway standards in California.

Caltrans is responsible for constructing, enhancing, and maintaining the State highway and interstate freeway systems. As a result, any change to the State roadway system requires an encroachment permit from Caltrans. Work that requires movement of oversized or excessive load vehicles on highway facilities requires a transportation permit by Caltrans.

In addition to maintaining highways and general regulations and laws dealing with licensing, traffic signage, and other noncommercial driver requirements, State laws, and regulations also govern motor carriers on roadways within the State.

4.12.2.2 Regional/Local

TRANSPORTATION AGENCY FOR MONTEREY COUNTY

TAMC is an independent association of local officials who oversee planning and funding of regional transportation improvements throughout the County of Monterey. The agency prepares the Regional Transportation Plan and oversees the implementation of its recommended improvements.

ASSOCIATION OF MONTEREY BAY AREA GOVERNMENTS

AMBAG prepares studies, plans, policy, and action recommendations that may be incorporated into regulatory documents. In addition to its transportation planning, study functions, and policy recommendations, AMBAG develops and maintains a regional travel demand forecasting model used for the planning of regional transportation facilities and the assessment of development proposals.

RELEVANT PLANNING DOCUMENTS

The 1982 Monterey County General Plan, Carmel Area Land Use Plan, Carmel Area Coastal Implementation Plan, Point Lobos State Reserve and Carmel River State Beach General Plan, the California CCA and the California PRC contain a variety of policies related to traffic and circulation. Please refer to **Section 4.9, Land Use and Planning** for a description of these regulations and plans, and **Appendix C, Applicable Land Use Plans, Policies, and Regulations Consistency Analysis for the Carmel Lagoon Project** for a list of relevant policies and the consistency analysis.

4.12.3 Impacts and Mitigation

4.12.3.1 Thresholds of Significance

Based on Appendix G of the State CEQA Guidelines, the project would result in significant impacts related to traffic and circulation if the project would:

a. Conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities; or
b. Conflict or be inconsistent with CEQA Guidelines CCR Section 15064.3, subdivision (b); or

c. Substantially increases hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment); or
d. Result in inadequate emergency access.

4.12.3.2 Impact Analysis Overview

APPROACH TO ANALYSIS

Construction related trip and traffic assumptions have been developed for each proposed project component. This analysis assumes the construction schedules of the proposed project components would be phased, with some activities occurring simultaneously. The analysis of potential impacts assumes all components would be constructed during an approximately 90-day construction period for the proposed EPB project component, and an approximately 60-day construction period for the proposed SRPS project component. The proposed ISMP project component would occur over one day in October, and two, three-day periods in the winter and summer seasons. This analysis assumed a total of 25 heavy duty truck trips per year would be needed for implementing the proposed ISMP project component. For the purposes of this analysis, it is assumed that one sandbar management event and one closure event would be required each year.

The implementation of the proposed ISMP project component would not involve the construction of any permanent structures requiring operation and maintenance and would not occur in the long-term. In addition, the implementation of the proposed ISMP project component would involve activities similar to short-term construction activities, primarily ground-disturbing activities to manage the Lagoon. Therefore, the potential impacts associated with the implementation of the proposed ISMP project component are considered in the construction impact analysis and this component is not analyzed as a long-term, operational impact.

Construction Assumptions for the Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure Project Components

Construction Duration and Schedule

- Construction is anticipated to be completed within two to five months, depending on the component phasing and the number of concurrent activities.
- General work hours are assumed to be between 7:00 AM and 6:00 PM, Monday through Friday.
- No nighttime construction would occur.

Construction Trips Assumptions

- Traffic-generating construction activities for the proposed EPB and SRPS project components are assumed to consist of the daily arrival and departure of construction work crews, trucks hauling equipment and materials to the work sites, hauling of excavated spoils from the site, and importing fill to the site.
- Proposed project generated truck trips would be dispersed throughout the day (from 9:00 AM to 4:00 PM on weekdays), thus lessening the effect on peak hour traffic.
- Workers would commute to and from the construction areas earlier or later than proposed project related construction truck trips. Based on anticipated work shifts, worker trips would occur prior to the morning peak hour period in order to arrive at the proposed project sites at 7:00 AM. However, worker trips would occur during the afternoon peak hour period from 4:00 PM to 6:00 PM.

- The traffic analysis assumes all workers will drive separately in single occupancy vehicles.
- The average capacity for haul trucks would be 10 cubic yards per truck.
- The truck (haul) trip counts include the number of trucks that would come to the site and leave the site: one incoming trip and one outgoing trip. The worst-case daily assumption would be that all trucks are heavy duty (semi-trucks). The purpose of the trips would be to deliver construction equipment, vehicles, and materials, and to remove construction materials, soil, and waste.
- County employees and contracted employees would implement the proposed ISMP project component, as needed. Activities would occur over one day in October, and two, three-day periods in the winter and summer seasons. This analysis assumed a total of 25 heavy duty truck trips per year would be needed for implementing the proposed ISMP project component.

Construction Staging Areas and Construction Techniques

- The limits of construction for the two proposed project components, including proposed staging and access areas, are shown on **Figure 3-9**, for the proposed EPB project component, and **Figure 3-15**, for the proposed SRPS project component (See **Section 3**, **Project Description**). The staging area for the proposed SRPS project component is proposed at the State Beach parking lot (half of the lot would not be available for public parking). The staging area for the proposed EPB project component would be at the Carmel River Elementary School field at the eastern terminus of 16th Avenue.
- To the extent feasible, parking for construction and worker vehicles would be accommodated within the construction work areas and on adjacent roadways.
- Construction could include site preparation, grading and excavation, equipment and materials deliveries, concrete formwork, trenching, installation of support equipment, installation of security fencing, and revegetation. Heavy construction equipment, including excavators, backhoes, graders, pavers, rollers, bulldozers, concrete trucks, flatbed trucks, boom trucks and/or cranes, forklifts, welding equipment, dump trucks, air compressors, and generators, would be used to perform earthmoving activities.

Construction Traffic and Roadway Controls

- All construction activities within roadways would be restricted to the right-of-way approved by the applicable agency for public right-of-way and property owner for private roads. All roadways disturbed during construction would be restored. Trench spoils would be temporarily stockpiled within the construction easement, then backfilled into the trench after placing materials (e.g., rock, wall, etc.).

Operational Assumptions for Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure Project Components[2]

Employees and Hours of Operation

- Upon completion of construction, the proposed EPB and SRPS project components would always be in place; however, the operation and maintenance of these components would not require any permanent, new employees. Maintenance of these facilities would require annual inspections and response in emergency situations by existing County employees. This analysis assumes four heavy duty truck trips per year would be necessary to maintain the facilities.

AREAS OF NO IMPACT

Some Threshold of Significance criteria outlined above are not applicable to the proposed project or the proposed project would not result in impacts related to these criteria, as explained below.

(a) Conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities. (No impact during the operation of the proposed project). The intent of significance criterion "a" is to account for potential project conflicts with adopted policies, plans, and programs addressing the circulation systems, including transit, roadway, bicycle, or pedestrian facilities or otherwise decrease the performance or safety of such facilities. The proposed project does not include changes in programs, plans, ordinances, or policies that address these facilities, and proposed project operation would not conflict with adopted programs, plans, ordinances, or policies that address these facilities (please refer to **Appendix C** of the Draft EIR). **Impact TRA-1** below addresses Potential temporary impacts to these facilities during proposed project construction.

(c) Substantially Increase Hazards Due to Design or Incompatible Uses. (No impact during construction or operation of the proposed project). Significance criterion "d" does not apply to either the design of the proposed components or construction or operation of the proposed project. The proposed project would not include any new geometric design or alterations of existing features (e.g., sharp curves or dangerous intersections) that could substantially increase hazards. In addition, operational traffic generated by the proposed project would be compatible with the mix of vehicle types (autos and trucks) currently using nearby proposed project area roads. Therefore, the construction and operation of the proposed project would not result in hazards caused by a road design feature or use that is incompatible with existing use.

(d) Result in inadequate emergency access. (No impact during the operation of the proposed project). Operation of the proposed project would have no impact on emergency access as the proposed project would not result in significant permanent impacts to emergency routes. **Section 4.12.3.3**, **Impacts and Mitigation Measures,** below addresses construction impact analyses related to criterion "d".

4.12.3.3 Impacts and Mitigation Measures

Impact TRA-1: <u>Conflict with a program, plan, ordinance, or policy addressing the circulation systems, including transit, roadway, bicycle, and pedestrian facilities during construction of the proposed project</u>. (Criterion a) (EPB: Less-Than-Significant with Mitigation) (SRPS: Less-than-Significant with Mitigation) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant with Mitigation)

[2] Potential impacts associated with the implementation of the proposed ISMP project component are considered in the construction impact analysis and the proposed ISMP project component is not analyzed as a long-term, operational impact.

CONSTRUCTION TRAFFIC LOS AND CAPACITY IMPACTS

Construction activities would result in a temporary increase in traffic on the regional circulation system during the construction period. Traffic generated during construction activities would include the daily arrival and departure of construction work crews, trucks hauling equipment and materials to the work sites, hauling of excavated debris and spoils from the site, and importing of fill to the construction sites. The number of construction related trips would vary among the proposed project components. Activities associated with the construction of the proposed project components and implementation of the proposed ISMP project component would take place at various locations in the proposed project area (e.g., staging area, pump stations, State Parks parking lot, etc.). The three proposed project components may be constructed simultaneously and the construction traffic for the components could use the same roads.

Construction workers and construction vehicles would use regional highways and local roadways to access the construction work areas. Highway 1, Rio Road, Carmelo Street, and 16th Avenue would be the primary access roads to the proposed project sites.

The construction of the proposed EPB project component could employ up to 10 workers per day, and, based on the assumptions described above, result in 20 trips per day for the three-month construction period. The construction of the proposed SRPS project component could employ up to 15 workers per day, and, based on the assumptions described above, result in 30 trips per day for the two-month construction period. Approximately 300 trips would be required for construction materials for the proposed EPB project component, and approximately 1,000 trips would be required for the proposed SRPS project component.

The ultimate construction schedule of the proposed project components would be determined when funding becomes available and design plans are finalized; as such, the schedule could vary from what is presented in this analysis. Likewise, the exact construction characteristics, such as excavation quantities or estimated truck trips, could also vary. However, the construction scenario characteristics summarized herein have been developed to allow a reasonable assessment of the nature and magnitude of potential construction impacts.

Construction-related worker trips are expected to occur prior to the weekday morning peak traffic periods (7:00 AM to 9:00 AM), but during the weekday afternoon peak traffic periods (4:00 PM to 6:00 PM) given the anticipated work shifts. Project generated truck trips would be dispersed throughout the day (9:00 AM to 4:00 PM on weekdays), thus lessening the effect on peak hour traffic.

Most traffic analyses (including analyses on projects consistency with programs, plans, ordinances, and policies) rely on an analysis of changes to an intersection or roadway LOS standards, as set by local jurisdictions, in order to evaluate the long-term effects of projects on the operations of roadways and intersections. Per the County's 1982 General Plan, the acceptable level of service for County roads and intersections is LOS C except in specified situations. However, construction projects that increase traffic only temporarily, or that result in traffic fluctuations, do not have a long-term effect on LOS. Additionally, most LOS analyses focus on the peak hours of traffic (typically morning and evening commute times). By contrast, many of the worker trips for the construction period would be outside these typical peak hours, as discussed above. Construction workers are expected to commute to and from the construction work areas earlier and/or later than project related construction truck trips, which are expected to be distributed throughout the day at any one work site. Additionally, daily traffic volumes on public roads typically vary from day to day by five to ten percent; therefore, any temporary increase in traffic due to construction would be within the typical daily fluctuation and would not be perceptible to the average motorist. Construction related vehicle trips on local, two-lane roadways in the proposed project area

would not substantially affect traffic flow if the traffic volumes remained within the carrying capacity of the roads (roughly 10,000 to 15,000 vehicles per day for two-lane roads, depending on design features). For all the reasons described above, the analysis of the proposed project construction traffic impacts focuses on overall roadway capacity and traffic safety, rather than the County's LOS standards.

Construction of the proposed EPB project component would be expected to result in approximately 20 daily trips. At worst-case, approximately 10 worker trips would occur during the weekday afternoon peak period. The peak hour trips would occur primarily on Carmelo Street and 16th Avenue and then onto Rio Road and Highway 1, with an estimated temporary traffic increase of approximately 10 peak hour trips along these routes over a three-month construction period. Traffic flows along these routes would not be substantially affected by the short-term, three-month construction activities at the EPB proposed project site. This impact would be less-than-significant.

Construction of the proposed SRPS project component would be expected to result in approximately 30 daily trips; at worst-case, approximately 15 worker trips would occur during the weekday afternoon peak period. The peak hour trips would occur primarily on Carmelo Street and then onto Rio Road and Highway 1, with an estimated temporary traffic increase of approximately 15 peak hour trips over a two-month construction period. Traffic flows along these routes would not be substantially affected by the short-term, two-month construction activities at the proposed SRPS project component site. This impact would be less-than-significant.

Construction at the proposed EPB and SRPS project components sites could result in overlapping construction schedules and both of these components could produce construction related trips along Highway 1. Based on the above discussion, it is estimated that approximately 25 construction workers and truck trips would be distributed along Highway 1 during the weekday afternoon peak period. The most recent Caltrans traffic volume counts identify peak hour volumes of 1,800 trips at the intersection of Highway 1 and Rio Road (Caltrans, 2020). The additional temporary construction trips represent approximately 0.01% of the peak hour trips. This impact would not be substantial and would be within the daily fluctuation of traffic volumes expected on the highway. Therefore, this impact would be less-than-significant.

The implementation of the proposed ISMP project component would require an estimated 25 truck trips to place the sandbags, conduct the breach, remove the sandbags, and close the sandbar over approximately four time periods, averaging two days each and six trips each. These activities would occur outside morning and afternoon peak hour periods based on anticipated work shifts. As a result, the implementation of the proposed ISMP project component would result in temporary, intermittent, increases in traffic in the proposed project vicinity due to vehicles accessing the site. This temporary, short-term traffic would not cause a substantial increase in traffic in relation to the existing traffic load and capacity of the surrounding road network. This impact would be less than significant.

CONSTRUCTION IMPACTS TO TRANSIT, BICYCLE, AND PEDESTRIAN FACILITIES

As described above, construction activities could occur within vehicle travel lanes and/or road shoulders, which may require temporary lane closures and/or detours. These lane closures and detours would temporarily reduce roadway performance and result in temporary traffic delays during project construction, potentially affecting transit, bicycle, and pedestrian facilities, as discussed below. These closures and detours may also include potential disruption of access to residences, businesses, schools, and/or recreational facilities. The movement of construction trucks could result in slower travel speeds and potential delays in the project area.

During project construction, bicyclists and pedestrians may need to enter the adjacent road shoulder or use other temporary detours to circumvent construction work areas. Construction activities may affect safety of bicycle and pedestrian facilities in the proposed project area due to:

- Conflicts between haul trucks and other large construction vehicles (with slower speeds and wider turning radii than automobiles) and automobiles, bicyclists, and pedestrians using the roadways.
- Conflicts related to the movement of traffic on travel lanes adjacent to construction work areas, particularly at entry and egress points where construction-related vehicles would access public roadways.
- Confusion on the part of bicyclists and pedestrians due to temporary changes in bicycle and pedestrian circulation along designated bicycle routes, bike lanes, and other sidewalks and public pathways.

The proposed EPB and SRPS project components sites are located within an area with high recreational use, including bicycle and pedestrian use, as well as vehicle traffic from tourists and locals due to the scenic views in the area. Therefore, impacts to bicycle and pedestrian facilities in the project area during construction of the proposed EPB and SRPS project components would be potentially significant, but implementation of **Mitigation Measure TRA-1a,** identified below, would reduce this impact to a less-than-significant level.

As described above, the implementation of the proposed ISMP project component would result in temporary, intermittent, increases in traffic in the proposed project vicinity due to vehicles accessing the site, but would not significantly affect bicycle or pedestrian facilities. This impact would be less-than-significant.

Construction activities for the proposed project components would not disrupt access to the bus stop in the proposed project vicinity, which is located on Carmel Rancho Boulevard east of Highway 1. No construction-related traffic delays, safety, or access limitations to transit operations or facilities would result from the construction of the proposed project components. This impact would be less-than-significant.

CONSTRUCTION PARKING INTERFERENCE

During the construction of the proposed EPB and SRPS project components, workers are assumed to drive their own vehicles to the component staging area or proposed project component construction site, which could result in an increased parking demand at certain locations. Parking demand would vary among the individual project components and would also depend on the construction phase and the nature of construction activities. Depending on the width of the vehicle travel lanes or adjacent road shoulders, construction activities could temporarily displace parking spots and adversely affect parking conditions due to worker parking demands, including parking in the Coastal Zone and near parks, such as the Carmel River Beach State Park. While a reduction of parking is not considered an environmental impact under the CEQA Guidelines, a parking deficit may result in roadway hazards in heavily trafficked residential and recreational areas. Therefore, this impact would be potentially significant. However, implementation of **Mitigation Measure TRA-1b,** identified below, may reduce this impact to a less-than-significant level.

As described above, the implementation of the proposed ISMP project component would result in temporary, intermittent, increases in traffic in the proposed project vicinity due to vehicles accessing the site, but would not significantly affect parking in the area. This impact would be less-than-significant.

CONSTRUCTION-RELATED ROADWAY DETERIORATION

Construction truck trips may result in increased wear and tear on the designated haul routes, which could result in temporary impacts to performance of the regional circulation system. The use of trucks to transport equipment and material to and from the construction work areas could affect road conditions on the designated haul routes by increasing the rate of road wear. The degree to which this impact would occur depends on the roadway design (pavement type and thickness) and the existing condition of the road. Freeways and major arterials (e.g., Rio Road and Highway 1) are designed to manage a mix of vehicle types, including heavy trucks. Therefore, the significant roadway deterioration impacts of project related construction traffic is not expected to occur on those roads. However, some local roadways may not have been constructed to support use by heavy construction trucks and vehicles, and project related construction truck trips could cause excessive wear and tear on these roadways, which would be a potentially significant impact. Implementation of **Mitigation Measure TRA-1c**, which requires rehabilitation of any roadways damaged following construction, would reduce this impact to a less-than-significant level.

As described above, the implementation of the proposed ISMP project component would result in temporary, intermittent, increases in traffic in the proposed project vicinity due to vehicles accessing the site, but would not result in significant roadway deterioration in the area. This impact would be less-than-significant.

Impact Conclusion

Proposed project related construction activities would result in a temporary increase in traffic from construction workers and trucks traveling to and from the construction work areas. The number of onsite workers would vary throughout the construction phases, and truck and equipment-related deliveries would be spread out over the construction workday. Given the anticipated worker shifts, most daily traffic would be outside of the peak traffic periods, except for construction worker traffic in the afternoon. The implementation of the proposed ISMP project component would result in approximately 25 trips to the site annually, spread out over four different time periods.

Construction traffic would use Highway 1 to access the proposed EPB and SRPS project component sites, which could result in increased trips along Highway 1 that are higher than the maximum number of daily vehicle trips associated with each proposed project component. However, the worst-case increases in traffic resulting from concurrent construction of two proposed project components during peak periods of construction would fall within the daily fluctuations of traffic on Highway 1.

Given the above, temporary construction traffic would not cause a substantial increase in traffic relative to existing conditions and roadway capacity or contribute substantial volumes of traffic during peak hours at the proposed EPB and SRPS project components sites. The estimated maximum increase in traffic along regional roadways would remain within the carrying capacities of the regional roadways and would not substantially affect traffic flow. Therefore, the impact is less-than-significant. As a result, the proposed project would not result in significant construction related LOS or capacity impacts, or conflict with any associated LOS or capacity programs, plans, ordinances, or policies. This impact would be less than significant and no mitigation measures are necessary.

The construction of the proposed EPB and SRPS project components would temporarily reduce roadway performance and result in temporary traffic delays, potentially affecting transit, bicycle, and pedestrian facilities. Therefore, impacts to bicycle and pedestrian facilities in the project area

during construction of the proposed EPB and SRPS project components would be potentially significant. However, Implementation of **Mitigation Measure TRA-1a (Traffic Control and Safety Assurance Plan),** identified below, would reduce this impact to a less-than-significant level .

Construction of the proposed EPB and SRPS project components could result in potentially significant parking impacts due to temporary increases in parking demand and the displacement of on-street parking. Implementation of **Mitigation Measure TRA-1b,** (**Construction Parking Requirements)** would reduce this impact to a less-than-significant level.

The use of trucks to transport construction equipment and materials could adversely affect road conditions on local roadways. However, implementation of **Mitigation Measure TRA-1c (Roadway Rehabilitation Program)** would reduce this impact to a less-than-significant level.

The implementation of the proposed ISMP project component would result in temporary, intermittent, increases in traffic in the proposed project vicinity due to vehicles accessing the site, but would not result in significant impacts to transit, bicycle, or pedestrian facilities, or result in significant parking reduction or roadway deterioration in the area. This impact would be less-than-significant.

Mitigation Measures

Mitigation Measure TRA-1a: Traffic Control and Safety Assurance Plan (Applies to EPB and SRPS project components). Prior to construction of the EPB and SRPS project components, the County and/or its contractor shall prepare and implement a traffic control plan or plans for the roadways and intersections affected by construction. The traffic control plan(s) shall comply with the affected jurisdiction's encroachment permit requirements and shall be based on detailed design plans. For all project construction activities that could affect public rights-of-ways (e.g., roadways, sidewalks, and walkways), the plan shall include measures that would provide for continuity of vehicular, pedestrian, and bicyclist access, reduce the potential for traffic accidents, and ensure worker safety in construction zones. Where project construction activities could disrupt mobility and access for bicyclists and pedestrians, the plan shall include measures to ensure safe and convenient access would be maintained.

The traffic control and safety assurance plan shall be developed on the basis of detailed design plans for the approved project. The plan shall include, but not necessarily be limited to, the elements listed below:

General

- Develop circulation and detour plans to minimize impacts on local streets. As necessary, signage and/or flaggers shall be used to guide vehicles to detour routes and/or through the construction work areas.
- Implement a public information program to notify motorists, bicyclists, nearby residents, and adjacent businesses of the impending construction activities (e.g., media coverage, email notices, websites, etc.). Notices of the location(s) and timing of lane closures shall be published in local newspapers and on available websites to allow motorists to select alternative routes.

Roadways

- Haul routes that minimize truck traffic on local roadways and residential streets shall be used to the extent feasible.

- Schedule truck trips outside of peak morning and evening commute hours to minimize adverse impacts on traffic flow.
- Limit lane closures during peak hours. Travel lane closures, when necessary, shall be managed such that one travel lane is kept open at all times to allow alternating traffic flow in both directions along affected two-lane roadways; the contractor shall use steel plates or trench backfilling to restore vehicle access at the end of each workday.
- Restore roads and streets to normal operation by covering trenches with steel plates outside of normal work hours or when work is not in progress.
- Comply with roadside safety protocols to reduce the risk of accidents. Provide "Road Work Ahead" warning signs and speed control (including signs informing drivers of State legislated double fines for speed infractions in a construction zone) to achieve required speed reductions for safe traffic flow through the work zone. Train construction personnel to apply appropriate safety measures as described in the plan.
- Provide flaggers in school areas at street crossings to manage traffic flow and maintain traffic safety during the school drop-off and pickup hours on days when pipeline installation would occur in designated school zones.
- Maintain access to private driveways.

Pedestrian and Bicyclists

- Perform construction that crosses on street and off-street bikeways, sidewalks, and other walkways in a manner that allows for safe access for bicyclists and pedestrians. Alternatively, provide safe detours to reroute affected bicycle/pedestrian traffic.

Recreational Trails

- At least two weeks prior to construction, post signage along all potentially affected recreational trails, Class I, II, and III bicycle routes, and pedestrian pathways to warn bicyclists and pedestrians of construction activities. The signs shall include information regarding the nature of construction activities, duration, and detour routes. Signage shall be composed of or encased in weatherproof material and posted in conspicuous locations, including on park message boards and existing wayfinding signage and kiosks, for the duration of the closure period. At the end of the closure period, the County or its contractors shall retrieve all notice materials.

Emergency Access

- Maintain access for emergency vehicles at all times. Coordinate with facility owners or administrators of sensitive land uses, such as police and fire stations, transit stations, hospitals, and schools.
- Provide advance notification to local police, fire, and emergency service providers of the timing, location, and duration of construction activities that could affect the movement of emergency vehicles on area roadways.
- Avoid truck trips through designated school zones during the school drop-off and pickup hours.

Mitigation Measure TRA-1b: Construction Parking Requirements (Applies to EPB and SRPS project components). Prior to commencing project construction, the construction contractor(s) shall coordinate with the potentially affected jurisdictions to identify designated worker parking areas that would avoid or minimize parking displacement. The contractors shall provide transport between the designated parking location and the construction work areas. The construction contractor(s) shall also provide incentives for workers that carpool or take public transportation to the construction work areas. The engineering and construction design plans shall specify that contractors limit the time of construction within travel lanes and public parking spaces and provide information to the public about locations of alternative spaces to reduce parking disruptions.

Mitigation Measure TRA-1c: Roadway Rehabilitation Program (Applies to EPB and SRPS project components). Prior to commencing project construction, the County shall detail the preconstruction condition of all local construction access and haul routes proposed for substantial use by project related construction vehicles. The construction routes surveyed must be consistent with those identified in the construction traffic control and safety assurance plan developed under **Mitigation Measure TRA-1a** (described above). After construction is completed, the same roads shall be surveyed again to determine whether excessive wear and tear or construction damage has occurred. Roads damaged by project related construction vehicles shall be repaired to a structural condition equal to that which existed prior to construction activities.

Impact TRA-2: Conflict or be inconsistent with CEQA Guidelines Section 15064.3(b). Construction and operation of the proposed project would not result in a significant increase in vehicle miles traveled or conflict or be inconsistent with CEQA Guidelines Section 15064.3(b). (Criterion b) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

As described in **Section 4.12.1.4, Vehicle Miles Traveled**, OPR released a technical advisory containing the recommendations regarding the assessment of VMT. The technical advisory provides recommendations for assessing VMT and significance thresholds for residential, office, retail, and transportation projects. It does not provide guidance on assessing VMT or recommend significance thresholds associated with public infrastructure projects similar to the proposed project. Section 15064.3(b) formally adopted the change to VMT as a part of CEQA Guideline updates on December 28, 2018.

The technical advisory discusses potential screening thresholds for land use projects. Many agencies use "screening thresholds" to quickly identify when a project should be expected to cause a less-than-significant impact without conducting a detailed study (CEQA Guidelines 15063(c)(3)(C), 15128, and Appendix G). The technical advisory suggests that lead agencies may screen out VMT impacts using project size, maps, and transit availability. Specifically, the advisory states, absent substantial evidence indicating that a project would generate a potentially significant level of VMT or would be inconsistent with a SCS or general plan, projects that generate or attract fewer than 110 trips per day generally may be assumed to cause a less-than-significant transportation impact.

While not formally adopted or approved, the County has developed Draft VMT thresholds based on the guidance provided by OPR. The County's Draft VMT thresholds consider the VMT performance of residential and non-residential components of a project separately, using the efficiency metrics of VMT per capita and VMT per employee, respectively. For retail components of a project, or other client-driven

uses, the county-wide VMT effect is analyzed. The County's Draft VMT thresholds of significance are summarized below for each of these components:

- Residential – 15% below baseline countywide VMT per Capita.
- Employment based land uses (e.g., office) – 15% below baseline countywide VMT per Employee
- Customer based non-residential land uses (e.g., retail) – No net increase in VMT.

However, these land use components are not applicable to the proposed project and the OPR technical advisory does not include guidance on analyzing a public infrastructure project similar to the proposed project. Therefore, in accordance with OPR's technical advisory, this analysis applies the threshold of the proposed project generating or attracting 110 trips or more per day to determine if the proposed project would cause a significant transportation impact.

The implementation of the proposed ISMP project component would require an estimated 25 truck trips to place the sandbags, conduct the breach, remove the sandbags, and close the sandbar over approximately four time periods, averaging two days each and six trips each. The construction of the proposed EPB project component could employ up to 10 workers per day, and, based on the assumptions described above, result in 20 trips per day for the three-month construction period. The construction of the proposed SRPS project component could employ up to 15 workers per day, and, based on the assumptions described above, result in 30 trips per day for the two-month construction period. Approximately 300 trips would be required for construction materials for the proposed EPB project component, and approximately 1,000 trips would be required for the proposed SRPS project component. Thus, the construction of the proposed EPB project component could result in approximately 30 trips per day, and the construction of the proposed SRPS project component could result in approximately 25 trips per day. The ultimate construction schedule of the proposed project components would be determined when funding becomes available and design plans are finalized. As such, the schedule could vary from what is presented in this analysis. However, given the nature and magnitude of the proposed project, it is reasonable to assume that these project components, individually or combined, would not generate, or attract 110 trips or more per day.

The operation of the proposed EPB and SRPS project components would not require any permanent, new employees or daily oversight and maintenance. Maintenance of these facilities would require annual inspections and response in emergency situations by existing County employees. This analysis assumes four heavy duty truck trips per year would be needed for the maintenance of the facilities. Therefore, the operation of these project components, individually or combined, would not generate, or attract 110 trips or more per day.

Impact Conclusion

The construction and operation of the proposed project components, individual or combined, would not generate, or attract 110 trips or more per day. Therefore, in accordance with the technical advisory, the proposed project would have a less-than-significant transportation impact and no mitigation measures are necessary.

Impact TRA-3: <u>Result in Inadequate Emergency Access</u>. Construction of the proposed EPB and SRPS project components would result in an increase in traffic and delays, which may affect emergency access in the project area. (Criterion d) (EPB: Less-than-Significant with Mitigation) (SRPS: Less-than-Significant with Mitigation) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant with Mitigation)

The County's 1982 General Plan identifies Highway 1 as an emergency access route. As discussed above, construction activities associated with the proposed EPB and SRPS project components could require construction within some vehicle travel lanes and road shoulders. Temporary reductions in travel lanes and the roadway capacities to accommodate work areas could result in delays for emergency vehicles. This impact would be potentially significant.

As described above, the implementation of the proposed ISMP project component would result in temporary, intermittent, increases in traffic in the proposed project vicinity due to vehicles accessing the site, but would not significantly affect access to the area. This would be a less-than-significant impact.

Impact Conclusion

Traffic delays and access limitations resulting from temporary lane closures and detours could result in delays to emergency access during construction of the proposed EPB and SRPS project components, but the effects would be short-term in duration for any one location. Construction would require issuance of encroachment permits from the County, Carmel Unified School District, and State Parks for any construction within public rights-of-ways. However, implementation of **Mitigation Measure TRA-1a (Traffic Control and Safety Assurance Plan)**, which includes measures to minimize the adverse effects of roadway construction and detours, would reduce these impacts to a less-than-significant level.

Implementation of the proposed ISMP project component would not result in significant access issues for emergency vehicles. This impact would be less than significant and no mitigation is necessary.

4.12.4 References

California Governor's Office of Planning and Research. 2018. Technical Advisory on Evaluating Transportation Impacts in CEQA. Available at: https://opr.ca.gov/ceqa/docs/20190122-743_Technical_Advisory.pdf

[Caltrans] California Department of Transportation, 2020. *2020 Traffic Volumes on California State Highways*, 2013. Available online at: https://dot.ca.gov/programs/traffic-operations/census. Accessed July 27, 2023.

[County] Monterey County. 1982. General Plan.

[County] Monterey County. 1999. Carmel Area Land Use Plan

[County] Monterey County. 2010. General Plan.

[TAMC] Transportation Agency for Monterey County. 2010. Regional Transportation Plan.

Transportation Research Board, 2000. Highway Capacity Manual. Available at: https://sjnavarro.files.wordpress.com/2008/08/highway_capacital_manual.pdf.

Traffic Operations Technical Memorandum (April 2004) and Addendum (August 2010).

4.13 ENERGY

This section describes the existing energy use at the State and regional level and evaluates the extent to which the proposed project could result in wasteful consumption of energy resources or conflict with regulations related to energy use. No comments concerning energy use were received during the public scoping period for the Draft EIR (refer to **Appendix A**, **NOP and Public Comment Letters**).

4.13.1 Environmental Setting

EIR's analyze energy consumption because of the environmental impacts associated with its production and usage. Such impacts include the depletion of nonrenewable resources (e.g., oil, natural gas, coal, etc.) and emissions of pollutants during both the production and consumption phases of energy use.

Energy usage is typically quantified using the British thermal unit (Btu).[1] As points of reference, the approximate amount of energy contained in a gallon of gasoline, a cubic foot of natural gas, and a kilowatt hour (kWh) of electricity are 123,000 Btus, 1,000 Btus, and 3,400 Btus, respectively. Utility providers measure natural gas usage in terms. One term is equal to 100,000 Btus.

Electrical energy is expressed in units of kilowatts (kW) and kWh. One kilowatt, a measurement of power (energy used over time), equals one thousand joules[2] per second. A kilowatt-hour is a measurement of energy. If run for one hour, a 1,000-watt (one kW) hair dryer would use one kilowatt-hour of electrical energy. Other measurements of electrical energy include the megawatt (1,000 kW) and the gigawatt (1,000,000 kW).

Total energy usage in California was approximately 7,830 trillion Btus in the year 2016 (the most recent year for which this specific data was available). The breakdown by sector was approximately 17.7% for residential uses, 18.9% for commercial uses, 23.7% for industrial uses, and 39.8% for transportation (Energy Information Administration, 2019).

According to the United States Energy Information Administration (EIA), existing energy use in California primarily consists of natural gas (2,248.9 trillion Btu in 2016), electricity (797.8 trillion Btu in 2016), and fuel for vehicle trips (1,713 trillion Btu in 2016) (EIA, 2019). Therefore, the remainder of this discussion will focus on the most relevant sources of energy: natural gas, electricity, and gasoline for vehicle trips.

Electricity supply in California involves a complex grid of power plants and transmission lines. In 2014, California produced approximately 75% of the electricity it consumed; it imported the remaining 25% from 11 western states, Canada, and Mexico. Decreases in hydroelectric generation resulting from lower precipitation in California and the northwest were replaced by an increase in renewable energy generation, specifically utility scale solar photovoltaic, solar thermal, and wind generation.

Starting in 2018, all Pacific Gas & Electric (PG&E) customers within the County of Monterey, County of San Benito, and County of Santa Cruz were automatically enrolled in Central Coast Community Energy (3CE) (formerly Monterey Bay Community Power [MBCP]). 3CE is a locally controlled public agency providing carbon free electricity to residents and businesses. Formed in February 2017, 3CE is a joint powers authority, and is based on a local energy model called community choice energy. 3CE partners with PG&E,

[1] A Btu is the amount of energy that is required to raise the temperature of one pound of water by one degree Fahrenheit.
[2] As defined by the International Bureau of Weights and Measures, the joule is a unit of energy or work. One joule equals the work done when one unit of force (a Newton) moves through a distance of one meter in the direction of the force.

which continues to provide billing, power transmission and distribution, customer service, grid maintenance services and natural gas services to the County of Monterey. 3CE's standard electricity offering is carbon free and is classified as 30 percent renewable. Of the electricity provided by 3CE in 2018, 40 percent was hydroelectric and 30 percent was solar and wind (eligible renewables) (3CE, 2019).

4.13.1.1 Electricity

In 2017, 34 percent of the State's electricity was generated by natural gas, nine percent by nuclear, 15 percent by large hydroelectric, and four percent by coal. Renewable sources such as photovoltaic systems, biomass power plants, and wind turbines accounted for 29 percent of California's electricity. Nine percent of California's power comes from unspecified sources (California Energy Commission [CEC], 2017a).

In 2017, total system electric generation for California was 292,039 gigawatt-hours (GWh), up 0.5 percent from 2016's total generation of 290,567 GWh. California's non-CO_2 emitting electric generation categories (nuclear, large hydroelectric, and renewable generation) accounted for more than 56 percent of total in-State generation for 2017, compared to 50 percent in 2016. California's in-state electric generation was up by four percent to 206,336 GWh compared to 198,227 GWh in 2016 while net imports were down by seven percent or 6,638 GWh to 85,703 GWh. The overall modest increase observed in California's total system electric generation for 2017 is consistent with the recently published California Energy Demand (CED) 2018 – 2030 Revised Forecast:

"Annual growth from 2016 – 2027 for the CED 2017 Revised forecast averages 1.64%, 1.32%, and 1.02% in the high, mid, and low cases, respectively, compared to 1.02% in the CED 2016 mid case" (CEC, 2018).

Factors contributing to the increase in total system electric generation include growth in the number of light duty electric vehicles registered in the State, increased manufacturing electricity consumption, and reductions in savings from energy efficiency programs, this last point suggesting that population growth is the primary driver of increased electricity consumption (CEC, 2018).

As of 2018, all PG&E customers within the County of Monterey, County of San Benito, and the County of Santa Cruz were automatically enrolled in 3CE, as discussed previously. Electricity usage for differing land uses varies substantially by the type of uses in a building, the type of construction materials used, and the efficiency of the electricity consuming devices used. Electricity in the County of Monterey in 2017 was primarily consumed by the non-residential sector at 73 percent, while the residential sector consumed 27 percent. In 2017, approximately 2,589 GWh of electricity was consumed in the County of Monterey (CEC, 2017b).

4.13.1.2 Natural Gas

California continues to depend upon out-of-state imports for nearly 90 percent of its natural gas supply, approximately 10 percent of California's natural gas supply came from in-state production (CEC, 2018). In 2015, approximately 36 percent of the natural gas delivered for consumption in California was for electricity generation, 35 percent for industrial uses, 18 percent for residential uses, 10 percent for commercial uses and less than one percent for transportation. As with electricity usage, natural gas usage depends on the type of uses in a building, the type of construction materials used, and the efficiency of natural gas consuming devices. In 2015, the State of California consumed approximately 2.3 trillion cubic feet of natural gas, or 2.36 quads (1,015 Btu) (EIA, 2018a and 2018b).

Overall demand for direct service natural gas in the commercial residential sectors of California is expected to flatten or decrease because of overall energy efficiency. Demand for natural gas at power

plants for electricity generation is also expected to decrease by one percent by 2025 (as compared to 2013 demand rates). This decrease is a result of increases in renewable power generation (CEC, 2013).

4.13.1.3 Gasoline for Motor Vehicles

Excluding federal offshore areas, California was the third largest producer of petroleum among the 50 states in 2016, after Texas and North Dakota. As of January 2017, California was third in oil refining capacity, with a combined capacity of almost 2,000,000 barrels per calendar day at the State's 18 operable refineries. In 2015, California accounted for one-fifth of the nation's jet fuel consumption (CEC, 2017a).

The average fuel economy for light-duty vehicles (autos, pickups, vans, and SUVs) in the United States has steadily increased from about 13.1 miles-per-gallon (mpg) in the mid-1970s to 23.9 mpg in 2015 (United States Bureau of Transportation Statistics, 2015). Federal fuel economy standards have changed substantially since the Energy Independence and Security Act was passed in 2007. The 2007 standard, which originally mandated a national fuel economy standard of 35 miles per gallon by the year 2020, was subsequently revised to apply to cars and light trucks of Model Years 2011 through 2020 (U.S. Department of Energy, 2007). In 2012, the federal government raised the fuel economy standard to 54.5 mpg for cars and light-duty trucks by Model Year 2025.

4.13.2 Regulatory Environment

4.13.2.1 Federal

At the federal level, energy standards set by the United States EPA apply to numerous consumer and commercial products (e.g., the EnergyStar™ program). The EPA also sets fuel efficiency standards for automobiles and other modes of transportation.

FEDERAL ENERGY POLICY AND CONSERVATION ACT

Congress passed the Energy Policy and Conservation Act of 1975 in response to the oil crisis of 1973, which increased oil prices due to a shortage of reserves and sought to ensure all vehicles sold in the United States would meet certain fuel economy standards. The Act established the first fuel economy standards for on-road motor vehicles in the United States. Since 1996, the fuel economy standard for new light trucks (gross vehicle weight of 8,500 pounds or less) has been 20.7 miles per gallon. Heavy-duty vehicles (i.e., vehicles and trucks over 8,500 pounds gross vehicle weight) are not subject to fuel economy standards.

4.13.2.2 State

CALIFORNIA RENEWABLE ENERGY STANDARDS

In 2002, California established its Renewables Portfolio Standard (RPS) Program, with the goal of increasing the percentage of renewable energy in the State's electricity mix to 20 percent of retail sales by 2010. In 2006, SB 107 codified California's 20 percent by 2010 RPS goal. Under the provisions of SB 107 (signed into law in 2006), investor-owned utilities were required to generate 20 percent of their retail electricity using qualified renewable energy technologies by the end of 2010. In 2008, EO S-14-08 established that retail sellers of electricity serve 33 percent of their load with renewable energy by 2020. As described previously, PG&E's (the electricity provider to the project site) 2015 electricity mix was 30 percent renewable.

In October 2015, SB 350 was passed, which codified California's climate and clean energy goals. A key provision of SB 350 for retail sellers and publicly owned utilities requires them to procure 50 percent of the State's electricity from renewable sources by 2030.

CALIFORNIA BUILDING CODES

At the State level, the 1978 Energy Efficiency Standards for Residential and Nonresidential Buildings, as specified in Title 24, Part 6, of the CCR, came in response to a legislative mandate to reduce California's energy consumption. Title 24 is updated approximately every three years; the 2016 standards became effective January 1, 2017. The 2019 Title 24 updates were adopted May 9, 2018, and went into effect on January 1, 2020 (BSC, 2018a). Compliance with Title 24 is mandatory at the time new building permits are issued by city and county governments (CEC, 2015).

4.13.3 Impacts and Mitigation

4.13.3.1 Thresholds of Significance

Based on Appendix G of the State CEQA Guidelines, the project would have a significant energy impact 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.

4.13.3.2 Impact Analysis Overview

APPROACH TO ANALYSIS

The proposed project would be subject to all applicable Federal, State, and California Building Code policies and would thus need to use energy efficient features. Energy impacts related to construction could occur due to transport of materials to the site as well as use of petroleum-based fuels associated with construction equipment. Operational impacts due to energy usage could result from maintenance activities at the site and vehicle trips.

The evaluation is based on a review of energy use of the proposed project during construction or operation. Applicable regulatory requirements are used to assess each potential impact, such as mandatory compliance with various Federal and State regulations that would serve to prevent significant impacts from occurring.

4.13.3.3 Impacts and Mitigation Measures

Impact ENG-1: Result in Wasteful, Inefficient, or Unnecessary Consumption of Energy or Conflict with a state or local plan for renewable energy or energy efficiency. Construction and operation activities associated with the proposed project would require the use of energy, but these activities would not result in wasteful, inefficient, or unnecessary consumption of energy, nor would they conflict with state or local plans for renewable energy or energy efficiency. (Criteria a and b) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

Construction of the proposed project would require the use of energy for the manufacture and transportation of building materials, preparation of the site (e.g., trenching, excavation, and grading), and project construction. Petroleum based fuels such as diesel fuel and gasoline would be the primary sources of energy for these tasks. Additionally, the operation and maintenance associated by the proposed project would involve the use of energy associated with daily trips for operational maintenance. However, implementation of the proposed project would not cause inefficient, wasteful, or unnecessary consumption of energy. Equipment and fuel are not typically used wastefully because of the added expense associated with renting, maintaining, and fueling the equipment. Therefore, there are limited opportunities for efficiency gains during construction. Given the minimal increase in fuel consumption, as well as the utilization of energy efficient equipment required during construction and operation, impacts associated with energy usage would be less than significant. Therefore, the implementation of the project would not result in wasteful, inefficient, or unnecessary consumption of energy.

The California Air Resources Board (CARB) 2017 Climate Change Scoping Plan Update (2017 Scoping Plan) builds upon previous efforts to reduce greenhouse gas (GHG) emissions and is designed to shift the California economy away from dependence on fossil fuels. Appendix B of the 2017 Scoping Plan includes examples of local actions (municipal code changes, zoning changes, policy directions, and mitigation measures) that would support the State's climate goals. The examples provided include, but not limited to, enforcing idling time restrictions for construction vehicles, utilizing existing grid power for electric energy rather than operating temporary gasoline/diesel powered generators, and increasing use of electric and renewable fuel powered construction equipment. CARB developed such measures to address greenhouse gas emissions. However, they also directly and indirectly affect energy consumption by encouraging renewable energy and other clean energy options. Furthermore, even during the more intensive periods of construction, where construction activities would occur at the same time, activities that would demand energy and thus create emissions would be dispersed across the project area.

The proposed project would comply with existing state energy standards and would not conflict with or obstruct a state or local plan for renewable energy or energy efficiency. More specifically, the proposed project would be subject to the most recent energy conservation requirements of Title 24 of the CCR, known as the California Building Standards, as applicable. Measures to conserve energy may include efficient lighting and pumps. Additionally, electricity supplied during construction by PG&E would comply with the State Renewable Portfolio Standard, which requires investor-owned utilities, electric service providers, and community choice aggregators to increase procurement by 2020 and to 60% by 2030. Thus, a portion of the energy consumed during construction would originate from renewable sources.

For these reasons, the construction and operation of the proposed project would have a less-than-significant impact on energy resources as it would not result in wasteful, inefficient, or unnecessary consumption of energy, nor would the proposed project conflict with state or local plans for renewable energy or energy efficiency.

Impact Conclusion

The construction and operation of the proposed project would have a less-than-significant impact on energy resources as it would not result in wasteful, inefficient, or unnecessary consumption of energy, nor would the proposed project conflict with state or local plans for renewable energy or energy efficiency. This impact would be less-than-significant. No mitigation is required.

4.13.4 References

[BSC] 2018a. California Building Standards Code (California Code of Regulations, Title 24).

_____. 2018b. CalGreen. April 2018.

[CARB] California Air Resources Board. 2016. *California's 2017 Climate Change Scoping Plan, The strategy for achieving California's 2030 greenhouse gas target*. Available online at: <https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm>.

[3CE] Central Coast Community Energy. 2019. About 3CE. < https://3cenergy.org/about-us/>.

[CEC] California Energy Commission. 2013. *Natural Gas Issues, Trends, and Outlook*. Available online at: <https://efiling.energy.ca.gov/GetDocument.aspx?tn=72906>.

____. 2015. 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. June 2015. Available online at: <https://www.energy.ca.gov/title24/2016standards/>.

____. 2017a. Total Electricity System Power Generation. Available online at: <https://www.energy.ca.gov/almanac/electricity_data/total_system_power.html>.

____. 2017b. Electricity Consumption by County. Available online at: <http://www.ecdms.energy.ca.gov/elecbycounty.aspx>.

____. 2018. *News Release. Energy Commission Adopts Standards Requiring Solar Systems for New Homes, First in Nation.* May 9, 2018. Available online at: <https://www.energy.ca.gov/news/2018-05/energy-commission-adopts-standards-requiring-solar-systems-new-homes-first>.

[EIA] U.S. Energy Information Administration. 2018a. Natural Gas Summary. Available online at: <http://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_SCA_a.htm>.

_____. 2018b. Natural Gas Conversion Calculator. Available online at: <https://www.eia.gov/kids/energy.cfm?page=about_energy_conversion_calculator-basics#natgascalc.>.

_____. 2019. *California State Profile and Energy Estimates*. Available online at: <https://www.eia.gov/state/?sid=CA>.

U.S. Bureau of Transportation Statistics. 2015. Average Fuel Efficiency of U.S. Light Duty Vehicles. Available online at: <https://www.bts.gov/archive/publications/national_transportation_statistics/table_04_23>.

Chapter 5.0 ALTERNATIVES

5.1 INTRODUCTION AND APPROACH

This chapter presents the alternatives analysis for the proposed Carmel Lagoon EPB, SRPS, and ISMP Project. This section sets forth the objectives of the proposed project, summarizes its significant impacts, discusses the alternatives considered but eliminated from further analysis, describes the range of alternatives considered, and compares the impacts of the alternatives evaluated to the impacts of the proposed project.

The State CEQA Guidelines, CCR Section 15126.6(a), states that an EIR must describe and evaluate a reasonable range of alternatives to the proposed project, or to the location of the project, that would feasibly attain most of the project's basic objectives, but that would avoid or substantially lessen any significant adverse effects of the project. An EIR is not required to consider every conceivable alternative to a proposed project. Rather, it must consider a reasonable range of potentially feasible alternatives that will foster informed decision-making and public participation. The CEQA Guidelines further state that the specific alternative of "no project" shall also be evaluated. The EIR must evaluate the comparative merits of the alternatives and include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the impacts of the proposed project.

As discussed in **Chapter 1, Introduction**, the County received over 40 letters from public agencies, organizations, and the general public, which included challenges to and requests for additional technical studies related to the proposed SRPS component of the project and requests to discuss and analyze additional project alternatives. In addition, State Parks confirmed that the proposed EPB project component is not consistent with policies and guidelines associated with the reserve area, making the implementation of that component infeasible. Based on these comments and agency coordination efforts, the County retained Moffatt & Nichol to analyze the natural breach alignment and location and sediment transport, develop Preliminary 30% Design Plans for a SRPS Mid-Slope Wall Alternative, and prepare an assessment of potential beach impacts from the SRPS Mid-Slope Wall Alternative (*Carmel River Lagoon Natural Breach Alignment and Location* study, *Sediment Transport Study*, and *Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential* study; each of these reports are contained in **Appendix F** of this RDEIR). Due to the infeasibility of the proposed EPB project component, the County developed and evaluated two additional potential EPB alternatives (i.e., the EPB-Elevate Structures Alternative and EPB Garden Wall Alternative), and retained Balance Hydrologics, Inc. to prepare a drainage analysis for the EPB Garden Wall Alternative (Carmel Lagoon Interim EPB On-Property Line Drainage Analysis, 2023), which is included in **Appendix H** of this RDEIR. This chapter has been updated to include the analysis of additional alternatives.

5.1.1 Organization of this Chapter

This chapter is organized into the following sections:

Section 5.1, Introduction and Approach, provides an overview of CEQA requirements pertaining to the identification and analysis of alternatives, and the chapter organization. This section also includes the objectives of the proposed project and a summary of significant impacts of the proposed project by topical area (**Table 5-1**). The section concludes with the identification of CEQA alternatives evaluated in this chapter.

Section 5.2, Alternatives Considered but Eliminated*,* discusses the alternatives that were considered, but eliminated from further analysis in this EIR if the alternative failed to meet most of the project objectives, is determined infeasible, or is unable to avoid or lessen significant environmental impacts. This section is organized into two parts:

5.2.1 Alternative Components of the Proposed Project Considered but Eliminated

5.2.2 Alternative Projects of the Proposed Project Considered but Eliminated

Section 5.3, Alternatives Analysis*,* describes the alternatives to the proposed project, compares the impacts of the alternatives to the impacts of the proposed project, and also evaluates the alternatives' ability to accomplish the project objectives. This section is organized into four parts:

5.3.1 No Project Alternative

5.3.2 Alternatives Components to Proposed Project

5.3.3 Alternatives Projects to Proposed Project

Section 5.4, Environmentally Superior Alternative*,* identifies an environmentally superior alternative, as required by CEQA.

5.1.2 Project Objectives

As described in **Chapter 3, Project Description**, in an effort to demonstrate the commitment to assess towards implementation of permanent solutions to reduce or avoid mechanical breaching, the County worked with the USACE to develop a draft MOU that would include the USACE, County, and NMFS as signatory agencies. The MOU was reviewed by the USFWS as a consulting agency to the USACE. The MOU promulgated several items: 1) a long-term plan to balance protection of private property with protection of federally listed species; 2) the negative impacts to fish and wildlife resources from long-term mechanical sandbar breaching of the Lagoon; 3) two long-term solutions as alternative to performing sandbar management: the EPB and SRPS; and 4) the agreement among the MOU parties to allow the ISMP while the County develops and implements the EPB and SRPS projects. The MOU was approved by the Monterey County Board of Supervisors on June 11, 2013. The County developed the proposed project and Draft EIR consistent with the expectations of the permitting agencies.

In compliance with the MOU and to avoid a JO[1] issued by NMFS, the proposed project was developed as a multi-objective, multi-year, multi-organizational effort to improve habitat for threatened and endangered species in the lower Carmel River and Lagoon, improve natural floodplain function, and protect public infrastructure while maintaining flood protection to existing developed areas. Consideration for how to restore the natural breaching regime in the Lagoon while maintaining current flood protection to low-lying areas has been a cooperative effort between multiple Federal, State, regional, and local agencies, as well as conservation organizations, for more than two decades, and has included evaluating numerous project alternatives.

Recognizing the challenges associated with the existing development in the low-lying areas that has occurred over the past century adjacent to the Lagoon and the degradation caused by historic farming and breaching activities, the primary objective of the proposed project is to implement a solution to improve the functions and values of the ecosystem in and around the Lagoon by restoring the Lagoon's

[1] Under Section 7 of the ESA, if the NMFS or USFWS find that a proposed action may jeopardize listed species or adversely modify critical habitat, then a Biological Opinion is known as a Jeopardy Opinion, or JO.

historic hydrologic, pre-management conditions to the extent feasible to protect and improve habitat for fish and wildlife while maintaining flood protection. In addition, a natural breach in the northerly direction is preferred by the resource agencies to facilitate a longer and more natural flow channel, improving conditions for fish and wildlife within the Lagoon. To accomplish this primary objective, the proposed project would need to meet the following objectives:

- Consistent with the MOU, reduce the necessity for mechanical breaching of the sandbar to the greatest extent practicable;
- Maintain the current level of flood protection for existing public facilities and private structures in the low-lying developed areas located immediately to the north of and within the Lagoon;
- Protect Scenic Road embankment and the State Parks' restroom, interpretive, and parking facilities from scour resulting from a northerly-aligned Lagoon outflow channel that may result from a reduction in mechanical breaching;
- Protect the Scenic Road embankment from the increasing risk of erosion resulting from ocean storm surge and high tides, which could increase in severity due to climate change;
- Allow for interim management of the sandbar while the design and construction of the other project components proceed;
- Design and construct project elements within the required timeframe of the MOU; and
- Minimize infrastructure that could detract from the function and value of the natural environment.

As described in **Section 1.3, Changes Requiring Recirculation and Organization of the Revised EIR**, the MOU expired on September 30, 2020. As a result, the sandbar management activities within the Lagoon are subject to the permit conditions required by the USACE, CDFW, RWQCB, and CCC.[2] Therefore, the project objective associated with the MOU is no longer applicable to the proposed project:

- Design and construct project elements within the required timeframe of the MOU.

Because this project objective is no longer applicable, it is not used in the evaluation of alternatives.

However, although the MOU is expired, its intent remains a primary objective of the County, regulatory agencies, and interested stakeholders to reduce the necessity for mechanical breaching of the sandbar to the greatest extent practicable. Therefore, the following project objective remains applicable to the proposed project and is considered in the evaluation of project alternatives:

- Consistent with the MOU, reduce the necessity for mechanical breaching of the sandbar to the greatest extent practicable.

5.1.3 Significant Impacts of the Proposed Project

In **Chapter 4**, this EIR found that the proposed project would result in the significant impacts identified in **Table 5-1**, below, all of which would be reduced to a less-than-significant level with implementation of mitigation measures, with the exception of scenic vista and visual quality impacts resulting from the operation of the proposed EPB project component, flooding impacts resulting from the operation of the

[2] For a current list of permits, please refer to: https://www.co.monterey.ca.us/government/departments-a-h/housing-community-development/planning-services/library-current-major-projects/carmel-lagoon-ecosystem-protective-barrier-and-scenic-road-protective-barrier-systems.

proposed EPB project component, and operation and construction noise impacts resulting from the proposed EPB project component.

The EIR found that operation impacts on scenic vistas and the visual quality at the proposed EPB project component site would permanently degrade the visual character of the site and the surrounding area, which is a significant and unavoidable impact.

Construction of the proposed project would not result in any significant unavoidable impacts, except for construction noise impacts at the proposed EPB project component site. Given the proximity of existing residential land uses to the proposed pile driving locations, construction of the proposed EPB project component would likely still exceed the County's noise standard at the nearest residential property lines. Implementation of **Mitigation Measure NV-3** would reduce construction noise at the proposed EPB project component site, but would not reduce the impact to a less-than-significant level. This is a significant and unavoidable impact.

The predicted operational noise levels for both the pump station and the generator/control building at the proposed EPB project component site are projected to exceed applicable thresholds at the nearest residential property line. Implementation of **Mitigation Measure NV-2** would reduce operational noise impact, but would not reduce the impact to a less-than-significant level. This is a significant and unavoidable impact.

Table 5-1 summarizes the significant adverse construction and operational impacts identified in this EIR by the applicable proposed project component sites. In some cases, the operation of the proposed project would result in beneficial impacts on an environmental resource (please refer to **Table 5-2**, at the end of this chapter, for the proposed project's less-than-significant and beneficial impacts).

Table 5-1. Significant Impacts of Proposed Project

Significant Impacts of Proposed Project	Applicable Proposed Project Component(s)
Significant Impacts That Can Be Reduced To Less-Than-Significant With Mitigation	
4.3 Biological Resources	
BIO-1: Construction Impacts to Special-Status Species and Habitat.	Ecosystem Protective Barrier Scenic Road Protection Structure Interim Sandbar Management Plan
BIO-2: Construction Impacts to Sensitive Habitats.	Ecosystem Protective Barrier Scenic Road Protection Structure
BIO-3: Construction Impacts to Movement of Native Wildlife and Native Wildlife Nursery Sites.	Ecosystem Protective Barrier Scenic Road Protection Structure
4.4 Cultural Resources	
CR-1: Construction Impacts on Historic Resources.	Ecosystem Protective Barrier
CR-2: Construction Impacts on Archaeological Resources or Human Remains.	Ecosystem Protective Barrier Scenic Road Protection Structure Interim Sandbar Management Plan
CR-3: Construction Impacts on Human Remains.	Ecosystem Protective Barrier Scenic Road Protection Structure Interim Sandbar Management Plan
CR-4: Construction Impacts on Tribal Cultural Resources.	Ecosystem Protective Barrier Scenic Road Protection Structure Interim Sandbar Management Plan
4.8 Hydrology & Water Quality	
HYD-4: Operational Impacts to Water Quality due to Drainage Pattern Alterations and Discharges.	Ecosystem Protective Barrier
HYD-7: Operational Risks due to Location within a 100-Year Flood Hazard Area.	Ecosystem Protective Barrier
4.9 Land Use & Planning	
LU-1: Conflict with Plans, Policies, and Regulations during Construction and Operation.	Ecosystem Protective Barrier Scenic Road Protection Structure Interim Sandbar Management Plan

Table 5-1. Significant Impacts of Proposed Project

Significant Impacts of Proposed Project	Applicable Proposed Project Component(s)
4.10 Noise	
NV-1: Construction Ground-Borne Vibration and Noise.	Ecosystem Protective Barrier
NV-2: Construction Noise.	Scenic Road Protection Structure Interim Sandbar Management Plan
4.11 Public Services, Recreation, & Utilities	
PS-3: Construction Solid Waste Policies and Regulations.	Ecosystem Protective Barrier
4.12 Traffic & Circulation	
TRA-1: Conflict with a program, plan, ordinance, or policy addressing the circulation systems, including transit, roadway, bicycle, and pedestrian facilities during construction of the proposed project.	Ecosystem Protective Barrier Scenic Road Protection Structure
TRA-3: Result in Inadequate Emergency Access.	Ecosystem Protective Barrier Scenic Road Protection Structure
Significant and Unavoidable Impacts	
4.1 Aesthetics	
AES-2: Operation Impacts on Scenic Vistas and Visual Quality of the Surrounding Areas.	Ecosystem Protective Barrier
Significant and Unavoidable Impacts	
4.8 Hydrology & Water Quality	
HYD-6: Operational Drainage Pattern Alterations	Ecosystem Protective Barrier
4.10 Noise	
NV-2: Construction Noise.	Ecosystem Protective Barrier
NV-3: Operational Noise.	Ecosystem Protective Barrier

5.2 ALTERNATIVES CONSIDERED BUT ELIMINATED

In accordance with the State CEQA Guidelines, the lead agency is responsible for selecting a range of potentially feasible project alternatives for examination, and must briefly discuss the alternatives it eliminated from detailed consideration. Among the factors that may be used to eliminate alternatives from detailed consideration in an EIR are:

- Failure to meet most of the basic project objectives,
- Infeasibility, or
- Inability to avoid significant environmental impacts.

The following section discusses those alternatives that were considered but eliminated during the course of this CEQA evaluation. The CEQA alternatives that were considered but eliminated from more detailed evaluation are presented using the following framework:

5.2.1 Alternative Components of the Proposed Project Considered but Eliminated

5.2.2 Alternative Projects of the Proposed Project Considered but Eliminated

5.2.1 Alternative Components of the Proposed Project Considered but Eliminated

During preliminary design and project development, and as an initial phase of the EIR process, several feasibility-level and technical analyses were conducted to support development of the proposed EPB and SRPS project components and provide an initial screening for environmental issues. The technical reports provided an initial screening process to address key feasibility issues including alternative alignments and elevations, alternative materials, engineering feasibility, environmental considerations, permitting requirements, and timing. This section describes the alternative EPB and SRPS project components and why these alternative components were eliminated from more detailed evaluation in this EIR.

5.2.1.1 EPB – Low Elevation Alternative

The EPB – Low Elevation Alternative includes the same design elements as the proposed EPB project component, except proposes a design elevation of 16 feet instead of 17.5 feet. Elevation 16 feet is equal to the current FEMA 100-year flood elevation for the lagoon and is 0.6 feet higher than the highest lagoon level on record (15.4 feet in January 2008). It is also approximately equal to the elevation of the County's sandbag barrier, which was constructed along the periphery of the Fourth Addition neighborhood in the fall of 2012.

Because this alternative would be located along the same alignment, it would generally result in the same environmental impacts as the proposed EPB project component, and none of the impacts of the proposed EPB project component would be avoided or substantially reduced. Although the reduced height of this alternative may reduce visual impacts from some public vantage points, due to the high visual quality and exposure sensitivity of the site, this alternative would alter the existing visual character of the open space and this impact would remain significant and unavoidable. In addition, a top elevation of 16 feet is the current 100-year flood elevation, and would not account for flood elevation changes due to sea level rise over the life of the project (50 years). As a result, top elevation of 16 feet would result in significantly increasing the frequency of breach management activities, potentially to an unacceptable frequency, especially as peak lagoon levels increase over the life of the structure due to sea level rise.

Rationale for elimination from more detailed evaluation in this EIR: The EPB – Low Elevation Alternative would not avoid or reduce one or more significant impacts of the proposed EPB project component and would likely increase the need for breach management, and, thus, would not better accomplish the project objectives. In addition, constructing this alternative along the same alignment as the proposed EPB project component would not be feasible since it would be located within a designated State Natural Preserve and is opposed by the property owner (i.e., State Parks). Therefore, this alternative was rejected.

5.2.1.2 EPB – High Elevation Alternative

The EPB – High Elevation Alternative includes the same design elements as the proposed EPB project component, except proposes a design elevation of 19 feet instead of 17.5 feet. A top elevation of 19 feet would likely eliminate the need for breach management activities over the life of the structure taking into account sea level rise, and would provide the necessary freeboard that would remove homes in the Fourth Addition from flood risk. However, this alternative would increase visual impacts. This alternative would also likely increase flooding impacts to the CAWD and Mission Ranch properties. In addition, this alternative would result in the same environmental impacts since the alignment would be in the same location, and none of the environmental impacts would be avoided or reduced.

Rationale for elimination from more detailed evaluation in this EIR: The EPB – High Elevation Alternative would increase visual impacts and would not avoid or reduce one or more significant impacts of the proposed EPB project component. In addition, constructing this alternative along the same alignment as the proposed EPB project component would not be feasible since it would be located within a designated State Natural Preserve and is opposed by the property owner (i.e., State Parks). Therefore, this alternative was rejected.

5.2.1.3 EPB at Property Line Alternative

The EPB at Property Line (P/L) Alternative includes the same design elements as the EPB Near P/L (please refer to **Section 5.3.2.2** below), except that the wall would be located along the Fourth Addition neighborhood property line on private property. This alternative attempts to eliminate (or nearly eliminate) encroachment into State Parks property, depending on whether the maintenance easement would be over private or State Parks property. Since essentially no stormwater detention would be provided, approximately 40 cfs (18,000 gpm) of pumping capacity would be required, in addition to a 70 cfs bypass storm drain system. The bypassed storm water would not pass through any water quality treatment BMPs, but would pass through vault-based gross pollutant stormwater control measures such as screen filters. The wall could be constructed either on the north (Fourth Addition) or south (State Parks) side of the property line. Construction on the Fourth Addition side of the property line, on private property, would require land acquisition of, or easements on, 14 property owners. Whether the height of the EPB at P/L is 16 feet or 19 feet, visual impacts would be increased significantly due to the proximity to the property line. Although this alternative would reduce encroachment into State Parks property and reduce biological resources impacts, this alternative would result in increased significant and unavoidable operational aesthetic and noise impacts and increased water quality impacts.

Rationale for elimination from more detailed evaluation in this EIR: An alignment closer to the property line was considered technically infeasible, due to: 1) the need for access along the barrier for operation and maintenance activities, 2) the size of pumping equipment that would be required (due to the reduction in stormwater detention volume provided), and 3) the resulting lack of right of way for implementation of stormwater treatment facilities. A closer alignment would also require obtaining easements or land from approximately 14 residential property owners, in addition to State Parks and

Mission Ranch, and increased operation and maintenance costs due in part to the lack of storm water storage. Therefore, this alternative was rejected.

5.2.1.4 EPB – Earthen Levee Alternative

The EPB Levee Alternative includes similar design elements as the proposed EPB project component, except that an earthen levee would be constructed in lieu of a floodwall. However, the EPB Levee Alternative would increase temporary and permanent impacts to the Lagoon by directly and indirectly impacting sensitive habitats (e.g., filling wetlands and waters of the U.S.), decreasing stormwater detention volume due to the presence of the levee, increasing pumping capacity and frequency (and associated increase in noise from the pump operation), and increasing visual impacts.

Rationale for elimination from more detailed evaluation in this EIR: The EPB Levee Alternative would result in additional significant impacts, and therefore, would have insufficient benefit over a floodwall alternative. Therefore, this alternative was rejected.

5.2.1.5 EPB with Access Road Alternative

The EPB with Access Road Alternative has the same design elements as the proposed EPB project component, except that a maintenance access road would be constructed along the north side of the wall and the alignment would be located a minimum of 15 feet from the property line to avoid impacts to sensitive habitats and reduce the amount of land acquisition required. This alternative would be beneficial to allow ease of access for maintenance activities, including periodic painting, replacement of mechanical components, or clearing of drain inlets or pipes. However, this alternative would increase visual impacts due to the addition of an access road along the wall; increases noise and visual impacts due to larger pumping capacity and more frequent use of pumps (due to more limited detention volume relative to no-road alternative); and reduces opportunity for implementation of stormwater control measures due to maintenance of access road.

Rationale for elimination from more detailed evaluation in this EIR: The EPB with Access Road Alternative would result in additional significant impacts and insufficient benefit over a no-road alternative. In addition, constructing this alternative along the same alignment as the proposed EPB project component would not be feasible since it would be located within a designated State Natural Preserve and is opposed by the property owner (i.e., State Parks). Therefore, this alternative was rejected.

5.2.1.6 EPB with Reduced Drainage Infrastructure Alternative

The EPB with Reduced Drainage Infrastructure Alternative includes the same design elements as the proposed EPB project component, except that the interior drainage system would be sized based on a storm probability analysis. This alternative would result in decreases in noise and visual impacts due to smaller pumping capacity and less frequent use of pumps, and decreased temporary construction impacts to the neighborhood. In addition, this alternative would be a significant improvement over the current level of flood protection, but less protection than the proposed EPB project component.

Rationale for elimination from more detailed evaluation in this EIR: The EPB with Reduced Drainage Infrastructure Alternative would provide less flood protection than proposed EPB project component, and, thus, would not better accomplish the project objectives. In addition, constructing this alternative along the same alignment as the proposed EPB project component would not be feasible since it would be located within a designated State Natural Preserve and is opposed by the property owner (i.e., State Parks). Therefore, this alternative was rejected.

5.2.1.7 SRPS – Living Shoreline Alternative

A living shoreline is a protected, stabilized coastal edge made of natural materials such as plants, sand, or rock. Living shorelines provide a natural alternative to "hard" shoreline stabilization methods like rip rap or bulkheads. Unlike a concrete seawall or other hard structure, which impeded the growth of plants and animals, living shorelines grow over time. Natural infrastructure solutions like living shorelines provide wildlife habitat, as well as natural resilience to communities near the water. However, they do not provide the same type of protection as hard armor as they allow for dynamic natural shoreline processes to occur. Living shorelines are sometimes referred to as nature-based, green, or soft shorelines. They are an innovative and cost-effective technique for coastal management. Although often solely associated with engineered approaches for shoreline stabilization, the concept of living shorelines spans the full range of natural defenses, from fully functioning natural systems to hybrid green-"gray" (or hard) features. The intended purpose of living shorelines is to conserve or enhance an existing shoreline so that the land-water interface does not move further landward. Living shorelines may replace aging structures, such as an old dock or boat launch. Bays, rivers, and homes on the waterfronts are good candidates for this type of shoreline stabilization. Typically, living shorelines are not found on beaches on the open ocean. The type of living shoreline depends on site-specific conditions, including bank erosion rate, elevation level, existing vegetation, wave energy, wind patterns, wave activity, and soil type.

Under this alternative, a living shoreline, or living wall, would be constructed in lieu of the proposed SRPS project component. A living wall would consist of installing natural materials, such as including native plants, rocks, and soil, to stabilize the slopes under Scenic Road and around the State Parks parking lot. Living shorelines typically require sufficient horizontal space to establish the low slopes necessary to establish vegetation and dissipate wave energy. Therefore, it is reasonable that the SRPS Living Wall Alternative would require improvements beyond the toe of slope and at the beach level. The SRPS Living Shoreline Alternative would decrease visual impacts by eliminating hard structures at the site. This alternative may require eliminating or limiting public access to maintain slope stability. The construction of this alternative may result in decreased noise impacts.

Rationale for elimination from more detailed evaluation in this EIR: Living shoreline designs do not work in all situations. High energy shorelines, such as the CRSB, generally have too much wave energy to allow plants to survive. In addition, when the river breaches to the north, it would remove the living shoreline, undermining Scenic Road and damaging public infrastructure. While this alternative would reduce many environmental impacts, the site is not appropriate for soft shoreline stabilization techniques. Therefore, this alternative was rejected. However, a hybrid green-gray approach with some soft and some hard features, as described in **Section 5.3.2.8, SRPS Mid-Slope Wall Alternative**, would be appropriate at the site.

5.2.1.8 SRPS – Reinforced Earth Wall Located at Mid-Slope Alternative

The Reinforced Earth Wall Located at Mid-Slope Alternative consists of a retaining wall constructed at some location mid-slope below Scenic Road, but above beach level. A reinforced earth structural system (e.g., a soil nail wall with shotcrete facing) would be installed in the northern portion, while the southern portion would be revetment placed in the same locations and elevations of proposed SRPS project component. It is unknown whether this type of wall is feasible from an engineering standpoint as site-specific geotechnical investigations have not been conducted. Geotechnical feasibility would be based on proposed wall elevations, embankment slopes, and soil properties.

However, this alternative would have increased impacts to aesthetics as wall heights increase for each foot moved away from the toe of slope. Since the wall would be higher, the wall face may also be exposed.

In addition, if the river were to scour the beach from in front of the wall, a portion of the wall (possibly up to an approximately 25-foot-tall portion) could become exposed because of the higher top elevation. Summer and fall wave action may rebuild the beach in front of the wall, but the top half of the wall would remain exposed since it would be above normal beach elevations. The entire face of the wall may require an aesthetic treatment to address long-term visual considerations. Lastly, this alternative may have increased significant impacts on public access as pedestrian guard rail would be required along the top of the wall, or, alternatively, along Scenic Road. A vehicular guard rail may also be required.

Rationale for elimination from more detailed evaluation in this EIR: The Reinforced Earth Wall Located at Mid-Slope Alternative would result in an increase in significant impacts to aesthetic, recreational, and public access resources. Therefore, this alternative was rejected.

5.2.1.9 Sandbar Management Plan Only Alternative

The Sandbar Management Plan Alternative would involve only implementing sandbar management activities, including mechanical breaching as necessary in emergency, while implementing BMPs. This is currently the practice of the County. This alternative would meet all the project objectives with the exception of the objectives to reduce the necessity for mechanical breaching and to protect Scenic Road embankment and associated public infrastructure. The County previously submitted permit applications to implement a sandbar management plan, which was similar to this alternative. However, the NMFS informed the County that implementing the proposed management plan would result in significant impacts to steelhead and the agency would not be able to issue the necessary permits and authorizations. Please refer to **Section 3.2, Project Background**, for more history of the proposed project.

Rationale for elimination from more detailed evaluation in this EIR: The Sandbar Management Plan Only Alternative would not reduce the need for breach management or protect Scenic Road and associated infrastructure. Further, this alternative would be infeasible since the NMFS would not issue the necessary permits and authorizations for this alternative. Therefore, this alternative was rejected.

5.2.1 Alternative Projects of the Proposed Project Considered but Eliminated

This section describes the alternative projects to the proposed project, and why these alternative projects were eliminated from more detailed evaluation in this EIR.

5.2.1.1 Floodproof Structures Alternative

The Floodproof Structures Alternative would include floodproofing the existing structures in the low-lying areas of the Lagoon, thus allowing the Lagoon to naturally breach. Floodproofing is defined as any combination of structural and non-structural additions, changes, or adjustments to structure which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures, and their contents. Floodproofing techniques include installation of watertight shields for doors and windows, drainage collection systems, sump pumps, and check valves; reinforcement of walls to withstand floodwater pressures; use of sealants to reduce seepage through and around walls; and anchoring the building to resist floatation, collapse, and lateral movement.

Floodproofing measures are widely applied throughout the country where two types of floodproofing are widely recognized: wet and dry. Wet floodproofing reduces damage from flooding in three ways; (1) allowing flood waters to easily enter and exit a structure in order to minimize structural damage; (2) use

of flood damage resistant materials; and (3) elevating important utilities. On the other hand, dry floodproofing is the practice of making a building watertight or substantially impermeable to floodwaters up to the expected flood height.

Wet floodproofing measures typically include structural measures, such as properly anchoring structures against flood flows, using flood resistant materials below the expected flood depth, protection of mechanical and utility equipment, and use of openings or breakaway walls to allow passage of flood waters without causing major structural damage. A dry floodproofed structure is made watertight below the expected flood level in order to prevent floodwaters from entering in the first place. Making the structure watertight requires sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete, installing watertight shields on openings and fitting measures to prevent sewer backup.

Floodproofing can be applied in residential and non-residential buildings and the principles of floodproof design can also be applied to other important infrastructure such as electricity substations and sewage treatment facilities. However, residential and non-residential buildings are treated differently. A residential building must have a higher level of protection; if it is to be built in the floodplain, it must be elevated above the base flood elevation. Non-residential buildings, on the other hand, may be elevated or floodproofed. Floodproofing areas below the base flood elevation in residential buildings is not permitted under the FEMA NFIP except in communities that have been granted an exception to permit floodproofed basements. Floodproofing is not permitted in Coastal High Hazard Areas (Zone V, VE, or V1-30). It is recommended by FEMA that floodproofing be implemented up to one foot above base flood elevation for a factor of safety and to receive full credit for flood insurance rating.

The NFIP allows a new or substantially improved non-residential building in an A Zone (Zone A, AE, A1-30, AR, AO, or AH) to have a lowest floor below the base flood elevation, provided that the design and methods of construction have been certified by a registered professional engineer or architect as being dry floodproofed in accordance with established criteria.

Rationale for elimination from more detailed evaluation in this EIR: The alternative would require floodproofing of residential structures located in low-lying areas of the Lagoon (i.e., Zone AE). Floodproofing areas below the base flood elevation in residential buildings is not permitted under the NFIP except in communities that have been granted an exception to specifically permit floodproofed basements. Residences in the Lagoon area do not have basements and, therefore, would not be able to obtain an exception to floodproof below the base flood elevation. This alternative would not reduce potentially significant impacts on public infrastructure, and thus would not better accomplish the project objectives. Therefore, the Floodproof Structures Alternative is infeasible due to conflicts with existing floodplain regulations and was rejected.

5.2.1.2 Condemn Housing/Properties Alternative

The Condemn Housing/Properties Alternative includes removing buildings and structures within the floodplain, thus allowing the Lagoon to naturally breach. This alternative would require the County to purchase the properties and require the relocation of the owners. This would be of significant cost to the County and may also result in a decrease in property tax revenue depending on the relocation sites. Additionally, this alternative would not protect public infrastructure. It may result in improving fish and wildlife habitat and may even result in an increase in habitat where properties are removed, if restored. There would also likely be significant opposition from affected property owners, as there are not many available equivalent properties for them to relocate.

Rationale for elimination from more detailed evaluation in this EIR: The Condemn Housing/Properties Alternative does not reduce significant impacts on public infrastructure, and, thus, would not better accomplish the project objectives. If this alternative was combined with a SRPS alternative, it could meet the associated project objective. However, this alternative would involve regulatory action to require local residents and public facilities to relocate. Not only is this regulatory authority beyond that of the proposed project, but the high property acquisition costs and potential loss of property tax revenue makes this alternative infeasible based on the budget of the proposed project. Therefore, this alternative was rejected.

5.2.1.3 Relocation of Threatened Public Infrastructure Alternative

The Relocation of Threatened Public Infrastructure Alternative would close the vulnerable portion of Scenic Road and relocate public infrastructure (i.e., State Parks facilities and sewer infrastructure). Historically, Scenic Road was two lanes, and is now only one lane as a result of shoreline retreat. Under this alternative, Scenic Road would continue to be undermined by river and wave action, and may be closed indefinitely in the future. Implementing this alternative would eliminate access to residences along this portion of the road. This alternative would not address flooding issues and future conditions would continue to encroach on Scenic Road, and, ultimately, the existing residences. In addition, there would continue to be public safety issues.

Rationale for elimination from more detailed evaluation in this EIR: The Relocation of Threatened Public Infrastructure Alternative would not achieve most of the project objectives and would not reduce the significant impacts of the proposed project. Therefore, this alternative was rejected.

5.2.1.4 Mechanical Control of Lagoon Level Alternative

The Mechanical Control of Lagoon Level (e.g., additional outfalls, culvert with flap gate) Alternative would entail providing a secondary, man-made, fully controllable outfall so that the Lagoon level could be "controlled," primarily for the purpose of managing the Lagoon level in anticipation of a large storm event. It would meet the project objectives to reduce the necessity for mechanical breaching and maintain the current level of flood protection. It may also avoid or reduce impacts to public infrastructure, depending on the location of the outfall. However, the proposed new infrastructure improvements would have to be extremely large in order to accommodate design flood flows (thousands of cfs), unless the proposed project added a component to pre-drawdown the Lagoon (at a few hundred cfs, over the course of a day or two). In addition, the alternative would not meet the project goal of allowing the Lagoon to "naturalize" by definition.

Rationale for elimination from more detailed evaluation in this EIR: The primary objective of the proposed project is to implement a solution to improve the functions and values of the ecosystem in and around the Lagoon by restoring the Lagoon's historic hydrologic, pre-management conditions to the extent feasible to protect and improve habitat for fish and wildlife while maintaining flood protection. The Mechanical Control of Lagoon Level Alternative does not meet most of the proposed project objectives, specifically it would not allow for restoration of a natural hydrologic condition within the Carmel River and Lagoon, and may not reduce potential impacts on fish and wildlife. Therefore, this alternative was rejected.

5.2.1.5 Bypass Channel Alternative

The Bypass Channel Alternative, or flood overflow channel, would be constructed to reroute the water out of the Lagoon and into the ocean at a point far enough from significant fish habitat in the Lagoon so that fish populations would not be adversely affected. The channel or culvert would be constructed so that it remains permanently open throughout the flood season (note that the Salinas River Lagoon has this option). It would meet the project objectives to reduce the necessity of mechanical breaching, restore lagoon's historic hydrological conditions, and maintain current level of flood protection. However, this alternative may have significant impacts on fish habitat and does not meet the project goal of allowing the Lagoon to "naturalize" by definition.

Rationale for elimination from more detailed evaluation in this EIR: The primary objective of the proposed project is to implement a solution to improve the functions and values of the ecosystem in and around the Lagoon by restoring the Lagoon's historic hydrologic, pre-management conditions to the extent feasible to protect and improve habitat for fish and wildlife while maintaining flood protection. The Bypass Channel Alternative does not meet most of the proposed project objectives, specifically it would not allow for restoration of a natural hydrologic condition within the Carmel River and Lagoon, and may not reduce potential impacts on fish and wildlife. Therefore, this alternative was rejected.

5.2.1.6 Weir Alternative

The Weir Alternative would entail either finding an existing, or creating, a "rock sill," which would act as a weir to keep the Lagoon in some preferred (e.g., perched) hydrologic condition. The breach channel would have to be managed in order to keep the channel flowing over this weir. It would not meet the objective of reducing the necessity to mechanically breach the Lagoon. The technical feasibility of this alternative is questionable. This alternative may not protect public infrastructure depending on the location of the weir and channel management activities.

Rationale for elimination from more detailed evaluation in this EIR: The Weir Alternative was rejected due to technical infeasibility and not meeting the project objective to reduce the necessity of mechanical breaching.

5.2.1.7 Variable-Height Outlet Weir Alternative

The Variable-Height Outlet Weir Alternative would include a temporary, rubberized inflatable bladder dam could be placed in an excavation pit, before excavation of a breach channel, within the crown of the dune at the onset of the wet season. A breach channel would then be constructed on either side of the bladder to an appropriate invert elevation. Actual breaching and drainage of the Lagoon could then commence without risk to the operator and equipment by deflation of the rubber dam to a spillway elevation that avoids excessive evacuation of the Lagoon water and under controlled outflow discharge rates. This alternative may meet the project objectives to reduce the necessity for mechanical breaching, protect and improve habitat for fish and wildlife, and maintain current level of flood protection. However, the alternative is technically infeasible and would not protect public infrastructure.

Rationale for elimination from more detailed evaluation in this EIR: The Variable-Height Outlet Weir Alternative was rejected due to technical infeasibility and would not meet most project objectives.

5.2.1.8 Utilize CAWD Outfall Alternative

The CAWD Outfall Alternative includes utilizing an existing 36-inch discharge line which extends 600 feet to the ocean. However, assuming that the CAWD is not using the pipe for any flow from its own facility and the proposed project were to pump at the maximum rate the pipe could handle (which would be no more than 7 fps), the proposed project could only push 50 cfs through the pipe. This would not be adequate compared to the average daily river flow observed on the day of annual peak lagoon level (2,000 cfs) and the peak 10-year river flow (10,800 cfs).

Rationale for elimination from more detailed evaluation in this EIR: The CAWD Outfall Alternative was rejected due to technical infeasibility.

5.2.1.9 Permeable Outfall (High Permeability Beach Barrier) Alternative

The Permeable Outfall Alternative would increase the seepage through the beach berm and include a rip-rap option for Scenic Road. This could be accomplished by having the toe of the rip-rap function as a high seepage pathway between the Lagoon and the ocean. The toe itself would be scalable in width because it would be essentially buried below the beach. It could provide a conduit for a high amount of seepage from the Lagoon. Outflow could be controlled, if needed, in the summer by closing off the drainage (buried structure). The rock would be wrapped in fabric.

Rationale for elimination from more detailed evaluation in this EIR: The Permeable Outfall Alternative would not eliminate the need for proposed EPB project component; thus, would not reduce impacts and not meet the primary project objective. In addition, there is potential for the fabric wrapped around the rock to rip, thus allowing sand into the structure and plugging up the permeable seepage pathway. Therefore, this alternative was rejected.

5.2.1.10 Expand and Deepen the Lagoon Alternative

Additional areas of the Lagoon could be expanded and deepened by dredging out backwater areas away from the mouth of the river where it is typically breached (i.e., the South Arm). The alternative would allow for more deepwater habitat and low velocity refugia for juvenile fish and other aquatic organisms that have the ability to swim to calm water to avoid being swept out to ocean prematurely. In addition, expanding the interior Lagoon may also attract more juvenile and overwintering steelhead to productive areas of the Lagoon less affected by the breach. This alternative would meet the project objectives to reduce the necessity of mechanical breaching and to maintain the current level of flood protection. However, it may not necessarily improve habitat for fish and wildlife due to potential impacts to water quality and habitat resulting from dredging and alteration of the existing habitat. It would also not protect public infrastructure.

Rationale for elimination from more detailed evaluation in this EIR: The volume and extent of dredging associated with this alternative to be effective is uncertain and would require additional technical studies to inform design and regulator permitting efforts. In general, dredging the lagoon would result in great biological, hydrology/water quality, and geology impacts. In addition, the cost of dredging and acquiring regulatory permits may be high (if even feasible). Therefore, this alternative was rejected.

5.2.1.11 Temporary Flood Protection Alternative

The Temporary Flood Protection Alternative would provide temporary/seasonal flood protection measures (e.g., sand bagging). This alternative would meet the project objectives of restoring the Lagoon's historic hydrological conditions and protecting and improving habitat for fish and wildlife.

Rationale for elimination from more detailed evaluation in this EIR: Although there would be low initial costs associated with the Temporary Flood Protection Alternative, annual costs would be relatively high in perpetuity. In addition, this alternative may have increased significant flooding impacts to public and private property and would not protect public infrastructure, and thus would not better accomplish the project objectives. Therefore, this alternative was rejected.

5.2.1.12 Southern Breach – Emergency Alternative

The Southern Breach - Emergency Alternative would include mechanically breaching the southern sandbar in emergency situations. The alternative would meet the project objective of maintaining current levels of flood protection and protecting Scenic Road and associated infrastructure. However, it would still require mechanical breaching and may result in increased impacts on fish and wildlife habitat and cultural resources. Due to the emergency nature under which this alternative would occur, the mechanically breached channel may not be constructed in the least environmentally damaging location and/or elevation, further increasing potential impacts to biological and cultural resources. While this alternative is similar to the proposed ISMP project component, this alternative would only occur on the southern end and would not allow a natural breach in the northerly direction to facilitate a longer and more natural flow channel, improving conditions for fish and wildlife within the Lagoon.

Rationale for elimination from more detailed evaluation in this EIR: The Southern Breach-Emergency Alternative does not meet most project objectives, most specifically to reduce the necessity of mechanical breaching and to implement a solution to improve the functions and values of the ecosystem in and around the Lagoon by restoring the Lagoon's historic hydrologic, pre-management conditions to the extent feasible to protect and improve habitat for fish and wildlife while maintaining flood protection. The NMFS affirmed that mechanically breaching would likely jeopardize the Carmel River population of S-CCC steelhead and destroy and adversely modify its critical habitat. This alternative may result in increased impacts on fish and wildlife habitat and cultural resources. Therefore, this alternative was rejected.

5.2.1.13 Southern Breach – Managed Alternative

The Southern Breach - Managed Alternative would include performing a managed, mechanical southern breach according to permit conditions and requirements. A channel through the sand dune and beach prism would be cut along the base of bluff at the south edge of the Lagoon to allow the natural bedrock sill underlying the beach sand to prevent complete deep incision at the breach and evacuation of the Lagoon. This alternative would be designed to ensure that the Lagoon always retains an optimal level of water to provide shelter to steelhead and limit the depth and width of the breach to reduce flow rate.

The advantage of this alternative is that it uses a natural grade control (weir) to prevent the breached channel from incising to an elevation so low that extensive areas of the Lagoon are dewatered suddenly at a high rate of drainage outflow. In addition, there is the possibly of improved operational safety because the outflow discharge rate will be lower and actual breaching can occur closer to the lagoon end of the graded channel. However, cultural resources impacts may occur and there may be additional potential biological impacts to western snowy plover and Smith's blue butterfly.

Rationale for elimination from more detailed evaluation in this EIR: The Southern Breach - Managed Alternative may result in increased significant impacts on cultural resources and biological resources, specifically western snowy plover and Smith's blue butterfly. Therefore, this alternative does not better accomplish the project objectives and would increase significant impacts, and, therefore, was rejected.

5.2.1.14 Installation of a Pump or Overflow Device Alternative

The Installation of a Pump or Overflow Device Alternative would include installing a pump that could move water from the Lagoon into the ocean to be installed. The pump would have to be screened to protect fish. Studies would be conducted to determine the optimal water level for habitat in the Lagoon, and the pump could be used to maintain this level while preventing flooding until permanent breaching is considered acceptable to meet fish species life stage requirements. The design of this alternative would include constructing a water pumping pipe along rock wall at southern edge of the Lagoon that could be used to gradually open the barrier beach and reduce the level of the Lagoon prior to reaching flood height and, thereby, reduce the need to continuously breach.

Rationale for elimination from more detailed evaluation in this EIR: The Installation of a Pump or Overflow Device Alternative is unlikely to meet any project objectives and would likely result in increased significant environmental impacts. In addition, the alternative is technically infeasible due to the required large size of the pump and pipe. Therefore, this alternative was rejected.

5.2.1.15 Levee Modifications of Lower Reach Alternative

The Levee Modification of Lower Reach Alternative would be the same concept as the proposed EPB project component, except in lieu of using sheet piling, the barrier would be a levee. Adding new levees sufficient to maintain existing flood protection historically provided by mechanical breaching would result in significant unavoidable impacts to biological resources.

Rationale for elimination from more detailed evaluation in this EIR: The Levee Modification of Lower Reach Alternative does not reduce significant impacts and does not meet most of the project objectives. Therefore, this alternative was rejected.

5.2.1.16 Channel Maintenance Alternative

The Channel Maintenance Alternative assumes vegetation removal or channel dredging. However, either of these would pose significant impacts to biological resources and have no impact on reduction in flood risk for the Fourth Addition.

Rationale for elimination from more detailed evaluation in this EIR: The Channel Maintenance Alternative does not reduce significant impacts and does not meet most of the project objectives. Therefore, this alternative was rejected.

5.2.1.17 Carmel River Bank Stabilization Alternative

Bank stabilization (e.g., rip-rap, revegetation, or levees) along the lower Carmel River would result in increased impacts to biological resources and may not maintain the current level of flood protection in the context of reducing mechanical breaching of the barrier beach. This alternative would unlikely meet any of the project objectives and would not improve fish and wildlife habitat.

Rationale for elimination from more detailed evaluation in this EIR: The Bank Stabilization Alternative does not reduce significant impacts and does not meet most of the project objectives. Therefore, this alternative was rejected.

5.2.1.18 Upstream Flood Relief Measures Alternative

There are no upstream flood relief measures that would result in meeting the project objectives, including reducing the necessity to mechanically breach the Lagoon. The Upstream Flood Relief Measures Alternative could provide improvements to flood conditions upstream; however, they would likely have little to no effect in achieving project objectives downstream.

Rationale for elimination from more detailed evaluation in this EIR: The Upstream Flood Relief Measure Alternative does not reduce significant impacts and does not meet most of the project objectives. Therefore, this alternative was rejected.

5.2.1.19 EPB with Drainage Bypass Alternative

The EPB with Drainage Bypass Alternative has the same design elements as the proposed EPB project component, except a 70 cfs bypass storm drain would be constructed to collect runoff from areas upslope from the Fourth Addition neighborhood and would be setback 15 feet from the property line, but would be located within State Parks property. The intent of this alternative would be to minimize the volume and rate of stormwater which would need to be detained and pumped during the design storm event. In this alternative, storm drain inlets would be constructed at strategic locations within the drainage area and up-slope of the Fourth Addition neighborhood so as to collect and gravity drain as much of the tributary drainage area as possible. This storm drain would bypass the low-lying Fourth Addition neighborhood because the Fourth Addition is too low to be able to gravity drain into the lagoon at higher lagoon stages. The "bypass storm drain" would enable approximately 75% of the project drainage area to gravity drain to the lagoon. Some of the bypass storm drain system would be located within CSA-1. This would enable the pump stations in the Fourth Addition to be reduced in size. The bypassed storm water would not pass through any water quality treatment BMPs, but would pass through vault-based gross pollutant stormwater control measures such as screen filters.

Rationale for elimination from more detailed evaluation in this EIR: This proposed EPB project component alternative would result in nearly the same environmental impacts as the proposed EPB project component. However, due to the closer proximity to the property line (i.e., this EPB alternative alignment would be setback 15 feet while the proposed EPB alternative would have a minimum setback of 40 feet from the property line), the significant and unavoidable impacts associated with operational aesthetic impacts and construction noise and vibration impacts would increase in severity. This alternative would reduce the encroachment onto State Parks property, reduce operational noise associated with the pump and generator facilities, and reduce impacts to biological resources. This alternative may increase impacts to water quality due to the lack of available space to implement water quality treatment areas. The EPB with Drainage Bypass Alternative may also increase impacts associated with alteration of drainage patterns. A closer alignment would also result in increased operation and maintenance costs due in part to the lack of storm water storage.

The EPB with Drainage Bypass Alternative would meet the objectives of the project to reduce the necessity of mechanical breaching and to maintain the current level of flood protection. It would need to be implemented in combination with a SRPS project component alternative to meet the project objectives to protect public infrastructure. This alternative would not fully accomplish the project objectives as it

would not meet the project objective of minimizing infrastructure that could detract from the natural environment.

However, this alternative would not be feasible since it would be located within a designated State Natural Preserve and is opposed by the property owner (i.e., State Parks). Therefore, this alternative was rejected.

5.2.1.20 EPB Near Property Line Alternative

The EPB Near P/L Alternative has the same design elements as the proposed EPB project component, except that the flood wall would be located near the property line with an approximate 15-foot setback in closer proximity to the Fourth Addition neighborhood (i.e., this EPB alternative alignment would be setback 15 feet while the proposed EPB alternative would have a minimum setback of 40 feet from the property line; the EPB at P/L Alternative would be located on private property). This alternative would be constructed on State Parks property. This alternative targets 2.6 acre feet of detention volume, and a minimum 15 foot-wide access corridor between the Fourth Addition neighborhood and the flood wall. If a bypass storm drain is not provided as described above, approximately 40 cfs (18,000 gpm) of pumping capacity would be required. If a 70 cfs bypass storm drain system were provided, the pumping capacity could be reduced to approximately 10 cfs.

Rationale for elimination from more detailed evaluation in this EIR: This EPB project component alternative would result in nearly the same magnitude of environmental impacts as the proposed EPB project component. However, due to the closer proximity to the property line (i.e., this EPB alternative alignment would be setback 15 feet while the proposed EPB alternative would have a minimum setback of 40 feet from the property line), the significant and unavoidable impacts associated with operational aesthetic impacts and construction and operational noise and vibration impacts would increase in severity. This alternative would reduce the encroachment onto State Parks property. It would also reduce impacts to biological resources. This alternative may increase impacts to water quality due to the lack of available space to implement water quality treatment areas. The EPB Near P/L Alternative may also increase impacts associated with alteration of drainage patterns. A closer alignment would also result in increased operation and maintenance costs due in part to the lack of storm water storage.

The EPB Near P/L Alternative would meet the objectives of the project to reduce the necessity of mechanical breaching and to maintain the current level of flood protection. It would need to be implemented in combination with a SRPS project component alternative to meet the project objectives to protect public infrastructure. This alternative would not fully accomplish the project objectives as it would not meet the project objective of minimizing infrastructure that could detract from the function and value of the natural environment.

However, this alternative would not be feasible since it would be located within a designated State Natural Preserve and is opposed by the property owner (i.e., State Parks). Therefore, this alternative was rejected.

5.2.1.21 Variable Height EPB Alternative

The design elements of the Variable Height EPB Alternative would be similar to the proposed EPB project component in that it would be approximately 2,000 lf of flood wall and include reconstruction of 400 lf of Carmelo Street. However, the alignment location would occur at a 15-foot minimum setback from the property line on State Parks property. The alignment could be located at the same location as the proposed EPB project component (i.e., minimum of 40 feet from property line), but for the purposes of comparing alternatives, the 15-foot setback was selected. This alternative would implement the drainage bypass alternative described above in **Section 5.3.2.1**. The bypassed storm water would not pass through

any water quality treatment BMPs, but would pass through vault-based gross pollutant stormwater control measures such as screen filters.

Rationale for elimination from more detailed evaluation in this EIR: The Variable Height EPB Alternative would reduce the significant and unavoidable aesthetic impacts associated with placement of a flood wall in a scenic viewshed since the view impacts would occur only temporarily during flood events. This impact could be reduced to a less-than-significant impact with mitigation since the flood wall foundation could be screened by vegetation and would not be visible from public vantage points. In addition, this alternative would reduce impacts to habitat and species due to the reduced encroachment into the Lagoon. This alternative would also reduce land use policy inconsistency impacts to a less-than-significant level since the aesthetic impacts would be reduced. However, due to the closer proximity to the property line (i.e., this EPB alternative alignment would be located on the property line or setback 15 feet while the proposed EPB alternative would have a minimum setback of 40 feet from the property line), the significant and unavoidable impacts associated with construction and operational noise and vibration impacts would increase in severity. This alternative would result in higher costs related to construction, operation, and maintenance, as the wall would require rising and lowering for each flood event.

The Variable Height EPB Alternative provides a unique nexus of benefits for visual impacts, encroachment into State Parks property, flood control, and habitat impacts while meeting most of the project objectives when combined with a SRPS Component Alternative. The alternative provides a significant improvement over the current level of flood protection and unique costs and benefits when compared to the proposed EPB project component. On one hand, a variable height EPB could reduce the flood risk in the long term since the wall could be raised if required by sea level rise or other factors. On the other hand, a non-permanent wall has a higher risk of failure (over time) than a permanent/passive barrier (of the same elevation) because of the necessity for ongoing and timely operation and maintenance.

However, this alternative would not be feasible since it would be located within a designated State Natural Preserve and is opposed by the property owner (i.e., State Parks). Therefore, this alternative was rejected.

5.3 ALTERNATIVES ANALYSIS

This section describes the alternatives to the proposed project that were selected and evaluated in additional detail. The following information is provided for each alternative: (1) a description of the alternative, (2) analysis of the alternative's ability to reduce the impacts of the proposed project or result in any additional environmental impacts, and (3) assessment of the alternative's ability to meet the project objectives. A summary comparison of the alternatives is provided at the end of the section. This section is organized into four parts:

5.3.1 No Project Alternative

5.3.2 Alternatives Components to Proposed Project

5.3.3 Alternative Projects to Proposed Project

5.3.1 No Project Alternative

CEQA Guidelines Section 15126.6(e) requires that an EIR include an evaluation of the No Project Alternative to provide decision-makers the information necessary to compare the relative impacts of approving a project to not approving a project. The No Project Alternative is defined as a continuation of existing conditions, as well as conditions that are reasonably expected to occur in the event that a

proposed project is not implemented. Under the No Project Alternative for the proposed project, the proposed project components would not be built and no project objectives would be achieved.

It is reasonably likely that, pursuant to the regulatory agencies requiring a long-term solution to reduce the necessity of mechanical breaching and threat of litigation against the County for ceasing breaching activities, another project would be proposed and constructed. This future project would be required to undergo its own environmental review and discretionary approvals once defined and, therefore, is not included in the analysis of the No Project Alternative.

5.3.1.1 Description of Alternative

This alternative is considered because it is required by CEQA (i.e., continuation of existing conditions). In the event that the County of Monterey and its partner agencies do not implement the proposed project, the "no project" analysis assumes a "no action" scenario where none of the proposed project components would be constructed or operated. Although the regulatory agencies have stated that they will not permit the mechanical breaching activities that have historically occurred, future flood events are anticipated under the No Project Alternative and it is assumed that implementation of flood protection activities would be required to protect low-lying structures and public infrastructure under the No Project Alternative. This underlies the purpose and necessity of implementing a long-term solution, such as the proposed project. Future flood protection activities may include more intense sandbagging and public outreach efforts, and may include mechanical breaching in an emergency situation. These activities may be implemented by the County or other entity.

5.3.1.2 Environmental Impacts of the Alternative Compared to those of the Proposed Project

The No Project Alternative would eliminate all operational impacts of each of the proposed project components, including avoiding all significant impacts identified for the proposed project. However, the No Project Alternative would result in similar "construction-related" impacts to the proposed ISMP project component since it is assumed mechanical breaching would be required in emergency situations. Benefits of the proposed project related to special-status species, sensitive habitats, movement of native wildlife, and native nursery sites would not occur if the No Project Alternative was implemented. In fact, the emergency mechanical breaching would likely result in significant, unavoidable impacts to many of these resources. The beneficial impacts of the proposed project on water quality, specifically in respect to treatment of stormwater runoff before it enters the Lagoon, would also not occur. Please refer to **Table 5-2** for a comparison of the impacts of the No Project Alternative to the impacts of the proposed project.

5.3.1.3 Ability of the Alternative to Meet the Project Objectives

Under the No Project Alternative, none of the objectives of the proposed project would be met, and the benefits of the proposed project would not occur. The No Project Alternative would not enable the County to reduce the necessity of mechanical breaching, maintain existing flood protection, or protect public infrastructure. Private property along the northern edge of the Lagoon would remain vulnerable to flooding, infrastructure would continue to be susceptible to damage from scour, and the RMA would be at risk of not meeting regulatory requirements for sandbar management until non-emergency permits could be obtained. Further, the regulatory agencies have stated that they could not continue to issue permits for this alternative under an emergency scenario since mechanical breaching is anticipated to occur annually and, therefore, is not an emergency event.

5.3.2 Alternative Components to the Proposed Project

This section describes the alternative EPB and SRPS project components to the proposed project that were selected and evaluated in additional detail in this EIR.

5.3.2.1 SRPS – Seawall Located at the Toe of Slope Alternative

DESCRIPTION OF ALTERNATIVE

The SRPS – Seawall Located at the Toe of Slope Alternative consists of two sections of wall: the northern half would be a retaining wall constructed vertically (or near vertically) at the toe of slope, along an alignment similar to proposed SRPS project component; and the southern half would consist of revetment identical to proposed SRPS project component. Revetment is proposed for the southern half because beach topography in this area lends itself well to installation of revetment. Also, continued vehicle beach access across from the beach parking lot, both for breach management and emergency response, lends itself to a revetment alternative. The retaining wall structural system would consist of a tangent or secant pile wall.

The wall would be designed and constructed such that it would be completely buried most of the year, and would only be exposed during large riverine flow events or large wave events. Once the event has passed, normal wave action or mechanical sand movement would recover the structure with sand.

ENVIRONMENTAL IMPACTS OF ALTERNATIVE COMPARED TO THOSE OF THE PROPOSED PROJECT

This SRPS alternative is very similar to the proposed SRPS project component in terms of the alignment and profile of the earth slope above the wall, and in terms of the type of protection provided to Scenic Road. Therefore, the potential environmental impacts are very similar. Potential impacts to historical and archaeological resources and human remains would increase due to the increased amount of excavation. The right-of-way required for this alternative is slightly less than for the proposed component due to reduced encroachment onto the beach. The beach width available during a northerly-aligned breach is also slightly greater for this alignment than for the proposed alignment. The major differences between this alternative and the proposed SRPS project component are the increase in estimated project costs, and there would be the ability to provide an aesthetic treatment to the face of the wall for this alternative that may reduce aesthetic impacts compared to the revetment when visible. This alternative would have one of the highest costs of any of the alternatives and would create barriers to access and safety when the beach is eroded from the toe; a potentially 10-foot-high vertical drop would exist if the river flows to the north scour away the bluff toe, which is a public safety issue.

ABILITY OF ALTERNATIVE TO MEET PROJECT OBJECTIVES

This alternative meets most project objectives when combined with a sandbar management or EPB proposed component alternative. Specifically, the alternative meets the project objective to protect public infrastructure (Scenic Road embankment, State Parks restroom, and parking facilities) from scour resulting from a northerly-aligned lagoon outflow channel that may result from a reduction in mechanical breaching. In addition, the alternative protects the Scenic Road embankment from increasing risk of erosion from wave and river action, and sea level rise due to global warming.

5.3.2.2 SRPS Full Height Wall – Secant Pile Wall Alternative

DESCRIPTION OF ALTERNATIVE

The SRPS Full Height Wall – Secant Pile Wall Alternative would consist of construction within the footprint of the existing Scenic Road roadway. Preliminary 30% Plans have been prepared and are depicted in **Figures 5-1** and **5-2**. Due to its location at the top of the bluff, the full-height wall has a potential exposed height of approximately 25 feet. A cantilever wall of this height is infeasible, and, therefore, tieback anchors would have to be incorporated into the retaining wall design concept. The type of retaining wall would be a secant pile wall embedded into the marine terrace layer and tied back with earth anchors at the top of the wall extending under Scenic Road. After construction is completed, the roadway would be reconstructed and repaved. The completed pile wall would be completely below grade.

The wall would be completely buried until large riverine flow events or large wave events scour away the bluff toe. As the bluff toe scours, more of the pile wall becomes visible; eventually, the entire retained height could be exposed. Unlike the seawall at toe of slope SRPS alternative (**Section 5.3.2.4**), after the storm event has passed, normal wave action or mechanical sand movement would only partially recover the pile wall with sand, leaving the top portion visible.

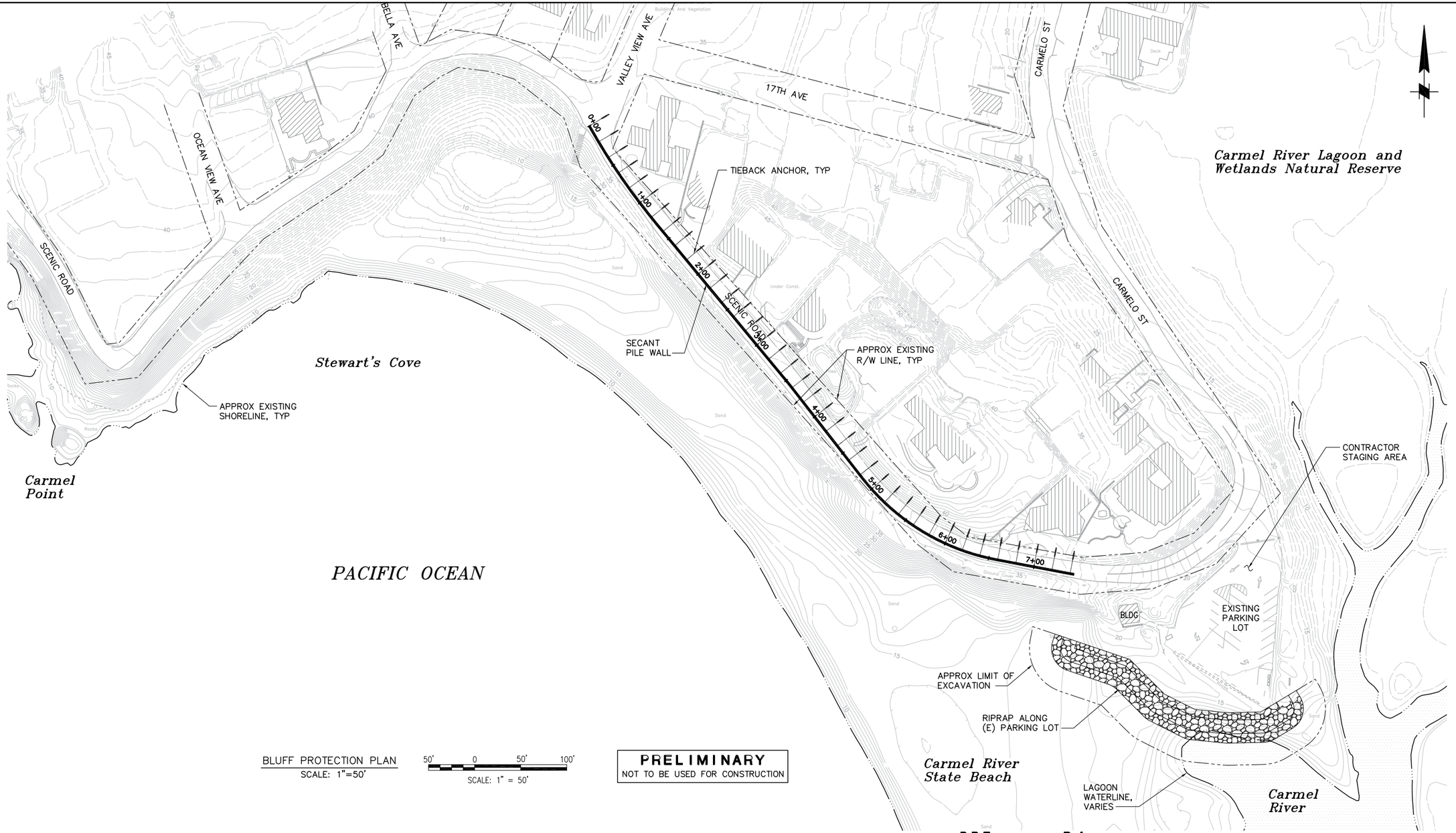
The tiebacks would likely extend beyond the right-of-way and an easement would be needed for the tiebacks to extend onto private property. It does include a rock toe to protect from scour, but that may be optional as well depending on the characteristics of the existing hard pan (marine terrace). An additional section of revetment extends around and protects the beach parking lot.

ENVIRONMENTAL IMPACTS OF ALTERNATIVE COMPARED TO THOSE OF THE PROPOSED PROJECT

Construction of the secant pile wall would require the full roadway width of Scenic Road. Large equipment (e.g., cranes, loaders, excavators, concrete trucks, dump trucks) would be required. Temporary access and detours would be provided during construction. Public access, including vehicles and pedestrians, would be prohibited along Scenic Road during construction. The existing parking lot would be protected by a 300-foot-long rock revetment. The rock revetment would require excavation, rock placement, and backfill. Construction of the rock revetment would be landward of the MHW line and, thus, would be out of jurisdictional limits. The parking lot would also be used as a contractor staging area for equipment and materials, and, therefore, public access to the parking lot and adjacent beach would be prohibited during revetment construction.

This SRPS alternative is very similar to the proposed SRPS project component in terms of the revetment alignment and in terms of the type of protection provided to Scenic Road. Therefore, the potential environmental impacts are very similar. Potential impacts to historical and archaeological resources and human remains would increase due to the increased amount of excavation. The SRPS Full Height Wall Alternative may be exposed after storm events and may not be recovered by the sand, and, therefore, aesthetic impacts would increase compared to the proposed SRPS project component. However, this impact could be mitigated through application of an architectural facing on the pile wall after it has been exposed. This alternative would result in the smallest footprint, providing the maximum beach width for riverine flow and beach users. It would also have the highest potential wall height and project cost. It would create significant barriers to beach access and safety once the beach is eroded from the toe and a 30- to 40-foot vertical drop occurs. As a result, this alternative may have the most significant impact on public access from Scenic Road since pedestrian and vehicular guard railing would be required along the top of the wall (which would be at level of Scenic Road).

This Page Intentionally Left Blank.



BLUFF PROTECTION PLAN
SCALE: 1"=50'

50' 0 50' 100'
SCALE: 1" = 50'

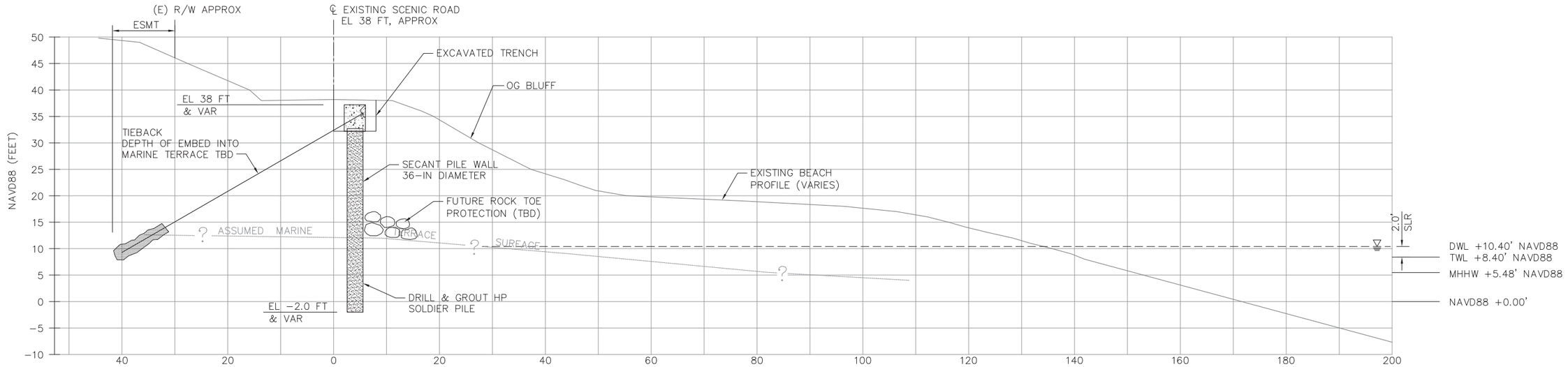
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Source: Moffatt & Nichol, June 29, 2015

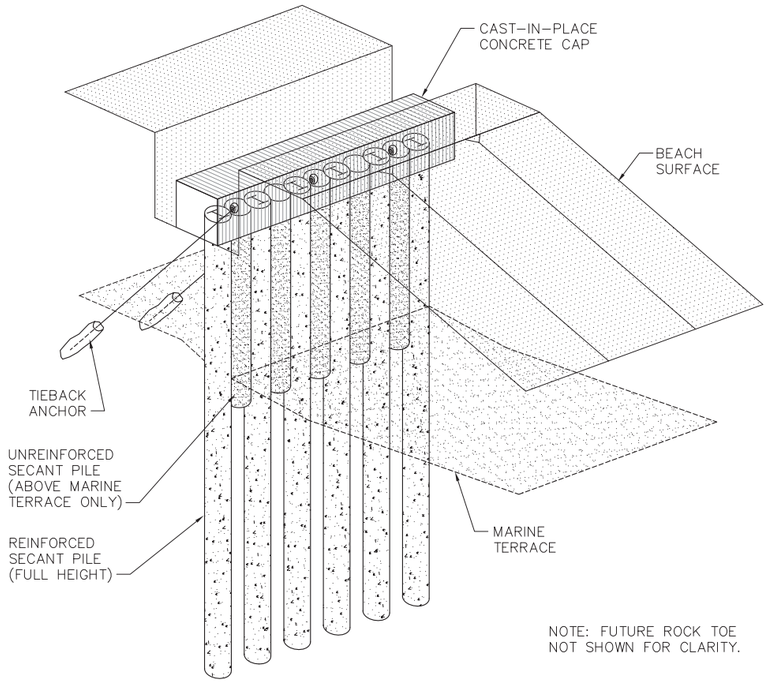
SRPS Full Height- Secant Pile Wall Alternative: Preliminary Site Plan

Denise Duffy and Associates, Inc. Planning and Environmental Consulting	Date 10-4-2016 Scale	Figure **5-1**

This Page Intentionally Left Blank.

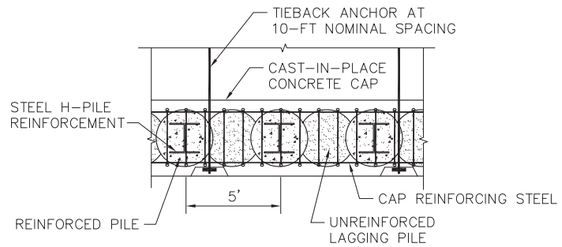


TYPICAL CROSS SECTION



NOTE: FUTURE ROCK TOE
NOT SHOWN FOR CLARITY.

TYPICAL ISOMETRIC VIEW
NOT TO SCALE



TYPICAL PLAN VIEW
NOT TO SCALE

NOTES:

1. STRUCTURAL ELEMENTS SHOWN ARE SCHEMATIC ONLY. ACTUAL SIZES AND DIMENSIONS WILL BE DETERMINED AS PART OF DESIGN PHASE.

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Source: Moffatt & Nichol, Full-Height Wall, August 2015

SRPS Full Height Wall - Scant Pile Wall Alternative: Preliminary Plan Views

Denise Duffy and Associates, Inc. Planning and Environmental Consulting	Date 10-4-2016 Scale	Figure **5-2**

This Page Intentionally Left Blank.

This alternative would result in increased significant construction noise impacts due to the closer proximity to residential areas. The right-of-way required for this alternative is significantly less than for the proposed component due to reduced encroachment onto the beach. This alternative would be the highest cost SRPS alternative.

ABILITY OF ALTERNATIVE TO MEET PROJECT OBJECTIVES

This alternative meets most project objectives when combined with a sandbar management or proposed EPB component alternative. Specifically, the alternative meets the project objective to protect public infrastructure (Scenic Road embankment, State Parks restroom, and parking facilities) from scour resulting from a northerly-aligned lagoon outflow channel that may result from a reduction in mechanical breaching. In addition, the alternative protects the Scenic Road embankment from increasing risk of erosion from wave and river action, and sea level rise due to global warming.

5.3.2.3 EPB – Elevate Structures Alternative

DESCRIPTION OF ALTERNATIVE

The Carmel Lagoon neighborhood between Camino Real, 16th Street, and Monte Verde Street is one of the areas in Monterey County where homes are frequently damaged by flooding. According to historical records, the Carmel Lagoon neighborhood has flooded 24 times since 1913. Over 27 homes reported flooding in January 2021, during the most recent flood event. Emergency actions to reduce flood risk, such as sandbar management, pumping, and sandbagging, are not a reliable solution to preventing flood damage and loss. Elevating structures is the most common means of reducing a structure's flood risk and one of the solutions to reliably reduce frequent property damage and flooding.

The process consists of raising the building to, or above, the BFE level. While the FEMA NFIP policy requires only the lowest floor of the building to be raised to the BFE, some states and NFIP communities enforce a "freeboard" requirement, which mandates that the building be raised above the BFE to meet the community's flood protection level. To significantly reduce flood risk, homes must be raised one foot above the 100-year BFE. In the low-lying Carmel Lagoon neighborhoods many homes are at 14.7-15.7 feet elevation (NAVD88), and the BFE as described by FEMA is 16 feet NAVD88. This would require a 2.3-foot elevation for the most low-lying homes to raise the ground floor one foot above the 100-year BFE, as required in Chapter 16.16 of the Monterey County Code.[3]

Currently, homes in this neighborhood are zoned Medium Density Residential in the Coastal Zone (MDR/2-D(18)(CZ)). The Carmel Area Land Use Plan limits height to 18 feet above the natural grade. To allow homeowners to raise structures to up 2.3 feet, an ordinance amendment would need to be processed by the County and the CCC to amend the height allowance so homes may keep their current roof line. A proposed 24-foot height restriction would be sufficient to allow all homes to raise their first floor one foot above the 100-year BFE.

The County cannot require homeowners to elevate individually owned homes unless a substantial improvement is being undertaken, as defined in the Monterey County Code. To encourage private homeowners to elevate their homes, a streamlined permit guide could be developed by the County, and a communication and outreach program could encourage homeowners to elevate their homes. In addition, the County could create and implement a Home Elevation Mitigation Program (program). The purpose of the program would be to support homeowners in flood-prone neighborhoods to protect their

[3] Chapter 16.16 - REGULATIONS FOR FLOODPLAINS IN MONTEREY COUNTY | Code of Ordinances | Monterey County, CA | Municode Library

homes through elevating and hardening. This program could be administered by the County and could encourage homeowners to take flood protection measures through grant funding disbursement, education, and permit streamlining.

The program could be modeled after that implemented by Sonoma County.[4] Utilizing funds from the FEMA Hazard Mitigation Grant Program (HMGP), the homeowner would fund 25% of the work. A homeowner would bring plans for home elevating to the County, who would determine eligibility. Any residential structure that has experienced flood damage would be eligible for assistance. The County would provide assistance in obtaining permits, receiving bids from contractors, and managing the construction process. Construction would involve four phases:

1. Elevating the structure above the flood level by a qualified house lifter.
2. Installation of new perimeter concrete foundation, as needed.
3. Construction of new supporting walls, lowering structure, and reattaching.
4. Completion of stairs, landings, finish trim, and paint.

Homeowners would be required to utilize an approved contractor and pay up front for the cost of the project. They would then be reimbursed by the County-held grant for up to 75% of the cost after the County building inspector has approved the work. Such a program would be depended on a number of factors including regulatory changes to allow increased height and availability of grant funds.

ENVIRONMENTAL IMPACTS OF ALTERNATIVE COMPARED TO THOSE OF THE PROPOSED PROJECT

This alternative would eliminate the significant and unavoidable aesthetic impacts associated with placement of a flood wall in a scenic viewshed. This alternative may improve views from some homes along the Lagoon, but could also block views from other home locations. This alternative would also reduce land use policy inconsistency impacts to a less-than-significant level since the aesthetic impacts would be reduced.

In addition, this alternative would avoid impacts to habitat and species due to the elimination of the proposed EPB component encroaching into the Lagoon. This alternative would eliminate the significant and unavoidable flooding impacts- on and off-site. It would also reduce the significant and unavoidable impacts associated with construction and operational noise and vibration impacts as the proposed EPB component would not be constructed. This alternative would also reduce construction-related traffic and public services/solid waste impacts.

This alternative would reduce damage to vulnerable structures constructed on the natural floodplain of the Carmel River and Lagoon; however, the flood impacts would remain until homeowners make the necessary improvements, the timing of which would be uncertain. This EPB alternative would require revisions to the Monterey County Code to require homeowners to elevate habitable structures in the floodplain. The County could provide incentives and create programs, but the County cannot require homeowners to elevate their homes. The alternative does not solve the problem of the Lagoon backwater affecting low-lying stormwater drains on residential streets upstream of the Lagoon unless these structures were also elevated. Although the Lagoon would be allowed to naturally breach once improvements were made, there would still be the potential to impact public infrastructure unless this alternative was combined with a SRPS component.

[4] Flood Elevation Mitigation Program | Housing and Neighborhood Investment | Community Development Commission | County of Sonoma (ca.gov)

ABILITY OF ALTERNATIVE TO MEET PROJECT OBJECTIVES

This alternative meets the project objectives when combined with a SRPS component. This alternative would meet the objectives of the project to reduce the necessity of mechanical breaching and to maintain the current level of flood protection. It would need to be implemented in combination with a SRPS project component alternative to meet the project objectives to protect public infrastructure.

5.3.2.4 EPB Garden Wall Alternative

DESCRIPTION OF ALTERNATIVE

Design Features

As described in **Chapter 3, Project Description**, the County currently implements management activities under existing permits to reduce potential flood impacts from rising lagoon level, including management of the sandbar and the seasonal placement of a sandbag barrier along property lines of homes and three streets (i.e., Camino Real, River Park Place, and Monte Verde Street) adjacent to the Lagoon.

The purpose of the proposed EPB component is to reduce or eliminate the need for mechanical breaching of the sandbar while maintaining or improving flood protection to the adjacent community. Functionally, the EPB, as designed and proposed in the 2016 Draft EIR, would allow the lagoon to rise high enough to breach the sandbar without mechanical breaching, and without backwatering into the adjacent neighborhood, except in extreme events. As described in the 2016 Draft EIR, the proposed EPB is a sheet pile wall built between 38 and 120 feet from residential property lines with an elevation of +17.5 feet NAVD88. By placing the EPB into the lagoon, the EIR analyzed a scenario where stormwater runoff was able to be detained within the lagoon on the north side of the EPB, and then drained through the EPB via a combination of gravity outfalls and a pump station built on the north (neighborhood) side of the EPB. There was significant opposition to the proposed EPB component by State Parks, the Fourth Addition Neighborhood residents, and other property owners along the Carmel Lagoon, as well as concerns from the regulatory agencies whether permits could be issued for the proposed component.

Thus, this "Garden Wall" Alternative was developed to meet the majority of the objectives of the proposed EPB project component while addressing concerns from State Parks, the Fourth Addition Neighborhood residents, and others. This alternative would consist of a concrete or concrete masonry unit (CMU) wall (typical ornamental wall construction, hence the name "garden wall") approximately 2 to 3 feet high placed along the property line at four properties, totaling approximately 550 linear feet (please refer to **Figure 5-3** for an example of the type of proposed wall and **Figure 5-4**, conceptual design plans prepared by Whitson Engineers, April 2023). The Garden Wall would be constructed along the same alignment as the temporary sandbag barrier, in effect replacing the sandbag barrier with a more permanent piece of infrastructure. Under this alternative, sandbags would continue to be placed seasonally by County staff within the County right-of-way at the lagoon end of Camino Real, River Park Place, and Monte Verde Street to assist in protecting the area from flooding. Under this alternative, when the sandbag barriers are in place at the end of these streets, two 11-inch inside diameter culverts with gate valves would protrude through each of the barriers to facilitate stormwater drainage when lagoon levels are low. The gate valves close when lagoon levels are high to prevent backflow.



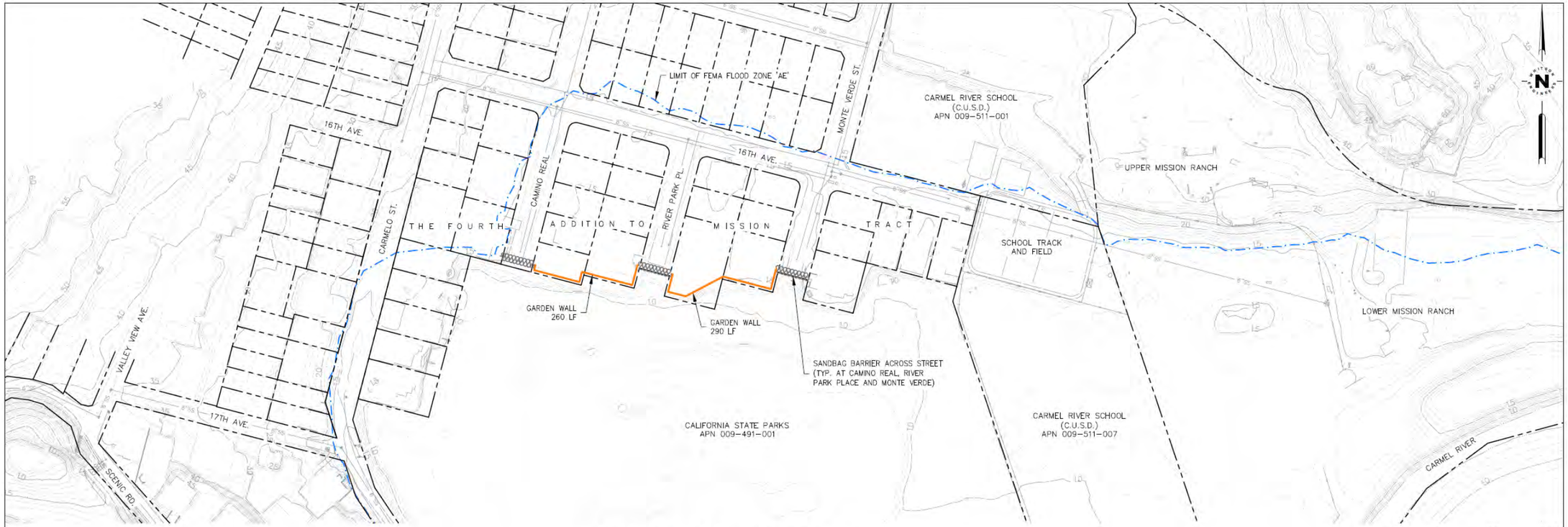
Figure 5-3. Example of type of proposed Garden Wall.

The proposed elevation of the top of the garden wall would be 16 feet NAVD88 to match the elevation of the existing sandbag barrier. Elevation 16 feet NAVD88 is also the current 100-year FEMA BFE. The existing ground elevations along the wall alignment range from 12.7 to 15.5 feet. The primary purpose of the Garden Wall is to protect homes and infrastructure from flooding due to rising lagoon levels. Critically, the effectiveness of the wall at holding back flood waters is limited by the minimum elevation along the entire wetted boundary of the lagoon that can be overtopped. The intent of setting the top of Garden Wall at elevation 16 was to protect against lagoon flooding up to the FEMA published 100-year BFE. However, the terminal extents of the wall would not tie off to high ground above elevation 16, and, therefore, susceptible to being outflanked by rising lagoon levels.

However, the Garden Wall Alternative is not designed to provide 100-year flood protection for existing conditions or for future conditions with sea level rise. Therefore, this alternative would be an interim flood protection solution while other EPB alternatives are being considered.

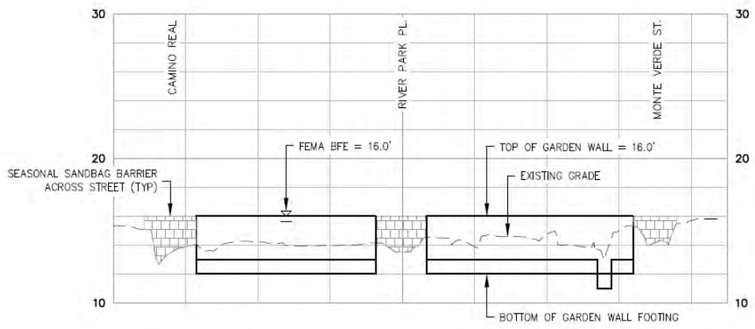
Construction and Maintenance

The garden walls would be constructed by each of the property owners and would be permitted under a County building permit and a California Coastal Commission coastal development permit.



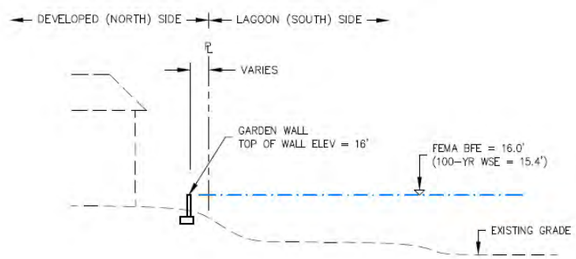
GARDEN WALL CONCEPT PLAN

SCALE: 1" = 100'



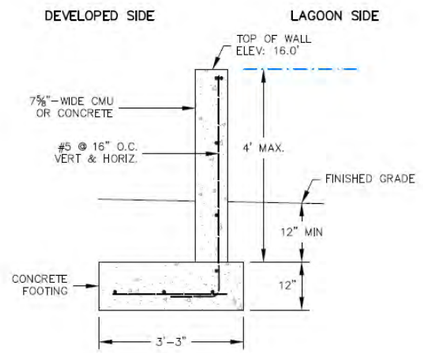
GARDEN WALL PROFILE

SCALE: 1" = 100' H & 1" = 5' V



GARDEN WALL TYPICAL SECTION

SCALE: 1" = 20' H & 1" = 10' V



GARDEN WALL TYPICAL DETAIL

NOT TO SCALE

CONCEPT PLAN NOT FOR CONSTRUCTION

Source: Whitson

EPB Garden Wall Alternative

Date 5/10/2023

Scale N/A

Denise Duffy & Associates, Inc.
Planning and Environmental Consulting

Figure 5-4

This Page Intentionally Left Blank

Each wall segment would require approximately four weeks to construct. Additional time may be needed for some decorative finishes, if wanted by the respective property owner. Since each property owner would be responsible for their own section of the wall; the various segments may be constructed separately. Construction would require up to six people working on the site, but generally would require two to four people. Construction access and staging would occur within the same property, and no off-site staging would be required. Staging within the County road right-of-way may occur, upon approval by the County. Construction would occur during standard, permitted hours. Construction equipment would include a backhoe, bobcat, mini-excavator, and walk-behind vibratory plate compactor. Maintenance of the garden walls would be owned and maintained by each property owner. Maintenance activities would be limited to occasional painting and repairs. It is anticipated that the project life would be around 20 years.

ENVIRONMENTAL IMPACTS OF ALTERNATIVE COMPARED TO THOSE OF THE PROPOSED PROJECT

Drainage Analysis

Balance Hydrologics, Inc. prepared a technical study to evaluate the level of flood protection achieved by the Garden Wall Alternative (referred to hereafter as the Drainage Analysis) (Carmel Lagoon Interim EPB On-Property Line Drainage Analysis, 2023), which is included in **Appendix H** of this RDEIR. Flood protection provided by the Garden Wall would primarily benefit the Fourth Addition Neighborhood (Fourth Addition), which is located immediately north of the lagoon and has a history of flooding. Specifically, the Fourth Addition encompasses an area bordered by the Lagoon to the south, 16th Avenue to the north, and includes homes along Camino Real, River Park Place, and Monte Verde Street (**Figure 5-5**).

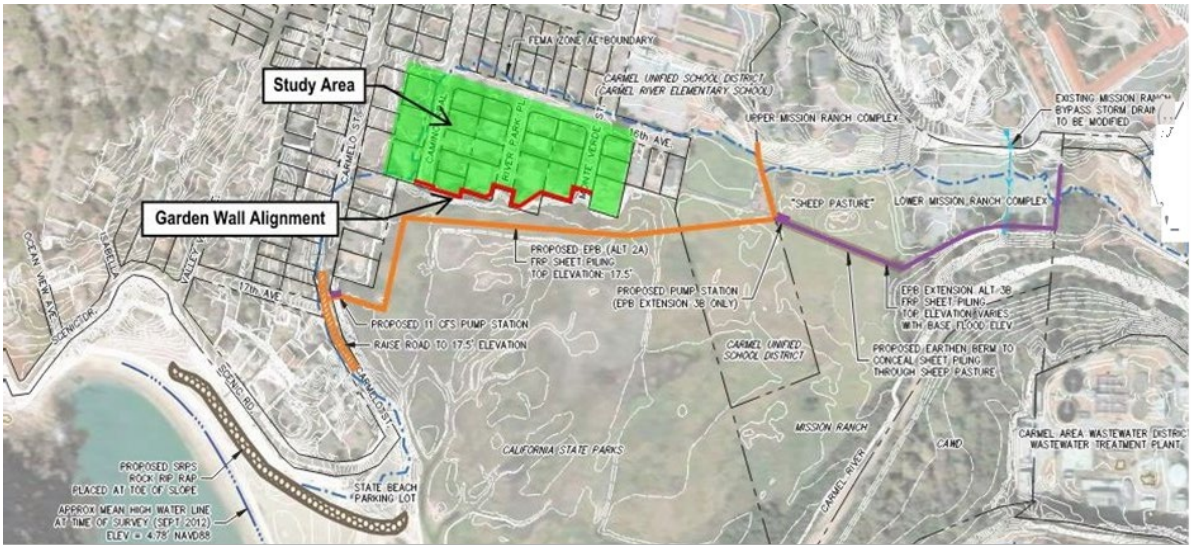


Figure 5-5. The proposed Garden Wall alignment is shown in red. The orange and purple lines represent the proposed EPB project component from the 2016 DEIR.

Flood risks for the Fourth Addition can be separated into two main sources: flooding due to rising lagoon levels and flooding due to stormwater runoff that builds up behind the temporary sandbag barrier and cannot drain into the Lagoon. The sandbag barrier includes culverts to gravity drain stormwater runoff when lagoon levels are low; however, when lagoon levels are high, gravity drainage is not possible. To address this, the County provides portable pumps at the end of each road.

The Drainage Analysis included modeling to estimate the extent and recurrence of flooding due to stormwater runoff, rising lagoon stage, and a combination of those two factors with the Garden Wall in

place. Additionally, the analysis studied the potential for flooding due to seepage through the sandbag barrier.

As described above, because the terminal extents of the wall would not tie off to high ground above elevation 16 feet, the wall would be susceptible to being outflanked by rising lagoon levels. The Drainage Analysis identified three locations where the Garden Wall would be outflanked at lagoon levels less than 16 feet:

1. At the western end of the proposed Garden Wall alignment, the temporary sandbag barrier ties off at approximately 15.3 feet and the Garden Wall would be outflanked at lagoon levels above this elevation (**Figure 5-6**).
2. At the eastern end of the proposed Garden Wall alignment, the temporary sandbag barrier ties off at approximately 15.1 feet and a flow path would occur between the sandbag barrier and a stone wall (**Figure 5-7**).
3. As lagoon levels increase above elevation 15 feet, the sports field at Carmel River Elementary School and the eastern end of 16th Avenue would become inundated. As lagoon levels continue to rise, the intersection of 16th Avenue and Monte Verde Street would become inundated. If lagoon levels rise above 15.8 feet (the low point of this intersection), flooding of the Fourth Addition is possible via water entering through the school property to the east (**Figure 5-8**).



Figure 5-6. Potential flow path around western Garden Wall terminus, looking south on Camino Real towards the lagoon.



Figure 5-7. Potential flow path around eastern Garden Wall terminus, looking southeast on Monte Verde towards the lagoon.

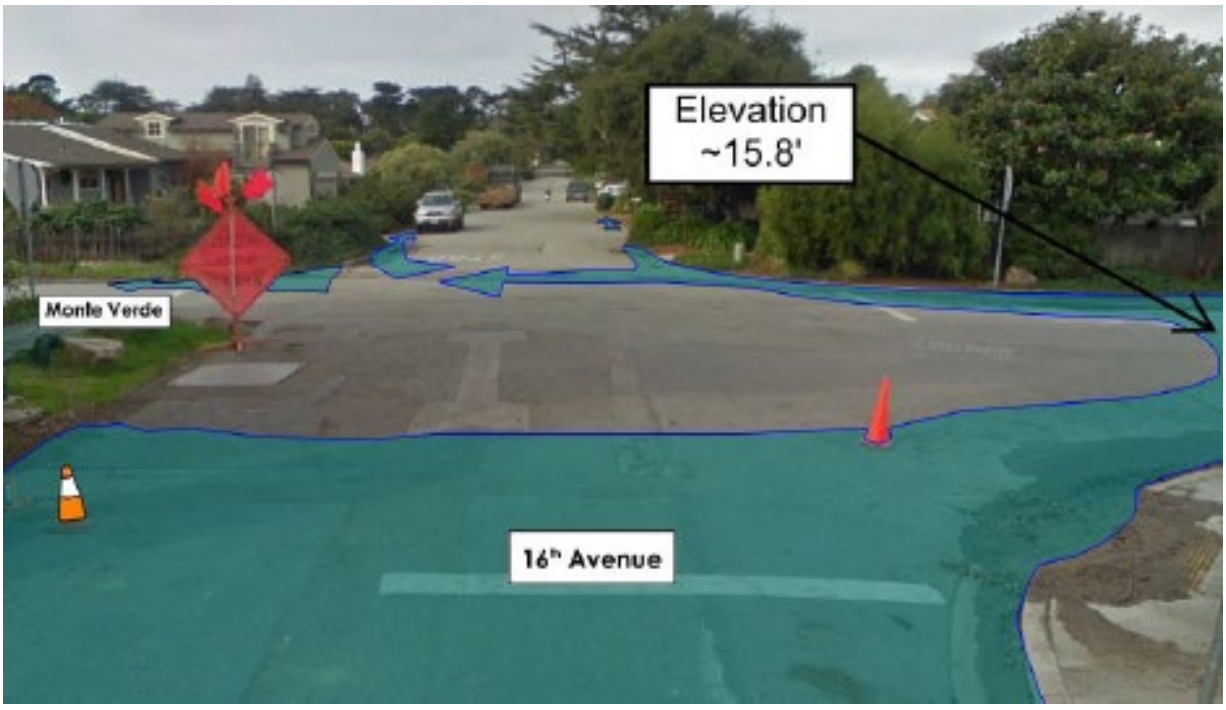


Figure 5-8. Potential flanking around intersection of Monte Verde Street and 16th Avenue, looking west.

The lowest point identified along the Garden Wall alignment was 15.1 feet, just beyond the eastern terminus of the alignment. Comparing this elevation to the flood frequency analysis, the wall would have a maximum 20-year level of flood protection.

The Fourth Addition is not serviced by any storm drain infrastructure; flow from the contributing watershed to the north of the lagoon flows over land to the south until it discharges into the lagoon or ponds within the Fourth Addition.

Lagoon Flooding

The Drainage Analysis modeled nine different scenarios to reasonably group flood risk from lagoon flooding, stormwater runoff, and a combination of these two factors. Three different design rainfall events were considered for the runoff calculations to mimic low, moderate, and high levels of precipitation: the 2-year, 10-year, and 100-year events. On the lagoon side, three different water surface elevations (WSE) were considered: elevation 13 feet, elevation 14 feet, and elevation 15 feet. These reflect the 2-year, 5-year, and 20-year events respectively based on the flood frequency analysis. Lagoon levels above 15 feet were not considered because the analysis showed that flooding would occur regardless of the proposed Garden Wall.

The modeling in the Drainage Analysis shows that rising lagoon levels alone would not cause flooding with the Garden Wall Alternative in place until lagoon levels rise above 15.1 feet NAVD88. The analysis of lagoon stage data shows that elevation 15.1 feet was equaled or exceeded three times between water years 2008 and 2022, and average lagoon levels have been trending upwards since 2015. The flood frequency analysis of the lagoon stage records shows that a lagoon elevation of 15.1 feet has an approximate 20-year recurrence interval. This analysis did not consider the effect of sea level rise since the Garden Wall Alternative would be an interim solution while other EPB alternatives are considered. Sea level rise is expected to push the average lagoon elevations higher in the coming decades.

The results from the Drainage Analysis show that flooding, as defined as the WSE rising above the minimum lowest adjacent grade (LAG) for a given street, occurs in every scenario except for the 2-year rainfall event with a lagoon tailwater (i.e., waters downstream) elevation of 13 feet at Camino Real. Monte Verde WSEs are predicted to rise above the LAG in the 2-year event and above. Flood elevations at Camino Real appear to be more sensitive to Lagoon WSE due to the overall lower terrain elevations, while Monte Verde results do not change significantly with rising lagoon levels. At lower lagoon levels, the model predicted duration of flooding is longer at Monte Verde than at Camino Real, potentially because Monte Verde is on the main flow path running north-south draining the upper watershed.

For this alternative, flood risk from the lagoon can be reduced by sealing the ends of the wall and implementing structural changes to the intersection of 16th Avenue and Monte Verde Street such that the Fourth Addition has some type of physical barrier above elevation 16 feet around the entire perimeter of the developed area. This would provide flood protection from rising lagoon levels up to the FEMA BFE of 16 feet; however, this would not address flooding issues due to limited stormwater drainage north of the wall and could potentially lead to higher flood levels from upland watershed runoff.

Stormwater Runoff

Stormwater runoff was shown to cause flooding in nearly all modeled scenarios. This in part reflects the lack of a municipal storm drain system within the Fourth Addition. Occasional high intensity rainfall combined with highly impervious, urbanized land cover can result in significant runoff volumes that must be conveyed within gutters along the streets or spread out as overland flow. This runoff ultimately ponds within the Fourth Addition as the lowest points in the watershed before draining into the lagoon. The proposed Garden Wall Alternative does not include any stormwater drainage improvements beyond the

existing conditions. At lower lagoon levels, when the culverts can discharge freely, the size of the culvert controls the maximum discharge rate into the lagoon. The two 11-inch culverts that are placed at the ends of each street have limited capacity for drainage. This can be seen in the model results with a lagoon WSE of 13 feet. In these scenarios, Monte Verde is predicted to flood in the 2-year rainfall event and above, and Camino Real is predicted to flood in the 10-year rainfall event and above. Pumping water at the street ends, as is the current County practice, can mitigate some of this flooding.

As the lagoon WSE increases, the culverts can only discharge when the WSE on the Fourth Addition side of the wall is higher than that in the lagoon (a positive head differential is required for gravity flow). Higher lagoon WSEs particularly affect Camino Real and River Park Place since their existing grades are lower overall than Monte Verde, resulting in a greater depth of flooding. Comparing the model results for the 2-year rainfall event with a lagoon WSE of 13 feet versus 15 feet shows that the WSE on Camino Real increase by over 1 foot between scenarios. At a lagoon WSE of 15 feet, the entire area north of the wall must pond above elevation of 15 feet to drain positively to the lagoon. That would inundate much of the terrain between River Park Place and Camino Real. At these lagoon levels, the only option to drain stormwater from north of the wall is to pump the water out and discharge it over the wall south into the lagoon.

Seepage

The Drainage Analysis also included a seepage analysis on both the temporary sandbag barrier and the Garden Wall to determine whether seepage would play a significant role in flooding. The results of the seepage flow analysis show that the rate of seepage is lower with the Garden Wall than with the sandbag barrier. In December 2023, during the near-record high surf height, the lagoon elevation continued to rise and could not outflow to the ocean. County maintenance crews observed “boiling” on the street side of the sandbag wall, indicating seepage was occurring (Ishii, personal communication, January 30, 2024). This intuitively makes sense due to the inclusion of a concrete footing with the Garden Wall that would impede the flow of water through the uppermost part of the soil column. The seepage calculations show that seepage under the Garden Wall is not likely to contribute significantly to flooding of the Fourth Addition. Assuming a constant lagoon WSE of 15 feet, it was calculated to take 42 hours for enough seepage to occur to cause flooding of Camino Real. In the three most recent periods where the lagoon WSE exceeded an elevation of 15 feet, the maximum period of inundation above 15 feet was 2.75 hours and the average across the three events was 1.5 hours. This shows that the duration of ponding required to create a flood risk to homes through seepage alone is far beyond what regularly occurs, even during high flooding events.

Drainage Analysis Conclusion

The results of this study demonstrate that the Fourth Addition is at risk of flooding from rising lagoon levels, stormwater runoff, and a combination of these two factors. Framing flood risk in terms of a statistical chance of flooding in any given year is made more difficult by the complexity of the processes involved and the interdependency of the two flooding sources with different probabilities of occurrence.

If the lagoon flooding source is analyzed independently, the proposed Garden Wall Alternative has a 20-year level of flood protection according to the statistical analysis of gage records. As described above, the level of lagoon flood protection is limited by low points along the Garden Wall alignment. However, without the Garden Wall or some other flood protection barrier, flood risk has the potential to be even higher as there would be nothing stopping the lagoon from flowing low areas below elevation 15 feet more frequently. Without a wall, lagoon level would be expected to reach the minimum LAG on Camino Real of 14.1 feet in 20% of years (a 5-year recurrence). Analysis of the existing topography showed that

increasing the level of flood protection up to elevation 16 feet is possible by addressing physical low points along the wall alignment, and would increase the level of flood protection to the 50-year recurrence.

With regards to flooding due to stormwater runoff, the Garden Wall Alternative does not provide any drainage improvements over the existing conditions. The modeling shows that flooding is possible even under the most favorable lagoon tailwater conditions during the 2-year rainfall event. Pumping, or other physical stormwater management actions, were not considered when assessing the level of flood protection of the Garden Wall. However, pumping or other physical stormwater management actions can mitigate some of this flooding. At low relative lagoon levels, stormwater drainage can be improved by enlarging the culverts placed at the end of each street. At high relative lagoon levels, the only way to improve drainage is through pumping.

Seepage was shown not to be a primary concern with the Garden Wall scenario, largely due to the limited head differential that is possible with a wall along the property line. This differs from past analyses of the proposed EPB project component which include an EPB within the lagoon and a much greater potential head difference.

Impacts Summary

This EPB project component alternative would reduce most of the environmental impacts associated with the proposed EPB project component. With the placement of the garden wall on the property line and smaller project footprint compared to the proposed EPB project component, potentially significant impacts to biological resources, cultural resources, hydrology and water quality, land use, public services, and traffic would be avoided or reduced. However, compared to the proposed EPB project component, water quality would not be improved through implementation of water quality treatment BMPs and runoff would continue to flow directly into the lagoon. Therefore, this alternative may increase impacts to water quality due to the lack of available space to implement water quality treatment areas.

This alternative would eliminate the significant and unavoidable aesthetic impacts associated with placement of a flood wall in a scenic viewshed. It would eliminate the significant and unavoidable impacts associated with construction noise as the scale and type of construction would not result in the same increase in noise levels. This alternative would also eliminate the significant and unavoidable impacts to potential flooding impacts to the CAWD and Mission Ranch properties and potential seepage impacts to the CAWD facility, as the lagoon WSE would have to be managed to not rise above 15 feet. This alternative would eliminate encroachment onto State Parks property.

ABILITY OF ALTERNATIVE TO MEET PROJECT OBJECTIVES

The EPB Garden Wall Alternative would meet the objectives of the project to reduce the necessity of mechanical breaching and to maintain the current level of flood protection. However, the Garden Wall Alternative would need to be combined with a sandbar management component to manage the lagoon WSE under 15 feet to avoid outflanking of the lagoon into the Fourth Addition. It would also need to be implemented in combination with a SRPS project component alternative to meet the project objectives to protect public infrastructure. This alternative would also meet the project objective of minimizing infrastructure that could detract from the function and value of the natural environment with the reduced project footprint of the Garden Wall.

5.3.2.5 SRPS Mid-Slope Wall Alternative

DESCRIPTION OF ALTERNATIVE

Design Features

In the past, rapid outflows of water from the lagoon associated with northerly breaches eroded a deep and wide channel along the base of the bluff, compromising Scenic Road and associated infrastructure as well as precluding beach access from the CRSB parking lot, which most recently occurred in January 2023. Therefore, as described in **Chapter 3, Project Description**, the County and its partners have been working to identify a long-term solution for this issue. The DEIR identified a low-profile, mid-height wall alternative (i.e., the Mid-Slope Toe Soldier Pile Wall) as the most feasible SRPS, that achieves the following:

1. Will not impede the formation of a lagoon breach channel with a northerly alignment along Scenic Road. A northerly alignment is preferred by the agencies as the breach channel can develop a milder slope and hydraulic gradient, which may permit gradual outflow from the lagoon without leading to a catastrophic breach event where the entire lagoon drains over a short period of time. Any amount of time that the breach channel can serve as an outlet for the lagoon will go towards a longer residence time for juvenile steelhead in the lagoon in terms of their growth and transition from a freshwater to a saltwater environment.
2. Allows the lagoon to breach to the north without eroding the bluff along Scenic Road. This will aid in protecting Scenic Road, protecting infrastructure along the road, and public access along Scenic Road. Further, it will help preserve the natural vegetation over the face of the bluff.
3. Prevents water flow and wave action from eroding the base of the bluff beyond its current state.

As discussed in **Chapter 1, Introduction**, the County received over 40 letters from public agencies, organizations, and the general public, which included challenges to and requests for additional technical studies related to the proposed SRPS component of the project and requests to identify and analyze additional project alternatives, as well as a more detailed analysis regarding the location and alignment of a natural breach of the Carmel River. Therefore, the County retained Moffatt & Nichol to analyze the natural breach alignment and location and sediment transport, and prepare an assessment of potential beach impacts from a mid-slope wall alternative similar to the Mid-Slope Toe Soldier Pile Wall analyzed in the DEIR (*Carmel River Lagoon Natural Breach Alignment and Location* study, *Sediment Transport Study*, and *Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential*; each of these reports are contained in **Appendix F** of this RDEIR).

Based on these technical analyses, Preliminary 30% Plans for a Mid-Slope Wall (MSW) Alternative (Moffatt & Nichol, March 24, 2023) were developed and are depicted in **Figures 5-9** through **5-12b**.

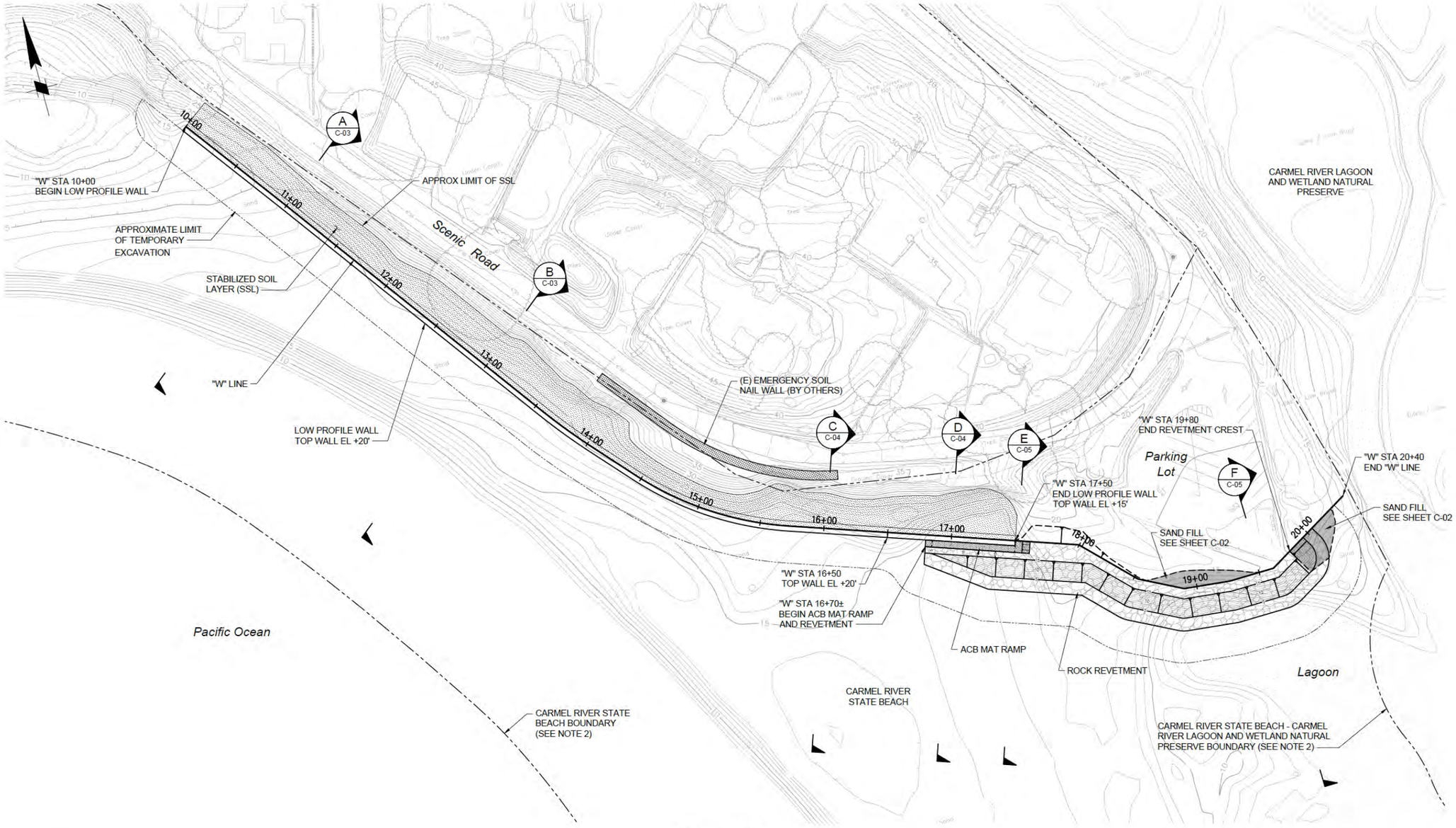
In addition to meeting the proposed project objectives, the basis of design for the MSW were as follows:

- Protect the base of the bluff along Scenic Road from eroding when the Carmel River flows adjacent to the bluff;
- Protect the bluff along Scenic Road from wave-related impacts;
- Would not impede natural formation of the lagoon and flow of the Carmel River to the north (e.g., the SRPS should not encroach significantly on the beach);
- Be as minimally intrusive as possible in terms of visual impact and public access;
- Avoid impacts to the existing wetland area located at the northern end of the CRSB;

- Minimize erosion impacts to Scenic Road;
- Maintain beach access from the CRSB parking lot;
- Consider the erosion events that have caused the beach level to erode down to the marine terrace (hardpan);
- Minimum crest elevation should be equal to the BFE of the lagoon (+16 feet NAVD88) to meet FEMA requirements to mitigate fluvial flood hazards; and,
- Protect the bluff from coastal flood hazards in the form of storm surge and wave runup, which can reach an elevation of +26.7 feet NAVD88 in a 1% annual chance storm event.

The proposed MSW Alternative would be approximately 1,040 feet, starting from the southern tip of the CRSB parking lot, continuing along the toe of the bluff parallel to Scenic Road approximately at elevation +8 feet NAVD88, terminating between Valley View Avenue and Isabella Avenue. This alternative would consist of a low-profile wall along Scenic Road and rock revetment along the edge of the CRSB parking lot. The scope and scale of this alternative would aim to protect the face of the bluff up to elevation +27 feet NAVD88 or higher, which is the FEMA 1% annual chance BFE and the approximate elevation of the roadway (**Figures 5-9** through **5-12b**).

The proposed low-profile wall alignment commences approximately 100 feet from the wetland area on the northern end of the Carmel River State Beach to avoid impacts to the wetland and public access to the beach (**Figure 5-9**). The wall structure would consist of a low-profile wall composed of a row of 3-foot diameter cast-in-drilled-hole (CIDH) piles at 8-foot spacing, founded on the marine terrace hardpan underlying the bluff formation. The wall would be secured with anchor rods drilled into the bluff and formed as a concrete wall with shotcrete facing, textured to mimic the natural appearance of the bluff. The crest of the wall would be at approximately elevation +20 feet NAVD88, which is the approximate level of the beach profile. Bluff protection would be incorporated above the crest of the wall between elevation +20 and +27 feet NAVD88, consisting of a vegetated, stabilized soil layer of controlled-low-strength-material (CLSM), placed at a 3H:1V slope (i.e., this portion of the wall would be a living wall, as described in **Section 5.2.1.7**). The CLSM is a self-consolidating, cementing material that has a lower strength than typical concrete products, which allows for natural weathering of the material.



1 SITE PLAN
SCALE: 1" = 40'

NOTES

1. EXISTING TOPOGRAPHY DATED NOV 27, 2012 BY WHITSON ENGINEERS (MONTEREY, CA) BASED ON AERIAL TOPOGRAPHIC SURVEY BY AERIAL PHOTOMAPPING SERVICES (CLOVIS, CA) ON AUG 29, 2012.
2. STATE PARK BOUNDARY SOURCE: CALIFORNIA STATE PARKS GIS DATA WEBSITE (https://www.parks.ca.gov/?page_id=29682).
3. ANCHOR END WALL INTO BLUFF.
4. EXCAVATION AT DEPTH MAY ENCOUNTER GRANODIORITE ROCK OUTCROPS, RIPRAP, AND OTHER DEBRIS. LIMIT EXCVATION TO MARINE TERRACE HARDPAN.
5. LAGOON EXTENT VARIES SEASONALLY.

40' 0' 40' 80'
SCALE: 1"=40'

PRELIMINARY DESIGN
ISSUED: MARCH 24, 2023
NOT TO BE USED FOR CONSTRUCTION

Source: Moffatt & Nichol

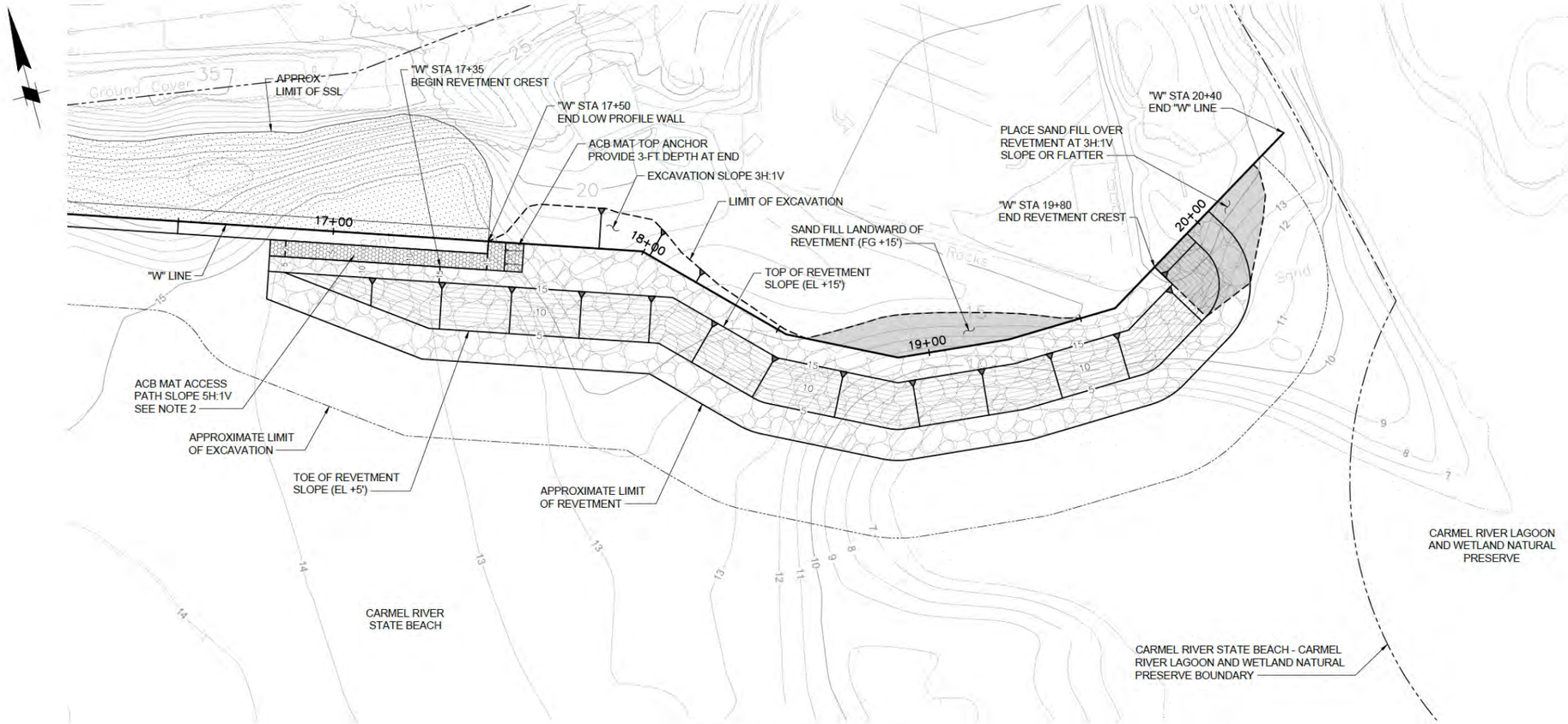
SRPS MSW Alternative - Site Plan

Date 5/10/2023
Scale N/A

Denise Duffy & Associates, Inc.
Planning and Environmental Consulting

Figure 5-9

This Page Intentionally Left Blank



1 REVETMENT PLAN
SCALE: 1" = 40'

NOTES

1. EXISTING TOPOGRAPHY DATED NOV 27, 2012 BY WHITSON ENGINEERS (MONTEREY, CA) BASED ON AERIAL TOPOGRAPHIC SURVEY BY AERIAL PHOTOMAPPING SERVICES (CLOVIS, CA) ON AUG 29, 2012.
2. ACB MAT SHALL BE ARMORROAD BY CONTECH ENGINEERED SERVICES, INC. FIELD-CONNECT ACB MAT BLOCKS WITH 3/16" SS316 CABLE. INSTALL ACB MAT PER MANUFACTURER FIELD INSTALLATION AND FIELD CABLING INSTRUCTIONS AND RECOMMENDATIONS EXCEPT AS OTHERWISE NOTED.

20' 0' 20' 40'
SCALE: 1"=20'

PRELIMINARY DESIGN
ISSUED: MARCH 24, 2023
NOT TO BE USED FOR CONSTRUCTION

Source: Moffatt & Nichol

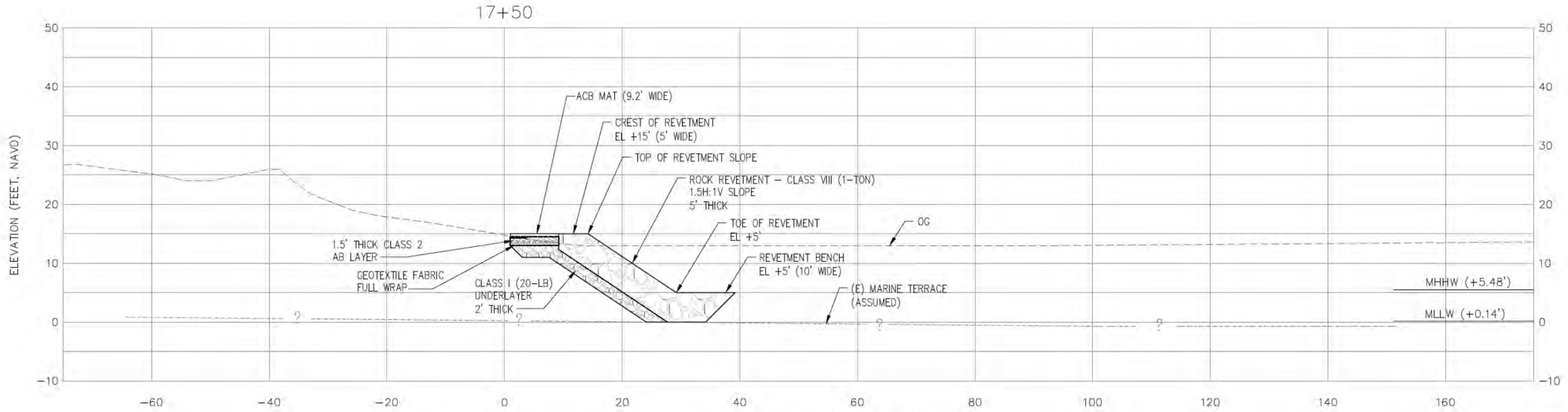
SRPS MSW Alternative - Revetment Plan

Date 5/10/2023
Scale N/A

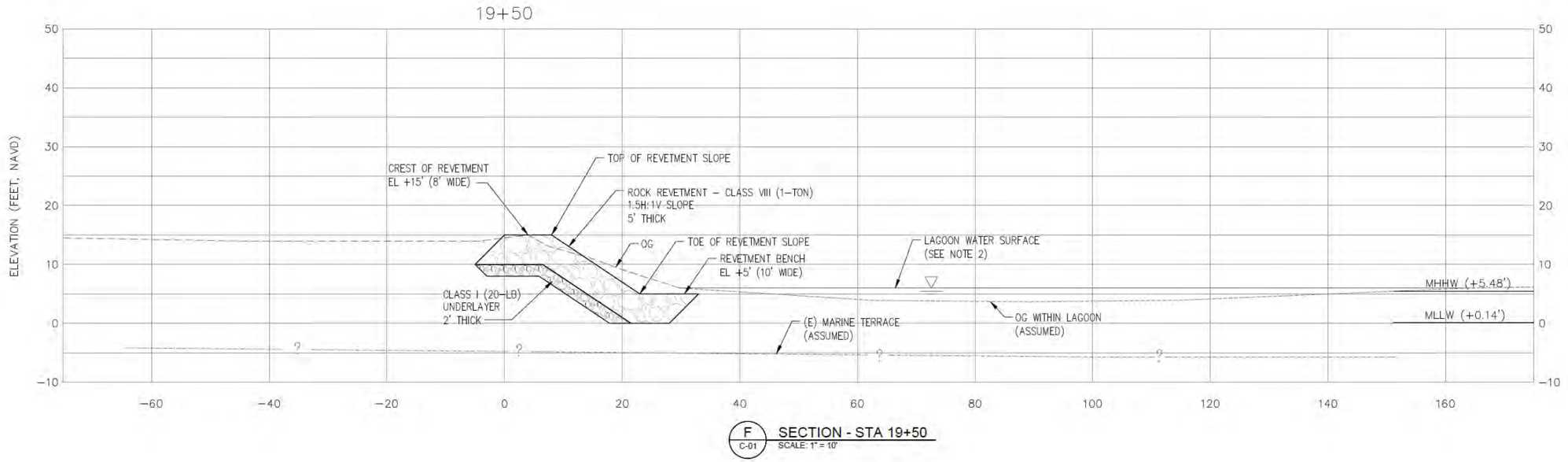
Denise Duffy & Associates, Inc.
Planning and Environmental Consulting

Figure 5-10

This Page Intentionally Left Blank.



E C-01 SECTION - STA 17+50
SCALE: 1" = 10'



F C-01 SECTION - STA 19+50
SCALE: 1" = 10'

NOTES

1. EXISTING TOPOGRAPHY DATED NOV 27, 2012 BY WHITSON ENGINEERS (MONTEREY, CA) BASED ON AERIAL TOPOGRAPHIC SURVEY BY AERIAL PHOTOMAPPING SERVICES (CLOVIS, CA) ON AUG 29, 2012.
2. LAGOON WATER SURFACE SHOWN PER TOPOGRAPHIC SURVEY ON NOV 27, 2012

10' 0' 10' 20'
SCALE: 1"=10'

PRELIMINARY DESIGN
ISSUED: MARCH 24, 2023
NOT TO BE USED FOR CONSTRUCTION

Source: Moffatt & Nichol

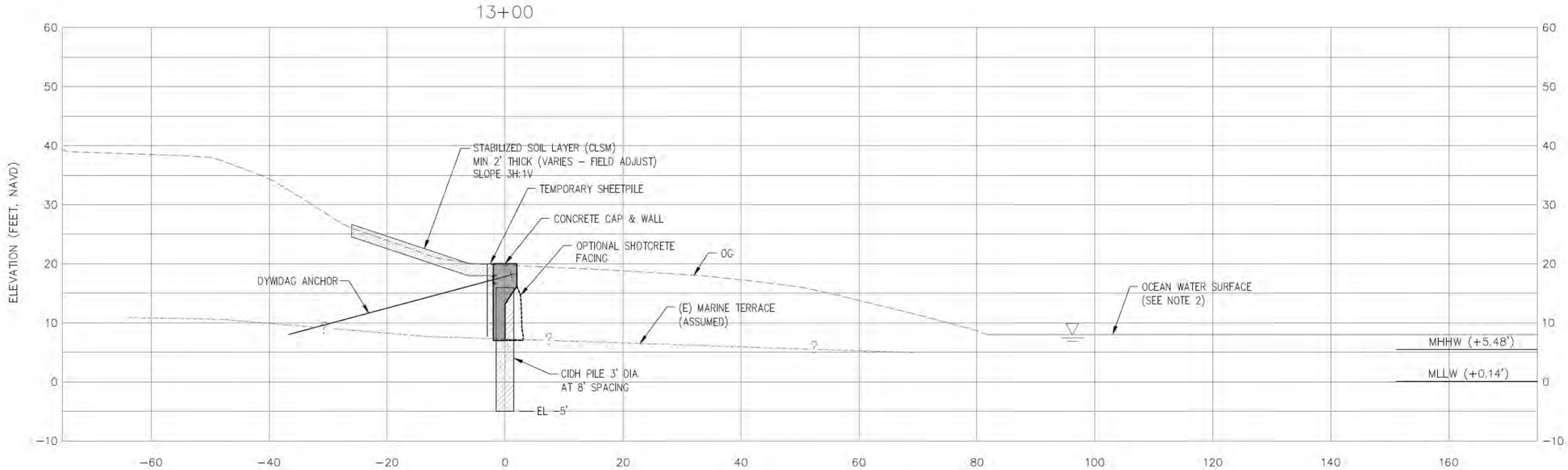
SRPS MSW Alternative - Revetment Typical Sections

Date 5/10/2023
Scale N/A

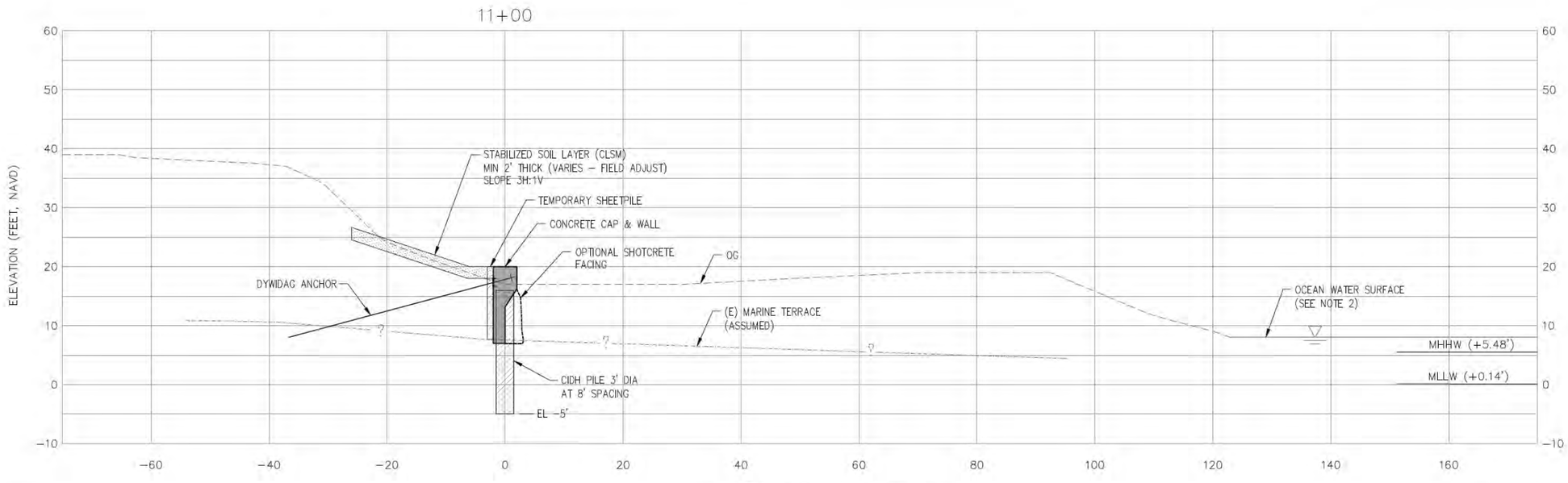
Denise Duffy & Associates, Inc.
Planning and Environmental Consulting

Figure 5-11

This Page Intentionally Left Blank.



B C-01 SECTION - STA 13+00
SCALE: 1" = 10'



A C-01 SECTION - STA 11+00
SCALE: 1" = 10'

NOTES

1. EXISTING TOPOGRAPHY DATED NOV 27, 2012 BY WHITSON ENGINEERS (MONTEREY, CA) BASED ON AERIAL TOPOGRAPHIC SURVEY BY AERIAL PHOTOMAPPING SERVICES (CLOVIS, CA) ON AUG 29, 2012.
2. OCEAN WATER SURFACE SHOWN PER TOPOGRAPHIC SURVEY ON NOV 27, 2012

10' 0' 10' 20'
SCALE: 1"=10'

PRELIMINARY DESIGN
ISSUED: MARCH 24, 2023
NOT TO BE USED FOR CONSTRUCTION

Source: Moffatt & Nichol

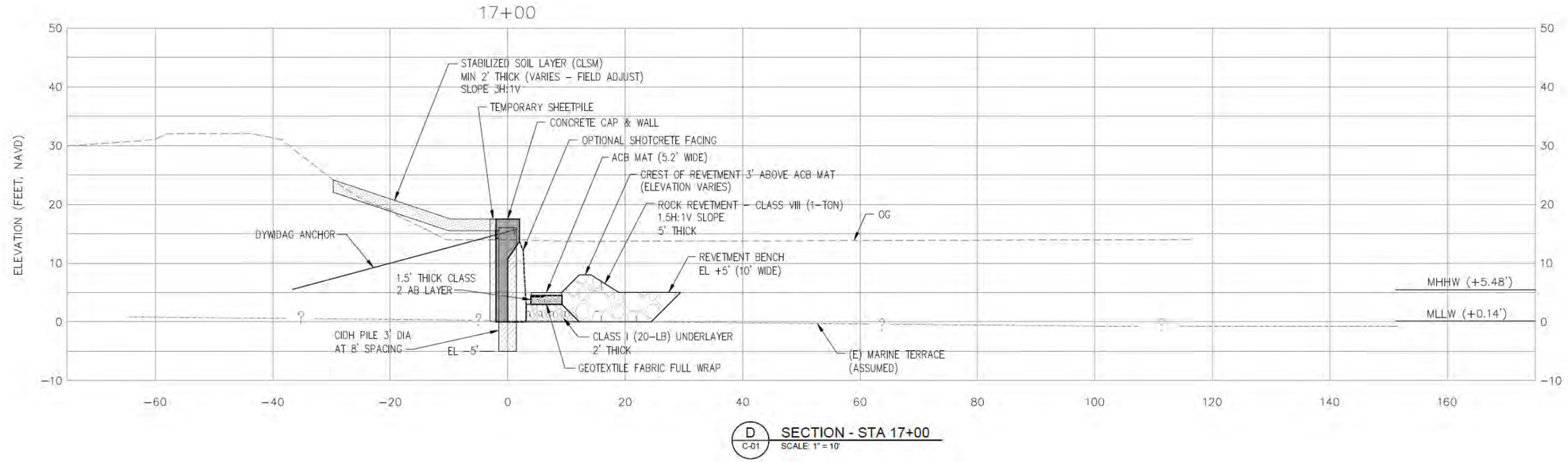
SRPS MSW Alternative - MSW Typical Sections

Date 5/10/2023
Scale N/A

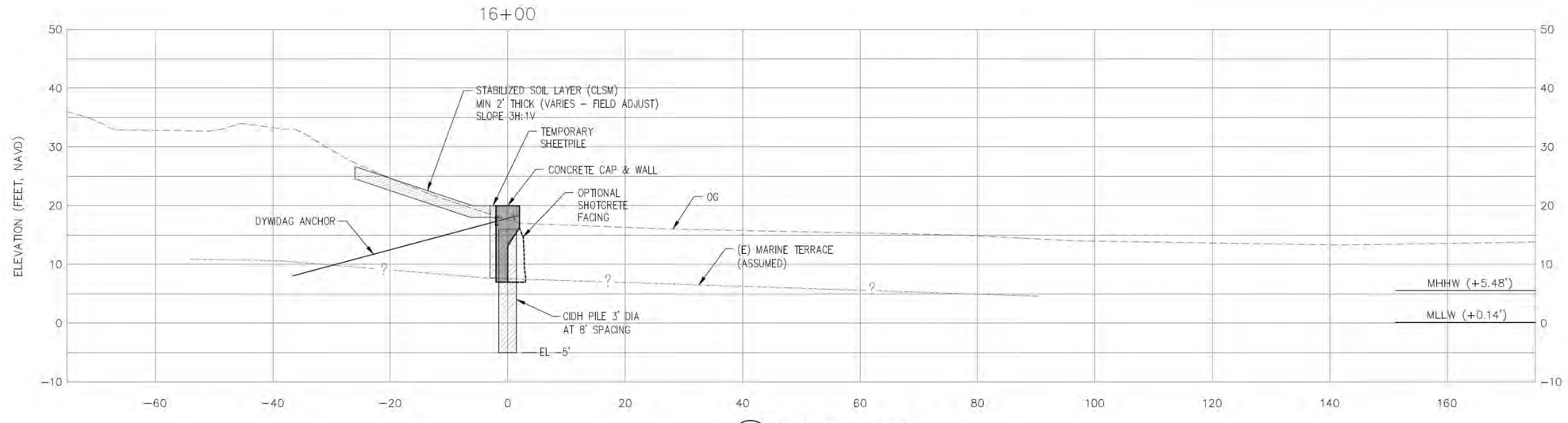
Denise Duffy & Associates, Inc.
Planning and Environmental Consulting

Figure 5-12a

This Page Intentionally Left Blank.



D / C-01 SECTION - STA 17+00
SCALE: 1" = 10'



C / C-01 SECTION - STA 16+00
SCALE: 1" = 10'

NOTES

1. EXISTING TOPOGRAPHY DATED NOV 27, 2012 BY WHITSON ENGINEERS (MONTEREY, CA) BASED ON AERIAL TOPOGRAPHIC SURVEY BY AERIAL PHOTOMAPPING SERVICES (CLOVIS, CA) ON AUG 29, 2012.

10' 0' 10' 20'
SCALE: 1"=10'

PRELIMINARY DESIGN
ISSUED: MARCH 24, 2023
NOT TO BE USED FOR CONSTRUCTION

Source: Moffatt & Nichol

SRPS MSW Alternative - MSW Typical Sections

Date 5/10/2023
Scale N/A

Denise Duffy & Associates, Inc.
Planning and Environmental Consulting

Figure 5-12b

This Page Intentionally Left Blank.

Where the wall alignment terminates, an articulating concrete block (ACB) mat ramp and rock revetment are proposed around the parking lot (**Figures 5-10** and **5-11**). An ACB mat system is a matrix of individual concrete blocks placed together to form an erosion-resistant overlay with specific hydraulic performance characteristics. The system includes a filter layer underlay that allows infiltration and exfiltration to occur while providing particle retention of the soil subgrade. The rock revetment would consist of one-ton boulders approximately 5 feet thick and 10 feet wide seated into the beach and marine terrace hardpan to the extent feasible around the parking lot. The proposed rock revetment is sized so that each individual boulder has sufficient weight not to be lifted out by wave action or streamflow. Additionally, the boulders are angular in shape, which helps them hold together (i.e., interlocking).

The low-profile wall would protect the lower portion of the bluff from wave, lagoon outflow, and sea-level rise related impacts, with overlying slope protection to protect the upper portion of the bluff against wave overtopping. The wall would be located on the marine terrace (hardpan) at the base of the bluff (**Figures 5-12a** and **5-12b**). The height of the low-profile wall would be set so that it would generally be buried under the beach sand under normal conditions and would not pose a visual obstruction. When buried under the sand, the MSW would not pose an obstruction to public access to the beach. This alignment would not negatively impact lagoon formation or the beach. The wall alignment would be located at the toe of the bluff to prevent construction-related impacts to the intact portions of the bluff. Due to the narrow footprint of the wall, it would not encroach on the intact bluff, beach, or lagoon. The rock revetment along the parking lot edge would incorporate an access ramp to facilitate public access to the beach.

Construction and Maintenance

It is anticipated that construction of the SRPS MSW Alternative would require approximately three to four months but may be prolonged depending on site conditions and/or if site restrictions are required. The estimate of construction duration assumes that installation of the CIDH piles can be carried out concurrently as two ongoing operations, commencing at the north and south ends of the wall alignment. Once the CIDH pile installation is complete, the temporary shoring can be installed backing the CIDH piles. The temporary shoring will prevent bluff material from sloughing during the period of construction. When the temporary shoring is in place, excavation for the wall construction can begin.

The construction crew is assumed to consist of the following contractor personnel:

- Pile Driving Crew (4): Crane Operator, Foreman, Laborers
- Shoring Crew (4): Excavator Operator, Foreman, Laborers
- Excavation Crew (4): Excavator Operator, Loader Operator, Foreman, Laborer
- Shotcrete Crew (5): Foreman, Nozzlemen, Laborers
- Revetment Crew (4): Excavator Operator, Loader Operator, Foreman, Laborer
- Controlled Low-Strength Material Crew (5): Foreman, Laborers, Finishers

The construction work can be staged in one of two ways or jointly via:

1. A temporary staging area to be built on the beach on pad constructed from beach sand.
2. Via the existing parking lot at the south end of the project site.

Rock and other materials needed for construction would be delivered to the parking lot. Public access to the beach would need to be closed during the period of construction with signage in place about the

period of construction and closure of the beach to the public. The construction duration cited above is estimated based on normal hours of construction, and 8-hour workdays.

The equipment anticipated for construction will consist of the following:

- Drill rig,
- Excavator(s),
- Loader(s),
- Concrete trucks,
- Generators, and
- Shotcrete equipment.

The anticipated life of the project is approximately 50 years from construction.

Annual maintenance of the SRPS MSW would include an annual inspection of the wall, CLSM and visual reconnaissance of the rock revetment and public access ramp. The inspection work may be timed to occur after the passage of winter storms and before the peak summer season commences, and/or dependent on a site habitat constraints and lagoon formation.

As discussed in **Section 4.1.1.3, Site Characteristics**, a 200-foot section of the bluff along Scenic Road was impacted during the January 5, 2023, storm event. Storm surge and wave action impacted the shoreline over a high tide coinciding with significant outflow from the Carmel River. The river outflow and wave action eroded the beach and the base of the bluff. The erosion at the base of the bluff caused sand and bluff material to slump, leaving sections of Scenic Road undercut and portions of the blacktop spanning across the undercut sections. The County constructed a temporary soil nail wall along the 200-foot section of Scenic Road that was impacted by the storm event. The soil nail wall stabilized the bluff and enabled repairs to the damaged sections of Scenic Road. The soil nail wall consists of a layer of reinforced concrete facing applied over the face of the bluff, anchored by soil nails drilled into the bluff. At the toe of the bluff, the base of the soil nail wall is supported on a row of micropiles. A rock apron was incorporated at the base of the soil nail wall to prevent wave-related erosion and undercutting of the soil nail wall foundation.

This emergency repair is a temporary solution, and the soil nail wall is not designed to meet the objectives and design criteria of the long-term solution. This analysis assumes that the temporary soil nail wall would be removed prior to constructing the MSW Alternative. However, the County may apply to the regulatory agencies for the temporary soil nail wall to be permitted as part of the permanent structure and construct the proposed MSW Alternative in front of the soil nail wall. However, the anchors of the MSW Alternative would need to penetrate through the temporary soil nail wall. Also, during pre-excavation, the contractor would need to locate and pull aside the rock and the base of the temporary soil nail wall. The rock could be replaced after construction, or removed from site, which could be considered a mitigation option by the regulatory agencies. Another option would be to have a break in the MSW alignment where the temporary soil nail wall is located, designing the MSW on both sides of the temporary soil nail wall. This option could be considered during final design; however, additional technical studies may be required to demonstrate that the temporary soil nail wall provides the same level of protection as the MSW Alternative.

ENVIRONMENTAL IMPACTS OF ALTERNATIVE COMPARED TO THOSE OF THE PROPOSED PROJECT

Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential

Moffatt & Nichol prepared an assessment of the potential impacts to the beach that may be associated with the implementation of the proposed SRPS MSW Alternative (Moffatt & Nichol, 2022) (**Appendix F**). The results of the analysis were the basis of design for the Preliminary 30% Plans (**Figures 5-9** through **5-12b**) (Moffatt & Nichol, 2023).

The analysis noted that the time from December to January when lagoon breach and sandbar management commonly takes place represents the most energetic and changeable conditions of the lagoon, sandbar, and ocean conditions. This is the time when:

- The lagoon can be subject to large inflows from the Carmel River leading to rapid changes in the lagoon water level.
- High water levels in the lagoon can approach flood stage for properties around the lagoon.
- The wave climate is the most dynamic. The passage of winter storm systems can generate high surf conditions, and swell waves from distant storm systems can be at their most energetic.
- Consequently, the beach and sandbar morphology are highly dynamic. Examples of this observed in the field include: the sandbar being overtopped by waves and infilling the lagoon with seawater; intermittent formation of lagoon breaches and their closure due to sediment deposition by wave action; migration of breach openings north or south along the beach due to wave action and longshore littoral transport; and washout of large quantities of beach material during lagoon breach event.

Need for SRPS Component

Figure 5-13 shows an aerial view of a northerly lagoon alignment with an open breach channel along Scenic Road (Photo: April 5, 2009, courtesy Ed. Thornton; Moffatt & Nichol, 2022). The outflow through the breach channel is estimated at around 80 cfs, which is at a level sufficient to keep the breach channel open. However, at discharge in this range (from 20 to 200 cfs), the mouth of the breach channel may close and reopen intermittently if exposed to wave action. This photo illustrates that the breach channel follows the toe of the bluff. It can be noted that the breach channel is very shallow (sand bottom visible) compared to the deeper lagoon (dark green) where the bottom is not visible.

Figure 5-14 shows a view of the beach and bluff along Scenic Road featuring an open breach channel. In this case, the discharge was between 450 and 650 cfs, and it can be seen that the flow carved a deep and wide breach channel into the beach. The elevation of the beach face prior to the breach can be estimated by the height of the patch of beach remaining between the breach channel and the bluff. Scenic Road runs along the top of the bluff at approximately elevation +37 feet NAVD88 (left side of photo) to elevation +33 feet NAVD88 (center of photo). The callouts a, b, c, d, and e in the photo point to key features identifiable in the following **Figure 5-15**.



Figure 5-13. Aerial view of lagoon breach channel with northerly alignment along Scenic Road (Moffatt & Nichol, 2022).



Figure 5-14. View of lagoon breach channel with northerly alignment along Scenic Road (Moffatt & Nichol, 2022)

Figure 5-15 shows how the flow through the beach eroded the remaining beach along the bluff and widened the breach channel to point where it cut into the base of the bluff. For reference, the peak discharge of around 650 cfs that caused the lagoon breach and erosion along the breach channel is a commonly occurring level of discharge that will be exceeded every year (on average).

The dashed black line in **Figure 5-15** indicates the location of the beach face as seen in **Figure 5-14**. Note that the green vegetation in **Figure 5-14**, which covered the entire face of the bluff down to the beach face was eroded with patches of vegetation overhanding scarps cut into the bluff toe in **Figure 5-15** (please refer to the callout markers in **Figures 5-14** and **5-15**).



Figure 5-15. View of eroded beach and bluff toe along Scenic Road (Moffatt & Nichol, 2022)

The dotted black line in **Figure 5-15** illustrates how much further the erosion of the bluff progressed after wave action eroded the remainder of the lowered beach face and wave runup further eroded the bluff as shown in **Figure 5-16**. Erosion along the top of the bluff reached the edge of Scenic Road where the dotted line ends at approximately marker c. Note the steep, near-vertical scarps in **Figure 5-16** that developed as a result of wave action eroding the bluff. This case analysis illustrates that there is a high risk of significant and potentially disastrous erosion along Scenic Road when the lagoon forms along the bluff and breaches to the north. This is demonstrated by the fact that the peak discharge from the lagoon was at a typical level and wave action was also representative of commonly occurring conditions. Had the level of discharge been higher, or the waves larger or occurring over a longer time span, erosion of the bluff could have easily damaged Scenic Road.



Figure 5-16. View of wave-induced bluff erosion along Scenic Road (Moffatt & Nichol, 2022)

Results

Based on the findings of the wave runup and beach erosion potential analysis, the recommended location of the SRPS mid-slope wall is at the base of the previously eroded bluff line, approximately at Elevation +8 feet NAVD88, and recommended crest elevation of the wall is at +20 feet NAVD88, which is four feet above the fluvial BFE (**Figure 5-17**). Installing the wall along this alignment achieves the following:

- The SRPS will not encroach on or damage the existing bluff, as the bluff face has previously eroded back to this level (purple profile shown in **Figure 5-17**).
- At typical beach levels, the SRPS mid-slope wall would be buried below the sand and would not present as a visual obstruction.
- Likewise, the wall would not pose an obstruction to public access to the beach.
- At the proposed height, the wall will accommodate a lagoon level up to +16 feet NAVD88 or higher (within the four-foot freeboard).
- The wall will prevent water flow from eroding the base of the bluff during a lagoon breach event.
- The wall and slope stabilization will prevent wave runup from eroding the bluff.
- The wall will not negatively impact lagoon formation or the beach.

The analysis also evaluated whether the proposed MSW Alternative could have the potential to negatively impact the beach. As shown in **Figure 5-17**, the wall would be buried below the sand under most

conditions and located at the back of the beach where it would not actively interact with wave runup and beach morphological processes. The wall could become exposed after a lagoon breach event to the north. Based on historical observations, lagoon migration to the north along the bluff occurs in approximately 11% of the cases, about every nine years on average. In connection with a northerly lagoon breach, the beach level could erode down to about the base of the wall, similar to the situation shown in **Figure 5-16**. This photo demonstrates that under typical conditions of wave and tide level, wave runup would just about reach the base of the bluff where the MSW would be located.

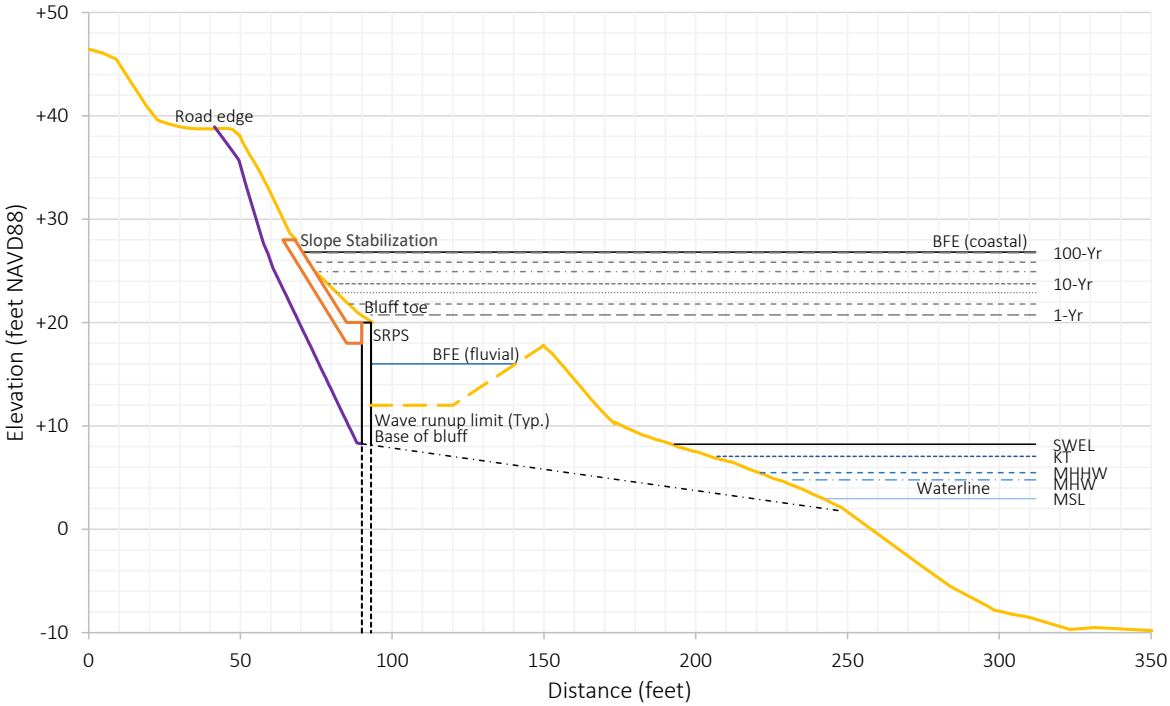


Figure 5-17. Recommended location and height of the SRPS MSW Alternative (Moffatt & Nichol, 2022)

Figure 5-18 summarizes the distribution of accretionary and erosive waves for the months of December and January, which is when lagoon breaches most commonly occur. The data shows that there would be a significant proportion of waves that would contribute to accretion and reformation of the sandbar. However, the figure also shows that erosive waves could occur (portion of data points above the black curve). However, with the SRPS MSW in place, episodes of erosive waves would not be able to impact the bluff. Erosive waves would also be unlikely to significantly impact the beach level, which is likely to be near or at the level of the marine terrace hardpan following a lagoon breach event. The large amounts of sand evacuated from the beach during a major breach event would be available to promote re-building of the sandbar and return of sand to the shoreline.

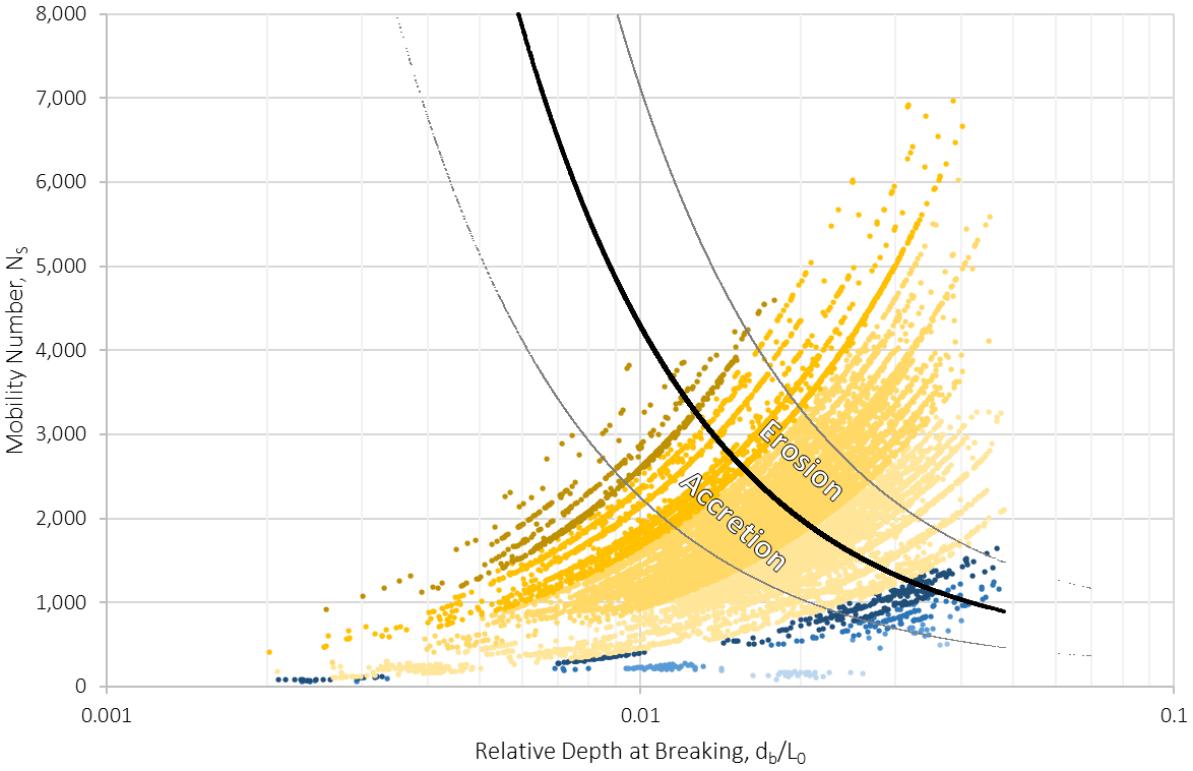


Figure 5-18. Accretion-Erosion distribution waves in December and January (Moffatt & Nichol, 2022)

The analysis of wave runup and beach erosion potential demonstrates that there is a potential for wave runup to interact with the MSW if the beach level is lowered in connection with a northerly lagoon breach, which is estimated to occur every nine years on average (in 11% of cases). Results of the wave runup and beach erosion potential analysis indicate that the sandbar would re-form when accretionary wave conditions are present (i.e., the waves deposit sediment, the opposite of erosion). The analysis estimates that wave conditions are accretionary 60% of the time in December and January when lagoon breach and sandbar management commonly take place.

Figures 5-19 through **5-24** provide renderings of the MSW Alternative during seasonal conditions based on the results of this analysis.

Impacts Summary

This SRPS alternative is very similar to the proposed SRPS project component in terms of the revetment alignment and in terms of the type of protection provided to Scenic Road. Therefore, the potential environmental impacts are very similar. As described in **Chapter 3, Project Description**, the proposed SRPS project component would consist of rip-rap placed at the toe of the slope, extending only far enough up the slope to protect against river scour and wave erosion in order to minimize the visual impact. However, the primary focus of the proposed SRPS project component design is armoring to protect the base of the bluff. As described above, the MSW Alternative was designed to meet the SRPS project objectives and the proposed design is based on analyses of beach levels, tide levels, estimated wave runup elevations, sea level rise, lagoon and beach morphology, breach alignment, and sediment transport. As a result, while potential environmental impacts of the MSW Alternative would be similar to the proposed SRPS project



Proposed MSW Alternative Visual Simulation of Wall (Winter/Spring)

Denise Duffy and Associates, Inc. Planning and Environmental Consulting	Date 1/31/2024	Figure 5-19
	Scale N/A	

This Page Intentionally Left Blank



Proposed MSW Alternative Visual Simulation of Wall (Summer/Fall)

DD&A	**Denise Duffy and Associates, Inc.** Planning and Environmental Consulting	Date 1/31/2024 Scale N/A	Figure 5-20

This Page Intentionally Left Blank



Proposed MSW Alternative Visual Simulation of Parking Lot Area and Beach Access (Typical Site Condition)

Denise Duffy and Associates, Inc. Planning and Environmental Consulting	Date 1/31/2024	Figure 5-21
	Scale N/A	

This Page Intentionally Left Blank



Proposed MSW Alternative Visual Simulation of Parking Lot Area and Beach Access (North Lagoon Beach Condition)

Denise Duffy and Associates, Inc. Planning and Environmental Consulting	Date 1/31/2024	Figure 5-22
	Scale N/A	

This Page Intentionally Left Blank



Proposed MSW Alternative Visual Simulation of Alignment (Winter/Spring)

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 1/31/2024

Scale N/A

Figure 5-23

This Page Intentionally Left Blank



Proposed MSW Alternative Visual Simulation of Alignment (Summer/Fall)

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 1/31/2024

Scale N/A

Figure 5-24

This Page Intentionally Left Blank

component, the MSW Alternative was developed to improve the design features of the proposed SRPS project component to better achieve the SRPS objectives and further reduce potential environmental impacts related to geology, soils, and climate change based on additional technical analyses. This alternative also addresses concerns from the agencies and public regarding efficacy, limited access, and safety issues that may be associated with the proposed rip-rap along the bluff. Impacts to Monterey cypress trees located west of Scenic Road will be minimized and avoided to the extent feasible. A licensed arborist or forester will be consulted in the final design of the SRPS and best management practices will be implemented to avoid and minimize impacts to trees. If tree removal cannot be avoided, removal will be limited to the minimum amount necessary for the project and new Monterey cypress trees will be planted as replacement for trees removed where space permits. This alternative would have a moderate cost when compared to other SRPS project component alternatives.

ABILITY OF ALTERNATIVE TO MEET PROJECT OBJECTIVES

This alternative meets most project objectives when combined with a sandbar management or EPB component alternative. Specifically, the alternative meets the project objective to protect public infrastructure (Scenic Road embankment, State Parks restroom, and parking facilities) from scour resulting from a northerly-aligned lagoon outflow channel. In addition, the alternative protects the Scenic Road embankment from increasing risk of erosion from wave and river action, and sea level rise due to global warming.

5.3.3 Alternative Projects to the Proposed Project

This section describes the alternative projects to the proposed project that were selected and evaluated in additional detail in this EIR.

5.3.3.1 SRPS, ISMP, and Delayed EPB

DESCRIPTION OF ALTERNATIVE

The SRPS, ISMP, and Delayed EPB Alternative would include implementation of the proposed SRPS project component and the proposed ISMP project component in the near-term while additional data is collected to determine the efficacy and design of the proposed EPB project component to be constructed in the future. Once the SRPS is constructed, the County would continue to implement the proposed ISMP project component as needed, but the river could flow north, as preferred by NMFS.

This alternative would include an 8-year Management and Monitoring Plan (MMP) to collect more data to inform the efficacy and design of an EPB project component. An 8-year MMP was recommended by Balance Hydrologics, Inc. in order to obtain additional information on the effects to biological resources, water quality, geology, and hydrology under a change in management from south end of the beach to the north, and to better inform sandbar management. The MMP would be initiated when the SRPS is constructed to understand the change in river breach dynamics. The proposed ISMP project component would continue, as needed, on the south end of the beach until construction of the SRPS is completed. Once constructed, the SRPS would provide protection to infrastructure when and if the river breaches to the north.

During this time period, the implementation of the ISMP would include surveying the sandbar and assessing if the elevation would create a flood risk. If so, then the County would consult with the resource agencies on a plan where and to what level to lower the sandbar elevation. Based on recent years of management activity, sandbar management could consist of lowering the sand level to an elevation that

would allow the barrier to saturate and breach on its own prior to flooding. Each year would require assessing the conditions and discussing the desired location and elevation for the breach. Some years may require little or no management depending on conditions. The County would also coordinate with the regulatory agencies to close the breach to maintain water levels, as well. This would address the possible taking issue by allowing smaller fish to move upstream when they feel the barrier weaken, which is similar to natural conditions. This alternative would also allow time for impacted homes to abate flood risk by elevating their homes, which may avoid the need for a future EPB.

Since management of the lagoon would only occur in emergency situations, the MMP would have to collect data that would allow reasonable inferences, addressing the duality of the flooding risks: riverine, which can evolve very slowly to rapidly; and wave overtopping, which likely evolve quickly. Potential monitoring actions may include:

- Beach topography: Surveying the geometry and dynamics of the barrier beach, specifically the minimum beach crest elevation and other key characteristics such as beach width at different elevations. At a minimum, beach topography would be assessed once a year.
- Beach dynamics: As a supplement to detailed topographic information, time-lapse photography of the beach from Scenic Road has the potential to provide important information on the dynamics.
- Lagoon water level: The MMP should make certain that there is enough redundancy that data is not lost at very crucial times due to equipment failure or calibration issues. The sampling rate should be no less than every 15 minutes and potentially every 5 minutes with respect to wave overtopping. With enough operating probes of sufficient resolution, it would be possible to fairly accurately calculate the volume of inflow to the lagoon from overtopping events. That would then allow the volume to be correlated to wave power data already collected off-shore by NOAA. Making that connection would allow for hindcast modeling using historical wave power data that could be very useful in EPB design. Also, it could be used in forecasting mode to tell the County when to be ready with extra sandbags, or when anticipatory breaching might be justified.
- Lagoon salinity: Measure salinity at various depths in the water column so that the partitioning between fresh and salt water could be identified. This would give additional info on the volume associated with overtopping events and allow for the quantification of the freshwater lens with respect to breach timing and location.
- Rainfall Runoff: Install a couple of simple instrumented gauging weirs at good locations and a minimum of two tip-bucket rain gauges in the respective catchments. The runoff information collected would help better inform the location of the EPB alignment, if determined necessary.

This alternative would also allow the County time to explore and implement programs to fund and/or incentivize projects to elevate homes out of the floodplain and protect public infrastructure (e.g., road and pipelines) to reduce the need to implement the ISMP.

ENVIRONMENTAL IMPACTS OF ALTERNATIVE COMPARED TO THOSE OF THE PROPOSED PROJECT

Deferring construction of an EPB allows the ability to collect data using a northern management strategy in order to evaluate the necessity and efficacy of an EPB component under this condition. Implementing this alternative would result in avoiding or reducing the adverse impacts (e.g., aesthetics, noise, biological, etc.) associated with the proposed EPB project component in the near-term. However, this alternative assumes that an EPB project component would be constructed in the future, and, therefore, the environmental impacts are anticipated to be similar to the proposed EPB project component. For the purposes of this analysis, it is assumed the future EPB project component would still result in significant

and unavoidable aesthetic, hydrology, and noise impacts. Depending on the information gathered during the 8-year MMP, some environmental impacts could be reduced in the future. Similar to the current sandbar management regime, this alternative would also include sandbagging, which has implications for water quality from runoff and may require pump facilities. If pump facilities are required, they could be located farther away from sensitive receptors to reduce potential noise impacts. This alternative could be modified to include the EPB Garden Wall Alternative, as described in **Section 5.3.2.7**, as an alternative to sandbagging properties. The continued practice of sandbagging would require the permission of homeowners.

ABILITY OF ALTERNATIVE TO MEET PROJECT OBJECTIVES

This alternative would fully achieve the project objectives. This alternative would include a sandbar management plan similar to the ISMP which would allow the river to flow to the north, as preferred by NMFS, once the SRPS is constructed. This alternative would also allow the County time to obtain additional information on the effects to biological resources, water quality, geology, and hydrology under a change in management from south end of the beach to the north, and to better inform sandbar management. This information may address some of the impacts associated with the EPB, including landowner agreements. However, the location of a future EPB component would need to be constructed outside of the State Parks reserve area to be considered feasible.

5.3.3.2 SRPS and Sandbar Management Plan (No EPB Component)

DESCRIPTION OF ALTERNATIVE

The SRPS and Sandbar Management Plan (SMP) Project Components Alternative would include implementation of the proposed SRPS project component and sandbar management. The proposed EPB project component would not be implemented under this alternative.

This alternative assumes that the SMP would be similar to the existing permit requirements for sandbar management activities (for more information regarding existing permits, please refer to **Section 1.3, Changes Requiring Recirculation and Organization of the Revised EIR**). Under the SMP, sandbar management would consist of lowering the sandbar by excavating a channel through the sandbar in a direction and manner as agreed upon in consultation with NFMS and in a manner that results in a more natural and less erosive breach. The Lagoon would continue to the lowered level or wave action would breach the Lagoon unassisted. Only in rare, emergency events would the County actually breach the sandbar. The breach would be managed to the south until the SRPS is constructed, and after the SRPS is in place, the sandbar could be lowered to manage a breach to the north end or be allowed to naturally breach to the north.

This alternative would include preparing and implementing a Management and Monitoring Plan (MMP) to collect data to inform the procedures of the sandbar management plan and provide adaptive management criteria. Management of the lagoon would occur only in emergency situations, the MMP would have to collect data that would allow reasonable inferences, addressing the duality of the flooding risks: riverine, which can evolve very slowly to rapidly, and wave overtopping, which likely evolve quickly. Potential monitoring actions may include:

- Beach topography: Surveying the geometry and dynamics of the barrier beach, specifically the minimum beach crest elevation and other key characteristics such as beach width at different elevations. At a minimum, beach topography would be assessed once a year.

- Beach dynamics: As a supplement to detailed topographic information, time-lapse photography of the beach from Scenic Road has the potential to provide important information on the dynamics.
- Lagoon water level: The MMP should make certain that there is enough redundancy that data is not lost at very crucial times due to equipment failure or calibration issues. The sampling rate should be no less than every 15 minutes and potentially every 5 minutes with respect to wave overtopping. With enough operating probes of sufficient resolution, it would be possible to fairly accurately calculate the volume of inflow to the lagoon from overtopping events. That would then allow the volume to be correlated to wave power data already collected off-shore by NOAA. Making that connection would allow for hindcast modeling using historical wave power data that could be very useful in EPB design. Also, it could be used in forecasting mode to tell the County when to be ready with extra sandbags, or when anticipatory breaching might be justified.
- Lagoon salinity: Measure salinity at various depths in the water column so that the partitioning between fresh and salt water could be identified. This would give additional info on the volume associated with overtopping events and allow for the quantification of the freshwater lens with respect to breach timing and location.
- Rainfall Runoff: Install a couple of simple instrumented gauging weirs at good locations and a minimum of two tip-bucket rain gauges in the respective catchments. The runoff information collected would help better inform the location of the EPB alignment, if determined necessary.

This alternative would also allow the County time to explore and implement programs to fund and/or incentivize projects to elevate homes out of the floodplain and protect public infrastructure (e.g., road and pipelines) to reduce the need to implement the SMP. This alternative would also allow time for impacted homes to abate flood risk by elevating their homes.

ENVIRONMENTAL IMPACTS OF ALTERNATIVE COMPARED TO THOSE OF THE PROPOSED PROJECT

Eliminating the construction of the proposed EPB project component would result in avoiding or reducing all less-than-significant and potentially significant impacts associated with the proposed EPB. The elimination of the proposed EPB project component would result in reduced construction impacts associated with aesthetics, air quality, biological resources, cultural resources, geology and soils, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning, noise, public services/utilities/recreation, and traffic. The elimination of the proposed EPB project component would also reduce operational impacts to aesthetics, geology and soils, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning, public services/utilities, and traffic. Most importantly, eliminating the proposed EPB project component would avoid significant and unavoidable impacts to aesthetics, hydrology, and noise. This alternative would retain the beneficial impacts to biological resources and water quality (please refer to **Table 5-2**). It also resolves the objections of CAWD and State Parks to the proposed EPB component.

Similar to the current sandbar management regime, this alternative would also include sandbagging, which has implications for water quality from runoff and may require pump facilities. If pump facilities are required, they could be located farther away from sensitive receptors to reduce potential noise impacts. This alternative could be modified to include the EPB Garden Wall Alternative, as described in **Section 5.3.2.7**, as an alternative to sandbagging properties. The continued practice of sandbagging would require the permission of homeowners.

This alternative would include the proposed SRPS project component and, therefore, the identified potential environmental impacts of this component would remain the same.

This alternative would likely result in similar impacts compared to the proposed ISMP project component since the regulatory permit requirements to minimize impacts would be implemented under both scenarios.

ABILITY OF ALTERNATIVE TO MEET PROJECT OBJECTIVES

This alternative would fully achieve the project objectives. This alternative would include a sandbar management plan similar to the proposed ISMP project component, but would include and incorporate recommendations from the data collected. The SMP would allow for the river to flow in a northerly alignment, as preferred by NMFS, once the SRPS is constructed. This alternative would also include annual sandbagging, which would require permission from private property owners for sandbags on private property. This alternative would resolve State Parks and CAWD's objections to the proposed EPB project component.

5.4 ENVIRONMENTALLY SUPERIOR ALTERNATIVE

CCR Section 15126.6(e)(2) of the CEQA Guidelines requires that an environmentally superior alternative be identified among the alternatives considered. According to CEQA Guidelines section 15126.6(e), if the environmentally superior alternative is the "no project" alternative, the EIR shall also identify an environmentally superior alternative among the other alternatives. The environmentally superior alternative is generally defined as the alternative that would result in the fewest adverse environmental impacts on the project site and surrounding area.

Table 5-2 compares the impacts of the No Project Alternative, the Alternative Components, and the Alternative Projects to the impacts of the proposed project. Of the alternatives considered, the No Project Alternative would eliminate all the identified significant impacts, but would not attain any of the project objectives. All of the impacts of the proposed project can be reduced to less-than-significant levels with mitigation with the exception of operational aesthetic, operational hydrology, and construction and operation noise impacts. The EIR found that the proposed EPB project component would permanently degrade the visual character of the site and the surrounding area, which is a significant and unavoidable impact. In addition, the operation of the proposed EPB project component would result in significant and unavoidable impacts to flooding on- and off-site.

Construction of the project would not result in any significant and unavoidable impacts, except for construction noise impacts at the proposed EPB project component site. Given the proximity of existing residential land uses to the proposed pile driving locations, construction of the proposed EPB project component would likely still exceed the County's noise standard at the nearest residential property lines. Implementation of **Mitigation Measure NV-3** would reduce construction noise at the proposed EPB project site, but would not reduce the impact to a less-than-significant level. The predicted operational noise levels for both the pump station and the generator/control building at the proposed EPB project component site are projected to exceed applicable thresholds at the nearest residential property line. Implementation of **Mitigation Measure NV-2** would reduce operational noise impact, but would not reduce the impact to a less-than-significant level.

Most importantly, as described in **Chapter 1, Introduction**, and **Section 5.1, Introduction and Approach**, State Parks confirmed that the proposed EPB project component is not consistent with policies and guidelines associated with the reserve area, making the implementation of that component infeasible.

The SRPS and SMP (No EPB) Alternative would eliminate the significant and unavoidable operational aesthetic, operational hydrology, and construction and operational noise impacts associated with the

proposed EPB project component, as well as reduce the majority of the identified impacts (**Table 5-2**). This alternative would also achieve all the project objectives.

As described in Section **5.3.2.8, SRPS Mid-Slope Wall Alternative**, the MSW Alternative was developed to improve the design features of the proposed SRPS project component to better achieve the SRPS objectives and further reduce potential environmental impacts related to geology, soils, and climate change based on additional technical analyses. This alternative also addresses concerns from the agencies and public regarding efficacy, limited access, and safety issues that may be associated with the proposed rip-rap along the bluff. Therefore, the SRPS MSW Alternative is the preferred SRPS component.

Accordingly, other than the No Project Alternative, the Environmentally Superior Alternative would be the SRPS MSW Alternative and SMP (No EPB) Alternative.

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
4.1 Aesthetics											
Impact AES-1: Construction Impacts on Scenic Vistas and Visual Quality of the Surrounding Areas.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact AES-2: Operation Impacts on Scenic Vistas and Visual Quality of the Surrounding Areas.	SU	LS	NI	NI	LS-	LS-	LSM	LSM	LSM	SU	LS
Impact AES-3: Impacts due to Permanent Light and Glare during Operations.	LS	NI	NI	NI	NI	NI	NI	NI	NI	LS	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Criterion AES-b: Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within view from a state scenic highway.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Criterion AES-d: Create a new source of substantial light or glare that would adversely affect day or nighttime views	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
in the area during construction											
4.2 Air Quality											
Impact AQ-1: Conflict with or Obstruct Implementation of Applicable Air Quality Plans.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact AQ-2: Violate any Air Quality Standard or Contribute Substantially to an Existing or Projected Air Quality Violation.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact AQ-3: Result in a Cumulatively	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
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.											
Impact AQ-4: Expose Sensitive Receptors to Substantial Pollutant Concentration.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact AQ-5: Create Objectionable	LS	LS	LS	NI	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Odors Affecting a Substantial Number of People.											
4.3 Biological Resources											
Impact BIO-1: Construction Impacts to Special-Status Species and Habitat.	LSM	LSM	LSM	SU	LS-	LS-	LSM	LSM	LSM	LSM	LSM-
Impact BIO-2: Construction Impacts to Sensitive Habitats.	LSM	LSM	LS	SU	LS-	LS-	LSM	LSM	LSM	LSM	LSM-
Impact BIO-3: Construction Impacts to Movement of	LSM	LSM	LS	SU	LS-	LS-	LSM	LSM	LSM	LSM	LSM-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Native Wildlife and Native Wildlife Nursery Sites.											
Impact BIO-4: Operational Impacts to Special-Status Species and Habitat.	BI	BI	NI	NI	BI	LS	BI	BI	BI	BI	BI
Impact BIO-5: Operational Impacts to Sensitive Habitats.	BI	BI	NI	NI	BI	LS	BI	BI	BI	BI	BI
Impact BIO-6: Operational Impacts to Movement of Native Wildlife	BI	BI	NI	NI	BI	LS	BI	BI	BI	BI	BI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
and to Native Wildlife Nursery Sites.											
Criterion BIO-e: Conflict with the provisions of an adopted HCP, NCCP, or other approved local, regional, or state habitat conservation plan.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
4.4 Cultural Resources											
Impact CR-1: Construction Impacts on Historic Resources (Extant	LSM	LS	LS	LS	LS-	LS-	LS	LS	LS	LSM	LS

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Buildings and Structures).											
Impact CR-2: Construction Impacts on Historical and/or Archaeological Resources.	LSM	LSM	LSM	LSM	LS-	LS-	LSM+	LSM+	LSM+	LSM	LSM-
Impact CR-3: Construction Impacts on Human Remains.	LSM	LSM	LSM	LSM	LS-	LS-	LSM+	LSM+	LSM+	LSM	LSM-
Impact CR-4: Construction Impacts on Tribal Cultural Resources.	LSM	LSM	LSM	LSM	LS-	LS-	LSM	LSM	LSM	LSM	LSM-
Criterion CR-a: Cause a substantial	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
adverse change in the significance of a historical resource as defined in CEQA Section 15064.5 during operation.											
Criterion CR-b: Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Section 15064.5 during operation.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Criterion CR-c: Directly or indirectly destroy	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
a unique paleontological resource or site or unique geologic feature during operation.											
Criterion CR-d: Disturb any human remains, including those interred outside of formal cemeteries during operation.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Criterion CR-e: Cause a substantial adverse change to a tribal cultural resource, as	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
defined in PRC Section 21074 during operation.											
4.5 Geology, Soils, & Seismicity											
Impact GS-1: Construction-Related Erosion and Loss of Topsoil.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact GS-2: Construction-Related Soil Collapse and Soil Constraints.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact GS-3: Exposure to Fault Rupture.	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-
Impact GS-4: Exposure to Seismic Ground	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Shaking and Liquefaction.											
Impact GS-5: Exposure to Coastal Erosion and Sea Level Rise.	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-
Impact GS-6: Operation-Related Erosion and Loss of Topsoil/Sand.	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-
Criterion GS-d: Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact; BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
substantial risks to life or property.											
Criterion GS-e: Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewer are not available for the disposal of waste water.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
4.6 Greenhouse Gases											
Impact GHG-1: Construction	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact; BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Greenhouse Gas Emissions.											
Impact GHG-2: Operational Greenhouse Gas Emissions.	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-
Criterion GHG-b: Conflict with any applicable plan, policy, or regulations of an agency adopted for the purpose of reducing the emissions of GHGs.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
4.7 Hazards & Hazardous Materials											
Impact HH-1: Use and Disposal of Hazardous	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Materials During Construction.											
Impact HH-2: Accidental Release of Hazardous Materials During Construction.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact HH-3: Use of Hazardous Materials During Construction Within 0.25-Mile of Schools.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact HH-4: Use and Disposal of Hazardous Materials and Accidental Release or	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Creation of Safety Hazards During Operation.											
Criterion HH-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.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Criterion HH-e, f: 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, the project would result in a safety hazard for people residing or working in the project area, or, for a project within the vicinity of a private	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
airstrip, the project would result in a safety hazard for people residing or working in the project area.											
Criterion HH-g: Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Criterion HH-h: Expose people or structures to a	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.											NI
4.8 Hydrology & Water Quality											
Impact HYD-1: Construction Impacts to Water Quality due to Discharge.	LS	LS	NI	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact HYD-2: : Construction	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Groundwater Supply and Management.											
Impact HYD-3: Construction Impacts to Water Quality due to Earthmoving, Drainage Alteration, and Use of Hazardous Chemicals.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-
Impact HYD-4: Operational Impacts to Water Quality due to Drainage Pattern and Discharges.	LSM	NI	NI	NI	LS-	LS-	NI	NI	NI	LSM	NI
Impact HYD- 5: Operational	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Impacts to Groundwater Supply and Management.											
Impact HYD-6: Operational Drainage Pattern Alterations resulting in erosion and/or flooding on- or off-site.	SU	LS	NI	NI	LS-	LS-	LS	LS	LS	LSM	LS-
Impact HYD-7: Operational Risks due to Location within a 100-Year Flood Hazard Area.	LSM	LS	NI	NI	LS-	LS-	LS	LS	LS	LSM	LS-
Criterion HYD-g: Place housing	NI	NI	NI	NI	LS-	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
within a 100-year flood hazard area.											
4.9 Land Use & Planning											
Impact LU-1: Conflict with Plans, Policies, and Regulations during Construction and Operation.	LSM	LSM	LSM	NI	LS-	LS-	LSM	LSM	LSM	LSM	LSM-
Criterion LU-a: Physically divide an established community.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Criterion LU-c: Conflict with any applicable habitat conservation plan or natural community	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
conservation plan.											
4.10 Noise											
Impact NV-1: Construction Ground-Borne Vibration and Noise.	LSM	LS	LS	LS	LS-	LS-	LSM	LSM	LSM	LSM	LS-
Impact NV-2: Construction Noise.	SU	LSM	LSM	LS	LS-	LS-	LSM+	LSM+	LSM+	SU	LSM-
Impact NV-3: Operational Noise.	SU	LS	NI	NI	LS-	LS-	LS	LS	LS	SU	LS
Criterion NV-b: Result in exposure of persons to or generation of excessive ground-	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
borne vibration or ground-borne noise levels during operation.											
Criterion NV-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 expose people residing or working in the project area to	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
excessive noise levels?											
Criterion NV-f: For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
4.11 Public Services, Recreation, & Utilities											
Impact PS-1: Construction Public Services Demand.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact; BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Impact PS-2: Construction Landfill Capacity.	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-
Impact PS-3: Construction Solid Waste Policies and Regulations.	LSM	LS	LS	NI	LS-	LS-	NI	NI	NI	LSM	LS-
Impact PS-4: Water Supply During Construction.	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-
Impact PS-5: Public Services Demand During Operation.	LS	LS	NI	NI	LS-	LS-	LS	LS	LS	LS	LS-
Impact PS-6: Energy Use During	LS	LS	LS	NI	LS-	LS-	NI	NI	NI	LS	LS-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Construction and Operation.											
Impact PS-7: Construction or Expansion of Recreational Facilities.	NI	LS	LS	LS	NI	NI	LSM	LSM	LSM	LS	LS
Criterion PS-b, c: Be served by a landfill with insufficient permitted capacity to accommodate the project's solid waste disposal needs or be out of compliance with federal, state, and local	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
statutes and regulations related to solid waste.											
Criterion PS-d: 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.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
Criterion PS-f: Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Criterion PS-g: Require or result in the construction of new water or wastewater facilities or require the expansion of existing facilities, the construction	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
of which could cause significant environmental effects.											
Criterion PS-h: Have insufficient water supplies available to serve the project from existing entitlements and resources, or require new or expanded entitlements.	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Criterion PS-i: Result in a determination by the wastewater treatment	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
provider, which serves or may serve the project, that it has inadequate capacity to serve the project's project demand in addition to the provider's existing commitments.											
4.12 Traffic & Circulation											
TRA-1: Conflict with a program, plan, ordinance, or policy addressing the circulation systems,	LSM	LSM	LSM	LS	LS-	LS-	LSM	LSM	LSM	LSM	LSM

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
including transit, roadway, bicycle, and pedestrian facilities during construction of the proposed project.											
TRA-2: Conflict or be inconsistent with CEQA Guidelines Section 15064.3(b).	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS
Impact TRA-3: Result in Inadequate Emergency Access.	LSM	LSM	LS	NI	LS-	LS-	LSM	LSM	LSM	LSM	LSM-

Table 5-2. Impact Summary for Proposed Project and Alternatives to the Proposed Project

Impact Statement	Proposed Project			No Project	EPB Component Alternatives		SRPS Component Alternatives			Project Alternatives	
	EPB	SRPS	ISMP		EPB Elevate Structures	EPB Garden Wall	SRPS Seawall Located at the Toe of Slope	SRPS Full Height Wall	SRPS Mid-Slope Wall	SRPS, ISMP, and Delayed EPB	SRPS and SMP (No EPB)
KEY to ACRONYMS: **SU = Significant Unavoidable Impact even with Mitigation; LSM = Significant Without Mitigation/Less-than-Significant with Mitigation; LS = Less-than-Significant Impact;** **BI = Beneficial Impact; NI = No Impact** *"+" Greater = Impact is greater compared to project impact* *"—" Reduced = Impact is reduced compared to project impact* *If neither "—" nor "+" is shown, the impact is the same or similar compared to the project impact*											
4.13 Energy											
ENG-1: Result in Wasteful, Inefficient, or Unnecessary Consumption of Energy or Conflict with a state or local plan for renewable energy or energy efficiency.	LS	LS	LS	LS	LS-	LS-	LS	LS	LS	LS	LS

This Page Intentionally Left Blank

Chapter 6.0 CEQA CONSIDERATIONS

6.1 GROWTH INDUCEMENT

CEQA requires that an EIR discuss the ways in which the proposed project could foster economic or population growth. Pursuant to State CEQA Guidelines CCR Section 15126.2(d), this discussion should include ways in which the proposed project could directly or indirectly foster economic or population growth or construction of new housing in the surrounding area. The discussion should include projects which could remove obstacles to population growth such as major public service expansion that allow for more construction in applicable services areas and characteristics of projects that may encourage and facilitate other activities that could result in significant impacts. According to the CEQA Guidelines, it must not be assumed growth in any area is necessarily beneficial, detrimental, or of little significance to the environment.

As discussed in **Chapter 3, Project Description**, the proposed project involves implementing three project components: the EPB, SRPS, and ISMP. The proposed EPB project component would maintain existing flood protection to low lying homes and public infrastructure along the north edge of the Lagoon, while the frequency of mechanical management of the sandbar is reduced in compliance with regulatory requirements. The proposed SRPS project component would provide protection from erosion along the northern sand cliffs and the undermining of Scenic Road which may result from northerly river flows or large ocean swells. The proposed ISMP project component is intended to provide a short-term (i.e., until the design, environmental review, permitting, and construction of the proposed EPB and SRPS project components are completed) solution to potential flooding issues by implementing select sandbar management actions that allow additional natural function in the Lagoon while still protecting properties and infrastructure, with the understanding that the development of the proposed EPB and SRPS project components would further reduce mechanical management of the sandbar and return the Lagoon, its sandbar, and associated riverine and ocean dynamics to more natural cycles. The proposed project does not include the construction of new homes or businesses in the area. Thus, the proposed project would not directly induce population or economic growth.

Once construction is completed, the County would utilize existing County staff to perform any necessary maintenance activities required at the proposed EPB project component or proposed SRPS project component sites. The proposed project would not result in any new jobs. Thus, the proposed project would not indirectly foster population growth because of the creation of new jobs.

The proposed project is an infrastructure project to reduce the necessity for mechanical breaching of the sandbar by allowing Lagoon levels to rise and the Lagoon to breach as naturally as possible, thereby improving fish and wildlife habitat while maintaining the current level of flood protection and protecting public infrastructure. The proposed project would not result in a reduction of flooding to the extent that additional new homes, buildings, or other habitable structures could be constructed in the floodplain. Additionally, the proposed project would not extend roads or public services into an unserved area. Therefore, the proposed project would not induce economic growth that would facilitate other activities that would have significant environmental effects.

In conclusion, the proposed project would not directly result in population or economic growth through the development of new residential or commercial uses and would not induce substantial population growth due to new permanent employees or extension of roads or public services to unserved locations. Therefore, the proposed project would not directly or indirectly result in growth inducing impacts.

6.2 CUMULATIVE IMPACTS

Cumulative impacts are defined as "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts" (CEQA Guidelines Section 15355). Cumulative impacts can result from individually minor, but collectively significant, actions when added to those of other closely related past, present, or reasonably foreseeable future projects. Guidance for cumulative impact analysis is provided in CCR Section 15130 of the CEQA Guidelines:

a. An EIR shall discuss cumulative impacts of a project when the project's incremental effect is "cumulatively considerable" (i.e., the incremental effects of an individual project are considerable when viewed in connection with the effects of past, current, and probable future projects, including those outside the control of the agency, if necessary).

b. An EIR should not discuss impacts that do not result in part from the project evaluated in the EIR. Thus, where the impacts of a proposed project are beneficial rather than adverse, the EIR need not address adverse effects that might arise due to other projects in the vicinity of the project at issue.

c. A project's contribution is less than cumulatively considerable, and thus not significant, if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact.

d. The discussion of impact severity and likelihood of occurrence need not be as detailed as for effects attributable to the project alone.

e. The focus of analysis should be on the cumulative impact to which the identified other projects contribute, rather than on attributes of the other projects that do not contribute to the cumulative impact.

CEQA further stipulates that the discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence; however, the level of detail concerning cumulative impacts is not required to be as great as is provided for the effects attributed to the project (CEQA Guidelines Section 15130(b)).

6.2.1 Approach to Cumulative Impact Analysis

CEQA Guidelines Section 15130(b)(3) further requires that the "geographic scope of the area affected by the cumulative effect" is defined and that the analysis should "provide a reasonable explanation for the geographic limitation used." The list approach typically identifies all the past, present, and probable future projects that may contribute to a cumulative impact, including those projects outside of the control of the agency. Alternatively, the cumulative impact analysis may rely on a summary of projections of future development described in local, regional, or statewide plans, or other similarly related planning documents, which describes or evaluates conditions contributing to cumulative effects. It is also common for the cumulative analysis to rely on a combined approach that includes elements of the list approach and projection approach.

This EIR has identified other projects that may cause cumulative impacts using the list approach. However, as required by the Monterey Bay Air Resource District (MBARD), the plan-based approach is used to assess cumulative impacts on regional air quality. Additionally, the cumulative analysis for traffic relies upon traffic modeling of the Association of Monterey Bay Area Governments (AMBAG), respectively. Greenhouse gases also are assessed using summaries of projections.

Section 15355 of the CEQA Guidelines defines "cumulative impacts" as two or more individual effects which, when considered together, are considerable or which compound or increase other environmental effects. The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time. In addition to assessing the combined impacts of the project and past, present, and probable future projects, the EIR determines whether the impact of the proposed project is cumulatively considerable. The analysis considers whether there would be a significant, adverse cumulative impact associated with project implementation in combination with past, present, and reasonably foreseeable projects in the geographical area, and, if so, whether the proposed project's incremental contribution to the cumulative impact would be considerable. Both conditions must apply for a project's cumulative impacts to rise to the level of significance.

Three criteria were used to determine an appropriate list of relevant past, present, and future projects to be considered in this cumulative analysis: (1) similar environmental impacts, (2) geographic scope and location, and (3) timing and duration of implementation. A relevant future probable project is defined as one that is "reasonably foreseeable," such as a proposed project that has approved funding or for which an application has been filed and deemed complete by an approving agency by the time of commencement of environmental review of the proposed project. In addition, some projects may be excluded from the cumulative list if the agency and/or applicant were not actively pursuing further entitlements at the time of preparation of this EIR.

6.2.1.1 Similar Environmental Impacts

Projects relevant to the cumulative impact analysis include projects that could contribute incremental environmental effects on the same resources as, and would have similar impacts to, those discussed in this EIR applicable to the proposed project. Cumulative impacts that could occur when the impacts of the proposed project are considered in combination with the impacts of other relevant projects are discussed in **Chapter 4, Environmental Setting, Impacts, and Mitigation Measures**, **Sections 4.1** through **4.13** of this EIR.

6.2.1.2 Geographic Scope and Location

Projects relevant to the cumulative analysis include those that are within the defined geographic scope for the cumulative effect. The defined geographic scope is dependent on the environmental resource topic affected. Generally, the geographic scope includes the area within and adjacent to the project component site. However, for certain environmental resource topics the geographic scope extends farther, such as the regional roadway network, regional air basin, or the Carmel River watershed. The geographic scope is described by resource topic in the section below.

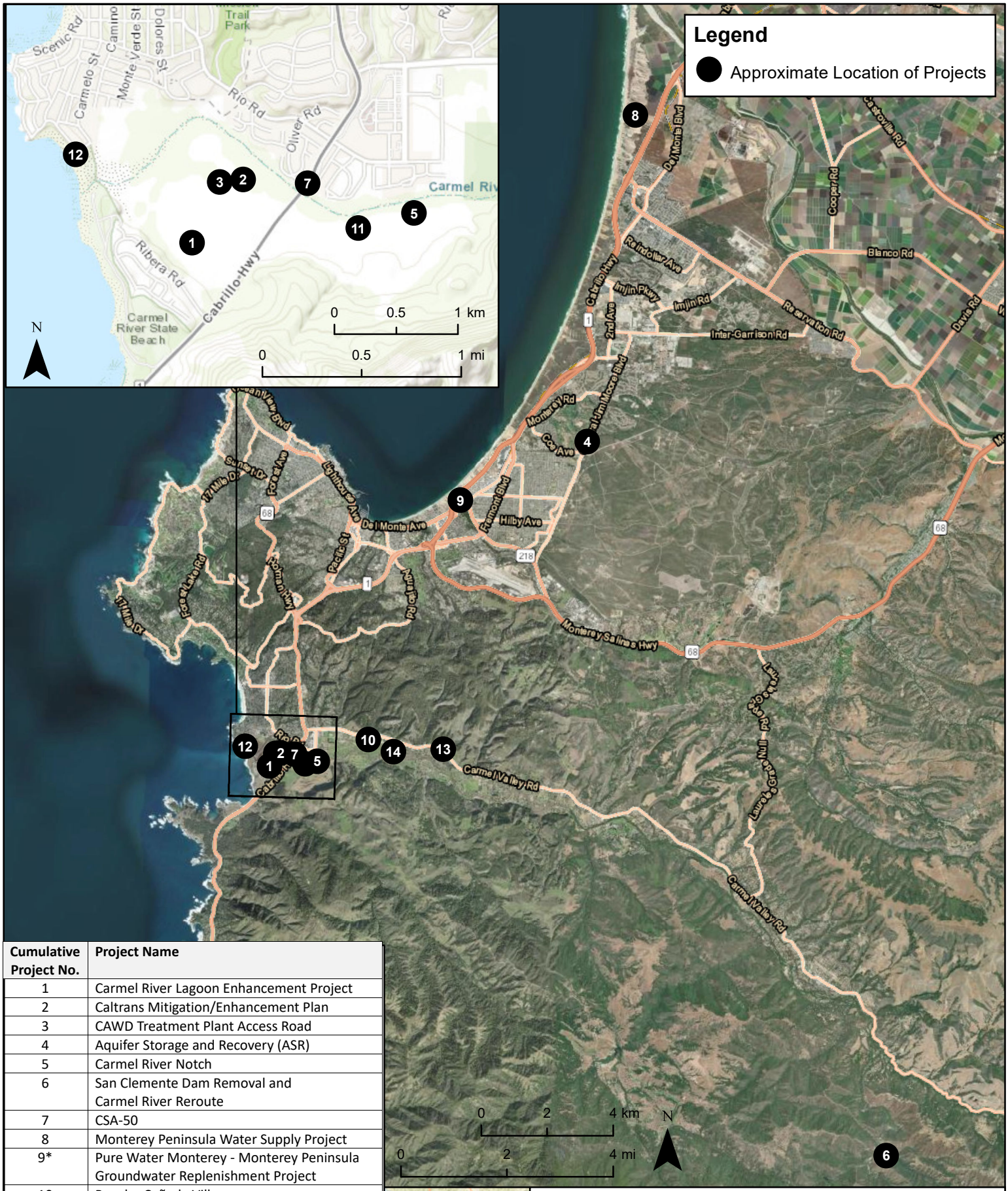
6.2.1.3 Timing and Duration of Implementation

Projects relevant to the cumulative analysis include projects that could contribute impacts that coincide with proposed project impacts during construction (short-term) or operation (long-term). Construction of the proposed project would last approximately five months (if not constructed concurrently) (please refer to **Chapter 3, Project Description, Section 3.4.2, Construction Duration and Phasing**). The construction timing of the proposed project is difficult to estimate for several reasons, including, but not limited to, the need to acquire funding for final design, permitting, and construction. It is unknown at this time when funding will be available and how much time will be required to complete final design and acquire all necessary regulatory permits. For the purposes of this analysis, it is assumed that the proposed project would be constructed between 2026 and 2036. For temporal impacts such as air pollutant emissions, and increased noise levels and traffic during construction, cumulative effects could overlap with those of the proposed project and would affect the same environmental resources.

6.2.2 List of Relevant Projects

Table 6-1. Projects Considered for Cumulative Impacts Analysis provides a list of the past, present, and probable future projects within and near the proposed project area, including a brief description of the projects and their anticipated construction schedules. **Figure 6-1** shows the location of the cumulative projects; the numbering of the projects in the table correlates to the numbered location of the projects on the figure.

The cumulative impact analysis is presented below by each resource topic included in **Chapter 4, Environmental Setting, Impacts, and Mitigation Measures**. Resources topics determined to have no impact because of the proposed project as described in **Section 6.5, Effects Not Found to be Significant**, below, are not included in the cumulative impact analysis. A summary of the projects considered for the cumulative impact analysis is provided in **Table 6-1**.



Cumulative Project No.	Project Name
1	Carmel River Lagoon Enhancement Project
2	Caltrans Mitigation/Enhancement Plan
3	CAWD Treatment Plant Access Road
4	Aquifer Storage and Recovery (ASR)
5	Carmel River Notch
6	San Clemente Dam Removal and Carmel River Reroute
7	CSA-50
8	Monterey Peninsula Water Supply Project
9*	Pure Water Monterey - Monterey Peninsula Groundwater Replenishment Project
10	Rancho Cañada Village
11	Carmel River Floodplain Restoration and Environmental Enhancement Project (CRFREE)
12	Scenic Road Emergency Slope Repairs
13	September Ranch Subdivision Project
14	Housing Element 6th Cycle Update 2023-2031

*The Groundwater Replenishment Project extends from just north of the City of Marina to the City of Pacific Grove.

Location of Projects Considered for Cumulative Analysis

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 11-6-2023
Scale: 1 in = 57.9 mi
Figure: 6-1

Path: R:\GIS_Archive\GIS Projects\2013-22 Carmel Lagoon\Final Products\EIR Maps\Figure 6-1 Projects Considered in Cumulative 2023.mxd

This Page Intentionally Left Blank

Table 6-1. Projects Considered for Cumulative Impact Analysis

Cumulative Project No.	Project Name	Project Description	Areas of Overlap (Potentially Affected Project Components)	Estimated Construction Schedule
1	Carmel River Lagoon Enhancement Project	Restoration of the south arm of the Carmel Lagoon	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	Completed
2	Caltrans Mitigation/ Enhancement Plan	20-acre riparian habitat enhancement along the south bank of the Carmel River	Similar environmental impacts and geographic scope (all Proposed Project Components)	Completed
3	Carmel Area Wastewater District (CAWD) Treatment Plant Access Road	Relocated road designed to function as an overflow weir during 10-year or greater floods, allowing flood waters from the Carmel River to pass through culverts under the road or over "at grade" sections to the floodplain surrounding the south arm of the Carmel Lagoon	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	Completed
4	Aquifer Storage and Recovery (ASR)	Diverting excess winter flows from the Carmel River through Cal-Am facilities and injecting water into the Seaside Groundwater Basin to reduce the amount of unauthorized pumping from the Carmel River during summer and fall	Similar environmental impacts and geographic scope (all Proposed Project Components)	Completed

Cumulative Project No.	Project Name	Project Description	Areas of Overlap (Potentially Affected Project Components)	Estimated Construction Schedule
5	Carmel River Notch	Removal of a small section of the south levee to alleviate flooding on the north bank of the Carmel River	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	Completed
6	San Clemente Dam Removal and Carmel River Reroute	Removal of the San Clemente Dam and re-route of a segment of the Carmel River to alleviate seismic safety concerns, restore habitat, and improve anadromous fish access to the watershed	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	Completed
7	CSA-50	Flood control improvements to reduce the risk of flood in CSA-50	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	Beyond 2024
8	Monterey Peninsula Water Supply Project	Construction and operation of desalination facility, expansion of existing aquifer storage and recovery project, and water recycling through Pure Water Monterey Project intended to provide additional supply to help reduce Cal-Am's pumping from the Carmel River	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	2022-2025

Cumulative Project No.	Project Name	Project Description	Areas of Overlap (Potentially Affected Project Components)	Estimated Construction Schedule
9	Pure Water Monterey - Monterey Peninsula Groundwater Replenishment Project	Reclaimed water would be used to recharge the Seaside Groundwater Basin to help reduce Cal-Am's pumping from the Carmel River	Geographic scope and location (all Proposed Project Components)	Construction completed in 2021; expansion anticipated in 2024/2025
10	Rancho Cañada Village	Replacement of a portion of an existing golf course with residential units and a restored riparian open-space corridor	Similar environmental impacts and geographic scope (all Proposed Project Components)	2024-2026
11	Carmel River Floodplain Restoration and Environmental Enhancement Project (CRFREE)	Improve flood control and to restore native riparian and floodplain habitat and hydrologic function to a portion of the lower floodplain along the Carmel River	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	2024-2028
12	Scenic Road Emergency Slope Repairs	Temporary emergency repairs under the roadway included a 200-foot, soil-nail, shotcrete wall	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	Completed
13	September Ranch Subdivision Project	Subdivision proposed on 891 acres with 94 market-rate residential lots, 15 units of inclusionary housing, 20.2-acre lot for existing equestrian facility, and 782.8 acres of open space	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	2023-2025

Cumulative Project No.	Project Name	Project Description	Areas of Overlap (Potentially Affected Project Components)	Estimated Construction Schedule
14	Housing Element 6th Cycle Update 2023-2031	Potential addition of housing sites within the Carmel River Watershed	Similar environmental impacts, geographic scope, and location (all Proposed Project Components)	Beyond 2024

6.2.3 Cumulative Impact Analysis

6.2.3.1 Aesthetics

The geographic scope for cumulative impact analysis on aesthetic resources consists of all proposed project component sites and the immediate vicinity around each of these sites visible from the same public vantage points as proposed project sites. Based on the list of cumulative projects provided in **Table 6-1. Projects Considered for Cumulative Analysis**, the following projects are within the same viewshed of the proposed project component sites: Carmel River Lagoon Enhancement Project, Carmel River Notch, CRFREE, and Scenic Road Emergency Slope Repairs. **Table 2-1,** in **Chapter 2, Summary of the Environmental Impact Report**, provides a summary of potential impacts from the proposed project to the aesthetic environment and significance determinations for each proposed project component by impact area for construction and operations.

The proposed project construction impacts (**AES-1**) on scenic vistas and visual quality of sites and permanent light and glare during operations (**AES-3**) were found to be less-than-significant. Construction of the Carmel River Notch, Carmel River Lagoon Enhancement, and Scenic Road Emergency Slope Repair projects has been completed. The construction of the proposed project may overlap with the construction of the CRFREE project. If an overlap occurs, the timing for the construction of specific components would be such that no construction on any one site would occur for a substantial period of time. Thus, there would be no significant construction related cumulative impacts of the proposed project combined with the CRFREE project. None of the cumulative projects within the same viewshed as the proposed project include, or would include, substantial new permanent lighting. The proposed EPB project component would include minimal new exterior lighting; however, the lighting would be low intensity and, where possible, directed downward and away from surrounding residential areas. Therefore, there would be no significant operation related light and glare cumulative impacts from the proposed project combined with these projects.

The operation of the proposed EPB and SRPS project components would place new development within a scenic vista and sensitive viewshed. The operation of the proposed EPB project component would result in a significant and unavoidable impact to the visual character of the site and would partially obstruct scenic vistas and sensitive viewsheds. The proposed EPB project component would be partially screened by Lagoon vegetation; however, the visual character would remain degraded and the scenic views partially obstructed. Implementation of **Mitigation Measure AES-2** would reduce the visual impacts of the proposed EPB project component but would not reduce the impact to a less-than-significant level. Therefore, operational aesthetic impacts associated with the proposed EPB project component would remain significant and unavoidable even with implementation of the identified mitigation measure. The

operation of the proposed SRPS project component would result in a moderate impact to the visual character of the site. The riprap would be covered by sand during most of the year and would be visible as a temporary visual degradation of the site and surrounding area. Therefore, this impact is less than significant. The other projects within the same viewshed would not result in significant operational impacts to scenic vistas or the visual quality of the surrounding area and would not result in any aesthetic improvements to the area in which the significant impacts of the proposed project would be reduced to a less-than-significant level. Therefore, the operation of the proposed EPB project component would result in significant and unavoidable impacts to scenic vistas and the visual quality and character of the surrounding area but would not contribute to any significant cumulative aesthetic impacts due to lack of impacts from any other cumulative projects. Further, the operation of the proposed SRPS project component would result in less-than-significant impacts to scenic vistas and the visual quality and character of the surrounding area and would not contribute to any significant cumulative aesthetic impacts due to lack of impacts from any other cumulative projects.

Cumulative Impact Conclusion

The combined cumulative projects with the proposed project would result in a less-than-significant cumulative impact to scenic vistas and visual quality of sites during construction and permanent light and glare during operations. Once constructed, the operation of the proposed EPB project component would result in significant unavoidable cumulative impacts on scenic vistas and the visual quality of the surrounding area. There are no additional mitigation measures available to reduce this cumulative impact; and, therefore, it remains significant and unavoidable. Once constructed, the operation of the proposed SRPS project component would result in less-than-significant cumulative impacts on scenic vistas and the visual quality of the surrounding area.

6.2.3.2 Air Quality

For localized air quality effects (such as exposure of nearby sensitive receptors to emissions from construction activities, such as diesel vehicle and equipment exhaust), the geographic scope is the vicinity of the proposed project component sites.

The geographic scope for cumulative analysis of regional criteria pollutant air quality impacts is the air basin in which the facilities would be constructed and operated and any downwind air basins that may be affected by emissions from the proposed project. In this case, due to the locations of the proposed project component sites and the predominantly west-northwest winds in the project region, the proposed project would not affect other air basins. Therefore, only projects and plans subject to the jurisdiction of the MBARD which is responsible for air quality across the Counties of Monterey, Santa Cruz and San Benito and Cities within the tri-County area which form the North Central Coast Air Basin (NCCAB) would apply. Projects throughout the NCCAB could have adverse effects on the regional air quality and sensitive receptors[1] within the region.

[1] The term sensitive receptors refer to specific population groups and the land uses where individuals would reside for long periods. Commonly identified sensitive population groups include children, the elderly, the acutely ill, and the chronically ill. Commonly identified sensitive land uses include facilities that house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants. Residential dwellings, schools, parks, playgrounds, childcare centers, convalescent homes, and hospitals are examples of sensitive land uses.

LOCALIZED, COMBINED EXPOSURES TO AIR POLLUTANTS

Cumulative Projects Contributing to Localized Impacts

Localized air pollutant emissions from cumulative projects may potentially impact sensitive receptors if intense construction activities (i.e., those activities with high air pollutant emissions) from two or more construction projects would occur near each other (i.e., within one mile). Two projects listed in **Table 6-1, Projects Considered for Cumulative Analysis** would be near each other and to the proposed project (i.e., the CSA-50 and CRFREE Projects), and some may be expected to be under construction during the same worst case and overlapping construction periods. The exact sequence of other projects' construction is outside the control of the County; but as currently envisioned, the construction periods may potentially overlap.

Proposed Project Localized Air Pollutants Impacts

Table 2-1 in **Chapter 2, Summary of the Environmental Impact Report** provides a summary of potential impacts related to air quality and significance determinations for each proposed project component. As detailed in **Section 4.2**, **Air Quality** the following five impacts are relevant to the cumulative localized air pollutant analysis and the proposed project would have a less-than-significant impact related to all of them:

- **AQ-1**: Conflict with or Obstruct Implementation of Applicable Air Quality Plans
- **AQ-2**: Violate any Air Quality Standard or Contribute Substantially to an Existing or Projected Air Quality Violation
- **AQ-3**: 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
- **AQ-4**: Expose Sensitive Receptors to Substantial Pollutant Concentration
- **AQ-5**: Create Objectionable Odors Affecting a Substantial Number of People

The proposed project would have less-than-significant emissions impacts nearby sensitive receptors. The other two cumulative projects with construction schedules with the potential to overlap with the proposed project are the CSA-50 and CRFREE Projects. Most of the construction using heavy equipment that would generate construction emissions would be completed at the Highway 1 overpass and east of Highway 1. Accordingly, the two projects would not result in significant cumulative impacts due to localized concentrations of pollutants or odors. Therefore, there would be no significant cumulative impacts due to localized air pollutant exposures or odors.

CUMULATIVE REGIONAL, CRITERIA AIR POLLUTANT EMISSIONS

For regional criteria air pollutants, the cumulative analysis is based on review of consistency with the MBARD's Air Quality Management Plan (AQMP), as well as prediction of emissions. Consistency determinations with the AQMP are used by MBARD to address a project's contribution to regional air quality (i.e., ozone levels).

MBARD prepares air quality plans which address attainment of the State ozone Ambient Air Quality Standards (AAQS) and maintenance of the National Ambient Air Quality Standards (NAAQS). These plans accommodate growth by projecting growth in emissions based on different indicators. For example, population forecasts adopted by AMBAG are used to forecast population related emissions. Through the planning process, emission growth is offset by basin wide controls on stationary, area, and transportation sources of air pollution. In developing emission-based thresholds, MBARD also considered the levels for

which a project's individual contribution would be cumulatively considerable to the NCCAB region. Since the proposed project would be consistent with the MBARD AQMP and proposed project emissions are not predicted to exceed MBARD's significance thresholds, the proposed project's incremental increase in emissions would not result in a cumulatively considerable contribution to existing or future regional air quality violations. The proposed project would not make a considerable contribution to any significant cumulative regional air quality impacts.

The region is in non-attainment for the state ambient air quality standard for PM_{10}. Construction of one or more of these projects at one time could result in potentially significant PM_{10} emissions if compared to the significance threshold. Therefore, this analysis assumes construction of multiple projects would result in a potentially significant cumulative impact. The significance thresholds used in the project-level analysis measure whether the project would make a cumulatively considerable contribution to a cumulatively significant impact. The analysis above regarding whether the proposed project would exceed the MBARD emissions thresholds provides a measure of whether the project would considerably contribute to significant air quality cumulative impacts, including exceedances/violations of air quality standards, exposure of sensitive receptors to substantial pollutants, or conflicts with air quality management plans. If the threshold is not exceeded, then one should conclude the project would not contribute to any violation, regardless of what additional PM_{10} emissions these cumulative projects contribute.

The proposed project would not exceed the PM_{10} significance thresholds for construction emissions, and, thus, the project's contribution to this potentially significant cumulative impact would not be cumulatively considerable (i.e., less than the MBARD's threshold).

Cumulative Impact Conclusion

The proposed project would not make a considerable contribution to significant cumulative regional emissions of PM_{10}; therefore, the impact is less-than-significant.

6.2.3.3 Biological Resources

The geographic scope for cumulative impact analysis on biological resources consists of the overall region (such as central coastal California) and more specifically, the Carmel River watershed, in which the project components are being constructed. Based on the list of cumulative projects provided in **Table 6-1, Projects Considered for Cumulative Analysis**, projects throughout the region could have adverse effects on the same sensitive species and habitats that occur within and adjacent to the proposed project component sites.

The proposed project has the potential to impact some of the same biological resources as other past, present, and probable future projects. However, the proposed project's construction related impacts would not be cumulatively considerable with implementation of the mitigation measures identified. Proposed project construction impacts to special-status species and habitat, and construction impacts to riparian, federally protected wetlands as defined by Section 404 of the CWA, or other sensitive natural community were found to be less-than-significant with mitigation. With mitigation, construction impacts from the proposed project can be reduced to less-than-significant.

Similarly, the proposed project's operational impacts would be less-than-significant, even beneficial in some instances, and would not be cumulatively considerable. The function of the proposed EPB project component is intended to improve and increase habitat for special-status wildlife species known or with the potential to occur in the Lagoon. The proposed EPB project component is expected to result in the following impacts:

1. Higher frequency of natural sandbar breaches.

2. A reduction in frequency of annual mechanical breaching.
3. Increased depth and duration of inundation within the Lagoon.

A more naturally functioning lagoon ecosystem will result in a higher water surface elevation for longer periods of time within the Lagoon. This increase in water surface level may also increase the amount of emergent marsh, riparian, and other sensitive vegetation types influenced by hydrology that provide habitat for many common and special-status species. Special-status species that may occur within areas affected by an increase in water surface elevation include Monterey-dusky-footed woodrat, tricolored blackbird, California horned lark, white-tailed kite, sharp-shinned hawk, nesting raptors and migratory bird species, California legless lizard, western pond turtle, California Red Legged Frog, South-Central California Coast Steelhead, and Smith's Blue Butterfly. This impact is a beneficial impact.

The function of the SRPS is intended to improve and increase habitat for special-status wildlife species known or with the potential to occur in the Lagoon. The function of the SRPS is expected to result in the following:

1. More northerly breaches of the barrier beach during the rainy season than the existing condition will result in relatively long channel alignments and drawdown over a longer period, resulting in a higher water surface elevation that will increase the amount of aquatic habitat and may reduce the potential for lagoon species to be drawn out into the ocean.
2. A more naturally functioning lagoon ecosystem resulting in a higher ratio of fresh water to salt water.
3. A more naturally functioning lagoon ecosystem.

This impact is a beneficial impact.

The proposed project operational impacts to the movement of native wildlife were found to be beneficial. The proposed project impacts from operations to riparian, federally protected wetlands, and other sensitive natural communities were found to be less-than-significant with mitigation. Therefore, the proposed project would not result in significant cumulative impacts to biological resources.

Cumulative Impact Conclusion

The proposed project would not make a considerable contribution to significant cumulative impacts to biological resources, and this is a less-than-significant cumulative impact.

6.2.3.4 Cultural Resources

The geographic scope for cumulative impact analysis on cultural and paleontological resources includes all sites upon which past, present, or future activities could affect the same cultural, historic, tribal cultural, and paleontological resources as the proposed project. Cumulative projects are provided in **Table 6-1, Projects Considered for Cumulative Impact Analysis**.

As described in **Section 4.4**, **Cultural Resources**, known and potential cultural resources may be affected by the proposed project components. As described in **Impacts CR-1, CR-2, CR-3,** and **CR-4**, construction of the proposed EPB and SRPS project components may result in significant impacts to historic resources (extant buildings and structures), historical and/or archaeological resources, human remains, and tribal resources. These impacts would be reduced to a less-than-significant level with implementation of the mitigation measures identified.

All the cumulative projects identified in **Table 6-1** could result in potential impacts to cultural resources; however, impacts to cultural resources are site-specific and are evaluated and mitigated on a project-by-project basis. None of the cumulative projects would be in sufficiently close proximity to result in combined impacts to the known historic and archaeological resources that could be affected by the proposed project.

Two of the cumulative projects (i.e., CSA-50 and CRFREE Projects) would be in the project vicinity and have the potential to significantly impact cultural, tribal cultural, and historic resources. The proposed project's construction schedule may overlap with the construction of these projects. Therefore, these projects may result in cumulative impacts to cultural, tribal cultural, and historic resources from construction related activities. Implementation of the mitigation measures identified in **Section 4.4, Cultural Resources** would reduce this impact to a less-than-significant level.

Cumulative Impact Conclusion

Construction of the proposed project would result in less-than-significant impacts to cultural resources with implementation of the mitigation identified. No cumulative impacts to cultural resources have been identified related to ongoing operation of cumulative projects. Therefore, the proposed project would not contribute to cumulative impacts related to cultural resources.

6.2.3.5 Geology, Soils, and Seismicity

The geographic scope for cumulative impact analysis on geology, soils, and seismicity consists of each proposed project component site and the immediate vicinity around each of these sites. Geologic and seismic impacts are generally site-specific because they result from the local geology and soil conditions at a given site and do not have additive effects with activities/projects beyond the immediate vicinity. Based on the list of cumulative projects provided in **Table 6-1, Projects Considered for Cumulative Impact Analysis**, there are no other proposed or planned developments within the immediate vicinity of the proposed project components.

The proposed project would not be within the same location as any other known projects. Because of the localized nature of the anticipated individual project impacts, the projects listed in **Table 6-1** would not combine with those of the proposed project to cause or contribute to potential cumulative geologic, soil, or seismic impacts. Construction of all projects would be subject to applicable codes and requirements of the CBC with California additions (CCR Title 24), and applicable County construction and grading ordinances.

Cumulative Impact Conclusion

With compliance with applicable regulations overseeing construction of the proposed project, the exposure to seismic or soils hazards would not result in a significant cumulative impact. Because of the localized nature of the anticipated impacts or other cumulative projects listed in **Table 6-1**, the cumulative projects, including the proposed project, would not result in cumulative geologic, soil, or seismicity impacts.

6.2.3.6 Greenhouse Gas Emissions

Because GHG emissions affect global climate change, the evaluation of GHG emissions is inherently a cumulative impact analysis. The geographic scope for cumulative impact analysis of GHG emissions includes the NCCAB, as well as the State of California.

GHG emissions contribute to the environmental effect of global climate change. The impacts of cumulative projects worldwide have been acknowledged to result in significant cumulative impacts (rising sea levels, species extinction, increased hydrologic and climate changes resulting in greater numbers and more severe storms and droughts, increased and more severe human illnesses, etc.). The proposed project would not result in a cumulatively considerable contribution to GHG emissions and global climate change because the proposed project greenhouse gas emissions would be below the significance threshold as discussed in **Section 4-6, Greenhouse Gases** and **Impact GHG-1** and **Impact GHG-2** analyses.

Cumulative Impact Conclusion

As described under **Impact GHG-1 (Construction Greenhouse Gas Emissions)**, the proposed project construction would not make a considerable contribution to significant cumulative impacts due to greenhouse gas emissions and the related global climate change impacts. Therefore, this cumulative impact is less-than-significant.

As described under **Impact GHG-1 (Operational Greenhouse Gas Emissions)**, the proposed project (including operational plus amortized construction greenhouse gas emissions) would not make a considerable contribution to significant cumulative impacts of greenhouse gas emissions and the related global climate change impacts and this cumulative impact is less-than-significant.

6.2.3.7 Hazards and Hazardous Materials

The geographic scope for the hazards and hazardous materials cumulative impact analysis consists of the proposed project component sites, and the immediate vicinity surrounding each of these sites, including roadways. Based on the list of cumulative projects provided in **Table 6-1, Projects Considered for Cumulative Impact Analysis**, no cumulative projects would be located sufficiently close to the proposed project construction sites such that a combined impact from hazards and hazardous materials would occur except for the CRFREE project, as discussed below.

The operation of the proposed project would not result in hazardous emissions, and thus, would not contribute to cumulative impacts pertaining to hazardous emissions within 0.25 miles of a school. Similarly, the proposed project would not result in new structural development that would result in airport hazards or safety issues. Thus, the proposed project would not contribute to potential cumulative impacts related to airport hazards. Finally, the proposed project operations would not increase wildland fire risks or impair implementation of an emergency access plan. Thus, cumulative impacts related to this topic are not further addressed as the proposed project would not contribute to a cumulative impact related to hazardous emissions, airport hazards, wildland fire hazards, or emergency access.

The CRFREE project includes construction of a causeway and restoration activities upstream of the proposed project along the Carmel River. The CRFREE project may be constructed starting in 2024 and ending in 2028, which may coincide with construction at the proposed project sites. Should an overlap of construction schedules occur, there could be overlapping cumulative impacts related to transport or use of hazardous materials during construction or operations on Highway 1. These projects would not result in a significant cumulative impact relating to transport, storage, and use of hazardous materials because both projects would be governed by the same statutory and regulatory requirements for use, transport, and disposal of hazardous materials that reduce the risk of hazardous conditions to less-than-significant. Therefore, no significant cumulative construction or operational hazards or hazardous materials impacts would occur in this area.

Cumulative Impact Conclusion

Construction of the CRFREE project and proposed project may have overlapping or close construction schedules, but the two projects would not result in significant cumulative impacts related to hazards or hazardous materials. These projects would be subject to compliance with applicable federal and state laws, and the combined projects would not result in significant cumulative impacts.

6.2.3.8 Hydrology/Water Quality

The geographic scope for cumulative impact analysis on hydrology and water quality includes the Carmel River Watershed, Carmel Bay, and groundwater basin.

COMBINED GROUNDWATER CONSTRUCTION AND OPERATION IMPACTS

The discussion of cumulative groundwater impacts addresses all relevant past, present, and probable future projects identified in **Table 6-1, Projects Considered for Cumulative Impact Analysis.** While the proposed project would use a small amount of water during construction (likely recycled water provided by the CAWD facility) and would introduce small amounts of impervious surfaces, there would be no noticeable change to groundwater levels or quality due to these construction-related changes. Construction of the proposed project would not change groundwater quality, recharge, levels, and storage in the groundwater basin on which proposed project components would be located. The operation of the EPB and SRPS project components would not result in a depletion of groundwater supplies or interfere with groundwater recharge. Therefore, the proposed project would not contribute considerably to cumulative impacts on groundwater resources during construction or operation.

COMBINED SURFACE WATER CONSTRUCTION IMPACTS

Table 2-1 in **Chapter 2, Summary of the Environmental Impact Report** provides a summary of impacts of the proposed project components for construction related impacts of hydrology and water quality, including surface water quality impacts due to discharges (**HYD-1**), and surface water quality impacts due to earthmoving, drainage alterations, and use of hazardous chemicals (**HYD-3**). These impacts were found to be less-than-significant with compliance with the requirements of state and local agencies and professional engineering standards during construction.

Because of the localized nature of the anticipated individual project impacts, the projects listed in **Table 6-1** would not combine with those of the proposed project to cause or contribute to potential cumulative surface water hydrology and water quality impacts. Construction of all projects would be subject to applicable County construction and grading ordinances, local permit requirements, and State Water Resources Control Board NPDES permit requirements. Thus, there would be no significant construction related cumulative impacts of the proposed project combined with all other projects related to surface water hydrology and water quality beyond the impacts of individual components of each project.

COMBINED SURFACE WATER OPERATION IMPACTS

The following proposed project operational impacts to hydrology and surface water quality were found to be less-than-significant with implementation of the identified mitigation measures:

- Operational Impacts to Water Quality due to Drainage Pattern Alterations and Discharges (**HYD-4**)
- Operational Risks due to Location within a 100-Year Flood Hazard Area (**HYD-7**)

Based on the proposed project objectives, implementation of the proposed project would beneficially impact the Carmel River system, including conditions due to erosion, bank stability, and water quality. Regarding hydrologic and water quality impacts due to discharges and risks associated with the 100-year floodplain, the proposed project has the potential to result in impacts to water quality from discharges from the pumps associated with the EPB project component and the validity of the base flood elevations cited in the current FEMA Flood Insurance Map Panel for the project area. Implementation of **Mitigation Measures HYD-4** and **HYD-7** would reduce the impacts to a less-than-significant level.

Both the proposed project and the cumulative projects identified in **Table 6-1** would have similar and less-than-significant impacts to operational surface water quality impacts due to the requirements for projects to comply with local and state regulatory programs to control discharges and runoff to prevent water quality changes by retaining discharges and runoff on site with appropriate BMPs and low impact development standards included in the relevant permits. The impacts of each project from risks of exposure of people or structures to flooding due to levee failure, coastal inundation and seiche, tsunami or mudflow risks would not be additive.

However, operational drainage pattern alterations associated with the proposed EPB project component would result in increased water surface elevations that would cause flooding on or off site, specifically at the CAWD and Mission Ranch properties (**HYD-6**). No feasible mitigation was identified; and, therefore, this impact is significant and unavoidable. The other projects within the Lagoon would not result in significant operational flooding impacts on or off site due to drainage pattern alterations. Therefore, the operation of the proposed EPB project component would result in significant and unavoidable impacts to flooding on- or off-site but would not contribute to any significant cumulative flooding impacts due to lack of impacts from any other cumulative projects.

Cumulative Impact Conclusion

There would not be significant cumulative construction flooding impacts to which the proposed project would contribute. However, construction and operation of the proposed EPB project component would result in significant and unavoidable flooding impacts, which would also be cumulatively significant and unavoidable. There would be no significant cumulative construction or operational impacts to hydrology and water quality to which the proposed project would contribute. Construction of the cumulative projects alongside the proposed project may have overlapping or proximate construction schedules. However, compliance with the permitting requirements of local and state agencies related to stormwater water quality and drainage would ensure combined impacts would not be significant.

6.2.3.9 Land Use

The geographic scope for cumulative impact analysis related to land use consists of the immediate area of each of the proposed project component sites. Potential project conflicts or inconsistencies with applicable adopted plans, policies, and regulations would be specific to an individual project component and would not combine to result in a cumulative impact related to plan consistency.

Furthermore, in cases where a potential conflict or inconsistency is identified, the proposed project would be consistent with implementation of mitigation measures recommended in this EIR, thus resulting in no contribution to cumulative land use impacts.

The discussion of cumulative impacts addresses the overall combined impacts of the proposed project and all relevant past, present, and probable future projects identified in **Table 6-1, Projects Considered for Cumulative Analysis**.

Table 2-1 in **Chapter 2, Summary of the Environmental Impact Report** provides a summary of potential impacts related to land use and significance determinations for each proposed project component. Potential inconsistencies with applicable land use plans, policies, and regulations during the construction and operation of the proposed EPB and SRPS project components and implementation of the proposed ISMP project components may occur; however, mitigation measures have been identified in this EIR to reduce these impacts to a less-than-significant level and, if implemented, would ensure that the proposed project would be consistent with the relevant policies.

It is unlikely that the cumulative projects identified in **Table 6-1** would result in the same potential inconsistencies as the proposed project, and if identified, would be required to mitigate, or obtain a plan amendment. The cumulative projects would not have similar impacts as the proposed project.

Cumulative Impact Conclusion

The proposed project would not result in significant cumulative land use impacts. Potential inconsistencies with applicable land use plans, policies, and regulations during the construction and operation of the proposed project. However, mitigation measures have been identified in this RDEIR to reduce these impacts to a less-than-significant level and, if implemented, would ensure the proposed project would be consistent with the relevant policies. The proposed project would not contribute to a significant cumulative impact related to land use.

6.2.3.10 Noise

The geographic scope for cumulative impact analysis of noise and vibration effects consists of the proposed project component sites and the immediate vicinity around each of these sites, in which noise could combine with noise from the proposed project to adversely affect the same sensitive receptors. Based on the list of cumulative projects provided in **Table 6-1**, no other projects have the potential to result in construction or operation noise impacts that could combine with noise impacts resulting from the proposed project.

Construction of the CRFREE project may occur at the same time. However, the projects are not in the immediate vicinity of each other; and, therefore, would not result in a combination of noise and vibration impacts that would affect sensitive receptors. None of the other cumulative development projects identified above would result in substantial permanent operational noise impacts as most projects are restoration, residential, and/or infrastructure projects that would not result in substantial noise producing equipment or uses.

However, noise and vibration impacts related to construction and operation of the proposed EPB project component would be significant and unavoidable. Therefore, the construction and operation of the proposed EPB project component would result in significant unavoidable impacts related to noise and vibration but would not contribute to any significant cumulative noise impacts due to lack of impacts from any other cumulative projects.

Cumulative Impact Conclusion

There would not be significant cumulative construction noise and vibration impacts to which the proposed project would contribute. However, construction and operation of the proposed EPB project component would result in significant unavoidable noise and vibration impacts, which would also be cumulatively significant and unavoidable.

6.2.3.11 Public Services, Recreation, and Utilities

The geographic scope for cumulative impact analysis of public services consists of the service areas of the public service providers evaluated (fire protection, police protection, schools, and parks/recreation). For landfill capacity, the geographic scope includes the service area of ReGen Monterey (previously, Monterey Regional Waste Management District). For compliance with solid waste statutes and regulations, the geographic scope encompasses the County of Monterey. Based on the list of cumulative projects provided in **Table 6-1, Projects Considered for Cumulative Analysis**, cumulative projects in the service areas in which the proposed project sites are located are summarized below in the discussion of potential cumulative impacts.

Table 2-1 in **Chapter 2, Summary of the Environmental Impact Report** summarizes project impacts public services, utilities, and recreation. The proposed project construction impacts on demand for public services and landfill capacity were found to be less-than-significant. Public services demand during operation was also determined to be less-than-significant. The construction of the proposed project would potentially conflict with state and local statutes, policies, and regulations related to solid waste. Implementation of **Mitigation Measure PS-3** would reduce this impact to a less-than-significant level. The proposed project would not result in new population growth that would require schools or parks and recreational services. Thus, public service impacts are only related to police and fire protection services and solid waste regulation compliance.

The cumulative projects identified in **Table 6-1** have similar public service impacts. These projects would also require minimal fire and police protection services during construction and operation but would not result in the need to construct new facilities that may have environmental impacts. Additionally, these projects would be required to comply with solid waste regulations and each project may require similar mitigation requirements to reduce this potential impact to a less-than-significant level.

The operation of these projects combined with the proposed project would not result in a considerable increase in demand for public services or result in a considerable contribution to cumulative impacts.

Cumulative Impact Conclusion

The proposed project would not contribute to any cumulative impact related to schools, parks, and recreational facilities. The proposed project's contribution to other public services and utilities (fire and police protection, solid waste) would not be cumulatively considerable.

6.2.3.12 Transportation

The geographic scope for the analysis of cumulative impacts on transportation consists of the roadways affected by the proposed project. A list of cumulative projects is provided in **Table 6-1, Projects Considered for Cumulative Impact Analysis**. Cumulative projects that would result in permanent traffic increases include development projects (i.e., Rancho Cañada Village, September Ranch Subdivision, and Housing Element 6th Cycle Update) in Carmel Valley. Relevant projects with potential traffic impacts that could combine with traffic impacts resulting from the proposed project are summarized below.

Table 2-1 in **Chapter 2, Summary of the Environmental Impact Report** provides a summary of potential impacts related to traffic and transportation and significance determinations for each proposed project component. The construction and operation of the proposed project would not result in a significant increase in VMT or conflict or be inconsistent with CEQA Guidelines Section 15064.3(b). The proposed project would temporarily reduce roadway performance and result in temporary traffic delays, potentially

affecting transit, bicycle, and pedestrian facilities and emergency access. Implementation of **Mitigation Measures TRA-1a** through **1c** would reduce these impacts to a less-than-significant level.

None of the identified cumulative projects near the proposed project are known to have overlapping construction schedules that would result in cumulative construction related impacts, except for potentially the CRFREE project. Construction trips on Highway 1 from both projects would be spread out throughout the day and would not result in a significant temporary cumulative impact related to construction traffic, traffic delays, safety hazards, access limitations, and roadway deterioration. Most of the construction related impacts would be in the immediate project vicinity of the two projects. Thus, there would be no significant cumulative traffic impacts resulting from the construction of the two projects.

Development projects (i.e., Rancho Cañada Village, September Ranch Subdivision, and Housing Element 6th Cycle Update) would primarily utilize Highway 1 and Carmel Valley Road. Operation of the cumulative projects identified in **Table 6-1** and located in the project vicinity would not result in a significant increase in traffic trips since these are primarily infrastructure projects that require minimal maintenance activity (i.e., CSA-50 and CRFREE projects). The operation of the proposed project would not result in a significant increase in traffic trips. Thus, there would be no significant cumulative traffic impacts resulting from the operation of these projects.

For these reasons, the proposed project's contribution to significant cumulative traffic impacts would not be cumulatively considerable.

Cumulative Impact Conclusion

Construction of the CRFREE project and proposed project may have overlapping or close construction schedules. Construction of both projects would not result in significant cumulative construction or operational traffic impacts. There are no other identified cumulative construction related traffic impacts to which the proposed project would contribute.

Cumulative development could result in significant cumulative traffic impacts along segments of Highway 1 and Carmel Valley Road. However, operation of the proposed project would result in minimal new trips, resulting in minor peak hour trip increase on Highway 1. Therefore, the proposed project's contribution to significant cumulative traffic impacts due to cumulative development projects would not be cumulatively considerable.

6.2.3.13 Energy

The geographic scope for the analysis of cumulative impacts on energy consists of each of the proposed project component sites and the overall region. A list of cumulative projects is provided in **Table 6-1, Projects Considered for Cumulative Impact Analysis**. The construction and operation of each of these projects combined with the proposed project would result in energy usage to varying degrees. This analysis evaluates whether the impacts of the proposed project, together with the impacts of cumulative development, would result in a cumulatively significant impact with respect to energy usage. This analysis then considers whether the incremental contribution of the impacts associated with the implementation of the proposed project would be significant. Both conditions must apply for a project's cumulative effects to rise to the level of significance.

Table 2-1 in **Chapter 2, Summary of the Environmental Impact Report** provides a summary of potential impacts related to energy and significance determinations for each proposed project component site. The construction and operation of the proposed project would have a less-than-significant impact on energy resources as it would not result in wasteful, inefficient, or unnecessary consumption of energy, nor would

the proposed project conflict with state or local plans for renewable energy or energy efficiency. Therefore, the proposed project's incremental contribution to any cumulative impacts to energy would not be cumulatively considerable. All cumulative projects would be required to comply with federal, state, and local regulations. Therefore, the construction and operation of these projects combined with the proposed project would not result in a considerable increase in demand for energy, resulting in wasteful, inefficient, or unnecessary consumptions of energy, or conflict with any applicable plans that would result in a considerable contribution to cumulative impacts.

Cumulative Impact Conclusion

The construction and operation of the cumulative projects combined with the proposed project would not result in a considerable increase in demand for energy, resulting in wasteful, inefficient, or unnecessary consumptions of energy, or conflict with any applicable plans that would result in a considerable contribution to cumulative impacts.

6.3 SIGNIFICANT UNAVOIDABLE IMPACTS

The proposed project would result in significant impacts in the following categories, as described in this EIR: aesthetics, air quality, biological resources, cultural resources, hydrology, noise, and transportation/traffic. All project impacts can be reduced to a less-than-significant level with implementation of mitigation identified in this EIR except for the following:

- Project and cumulative impacts to scenic vistas and viewsheds and visual character of the area associated with the operation of the proposed EPB project component (**AES-2**);
- Project and cumulative impacts to flooding on- or off-site associated with the operation of the proposed EPB project component (**HYD-6**); and
- Project and cumulative impacts to noise associated with the construction and operation of the proposed EPB project component (**NV-2** and **NV-3**).

6.4 IRREVERSIBLE ENVIRONMENTAL CHANGES

CEQA Guidelines CCR Section 15126(c) requires that an EIR include a discussion of significant, irreversible environmental changes that would result from the implementation of a project. Irreversible environmental changes are identified as those involving a large commitment of nonrenewable resources or irreversible damage resulting from environmental accidents. Public Resources Code Sec. 21100.1 provides further guidance identifying when the evaluation of potential irreversible environmental changes must be included in an EIR. An EIR must evaluate the significant irreversible impacts associated with the following types of projects:

- The adoption, amendment, or enactment of a plan, policy, or ordinance of a public agency.
- The adoption by local agency formation commission of a resolution making a determination.
- A project which will be subject to the requirement for preparing an environmental impact statement pursuant to the requirements of the National Environmental Policy Act of 1969.

The proposed project involves implementing three project components: 1) EPB; 2) SRPS; and 3) ISMP. The proposed EPB project component would maintain or improve existing flood protection to low lying homes and public infrastructure along the north edge of the Lagoon, while the frequency of mechanical management of the sandbar is reduced in compliance with regulatory requirements. The proposed SRPS

project component would provide protection from erosion along the northern sand cliffs and the undermining of Scenic Road which may result from northerly river flows or large ocean swells. The proposed ISMP project component is intended to provide a short-term (i.e., until the design, environmental review, permitting, and construction of the project is completed) solution to potential flooding issues by implementing select sandbar management actions that allow additional natural function in the Lagoon while still protecting properties and infrastructure. The environmental changes from the proposed project would occur because of project construction rather than operations. The only minor irreversible changes associated with the project include: 1) the use of nonrenewable resources during construction, including building materials (such as concrete and glass) and petroleum products, and 2) the use of electricity for new facilities during the operational phase of the proposed EPB project component.

6.5 EFFECTS FOUND NOT TO BE SIGNIFICANT

CEQA Guidelines CCR Section 15128 states an EIR shall contain a statement to briefly indicate the reasons that various possible significant effects of a project were determined not to be significant and were therefore not discussed in detail. These are as follows:

Agricultural Resources: The proposed project and alternatives would not have an effect on agricultural resources because the project area does not contain significant agricultural resources. There are no designated prime or important farmlands, or parcels with Williamson Act contracts within the proposed project sites.

Population and Housing: The proposed project would not directly result in population or economic growth through the development of new residential or commercial uses and would not induce substantial population growth due to new permanent employees or extension of roads or public services to unserved locations. Therefore, the proposed project would not directly or indirectly result in growth inducing impacts. The proposed project would not displace a substantial number of existing housing or cause the displacement of a substantial number of persons.

Mineral Resources: Sand, gravel, and petroleum are the primary mineral resources extracted in the County of Monterey. Construction grade aggregate (e.g., sand, gravel, and crushed stone) is the most abundant and commonly used mineral resource. The proposed project site contains sand; however, the proposed project site does not support any mining activities. Due to the sensitivity of the area, future mineral extraction in this area is unlikely. Therefore, the proposed project would not result in the loss of availability of a known mineral resource.

This Page Intentionally Left Blank

Chapter 7.0 LIST OF PREPARERS AND PERSONS CONSULTED

7.1 LEAD AGENCY

County of Monterey

- Mary Adams, District 5 Supervisor
- Colleen Courtney, Chief of Staff for Supervisor Adams
- Craig Spencer, Acting Director Housing and Community Development
- Melanie Beretti, Acting Chief of Planning
- Randell Ishii, Director of Public Works, Facilities, and Parks
- Shandy Carroll, Management Analyst III
- Damian Bye, Management Analyst II
- Kelsey Scanlon, Director Department of Emergency Management

7.2 ENVIRONMENTAL IMPACT REPORT CONSULTANTS

EIR Consultant: Denise Duffy and Associates, Inc.

- Denise Duffy, Principal
- Erin Harwayne, AICP, Senior Project Manager
- Josh Harwayne, Senior Environmental Scientist
- Jami Davis, Senior Environmental Scientist
- Oliviya Wyse, Deputy Project Manager/Associate Environmental Planner
- Robyn Simpson, Associate Environmental Planner
- Troy Lawson, Assistant Environmental Planner
- Luke Hiserman, Assistant Environmental Planner
- Mikaela Bogdan, Assistant Environmental Planner

Technical Consultants

Anthropological Studies Center

- Dr. Adrian Praetzellis, Registered Professional Archaeologist
- Kate Erickson Green, M.A., Registered Professional Archaeologist

Moffatt & Nichol

- Dilip Trivedi, Dr. Eng, PE
- Neil Nichols, PE
- Mads Jorgensen, PE

Whitson Engineers

- Richard Weber, PE, LS, QSD
- Nathaniel Milam, PE, QSD

Balance Hydrologics, Inc.

- Ed Ballman, Principal Engineer

- Scott Brown, P.G. - Senior Geomorphologist/Hydrologist
- Anne Senter, Geomorphologist/Hydrologist
- Eric Riedner, PE, Hydrologist

H. T. Harvey & Associated Ecological Consultants

- Ron Duke, President
- Sharon Kramer, Principal

Pacific Geotechnical Engineering

- Chalerm (Beeson) Liang, Senior Project Manager
- G. Reid Fisher, PhD, Senior Engineering Geologist

D. W. Alley & Associates

- Don Alley, Principal

Technical Advisory Committee

- Dr. Mara Orescanin, Professor of Coastal Oceanography at the Naval Postgraduate School
- Dr. Doug Smith, Professor of Hydrology and watershed restoration at California State University, Monterey Bay
- Larry Hampson, (retired) engineer and consultant for the Monterey Peninsula Water Management District
- Jeff Hagar, fisheries consultant for Hagar Environmental Science

7.3 PERSONS CONSULTED

In addition to all the above individuals, the following additional persons were consulted in the preparation of the Draft EIR and this RDEIR:

- Douglass Cooper, US Fish and Wildlife Service, Deputy Assistant Field Supervisor-North Coast Division
- Jacob Martin, US Fish and Wildlife Service, Senior Biologist
- Chad Mitcham, US Fish and Wildlife Service, Biologist
- Joyce Ambrosius, NOAA National Marine Fisheries Service, North-Central Coast Office's Central Coast Branch lead
- Joel Casagrande, NOAA National Marine Fisheries Service, Natural Resource Management Specialist
- Jacqueline Pearson-Meyer, NOAA National Marine Fisheries Service, Fisheries Biologist and Hydroacoustics
- Brian Meux, NOAA National Marine Fisheries Service, Natural Resource Specialist
- Paul Michel, Monterey Bay National Marine Sanctuary, Superintendent
- Deirdre Whalen, Monterey Bay National Marine Sanctuary, Government & Community Relations Coordinator
- Karen Grimmer, Monterey Bay National Marine Sanctuary, Resource Protection Coordinator
- Julie Vance, California Department of Fish and Wildlife, Region 4, Regional Manager
- Dr. Craig Shuman, California Department of Fish and Wildlife, Marine Region (Region 7), Regional Manager
- Linda Connolly, California Department of Fish and Wildlife, Senior Environmental Scientist

- Brandon Sanderson, California Department of Fish and Wildlife, Environmental Scientist
- Craig Bailey, California Department of Fish and Wildlife, Environmental Scientist
- Eric Wilkins, California Department of Fish and Wildlife, Environmental Scientist
- Dan Carl, California Coastal Commission, Central Coast District Deputy Director
- Susan Craig, California Coastal Commission, Central Coast District Manager
- Mike Watson, California Coastal Commission, Coastal Planner
- Mathew Fuzie, California Department of Parks and Recreation, Monterey District Superintendent
- Stephen Bachman, California Department of Parks and Recreation, Senior Environmental Scientist
- Amy Palkovic, California Department of Parks and Recreation, Environmental Scientist
- Grace Kato, California State Lands Commission, Assistant Chief, Land Management
- Lisa McCann, California Regional Water Quality Control Board, Central Coast Region (3) Regional Environmental Program Manager
- Kim Sanders, California Regional Water Quality Control Board, Central Coast Region (3) Program Coordinator
- Phil Hammer, California Regional Water Quality Control Board, Senior Environmental Scientist
- Katerina Galacatos, US Army Corps of Engineers, South Branch Chief
- Holly Costa, US Army Corps of Engineers, Acting Division Chief
- Jane M. Hicks, US Army Corps of Engineers, Division Chief
- Lisa Mangione, US Army Corps of Engineers, Senior Regulatory Project Manager
- Gregory Brown, US Army Corps of Engineers, Permit Manager
- Barbara Buikema, Camel Area Wastewater District, General Manager
- Drew Lander, Camel Area Wastewater District, Engineer
- Larry Hampson, Monterey Peninsula Water Management District, Planning and Engineering Manager/District Engineer
- Thomas Christensen, Monterey Peninsula Water Management District, Riparian Projects Coordinator
- Kevan Urquhart, Monterey Peninsula Water Management District, Senior Fisheries Biologist
- Tom Lindberg, Monterey Peninsula Water Management District, Associate Hydrologist
- Rachel Saunders, Big Sur Land Trust, Director of Conservation
- Sarah Hardgrave, Big Sur Land Trust, Conservation Programs Manager
- Lorin Letendre, Executive Director, Carmel River Watershed Conservancy
- Morgan G. Gilman, CSA-1

This Page Intentionally Left Blank

APPENDIX E

Biological Resources Report

This Page Intentionally Left Blank

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
PLANTS							
Allium hickmanii Hickman's onion	-- / -- / 1B	Closed-cone coniferous forests, maritime chaparral, coastal prairie, coastal scrub, and valley and foothill grasslands at elevations of 5-200 meters. Bulbiferous perennial herb in the Alliaceae family; blooms March-May.	**Not Present:** Suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats; however, this species was not observed during surveys in March and June 2014, or March, April and May 2015. The CNDDB reports 15 occurrences within the quads evaluated, the nearest of which is approximately 0.4 mile from the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos edmundsii Little Sur manzanita	-- / -- / 1B	Coastal bluff scrub and chaparral on sandy soils at elevations of 30-105 meters. Evergreen shrub in the Ericaceae family; blooms November-April.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos hookeri ssp. *hookeri* Hooker's manzanita	-- / -- / 1B	Closed-cone coniferous forest, chaparral, cismontane woodland, and coastal scrub on sandy soils at elevations of 85-536 meters. Evergreen shrub in the Ericaceae family; blooms January-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos montereyensis Toro manzanita	-- / -- / 1B	Maritime chaparral, cismontane woodland, and coastal scrub on sandy soils at elevations of 30-730 meters. Evergreen shrub in the Ericaceae family; blooms February-March.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos pajaroensis Pajaro manzanita	-- / -- / 1B	Chaparral on sandy soils at elevations of 30-760 meters. Evergreen shrub in the Ericaceae family; blooms December-March.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos pumila Sandmat manzanita	-- / -- / 1B	Openings of closed-cone coniferous forests, maritime chaparral, cismontane woodland, coastal dunes, and coastal scrub on sandy soils at elevations of 3-205 meters. Evergreen shrub in the Ericaceae family; blooms February-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. The CNDDB reports one non-specific occurrence that includes a portion of the Action Area however, no suitable habitat is present.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arenaria paludicola marsh sandwort	FE / SE / 1B	Known from only two natural occurrences in Black Lake Canyon and at Oso Flaco Lake. Sandy openings of freshwater of brackish marshes and swamps at elevations of 3-170 meters. Stoloniferous perennial herb in the Caryophyllaceae family; blooms May-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat is present; however, the Action Area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present; however, the Action Area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the implementation area is outside of highly endemic range for the species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Astragalus tener var. *titi* coastal dunes milk-vetch	FE / SE / 1B	Sandy soils in coastal bluff scrub, coastal dunes, coastal prairie (mesic); elevation 3-164 feet. Annual herb in the Fabaceae family; blooms March-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Sulcaria spiralifera twisted horsehair lichen	-- / -- / 1B	California North Coast coniferous forest at elevations of 0–30 meters. Often found on conifers, including *Picea sitchensis*, *Pinus contorta* var. *contorta*, *Pseudotsuga menziesii*, *Abies grandis*, and *Tsuga heterophylla*. Fruticose lichen in the Parmeliaceae family.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Castilleja ambigua var. *insalutata* Pink johnny-nip	-- / -- / 1B	Coastal prairie and coastal scrub at elevations of 0-100 meters. Annual herb in the Orobanchaceae family; blooms May-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area, or in areas affected by an increased WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Centromadia parryi ssp. *congdonii* Congdon's tarplant	-- / -- / 1B	Valley and foothill grassland on alkaline soils at elevations of 0-230 meters. Annual herb in the Asteraceae family; blooms May-November.	**Not Present:** No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** No suitable habitat is present within or adjacent to the construction area.	**Not Present:** No suitable habitat is present within area affected by a change in WSE.	**Not Present:** No suitable habitat is present within or adjacent to the construction area.	**Not Present:** No suitable habitat is present within or adjacent to the implementation area.
Chorizanthe minutiflora Fort Ord spineflower	-- / -- / 1B	Sandy openings of maritime chaparral and coastal scrub at elevations of 55-150 meters. Only known occurrences on Fort Ord National Monument. Annual herb in the Polygonaceae family; blooms April-July.	**Not Present:** The Action Area is outside the known range of this species. Although this species was not a target species during 2014 and 2015 surveys, it would have been misidentified as Monterey spineflower (see below) if it were present within the Action Area.	**Not Present:** Construction area lacks microhabitat requirements, and the Action Area is outside the known range of this species.	**Not Present:** The Action Area is outside the known range of this species.	**Not Present:** Construction area lacks microhabitat requirements, and the Action Area is outside the known range of this species.	**Not Present:** Implementation area lacks microhabitat requirements, and the Action Area is outside the known range of this species.
Chorizanthe pungens ssp. *pungens* Monterey spineflower	FT / -- / 1B	Maritime chaparral, cismontane woodland, coastal dunes, coastal scrub, and valley and foothill grassland on sandy soils at elevations of 3-450 meters. Annual herb in the Polygonaceae family; blooms April-July.	**Not Present:** Suitable habitat is present within the coastal dune scrub habitat; however, this species was not observed during surveys in March and June 2014, or March, April and May 2015. The CNDDB reports nine occurrences within the quads evaluated, the nearest of which is approximately 2.6 miles from the Action Area.	**Not Present:** Construction area lacks microhabitat requirements, and this species was not observed in adjacent areas during surveys in March and June 2014, and March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Construction area lacks microhabitat requirements and this species was not observed in adjacent areas during surveys in March and June 2014, and March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Implementation area lacks microhabitat requirements for the species.
Clarkia jolonensis Jolon clarkia	-- / -- / 1B	Cismontane woodland, chaparral, riparian woodland, and coastal scrub at elevations of 20-660 meters. Annual herb in the Onagraceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Collinsia multicolor San Francisco collinsia	-- / -- / 1B	Closed-cone coniferous forest and coastal scrub, sometimes on serpentinite soils, at elevations of 30-250 meters. Annual herb in the Plantaginaceae family; blooms March-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present within the coastal scrub habitat; however the Action Area is outside of the currently known range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the currently known range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. I
Cordylanthus rigidus ssp. *littoralis* Seaside bird's-beak	-- / SE / 1B	Closed-cone coniferous forests, maritime chaparral, cismontane woodlands, coastal dunes, and coastal scrub on sandy soils, often on disturbed sites, at elevations of 0-425 meters. Annual hemi-parasitic herb in the Orobanchaceae family; blooms April-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Delphinium californicum ssp. *interius* Hospital Canyon California larkspur	-- / -- / 1B	Openings in chaparral, coastal scrub, and mesic areas of cismontane woodland at elevations of 230-1095 meters. Perennial herb in the Ranunculaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Delphinium hutchinsoniae Hutchinson's larkspur	-- / -- / 1B	Broadleaved upland forest, chaparral, coastal scrub, and coastal prairie at elevations of 0-427 meters. Perennial herb in the Ranunculaceae family; blooms March-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Ericameria fasciculata Eastwood's goldenbush	-- / -- / 1B	Openings in closed-cone coniferous forest, maritime chaparral, coastal dunes, and coastal scrub on sandy soils at elevations of 30-275 meters. Evergreen shrub in the Asteraceae family; blooms July-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat is present within the coastal scrub habitat; however, the Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present; however, the area affected by a change in WSE is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Eriogonum nortonii Pinnacles buckwheat	-- / -- / 1B	Chaparral and valley and foothill grassland on sandy soils, often on recent burns, at elevations of 300-975 meters. Annual herb in the Polygonaceae family; blooms May-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Erysimum ammophilum Sand-loving wallflower	-- / -- / 1B	Openings in maritime chaparral, coastal dunes, and coastal scrub on sandy soils at elevations of 0-60 meters. Perennial herb in the Brassicaceae family; blooms February-June.	**Not Present:** Suitable habitat is present within the coastal dune scrub habitat; however, this species was not observed during surveys in March and June 2014, or March, April and May 2015. No occurrences are known within the Action Area.	**Not Present:** Suitable habitat is present adjacent to the construction area; however, this species was not observed during surveys in March and June 2014, or March, April, and May 2015.	**Not Present:** Suitable habitat is present; however, this species was not observed during surveys in March and June 2014, or March, April, and May 2015.	**Not Present:** Suitable habitat is present adjacent to the construction area; however, this species was not observed during surveys in March and June 2014, or March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Erysimum menziesii Menzie's wallflower	FE / SE / 1B	Coastal dunes at elevations of 0-35 meters. Perennial herb in the Brassicaceae family; blooms March-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Fritillaria liliacea Fragrant fritillary	-- / -- / 1B	Cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland, often serpentinite, at elevations of 3-410 meters. Bulbiferous perennial herb in the Liliaceae family; blooms February-April.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. The CNDDB reports one non-specific occurrence that includes a portion of the Action Area; however, this occurrence is likely extirpated and no suitable habitat is present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Gilia tenuiflora ssp. *arenaria* sand gilia	FE / ST / 1B	Openings in maritime chaparral, cismontane woodland, coastal dunes, and coastal scrub on sandy soils at elevations of 0-45 meters. Annual herb in the Polemoniaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Hesperocyparis goveniana Gowen cypress	FT / -- / 1B	Closed-cone coniferous forest and maritime chaparral at elevations of 30-300 meters. Evergreen tree in the Cupressaceae family. Natively occurring only at Point Lobos near Gibson Creek and the Huckleberry Hill Nature Preserve near Highway 68.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. The Action Area is outside of the highly endemic range and elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of the highly endemic range for this species.
Hesperocyparis macrocarpa Monterey cypress	-- / -- / 1B	Closed-cone coniferous forest at elevations of 10-30 meters. Evergreen tree in the Cupressaceae family. Natively occurring only at Cypress Point in Pebble Beach and Point Lobos State Park; widely planted and naturalized elsewhere.	**Not Present:** Monterey cypress trees are present within the Action Area. However, these individuals are likely planted and from unknown genetic stock, and are therefore not considered native.	**Not Present:** Monterey cypress trees are present adjacent to the construction area. However, these individuals are likely planted and from unknown genetic stock, and are therefore not considered native.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Monterey cypress trees are present within and adjacent to the construction area. However, these individuals are likely planted and from unknown genetic stock, and are therefore not considered native.	**Not Present:** No suitable habitat is present within or adjacent to the implementation area.
Horkelia cuneata ssp. *sericea* Kellogg's horkelia	-- / -- / 1B	Openings of closed-cone coniferous forests, maritime chaparral, coastal dunes, and coastal scrub on sandy or gravelly soils at elevations of 10-200 meters. Perennial herb in the Rosaceae family; blooms April-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Horkelia marinensis Point Reyes horkelia	-- / -- / 1B	Coastal dunes, coastal prairie, and coastal scrub on sandy soils at elevations of 5-755 meters. Perennial herb in the Rosaceae family; blooms May-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present within the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Lasthenia conjugens Contra Costa goldfields	FE / -- / 1B	Mesic areas of valley and foothill grassland, alkaline playas, cismontane woodland, and vernal pools at elevations of 0-470 meters. Annual herb in the Asteraceae family; blooms March-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Layia carnosa beach layia	FT / SE / 1B	Coastal dunes and coastal scrub on sandy soils at elevations of 0-60 meters. Annual herb in the Asteraceae family; blooms March-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Lupinus tidestromii Tidestrom's lupine	FE / SE / 1B	Coastal dunes at elevations of 0-100 meters. Perennial rhizomatous herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Malacothamnus palmeri var. involucratus Carmel Valley bush-mallow	-- / -- / 1B	Chaparral, cismontane woodland, and coastal scrub at elevations of 30-1100 meters. Perennial deciduous shrub in the Malvaceae family; blooms May-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present; however, the area affected by a change in WSE is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Malacothrix saxatilis var. arachnoidea Carmel Valley malacothrix	-- / -- / 1B	Chaparral and coastal scrub on rocky soils at elevations of 25-1036 meters. Perennial rhizomatous herb in the Asteraceae family; blooms June-December.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Microseris paludosa Marsh microseris	-- / -- /1B	Closed-cone coniferous forest, cismontane woodland, coastal scrub, and valley and foothill grassland at elevations of 5-300 meters. Perennial herb in the Asteraceae family; blooms April-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present within the disturbed herbaceous mosaic habitat. One non-specific CNDDB occurrence includes a portion of the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Monardella sinuata ssp. *nigrescens* Northern curly-leaved monardella	-- / -- /1B	Chaparral, coastal dunes, coastal scrub, and lower montane coniferous forest (ponderosa pine sandhills) on sandy soils at elevations of 0-300 meters. Annual herb in the Lamiaceae family; blooms April-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Monolopia gracilens Woodland woollythreads	-- / -- / 1B	Openings of broadleaved upland forest, chaparral, cismontane woodland, North Coast coniferous forest, and valley and foothill grassland on serpentinite soils at elevations of 100-1200 meters. Annual herb in the Asteraceae family; blooms February-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Pinus radiata Monterey pine	-- / -- / 1B	Closed-cone coniferous forest and cismontane woodland at elevations of 25-185 meters. Evergreen tree in the Pinaceae family. Only three native stands in CA at Ano Nuevo, Cambria, and the Monterey Peninsula; introduced in many areas.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Piperia yadonii Yadon's rein orchid	FE / -- / 1B	Sandy soils in coastal bluff scrub, closed-cone coniferous forest, and maritime chaparral at elevations of 10-510 meters. Annual herb in the Orchidaceae family; blooms February-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Plagiobothrys uncinatus Hooked popcorn-flower	-- / -- / 1B	Chaparral, cismontane woodlands, and valley and foothill grasslands on sandy soils at elevations of 300-760 meters. Annual herb in the Boraginaceae family; blooms April-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Potentilla hickmanii Hickman's cinquefoil	FE / SE / 1B	Coastal bluff scrub, closed-cone coniferous forests, vernally mesic meadows and seeps, and freshwater marshes and swamps at elevations of 10-149 meters. Perennial herb in the Rosaceae family; blooms April-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Construction area lacks microhabitat requirements for the species. Construction area is outside of highly endemic range for the.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Implementation area lacks microhabitat requirements for the species. Implementation area is outside of highly endemic range for the species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Ramalina thrausta Angel's hair lichen	-- / -- / 2B	North coast coniferous forest on dead twigs and other lichens. Epiphytic fructose lichen in the Ramalinaceae family. In northern CA it is usually found on dead twigs, and has been found on *Alnus rubra*, *Calocedrus decurrens*, *Pseudotsuga menziesii*, *Quercus garryana*, and *Rubus spectabilis*. In Sonoma County it grows on and among dangling mats of *R. menziesii* and *Usnea* spp.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Rosa pinetorum Pine rose	-- / -- / 1B	Closed-cone coniferous forest at elevations of 2-300 meters. Perennial shrub in the Rosaceae family; blooms May-July. Possible hybrid of *R. spithamea, R. gymnocarpa*, or others; further study needed.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Stebbinsoseris decipiens Santa Cruz microseris	-- / -- / 1B	Broadleaved upland forest, closed-cone coniferous forest, chaparral, coastal prairie, coastal scrub, and openings in valley and foothill grassland, sometimes on serpentinite, at elevations of 10-500 meters. Annual herb in the Asteraceae family; blooms April-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Tortula californica California screw moss	-- / -- / 1B	Valley and foothill grassland and chenopod scrub on sandy soils at elevations of 10-1460 meters. Moss in the Pottiaceae family.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Trifolium buckwestiorum Santa Cruz clover	-- / -- / 1B	Gravelly margins of broadleaved upland forest, cismontane woodland, and coastal prairie at elevations of 105-610 meters. Annual herb in the Fabaceae family; blooms April-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Trifolium hydrophilum Saline clover	-- / -- / 1B	Marshes and swamps, mesic and alkaline valley and foothill grassland, and vernal pools at elevations of 0-300 meters. Annual herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present within the disturbed herbaceous mosaic habitat. The CNDDB reports one occurrence within the quads evaluated, located approximately 4.6 miles from the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area; however, suitable habitat present within areas affected by an increased WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Trifolium polyodon Pacific Grove clover	-- / SR / 1B	Mesic areas of closed-cone coniferous forest, coastal prairie, meadows and seeps, and valley and foothill grassland at elevations of 5-120 meters. Annual herb in the Fabaceae family; blooms April-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present within the disturbed herbaceous mosaic habitat. The CNDDB reports 12 occurrences within the quads evaluated, the nearest of which is located approximately 0.9 mile from the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area; however, suitable habitat is present within areas affected by an increased WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Trifolium trichocalyx Monterey clover	FE / SE / 1B	Sandy openings and burned areas of closed-cone coniferous forest at elevations of 30-240 meters. Annual herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
MAMMALS							
Arctocephalus townsendi Guadalupe fur seal	FT/ST & CFP/--	Tropical waters of Southern California/Mexico region. During breeding season, they are found in coastal rocky habitats and caves. Breeds on Guadalupe Island off Mexico and some individuals are seen on the Channel Islands. This species occurs infrequently in the MBNMS. A juvenile male was reported off of the beach at former Fort Ord in April 1977 and in San Mateo County in May 1984.	**Unlikely:** Although this species has been observed twice in the MBNMS historically, the Action Area does not provide breeding habitat for this species and is likely too populated to be used as a haul-out site.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Corynorhinus townsendii Townsend's big-eared bat	-- / CSC / --	Found primarily in rural settings from inland deserts to coastal redwoods, oak woodland of the inner Coast Ranges and Sierra foothills, and low to mid-elevation mixed coniferous-deciduous forests. Typically roost during the day in limestone caves, lava tubes, and mines, but can roost in buildings that offer suitable conditions. Night roosts are in more open settings and include bridges, rock crevices, and trees.	**Low:** The CNDDB does not report any occurrences of this species within quads evaluated; however, suitable foraging and roosting habitat is present within the Action Area. No suitable breeding habitat is present within the Action Area.	**Low:** This species may forage over the construction area; however, no suitable roosting habitat is present within or adjacent to the construction area. This species may also forage over areas affected by an increased WSE.	**Low:** Suitable foraging and roosting habitat is present within the area affected by a change in WSE; however, no suitable breeding habitat is present.	**Low:** This species may forage over the construction area; however, no suitable roosting habitat is present within or adjacent to the construction area.	**Low:** This species may forage over the implementation area; however, no suitable roosting habitat is present within or adjacent to the implementation area.
Enhydra lutris nereis southern sea otter	FT / CFP / --	Generally found inhabiting nearshore coastal waters of less than 117 feet in depth. *E. lutris* can be found in association with both rocky and soft-bottom habitats. Typical haunts of the sea otter are characterized by precipitous rocky shores, barrier reefs, tidewater stones, and dense kelp forests.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species may be present within the Carmel Bay portion of the Action Area and may utilize the coastal strand as a haul-out site on occasion.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** This species may utilize the construction area as a haul-out site on occasion.	**Low:** This species may utilize the implementation area as a haul-out site on occasion.
Eumetopias jubatus Steller sea lion (Eastern DPS)	FT / -- / --	Colder temperate to sub-arctic waters of North Pacific Ocean. Ano Nuevo Island is the southernmost breeding area for this species; rarely seen at other haul-out sites in the MBNMS. Formerly abundant at Point Lobos State Reserve, but no longer occurs there.	**Unlikely:** This species is known to breed north of the project site; however, it has not been observed south of Ano Nuevo and there are not documented occurrences within the Carmel Bay.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Lasiurus cinereus Hoary bat	-- / CNDDB / --	Prefers open habitats or habitat mosaics with access to trees for cover and open areas or edge for feeding. Generally roost in dense foliage of trees; does not use buildings for roosting. Winters in California and Mexico and often migrates towards summer quarters in the north and east during the spring. Young are born and reared in summer grounds, which is unlikely to occur in California.	**Low:** Suitable foraging and roosting habitat is present within the Action Area; however, this species is unlikely to breed within the Action Area. The CNDDB reports two occurrences within the quads evaluated, the nearest of which is approximately 0.5 mile from the Action Area.	**Low:** This species may forage over the construction area; however, no suitable roosting or breeding habitat is present within or adjacent to the construction area. This species may also forage over areas affected by an increased WSE.	**Low:** Suitable foraging and roosting habitat is present within the area affected by a change in WSE; however, this species is unlikely to breed in this area.	**Low:** This species may forage over the construction area; however, no suitable roosting or breeding habitat is present within or adjacent to the construction area.	**Low:** This species may forage over the construction area; however, no suitable roosting or breeding habitat is present within or adjacent to the construction area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Neotoma macrotis luciana Monterey dusky-footed woodrat	-- / CSC / --	Forest and oak woodland habitats of moderate canopy with moderate to dense understory. Also occurs in chaparral habitats.	**Present:** The CNDDB does not report any occurrences of this species within quads evaluated; however, this species is known to occur throughout Monterey County. Woodrat nests were observed within the riparian habitat within the Action Area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species; however, this species may be present within areas affected by an increased WSE.	**Present:** Woodrat nests were observed within the riparian habitat within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Phoca vitulina Harbor seal	MMPA / -- / --	California coast in subtidal and intertidal habitat. Hauls out in small to moderate-sized groups on emergent offshore and tidal rocks, mudflats, sandbars, and sandy beaches.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species may be present within the Carmel Bay portion of the Action Area and may utilize the coastal strand as a haul-out site on occasion.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** This species may utilize the construction area as a haul-out site on occasion.	**Low:** This species may utilize the implementation area as a haul-out site on occasion.
Reithrodontomys megalotis distichlis Salinas harvest mouse	-- / CNDDB / --	Known only to occur from the Monterey Bay region. Occurs in fresh and brackish water wetlands and probably in the adjacent uplands around the mouth of the Salinas River.	**Unlikely:** Suitable habitat may be present; however, the Action Area is out of the currently known range for this species.	**Unlikely:** Suitable habitat may be present; however, the construction area is outside of highly endemic range for the.	**Unlikely:** Suitable habitat may be present; however, the area affected by a change in WSE is out of the currently known range for this species.	**Unlikely:** Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Unlikely:** No suitable habitat within the Implementation Area. Implementation area is outside of highly endemic range for the species.
Sorex ornatus salarius Monterey ornate shrew	-- / CSC / --	Mostly moist or riparian woodland habitats and within chaparral, grassland, and emergent wetland habitats where there is a thick duff or downed logs.	**Low:** Suitable habitat is present within the Action Area. The CNDDB reports five occurrences of this species within the quadrangles reviewed, including an occurrence which overlaps the Action Area. However, this occurrence is historical (1938) and is non-specific (mapped to the Carmel area). Several other occurrences are reported within five miles of the Action Area, but they are also all historical (1927 and older).	**Low:** Suitable habitat is present within emergent wetland habitat within the construction area. However, all reported occurrences of this species in the vicinity are historical.	**Low:** Suitable habitat is present within emergent wetland and riparian habitat within the area affected by a change in WSE. However, all reported occurrences of this species in the vicinity are historical.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Taxidea taxus American badger	-- / CSC / --	Dry, open grasslands, fields, pastures savannas, and mountain meadows near timberline are preferred. The principal requirements seem to be sufficient food, friable soils, and relatively open, uncultivated grounds.	**Low:** Suitable habitat may be present; however, this species is not known to occur on adjacent public lands. The nearest CNDDB occurrence is approximately six miles from the Action Area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat may be present; however, this species is not known to occur on adjacent public lands.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Zalophus californianus California sea lion	MMPA / -- / --	California coast in pelagic, nearshore, and surf zones. Hauls out on offshore rocks, sloping outcrops, sandy and cobblestone beaches, jetties, and buoys.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species may be present within the Carmel Bay portion of the Action Area and may utilize the coastal strand as a haul-out site on occasion.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** This species may utilize the construction area as a haul-out site on occasion.	**Low:** This species may utilize the implementation area as a haul-out site on occasion.
BIRDS							
Accipiter striatus Sharp-shinned hawk	-- / CNDDB / --	Uses dense stands in close proximity to open areas. Roosts in intermediate to high-canopy forest. Nests in dense, even-aged, single-layered forest canopy. Winters in woodlands.	**Moderate:** The CNDDB does not report any occurrences of this species within quads evaluated; however, this species is known to occur at the lagoon (State Parks, 2002) and historically bred within the vicinity (Roberson, 2002). Suitable nesting and foraging habitat is present within the Action Area.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Agelaius tricolor Tricolored blackbird (nesting colony)	-- / ST / --	Nest in colonies in dense riparian vegetation, along rivers, lagoons, lakes, and ponds. Forages over grassland or aquatic habitats.	**Moderate:** No CNDDB occurrences are known within the Action Area. Roberson (2002) reports that this species occurs at the Carmel Lagoon; however, breeding has not been documented within the area (Roberson, 2002; Information Center for the Environment [University of California, Davis], 2016).	**Moderate:** Suitable habitat is present within the construction area; however, nesting colonies are not expected to occur within the construction area.	**Moderate:** Suitable habitat is present within the area affected by a change in WSE; however, nesting colonies are not expected to occur within the construction area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Athene cunicularia Burrowing owl (burrow sites & some wintering sites)	-- / CSC / --	Year round resident of open, dry grassland and desert habitats, and in grass, forb and open shrub stages of pinyon-juniper and ponderosa pine habitats. Frequent open grasslands and shrublands with perches and burrows. Use rodent burrows (often California ground squirrel) for roosting and nesting cover. Pipes, culverts, and nest boxes may be substituted for burrows in areas where burrows are not available.	**Moderate:** No CNDDB occurrences are known within the Action Area. Roberson (2002) reports that this species occurs during the winter on the south side of the Carmel River mouth; however, breeding has not been documented within the area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Brachyramphus marmoratus marbled murrelet	FT / SE / --	Occur year-round in marine subtidal and pelagic habitats from the Oregon border to Point Sal. Partial to coastlines with stands of mature redwood and Douglas-fir. Require dense old growth forests of redwood and/or Douglas-fir in higher elevations for breeding and nesting.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Buteo regalis Ferruginous hawk (wintering)	-- / CNDDB / --	An uncommon winter resident and migrant at lower elevations and open grasslands in the Modoc Plateau, Central Valley, and Coast Ranges and a fairly common winter resident of grassland and agricultural areas in southwestern California. Frequent open grasslands, sagebrush flats, desert scrub, low foothills surrounding valleys, and fringes of pinyon-juniper habitats. Does not breed in California.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species has been documented at the lagoon (State Parks, 2002) and suitable foraging habitat is present within the Action Area. The Action Area is not within the breeding range for this species.	**Moderate:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, this area is not within the breeding range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Charadrius alexandrinus nivosus western snowy plover	FT / CSC / --	Sandy beaches on marine and estuarine shores, also salt pond levees and the shores of large alkali lakes. Requires sandy, gravelly, or friable soil substrates for nesting.	**Present:** No CNDDB occurrences are known within the Action Area. Roberson (2002) reports that this species may winter at the beach near the mouth of the lagoon; however, they are not known to breed within this area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**High:** Roberson (2002) reports that this species may winter at the beach near the mouth of Carmel Lagoon; however, they are not known to breed within the construction area.	**High:** Roberson (2002) reports that this species may winter at the beach near the mouth of Carmel Lagoon; however, they are not known to breed within the implementation area.
Circus cyaneus Northern harrier	-- / CSC / --	Generally found in flat open areas with tall, dense grasses, shrubs, and edges for cover and breeding. Use tall grasses in wetlands or at wetland borders for nesting.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002). Suitable foraging and breeding habitat is present within the Action Area; however, this species is not known to breed at the lagoon (Roberson, 2002).	**Moderate:** Suitable foraging and nesting habitat is present within the construction area and/or immediate vicinity.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Coturnicops noveboracensis Yellow rail	-- / CSC / --	Wet meadows and coastal tidal marshes. Occurs year round in California, but in two primary seasonal roles: as a very local breeder in the northeastern interior and as a winter visitor (early Oct to mid-Apr) on the coast and in the Suisun Marsh region	**Moderate:** Suitable overwintering habitat is present within the Action Area. The CNDDB reports two occurrences of this species in the quadrangles reviewed, both located within seven miles of the Action Area on the Monterey Peninsula.	**Moderate:** Suitable overwintering habitat is present within emergent wetland habitat within the construction area.	**Moderate:** Suitable overwintering habitat is present within emergent wetland habitat within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Cypseloides niger Black swift (nesting)	-- / CSC / --	Regularly nests in moist crevice or cave on sea cliffs above the surf, or on cliffs behind, or adjacent to, waterfalls in deep canyons. Forages widely over many habitats.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Elanus leucurus White-tailed kite (nesting)	-- / CFP / --	Open groves, river valleys, marshes, and grasslands. Prefer such area with low roosts (fences etc.). Nest in shrubs and trees adjacent to grasslands.	**High:** This species was observed by DD&A biologists in the southern portion of the Action Area over the annual grassland/non-native herb areas. Suitable nesting habitat is present and the Action Area is within the known breeding range for the species in Monterey County (Roberson, 2002).	**Moderate:** Trees present adjacent to the construction area may provide suitable nesting habitat for this species.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Moderate:** Trees present adjacent to the construction area may provide suitable nesting habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Empidonax traillii extimus southwestern willow flycatcher	FE / SE / --	Dense willow thickets are required for nesting and roosting. Low, exposed branches are used for singing posts and hunting perches. Open, cup nest is placed in an upright fork of willow or other shrub, or occasionally on a horizontal limb. Most numerous where extensive thickets of low, dense willows edge on wet meadows, ponds, or backwaters.	**Unlikely:** No occurrences are known within the Action Area. Suitable habitat is present within the riparian habitat; however, the Action Area is very likely outside of the currently known range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species. Construction area is very likely outside the current range of the species.	**Unlikely:** Suitable habitat is present within the riparian habitat; however, the area affected by a change in WSE is very likely outside of the currently known range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species. Construction area is very likely outside the current range of the species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species. Implementation area is very likely outside the current range of the species.
Eremophila alpestris actia California horned lark	-- / CNDDB / --	Variety of open habitats, usually where large trees and/or shrubs are absent. Found from grasslands along the coast to deserts at sea-level and alpine dwarf-shrub habitats are higher elevations. Builds open cup-like nests on the ground.	**Moderate:** No occurrences are reported within the Action Area; however suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats. The nearest CNDDB occurrence is approximately 13 miles from the Action Area.	**Moderate:** Construction area and/or immediate vicinity does not provide habitat for this species; however, this species may be present within areas affected by an increased WSE.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species. Adjacent trees may provide nesting habitat.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Falco columbarius Merlin	-- / CNDDB / --	Uses a variety of habitats in both winter and during migration. Frequents coastlines, open grasslands, savannahs, woodlands, lakes, wetland edges, and early successional stages. Does not breed in California.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002) and suitable foraging habitat is present within the Action Area. The Action Area is not within the breeding range for this species.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, this area is not within the breeding range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Falco peregrinis anatum American peregrine falcon	-- / -- / --	Forages for other birds over a variety of habitats. Breeds primarily on rocky cliffs.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002). Suitable foraging habitat is present within the Action Area; however, no suitable nesting habitat is present.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, no suitable nesting habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Gymnogyps californianus California condor	FE / SE /--	Roosting sites in isolated rocky cliffs, rugged chaparral, and pine covered mountains 2000-6000 feet above sea level. Foraging area removed from nesting/roosting site (includes rangeland and coastal area - up to 19 mile commute one way). Nest sites in cliffs, crevices, potholes.	**Unlikely:** No occurrences are reported within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species
Hydrobates homochroa Ashy storm-petrel (nesting colony)	-- / CSC / --	Tied to land only to nest, otherwise remains over open sea. Nests in natural cavities, sea caves, or rock crevices on offshore islands and prominent peninsulas of the mainland.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Laterallus jamaicensis coturniculus California black rail	-- / ST & CFP / --	Inhabits freshwater marshes, wet meadows & shallow margins of saltwater marshes bordering larger bays. Needs water depths of about 1 inch that does not fluctuate during the year & dense vegetation for nesting habitat.	**Low:** Suitable vegetation types are present within the Action Area, but the Action Area is subject to seasonal fluctuations in water levels. The CNDDB reports two occurrences of this species in the quadrangles reviewed, both located within seven miles of the Action Area on the Monterey Peninsula.	**Low:** Suitable vegetation types are present within emergent wetland habitat within the construction area, but these areas are subject to seasonal fluctuations in water levels.	**Low:** Suitable vegetation types are present within emergent wetland habitat within the area affected by a change in WSE, but these areas are subject to seasonal fluctuations in water levels.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Pandion haliaetus Osprey	-- / CNDDB / --	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats. Uses large trees, snags, and dead-topped trees in open forest habitats for cover and nesting. Breeds in northern California from the Cascade Ranges, south to Lake Tahoe and along the coast south to Marin County and is an uncommon winter visitor along the coast of Southern California.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002) and suitable foraging habitat is present within the Action Area. The Action Area is not within the breeding range for this species.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, this area is not within the breeding range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Pelecanus occidentalis californicus California brown pelican (nesting colony & communal roosts)	-- / -- / --	Found in estuarine, marine subtidal, and marine pelagic waters along the California coast. Usually rests on water or inaccessible rocks, but also uses mudflats, sandy beaches, wharfs, and jetties.	**Present:** No CNDDB occurrences are known within the Action Area. This species has been observed at the lagoon (State Parks, 2002); however nesting and communal roosting habitat is not present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Present:** This species has been observed within the area affected by a change in WSE; however nesting and communal roosting habitat is not present.	**High:** This species may be found on the beach within the construction area and/or immediate vicinity. However, no nesting or communal roosting habitat is present.	**High:** This species may be found on the beach within the implementation area and/or immediate vicinity. However, no nesting or communal roosting habitat is present.
Rallus longirostris obsoletus California clapper rail	FE/SE & CFP/--	Salt and brackish marshes.	**Unlikely:** No CNDDB occurrences are known within the Action Area. Suitable habitat is present within the Action Area; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present in the immediate vicinity; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.
Riparia riparia Bank swallow (nesting)	-- / ST / --	Nest colonially in sand banks. Found near water; fields, marshes, streams, and lakes.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Sterna antillarum browni California least tern	FE / SE / --	Prefers undisturbed nest sites on open, sandy/ gravelly shores near shallow-water feeding areas in estuaries. Sea beaches, bays, large rivers, bars.	**Unlikely:** No occurrences are known within the Action Area. Possible habitat is present; however, the Action Area is very likely outside of the current range for this species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the area affected by a change in WSE; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the implementation area; however, very likely outside the current range of the species.
Vireo bellii pusillus Least bell's Vireo	FE / SE / --	Riparian areas and drainages. Primarily found south of the Action Area.	**Unlikely:** No occurrences are known within the Action Area. Suitable habitat is present; however, the Action Area is very likely outside of the current range for this species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Suitable habitat is present; however, the area affected by a change in WSE is very likely outside of the current range for this species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the implementation area; however, very likely outside the current range of the species.
REPTILES AND AMPHIBIANS							
Ambystoma californiense California tiger salamander	FT / ST / --	Annual grassland and grassy understory of valley-foothill hardwood habitats in central and northern California. Need underground refuges and vernal pools or other seasonal water sources.	**Not Present:** No occurrences are known within the Action Area and no suitable habitat is present.	**Not Present:** Construction area and/or immediate vicinity does not provide habitat for this species. No known breeding locations within 2.2 km.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Not Present:** Construction area and/or immediate vicinity does not provide habitat for this species. No known breeding locations within 2.2 km.	**Not Present:** Implementation area and/or immediate vicinity does not provide habitat for this species. No known breeding locations within 2.2 km.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Anniella pulchra Northern California legless lizard	-- / CSC / --	Requires moist, warm habitats with loose soil for burrowing and prostrate plant cover, often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas.	**Present:** The CNDDB includes 11 non-specific occurrences that include the entire Action Area. Within the Action Area, this species has been observed at the CRMB (State Parks, 2002) and within the foredunes at the beach (State Parks, 2007). Suitable habitat for this species is present within the Action Area where suitable soil conditions are present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Present:** This species has been observed within the area affected by a change in WSE and suitable habitat is present.	**Present:** This species has been observed within the construction area and suitable habitat is present.	**Not Present:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Emys marmorata Western pond turtle	-- / CSC / --	Associated with permanent or nearly permanent water in a wide variety of habitats including streams, lakes, ponds, irrigation ditches, etc. Require basking sites such as partially submerged logs, rocks, mats of vegetation, or open banks.	**Present:** The CNDDB reports one occurrence within the Action Area. Suitable habitat is present within the Action Area.	**High:** Suitable habitat for this species is present within the construction area and within areas affected by an increased WSE.	**Present:** This species has been observed within the area affected by a change in WSE and suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Phrynosoma blainvillii Coast horned lizard	-- / CSC / --	Associated with open patches of sandy soils in washes, chaparral, scrub, and grasslands.	**Unlikely:** No occurrences are known within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Rana boylii Foothill yellow-legged frog	FC / SE / --	Partly shaded, shallow streams and riffles with a rocky substrate in a variety of habitats, including hardwood, pine, and riparian forests, scrub, chaparral, and wet meadows. Rarely encountered far from permanent water.	**Moderate:** Suitable habitat is present within the Action Area. The CNDDB reports seven occurrences of this species within the quadrangles reviewed, the nearest located approximately 0.5 mile south of the Action Area (mapped to San Jose Creek).	**Moderate:** Suitable upland habitat is present within emergent wetland habitat within the construction area. No aquatic breeding habitat is present.	**Moderate:** Suitable habitat is present within emergent wetland and riparian habitat within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Rana draytonii California red-legged frog	FT / CSC / --	Lowlands and foothills in or near permanent or late-season sources of deep water with dense, shrubby, or emergent riparian vegetation. During late summer or fall adults are known to utilize a variety of upland habitats with leaf litter or mammal burrows.	**Present:** The CNDDB reports one occurrence within the Action Area. Additionally, multiple occurrence records of CRLF tadpoles and adults are known in the south arm of the lagoon	**Present:** CRLF are known to occur within the lagoon. Suitable upland and dispersal habitat are present within the construction area. Suitable breeding and non-breeding habitat are present in the immediate vicinity.	**Present:** CRLF are known to occur within the lagoon. Suitable aquatic breeding and non-breeding, upland, and dispersal habitat are present area affected by a change in WSE.	**Unlikely:** CRLF are known to occur within the lagoon; however, the beach habitat within the construction area is unlikely to support this species.	**Present:** CRLF are known to occur within the lagoon, which supports suitable upland, breeding, aquatic non-breeding, and dispersal habitat.
Taricha torosa Coast Range newt	-- / CSC / --	Occur mainly in valley-foothill hardwood, valley-foothill hardwood-conifer, coastal scrub, and mixed chaparral, but is known to occur in grasslands and mixed conifer types. Seek cover under rocks and logs, in mammal burrows, rock fissures, or man-made structures such as wells. Breed in intermittent ponds, streams, lakes, and reservoirs.	**Low:** Suitable habitat may be present within the Carmel River and adjacent riparian habitat, and freshwater areas of the lagoon. The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species is known to occur approximately three miles from the Action Area at the Santa Lucia Preserve.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat may be present within the Carmel River and adjacent riparian habitat, and freshwater areas of the lagoon.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
FISH							
Acispenser medirostris Green sturgeon - southern DPS	FT / CSC / --	San Francisco Bay, San Pablo Bay, and the lower San Joaquin River and Delta (Radtke, 1966). Spawning locations are uncertain, an anadromous fish that spends most of its life in salt water and returns to spawn in fresh water.	**Unlikely:** No suitable habitat present within the Action Area.	**Unlikely:** Construction area does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area does not provide habitat for this species.	**Unlikely:** Implementation area does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Eucyclogobius newberryi tidewater goby	FE / CSC / --	Brackish water habitats, found in shallow lagoons and lower stream reaches. Tidewater gobies appear to be naturally absent (now and historically) from three large stretches of coastline where lagoons or estuaries are absent and steep topography or swift currents may prevent tidewater gobies from dispersing between adjacent localities. The southernmost large, natural gap occurs between the Salinas River in Monterey County and Arroyo del Oso in San Luis Obispo County.	**Unlikely:** Suitable habitat is present; however, no occurrences of this species have been identified within the Action Area (State Parks, 2002). The Action Area is present within the southernmost gap where this species is currently and historically absent.	**Unlikely:** Construction area does not provide habitat for this species. Species is not known to occur in adjacent habitat (State Parks, 2002).	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area does not provide habitat for this species. Species is not known to occur in adjacent habitat (State Parks, 2002).	**Unlikely:** Suitable habitat is present; however, no occurrences of this species have been identified within the Action Area (State Parks, 2002).
Lavinia exilicauda harengus Monterey hitch	-- / CSC / --	Found only within the Pajaro and Salinas River systems. Can occupy a wide variety of habitats, however, they are most abundant in lowland areas with large pools or small reservoirs that mimic such conditions. May be found in brackish water conditions within the Salinas River lagoon during the early summer months when the sandbar forms at the mouth of the river.	**Unlikely:** The Action Area is outside the known range of this species.	**Unlikely:** The construction area is outside the known range of this species.	**Unlikely:** The area affected by a change in WSE is outside the known range of this species.	**Unlikely:** The construction area is outside the known range of this species.	**Unlikely:** The implementation area is outside the known range of this species.
Oncorhynchus mykiss irideus Steelhead – south/central California coast DPS	FT / -- / --	Cold headwaters, creeks, and small to large rivers and lakes; anadromous in coastal streams.	**Present:** The CNDDB reports one occurrence within the Action Area, located within the Carmel River and Lagoon.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon. Appropriate habitat for this species exists adjacent to the construction area.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon. Appropriate habitat for this species exists within the area affected by a change in WSE when inundated.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon; however, the beach habitat within the construction area is unlikely to support this species.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon. Appropriate habitat for this species exists within the implementation area.
INVERTEBRATES							
Branchinecta lynchi vernal pool fairy shrimp	FT / -- / --	Require ephemeral pools with no flow. Associated with vernal pools/grasslands from near Red Bluff (Shasta County), through the central valley, and into the south Coast Mountains region.	**Unlikely:** No occurrences are known within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Bombus caliginosus Obscure bumble bee	-- / CNDDB / --	Native to the West Coast of the United States. Occurs primarily along the coast in grassy prairies and meadows within the Coast Range. This species can nest both under and above ground. When nesting above ground the species may utilize abandoned bird nests. Found in areas that are relatively humid including areas that are frequently foggy. Select food genera include *Baccharis, Cirsium, Lupinus, Lotus, Grindelia*, and *Phacelia* (Pollinator Partnership and USFS, 2012).	**Low:** The CNDDB includes an occurrence from 1925 approximately 235 feet from the Action Area. Suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats within the Action Area. This species has a low potential to occur as CNDDB reported occurrences of this species within and adjacent to the proposed project site are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat is present within the area affected by a change in WSE; however, the CNDDB reported occurrences of this species in the within the proposed project area or the immediate vicinity are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Bombus occidentalis Western bumble bee	-- / SC / --	Occurs in open grassy areas, urban parks, urban gardens, chaparral, and meadows. This species generally nests underground. Select food plant genera include *Melilotus*, *Cirsium, Trifolium, Centaurea, Chrysothamnus*, and *Eriogonum* (Pollinator Partnership and USFS 2012).	**Moderate** The CNDDB includes an occurrence from 1972 approximately 235 feet from the Action Area. Suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats within the Action Area	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat is present within the area affected by a change in WSE; however, the CNDDB reported occurrences of this species in the within the proposed project area or the immediate vicinity are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Biological Study Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Coelus globosus Globose dune beetle	-- / CNDDB / --	Coastal dunes. These beetles are primarily subterranean, tunneling through sand underneath dune vegetation.	**Low:** The CNDDB includes an occurrence from 1947 along the beach within the Action Area; however, State Parks reports that this species is not known within the beach (2007). Suitable habitat is present within the coastal strand habitat; however, this species has a low potential to occur, as CNDDB reported occurrences of this species within and adjacent to the proposed project site are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** Suitable habitat for this species is present within and adjacent to the construction area; however, the CNDDB reported occurrences of this species in the within the proposed project area or the immediate vicinity are historic.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Danaus plexippus Monarch butterfly- California Overwintering Population #1	FC / -- / --	Overwinters in coastal California using colonial roosts generally found in Eucalyptus, pine and acacia trees. Overwintering habitat for this species within the Coastal Zone represents ESHA. Local ordinances often protect this species as well.	**Low:** The CNDDB reports seven non-specific occurrences, which include the entire Action Area. Low quality habitat is present within the eucalyptus grove within the Project Study Area, near the CAWD WTP.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Euphilotes enoptes smithi Smith's blue butterfly	FE / -- / --	Most commonly associated with coastal dunes and coastal sage scrub plant communities in Monterey and Santa Cruz Counties. Plant hosts are *Eriogonum latifolium* and *E. parvifolium*.	**Present:** No occurrences are known within the Action Area. *E. parvifolium* is present adjacent to the Carmel River State Park parking lot. Presence of SBB is inferred based on the presence of the host plant species.	**Not Present:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Assumed Present:** *E. parvifolium* is present within the area affected by a change in WSE. Presence of SBB is inferred based on the presence of the host plant species.	**Assumed Present:** *E. parvifolium* is present adjacent to the Carmel River State Park parking lot. Presence of SBB is inferred based on the presence of the host plant species.	**Not Present:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Haliotis cracherodii Black abalone	FE / -- / --	Abalones live in areas with rocky reef because they require hard substrate for attachment. Black abalone live on coastal rocks from the high intertidal zone out to 6 m depth, though they are most abundant intertidally.	**Unlikely:** No suitable habitat within Action Area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Linderiella occidentalis California linderiella (fairy shrimp)	-- / CNDDB / --	Ephemeral ponds with no flow. Generally associated with hardpans.	**Unlikely:** No occurrences are known within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Federal
FE = listed as Endangered under ESA
FT = listed as Threatened under ESA
MMPA = Marine Mammal Protection Act
-- = not listed

State
SE = listed as Endangered under CESA
ST = listed as Threatened under CESA
SR = listed as Rare under CESA
SC = candidate for listing under CESA
CSC = California Department of Fish and Wildlife Species of Special Concern
CFP = California Fully Protected Species
CNDDB = This designation is being assigned to animal species that are not assigned any of the other status designations defined in this table. These animal species are included in the Department's CNDDB "Special Animals" list (2010), which includes all taxa the CNDDB is interested in tracking, regardless of their legal or protection status. This list is also referred to as the list of "species at risk" or "special-status species." The Department considers the taxa on this list to be those of greatest conservation need.
-- = not listed

California Native Plant Society
1A = California Rare Plant Rank 1A species; plants presumed extinct in California
1B = California Rare Plant Rank 1B species; plants rare, threatened, or endangered in California and elsewhere

2B = California Rare Plant Rank 2B species; plants rare, threatened, or endangered in California, but more common elsewhere
-- = no listing

POTENTIAL TO OCCUR
Present – known occurrence of species within the site; presence of suitable habitat conditions; or observed during field surveys
High – known occurrence of species in the vicinity from the CNDDB or other documentation; presence of suitable habitat conditions
Moderate – known occurrence of species in the vicinity from the CNDDB or other documentation; presence of marginal habitat conditions
Low – species known to occur in the vicinity from the CNDDB or other documentation; presence of low quality habitat conditions
Unlikely – species not known to occur in the vicinity from the CNDDB or other documentation; no suitable habitat is present
Not Present – species not observed during surveys

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (Marina (3612167) OR Monterey (3612158) OR Mt. Carmel (3612147) OR Seaside (3612157) OR Soberanes Point (3612148))
 AND Taxonomic Group IS (Fish OR Amphibians OR Reptiles OR Birds OR Mammals OR Mollusks OR Arachnids OR Crustaceans OR Insects OR Ferns OR Gymnosperms OR Monocots OR Dicots OR Lichens OR Bryophytes)

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Threatened	G1G2	S2	SSC
Allium hickmanii Hickman's onion	PMLIL02140	None	None	G2	S2	1B.2
Ambystoma californiense pop. 1 California tiger salamander - central California DPS	AAAAA01181	Threatened	Threatened	G2G3T3	S3	WL
Anniella pulchra Northern California legless lizard	ARACC01020	None	None	G3	S2S3	SSC
Arctostaphylos edmundsii Little Sur manzanita	PDERI04260	None	None	G2	S2	1B.2
Arctostaphylos hookeri ssp. hookeri Hooker's manzanita	PDERI040J1	None	None	G3T2	S2	1B.2
Arctostaphylos montereyensis Toro manzanita	PDERI040R0	None	None	G2?	S2?	1B.2
Arctostaphylos pajaroensis Pajaro manzanita	PDERI04100	None	None	G1	S1	1B.1
Arctostaphylos pumila sandmat manzanita	PDERI04180	None	None	G1	S1	1B.2
Astragalus tener var. titi coastal dunes milk-vetch	PDFAB0F8R2	Endangered	Endangered	G2T1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S2	SSC
Bombus caliginosus obscure bumble bee	IIHYM24380	None	None	G2G3	S1S2	
Bombus occidentalis western bumble bee	IIHYM24252	None	Candidate Endangered	G3	S1	
Buteo regalis ferruginous hawk	ABNKC19120	None	None	G4	S3S4	WL
Castilleja ambigua var. insalutata pink Johnny-nip	PDSCR0D403	None	None	G4T2	S2	1B.1
Centromadia parryi ssp. congdonii Congdon's tarplant	PDAST4R0P1	None	None	G3T2	S2	1B.1
Charadrius nivosus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S3	SSC
Chorizanthe minutiflora Fort Ord spineflower	PDPGN04100	None	None	G1	S1	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Chorizanthe pungens var. pungens Monterey spineflower	PDPGN040M2	Threatened	None	G2T2	S2	1B.2
Clarkia jolonensis Jolon clarkia	PDONA050L0	None	None	G2	S2	1B.2
Coelus globosus globose dune beetle	IICOL4A010	None	None	G1G2	S1S2	
Collinsia multicolor San Francisco collinsia	PDSCR0H0B0	None	None	G2	S2	1B.2
Cordylanthus rigidus ssp. littoralis seaside bird's-beak	PDSCR0J0P2	None	Endangered	G5T2	S2	1B.1
Corynorhinus townsendii Townsend's big-eared bat	AMACC08010	None	None	G4	S2	SSC
Coturnicops noveboracensis yellow rail	ABNME01010	None	None	G4	S2	SSC
Cypseloides niger black swift	ABNUA01010	None	None	G4	S3	SSC
Danaus plexippus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	Candidate	None	G4T1T2Q	S2	
Delphinium californicum ssp. interius Hospital Canyon larkspur	PDRAN0B0A2	None	None	G3T3	S3	1B.2
Delphinium hutchinsoniae Hutchinson's larkspur	PDRAN0B0V0	None	None	G2	S2	1B.2
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Eremophila alpestris actia California horned lark	ABPAT02011	None	None	G5T4Q	S4	WL
Ericameria fasciculata Eastwood's goldenbush	PDAST3L080	None	None	G2	S2	1B.1
Eriogonum nortonii Pinnacles buckwheat	PDPGN08470	None	None	G2	S2	1B.3
Erysimum ammophilum sand-loving wallflower	PDBRA16010	None	None	G2	S2	1B.2
Erysimum menziesii Menzies' wallflower	PDBRA160R0	Endangered	Endangered	G1	S1	1B.1
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	
Eumetopias jubatus Steller sea lion	AMAJC03010	Delisted	None	G3	S2	
Euphilotes enoptes smithi Smith's blue butterfly	IILEPG2026	Endangered	None	G5T2	S2	
Fritillaria liliacea fragrant fritillary	PMLIL0V0C0	None	None	G2	S2	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Gilia tenuiflora ssp. arenaria Monterey gilia	PDPLM041P2	Endangered	Threatened	G3G4T2	S2	1B.2
Hesperocyparis goveniana Gowen cypress	PGCUP04031	Threatened	None	G1	S1	1B.2
Hesperocyparis macrocarpa Monterey cypress	PGCUP04060	None	None	G1	S1	1B.2
Horkelia cuneata var. sericea Kellogg's horkelia	PDROS0W043	None	None	G4T1?	S1?	1B.1
Horkelia marinensis Point Reyes horkelia	PDROS0W0B0	None	None	G2	S2	1B.2
Hydrobates homochroa ashy storm-petrel	ABNDC04030	None	None	G2	S2	SSC
Lasiurus cinereus hoary bat	AMACC05032	None	None	G3G4	S4	
Lasthenia conjugens Contra Costa goldfields	PDAST5L040	Endangered	None	G1	S1	1B.1
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3T1	S2	FP
Lavinia exilicauda harengus Monterey hitch	AFCJB19013	None	None	G4T3	S3	SSC
Layia carnosa beach layia	PDAST5N010	Threatened	Endangered	G2	S2	1B.1
Linderiella occidentalis California linderiella	ICBRA06010	None	None	G2G3	S2S3	
Lupinus tidestromii Tidestrom's lupine	PDFAB2B3Y0	Endangered	Endangered	G1	S1	1B.1
Malacothamnus palmeri var. involucratus Carmel Valley bush-mallow	PDMAL0Q0B1	None	None	G3T2Q	S2	1B.2
Malacothrix saxatilis var. arachnoidea Carmel Valley malacothrix	PDAST660C2	None	None	G5T2	S2	1B.2
Microseris paludosa marsh microseris	PDAST6E0D0	None	None	G2	S2	1B.2
Monardella sinuata ssp. nigrescens northern curly-leaved monardella	PDLAM18162	None	None	G3T2	S2	1B.2
Monolopia gracilens woodland woollythreads	PDAST6G010	None	None	G3	S3	1B.2
Oncorhynchus mykiss irideus pop. 9 steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	G5T2Q	S2	
Pelecanus occidentalis californicus California brown pelican	ABNFC01021	Delisted	Delisted	G4T3T4	S3	FP
Phrynosoma blainvillii coast horned lizard	ARACF12100	None	None	G4	S4	SSC

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Pinus radiata Monterey pine	PGPIN040V0	None	None	G1	S1	1B.1
Piperia yadonii Yadon's rein orchid	PMORC1X070	Endangered	None	G1	S1	1B.1
Plagiobothrys uncinatus hooked popcornflower	PDBOR0V170	None	None	G2	S2	1B.2
Potentilla hickmanii Hickman's cinquefoil	PDROS1B370	Endangered	Endangered	G1	S1	1B.1
Ramalina thrausta angel's hair lichen	NLLEC3S340	None	None	G5?	S2S3	2B.1
Rana boylii pop. 6 foothill yellow-legged frog - south coast DPS	AAABH01056	Proposed Endangered	Endangered	G3T1	S1	
Rana draytonii California red-legged frog	AAABH01022	Threatened	None	G2G3	S2S3	SSC
Reithrodontomys megalotis distichlis Salinas harvest mouse	AMAFF02032	None	None	G5T1	S2	
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S3	
Rosa pinetorum pine rose	PDROS1J0W0	None	None	G2	S2	1B.2
Sidalcea malachroides maple-leaved checkerbloom	PDMAL110E0	None	None	G3	S3	4.2
Sorex ornatus salarius Monterey shrew	AMABA01105	None	None	G5T1T2	S1S2	SSC
Stebbinsoseris decipiens Santa Cruz microseris	PDAST6E050	None	None	G2	S2	1B.2
Sulcaria spiralifera twisted horsehair lichen	NLT0042560	None	None	G3G4	S2	1B.2
Taricha torosa Coast Range newt	AAAAF02032	None	None	G4	S4	SSC
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Tortula californica California screw moss	NBMUS7L090	None	None	G2G3	S2?	1B.2
Trifolium buckwestiorum Santa Cruz clover	PDFAB402W0	None	None	G2	S2	1B.1
Trifolium hydrophilum saline clover	PDFAB400R5	None	None	G2	S2	1B.2
Trifolium polyodon Pacific Grove clover	PDFAB402H0	None	Rare	G1	S1	1B.1
Trifolium trichocalyx Monterey clover	PDFAB402J0	Endangered	Endangered	G1	S1	1B.1

Record Count: 81

IPaC **U.S. Fish & Wildlife Service**

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

Monterey County, California



Local office

Ventura Fish And Wildlife Office

(805) 644-1766
(805) 644-3958
FW8VenturaSection7@FWS.Gov

2493 Portola Road, Suite B
Ventura, CA 93003-7726

NOT FOR CONSULTATION

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).

NOT FOR CONSULTATION

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
California Condor Gymnogyps californianus There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/8193	Endangered
California Least Tern Sterna antillarum browni Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Hawaiian Petrel Pterodroma sandwichensis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6746	Endangered
Least Bell's Vireo Vireo bellii pusillus Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/5945	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Short-tailed Albatross Phoebastria (=Diomedea) albatrus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/433	Endangered

NOT FOR CONSULTATION

Southwestern Willow Flycatcher Empidonax traillii extimus — Endangered
Wherever found
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/6749

Western Snowy Plover Charadrius nivosus nivosus — Threatened
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/8035

Yellow-billed Cuckoo Coccyzus americanus — Threatened
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/3911

Amphibians

NAME	STATUS

California Red-legged Frog Rana draytonii — Threatened
Wherever found
There is **final** critical habitat for this species. Your location overlaps the critical habitat.
https://ecos.fws.gov/ecp/species/2891

California Tiger Salamander Ambystoma californiense — Threatened
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/2076

Foothill Yellow-legged Frog Rana boylii — Proposed Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/5133

Fishes

NAME	STATUS

Tidewater Goby Eucyclogobius newberryi — Endangered
Wherever found
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/57

NOT FOR CONSULTATION

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
Smith's Blue Butterfly Euphilotes enoptes smithi Wherever found There is **proposed** critical habitat for this species. https://ecos.fws.gov/ecp/species/4418	Endangered

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp Branchinecta lynchi Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/498	Threatened

Flowering Plants

NAME	STATUS
Clover (tidestrom''s) Lupine Lupinus tidestromii Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4459	Endangered
Coastal Dunes Milk-vetch Astragalus tener var. titi Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/7675	Endangered
Hickman's Potentilla Potentilla hickmanii Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6343	Endangered

NOT FOR CONSULTATION

Marsh Sandwort Arenaria paludicola — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2229

Monterey Clover Trifolium trichocalyx — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4282

Monterey Gilia Gilia tenuiflora ssp. arenaria — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/856

Monterey Spineflower Chorizanthe pungens var. pungens — Threatened
Wherever found
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/396

Yadon's Piperia Piperia yadonii — Endangered
Wherever found
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
https://ecos.fws.gov/ecp/species/4205

Conifers and Cycads

NAME	STATUS
Gowen Cypress Cupressus goveniana ssp. goveniana Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8548	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE

NOT FOR CONSULTATION

California Red-legged Frog Rana draytonii https://ecos.fws.gov/ecp/species/2891#crithab	Final

Bald & Golden Eagles

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

Any person or organization who plans or conducts activities that may result in impacts to bald or golden eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

Additional information can be found using the following links:

- Eagle Managment https://www.fws.gov/program/eagle-management
- 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

There are bald and/or golden eagles in your project area.

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	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus 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.	Breeds Jan 1 to Aug 31
Golden Eagle Aquila chrysaetos 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	Breeds Jan 1 to Aug 31

NOT FOR CONSULTATION

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.
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.

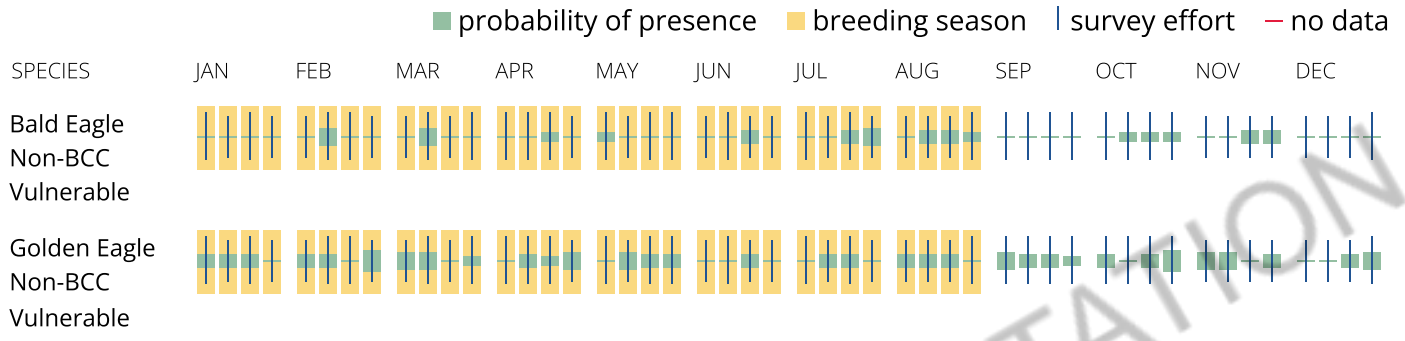
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

NOT FOR CONSULTATION

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.



What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence 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). To see a list of all birds potentially present in your project area, please visit the Rapid Avian Information Locator (RAIL) Tool.

What does IPaC use to generate the probability of presence graphs of bald and golden eagles 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 Rapid Avian Information Locator (RAIL) Tool.

What if I have eagles on my list?

NOT FOR CONSULTATION

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. Please contact your local Fish and Wildlife Service Field Office if you have questions.

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.

NOT FOR CONSULTATION

NAME	BREEDING SEASON
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Bald Eagle Haliaeetus leucocephalus 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.	Breeds Jan 1 to Aug 31
Belding's Savannah Sparrow Passerculus sandwichensis beldingi 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/8	Breeds Apr 1 to Aug 15
Black Oystercatcher Haematopus bachmani This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Scoter Melanitta nigra 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.	Breeds elsewhere
Black Skimmer Rynchops niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/5234	Breeds May 20 to Sep 15
Black Swift Cypseloides niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8878	Breeds Jun 15 to Sep 10
Black Turnstone Arenaria melanocephala This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere

NOT FOR CONSULTATION

Black-footed Albatross Phoebastria nigripes This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8033	Breeds elsewhere
Black-legged Kittiwake Rissa tridactyla 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.	Breeds elsewhere
Black-vented Shearwater Puffinus opisthomelas This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Brown Pelican Pelecanus occidentalis 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.	Breeds Jan 15 to Sep 30
Bullock's Oriole Icterus bullockii This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA	Breeds Mar 21 to Jul 25
California Gull Larus californicus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 1 to Jul 31
California Thrasher Toxostoma redivivum This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jan 1 to Jul 31
Clark's Grebe Aechmophorus clarkii This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jun 1 to Aug 31

NOT FOR CONSULTATION

Common Loon gavia immer — Breeds Apr 15 to Oct 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/4464

Common Murre Uria aalge — Breeds Apr 15 to Aug 15

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.

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

Long-tailed Duck Clangula hyemalis — Breeds elsewhere

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/7238

NOT FOR CONSULTATION

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

Pink-footed Shearwater Puffinus creatopus — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Pomarine Jaeger Stercorarius pomarinus — Breeds elsewhere

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.

Red Phalarope Phalaropus fulicarius — Breeds elsewhere

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.

Red-breasted Merganser Mergus serrator — Breeds elsewhere

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

Red-necked Phalarope Phalaropus lobatus — Breeds elsewhere

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.

Red-throated Loon Gavia stellata — Breeds elsewhere

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.

Ring-billed Gull Larus delawarensis — Breeds elsewhere

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.

Royal Tern Thalasseus maximus — Breeds Apr 15 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.

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

Surf Scoter Melanitta perspicillata — Breeds elsewhere

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.

Tricolored Blackbird Agelaius tricolor — Breeds Mar 15 to Aug 10

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3910

NOT FOR CONSULTATION

Tufted Puffin Fratercula cirrhata 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/430	Breeds elsewhere
Western Grebe aechmophorus occidentalis This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31
White-winged Scoter Melanitta fusca 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.	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

NOT FOR CONSULTATION

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.
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.

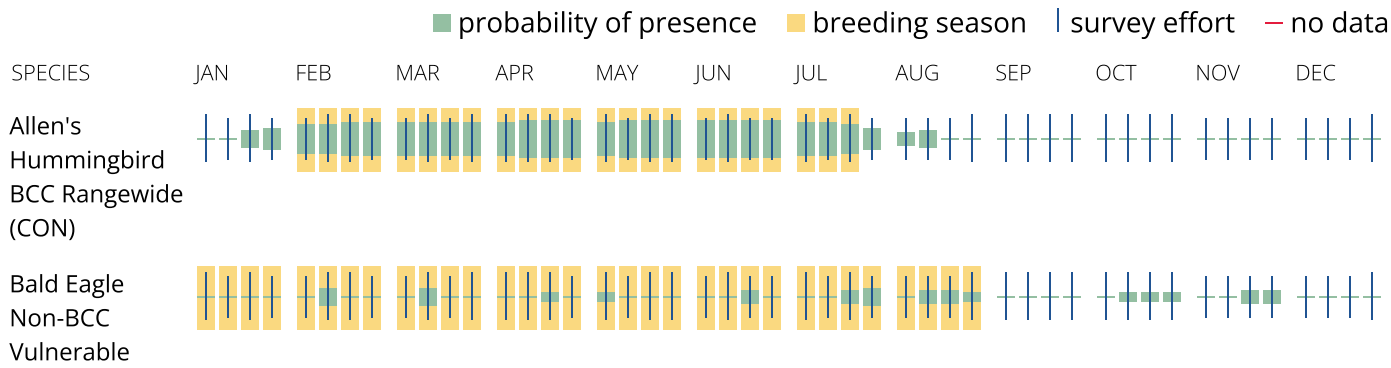
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

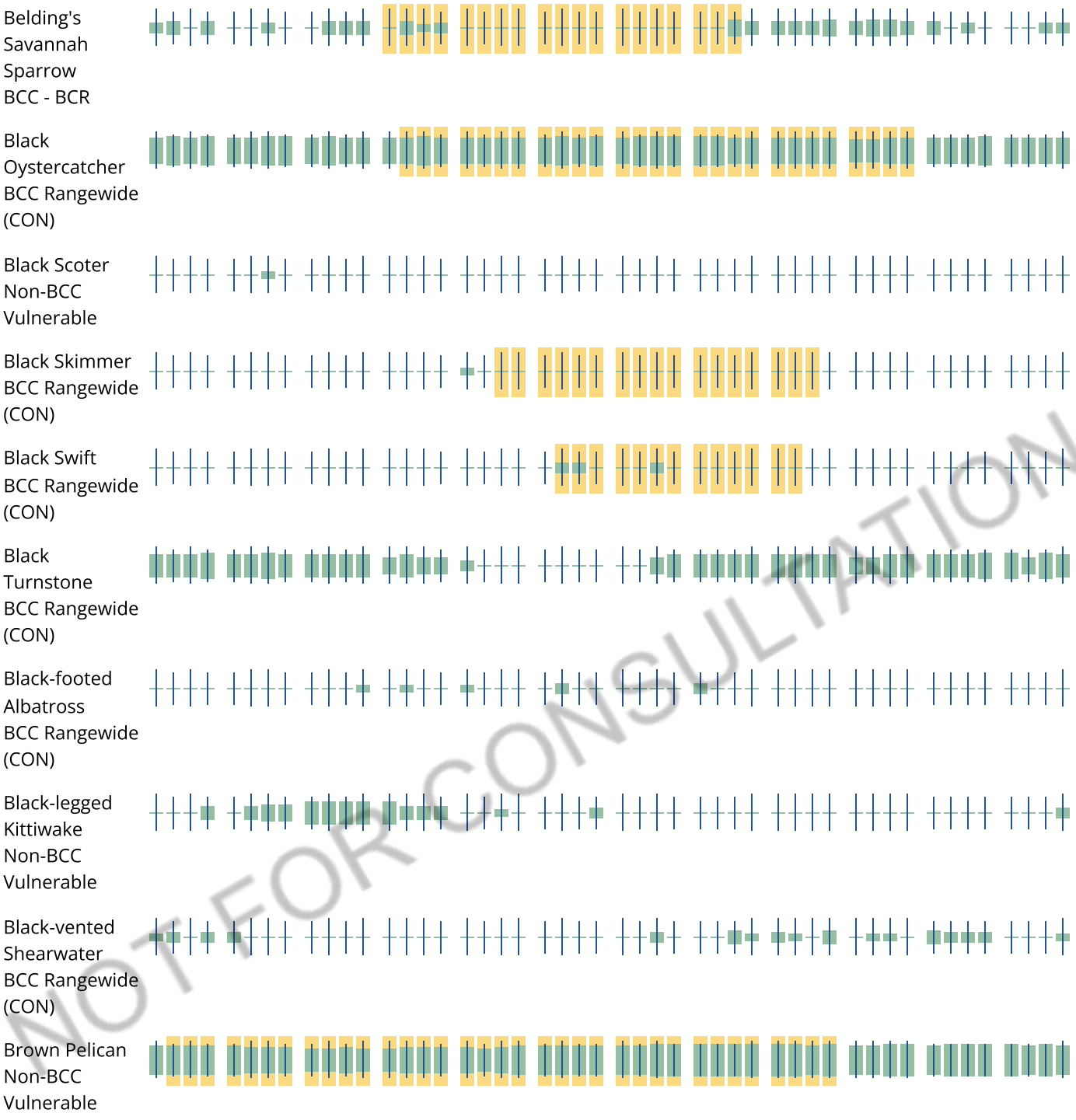
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

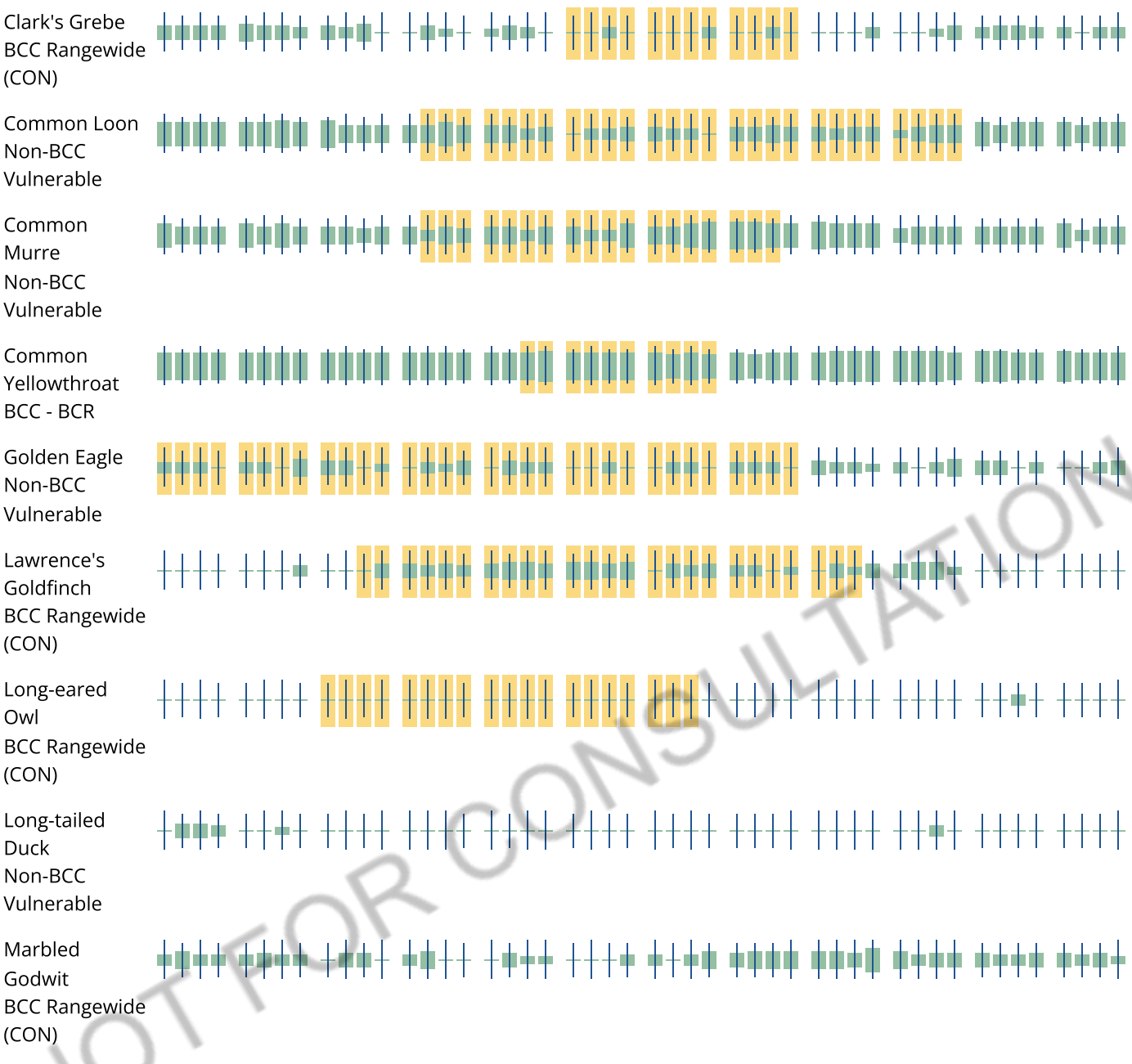
Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

NOT FOR CONSULTATION

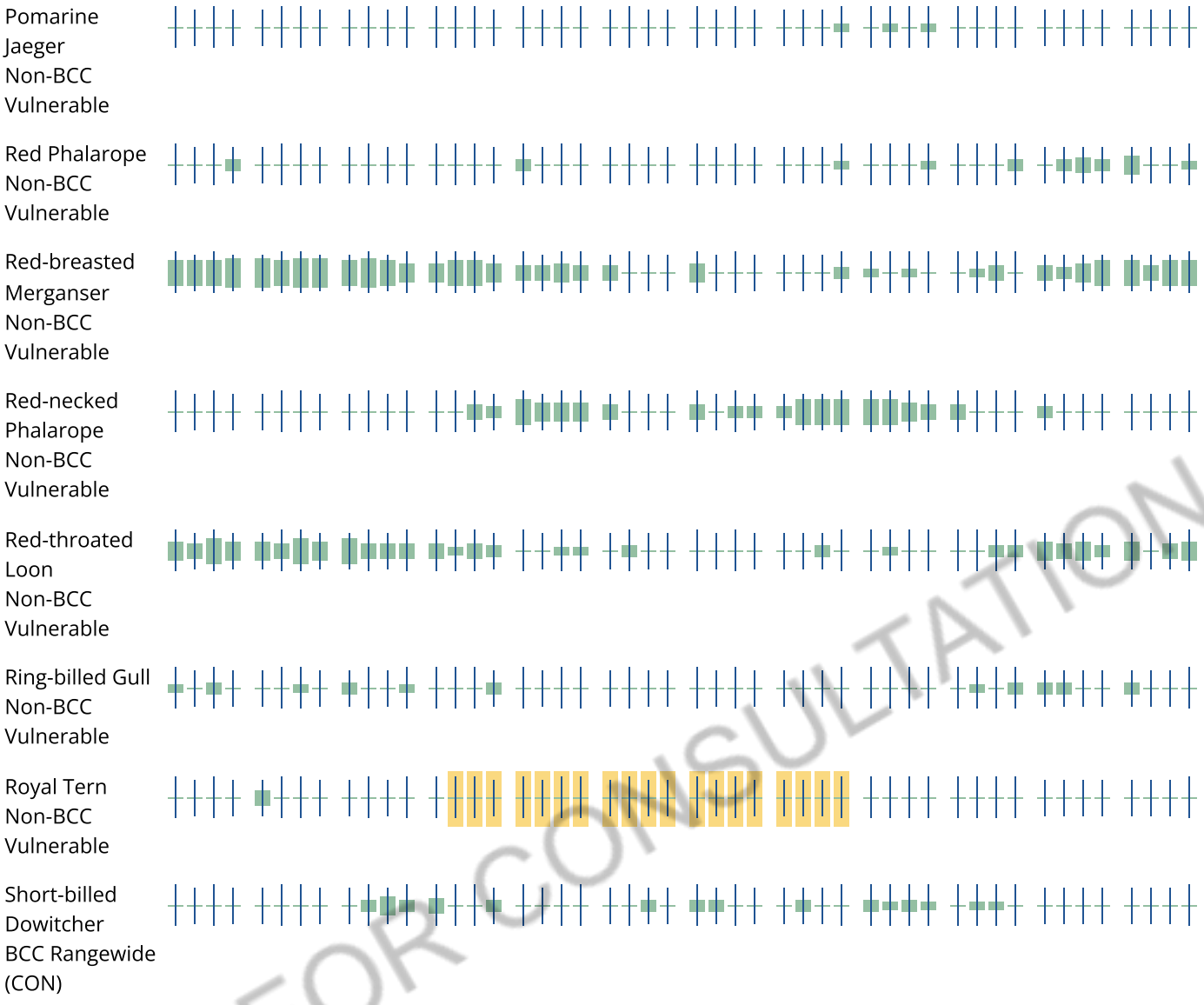




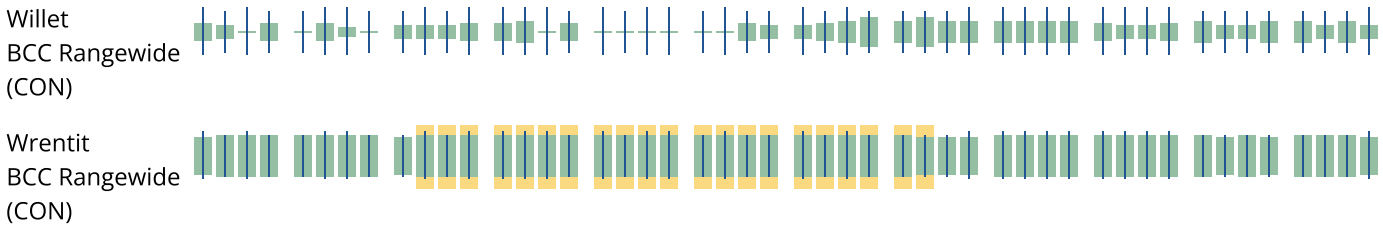
NOT FOR CONSULTATION



NOT FOR CONSULTATION



NOT FOR CONSULTATION



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 list of migratory birds that potentially occur 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 Rapid Avian Information Locator (RAIL) 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 or migrating in my area?

NOT FOR CONSULTATION

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 query your location using the RAIL Tool and look at the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. 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

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

NOT FOR CONSULTATION

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.

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 (NWI)

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.

NOT FOR CONSULTATION

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

This Page Intentionally Left Blank

Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Managemet Plan (ISMP) Project

DRAFT
BIOLOGICAL RESOURCES REPORT

February 2016



Prepared For:

County of Monterey
Resource Management Agency
168 W. Alisal Street, 2nd Floor
Salinas, CA 93901

Prepared By:

Denise Duffy & Associates, Inc.
Contact: Josh Harwayne
947 Cass Street, Suite 5
Monterey, CA 93940

Executive Summary

The Carmel Lagoon (lagoon), located at the mouth of the Carmel River, is a very productive estuary that serves as habitat for federally listed South-Central California Coast steelhead (S-CCC steelhead; *Oncorhynchus mykiss irideus*), California red-legged frog (CRLF, *Rana draytonii*), and several other special-status species.

Sandbar management activities at the lagoon have historically been conducted at the Carmel River State Beach to mitigate flooding impacts to low-lying properties when river flow increases in the fall and early winter. Lagoon water levels can rise to flood stage with the result that public and private properties are threatened with flooding before the sandbar would open naturally. Breaching dynamics directly affect lagoon stage (water surface elevation [WSE]), which in turn determines aquatic habitat volume and area, as well as water quality. As a result, mechanical breaching of the lagoon (i.e., for flood protection) has the potential to adversely affect federally listed fish and wildlife in conflict with federal law. Natural breaching is therefore preferred by environmental groups and key governmental agencies with an interest in the lagoon. Breaching at the north end of the lagoon facilitates a longer and more natural outflow channel, improving conditions for fish and wildlife within the lagoon, but has threatened to undermine Scenic Road in the past.

Project Description

The Proposed Project is a comprehensive plan meant to promote improvement in ecological function of the lagoon, including natural floodplain function and improvement of habitat for federally listed species associated with the lagoon, by allowing the lagoon to breach naturally, without increasing flood and erosion risk to private structures and public facilities. The Project Study Area consists of all areas that have the potential to be impacted by the project, including portions of the lagoon that may be affected by indirect, permanent changes in WSE. The Proposed Project involves implementing three project components: 1) Ecosystem Protective Barrier (EPB); 2) Scenic Road Protection Structure (SRPS); and 3) Interim Sandbar Management Plan (ISMP). The Proposed Project is intended to provide a long-term solution to flooding and habitat impact issues that avoids unauthorized take of listed species in compliance with federal law, while maintaining the existing level of protection to properties and infrastructure.

Summary of Results

Eleven vegetation types were observed within the Project Study Area: riparian, semi-permanent emergent marsh, seasonal emergent marsh, non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, coastal scrub, coastal dune scrub, ruderal coastal dune, and eucalyptus grove. Additionally, three unvegetated areas are present: coastal strand, aquatic, and developed. The Riparian and seasonal emergent marsh support vegetation characteristic of vegetation types identified as sensitive on the California Department of Fish and Wildlife's (Department's) *Natural Communities List* (Department, 2010). Other sensitive habitats include wetlands and waters that are potentially under the jurisdiction of the U.S. Army Corps of Engineers (USACE), Regional Water Quality Control Board (RWQCB), and California Coastal Commission (CCC); potential Environmentally Sensitive Habitat Areas (ESHA) under the jurisdiction of the CCC; and critical habitat for federally-listed species under the jurisdiction of the United States Fish and Wildlife Service (Service) and National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) .

Several special-status species are known or have the potential to occur within the Project Study Area based on observations, presence of appropriate habitat, and known occurrences within the vicinity. The following special-status species are known to or have been determined to have a moderate or high potential to occur within or immediately adjacent the Project Study Area. This report evaluates the potential for these special-status species to be affected by the construction or implementation of the three project components. Please refer to Appendix A and Chapter 6 for an analysis of each species within the specific project components. All other species presented in Appendix A are assumed "unlikely to occur," have a low potential to occur but are unlikely to be impacted for the species-specific reasons presented, or were determined not present based on the results of focused surveys. Table ES-1 identifies the special-status wildlife species that are known or have a moderate or high potential to occur within the Project Study Area.

Table ES-1. Special-Status Wildlife Species Known or with the Potential to Occur within the Project Study Area

Common Name	Scientific Name	Federal	State
Southern sea otter	*Enhydra lutris nereis*	FT[1]	CFP
Monterey dusky-footed woodrat	*Neotoma macrotis fuscipes*		CSC
Harbor seal	*Phoca vitulina*	MMPA	
California sea lion	*Zalophus californianus*	MMPA	
Tricolored blackbird	*Agelaius tricolor*	MBTA	SC
Western burrowing owl	*Athene cunicularia*	MBTA	CSC
Western snowy plover	*Charadrius nivosus nivosus*	FT/MBTA	CSC
California horned lark	*Eremophila alpestris actia*	MBTA	CNDDB
California brown pelican	*Pelecanus occidentalis californicus*	MBTA	CFP
Sharp-shinned hawk	*Accipiter striatus*	MBTA	CNDDB
Ferruginous hawk	*Buteo regalis*	MBTA	CNDDB
Northern harrier	*Circus cyaneus*	MBTA	CSC
White-tailed kite	*Elanus leucurus*	MBTA	CFP
Merlin	*Falco columbarius*	MBTA	CNDDB
American peregrine falcon	*Falco peregrinis anatum*	MBTA	CFP
Osprey	*Pandion haliaetus*	MBTA	CNDDB
California legless lizard	*Anniella pulchra*		CSC
Western pond turtle	*Emys marmorata*		CSC
California red-legged frog (CRLF)	*Rana draytonii*	FT	CSC
South-Central California Coast steelhead DPS (S-CCC steelhead)	*Oncorhynchus mykiss irideus*	FT	

[1] FE: Federally Endangered; FT: Federally Threatened; SC; California State Candidate for Listing; CFP: California Fully Protected; CSC: California Species of Special Concern; CNDDB: species on the Department's "Special Animals" list; MBTA: Protected under the Migratory Bird Treaty Act (MBTA); MMPA: Protected under the Marine Mammal Protection Act.

Common Name	Scientific Name	Federal	State
Smith's blue butterfly (SBB)	*Euphilotes enoptes smithi*	FE	
Nesting raptors and other migratory bird species		MBTA	

Several sensitive habitats are present within the Project Study Area. Table ES-2 identifies the sensitive habitats that occur within the Project Study Area.

Table ES-2. Sensitive Habitats within the Project Study Area

Sensitive Habitat	Acreage Within the Project Study Area
Riparian	69.1
Federal Wetlands	49.0
Other Waters of the U.S.	32.0
Coastal Wetlands/Waters of the State	133.3
Active Beach	7.9
SBB Habitat	0.2
CRLF Critical Habitat	186.9
S-CCC Steelhead Critical Habitat	154.9

This page was left intentionally blank

Table of Contents

Executive Summary i

Chapter 1. Introduction 1
1.1. Project Location 3

Chapter 2. Project Description 5
2.1. Project Study Area 5
2.2. Project Components 5
Ecosystem Protective Barrier (EPB) Component 5
Scenic Road Protection Structure (SRPS) Component 5
Interim Sandbar Management Plan (ISMP) 5

Chapter 3. Methods 11
3.1. Data Sources 11
Technical Documents 11
Botany 12
Wildlife 12
3.2. Personnel and Survey Dates 13
3.3. Definitions 14
Special-Status Species 14
Sensitive Habitats 15
3.4. Regulatory Setting 15
Federal Regulations 15
State Regulations 17
Local Regulations 20

Chapter 4. Environmental Setting 21
Soils and Geology 21
Hydrology 23
Coastal Processes 25

Chapter 5. Results 27
5.1. Vegetation Types 27
Riparian 29
Semi-Permanent Emergent Marsh 30
Seasonal Emergent Marsh 30
Dune Swale Wetland 31
Disturbed Herbaceous Mosaic 31
Non-Native Annual Grassland 32
Ruderal Grassland 33
Coastal Scrub 34
Coastal Dune Scrub 34
Ruderal Coastal Dune 35
Eucalyptus Grove 35
Coastal Strand 35
Aquatic 36
Developed 37
5.2. Special-Status Species 37
5.3. Sensitive Habitats 48
Riparian 50

Wetlands and Other Waters 50
Active Beach 52
SBB Habitat 52
Critical Habitat 52

Chapter 6. Impacts and Mitigation 55
6.1. Thresholds of Significance 55
6.2. Impact Analysis Overview 55
Areas of No Impact 55
Approach to Analysis 55
6.3. Construction Impacts and Mitigation Measures 57
Mitigation Measures for Construction Impacts to Special-Status Species 61
Mitigation Measures for Construction Impacts to Sensitive Habitats 70
6.4. Operational Impacts and Mitigation Measures 71

Chapter 7. References 74

Appendix A: List of Threatened and Endangered Species with the Potential to be Affected by the Proposed Project

Appendix B: Technical Reports

Appendix C: Service IPaC Report

Appendix D: CNDDB Rare Find Report

Appendix E: Plant Species Observed within Project Study Area

Appendix F: Wetland Delineation

Appendix G: Avian Species List

Appendix H: California Department of Fish and Wildlife Avoidance and Minimization Measures

List of Figures

Figure 1. Regional Map 2
Figure 2. Project Study Area 4
Figure 3. Proposed Project 6
Figure 4. EPB 30% Site Plans 7
Figure 5. SRPS 30% Site Plans 8
Figure 6. Soils within Project Study Area 22
Figure 7. Site Geologic Map 24
Figure 8. Habitat Map 28
Figure 9. CRLF Occurrences within Project Study Area 46
Figure 10. Steelhead Occurrence within Project Study Area 47
Figure 11. SBB Habitat within Project Study Area 49
Figure 12. Sensitive Habitats 51

List of Abbreviated Terms

Bio Memo	Memorandum To Whitson Engineers for Feasibility Report: *Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues*, prepared by H.T. Harvey & Associates, May 2013
BMPs	Best Management Practices
Caltrans	California Department of Transportation
Carmel USD	Carmel Unified School District
CAWD	Carmel Area Wastewater District
CCA	California Coastal Act
CCC	California Coastal Commission
CDFA	California Department of Food and Agriculture
CDP	Coastal Development Permit
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFP	California Fully Protected
CNDDB	California Natural Diversity Data Base
CNPPA	California Native Plant Protection Act
CNPS	California Native Plant Society
Coastal Analysis	*Carmel River Lagoon Biological Assessment Coastal Engineering Analysis*, prepared by Moffatt & Nichol, August 2013
County	County of Monterey
CRLEP	Carmel River Lagoon Enhancement Project
CRLF	California red-legged frog
CRMB	Carmel River Mitigation Bank
CRPR	California Rare Plant Rank
CSC	California Species of Concern
CSUMB	California State University Monterey Bay
CWA	Clean Water Act
DD&A	Denise Duffy & Associates, Inc.
Department	California Department of Fish and Wildlife
DWA Associates	D.W. ALLEY & Associates
EPA	Environmental Protection Agency
EPB	Ecosystem Protective Barrier
ESA	Federal Endangered Species Act
ESHA	Environmentally Sensitive Habitat Area
FE	Federally Endangered

FT	Federally Threatened
Feasibility Report	*Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report* prepared by Whitson Engineers, May 2013
Fisheries Report	*Fisheries Analysis for the Carmel River Lagoon Biological Assessment Report* prepared by D.W. ALLEY & Associates, March 2014
FMP	Forest Management Plan
FR	Federal Register
Geotechnical Report	*Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California*, prepared by Pacific Geotechnical Engineering, May 2013
HCP	Habitat Conservation Plan
HTH	H.T. Harvey & Associates
Hydrology Report	*The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report* prepared by Balance Hydrologics, Inc, January 2014
IS/MND	Initial Study/Mitigated Negative Declaration
ISMP	Interim Sandbar Management Plan
km	kilometer(s)
lagoon	Carmel Lagoon
LCP	Local Coastal Plan
MBTA	Migratory Bird Treaty Act of 1918
MCWRA	Monterey County Water Resources Agency
Mission Ranch	Homestead Inn/Mission Ranch
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MPWMD	Monterey Peninsula Water Management District
NAVD88	North American Vertical Datum of 1988
NCCP	Natural Community Conservation Plan
NMFS	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
OHW	Ordinary High Water
PCE(s)	Primary Constituent Element(s)
Porter-Cologne	Porter-Cologne Water Quality Control Act of 1969
Proposed Project	Collectively, the EPB, SRPS, and ISMP project components
RWD	Reports of Waste Discharge

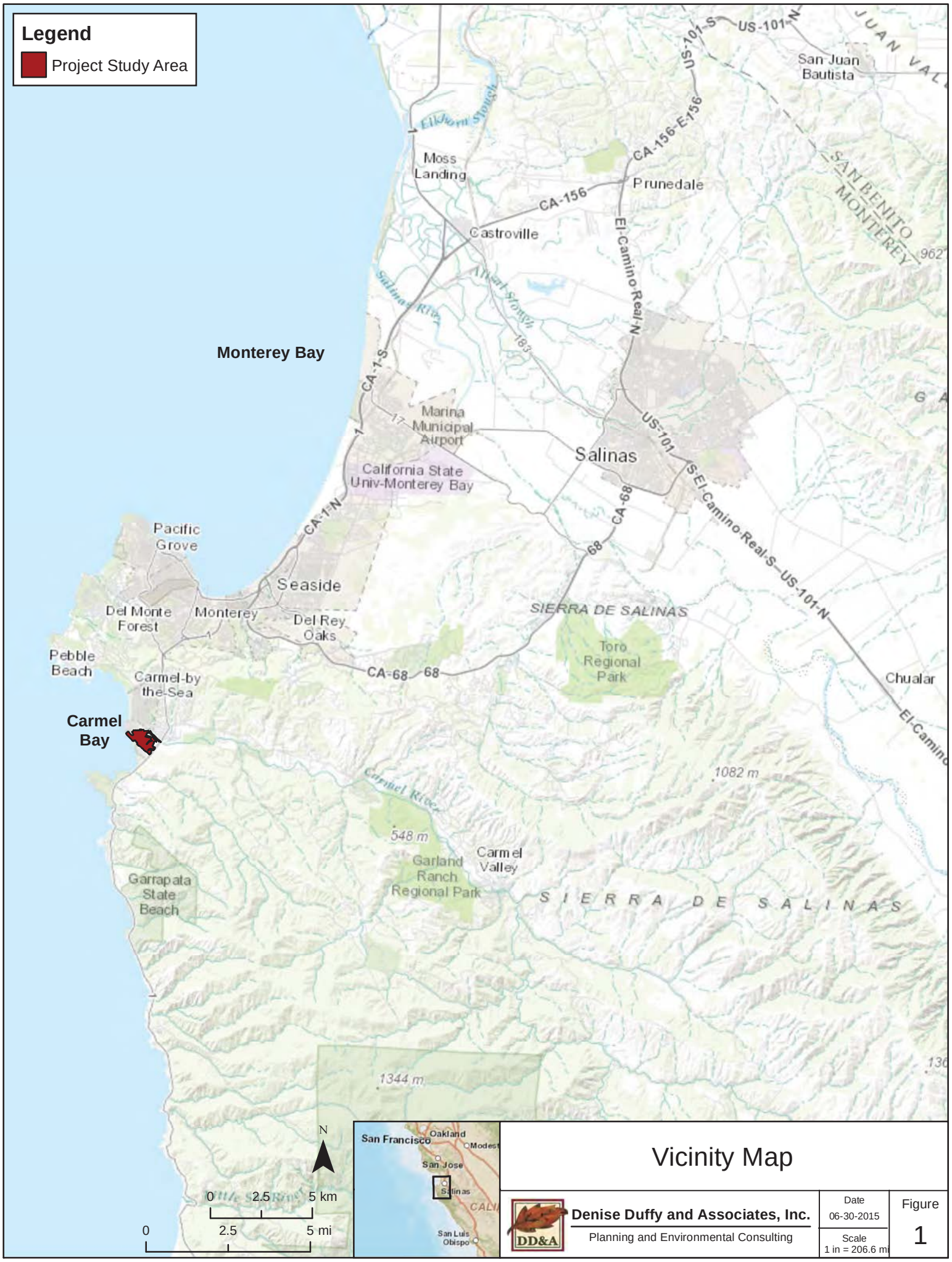
RWQCB	Regional Water Quality Control Board
SBB	Smith's blue butterfly
S-CCC Steelhead	South-Central California Coast steelhead
Service	U.S. Fish and Wildlife Service
SR	State Route
SRPS	Scenic Road Protection Structure
State Board	State Water Resources Control Board
State Parks	California Department of Parks and Recreation
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geologic Survey
Waters of the U.S.	Waters of the United States
WDR	Waste Discharge Requirements
WSE	Water surface elevation

Chapter 1. Introduction

DENISE DUFFY & ASSOCIATES, Inc. (DD&A) was contracted by the County of Monterey (County) to prepare a Biological Resources Report for the Carmel Lagoon Ecosystem Protective Barrier, Scenic Road Protection Structure, and Interim Sandbar Management Plan Project (Proposed Project) located in the unincorporated Carmel area of Monterey County, California (Figure 1). The emphasis of this study is to describe existing biological resources within and surrounding the Project Study Area, identify any special-status species and sensitive habitats within the Project Study Area, assess potential impacts that may occur to biological resources, and recommend appropriate avoidance, minimization, and mitigation measures necessary to reduce those impacts in accordance with the California Environmental Quality Act (CEQA).

Sandbar management activities at the lagoon have historically been conducted at the Carmel River State Beach to mitigate flooding impacts to low-lying properties, including the Carmel Area Wastewater District (CAWD) facility, California Department of Parks and Recreation (State Parks) infrastructure, and residential structures along the northern edges of the lagoon. Breaching dynamics directly affect lagoon stage (water surface elevation [WSE]), which in turn determines aquatic habitat volume and area, as well as water quality. As a result, mechanical breaching of the lagoon (i.e., for flood protection) has the potential to adversely affect fish and wildlife, including the federally listed South-Central California Coast steelhead (S-CCC steelhead; *Oncorhynchus mykiss irideus*) and California red-legged frog (CRLF; *Rana draytonii*), and puts the County in conflict with federal law. Natural breaching is therefore preferred by environmental groups and key governmental agencies with an interest in the lagoon. There has also been a preference noted by the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) and other stakeholders for a breach at the north end of the lagoon to facilitate a longer and more natural outflow channel, improving conditions for fish and wildlife within the lagoon. In the past, breaches at that north end, along with wave action and other erosive factors, have affected Scenic Road by causing erosion of the toe of its road bed. The road contains sewer and power infrastructure which could be damaged if the erosion is not controlled.

The Proposed Project is a comprehensive plan meant to promote improvement in ecological function of the lagoon, including natural floodplain function and improvement of habitat for special-status species within the lagoon, by allowing the lagoon to breach naturally without increasing flood risk to private structures and public facilities. The Proposed Project involves implementing three project components: 1) Ecosystem Protective Barrier (EPB); 2) Scenic Road Protection Structure (SRPS); and 3) Interim Sandbar Management Plan (ISMP). The EPB would maintain existing flood protection to low-lying homes and other local Carmel-by-the-Sea infrastructure along the north edge of the lagoon, while the frequency of mechanical management of the sandbar is reduced in compliance with regulatory requirements. The SRPS would provide protection from erosion along the northern sand cliffs and the undermining of Scenic Road resulting from northerly river flows or large ocean swells. The ISMP is intended to provide a short-term solution to potential flooding issues with select sandbar breaching actions that allow additional natural function in the lagoon while still protecting properties and infrastructure, with the understanding that the development of the EPB and SRPS will reduce mechanical management of the sandbar and lead to potential long-term solutions that return the lagoon, its sandbar, and associated riverine and ocean dynamics to more natural cycles.



Vicinity Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 06-30-2015
Scale: 1 in = 206.6 mi
Figure: 1

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\Vicinity Map.mxd

1.1. Project Location

The Proposed Project would be located within the lagoon between State Route (SR) 1 and the Pacific Ocean in the unincorporated Carmel area of Monterey County, California (Figures 1 and 2). The Carmel River drains approximately 246 square miles of the Santa Lucia and Sierra de Salinas Mountains into the Carmel Bay. About 270 acres of the Carmel River Beach and Lagoon are owned by the State of California/State Parks. Other property owners within the lagoon include CAWD (16 acres), Carmel Unified School District (Carmel USD; 9 acres), City of Carmel-by-the-Sea (6 acres), and Homestead Inn/Mission Ranch (Mission Ranch; 16 acres).

The Project Study Area includes all areas directly impacted by construction activities and operation of the project. Limits of construction were provided by the Project Engineer. The operational impact area was defined by the highest water surface elevation (WSE) that the lagoon could rise to before overtopping the EPB structure (17.5 feet).



Project Study Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 06-30-2015
Scale 1 in=0.1 mi
Figure 2

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\Project Study Area Map.mxd

Chapter 2. Project Description

2.1. Project Study Area

The Project Study Area consists of all areas that have the potential to be impacted by the project, including portions of the lagoon that may be affected by indirect, permanent changes in WSE.

2.2. Project Components

The Proposed Project involves implementing three project components, the EPB, SRPS, and ISMP (Figure 3). Project components consist of areas within the Project Study Area that will be directly affected by the construction and operation of the various project components. Each of the project components is discussed below.

ECOSYSTEM PROTECTIVE BARRIER (EPB) COMPONENT

The proposed EPB alignment ranges from 38 to 120 feet from the property lines to the north of State Parks property with a top of wall elevation of 17.5 feet based on the North American Vertical Datum of 1988 (NAVD88) (Figure 4). This option was recommended in the Feasibility Report as a component of the Preferred Alternative because it:

- maintains current level of protection of facilities and homes accounting for sea level rise over the next 50 years;
- minimizes ecological impacts by eliminating drainage infrastructure and fill;
- minimizes visual impacts with a lower height and greater area of vegetative cover;
- reduces noise because of smaller pumps with less frequent pumping; and
- increases area that serves as a bioswale to collect urban runoff.

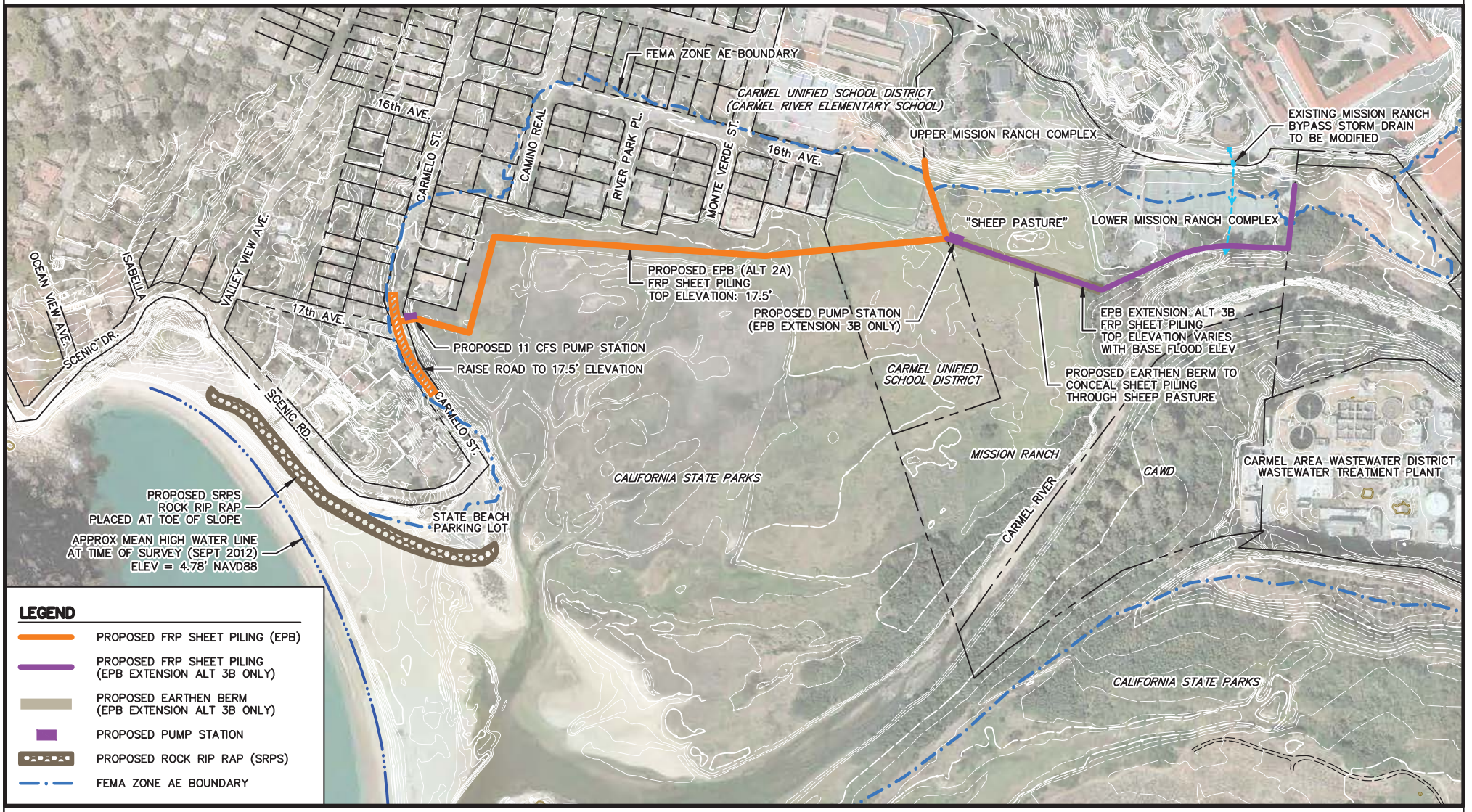
SCENIC ROAD PROTECTION STRUCTURE (SRPS) COMPONENT

The Feasibility Report evaluated four different alignments and designs ranging from rip rap at the toe of slope to a pile wall located at the top of slope (edge of right-of-way). SRPS Alternative 1 – Revetment (Rip Rap) Located at Toe of Slope was determined to be the Preferred Alternative (Figure 5). The proposed SRPS project component consists of rock slope protection, also known as rock rip-rap or revetment, placed at the toe of the road embankment. The placement of armor rock would be determined through analyses to extend above existing grade as needed to protect Scenic Road from river scour and would extend below the anticipated outlet channel scour elevation. The outer rock layer would be sized to withstand extreme ocean wave and river current forces (e.g., 1 to 2-ton sized rock) with a layer of smaller rock and/or geotextile fabric underneath to prevent underlying soils from being eroding through the revetment.

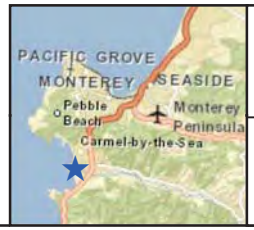
The Feasibility Report determined that rip rap provides the most natural material and the structure would be covered with sand when the beach is not breached. The alignment allows continued use of the beach area located north of the barrier when (and if) the beach breaches to the north.

INTERIM SANDBAR MANAGEMENT PLAN (ISMP)

The County is seeking permits for a long-term solution that would avoid performing mechanical breaching for flood control purposes. The process to complete design, environmental review, permitting, and construction is estimated to take up to eight years, depending on resource availability;



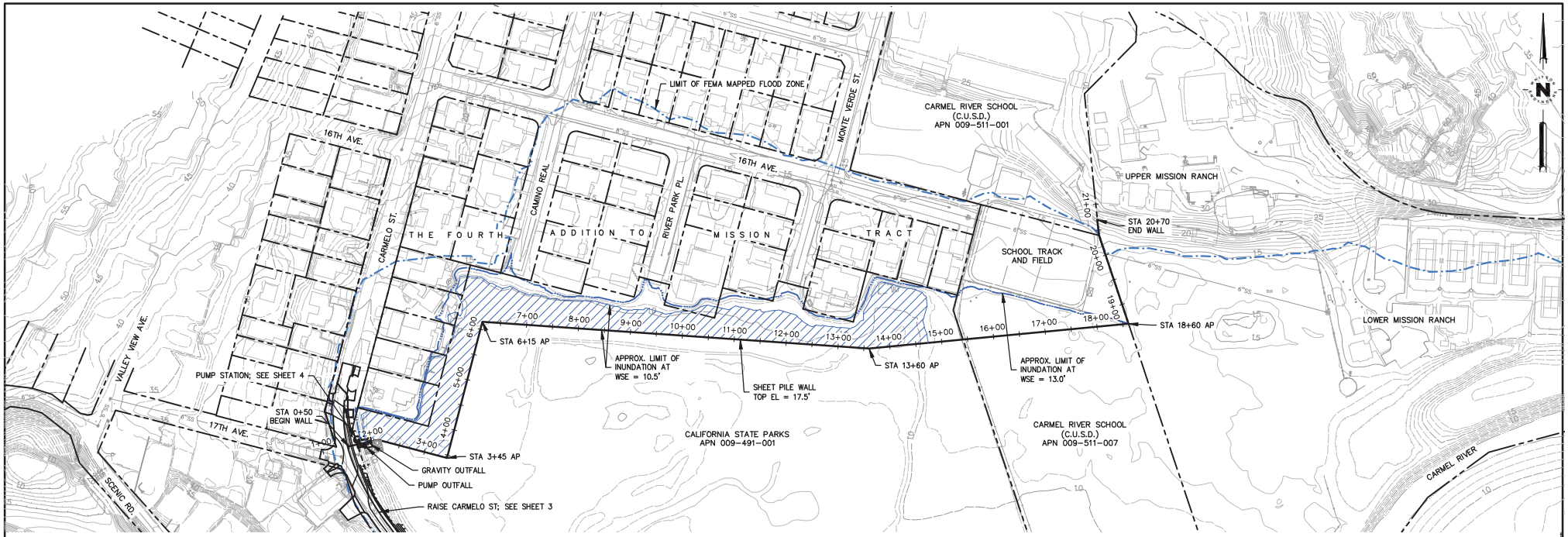
Source: Whitson Engineers, Inc., August 7, 2013



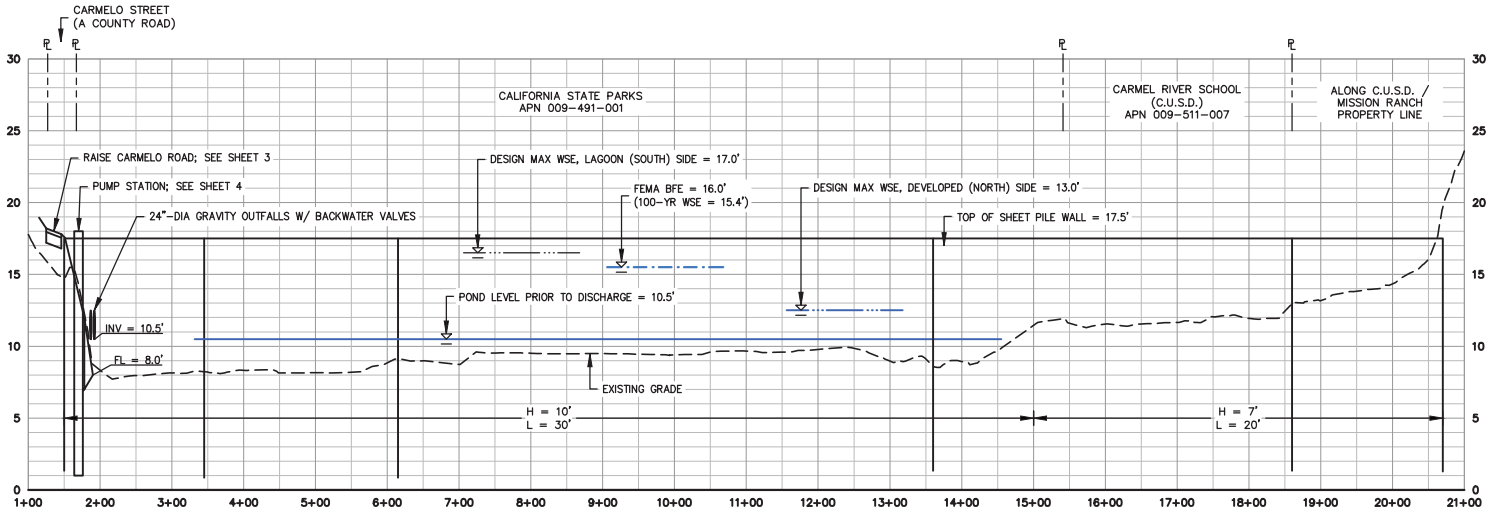
Proposed Project

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

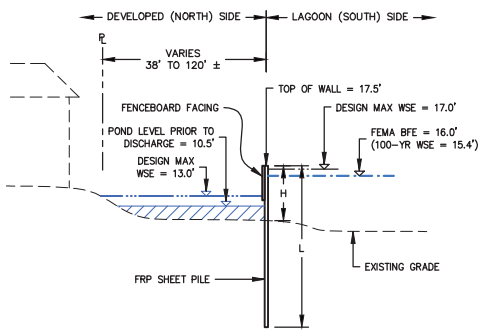
Date 03-27-2014
Scale 1 in=1.3 mi
Figure 3



SHEET PILE WALL PLAN



SHEET PILE WALL PROFILE



SHEET PILE WALL TYPICAL SECTION

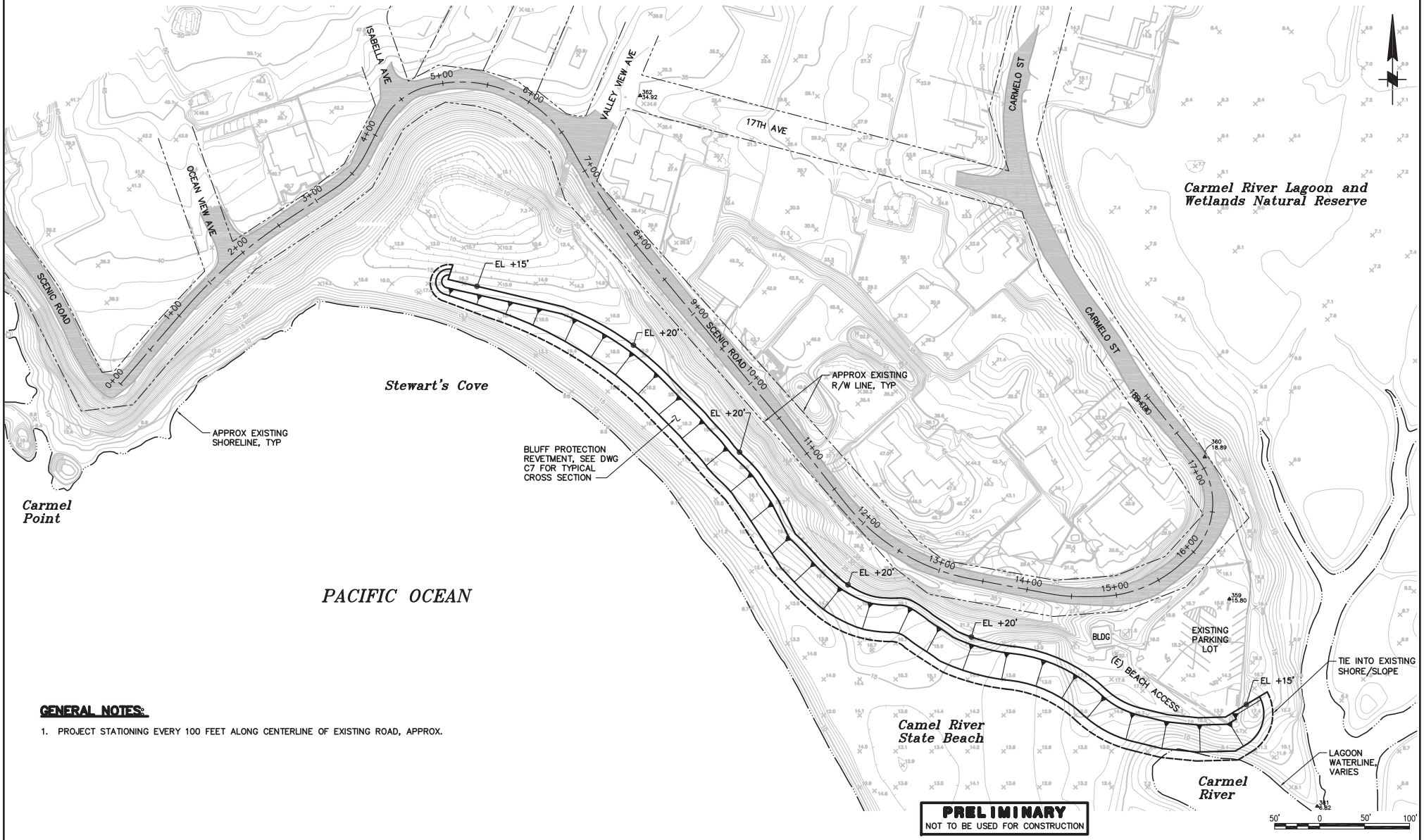
Source: Whitson Engineers July 2, 2015



EPB 30% Site Plans

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 07-26-2015
Scale 1 in=1.3 mi
Figure 4



GENERAL NOTES:

1. PROJECT STATIONING EVERY 100 FEET ALONG CENTERLINE OF EXISTING ROAD, APPROX.



SRPS 30% Site Plans

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 06-26-2015

Scale 1 in=1.3 mi

Figure 5

Source: Moffatt & Nichol, July 30, 2014

however, the County is making every effort to reduce this timeframe to five years or less. In the interim, the County has developed the ISMP for managing the lagoon, including winter openings and summer closure in the best possible manner that reduces potential impacts to both wildlife and property.

The ISMP includes the following components:

- Sand bags: As a first course of action ahead of the rain season (generally beginning October 15) and before mechanically managing the sandbar, the County will stockpile sand and place sand bags along the property boundary of State Parks and homes along the north end of the Carmel Lagoon (Camino Real, River Park Place, Monte Verde Street, and 16th Avenue).
- Public Outreach: The County will initiate public outreach to warn homeowners so they take appropriate precautions to protect their property during the rain season (generally October 15 – April 15).
- Sandbar management: The County, after receiving appropriate approvals from permitting agencies, will manage the sandbar for flood protection (e.g., mechanical breaching).
- Re-establishment/Summer Management: The County would assure any outlet channel work performed during the winter is closed off and the sandbar is restored at the conclusion of the rain season.

This page was left intentionally blank

Chapter 3. Methods

The following section discusses sources used to develop information on the Project Study Area. Study methods and sources used consisted of a review of technical reports prepared for the Proposed Project, occurrence records for special-status species with the potential to be affected by the Proposed Project, and existing documentation relevant to the Proposed Project, as well as field reconnaissance and evaluation of impacts to identified resources. Additionally, a regulatory discussion is presented within the section that describes the major laws that may be applicable to the Proposed Project.

3.1. Data Sources

TECHNICAL DOCUMENTS

The following is a list of technical documents that have been prepared as part of the planning for the Proposed Project.

- *Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report* prepared by Whitson Engineers, May 2013 (Feasibility Report)
- *Memorandum Of Understanding Between County Of Monterey, U.S. Army Corps Of Engineers, And National Marine Fisheries Service, Regarding Flood Prevention And Habitat Protection At The Carmel Lagoon*, June 2013 (MOU), including Exhibit A: *Interim Plan And Criteria For Flood Control And Summer Management Of The Carmel River Lagoon* (ISMP)
- Memorandum To Whitson Engineers for Feasibility Report: *Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues*, prepared by H.T. Harvey & Associates (HTH), May 2013 (Bio Memo)
- *Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California*, Pacific Geotechnical Engineering, May 2013 (Geotechnical Report)

The following is a list of technical reports prepared in support of the Bio Report and included in Appendix B.

- *Carmel River Lagoon Biological Assessment Coastal Engineering Analysis*, prepared by Moffatt & Nichol, August 2013 (Coastal Analysis)
- *The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report* prepared by Balance Hydrologics, Inc, January 2014 (Hydrology Report)
- *Fisheries Analysis for the Carmel River Lagoon Biological Assessment Report* prepared by D.W. ALLEY & Associates (DWA Associates), March 2014 (Fisheries Report)

The documents listed above are utilized throughout the Bio Report to the greatest extent applicable. Much of the language and technical information provided comes directly from these documents.

Additional literature and data sources include: current agency status information from the U.S. Fish and Wildlife Service (Service) and California Department of Fish and Wildlife[2] (Department) for species listed, proposed for listing, or candidates for listing as threatened or endangered under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA), or are Department "species of special concern" (Appendix C, Service, 2016; Appendix D, Department, 2016a); California Natural Diversity Data Base (CNDDB) occurrence reports (Appendix D, Department, 2016b); several documents prepared by the California State University Monterey Bay (CSUMB) Watershed Institute for the Carmel Lagoon; the Draft and Final Initial Study/Mitigated Negative Declaration (IS/MND) and Monitoring Reports prepared by State Parks for the Carmel River Lagoon Enhancement Project (CRLEP) (State Parks, 2002a, 2002b, 2007, 2008a, and 2009); and the Draft and Final IS/MND prepared by State Parks for the Carmel River State Beach Lagoon Water Level Management Project (State Parks, 2008b and 2008c). The CNDDB RareFind occurrence reports were reviewed from the Monterey quadrangle and the surrounding quadrangles (Marina, Mt. Carmel, Seaside, and Soberanes Point) (Appendix D, Department, 2016b).

BOTANY

The following materials were reviewed in order to determine if special-status plant species have the potential to occur within the Project Study Area: HTH's Bio Memo, two IS/MNDs prepared by State Parks (State Parks 2002a and 2008b), the CNPS *Inventory of Rare and Endangered Vascular Plants of California* (CNPS, 2015), and CNDDB occurrences (Department, 2016b). Additionally, to classify habitats within the Project Study Area, descriptions in Casagrande's *Wetland Habitat Types of the Carmel River Lagoon* (2006) and HTH's Bio Memo were reviewed. The final classification and characterization of the vegetation within the Project Study Area is based on field observations. Vegetation types identified in *A Manual of California Vegetation* (Sawyer et al., 2009) were utilized to determine if vegetation types identified as sensitive on the Department's *Natural Communities List* (Department, 2010) are present within the Project Study Area. Scientific nomenclature for plant species identified within this document follows *The Jepson Manual: Vascular Plants of California, Edition 2* (Baldwin et al., 2012).

The Project Study Area was surveyed for botanical resources following the applicable guidelines outlined in: *Guidelines for Conducting and Reporting Botanical Inventories for Federally listed, Proposed and Candidate Plants* (Service, 2000), *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (Department, 2009), *CNPS Botanical Survey Guidelines* (CNPS, 2001), and recommendations for conducting botanical surveys during drought years (Deborah Hillyard, Senior Environmental Scientist, Department, personal communication, email: March, 11, 2014).

WILDLIFE

A focused review of literature and data sources was conducted in order to determine which special-status wildlife species have the potential to occur within the Project Study Area. Additionally, occurrence information and potential project effects for listed wildlife species included in the Bio Memo were utilized to a great extent. The potential for hydroacoustic impacts to S-CCC steelhead from the proposed project was evaluated using the California Department of Transportation (Caltrans) *Technical Guidance for Assessment and Mitigation of Hydroacoustic Effects of Pile Driving on Fish*

[2] California Department of Fish and Game (DFG) changed its name to California Department of Fish and Wildlife (Department), effective January 1, 2013. Please note that although the name has changed, "game" from "California Fish and Game Code" was not changed.

(Caltrans, 2015). Although Caltrans has no jurisdiction associated with the proposed project, this detailed guidance was determined to be the most appropriate to evaluate hydroacoustic impacts as the information was developed by the Fisheries Hydroacoustic Working Group (FHWG). The FHWG is composed of representatives from Caltrans, the departments of transportation in Oregon and Washington, the Northwest and Southwest offices of the NMFS, USFWS, CDFW, and USACE, and is supported by a panel of hydroacoustic and fisheries experts. The goal of the FHWG is to reach agreement on: 1) the nature and extent of knowledge about the current scientific basis for underwater noise effects on fish; 2) interim guidelines for project assessment, mitigation, and monitoring for effects of pile-driving noise on fish species; and; 3) future scientific research needed to satisfactorily resolve uncertainties regarding hydroacoustic impacts on fish species. Information regarding S-CCC steelhead occurrences, project effects, etc. is taken directly from the Fisheries Report. In addition, the following literature and data sources were reviewed: *Habitat Characteristics of California Red-Legged Frogs (Rana aurora draytonii) Ecological Differences Between Eggs, Tadpoles, and Adults in a Coastal Brackish and Freshwater System* (Reis, 1999); Monterey Birds (Roberson, 2002); Department reports on special-status wildlife (Remsen, 1978; Williams, 1986; Jennings and Hayes, 1994; Thelander, 1994); California Wildlife Habitat Relationships Program species-habitat models (Department, 2008; Zeiner et al., 1988 and 1990); and general wildlife references (Stebbins, 1985).

3.2. Personnel and Survey Dates

HTH's plant, wildlife, and fish ecologists conducted reconnaissance-level surveys within the construction areas of the EPB and SRPS on January 17, 2013 to assess existing vegetation types, identify sensitive habitats, and assess the potential for the site to support special-status plant and animal species. The results of this survey are provided in the Bio Memo.

DD&A staff biologists, Matt Johnson and Jami Davis, conducted additional field surveys in June 2014 to confirm, update, and complete the vegetation mapping and descriptions based on current conditions within the entire Project Study Area. Survey methods included walking the Project Study Area and using aerial maps to identify general vegetation types and potential sensitive habitats, and conducting a focused survey of appropriate habitat for special-status plant species. General vegetation types were mapped using a combination of GPS and hand drawing on aerial maps, which were later digitized using ArcGIS software. Concurrently, a reconnaissance-level wildlife habitat survey was conducted to identify suitable habitat and observe any special-status wildlife species.

A wetland delineation to identify wetlands and waters potentially under the jurisdiction of the U.S. Army Corps of Engineers (USACE) and California Coastal Commission (CCC) was conducted by DD&A staff biologists, Matt Johnson and Jami Davis, within the Project Study Area in June 2014; a report was prepared by DD&A under separate cover (Appendix F; DD&A, 2015).

Focused surveys for special-status plant species were conducted by DD&A staff biologists, Jami Davis and Shaelyn Hession, in March, April, and May 2015. Prior to conducting focused botanical surveys, an analysis of special-status plant species known to occur within the vicinity was conducted to determine the potential for their presence within the Project Study Area based on presence of suitable habitats, soils, elevation range, and currently known geographic range. An effort was made to identify local reference populations for species determined to have the potential to occur within the Project Study Area, in order to determine the appropriate survey timing (i.e. peak bloom) for these species. A list of all plant species observed during focused surveys is provided in Appendix E. No focused surveys for sensitive wildlife species were conducted as a part of this survey effort.

3.3. Definitions

SPECIAL-STATUS SPECIES

Special-status species are those plants and animals that have been formally listed or proposed for listing as endangered or threatened, or are candidates for such listing under ESA or CESA. Listed species are afforded legal protection under the ESA and CESA. Species that meet the definition of rare or endangered under the CEQA Section 15380 are also considered special-status species. Animals on the Department's list of "species of special concern" (most of which are species whose breeding populations in California may face extirpation if current population trends continue) meet this definition and are typically provided management consideration through the CEQA process, although they are not legally protected under the ESA or CESA. Additionally, the Department also includes some animal species that are not assigned any of the other status designations in the CNDDB "Special Animals" list. The Department considers the taxa on this list to be those of greatest conservation need, regardless of their legal or protection status.

Plants listed as rare under the California Native Plant Protection Act (CNPPA) or included in California Native Plant Society (CNPS) California Rare Plant Ranks (CRPR; formerly known as CNPS Lists) 1A, 1B, 2A, and 2B are also treated as special-status species as they meet the definitions of Sections 2062 and 2067 of the CESA and in accordance with CEQA Guidelines Section 15380.[3] In general, the Department requires that plant species on CRPR 1A (Plants presumed extirpated in California and Either Rare or Extinct Elsewhere), CRPR 1B (Plants rare, threatened, or endangered in California and elsewhere), CRPR 2A (Plants presumed extirpated in California, but more common elsewhere); and CRPR 2B (Plants rare, threatened, or endangered in California, but more common elsewhere) of the CNPS *Inventory of Rare and Endangered Vascular Plants of California* (CNPS, 2015) be fully considered during the preparation of environmental documents relating to CEQA.[4] In addition, species of vascular plants, bryophytes, and lichens listed as having special-status by the Department are considered special-status plant species (Department, 2016b).

Raptors (e.g., eagles, hawks, and owls) and their nests are protected under both federal and state laws and regulations. The federal Migratory Bird Treaty Act (MBTA) of 1918 and California Fish and Game Code Section 3513 prohibit killing, possessing, or trading migratory birds except in accordance with regulation prescribed by the Secretary of the Interior. Birds of prey are protected in California under Fish and Game Code Section 3503.5. Section 3503.5 states that it is "unlawful to take, possess, or destroy the nest or eggs of any such bird except otherwise provided by this code or any regulation adopted pursuant thereto." In addition, fully protected species under the Fish and Game Code Section 3511 (birds), Section 4700 (mammals), Section 5515 (fish), and Section 5050 (reptiles and amphibians) are also considered special-status animal species. Species with no formal special-status designation but thought by experts to be rare or in serious decline are also considered special-status animal species (Department, 2016b).

[3] CNPS initially created five CRPR in an effort to categorize degrees of concern; however, in order to better define and categorize rarity in California's flora, the CNPS Rare Plant Program and Rare Plant Program Committee have developed the new CRPR 2A and CRPR 2B.

[4] Species on CRPR 3 (Plants about which we need more information - a review list) and CRPR 4 (Plants of limited distribution - a watch list) may, but generally do not, meet the definitions of Sections 2062 and 2067 of CESA, and are not typically considered in environmental documents relating to CEQA.

SENSITIVE HABITATS

Sensitive habitats include riparian corridors, wetlands, habitats for legally protected species, areas of high biological diversity, areas supporting rare or special-status wildlife habitat, and unusual or regionally restricted vegetation types. Vegetation types considered sensitive include those listed on the Department's *Natural Communities List* (i.e., those habitats that are rare or endangered within the borders of California) (Department, 2010), those that are occupied by species listed under ESA or are critical habitat in accordance with ESA, and those that are defined as Environmentally Sensitive Habitat Areas (ESHA) under the California Coastal Act (CCA). Specific habitats may also be identified as sensitive in city or county general plans or ordinances. Sensitive habitats are regulated under federal regulations (such as the Clean Water Act [CWA] and Executive Order 11990 – Protection of Wetlands), state regulations (such as CEQA and the Department Streambed Alteration Program), or local ordinances or policies (such as city or county tree ordinances and general plan policies).

3.4. Regulatory Setting

FEDERAL REGULATIONS

Federal Endangered Species Act

Provisions of the ESA of 1973 (16 USC 1532 et seq., as amended) protect federally listed threatened or endangered species and their habitats from unlawful take. Listed species include those for which proposed and final rules have been published in the Federal Register. The ESA is administered by the Service or NMFS. In general, the NMFS is responsible for the protection of ESA-listed marine species and anadromous fish, whereas other listed species are under Service jurisdiction.

Section 9 of ESA prohibits the take of any fish or wildlife species listed under ESA as endangered or threatened. Take, as defined by ESA, is "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." Harm is defined as "any act that kills or injures the fish or wildlife…including significant habitat modification or degradation that significantly impairs essential behavioral patterns of fish or wildlife." In addition, Section 9 prohibits removing, digging up, and maliciously damaging or destroying federally listed plants on sites under federal jurisdiction. Section 9 does not prohibit take of federally listed plants on sites not under federal jurisdiction. If there is the potential for incidental take of a federally listed fish or wildlife species, take of listed species can be authorized through either the Section 7 consultation process for federal actions or a Section 10 incidental take permit process for non-federal actions. Federal agency actions include activities that are on federal land, conducted by a federal agency, funded by a federal agency, or authorized by a federal agency (including issuance of federal permits).

Critical Habitat

Critical habitat is a term defined and used in the ESA. It is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. An area is designated as "critical habitat" after the Service publishes a proposed federal regulation in the Federal Register and then public comments are received and considered on the proposal. The final boundaries of the critical habitat area are also published in the Federal Register. Federal agencies are required to consult with the Service on actions they carry out, fund, or authorize to ensure that their actions will not destroy or

adversely modify critical habitat. In this way, a critical habitat designation protects areas that are necessary for the conservation of the species.

Recovery Plans

The ultimate goal of the ESA is the recovery (and subsequent conservation) of endangered and threatened species and the ecosystems on which they depend. A variety of methods and procedures are used to recover listed species, such as protective measures to prevent extinction or further decline, consultation to avoid adverse impacts of federal activities, habitat acquisition and restoration, and other on-the-ground activities for managing and monitoring endangered and threatened species. The collaborative efforts of the Service and its many partners (federal, state, and local agencies, tribal governments, conservation organizations, the business community, landowners, and other concerned citizens) are critical to the recovery of listed species.

Two recovery plans have been prepared for listed species known or with the potential to occur within the Project Study Area:

- Smith's Blue Butterfly Recovery Plan (Service, 1984), and
- Recovery Plan for the California Red-legged Frog (Service, 2002).

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 USC 651 Et Seq.) requires all federal agencies to consult with and give strong consideration to the views of the Service, the NMFS, and state wildlife agencies regarding the fish and wildlife impacts of projects that propose to impound, divert, channel, or otherwise alter a body of water.

Migratory Bird Treaty Act

The MBTA of 1918 prohibits killing, possessing, or trading migratory birds except in accordance with regulation prescribed by the Secretary of the Interior. Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of the MBTA. The Service is responsible for overseeing compliance with the MBTA and implements Conventions (treaties) between the United States and four countries for the protection of migratory birds – Canada, Mexico, Japan, and Russia. The Service maintains a list of migratory bird species that are protected under the MBTA, which was updated in 2010 to: 1) correct previous mistakes, such as misspellings or removing species no longer known to occur within the United States; 2) add species, as a result of expanding the geographic scope to include Hawaii and U.S. territories and new evidence of occurrence in the United States or U.S. territories; and 3) update name changes based on new taxonomy (Service, 2010a).

The Clean Water Act

The USACE and Environmental Protection Agency (EPA) regulate discharge of dredged and fill material into "Waters of the United States" (waters of the U.S.) under Section 404 of the CWA. Waters of the U.S. are defined broadly as waters susceptible to use in commerce (including waters subject to tides, interstate waters, and interstate wetlands) and other waters (such as interstate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds) (33 CFR 328.3). Potential wetland areas are identified as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support,

and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils conditions."

Under Section 401 of the CWA, any applicant receiving a Section 404 permit from the USACE must also obtain a Section 401 Water Quality Certification from the Regional Water Quality Control Board (RWQCB). A Section 401 Water Quality Certification is issued when a project is demonstrated to comply with state water quality standards and other aquatic resource protection requirements.

Executive Order 11990 - Protection of Wetlands

Executive Order 11990 - Protection of Wetlands calls for no net loss of wetlands. For the regulatory process, the USACE and EPA jointly define wetlands as follows: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Federal agencies are required to implement the following procedures for any federal action that involves wetlands: 1) provide an opportunity for early public involvement; 2) consider alternatives that would avoid wetlands, and it avoidance is not possible, measures to minimize harm to wetlands must be included in the action; 3) prepare a "Wetlands Only Practicable Alternative Finding" for actions that require an Environmental Impact Study.

Executive Order 13112-Invasive Species

Executive Order 13112 - Invasive Species requires the prevention of introduction and spread of invasive species. Invasive species are defined as "alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Each federal agency whose actions may affect the status of invasive species on a project site shall, to the extent practicable and permitted by law, subject to the availability of appropriations, use relevant programs and authorities to: 1) prevent the introduction of invasive species; 2) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; 3) monitor invasive species populations accurately and reliably; 4) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; 5) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and 6) promote public education on invasive species and the means to address them. A national invasive species management plan was prepared by the National Invasive Species Council and the Invasive Species Advisory Committee that recommends objectives and measures to implement the Executive Order.

STATE REGULATIONS

California Endangered Species Act

The CESA was enacted in 1984. The California Code of Regulations (Title 14, §670.5) lists animal species considered endangered or threatened by the state. Section 2090 of CESA requires state agencies to comply with endangered species protection and recovery and to promote conservation of these species. Section 2080 of the Fish and Game Code prohibits "take" of any species that the commission determines to be an endangered species or a threatened species. "Take" is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." A Section 2081 Incidental Take Permit from the Department may be obtained to authorize "take" of any state listed species.

California Fish and Game Code

Birds: Section 3503 of the Fish and Game Code states that it is "unlawful to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Section 3503.5 prohibits the killing, possession, or destruction of any birds in the orders Falconiformes or Strigiformes (birds-of-prey). Section 3511 prohibits take or possession of fully protected birds. Section 3513 prohibits the take or possession of any migratory nongame birds designated under the federal MBTA. Section 3800 prohibits take of nongame birds.

Fully Protected Species: The classification of fully protected was the state's initial effort in the 1960's to identify and provide additional protection to those animals that were rare or faced possible extinction. Lists were created for fish (§5515), mammals (§4700), amphibians and reptiles (§5050), and birds (§3511). Most fully protected species have also been listed as threatened or endangered species under the more recent endangered species laws and regulations. Fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation of the bird species for the protection of livestock.

Species of Special Concern: As noted above, the Department also maintains a list of animal "species of special concern." Although these species have no legal status, the Department recommends considering these species during analysis of project impacts to protect declining populations and avoid the need to list them as endangered in the future.

Lake or Streambed Alteration: Sections 1600-1607 of the Fish and Game Code require any agency that proposes a project that will substantially divert or obstruct the natural flow of or substantially change the bed or bank of a river, stream, or lake to notify the Department before beginning construction. If the Department determines that the project may substantially and adversely affect fish or wildlife resources, a Lake or Streambed Alteration Agreement will be required. The Department's jurisdictional limits are usually defined by the tops of the stream or lake banks, or the outer edge of riparian vegetation, whichever is wider.

California Native Plant Protection Act

The CNPPA of 1977 directed the Department to carry out the legislature's intent to "preserve, protect and enhance rare and endangered plants in the state." The CNPPA prohibits importing rare and endangered plants into California, taking rare and endangered plants, and selling rare and endangered plants. The CESA and CNPPA authorized the Fish and Game Commission to designate endangered, threatened and rare species and to regulate the taking of these species (§2050-2098, Fish and Game Code). Plants listed as rare under the CNPPA are not protected under CESA.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1969 (Porter-Cologne) is California's statutory authority for the protection of water quality and applies to surface waters, wetlands, and groundwater, and to both point and nonpoint sources. Under the Porter-Cologne, the State Water Resources Control Board (State Board) has the ultimate authority over State water rights and water quality policy. However, Porter-Cologne also establishes nine RWQCBs to oversee water quality on a day-to-day basis at the local/regional level. The Project Study Area is located within Region 3 – Central Coast RWQCB. Porter-Cologne incorporates many provisions of the federal CWA, such as delegation to the State Board and RWQCBs of the National Pollutant Discharge Elimination System (NPDES) permitting program.

Under Porter-Cologne, the state must adopt water quality policies, plans, and objectives that protect the state's waters for the use and enjoyment of the people. Regional authority for planning, permitting, and enforcement is delegate to the nine RWQCBs. The regional boards are required to formulate and adopt water quality control plans for all areas in the region and establish water quality objectives in the plans. The Porter-Cologne sets forth the obligations of the State Board and RWQCBs to adopt and periodically update water quality control plans (basin plans). The act also requires waste dischargers to notify the RWQCBs of such activities through filing of Reports of Waste Discharge (RWD) and authorizes the State Board and RWQCBs to issue and enforce waste discharge requirements (WDRs), NPDES permits, Section 401 water quality certifications, or other approvals. The RWQCBs also have authority to issue waivers to RWD requirements and WDRs for broad categories of "low threat" discharge activities that have minimal potential for adverse water quality effects, when implemented according to prescribed terms and conditions.

The term "Waters of the State" is defined by Porter-Cologne as "any surface water or groundwater, including saline waters, within the boundaries of the state." The RWQCB protects all waters in its regulatory scope but has special responsibility for wetlands, riparian areas, and headwaters, including isolated wetlands, and waters that many not be regulated by the USACE under Section 404 of the CWA. Waters of the State are regulated by the RWQCB under the State Water Quality Certification Program, which regulates discharges of fill and dredged material under Section 401 of the CWA and the Porter-Cologne.

California Coastal Act

The CCC was established by voter initiative in 1972 (Proposition 20) and later made permanent by the California State Legislature through adoption of the California Coastal Act of 1976. The CCC, in partnership with coastal cities and counties, plans and regulates the use of land and water in the coastal zone. California's coastal zone generally extends 1,000 yards inland from the mean high tide line. In significant coastal estuarine habitat and recreational areas, it extends inland to the first major ridgeline or five miles from the mean high tide line, whichever is less. In developed urban areas, the boundary is generally less than 1,000 yards[5]. Development activities, which are broadly defined by the Coastal Act to include (among others) construction of buildings, divisions of land, and activities that change the intensity of use of land or public access to coastal waters, generally require a Coastal Development Permit (CDP) from either the CCC or the local government if a Local Coastal Program (LCP) has been certified. After certification of a LCP, coastal development permit authority is delegated to the appropriate local government, but the Commission retains original permit jurisdiction over certain specified lands (such as tidelands and public trust lands). The Commission also has appellate authority over development approved by local governments in specified geographic areas as well as certain other developments. A CDP is required in addition to any other permit required from resource agencies.

The Commission or the local government may designate areas of rare or unique biological value, such as wetland and riparian habitat and habitats for special-status species, as ESHA. Section 30107.5 of the CCA defines an "environmentally sensitive area" as any area in which plant or animal life or their habitat are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. Development is restricted within the coastal zone and prohibited within designated ESHA, unless the development is coastal dependent and does not have a significant effect on the resources. Coastal Act

[5] NMFS website http://coastalmanagement.noaa.gov/consistency/resources.html link to State Coastal Zone Boundaries

Section 30240 states that "environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas." This section also states that "development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas."

The Carmel Lagoon is under original jurisdiction of the CCA and is regulated by the CCC.

LOCAL REGULATIONS

Monterey County Code

Title 16, Chapter 16.60, Monterey County Code, provides for the preservation of oaks and other protected tree species within the unincorporated areas of the County. As defined in Chapter 16.60.040 C, removal of more than three protected trees on a lot in a one-year period requires a Forest Management Plan (FMP) and approval of a Use Permit by the Monterey County Planning Commission. The FMP must be prepared by a qualified forester selected from the County's list of consultants. Chapter 16.060.040 D requires that the applicant relocate or replace each removed tree on a one-to-one ratio. This ratio may be varied upon showing that such a requirement will create a special hardship in the use of the site or such a replacement would be detrimental to the long-term health and maintenance of the remaining habitat. The Proposed Project will not remove any protected trees.

Habitat Conservation Plans or NCCP

There are no adopted Habitat Conservation Plans (HCP) or Natural Community Conservation Plans (NCCP) associated with the Project Study Area.

Chapter 4. Environmental Setting

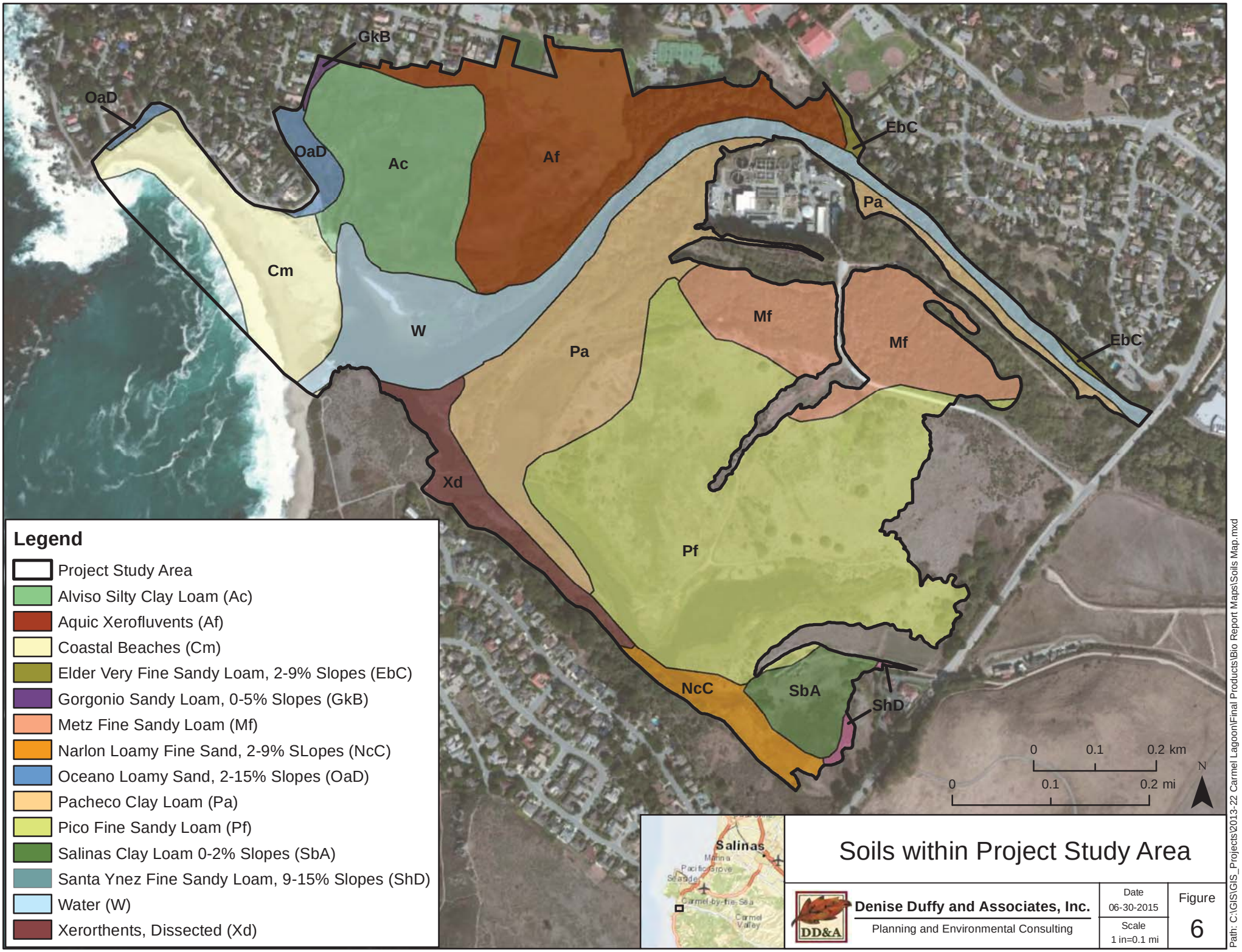
The Carmel River drains approximately 246 square miles of the Santa Lucia and Sierra de Salinas Mountains into the Carmel Bay. Historically, the Carmel River meandered along the floor of the valley resulting in a dynamic riparian corridor the spanned much of the valley floor. Development of the valley has confined the river and isolated portions of the historic riparian corridor both physically and hydrologically. Golf courses, agricultural fields, and residential developments dominate the landscape, although some areas of natural vegetation still exist, particularly within the Carmel River Riparian Corridor and the lagoon.

As identified in the Bio Memo, the lagoon ecosystem has also been altered by development and hydrologic manipulation. Early in the 20th century, wetlands on the north side of the lagoon were partially filled, first for use as pasture, then for residential development. The fill was in place by 1939; however, few houses were built until the 1950s. The floodplain north and east of the lagoon was also leveed for commercial and residential development, and the floodplain south and east of the lagoon (the former Odello property) was leveed and graded for agricultural use. Other hydrologic alterations to the lagoon ecosystem include upstream development, and diversion of water from the Carmel River for municipal and agricultural use.

Significant restoration efforts have been conducted within the Project Study Area in the past 20 years. Farming on approximately 43 acres of the former Odello West property (purchased by State Parks in 1974) was discontinued following flooding and damage to the fields in 1995, and State Parks entered into a Cooperative Agreement with the Caltrans to restore and enhance the area as a mitigation bank for unavoidable impacts to wetland and riparian habitats associated with future transportation projects in the Monterey Area (State Parks, 2002a). Farming of the remaining portion of the former Odello West property was discontinued following flooding in 1998. In 2004, State Parks implemented the CRLEP to restore the natural landforms and plant communities within this area. Restoration efforts within the Carmel River Mitigation Bank (CRMB) and CRLEP included levee removal, excavation of the South Arm of the lagoon, significant grading to modify drainage on the site and lower the elevation of the areas adjacent to the recreated South Arm, and planting with native riparian and wetland species (Monterey Peninsula Water Management District [MPWMD], 2005). Monitoring and maintenance of these areas by State Parks is ongoing.

SOILS AND GEOLOGY

The Web Soil Survey (United States Department of Agriculture [USDA]-Natural Resource Conservation Service [NRCS], 2003) identifies 14 map units within the Project Study Area (Figure 6): Alviso silty clay loam (Ac); Aquic xerofluvents (Af); Coastal beaches (Cm); Elder very fine sandy loam, 2-9% slopes (EbC); Gorgonio sandy loam, 0-5% slopes (GkB); Metz fine sandy loam (Mf); Narlon loamy fine sand, 2-9% slopes (NcC); Oceano loamy sand, 2-15% slopes (OaD); Pacheco clay loam (Pa); Pico fine sandy loam (Pf); Salinas clay loam, 0-2% slopes (SbA); Santa Ynez fine sandy loam, 9-15% slopes (ShD); Water (W), and Xerothents, dissected (Xd). The National Hydric Soils List (USDA-NRCS, 2014) identifies Alviso silty clay loam, Aquic xerofluvents, coastal beaches, Gorgonio sandy loam, Metz fine sandy loam, Narlon loamy fine sand, Pacheco clay loam, Pico fine sandy loam, and Salinas clay loam as hydric soils. Please note that the National Hydric Soils List cannot be used in the field to determine hydric soils as it is only a list of soils that are *likely* to by hydric.



Soils within Project Study Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 06-30-2015
Scale 1 in=0.1 mi
Figure 6

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\Soils Map.mxd

The following is a summary of the existing geologic conditions within the lagoon provided in the Geotechnical Report:

Pleistocene and Holocene coastal dunes lap across and overlie the coastal terrace deposits in the SRPS vicinity (Figure 7). Dune deposits consist of "unconsolidated, well-sorted, fine- to medium-grained sand" locally up to about 75 feet thick. Beach sand is mapped along the shore of Stewart's Cove, and makes up the seasonal barrier across the mouth of the Carmel River. Texturally, beach sand is typically "unconsolidated, well-sorted, medium- to coarse-grained sand with local layers of pebbles and cobbles and thin discontinuous lenses of silt in back-beach areas.

Flood-plain deposits occur to the north and south of the Carmel River (Figure 7). The oldest of these flood-plain deposits is mapped along a swath a few hundred feet north of, and roughly paralleling, the EPB. Texturally, these sediments consist of "unconsolidated, relatively fine-grained, heterogeneous deposits of sand and silt commonly including relatively thin layers of clay." Inset into these older flood-plain deposits are younger flood-plain deposits, which generally underlie the proposed EPB alignment. Texturally, these are very similar to older flood-plain deposits, with variable gravel content. These younger flood-plain deposits are generally less than about 20 feet (6 meters) thick.

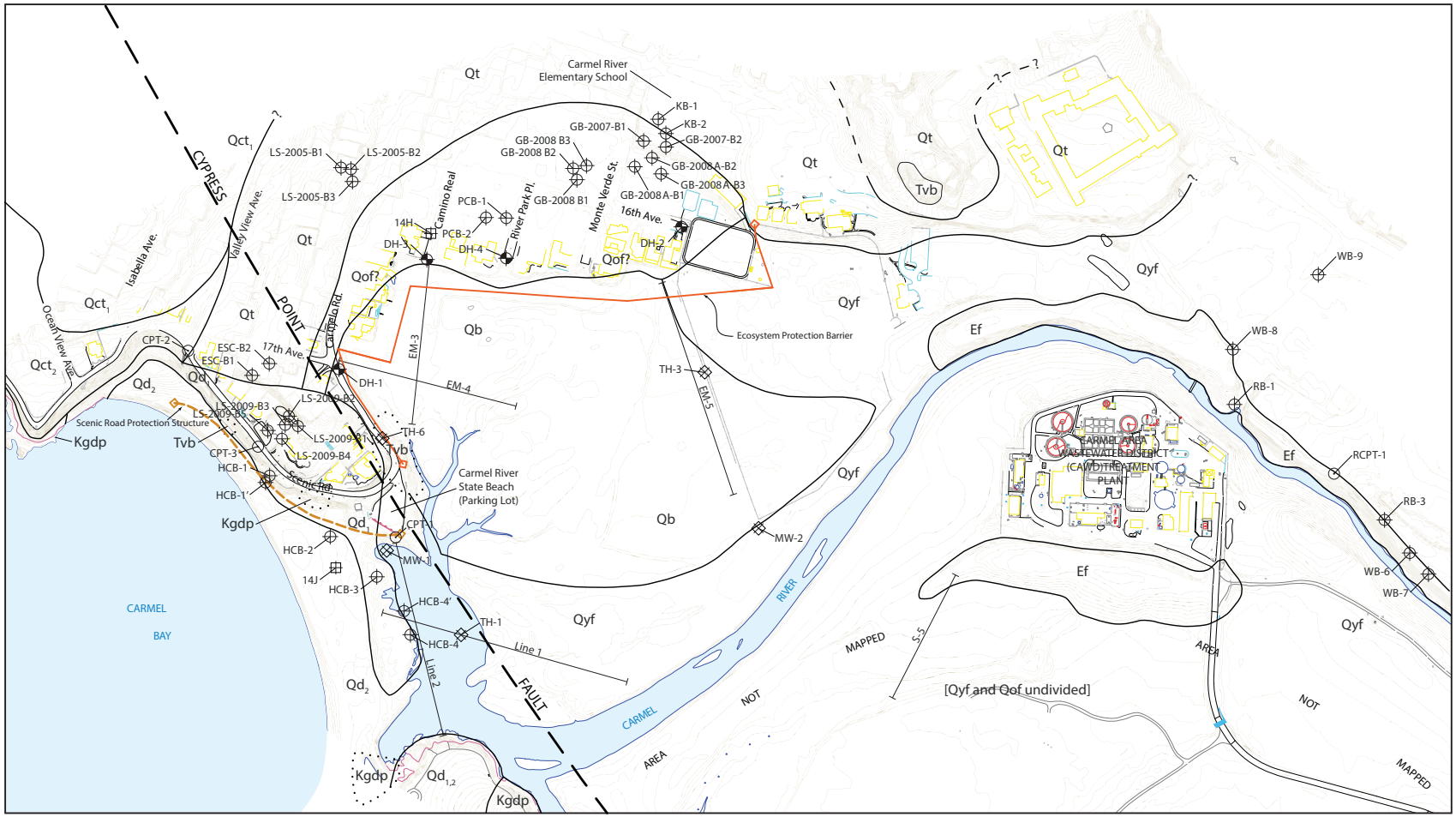
Basin deposits are mapped in the area of the lagoon (Figure 7). Basin deposits are described as "unconsolidated, plastic clay and silty clay containing much organic material, and locally contain[ing] interbedded thin layers of silt and silty sand."

Developed and graded sites typically have discontinuous fill deposits, particularly at the outboard edges of graded pads on sloping ground, and the outboard shoulders of roads on sloping ground. The outboard edge of Scenic Road currently has a sloping sandy ramp that descends to the beach. Department of Public Works personnel indicate that this ramp is underlain by a prism of rip-rap.

HYDROLOGY

The following is a summary of the existing hydrologic conditions within the lagoon provided in the Hydrology Report (Appendix B):

The Carmel River Watershed has large variations in seasonal and yearly discharge rates, brought about in large part by the unique nature of the coastal California geographic location within a Mediterranean climate zone, as well as by the size, vertical extent, geology, and geomorphic structure of the watershed. Carmel Lagoon, located at the bottom of the watershed, serves as an ecological interface zone between the watershed and the ocean. The lagoon is generally not connected to the ocean during times of very low or zero streamflow, when ocean waves build a barrier beach (sandbar) across the mouth of the lagoon and close the outflow channel. When river inflow is relatively low and the lagoon is not open to the ocean, a dynamic equilibrium is reached between streamflow and groundwater inflows, outflow through the barrier beach, evapotranspiration, and ocean wave overtopping. In summer this leads to lower WSEs and in the fall prior to opening, abrupt increases in WSE can occur due to overtopping. As streamflows increase in the fall and early winter, lagoon WSEs can rise to flood stage depending on precipitation patterns. When flooding does occur, infrastructure along the northern edge of the lagoon and within the lagoon floodplain are threatened before the sandbar would typically open naturally. In response to the flooding scenario, since at least the early 20th century, the sandbar has been mechanically managed (breached) in order to lower WSEs to below flood stage.



EXPLANATION

Earth Materials

- Ef — Earth fill - various textures. Fill prisms along roads not mapped for legibility
- Qd — Dune sand - locally subdivided into Qd_1 (older) and Qd_2 (younger)
- Qb — Basin deposits - plastic clay and silty clay
- Qyf — Younger floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qof — Older floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qt — Alluvial terrace deposits - silt, silty clay, sand and gravel; locally subdivided
- Qct — Coastal terrace deposits - sand with thin, discontinuous gravelly layers
- Tvb — Volcanic rocks - basaltic andesite flows and flow breccia
- Kgdp — Granodiorite (porphyritic granodiorite of Monterey of Ross (1976))

Symbols

- Geologic contact, dashed where approximate, queried where uncertain, dotted where concealed
- Inferred, buried fault
- DH-4 — Exploratory drill hole (this investigation)
- CPT-2 — CPT sounding (this investigation)
- Exploratory drill hole (investigations by others)
  - KB-2 (Kleinfelder, 2011)
  - GB-2008A-B3 (Grice, 2008A)
  - GB-2008 B3 (Grice, 2008B)
  - PCB-2 (Pacific Crest, 2008)
  - LS-2009-B5 (Landset, 2009)
  - LS-2005-B5 (Landset 2005)
  - ESC-B2 (Earth Systems Consultants, 2010)
  - HCB-4 (Hydro-Search, 1981)
  - WB-9 (Wahler, 1989; compiled in Raas [2000])
  - RB-3 (Raas, 2000)
- MW-3 — MW-2 (Staal, Gardner, Dunne, 1989b)
- TH-6 — TH-6 (Staal, Gardner, Dunne, 1989b)
- 14H (Previous borings compiled by Staal, Gardner, Dunne, 1989b)
- RCPT-3 — CPT sounding (Raas, 2000)
- Geophysical transects (Staal, Gardner, Dunne, 1989)
- Proposed Ecosystem Protection Barrier
- Scenic Road Protection Structure

Notes:

1. Base provided by Whitson Engineers
2. Geologic interpretation modified from Clark, Dupre and Rosenberg (1997), with additions
3. Scenic Road Protection Structure preliminary alignment provided by Moffat & Nichol
4. Ecosystem Protection Barrier preliminary alignment provided by Whitson Engineers

Source: Pacific Geotechnical Engineers, 2013



Site Geologic Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 02-24-2016
Scale: N/A
Figure: 7

Scale in feet: 100 0 100 200

Path: P:\DDA Current Projects\2013-22 Carmel Lagoon\EIR EA\Admin Draft EIR EA\Figures\Indesign\ 8.5x11 landscape

In the lagoon ecosystem, among other similar Coastal California systems, riverine dynamics play an important role in lagoon dynamics and, at least to some degree, drive "whether, when, and for how long" the lagoon is open, while the formation of the sandbar beach and configuration of the outlet channel are somewhat more wave-dominated processes. The dual role of river processes and ocean dynamics can be seen in the lagoon during California's summer dry season, as streamflows dry up (in part due to groundwater extractions and streamflow diversions), and ocean forces deposit sands onto the beach that are structurally capable of keeping the lagoon closed. Likewise in the winter season, streamflows can gradually fill the lagoon and breach the sand barrier, or suddenly generate fresh water forces strong enough to overcome ocean forces for extended periods, depending on the timing, duration, and quantity of rainfall and runoff.

Perched lagoon morphology is defined by NMFS as a lagoon with a WSE above mean high tide, and can refer to fresh water lagoons with closed sandbars as well as to lagoons where fresh water flows out to the ocean over the sandbar at the lagoon's mouth. Summer wave action that tends to deposit sand onto beaches helps build up beach berms. This elevation increase can create perched lagoon morphology by formation of a high berm combined with an outflow channel that provides the greatest ratio of fresh water to saline water during open-bar dynamics, as well as providing the highest lagoon WSE upon closure. The ideal lagoon morphology during open conditions would be to retain a perched condition, where lagoon WSEs of greater than about six feet persist when mean high tides are in, providing a minimum of about 41 acre-feet of volume.

COASTAL PROCESSES

The following is a summary of the existing coastal processes occurring within the lagoon provided in the Coastal Analysis Report (Appendix B):

The Carmel River Beach is steep, reflective, and composed of fairly coarse sand delivered to the beach by the river. Beach face slopes typically vary along the length of the beach, ranging from as low as 8% at the north to 28% to the south. The mean grain sizes also increase to the south, corresponding to the increased wave energy along the less-sheltered portion.

The shape of the beach shoreline is typical of crenulate or headland-bay beaches where the equilibrium condition can be described by one of several mathematical shape functions, usually log-spiral in form. These equilibrium beach shapes are typically present where a headland fixes the shape at one beach end and waves approach from a predominant direction. Waves approaching the beach both refract and diffract into the sheltered zone behind the up-coast headland, and differential long-shore transport shapes the beach so that it is perpendicular to the resulting wave rays at equilibrium. While littoral transport is limited at the beach, the differences in wave energy reaching the different beach sections has resulted in alongshore variation in beach berm heights with lower berm elevations to the north.

The Carmel River Beach forms a barrier between the Pacific Ocean and the adjacent Carmel River Lagoon that is seasonally breached (either naturally or artificially) when high rainfall events increase the water level in the lagoon. Because the Carmel River is ephemeral and the beach is subjected to swell for most of the year, wave run-up rebuilds the berm and closes off the barrier beach when river outflows are low or absent.

During the early fall, the lagoon mouth usually remains closed to the sea, but occasional overtopping of the beach berm by long period ocean swell can raise the lagoon water level over the typical low,

summer levels. Major fall overtopping-induced water level increases have usually been associated with high waves in conjunction with higher tide levels. During late fall/early winter, rainfall in the Carmel River Watershed is usually sufficient to advance the flowing river to the lagoon and fill up the available storage. At this point, the beach berm has historically been mechanically breached to prevent flooding of roads and homes along the northern edge of the lagoon. Lagoon outflow through the breach quickly scours a channel sufficient to release most of the stored lagoon water into the ocean. Based on 13 years of observations, the berm breach remains open approximately 85% of the time, with river inflows of 100 cubic feet per second, usually ensuring that the breach will not be closed by predominant wave-transported sand. Because lower flows or large waves encourage breach closure (and then an increase in water level as the lagoon fills), the water level in the lagoon is not directly correlated to river inflow.

Historically, the initial artificial breach channel has been excavated straight offshore near the southern end of the beach, though the breach management strategy has varied considerably over the past decade, and has included northerly and southerly managed breaches. Bedrock sills underlie the beach along both the north and south edges, so scour by migrating channels or channels intentionally opened in these sections is less than that when channels are excavated through the central beach portion. With the relatively long channel alignments, further limited by the sills north and south of the river mouth, river outflow is extending over a longer period (drawdown), which is beneficial for threatened species. In 2005, the berm was breached toward the north with the unintended consequence of severe erosion along the backing bluff which supports road and wastewater infrastructure.

An elongated channel forms to the north along the beach in half of the years of observation and either natural breaching or channel migration is expected to tend towards the northern alignment since the antecedent, lowered beach alignment has not recovered to typical berm heights and widths. The lower berm elevations, due to milder beach slope and finer sediment, also favor natural breaching or channel migration towards the northern portion of the beach; however, this varies greatly on a year to year basis and depends on wave energy arriving over the winter/spring seasons.

Chapter 5. Results

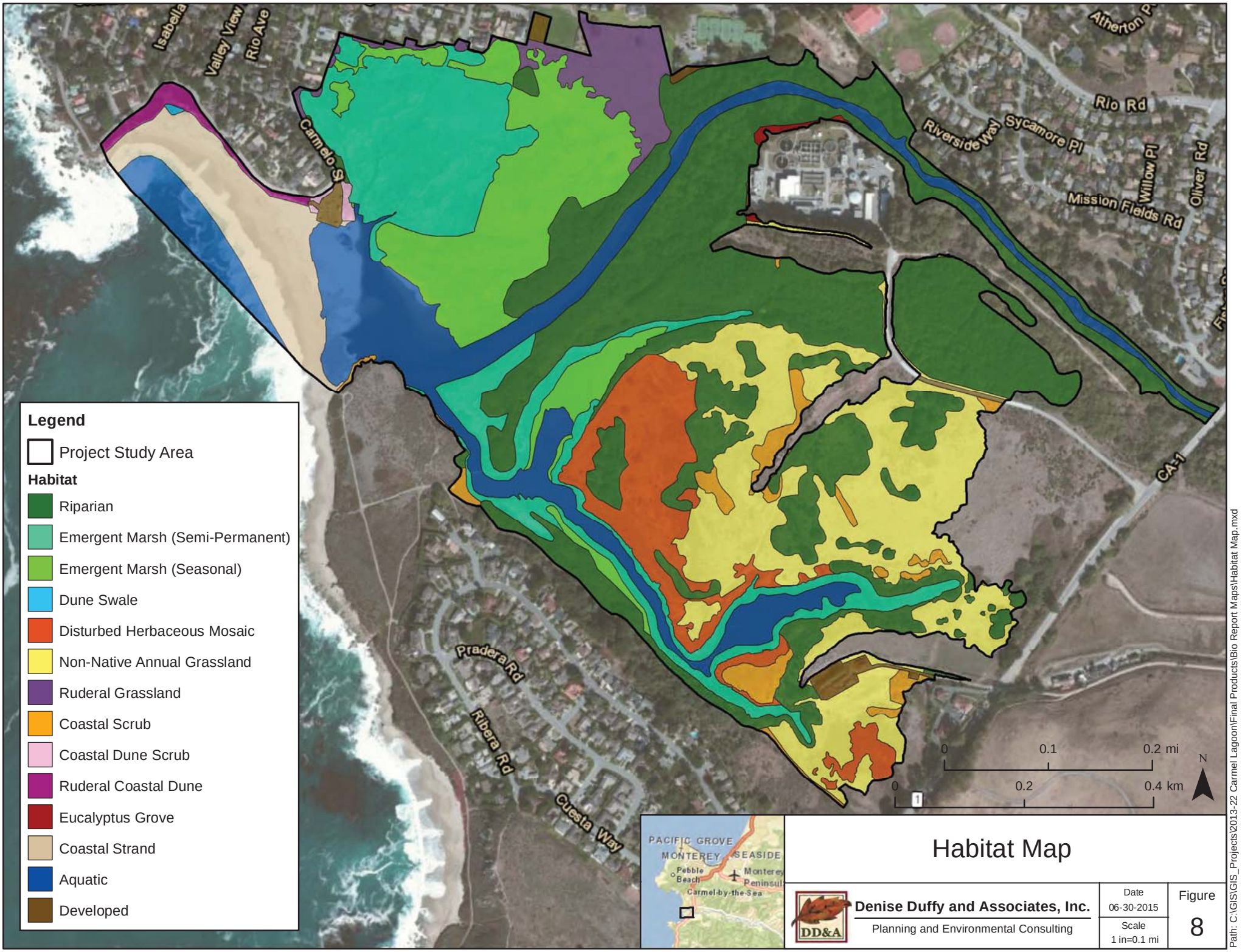
5.1. Vegetation Types

The survey results include mapping and quantification of the acreage of 11 vegetation types within the Project Study Area: riparian, semi-permanent emergent marsh, seasonal emergent marsh, dune swale wetland, non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, coastal scrub, coastal dune scrub, ruderal coastal dune, and eucalyptus grove (Figure 8). Additionally, three unvegetated areas are present: coastal strand, aquatic, and developed. As identified in Chapter 3: Methods, vegetation types present within portions of the Project Study Area were described by HTH (2013) and Casagrande (2006), and additional field surveys were conducted by DD&A staff biologists to confirm, update, and complete the vegetation mapping and descriptions. A brief description of each of these vegetation types can be found below along with a statement of the presence or potential presence of special-status species within each vegetation type and if it is a sensitive habitat. A generalized nomenclature for vegetation types is used within this document for ease of reference; however each habitat type description also lists the *Manual of California Vegetation* (Sawyer et al., 2009) vegetation type(s) in order to provide a crosswalk to the *Natural Communities List* (Department, 2010). Table 5-1 provides the acreages of these vegetation types within the Project Study Area and within each project component.

Table 5-1. Vegetation Types within the Project Study Area and Project Components

Vegetation Type	Project Study Area	EPB	SRPS	ISMP
Riparian	69.1	0.1	0	Not Present[6]
Semi-Permanent Emergent Marsh	28.3	1.4	0	Not Present
Seasonal Emergent Marsh	22.2	1.5	0	Not Present
Dune Swale Wetland	0.1	0	0	Not Present
Disturbed Herbaceous Mosaic	13.4	0	0	Not Present
Non-Native Annual Grassland	32.2	0	0	Not Present
Ruderal Grassland	6.2	1.4	0	Not Present
Coastal Scrub	4.6	0	0	Not Present
Coastal Dune Scrub	0.4	0	0.3	Not Present
Ruderal Coastal Dune	1.5	0	0	Not Present
Eucalyptus Grove	0.4	0	0	Not Present
Coastal Strand	6.0	0	2.0	Present
Aquatic	32.0	0	0.3	Present
Developed	2.7	0.7	0.5	Not Present

[6] Due to the dynamic nature of the sandbar and the implementation process of the ISMP, the area of vegetation types within the ISMP cannot be calculated. As such, Table 5-1 only identifies whether a vegetation type is present within the ISMP implementation area or not.


Legend
Project Study Area
Habitat
Riparian
Emergent Marsh (Semi-Permanent)
Emergent Marsh (Seasonal)
Dune Swale
Disturbed Herbaceous Mosaic
Non-Native Annual Grassland
Ruderal Grassland
Coastal Scrub
Coastal Dune Scrub
Ruderal Coastal Dune
Eucalyptus Grove
Coastal Strand
Aquatic
Developed
Isabella
Valley View
Rio Ave
Carmelo St
Atherton P
Rio Rd
Riverside Way
Sycamore Pl
Willow Pl
Oliver Rd
Mission Fields Rd
CA-1
Pradera Rd
Ribera Rd
Cuesta Way
0
0.1
0.2 mi
0
0.2
0.4 km
1
N
PACIFIC GROVE
MONTEREY
SEASIDE
Pebble Beach
Monterey Peninsul
Carmel-by-the-Sea
Habitat Map
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date
06-30-2015
Scale
1 in=0.1 mi
Figure
8
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\Habitat Map.mxd

RIPARIAN

A Manual of California Vegetation **classification**: Arroyo willow thickets (*Salix lasiolepis* Shrubland Alliance)

Two types of riparian vegetation are supported within the lagoon. Dense riparian forest is present along the Carmel River, upstream of the main embayment, and is dominated by Arroyo willow (*Salix lasiolepis*) and black cottonwood (*Poplus trichocarpa*) trees with and understory dominated by California blackberry (*Rubus ursinus*). Riparian scrub-shrub is present immediately adjacent to the confluence of the Carmel River and the main embayment, adjacent to the Carmelo Road roadway embankment, and in areas slightly higher in elevation throughout the south arm of the lagoon. Vegetation within the riparian scrub-shrub consists of Arroyo willow and red willow (*S. laevigata*), and various shrubs and vines, such as California blackberry, often in the form of dense thickets less than 20 feet in height. The total area of riparian vegetation within the Project Study Area is approximately 69.1 acres (Figure 8).

Riparian areas provide habitat for many wildlife species, particularly birds and herpetofauna. Common species that may be found within the riparian habitat in the Project Study Area includes Sierran treefrog (*Pseudacris sierra*), Monterey ensatina (*Ensatina eschscholtzii eschscholtzii*), California striped racer (*Coluber lateralis lateralis*), tree swallow (*Tachycineta bicolor*), northern flicker (*Colaptes auratus*), black headed grosbeak (Black-headed Grosbeak (*Pheucticus melanocephalus*), black phoebe (*Sayornis nigricans*), song sparrow (*Melospiza melodia*), Pacific-slope flycatcher (*Empidonax difficilis*), and western screech owl (*Megascops kennicottii*). Additional avian species that may be found within the riparian vegetation are presented in Appendix G.

Several special-status species are known or have the potential to occur within this vegetation type. The California legless lizard (*Anniella pulchra*) is known in the riparian habitat within the CRMB (State Parks, 2002a) and is assumed to occur throughout the riparian habitat where suitable conditions occur. CRLF and western pond turtle (*Emys marmorata*) are assumed present within the riparian habitat as these species are known to occur within the lagoon. Additionally, several woodrat nests were observed throughout the riparian vegetation and Monterey dusky-footed woodrat (*Neotoma macrotis fuscipes*) is assumed present. The riparian vegetation within the Project Study Area may also provide suitable nesting habitat for the tricolored blackbird (*Agelaius tricolor*), raptors, including white-tailed kite (*Elanus leucurus*), and sharp-shinned hawk (*Accipiter striatus*), and other migratory bird species. No special-status plant species were identified within the riparian habitat.

Both types of riparian vegetation within the Project Study Area support vegetation characteristic of Arroyo willow thickets, as described in the *Manual of California Vegetation* (Sawyer, et al., 2009), which is identified as sensitive on the Department's *Natural Communities List* (Department, 2010). Riparian vegetation is also regulated under Sections 1600-1616 of the Fish and Game Code. In addition, portions of this vegetation type meet the definition of wetlands under the jurisdiction of the USACE, and all of this vegetation type meets the definition of waters of the state under the jurisdiction of the RWQCB and ESHA under the jurisdiction of the CCC. As such, this vegetation type is considered a sensitive habitat.

SEMI-PERMANENT EMERGENT MARSH

***A Manual of California Vegetation* classification**: California bulrush marsh (*Schoenoplectus californicus* Herbaceous Alliance)

Siltation has resulted in a narrowing of the main body of the lagoon, more pronounced on the north side, where up to 350 feet of the old active channel in now vegetated wetland. The majority of these wetlands, while experiencing seasonal fluctuation, remain flooded for significant portions of the year, when the sandbar is closed and stream flow entering the lagoon is present. These semi-permanent emergent wetlands are dominated by California bulrush (*Schoenoplectus californicus*), with few associated species. Within the Project Study Area, this vegetation type covers approximately 28.3 acres (Figure 8).

The semi-permanent emergent marsh provides habitat for many avian and amphibian species, including Sierran treefrog, red-winged blackbird (*Agelaius phoeniceus*), mallard (*Anas platyrhynchos*), great blue heron (*Ardea herodias*), pied-billed grebe (*Podilymbus podiceps*), great egret (*Ardea alba*), snowy egret (*Egretta thula*), and American coot (*Fulica americana*).

CRLF are known to occur and breed within the lagoon and are assumed present within the semi-permanent emergent marsh. Additionally, during periods of inundation, these areas provide habitat for S-CCC steelhead. This vegetation type may also provide suitable habitat for the western pond turtle, tricolored blackbird, northern harrier (*Circus cyaneus*), and migratory bird species. No special-status plant species were identified within the semi-permanent emergent marsh vegetation type.

All areas of the semi-permanent emergent marsh meet the definition of wetlands under the jurisdiction of the USACE and CCC and waters of the state under the jurisdiction of the RWQCB. As such, this vegetation type is considered a sensitive habitat.

SEASONAL EMERGENT MARSH

***A Manual of California Vegetation* classification**: Pacific silverweed marsh (*Argentina egedii* [*Potentilla anserina* subsp. *pacifica*] Herbaceous Alliance)

At higher elevations in the lagoon, where flooding is less frequent, the vegetation shifts from the tall California bulrush to areas dominated by Baltic rush (*Juncus balticus* subsp. *ater*) and Pacific silverweed (*Potentilla anserina* subsp. *pacifica*), intergrading with dotted smartweed (*Persicaria punctata*), brass buttons (*Cotula coronopifolia*), marsh spike-rush (*Eleocharis palustris*), and three-square bulrush (*Schoenoplectus pungens*). Approximately 22.2 acres of seasonal emergent marsh are present within the Project Study Area (Figure 8).

Common species that occur within the seasonal emergent marsh are similar to those described above for the semi-permanent emergent marsh.

CRLF are known to occur and breed within the lagoon and are assumed present within the seasonal emergent marsh. Additionally, during periods of inundation, portions of this area may provide habitat for S-CCC steelhead. This vegetation type may provide suitable habitat for the western pond turtle, northern harrier, and migratory bird species. Special-status avian species may also forage within this vegetation type, including sharp-shinned hawk, ferruginous hawk (*Buteo regalis*), white-tailed kite, merlin (*Falco columbarius*), American peregrine falcon (*F. peregrinis anatum*), and osprey (*Pandion haliaetus*). No special-status plant species were identified within the seasonal emergent marsh habitat.

The seasonal emergent marsh habitat supports vegetation characteristic of pacific silverweed marsh, as described in the *Manual of California Vegetation* (Sawyer, et al., 2009), and is identified as sensitive on the Department's *Natural Communities List* (Department, 2010). In addition, portions of this vegetation type meet the definition of wetlands under the jurisdiction of the USACE, and all of this vegetation type meets the definition of waters of the state under the jurisdiction of the RWQCB and wetlands under the jurisdiction of the CCC. As such, this vegetation type is considered a sensitive habitat.

DUNE SWALE WETLAND

***A Manual of California Vegetation* classification**: California bulrush marsh (*Schoenoplectus californicus* Herbaceous Alliance)

An approximately 0.1 acre freshwater coastal dune swale wetland is located at the north end of the coastal strand near the headlands, at the base of the bluff (Figure 8). This wet depression is likely a remnant of past scouring in this region. The water table remains high enough to support wetland plants including California bulrush, common three-square bulrush, and dotted smartweed.

The dune swale wetland may provide habitat for common avian and amphibian species, such as Sierran treefrog, red-winged blackbird, and mallard. Additional avian species that may be found within the dune swale wetland are presented in Appendix G.

Due to its small size and isolated location, this vegetation type is unlikely to support any special-status species; however, migratory bird species may occur. Additionally, no special-status plant species were identified within the dune swale wetland habitat.

All areas of the dune swale wetland meet the definition of wetlands under the jurisdiction of the USACE and CCC, and waters of the state under the jurisdiction of the RWQCB. As such, this vegetation type is considered a sensitive habitat.

DISTURBED HERBACEOUS MOSAIC

***A Manual of California Vegetation* classification**: Perennial Rye Grass Fields (*Lolium perenne* Semi-Natural Herbaceous Stands), Gum Plant Patches (*Grindelia stricta* Provisional Herbaceous Alliance)

Approximately 13.4 acres of the Project Study Area are dominated by a mosaic of native and non-native herbaceous vegetation, where one or two species dominate in patches that cannot be discerned at the scale utilized for this mapping effort (Figure 8). The mosaic nature of this vegetation type is a result of the historic disturbance, the subsequent planting and colonization of native species, and the persistence of non-native species. This vegetation type is present in areas that were historically used for agriculture and were graded in 2004 as a part of the restoration of the south arm of the lagoon (State Parks, 2008a).

The elevation at which most of this habitat occurs allows the area to be intermittently inundated during periods of high WSE within the lagoon. This vegetation type is also present in the southern corner of the Project Study Area, adjacent to SR1, in areas where the water from the culvert under the highway and seepage from the adjacent hillside intermittently inundate the nearly flat landscape. As such, this vegetation type is dominated by plant species adapted to mesic conditions. The dominant species include Pacific gum plant (*Grindelia stricta*), perennial rye grass (*Festuca perennis*), mule fat (*Baccharis salicifolia*), sneeze weed (*Helenium puberulum*), bristly ox-tongue (*Helminthotheca*

echioides), cut-leaved plantain (*Plantago coronopus*), tall sedge (*Cyperus eragrostis*), curly dock (*Rumex crispus*), and Santa Barbara sedge (*Carex barbarae*).

Common wildlife species that are likely to occur within the disturbed herbaceous mosaic include coast garter snake (*Thamnophis elegans terrestris*), Sierran treefrog, killdeer (*Charadrius vociferous*), red-winged blackbird, white-crowned sparrow (*Zonotrichia leucophrys*), and American goldfinch (*Spinus tristis*). Raptors, black-tailed deer (*Odocoileus hemionus columbianus*), and wild boar (*Sus scrofa*) are also known to forage in this habitat. Additional avian species that may be found within the disturbed herbaceous mosaic are presented in Appendix G.

CRLF and western pond turtle are known to occur and breed within the lagoon and are assumed present within this vegetation type. Suitable nesting habitat is present within the disturbed herbaceous mosaic habitat for special-status avian species, including California horned lark (*Eremophila alpestris actia*), tricolored blackbird, northern harrier, and other migratory bird species. Special-status avian species may also forage within this vegetation type, including sharp-shinned hawk, ferruginous hawk, white-tailed kite, merlin, American peregrine falcon, and osprey. No special-status plant species were identified within the disturbed herbaceous mosaic habitat.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the Department's *Natural Communities List* (Department, 2010). However, this vegetation type meets the definition of wetlands under the jurisdiction of the CCC and waters of the state under the jurisdiction of the RWQCB.

NON-NATIVE ANNUAL GRASSLAND

***A Manual of California Vegetation* classification**: Wild Oats Grassland (*Avena barbata, fatua* Semi-Natural Herbaceous Stands), Annual Brome Grasslands (*Bromus diandrus, hordeaceus-Brachypodium distachyon* Semi-Natural Herbaceous Stands), Poison Hemlock or Fennel Patches (*Conium maculatum – Foeniculum vulgare* Semi-Natural Herbaceous Stands, Upland mustards (*Brassica nigra* and Other Mustards Semi-Natural Herbaceous Stands)

Approximately 32.2 acres of non-native annual grassland are present within the Project Study Area (Figure 8). Similar to the disturbed herbaceous mosaic habitat, these areas were historically used for agriculture and were graded in 2004 as part of the restoration of the south arm of the lagoon. However, this vegetation type is present at a somewhat higher elevation and is not inundated as frequently. Dominant grass species within this vegetation type include slender oat (*Avena barbata*), ripgut brome (*Bromus diandrus*), soft chess (*B. hordeaceus*), and rattail fescue (*Vulpia myuros*). Dense patches of non-native poison hemlock (*Conium maculatum*) and wild radish (*Raphanus sativus*) are also present within this area; however, they are not discernable at the scale utilized for this mapping effort.

Non-native annual grasslands provide habitat to a number of wildlife species, such as the Botta's pocket gopher (*Thomomys bottae*), California ground squirrel (*Spermophilus beecheyi*), northern pacific rattlesnake (*Crotalus oreganus* ssp. *oreganus*), gopher snake (*Pituophis catenifer catenifer*), coast range fence lizard (*Sceloporus occidentalis bocourtii*), California quail (*Callipepla californica*), American robin (*Turdus migratorius*), western meadowlark (*Sturnella neglecta*), and American goldfinch. Raptors and black-tailed deer are also known to forage in this habitat. Additional avian

species that may be found within the non-native annual grassland habitat are presented in Appendix G.

Special-status wildlife species that have the potential to occur within the non-native annual grassland include the western burrowing owl (*Athene cunicularia*), California horned lark, and California legless lizard. SBB is assumed present within this vegetation type where dune buckwheat (*Eriogonum parvifolium*) is present. The non-native annual grassland may also provide upland and dispersal habitat for CRLF and western pond turtle. Special-status avian species may also forage within this vegetation type, including white-tailed kite (which was observed hunting during surveys in June 2014), tricolored blackbird, sharp-shinned hawk, ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey. No special-status plant species were identified within the non-native annual grassland habitat.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the Department's *Natural Communities List* (Department, 2010). This vegetation type is not considered sensitive for the purposes of this analysis.

RUDERAL GRASSLAND

***A Manual of California Vegetation* classification**: Fountain Grass swards (*Pennisetum setaceum* Semi-Natural Stands)

Approximately 6.2 acres of ruderal grassland are present within the Project Study Area (Figure 8). The field owned by Mission Ranch and the Carmel USD supports a nearly monoculture area of kikuyu grass (*Pennisetum clandestinum*) in areas higher in elevation than the adjacent emergent marsh. This area is currently being grazed by sheep and is highly disturbed. Additionally, between the north/northwestern sides of the lagoon and the Fourth Addition neighborhood, there is a relatively narrow (up to approximately 15 feet wide) strip dominated by kikuyu grass and weedy herbs, including wild radish and naturalized garden nasturtium (*Tropaeolum majus*). A number of landscape trees, including Monterey cypress (*Hesperocyparis macrocarpa*), have also been planted at the development edge.

Common wildlife species which do well in urbanized and disturbed areas can utilize this habitat, such as the American crow (*Corvus brachyrhynchos*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), western scrub jay (*Aphelocoma californica*), European starling (*Sturnus vulgaris*), and rock pigeon (*Columba livia*). Additional avian species that may be found within the ruderal grassland are presented in Appendix G.

Special-status wildlife species that have the potential to occur within the ruderal grassland include the California horned lark and California legless lizard. This vegetation type may also provide upland habitat for CRLF and western pond turtle. Special-status avian species may also forage within this vegetation type, including sharp-shinned hawk, ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey. Additionally, raptors including white-tailed kite, and other migratory bird species may nest within the large Monterey cypress and other trees present within this vegetation type. No special-status plant species were identified within the ruderal grassland habitat.

A small portion of this vegetation type may be considered ESHA by the CCC and sensitive because dune buckwheat plants are present that may provide habitat for the federally-listed SBB. Therefore, a small portion of this vegetation type is considered a sensitive habitat.

COASTAL SCRUB

***A Manual of California Vegetation* classification**: Coyote Brush Scrub (*Baccharis pilularis* Shrubland Alliance)

Approximately 4.6 acres of coastal scrub are present within the Project Study Area (Figure 8). The slope adjacent to the Carmel Meadows residential development supports dense coyote brush (*Baccharis pilularis*) and poison oak (*Toxicodendron diversilobum*). Coyote brush has also been planted in the upland areas surrounding the south arm of the lagoon as part of the restoration by State Parks. In these areas, the coyote brush is less dense and annual grass species indicative of the adjacent non-native annual grassland are present in the understory.

Coastal scrub habitats provide cover and food for a number of wildlife species, including songbirds, snakes, lizards, rodents, and other small mammals. Common species that may occur within the coastal scrub include California quail, Anna's hummingbird, American robin, western scrub jay, coast range fence lizard, northern pacific rattlesnake, gopher snake, and brush rabbit (*Sylvilagus bachmani*). Additional avian species that may be found within the coastal scrub habitat are presented in Appendix G.

Special-status wildlife species that may occur within this vegetation type include California legless lizard and Monterey dusky-footed woodrat. Special-status avian species may also forage within this vegetation type including white-tailed kite, sharp-shinned hawk, ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey. The coastal scrub habitat may also provide upland and dispersal habitat for CRLF and western pond turtle. No special-status plant species were identified within the coastal scrub habitat.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the Department's *Natural Communities List* (Department, 2010). This vegetation type is not considered sensitive for the purposes of this analysis.

COASTAL DUNE SCRUB

***A Manual of California Vegetation* classification**: California Sagebrush-California Buckwheat Scrub (*Artemisia californica-Eriogonum fasciculatum* Shrubland Alliance)

The parking lot at the Carmel River State Beach has been placed on fill material. The sandy slopes bordering the parking lot are stable enough to support species characteristic of coastal dune scrub in the region. The slope is dominated by the native species California sagebrush (*Artemisia californica*) and coyote brush, with dune buckwheat, seaside woolly sunflower (*Eriophyllum staechadifolium*), and mugwort (*Artemisia douglasiana*). The non-native species wild radish and New Zealand spinach (*Tetragonia tetragonioides*) are also present. Approximately 0.4 acres of coastal dune scrub is present within the Project Study Area (Figure 8).

Common species that may occur within the coastal dune scrub habitat include coast range fence lizard, western scrub jay, Anna's hummingbird (*Calypte anna*), and killdeer. Additional avian species that may be found within the California sagebrush scrub are presented in Appendix G.

Special-status wildlife species with the potential to occur within this vegetation type include California legless lizard. SBB is assumed present within this vegetation type where dune buckwheat is present. No special-status plant species were identified within the coastal dune scrub habitat.

The coastal dune scrub is present within the Coastal Zone and dune buckwheat plants within this vegetation type may provide habitat for the federally-listed SBB. Therefore, this vegetation type may be considered ESHA by the CCC and protected by the Service under the ESA, and is considered a sensitive habitat.

RUDERAL COASTAL DUNE

***A Manual of California Vegetation* classification**: Ice Plant Mats (*Carpobrotus edulis* or Other Ice Plant Semi-Natural Herbaceous Stands)

The bluff bordering Scenic Road is very steep and sandy. Non-native hottentot fig (*Carpobrotus edulis*), a type of iceplant often planted for erosion control on sandy slopes, dominates in a majority of the area; however, at the north end of the bluff, California sagebrush co-occurs with the hottentot fig. Large Monterey cypress trees have also been planted within this area. Large areas of the bluff are also devoid of vegetation, especially near the toe of the slope and where there has been slope failure. This ruderal coastal dune area covers approximately 1.5 acres of the Project Study Area (Figure 8).

Common species that may occur within the ruderal coastal dune are similar to those described above for the ruderal grassland.

Special-status wildlife species with the potential to occur within this vegetation type include California legless lizard. Additionally, raptors including white-tailed kite, and other migratory bird species may nest within the large Monterey cypress and other trees present within this vegetation type. No special-status plant species were identified within the ruderal coastal dune habitat.

The ruderal coastal dune is present within the Coastal Zone and may be considered ESHA by the CCC. As such, this vegetation type is considered a sensitive habitat.

EUCALYPTUS GROVE

***A Manual of California Vegetation* classification**: Eucalyptus Grove (*Eucalyptus globulus, camadulensis* Semi-Natural Woodland Stands)

An approximately 0.4 acre grove of eucalyptus trees (*Eucalyptus globulus*) is present within the Project Study Area (Figure 8). This small grove is present surrounding the CAWD WTP and has a maintained understory. Raptors, including red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), and other migratory bird species may nest within these trees. Additionally, monarch butterfly (*Danaus plexippus*) may overwinter within these trees. No special-status plant species were identified within the Eucalyptus grove habitat.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the Department's *Natural Communities List* (Department, 2010). This vegetation type is not considered sensitive for the purposes of this analysis.

COASTAL STRAND

***A Manual of California Vegetation* classification**: None

A broad unvegetated stretch of beach, referred to as the coastal strand, occurs bordering Scenic Road, at the base of the bluff. The coastal strand area extends from the mouth of the Carmel River north to

where the beach abruptly ends at a bedrock headland and south towards Monastery State Beach. Within the Project Study Area, approximately 6.0 acres of coastal strand are present (Figure 8). Coastal strand areas are typically dynamic, responding to seasonal shifts in wind and wave energy and storm events. The coastal strand bordering Scenic Road is subject to extreme seasonal and annual changes in morphology in response to storm frequency and intensity, changes in wind and wave energy, stream flow intensity and duration, and the frequency of sandbar management for flood protection. This highly dynamic system precludes the development of vegetation along the strand.

The coastal strand areas provides little habitat for wildlife species due to the lack of vegetation; however, several shore birds are often found in these areas. Common species that may occur include California gull (*Larus californicus*), western sandpiper (*Calidris mauri*), great blue heron, snowy egret, and great egret.

The western snowy plover (*Charadrius nivosus nivosus*) is known to occur within the coastal strand within the Project Study Area; however, this species has not been documented to nest there. The California brown pelican (*Pelecanus occidentalis californicus*) and other migratory bird species may also utilize the coastal strand area. Marine mammals may use the coastal strand area as a haul-out site, including the southern sea otter (*Enhydra lutris nereis*), harbor seal (*Phoca vitulina*), and California sea lion (*Zalophus californianus*). No special-status plant species were identified within the coastal strand habitat.

The coastal strand area is present within the Coastal Zone and may be considered ESHA by the CCC. As such, this area is considered a sensitive habitat.

AQUATIC

***A Manual of California Vegetation* classification**: None

Approximately 32.0 acres of aquatic habitat is present within the Project Study Area (Figure 8). The South Arm and a small portion of the North Arm are permanently flooded areas of the lagoon. Portions of the main embayment are also perennial; however, the boundary of the permanent water varies both seasonally and annually with changes in the lagoon water volume, sediment accumulation, stream flow, and the river's opening to the ocean, which ultimately depend on the timing of the sandbar breaching and closure. When the sandbar is closed, water accumulates in the main embayment of the lagoon creating semi-permanent open water habitat. When the sandbar is open, and the water subsides, mudflats or other open shore habitat is present. The main embayment lacks emergent vegetation; however, portions of the South Arm support beds of submerged pondweed (*Potamogeton* sp.).

Common wildlife using the aquatic area include waterfowl, such as Canada goose (*Branta canadensis*), mallard, American coot, great egret, bufflehead (*Bucephala albeola*), cormorants (*Phalacrocorax* sp.), willet (*Tringa semipalmata*), and spotted sandpiper (*Actitis macularius*), and fish species, such as threespine stickleback (*Gasterosteus aculeatus*), staghorn sculpin (*Leptocottus armatus*), and starry flounder (*Platichthys stellatus*).

The S-CCC steelhead, CRLF, and western pond turtle are known to occur in the lagoon and Carmel River, and are therefore present within the aquatic areas of the Project Study Area. Migratory waterfowl and some seabird species, including California brown pelican, may also occur within the aquatic areas of the Project Study Area. No special-status plant species were identified within the aquatic habitat areas.

The aquatic areas within the Project Study Area meet the definition of other waters under the jurisdiction of the USACE and RWQCB. Additionally, the aquatic areas provide habitat for special-status species, including the federally listed CRLF and S-CCC steelhead, and therefore may be considered ESHA by the CCC and critical habitat by the Service and NMFS. As such, this area is considered a sensitive habitat.

DEVELOPED

***A Manual of California Vegetation* classification**: None

Approximately 2.7 acres of developed area occur within the Project Study Area (Figure 8). These include the State Parks parking lot and facilities, and the associated access roads. Most of the developed areas within in the Project Study Area are completely devoid of vegetation. However, some areas, such as the area surrounding the State Parks facilities in the southern portion of the Project Study Area, include vegetation dominated by annual grasses, poison hemlock, and wild radish.

Common species that may occur within the developed areas are similar to those described above for the ruderal grassland. These areas considered to have low biological value, as very little vegetation is present to provide habitat.

Raptors and other migratory bird species, including white-tailed kite (*Elanus leucurus*), may forage and nest within trees that occur within and adjacent to ruderal areas. No special-status plant species were identified within the ruderal areas.

While this habitat may be marginally used by some special-status species, it is not the primary habitat for any. In addition, this vegetation type is not identified as sensitive on the Department's *Natural Communities List* (Department, 2010). This vegetation type is not considered sensitive for the purposes of this analysis.

5.2. Special-Status Species

Published occurrence data within the Project Study Area and surrounding USGS Quads were evaluated to compile a table of special-status species known to occur in the vicinity of the Project Study Area (Please refer to "Methods Section"). Each of these species was evaluated for their likelihood to occur within and immediately adjacent to the Project Study Area and the three project components (Appendix A).[7] The special-status species that are known to or have been determined to have a moderate or high potential to occur within or immediately adjacent the Project Study Area are discussed below. All other species presented in Appendix A are assumed "unlikely to occur," have a

[7] Please see Appendix A for the evaluation standards for the potential for species to occur.

Table 6-2. Potential for Special-Status Wildlife Species Presence within Project Components[8]

Species	Project Study Area	EPB		SRPS	ISMP
		Construction Area	*Area Affected by WSE*		
Southern sea otter	Moderate	Unlikely	Unlikely	Low	Low
Monterey dusky-footed woodrat	Present	Unlikely	Present	Unlikely	Unlikely
Harbor seal	Moderate	Unlikely	Unlikely	Low	Low
California sea lion	Moderate	Unlikely	Unlikely	Low	Low
Tricolored blackbird	Moderate	Moderate	Moderate	Unlikely	Unlikely
Western burrowing owl	Moderate	Unlikely	Moderate	Unlikely	Unlikely
Western snowy plover	Present	Unlikely	Unlikely	High	High
California horned lark	Moderate	Unlikely	Moderate	Unlikely	Unlikely
California brown pelican	Present	Unlikely	Unlikely	High	High
Sharp-shinned hawk	Moderate	Low	Low	Unlikely	Unlikely
Ferruginous hawk	Moderate	Low	Moderate	Unlikely	Unlikely
Northern harrier	Moderate	Moderate	Moderate	Unlikely	Unlikely
White-tailed kite	Present	Moderate (Adjacent)	High	Moderate (Adjacent)	Unlikely
Merlin	Moderate	Low	Moderate	Unlikely	Unlikely
American peregrine falcon	Moderate	Low	Moderate	Unlikely	Unlikely
Osprey	Moderate	Low	Moderate	Unlikely	Unlikely
California legless lizard	Present	Unlikely	Present	Present	Unlikely
Western pond turtle	Present	Present	Present	Unlikely	Unlikely
California red-legged frog	Present	Present	Present	Unlikely	Present
S-CCC steelhead	Present	Present	Present (When Inundated)	Present (When Inundated)	Present
Smith's blue butterfly	Assumed Present	Not Present	Assumed Present	Assumed Present	Not Present

[8] The Project Study Area consists of all areas that have the potential to be impacted by the Project, including portions of the lagoon that may be affected by indirect, permanent changes in WSE. Project components consists of areas within the Project Study Area that will be directly affected by the construction and operation of the various Project components. A species may have the potential to occur in a portion of the Project Study Area, such as the lagoon, but may have a lesser potential to occur within or be directly affected by the construction of a Project component.

low potential to occur but are unlikely to be impacted for the species-specific reasons presented, or were determined "not present" based on the results of focused surveys[9].

Southern Sea Otter

The southern sea otter is the largest member of the weasel family, Mustelidae, and the smallest marine mammal species in North America. Sea otters occupy hard- and soft-sediment marine habitats in the shallow coastal waters, ranging from 0.5 to one mile from shore. They generally forage at depths of less than 80 feet, feeding on invertebrates associated with kelp forests (e.g., abalone, sea urchins, crabs, chitons, mussels, and clams). They utilize kelp forests as a refuge from predation by white sharks and winter storms, and as nursery areas. Sea otters give birth to a single pup each year, mostly occurring from late February to early April.

The main threats to this species are habitat degradation (including oil spills and other environmental contaminants) and human disturbance (including shooting, entanglement in fishing gear, and harassment). Once distributed along the west coast from central Baja California to Alaska, sea otters were hunted nearly to extinction between 1741 and 1911. The estimated number of otters before commercial exploitation ranges from approximately 16,000 to 20,000 individuals; the current population contains about 2,000 individuals. Sea otters have been referred to as "keystone species" (a species that despite low biomass exerts strong effects on the structure of the communities they inhabit) because they can have significant impacts on sea urchin populations, which in turn may affect the kelp forest structure.

The CNDDB does not report any occurrence of Sothern sea otters within the Project Study Area. However, southern sea otters are known to occur within Carmel Bay and may use the coastal strand habitat within the Project Study Area.

Monterey Dusky-Footed Woodrat

The Monterey dusky-footed woodrat is a Department species of special concern. This is a subspecies of the dusky-footed woodrat *(Neotoma macrotis)*, which is common to oak woodlands and other forest types throughout California. Dusky-footed woodrats are frequently found in forest habitats with moderate canopy cover and a moderate to dense understory, including riparian forests; however, they may also be found in chaparral communities. Relatively large nests are constructed of grass, leaves, sticks, and feathers and are built in protected spots, such as rocky outcrops or dense brambles of blackberry and/or poison oak. Typical food sources for this species include leaves, flowers, nuts, berries, and truffles. Dusky-footed woodrats may be a significant food source for small- to medium-sized predators. Populations of this species may be limited by the availability of nest material. Within suitable habitat, nests are often found in close proximity to each other.

The CNDDB does not report any occurrences of Monterey dusky-footed woodrat within the five quadrangles reviewed; however, this species is known to occur throughout Monterey County. Woodrat nests were observed within the riparian habitat within the Project Study Area and are assumed present where suitable habitat occurs.

[9] Focused surveys for special-status plant species were conducted in March, April, and May 2015. No special-status plant species were observed during these surveys, therefore, special-status plants are not discussed further within this document.

Pinnipeds

Pinnipeds known to occur in the Carmel Bay include the California sea lion and harbor seal. These species are discussed together due to similar habitat requirements. Harbor seals are residents in the bay throughout the year, while California sea lions are most common during fall and spring migrations between southern breeding areas and northern feeding areas. These species come ashore at numerous locations in Carmel Bay to rest at haul-out sites. These areas are usually isolated locations relatively free from land predators and removed from human harassment, and, thus, haul-out sites are the most important habitats for pinnipeds. The CNDDB does not report any occurrences of these species within the Project Study Area; however, California sea lions and harbor seals may use the coastal strand habitat within the Project Study Area as a haul-out or resting site.

Tricolored Blackbird

The tricolored blackbird is a California State candidate for listing as threatened or endangered and is also protected under the MBTA. This species is common locally throughout the Central Valley and in coastal districts from Sonoma County south. These birds are summer residents in northeastern California, occurring regularly only at Tule Lake, but found as far south as Honey Lake in some years. In winter, this species becomes more widespread along the central coast and San Francisco Bay area (Grinnell and Miller, 1944). Tricolored blackbirds breed near fresh water, preferably in emergent wetlands with tall, dense cattails or tules, but also in thickets of willow, blackberry, wild rose, and tall herbs, which also serve as their preferred nesting habitat. Nests are built of mud and plant materials, and this species is highly colonial; the minimum nesting colony size is about 50 pairs (Grinnell and Miller, 1944). Drinking water is probably required, at least when seeds and grains are the major foods.

The CNDDB reports three occurrences of tricolored blackbird within the five quadrangles reviewed, the nearest of which is located approximately eight miles from the Project Study Area. Roberson (2002) reports that although this species occurs at the lagoon, breeding has not been documented within the area. Additionally, breeding was not documented at the lagoon in the 2008 or 2011 statewide survey for tricolored blackbirds (Information Center for the Environment [University of California, Davis], 2016). Suitable habitat for this species is present within the semi-permanent emergent marsh, riparian, and disturbed herbaceous mosaic vegetation types.

Western Burrowing Owl

Western burrowing owls are a Department species of special concern and are also protected under the MBTA. Burrowing owls are a year-round resident of open, dry grassland and desert vegetation types, and grass, forb and open shrub stages of pinyon-juniper and ponderosa pine vegetation types. In general, burrowing owls frequent open grasslands and shrublands with perches and burrows. Burrowing owls use rodent burrows (often California ground squirrel) for roosting and nesting cover. These burrows are lined with excrement, pellets, debris, grass, and feathers (occasionally are unlined). Pipes, culverts, and nest boxes may be substituted for burrows in areas where burrows are not available. Breeding occurs from March through August, with the peak occurring in April and May. This species is semi-colonial and is probably the most gregarious owl in North America. Burrowing owls eat mostly insects, but small mammals, reptiles, birds, and carrion are also taken. This species usually hunts from a perch and hovers, hawks, dives, and hops after prey on the ground. Conversion of grassland to agriculture, poisoning of ground squirrels, and other forms of habitat destruction have led to the reduction in their numbers in the recent decades.

The CNDDB reports three occurrences of western burrowing owl within the five quadrangles reviewed, the nearest of which is located approximately four miles from the Project Study Area. Roberson (2002) reports that this species occurs during the winter on the south side of the Carmel River mouth; however, breeding has not been documented within the area. Suitable habitat for this species is present within the non-native annual grassland habitat.

Western Snowy Plover

The western snowy plover was listed as a federally Threatened species on March 5, 1993 (58 FR 12864-12874). Additionally, the western snowy plover is protected under the MBTA. This species is associated with sandy marine and estuarine shores and also occurs rarely occurs at salt ponds. Snowy plovers require a flat, sandy, gravelly or friable soil substrate for nesting. Snowy plover nests are shallow depressions in the sand or soil, sometimes lined with small pebbles, glass fragments, or gravel. Nests are often near objects such as driftwood, rocks, or defoliated bushes, although nests may also be found on barren ground with no nearby cover. Nests are typically within 100 meters (328 feet) of water, but can be several hundred meters away where no vegetative barrier exists between the nest and water (Service, 2007). The breeding season in California typically begins in early March and extends through August. Clutch size is typically two to six eggs and chicks reach fledging age approximately one month after hatching (Service, 2007). Snowy plovers glean insects and amphipods from the dry sand of upper beaches along the coast, occasionally foraging in wet sand for young sand crabs. Gulls, ravens, coyotes, and skunks are predators of adults, eggs, and young. The historical nesting of snowy plovers on sandy marine beaches has brought them into constant contact with humans using these areas for recreation.

The CNDDB reports six occurrences of western snowy plover within the five quadrangles reviewed, the nearest of which is located approximately 4.6 miles from the Project Study Area. Roberson (2002) reports that this species may winter at the Carmel River State Beach near the mouth of the lagoon and individual snowy plovers were reported at the beach adjacent to Scenic Road during surveys conducted in the summer of 2012 (HTH, 2013). Suitable habitat is present within the coastal strand area of the Project Study Area; however, although snowy plovers may utilize the beach, they have never been documented to breed within this area (Roberson, 2002; HTH, 2013).

California Horned Lark

California horned lark is included on the Department's CNDDB "Special Animals" list and is also protected under the MBTA. California horned larks are a common to abundant resident in a variety of open habitats and are frequently found in grasslands with low, sparse vegetation. This species builds a grass-lined cup nest in a depression on the ground, generally in the open. Breeding occurs between March and July, with peak activity occurring in May. California horned larks often form large flocks which forage and roost gregariously after breeding. This species eats mainly insects, snails, and spiders during the breeding season, and add grass and forb seeds (as well as other plant material) to their diet seasonally.

The CNDDB reports two occurrences of California horned lark within the five quadrangles reviewed, the nearest of which is approximately 13 miles from the Project Study Area. Suitable foraging and nesting habitat for this species is present within the non-native annual grassland, disturbed herbaceous mosaic, and ruderal grassland vegetation types at within the Project Study Area.

California Brown Pelican

The California brown pelican is a California fully protected species and is also protected under the MBTA. This species is found in estuarine, marine subtidal, and marine pelagic waters along the California coast. California brown pelicans usually rest of water on inaccessible rocks (either offshore or on mainland), but also use mudflats, sandy beaches, wharfs, and jetties. Breeding occurs on the Channel Islands and in Mexico from March to early August, after which the brown pelicans disperse along the entire California coast. Small number of individuals will also visit the Salton Sea and Colorado River reservoirs. California brown pelicans forage mainly in the early morning or late afternoon, or when the tide is rising, and feed almost entirely on fish caught diving from six to 12 meters (20-40 feet) in the air.

The CNDDB reports two occurrences of California brown within the five quadrangles reviewed, the nearest of which is approximately 1.2 miles from the Project Study Area. This species has been observed at the lagoon within the aquatic and coastal strand areas (State Parks, 2002b, 2008a); however; suitable nesting and communal roosting habitat is not present within the Project Study Area.

Nesting Raptors and Other Migratory Bird Species

Raptors and their nests are protected under Fish and Game Code and the MBTA. While the life histories of these species vary, overlapping nesting and foraging similarities (approximately February through August) allow for their concurrent discussion. Most raptors are breeding residents throughout most of the wooded portions of the state. Stands of live oak, riparian deciduous, or other forest vegetation types, as well as open grasslands, are used most frequently for nesting. Breeding occurs February through August, with peak activity May through July. Prey for these species includes small birds, small mammals, and some reptiles and amphibians. Many raptor species hunt in open woodland and habitat edges. Various common raptor species (such as red-tailed hawk, red-shouldered hawk, great horned owl, western screech owl, American kestrel, and turkey vulture [*Cathartes aura*]) have a potential to nest within any of the large trees present within and adjacent to the Project Study Area, which includes dense willows and several individuals or small clusters of cypress, Monterey pine, coast live oak, and eucalyptus trees. Several special-status raptor species are known to occur within the Project Study Area (State Parks, 2002b). White-tailed kite is known to breed within the Project Study Area and this species was observed foraging over the non-native annual grassland by DD&A biologists during surveys in June 2014. The sharp-shinned hawk historically bred within the Project Study Area and suitable nesting and foraging habitat for this species is present. Other special-status raptor species that are known to occur within the Project Study Area but do not breed there include: ferruginous hawk, northern harrier, merlin, American peregrine falcon, and osprey[10].

Suitable nesting and foraging habitat for several other avian species protected under the MBTA is also present within the Project Study Area. Migratory bird species known to occur within the Project Study Area includes, but is not limited to, common poorwill (*Phalaenoptilus nuttallii*), western meadowlark, Townsend's warbler (*Setophaga townsendii*), black phoebe (*Sayornis nigricans*), white-crowned sparrow, California thrasher (*Toxostoma* redvivum), ash-throated flycatcher (*Myiarchus cinerascens*), American coot, great blue heron, pied-billed grebe, great egret, mallard and tree swallow. Additional migratory bird species that may occur within the Project Study Area are presented in Appendix C.

[10] Please refer to Appendix A for species-specific discussions and additional information regarding breeding habitat.

California Legless Lizard

The Department has recognized two subspecies of the California legless lizard as species of special concern, the black legless lizard (*Anniella pulchra* ssp. *nigra*) and silvery legless lizard (A. p. ssp. pulchra. These subspecies are based primarily on phenotypic differences and very limited genetic work. Further, the range of the black legless lizard has historically been classified as "restricted to coastal and interior dune sand other areas of sandy soils in the vicinity of Monterey Bay and the Monterey Peninsula" (Service, 1998), while the range of silvery legless lizard has been classified as widespread throughout central California (Parham and Papenfuss, 2008). However, recent genetic studies have revealed five lineages of this species which correspond with different geographic areas of California (Parham and Papenfuss, 2008). These studies do not, however, identify the legless lizards occurring on the coast of Monterey as a separate lineage. As such, for the purposes of this report, the California legless lizard will be discussed on a species level and not at the Department-recognized subspecies level. Additionally, both subspecies and all lineages will be considered a Department species of special concern.

The California legless lizard is a fossorial (burrowing) species that typically inhabits sandy or loose (friable) soils. Vegetation types known to support this species include (but are not limited to) coastal dunes, valley and foothill grasslands, chaparral, and coastal scrub at elevations from near sea level to approximately 1800 meters (6000 feet). The California legless lizard forages on invertebrates beneath the leaf litter or duff layer at the base of bushes and trees or under wood, rocks, and slash in appropriate vegetation types. Little is known about the specific habitat requirements for courtship and breeding; however, the mating season for this species is believed to begin late spring or early summer, with one to four live young born between September and November. The diet of this species likely overlaps to some extent with that of juvenile alligator lizards and perhaps some other salamanders. California legless lizards eat insect larvae, small adult insects, and spiders. This species may be preyed upon by alligator lizards, snakes, birds, and small mammals.

The CNDDB reports 28 occurrences of California legless lizard within the five quadrangles reviewed. The CNDDB does not present specific location data for these occurrences; however, non-specific occurrences are documented in three of the five quadrangles reviewed, including the Monterey quadrangle. In addition, this species has been observed at the CRMB (State Parks, 2002) and within the foredunes at the beach (State Parks, 2007). Suitable habitat for California legless lizard is present throughout the Project Study Area where appropriate soils and cover conditions occur. Coastal scrub, coastal dune scrub, ruderal coastal dune, and riparian vegetation types provide the most suitable habitat for this species; however, the species may occur also in the non-native annual grassland where suitable soils and cover exist.

Western Pond Turtle

The western pond turtle is a Department species of special concern. Western pond turtles are uncommon to common in permanent or nearly permanent aquatic resources in a wide variety of habitats throughout California, west of the Sierra-Cascade crest and are absent from desert regions, except in the Mojave Desert along the Mojave River and its tributaries. Elevation range extends from near sea level to 1430 meters (4690 feet). Western pond turtles require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks. The home range of western pond turtles is typically quite restricted; however, ongoing research indicates that in many areas, turtles may leave the watercourse in late fall and move into upland habitats where they burrow into duff and/or soil and overwinter (Holland, 1994). However, western pond turtles remain active year-round and may move several times during the course of overwintering. The time spent in the

terrestrial habitat appears highly variable; in southern California, western pond turtles may remain in these sites for only a month or two. In pond and lake habitats, however, some turtles remain in the pond during the winter (Holland, 1994). Additionally, during the spring or early summer, females move overland for up to 325 feet (100 meters) to find suitable sites for egg-laying. Nests are typically excavated in compact, dry soils in areas characterized by sparse vegetation, usually short grasses or forbs (Holland, 1994). Three to 11 eggs are laid from March to August depending on local conditions (Ernst and Barbour, 1972). The western pond turtle is not known to be territorial, but aggressive encounters, including gesturing and physical combat (Bury and Wolfheim, 1973), are common and may function to maintain spacing on basking sites and to settle disputes over preferred spots. This species is considered omnivorous and food sources include aquatic plant material, beetles, and a wide variety of aquatic invertebrates. Fishes, frogs, and carrion have also been reported among their food (Stebbins, 1972).

The CNDDB reports seven occurrences of western pond turtle within the five quadrangles reviewed, including one within the Project Study Area. Additionally State Parks (2002a, 2008a) reports occurrences of this species within the south arm of the lagoon. Suitable habitat for this species includes aquatic areas and the surrounding riparian, emergent marsh, and disturbed herbaceous mosaic vegetation types. Western pond turtles may also utilize the non-native annual grassland habitat as upland or dispersal habitat.

California Red-Legged Frog

The CRLF was listed as a federally Threatened species on June 24, 1996 (61 FR 25813-25833) and is also a Department species of special concern. The CRLF is the largest native frog in California (44-131 mm snout-vent length) and was historically widely distributed in the central and southern portions of the state (Jennings & Hayes, 1994). Adults generally inhabit aquatic habitats with riparian vegetation, overhanging banks, or plunge pools for cover, especially during the breeding season (Jennings and Hayes, 1988). They may take refuge in small mammal burrows, leaf litter, or other moist areas during periods of inactivity or to avoid desiccation (Rathbun, et al., 1993; Jennings and Hayes, 1994). Radiotelemetry data indicates that adults engage in straight-line breeding season movements irrespective of riparian corridors or topography and they may move up to two miles between non-breeding and breeding sites (Bulger et al., 2003). During the non-breeding season, a wider variety of aquatic habitats are used including small pools in coastal streams, springs, water traps, and other ephemeral water bodies (Service, 1996). CRLF may also move up to 300 feet from aquatic habitats into surrounding uplands, especially following rains, where individuals may spend days or weeks (Bulger et al., 2003).

This species requires still or slow-moving water during the breeding season where it can deposit large egg masses, which are most often attached to submergent or emergent vegetation. Breeding typically occurs between December and April depending on annual environmental conditions and locality. Eggs require six to 12 days to hatch and metamorphosis generally occurs after 3.5 to seven months, although larvae are also capable of over-wintering. Following metamorphosis, generally between July and September, juveniles are 25-35 mm in size. Juvenile CRLF appear to have different habitat needs than adults. Jennings and Hayes (1988) recorded juvenile frogs mostly from sites with shallow water and limited shoreline or emergent vegetation. Additionally, it was important that there be small one-meter breaks in the vegetation or clearings in the dense riparian cover to allow juveniles to sun themselves and forage, but to also have close escape cover from predators. Jennings and Hayes also noted that tadpoles have different habitat needs and that in addition to vegetation cover, tadpoles use

mud. It is speculated that CRLF larvae are algae grazers, however, foraging larval ecology remains unknown (Jennings, et al., 1993).

It has been shown that occurrences of CRLF are negatively correlated with presence of non-native bullfrogs (Moyle, 1973; Jennings and Hayes, 1986 and 1988), although both species are able to persist at certain locations, particularly in the coastal zone. It is estimated that CRLF has disappeared from approximately 75% of its former range and has been nearly extirpated from the Sierra Nevada, Central Valley, and much of southern California (Service, 1996).

The CNDDB reports 39 occurrences of CRLF within the five quadrangles reviewed, including one occurrence within the Project Study Area (Figure 9). There are multiple occurrence records of CRLF tadpoles and adults in the south arm of the lagoon, indicating that reproduction occurs there (HTH, 2013). Suitable aquatic breeding and non-breeding habitat, upland habitat, and dispersal habitat is present within the Project Study Area. There are no known CRLF records in the lagoon/wetlands along the north side of the Carmel River.

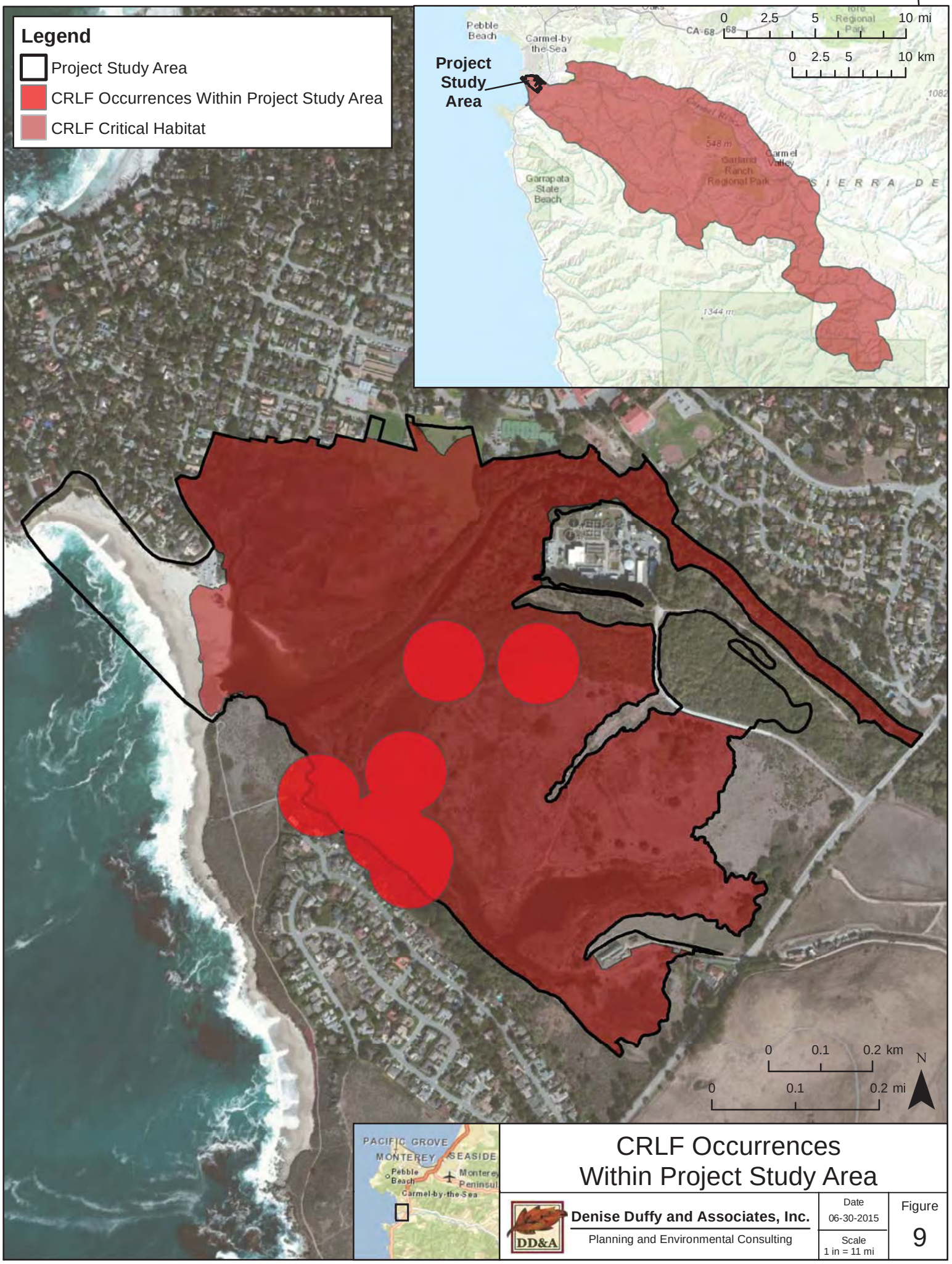
South-Central California Coast Steelhead DPS

The steelhead is currently designated as federally Threatened in all naturally spawned populations (and their progeny) in streams from the Pajaro River (inclusive) located in Santa Cruz County, CA, to (but not including) the Santa Maria River (71 FR 833-862) in San Luis Obispo County.

In North America, steelhead are found in Pacific Ocean drainages from southern California to Alaska. In California, known spawning populations are found in coastal streams from Malibu Creek in Los Angeles County to the Smith River near the Oregon border, and in the Sacramento and San Joaquin River systems. The present distribution and abundance of steelhead in California has been greatly reduced from historical levels. In general, steelhead migrate to sea as two year old fish, spend two years in the ocean, and then return to fresh water to spawn. Peak spawning for steelhead occurs from December through April in small streams and tributaries. Unlike Pacific salmon, steelhead do not necessarily die after spawning, although repeat spawning rates are generally low and vary considerably among populations. Steelhead have traditionally been grouped into seasonal runs according to their peak migration period; in California there are well-defined winter, spring, and fall runs.

The CNDDB reports two occurrences of S-CCC steelhead within the five quadrangles reviewed, including one occurrence within the Project Study Area (Figure 10). Additionally, as described in the Fisheries Report (Appendix B), S-CCC steelhead are known from the Carmel River and Lagoon. Aquatic areas within the Project Study area provide habitat for this species. Additionally, during times of inundation, the semi-permanent emergent marsh, seasonal emergent marsh, and herbaceous mosaic vegetation types may also provide habitat for S-CCC steelhead.

.

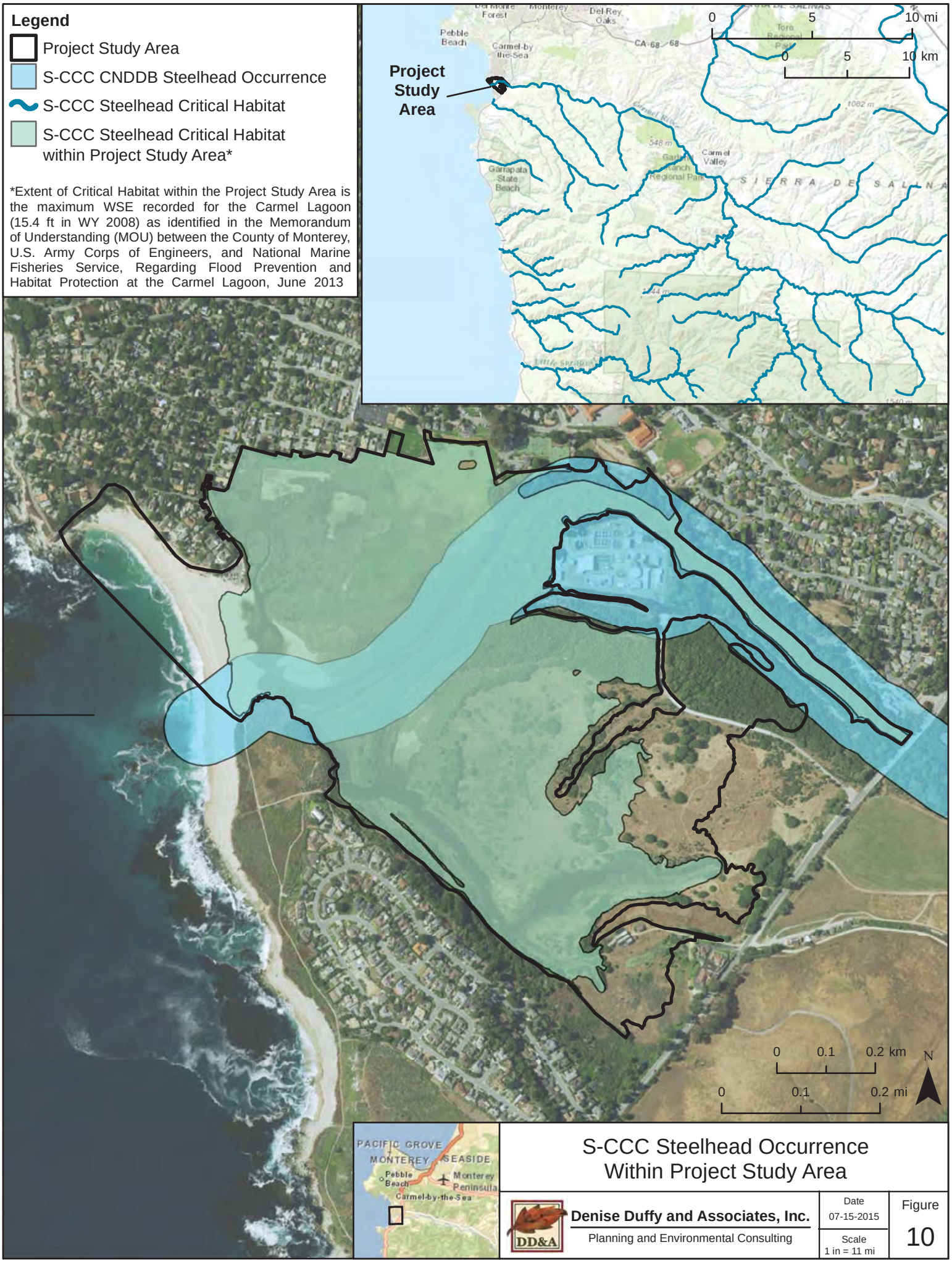


CRLF Occurrences Within Project Study Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 06-30-2015
Scale: 1 in = 11 mi
Figure: 9

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\CRLF Critical Habitat Map.mxd


Legend
Project Study Area
S-CCC CNDDB Steelhead Occurrence
S-CCC Steelhead Critical Habitat
S-CCC Steelhead Critical Habitat within Project Study Area*
*Extent of Critical Habitat within the Project Study Area is the maximum WSE recorded for the Carmel Lagoon (15.4 ft in WY 2008) as identified in the Memorandum of Understanding (MOU) between the County of Monterey, U.S. Army Corps of Engineers, and National Marine Fisheries Service, Regarding Flood Prevention and Habitat Protection at the Carmel Lagoon, June 2013
Project Study Area
Del Monte Forest
Monterey
Del Rey Oaks
Pebble Beach
Carmel-by the-Sea
CA-68
Carmel Valley
Garrapata State Beach
SIERRA DE SALINAS
0 5 10 mi
0 5 10 km
0 0.1 0.2 km
0 0.1 0.2 mi
N
PACIFIC GROVE
MONTEREY
SEASIDE
Pebble Beach
Monterey Peninsula
Carmel-by-the-Sea
S-CCC Steelhead Occurrence Within Project Study Area
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date
07-15-2015
Scale
1 in = 11 mi
Figure
10
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\Steelhead Occurrence and CH.mxd

Smith's Blue Butterfly

SBB was listed as a federally Endangered species on June 1, 1976 (41 FR 22041-22044). This species historically ranged along the California coast from Monterey Bay south through Big Sur to near Point Gorda, occurring in scattered populations in association with coastal dune, coastal scrub, chaparral, and grassland vegetation types. The primary limiting factor for SBB populations is the occurrence of their host plants, dune buckwheat and coast buckwheat (*Eriogonum latifolium*), in which they are associated with for their entire life span. There is also a potential for SBB to use naked buckwheat (*E. nudum*) within a range of the obligate host species (pers. comm. Dave Dixon, State Parks). The presence of the host plant, however, is not always an indication of the occurrence of the butterfly, as the host plant distribution is much more extensive than that of the butterfly.

Individual adult males and females live approximately one week. Adult emergence and seasonal activity is synchronized with the blooming period of the particular buckwheat used at a given site. Dispersal data from capture-recapture studies (Arnold, 1983) indicate that most adults are quite sedentary, with home ranges no more than a few acres. SBB has only one generation per year. Females lay single eggs into buckwheat flower heads, which hatch in approximately one week. Caterpillars mature over a span of approximately three to four weeks, feeding on petals and seeds of the buckwheat plant. Chrysalis formation then takes place in the buckwheat flower head and the chrysalis eventually falls in to the leaf litter and topsoil beneath the plant where it remains for approximately 47 weeks until the cycle begins again (Dixon, 1999).

The CNDDB reports 36 occurrences of SBB within the five quadrangles reviewed, the nearest of which is located approximately one mile from the Project Study Area. However, dune buckwheat plants that may provide habitat for SBB are present within the coastal dune scrub habitat, located directly adjacent to the Carmel River State Beach parking lot next to Scenic Road, and within the non-native annual grassland habitat near the south arm of the lagoon (Figure 11). The presence of SBB within the Project Study Area is assumed based on the presence of the host plant and the known occurrences of the species within the vicinity.

5.3. Sensitive Habitats

Several sensitive habitats were identified within the Project Study Area. Table 5-3 identifies the acreage of sensitive habitats within the Project Study Area and within each of the project components. These habitats may be considered ESHA by the CCC as they occur in the coastal zone. In addition, under Section 30107.5 of the CCA, an "environmentally sensitive area" is any area in which plant or animal life or their habitat are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. Therefore, the CCC may designate additional habitat areas within the Project Study Area as ESHA if CCC determines that it meets this definition.



SBB Habitat Within Project Study Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 06-30-2015
Scale: 1 in = 11 mi
Figure: 11

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\SBB Habitat Map.mxd

Table 5-3. Sensitive Habitats within the Project Study Area and Project Components[11]

Sensitive Habitat	Project Study Area	EPB	SRPS	ISMP
Riparian	69.1	0.1	0	Not Present[12]
Federal Wetlands	49.0	2.7	0	Not Present
Other Waters of the U.S.	32.0	0	0.3	Present
Coastal Wetlands/Waters of the State	133.3	3.0	0	Not Present
Active Beach	7.9	0	2.4	Present
SBB Habitat	0.2	0	0.2	Not Present
CRLF Critical Habitat	186.9	4.3	0.3	Present
S-CCC Steelhead Critical Habitat	154.9	4.3	0.3	Present

RIPARIAN

Approximately 69.1 acres of riparian habitat is present within the Project Study Area (Figure 12). The riparian habitat within the Project Study Area supports vegetation characteristic of Arroyo willow thickets, as described in the *Manual of California Vegetation* (Sawyer, et al., 2009), which is identified as sensitive on the Department's *Natural Communities List* (Department, 2010). Riparian habitat is also regulated under Sections 1600-1616 of the Fish and Game Code, and may also be considered waters of the state by the RWQCB and ESHA by the CCC. In addition, portions of this vegetation type meet the definition of wetlands under the jurisdiction of the USACE and all of this vegetation type meets the definition of wetlands under the jurisdiction of the CCC. Please refer to the discussion of Wetlands and Other Waters below. Portions of the riparian vegetation within the Project Study Area are also critical habitat for the federally listed CRLF and S-CCC. Please refer to the discussion in the Critical Habitat section below.

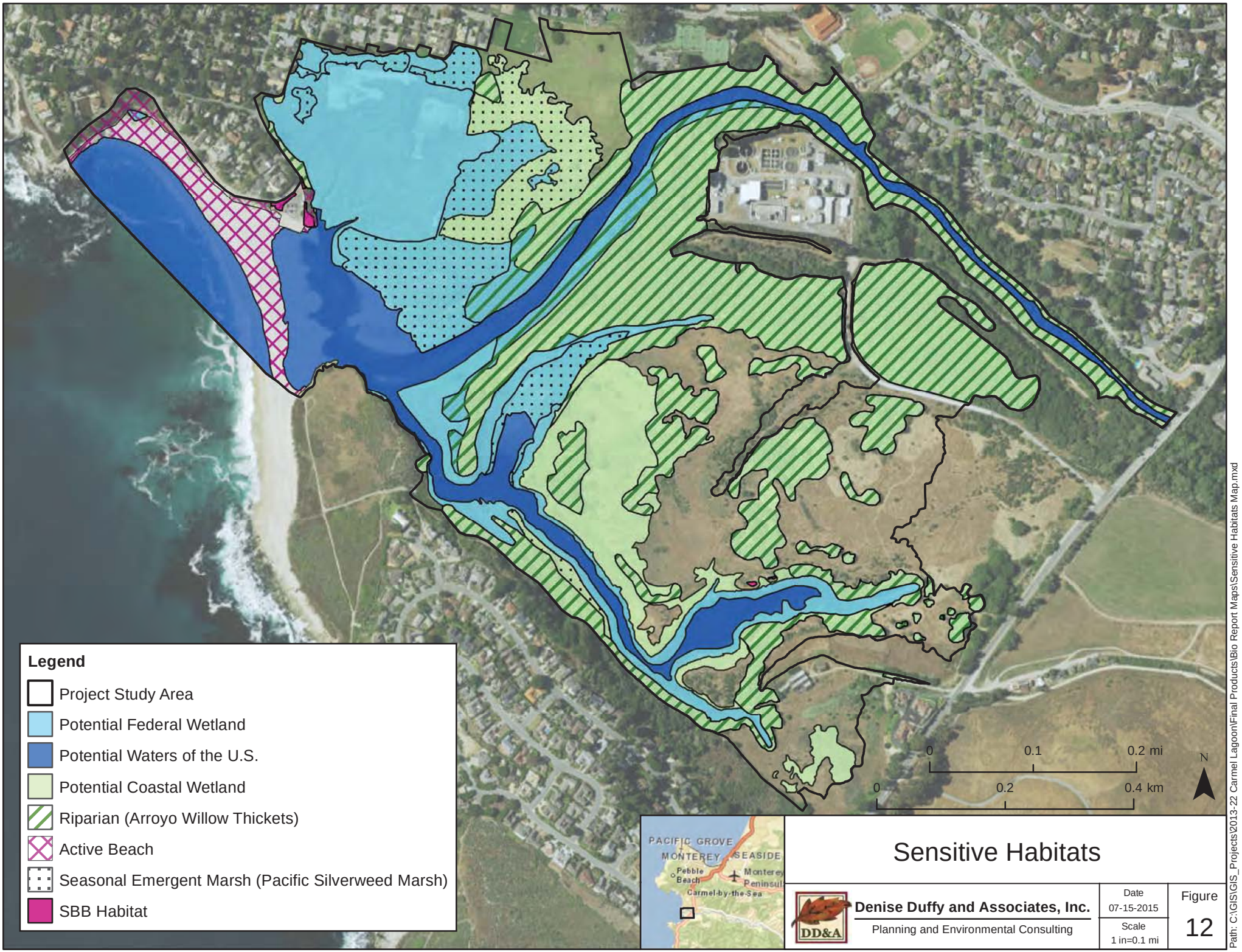
WETLANDS AND OTHER WATERS

Approximately 49.0 acres of federal wetlands and 32.0 acres of other waters of the U.S. potentially under the jurisdiction of the USACE were identified within the Project Study Area (Figure 12; Appendix F). The mapping of potential other waters of the U.S. is based on the presence of an ordinary high water (OHW) mark associated with the un-vegetated bed of the Carmel River and un-vegetated portions of the Carmel Lagoon.

Approximately 133.3 acres of coastal wetlands potentially under the jurisdiction of CCC were identified within the Project Study Area (Figure 12). These coastal wetlands may also be considered waters of the state under the jurisdiction of the RWQCB. This number includes potentially federally jurisdictional wetlands and additional areas that met only one or two parameters. The mapping of coastal wetlands/waters of the state beyond those identified as federal is based on the distribution of wetland plant species.

[11] The Project Study Area consists of all areas that have the potential to be impacted by the Project, including portions of the lagoon that may be affected by indirect, permanent changes in WSE. Project components consists of areas within the Project Study Area that will be directly affected by the construction and operation of the various Project components.

[12] Due to the dynamic nature of the sandbar and the implementation process of the ISMP, the area of sensitive habitat within the ISMP cannot be calculated. As such, Table 5-3 only identifies whether sensitive habitats are present within the ISMP implementation area or not.



Sensitive Habitats

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 07-15-2015
Scale: 1 in=0.1 mi
Figure: 12

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Bio Report Maps\Sensitive Habitats Map.mxd

A number of vegetation types make up the areas identified as wetland. Areas identified as potential federal wetlands include the entire semi-permanent emergent marsh and portions of the riparian and seasonal emergent marsh vegetation types. Areas identified as potential coastal wetlands include the entirety of these three vegetation types, as well as the disturbed herbaceous mosaic vegetation type. In addition to protection under the CWA and CCA, the seasonal emergent marsh supports vegetation characteristic of "Pacific silverweed marsh," as described in the *Manual of California Vegetation* (Sawyer, et al., 2009), which is identified as sensitive on the Department's *Natural Communities List* (Department, 2010). Riparian vegetation is also identified as a sensitive habitat on the Department's *Natural Communities List*, as described above. As such, approximately 91.3 acres of wetlands (22.2 acres of seasonal emergent marsh and 69.1 acres of riparian) are also considered sensitive and under the jurisdiction of the Department.

Wetlands within the Project Study Area are also critical habitat for the federally listed CRLF and S-CCC. Please refer to the discussion in the Critical Habitat section below.

ACTIVE BEACH

The active beach within the Project Study Area is present within the Coastal Zone and may be considered ESHA by the CCC. This may include the coastal strand, coastal dune scrub, dune swale wetland, and ruderal coastal dune vegetation types as described in Section 5.1 above. Approximately 7.9 acres of active beach is present within the Project Study Area (Figure 12).

SBB HABITAT

Approximately 0.2 acre of dune buckwheat plants is present within the Project Study Area (Figures 11 and 12). These plants may provide habitat for the federally Endangered SBB. These plants are present within the Coastal Zone and therefore, this habitat may be considered ESHA by the CCC. This habitat is also protected by the Service under ESA.

CRITICAL HABITAT

CRLF

Critical habitat was designated for CRLF on April 13, 2006 (71 FR 19244-19346) and revised on March 17, 2010 (75 FR 12816-12959). The revised critical habitat went into effect on April 16, 2010. The primary constituent elements (PCEs) CRLF critical habitat are:

1) **Aquatic Breeding Habitat:** Standing bodies of fresh water (with salinities less than 7.0 ppt.), including natural and manmade ponds, slow moving streams or pools within streams, and other ephemeral or permanent water bodies that typically become inundated during winter rains and hold water for a minimum of 20 weeks in all but the driest years.

2) **Non-Breeding Aquatic Habitat:** Fresh water habitats, as described above, that may or may not hold water long enough for the subspecies to hatch and complete its aquatic life cycle but that do provide for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult CRLF. Other wetland habitats that would be considered to meet these elements include, but are not limited to: plunge pools within intermittent creeks; seeps; quiet water refugia during high water flows; and springs of sufficient flow to withstand the summer dry period.

3) **Upland Habitat:** Upland areas within 200 feet (60 meters) of the edge of the riparian vegetation or dripline surrounding aquatic and riparian habitat, and comprised of various vegetational series such as grasslands, woodlands, and/or wetland/riparian plant species that

provides the frog shelter, forage, and predator avoidance. Upland features are also essential in that they are needed to maintain the hydrologic, geographic, topographic, ecological, and edaphic features that support and surround the wetland or riparian habitat. These upland features contribute to the filling and drying of the wetland or riparian habitat and are responsible for maintaining suitable periods of pool inundation for larval frogs and their food sources, and provide breeding, non-breeding, feeding, and sheltering habitat for juvenile and adult frogs (e.g., shelter, shade, moisture, cooler temperatures, a prey base, foraging opportunities, and areas for predator avoidance). Upland habitat can include structural features such as boulders, rocks and organic debris (e.g. downed trees, logs), as well as small mammal burrows and moist leaf litter.

4) **Dispersal Habitat:** Accessible upland or riparian dispersal habitat within designated units and between occupied locations within 0.7 mile (1.2 km) of each other that allows for movement between such sites. Dispersal habitat includes various natural habitats and altered habitats such as agricultural fields, which do not contain barriers to dispersal (an example of a barrier to dispersal is a heavily traveled road constructed without bridges or culverts). Dispersal habitat does not include moderate to high density urban or industrial developments with large expanses of asphalt or concrete, nor does it include large reservoirs over 50 acres (20 ha) in size, or other areas that do not contain those features identified in PCE 1, 2, or 3 as essential to the conservation of the subspecies.

The Project Study Area is located within CRLF critical habitat mapping unit MNT-2 (Figure 9). The Project Study Area contains all PSEs. Approximately 186.9 acres of CRLF critical habitat is present within the Project Study Area (Figure 9). As identified above, CRLF critical habitat includes wetlands and other waters, and portions of the riparian vegetation. Other vegetation types included in the CRLF critical habitat include non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, and coastal scrub.

S-CCC Steelhead

The designation of critical habitat for S-CCC steelhead became effective on September 2, 2005 (70 FR 52487-52627). The lateral extent of critical habitat for S-CCC steelhead is the width of the stream channel, defined as the ordinary high-water mark as defined by the USACE in 33 CFR 329.11. In areas for which ordinary high-water has not been defined pursuant to 33 CFR 329.11, the width of the stream channel is defined by its bankfull elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

The PCE's of S-CCC steelhead critical habitat include:

1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
2) Freshwater rearing sites with:
    i. Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    ii. Water quality and forage supporting juvenile development; and
    iii. Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
4) Estuarine areas free of obstruction and excessive predation with:
    i. Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;
    ii. Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and
    iii. Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Carmel River and Lagoon is designated critical habitat for S-CCC steelhead. Per the definition of the lateral extent of critical habitat, extreme high water is the extent of the critical habitat within the Carmel Lagoon. The maximum WSE recorded for the Carmel Lagoon is at 15.4 feet in 2008, as identified in the MOU. Approximately 154.9 acres of S-CCC steelhead critical habitat is present within the Project Study Area (Figure 10). As identified above, S-CCC steelhead critical habitat includes wetlands and other waters, and portions of the riparian vegetation. Other vegetation types included in the S-CCC steelhead critical habitat include non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, and coastal scrub.

Chapter 6. Impacts and Mitigation

6.1. Thresholds of Significance

In accordance with Appendix G of the State CEQA Guidelines, a project impact would be considered significant if the Proposed Project would:

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 Department or Service; or

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 Department or Service; or

c) have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the CWA (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means; or

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; or

e) conflict with the provisions of an adopted HCP, NCCP, or other approved local, regional, or state habitat conservation plan

6.2. Impact Analysis Overview

AREAS OF NO IMPACT

No adopted HCPs have been developed for the Project Study Area. Therefore, the project will not conflict with the provisions of an adopted HCP and significance criterion E is not applicable to the proposed project.

APPROACH TO ANALYSIS

This impact analysis addresses direct and indirect impacts that may result from the construction/implementation and operation of the three Proposed Project components (i.e., EPB, SRPS, and ISMP). Direct impacts are those effects of a project that occur at the same time and place of project implementation, such as removal of habitat from ground disturbance. Indirect impacts are those effects of a project that occur either later in time or at a distance from the project location but are reasonably foreseeable, such as changes in the WSE of the lagoon. Direct and indirect impacts can also vary in duration and result in temporary, short-term, and long-term effects on biological resources. A temporary effect would occur only during the activity. A short-term effect would last from the time an activity ceases to some intermediate period of approximately 1-5 years (i.e., revegetation of areas disturbed by construction). A long-term or permanent effect would last longer than 5 years after an activity ceases. Long-term effects may include the ongoing maintenance and operation of a project, or may result in a permanent change in the condition of a resource, in which case it could be considered a permanent impact. The biological analysis herein includes a comprehensive, detailed analysis of the biological resources present or with the potential to occur within the Project Study Area and the Project components. The Project Study Area consists of all areas that have the potential to be impacted by the Project, including portions of the lagoon that may be affected by indirect, permanent changes in WSE. Project components consist of areas within the

Project Study Area that will be directly affected by the construction and operation of the various Project components.

Direct impacts may result from construction of the EPB and SRPS, and implementation of the ISMP. These are short-term impacts and are identified below as "construction impacts." Indirect impacts may result from the function of the EPB and SRPS. These are long-term impacts and are identified below as "operational impacts." The implementation of the ISMP project component would not involve the construction of any permanent structures requiring operation and maintenance, and would not occur in the long-term. In addition, the implementation of the ISMP would involve activities similar to short-term construction activities, primarily ground-disturbing activities to breach the Lagoon. Therefore, the potential impacts associated with the implementation of the ISMP are considered in the construction impact analysis and this component is not analyzed as a long-term, operational impact.

While there is the potential for short-term direct and indirect impacts to biological resources associated with the construction of the EPB and SRPS and the implementation of the ISMP, the long-term effects of the Proposed Project on the lagoon ecosystem will be beneficial. Breaching dynamics directly affect lagoon stage (WSE), which in turn determines aquatic habitat volume and area, as well as water quality. Artificial breaching has disrupted seasonal flow and sediment dynamics for decades, directly impacting aquatic and terrestrial habitat. Historical, artificial breaching actions have had deleterious effects on the lagoon habitat conditions, which differ significantly from what would have occurred with a natural opening and closing regime.

The Proposed Project will facilitate a reduction in mechanical breaching of the lagoon sandbar. Reducing mechanical breaching to only true flooding emergencies will allow for improved hydrological and morphological processes to occur, increasing the depth and duration of inundation of the lagoon. In addition, breaching at the north end of the lagoon facilitates a longer and more natural outflow channel, improving conditions for fish and wildlife within the lagoon by allowing for a perched morphology and avoiding a rapid drawdown.

The lagoon is a dynamic environment, with the depth and duration of inundation dependent on a large number of contributing factors such as barrier beach height and geomorphology, precipitation, tide, and wind. The exact results of the implementation of the Proposed Project on biological resources cannot be characterized in the context of annual lagoon dynamics because the combination of factors described above interact in a unique and independent way for any given event; be it flood event or lagoon closure subsequent to the wet season. Rigorous analysis shows that the implementation of the Proposed Project may have little effect in the context of current conditions in some years (Balance, 2014). However, this analysis also shows that under certain critical circumstances the project would have a significant effect on the lagoon in reducing the number of emergency breaches, extending the depth and duration of inundation, and reducing the drawdown rate of both natural and emergency breaches. Based on an analysis of the last 20 years for which data exists, the implementation of the Proposed Project has the potential to increase the depth of the lagoon by approximately two feet in the fall/early winter when the lagoon is filling prior to first breach. The duration of this increased WSE would be negligible in most years, but may extend a number of days or even weeks under certain conditions (approximately 25% of the years evaluated).

Several special-status species are known or have the potential to occur within the Project Study Area. This includes four federally listed species: CRLF, S-CCC steelhead, western snowy plover, and SBB; one candidate species for state listing: tricolored blackbird; three fully protected species: California

brown pelican, white-tailed kite, and American peregrine falcon; five California species of special concern: Monterey dusky-footed woodrat, western burrowing owl, northern harrier, California legless lizard, and western pond turtle; nine species on the Department's CNDDB "Special Animals" list: California horned lark, sharp-shinned hawk, ferruginous hawk, merlin, and osprey; and three species protected under the MMPA: southern sea otter, harbor seal, and California sea lion. Additionally, raptors and other avian species protected under the MBTA have the potential to occur within the Project Study Area. No special-status plant species were identified within the Project Study Area during focused surveys and none are expected to occur. Therefore, the Proposed Project will not result in impacts to special-status plant species.

Several sensitive habitats also occur within the Project Study Area. This includes riparian habitat; federal and coastal wetlands and other waters of the U.S. and state; active beach SBB habitat; and critical habitat for CRLF and S-CCC steelhead. The regulatory agencies with potential jurisdiction over these sensitive habitat overlap in many areas and includes the Department, USACE, CCC, Service and RWQCB.

Although the special-status species identified above are known of have the potential to occur within the Project Study Area, not all species have the potential to be impacted by the Proposed Project. Suitable foraging habitat for the western snowy plover, ferruginous hawk, merlin, California brown pelican, American peregrine falcon, and osprey is present within the Project Study Area; however, these species are not expected to nest within the construction areas and the amount of suitable foraging habitat will not be affected by an increase in WSE. Additionally, southern sea otters, harbor seals, and California sea lions have the potential to use the coastal strand habitat within the Project Study Area as a haul-out or resting site; however, due to their mobility, the short duration of construction, and the continual disturbance within the area, no impacts to these species is expected. Therefore, these species will not be discussed further.

6.3. Construction Impacts and Mitigation Measures

Impact 1: <u>Construction Impacts to Special-Status Species and Habitat.</u> Proposed Project construction would not have a substantial adverse effect, either directly or through habitat modification, on special-status wildlife species and their habitat within the Project Study Area. (Criteria a, b, c, and d) (Less-than-Significant with Mitigation)

Construction of the Proposed Project may result in direct and indirect impacts to special-status wildlife species. Impacts to special-status wildlife species may occur due to use of heavy equipment and other construction activities that could result in the loss of individuals, soil compaction, dust, vegetation removal/loss of habitat, wildlife harassment or mortality, erosion, destruction or disturbance of nests, and introduction and spread of non-native, invasive species. Nighttime construction activities could introduce temporary nighttime lighting at the EPB and SRPS construction locations. The majority of construction activities would occur during the daytime and would not result in new or increased sources of light or glare. However, extended work hours into the night could be necessary during construction of the EPB and SRPS.

<u>EPB</u>

Construction of the EPB may result in impacts to tricolored blackbird, northern harrier, white-tailed kite, western pond turtle, CRLF, S-CCC steelhead, and nesting raptors and migratory bird species as suitable habitat for these species is present within and adjacent to the EPB construction area. Additionally, the footprint of the EPB may reduce habitat available to some species and may also

result in a reduction in use of approximately 3.1 acres of habitat that will be isolated from the lagoon by the placement of the EPB, which may present a full or partial barrier to some species. The following is a discussion of the potential for impacts to each of these species that may result from construction of the EPB.

Tricolored Blackbird and Northern Harrier

Tricolored blackbird and northern harrier have been observed within the Project Study Area and suitable nesting and foraging habitat is present within the emergent marsh vegetation types within the EPB construction area. However, neither species has been documented to nest within the area and, therefore, destruction or disturbance of nests for these species is not expected to occur. If present during the time of construction, temporary disturbance of these species may occur. However, due to the highly mobile nature of these species and the amount of suitable habitat within the Project Study Area outside of the EPB construction area, impacts to these species are considered less-than-significant.

White-Tailed Kite, Tricolored Blackbird, Nesting Raptors, and Other Migratory Bird Species

Suitable nesting habitat for white-tailed kite, raptors, and other migratory bird species is present within the trees adjacent to the EPB construction area. Suitable nesting habitat for tricolored blackbird and migratory bird species may also be present within the semi-permanent marsh habitat within the EPB construction area. Construction activities may result in disturbance and destruction of nests. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1b, and Bio-1c identified below.

Western Pond Turtle

Western pond turtles have the potential to occur within the emergent marsh habitat within the EPB construction area. Direct mortality of individuals and disturbance of nests may occur as a result of construction activities. Reduced water quality in the summer lagoon, resulting from high turbidity and introduction of hydrogen sulfide from disturbance of decomposing lagoon bottom material, may impact habitat for this species. Additionally, approximately 0.1 acre of habitat for western pond turtle will be permanently removed associated with the footprint of the EPB and a reduction in use of approximately 3.1 acres habitat that will be isolated from the lagoon may result from the placement of the EPB, which may present a full or partial barrier to western pond turtles. These are considered potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1c, and Bio-1d identified below.

CRLF

During periods of inundation, the EPB construction area may provide suitable breeding and aquatic non-breeding habitat for CRLF. During dry periods, the EPB construction area may provide upland or dispersal habitat for this species. Direct mortality of CRLF may occur associated with construction activities. Additionally, reduced water quality in the summer lagoon, resulting from high turbidity and introduction of hydrogen sulfide from disturbance of decomposing lagoon bottom material, may impact habitat for CRLF. Additionally, approximately 0.1 acre of CRLF habitat will be permanently removed associated with the footprint of the EPB and a reduction in use of approximately 3.1 acres of habitat that will be isolated from the lagoon may result from the placement of the EPB, which may present a full or partial barrier to CRLF. These are considered potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1c, Bio-1e, and Bio-1h identified below.

S-CCC Steelhead

During periods of inundation, the EPB construction area may provide suitable habitat for this species. Trapping of juvenile S-CCC steelhead in standing water beyond the footprint of the EBP may occur during construction if the wetted marsh is continuous with the lagoon within the work area. Additionally, reduced water quality in the summer lagoon, resulting from high turbidity and introduction of hydrogen sulfide from disturbance of decomposing lagoon bottom material, may impact habitat for S-CCC steelhead. Installation of the sheet piling for the EPB may result in acoustic impacts to S-CCC steelhead if the thresholds for sound exposure level (SEL) developed by the NMFS are met or exceeded. Although the methodology for pile driving has not been identified at this time, it is likely that either a vibratory hammer or impact driver would be used. There are no established injury criteria for vibration pile driving, and resource agencies in general are not concerned that vibratory pile driving will result in adverse effects on fish (Caltrans, 2015). Therefore, if a vibratory hammer is used, no acoustic impacts to S-CCC steelhead are expected. Impacts to S-CCC steelhead that may result if SELs are met or exceeded from use of an impact hammer include alteration of behavior, auditory tissue damage, temporary hearing loss, swim bladder tear or rupture, capillary rupture in skin, neurotrauma, eye hemorrhage, or death (Caltrans, 2015). Furthermore, the EPB will result in a loss of approximately 3.1 acres of critical habitat that includes the actual footprint of the EPB. While the habitat behind the structure (approximately 0.1 acre) would be left intact with no permanent physical impacts, it would be hydrologically separated from the lagoon and use of the area by S-CCC steelhead would be precluded. While this area meets the technical definition of critical habitat, it is on the very margin of the lagoon and only very rarely sees lagoon depth sufficient to be considered preferred S-CCC steelhead habitat (i.e., greater than three feet in depth). These are considered potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1c, Bio-1f, and Bio-1g identified below.

SRPS

Construction of the SRPS may result in impacts to California legless lizard, white-tailed kite, and nesting raptors and migratory bird species, as suitable habitat for these species is present within the SRPS construction area. The SRPS construction area may also provide habitat for S-CCC steelhead on the occasions when the sandbar is open and water is flowing from the lagoon to the ocean in that area. Additionally, suitable habitat for SBB is present adjacent to the SRPS construction area. The following is a discussion of the potential for impacts to each of these species that may result from construction of the SRPS.

California Legless Lizard

The California legless lizard has the potential to occur within the coastal dune scrub and ruderal coastal dune vegetation types within the SRPS construction area. Direct mortality of California legless lizard may occur associated with construction activities. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1c, and Bio-1i identified below.

White-Tailed Kite, Nesting Raptors, and Other Migratory Bird Species

Suitable nesting habitat for white-tailed kite, raptors, and other migratory bird species is present within the trees adjacent to the SRPS construction area. Construction activities may result in disturbance or destruction of nests. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1b, and Bio-1c identified below.

S-CCC Steelhead

During the periods that water is flowing from the lagoon to the ocean, S-CCC steelhead may be present within the SRPS construction area. Mortality of individual S-CCC steelhead may result from construction activities if the lagoon is continuous with the ocean during construction. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1c, Bio-1f, and Bio-1g identified below.

SBB

Loss of SBB habitat and direct mortality of individuals may occur if dune buckwheat plants are damaged or removed during construction. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a, Bio-1c, Bio-1i, and Bio-1i identified below.

ISMP

The ISMP has been designed to reduce impacts to CRLF and S-CCC steelhead. Specific measures in the ISMP include:

- Early season coordination with NMFS and the ACOE to agree upon sandbar management techniques to be implemented during the upcoming winter months, including the management location, channel configuration, target lagoon water elevations, and access.
- Following an opening action and after high inflows from the river have receded, the lagoon shall either be allowed to naturally close or remain open with an open outlet channel flowing over the beach in a meandering channel that is designed to mute tidal influence and rapid draining of the lagoon, which shall be maintained at a minimum six-foot WSE. The river mouth and lagoon WSE will be monitored during and after the channel has been opened.
- A qualified biological fish monitor will be present during the initial opening or closure of the channel and while an outlet channel remains open, and shall monitor the channel twice daily (a.m. and p.m.) to document fish entrainment, strandings, or other occurrences that pose risk to S-CCC steelhead. If stranded S-CCC steelhead are observed, the County shall contact NMFS and the Department to coordinate any necessary fish rescues, and regular updates shall be provided to address any action that may be necessary if 'take' of S-CCC steelhead occurs. The monitor shall also produce a report documenting construction activities and any observation of fish mortalities and/or harm or harassment, and submit to the ACOE and NMFS following construction.

However, although the ISMP reduces impacts, implementation of the ISMP may still result in impacts to CRLF and S-CCC steelhead. The following is a discussion of the potential for impacts to each of these species that may result from implementation of the ISMP.

CRLF

Direct mortality of CRLF may occur associated with the mechanical sandbar breaching actions resulting from the implementation of the ISMP. Mechanical breaching may also result in loss of shallow water areas suitable for CRLF breeding, potential stranding of larvae and eggs, increased predation upon individuals that remain in the shallower estuary, and potential flushing of individuals into the ocean. While the ISMP is focused specifically to avoid and minimize, to the greatest extent feasible, potential impacts to CRLF which may occur with its implementation, these are considered

potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measure Bio-1e and Bio-1h identified below.

S-CCC Steelhead

Mechanical sandbar breaching may result in loss of juvenile S-CCC steelhead rearing habitat, potential stranding of juveniles, increased predation upon juveniles that remain in the shallower estuary, premature flushing of juvenile into the ocean to cause osmotic stress, and mortality or reduced survival to adulthood due to smaller size. These are considered potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measure Bio-1e and Bio-1h identified below.

MITIGATION MEASURES FOR CONSTRUCTION IMPACTS TO SPECIAL-STATUS SPECIES

Bio-1a: Implement Construction Best Management Practices (Applies to EPB and SRPS)

The following best management practices shall be implemented during all identified phases of construction (i.e., pre-, during, and post-) to reduce impacts to special-status wildlife species:

1. A qualified biologist will conduct an Employee Education Program for the construction crew prior to any construction activities. A qualified biologist will meet with the construction crew at the onset of construction at the project site to educate the construction crew on the following: 1) the appropriate access route(s) in and out of the construction area and review project boundaries; 2) how a biological monitor will examine the area and agree upon a method which will ensure the safety of the monitor during such activities, 3) the special-status species and sensitive habitats that are known to occur or that may be present, their habitat, and proper identification; 4) the specific mitigation measures that will be incorporated into the construction effort; 5) the general provisions and protections afforded by the Service and Department; and 6) the proper procedures if a special-status species is encountered within the project site.
2. Protective fencing will be placed prior to and during construction as to keep construction equipment and personnel from impacting vegetation outside of work limits. A biological monitor will supervise the installation of protective fencing and monitor at least once per week until construction is complete to ensure that the protective fencing remains intact. Orange cyclone fencing or other materials that can entrap CRLF and other special-status species shall not be used.
3. Following construction, disturbed areas will be restored to pre-project contours to the maximum extent possible and revegetated. A Revegetation Plan shall be prepared for the project that shall include, but not be limited to, the following:
    - the use of locally-occurring native species and native erosion control seed mix appropriate for the habitat(s) disturbed;
    - procedures to control non-native species invasion and elimination of existing non-native species within the area of impact;
    - provisions to ensure compliance with the requirements of the plan; and
    - a monitoring program that describes annual monitoring efforts which incorporate success criteria and contingency plans if success criteria are not met.

4. Grading, excavating, and other activities that involve substantial soil disturbance will be planned and carried out in consultation with a qualified hydrologist, engineer, or erosion control specialist, and will utilize standard erosion control and slope stabilization techniques in satisfaction of Monterey County erosion control guidelines to minimize erosion of slopes and sedimentation to native vegetation and special-status species habitat (pre-, during, and post-construction). If silt fencing is required, only high-quality reinforced silt fencing shall be used and efforts shall be made to install it in a way that does not inhibit movements of special-status species. Openings shall be created approximately every 100 feet.

5. No firearms or pets will be allowed on the project site at any time.

6. All food-related and other trash will be disposed of in closed containers and removed from the project area at least once a week during the construction period, or more often if trash is attracting avian or mammalian predators. Following construction, all trash and construction debris shall be removed from work areas and disposed of properly. Construction personnel will not feed or otherwise attract wildlife to the area.

7. To prevent inadvertent entrapment of special-status wildlife during the Proposed Project, all excavated, steep-walled holes or trenches more than two feet deep will be covered at the close of each working day with plywood or similar materials. Before such holes or trenches are filled, they will be thoroughly inspected for trapped animals.

8. Cleaning and refueling of equipment and vehicles shall occur only within designated staging areas. No maintenance, cleaning or fueling of equipment shall occur within wetland, riparian, or other sensitive habitat areas and, at a minimum, all equipment and vehicles will be checked and maintained on a daily basis to ensure proper operation and avoid potential leaks or spills. During construction, all construction-related spills of hazardous materials within or adjacent to the construction site will be cleaned up immediately. Spill prevention and clean-up materials shall be onsite at all times during construction. Construction materials/debris will also be stored within the designated staging areas. No debris, soil, silt, sand, oil, petroleum products, cement, concrete, or washings thereof shall be allowed to enter into, or be placed where they may be washed by rainfall or runoff, into wetland, riparian, or other sensitive habitats.

9. If necessary to work during the nighttime, construction lighting shall be focused and downward directed to preclude night illumination of adjacent habitats.

10. The following measures will be implemented to reduce the introduction and spread of non-native, invasive species:
    - Any landscaping or replanting required for the project will not use species listed as noxious by the CDFA.
    - Bare and disturbed soil will be landscaped with CDFA recommended seed mix or plantings from locally adopted species to preclude the invasion on noxious weeds in the project site.
    - Construction equipment will be cleaned of mud or other debris that may contain invasive plants and/or seeds and inspected to reduce the potential of spreading noxious weeds, before mobilizing to arrive at the construction site and before leaving the construction site.
    - All non-native, invasive plant species will be removed from disturbed areas prior to replanting

Bio-1b: Conduct Pre-Construction Surveys for White-Tailed Kite, Nesting Raptors, and Other Migratory Bird Species (Applies to EPB and SRPS)

Construction activities that may directly (e.g., vegetation removal) or indirectly (e.g., noise/ground disturbance) affect protected nesting avian species will be timed to avoid the breeding and nesting season. Specifically, vegetation and/or tree removal can be scheduled after September 16 and before January 31. Alternatively, a qualified biologist will be retained by the project applicant to conduct pre-construction surveys for nesting raptors and other protected avian species within 500 feet of proposed construction activities if construction occurs between February 1 and September 15. Pre-construction surveys will be conducted no more than 14 days prior to the start of construction activities during the early part of the breeding season (February through April) and no more than 30 days prior to the initiation of these activities during the late part of the breeding season (May through August). Because some bird species nest early in spring and others nest later in summer, surveys for nesting birds may be required to continue during construction to address new arrivals, and because some species breed multiple times in a season. The necessity and timing of these continued surveys will be determined by the qualified biologist based on review of the final construction plans and in coordination with the Service and Department, as needed.

If raptors or other protected avian species nests are identified during the pre-construction surveys, the qualified biologist will notify the project applicant and an appropriate no-disturbance buffer will be imposed within which no construction activities or disturbance should take place (generally 300 feet in all directions for raptors; other avian species may have species-specific requirements) until the young of the year have fledged and are no longer reliant upon the nest or parental care for survival, as determined by a qualified biologist.

Bio-1c: Implement Construction-Phase Monitoring (Applies to EPB and SRPS)

The Project Proponent shall retain a qualified biologist to monitor all ground disturbing construction activities (i.e., vegetation removal, grading, excavation, or similar activities) to protect any special-status species encountered. Any handling and relocation protocols of special-status wildlife species shall be determined in coordination with the Department prior to any ground disturbing activities, and conducted by a qualified biologist with appropriate scientific collection permit. After ground disturbing project activities are complete, the qualified biologist shall train an individual from the construction crew to act as the on-site construction biological monitor. The construction biological monitor shall be the contact for any special-status wildlife species encounters, shall conduct daily inspections of equipment and materials stored on site and any holes or trenches prior to the commencement of work, and shall ensure that all installed fencing stays in place throughout the construction period. The qualified biologist shall then conduct regular scheduled and unscheduled visits to ensure the construction biological monitor is satisfactorily implementing all appropriate mitigation protocols. Both the qualified biologist and the construction biological monitor shall have the authority to stop and/or redirect project activities to ensure protection of resources and compliance with all environmental permits and conditions of the project. The qualified biologist and the construction monitor shall complete a daily log summarizing activities and environmental compliance throughout the duration of the project. The log shall also include any special-status wildlife species observed and relocated.

Bio-1d: Avoid and Minimize Impacts to Western Pond Turtle (Applies to EPB)

A qualified biologist shall survey suitable habitat no more than 48 hours before the onset of work activities at the EPB component site for the presence of western pond turtle. If pond turtles are found and these individuals are likely to be killed or injured by work activities, the biologist shall

be allowed sufficient time to move them from the site before work activities begin. The biologist shall relocate the pond turtles the shortest distance possible to a location that contains suitable habitat and would not be affected by activities associated with the project.

Bio-1e: Avoid and Minimize Impacts to CRLF (Applies to EPB)

The following measures for avoidance and minimization of adverse impacts to CRLF during construction of the EPB and SRPS are those typically employed for construction activities that may result in short-term impacts to individuals and their habitat. The focus of these measures is on scheduling activities at certain times of year, keeping the disturbance footprint to a minimum, and monitoring.

1. Construction activities shall occur during the dry season within a work window determined in consultation with the Service. No work shall occur within areas where standing water is present at the time of construction.

2. During ground disturbing and vegetation removal activities, a Service-approved biologist shall survey appropriate areas of the construction site daily before the onset of work activities for the presence of CRLF. Vegetation shall initially be removed by hand (brush-cutters, weed whackers, and chainsaws). Piles of woody debris shall be cleared by hand. Larger debris will only be moved after being inspected by the Service-approved biologist. The Service-approved biologist shall remain at the work site until all ground disturbing activities are completed. If any life stage of the CRLF is found and these individuals are likely to be killed or injured by work activities, the Service-approved biologist shall stop work in that area and relocate the CRLF the shortest distance possible to an area that contains suitable habitat and will not be affected by construction activities. The Service-approved biologist shall maintain detailed records of any individuals that are moved (e.g., size, coloration, any distinguishing features, photographs [digital preferred]) to assist him or her in determining whether translocated animals are returning to the original point of capture. Only Service-approved biologists shall participate in activities associated with the capture, handling, and monitoring of CRLF.

3. After ground disturbing and vegetation removal activities are complete, the Service-approved biologist will designate a person to monitor on-site compliance with all avoidance and minimization measures. The Service-approved biologist shall ensure that this monitor receives the sufficient training in the identification of CRLF. The monitor or the Service-approved biologist is authorized to stop work if the avoidance and/or minimization measures are not being followed. If work is stopped, the Service shall be notified.

Bio-1f: Avoid or Reduce Hydroacoustic Impacts to S-CCC Steelhead (Applies to EPB).

The following measures for avoidance and minimization of adverse impacts to S-CCC steelhead resulting from noise attenuation during construction of the EPB are those typically employed for construction activities that may result in short-term hydroacoustic impacts to fish.

1. A vibratory hammer shall be used for pile driving to the greatest extent feasible.
2. If necessary, an impact hammer may be used. If an impact driver is used, a hydroacoustic impact assessment would need to be conducted, based on assumptions regarding the number, size, and location of piles along with the number of impact strikes that could occur in a single day, to determine if SELs are met or exceeded that would result in an impact to S-CCC steelhead. The impact assessment shall follow guidance provided in the most current Caltrans

Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish and the NMFS Pile Driving Calculations Spreadsheet. If it is determined that pile driving will result in impacts to S-CCC steelhead, an Underwater Noise Monitoring Plan consistent with the most current FHWG template shall be developed and approved by the NMFS prior to the start of construction. The plan will include monitoring and reporting of underwater sound levels in the Lagoon and/or River during the initiation of construction to detect if underwater noise levels meet or exceed established impact thresholds. The plan will also include feasible measures to reduce noise levels below established thresholds if necessary based on the monitoring results.

Bio-1g: Avoid and Minimize Impacts to S-CCC Steelhead (Applies to EPB and SRPS)

The following measures for avoidance and minimization of adverse impacts to S-CCC steelhead during construction of the EPB and SRPS are those typically employed for construction activities that may result in short-term impacts to individuals and their habitat. The focus of these measures is on scheduling activities at certain times of year, keeping the disturbance footprint to a minimum, and monitoring.

1. Construction activities shall occur during the dry season within a work window determined in consultation with the NMFS. No work shall occur within areas where standing water is present at the time of construction.

2. All applicable measures outlined in the attached Department Avoidance and Minimization Measures (Appendix H) shall be implemented.

Bio-1h: Reduce Impacts to CRLF and S-CCC Steelhead (Applies to ISMP)

A monitoring and reporting program will be developed in consultation with the Service and NMFS prior to the initiation of construction and will be implemented to document the effects of the ISMP and inform an adaptive management approach for the duration of the permit. The monitoring program will assess breeding/rearing conditions and relative numbers and distribution of CRLF and S-CCC steelhead, and degree of smoltification of S-CCC steelhead throughout the year and in response to lagoon sandbar management activities.

Bio-1i: Avoid and Minimize Impacts to SBB (Applies to SRPS)

The following measures for avoidance and minimization of adverse impacts to SBB during construction of the SRPS are those typically employed for construction activities that may result in impacts to individuals and their habitat. The focus of these measures is on keeping the disturbance footprint to a minimum, restoration, and monitoring.

1. Dune buckwheat plants that are not scheduled for removal as a result of Project activities will be protected by exclusionary fencing. The fencing shall be installed prior to any grubbing or construction activities associated with the project. No construction activities or equipment will be allowed within the fencing. A qualified biologist shall be onsite during the fence installation. Once these activities are completed for this area, the monitor will visit the site as needed until project completion to ensure that the exclusionary fencing is properly maintained throughout construction activities.

2. Dune buckwheat plants that will be impacted, as well as the duff and/or soils underneath the plants, will be hand removed prior to disturbance by a Service-approved biologist and placed

as close as possible to, but not on, living dune buckwheat plants within the exclusionary fencing installed around existing plants not scheduled for removal. The number of plants removed shall be counted and the area of disturbance measured.

3. Impacts to SBB that occur as a result of the removal of obligate host plants will be mitigated by replanting disturbed areas upon the completion of construction activities. Following construction, locally sourced seedlings shall be planted at a 2:1 ratio. Planting shall occur in the fall after the first rain.

The planting areas shall be monitored annually for three years. Success criteria for buckwheat plantings are as follows:

- The percentage of dune buckwheat plants that survive is greater than 75% the first year and 50% at year three.

If the criteria aren't met, the need for additional planting in order to achieve success at the end of the three year monitoring period shall be evaluated.

After each inspection, a report shall be submitted to the Service. The report shall quantify the state of the restoration and shall include photographic documentation, as well as recommendations for further maintenance and management that may be necessary for maintaining the success criteria.

Impact 2: <u>Construction Impacts to Sensitive Habitats.</u> Proposed Project construction would not have a substantial effect on sensitive habitats (including riparian, wetlands, and/or other sensitive natural communities) within the Project Study Area. (Criteria b and c) (Less-than-Significant with Mitigation)

Several sensitive habitats were identified within the Project Study. Construction of the Proposed Project may result in direct and indirect impacts to sensitive habitats (defined herein to include any riparian habitat, federally protected wetlands as defined by Section 404 of the Clean Water Act, waters of the state protected under the Porter-Cologne Act, critical habitat for federally listed species, sensitive vegetation types on the Department's *Natural Communities List* [Department, 2010], or areas potentially considered ESHA by the CCC[13]). Impacts to sensitive habitats may include direct and indirect impacts associated with construction activities that could result in the direct loss of habitat, soil compaction, root damage, erosion, and introduction and spread of non-native, invasive species. These are considered potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measures identified below.

<u>EPB</u>

Wetlands potentially under the jurisdiction of the USACE and CCC are present within the EPB construction area. The portions of the wetlands identified as seasonal emergent marsh and riparian support vegetation characteristic of pacific silverweed marsh and arroyo willow thickets, respectively, as described in the *Manual of California Vegetation* (Sawyer, et al., 2009), which are identified as sensitive on the Department's *Natural Communities List* (Department, 2010). Additionally, portions of the EPB construction area are considered federal critical habitat for CRLF and S-CCC steelhead,

[13] Under Section 30107.5 of the CCA, an "environmentally sensitive habitat area" is any area in which plant or animal life or their habitat are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. Therefore, the CCC may designate additional habitat areas within the Project Study Area as ESHA if the CCC determines that it meets this definition.

and may be considered waters of the state by the RWQCB and ESHA by the CCC. Impacts to sensitive habitats may include direct and indirect impacts associated with heavy equipment and construction activities that could result in disturbance of habitat, soil compaction, dust, erosion, and introduction and spread of non-native, invasive species. These sensitive habitats, as well as riparian habitat, are also present adjacent to the EPB construction area and may be impacted by erosion and sedimentation that could result from the construction activities. The following identifies the area of potential direct and indirect impacts to each of these sensitive habitats that may result from construction of the EPB[14].

Federal and Coastal Wetlands and Waters of the State

Approximately 2.7 acres of potential federal wetland and 3.0 acres of potential coastal wetland are present within the EPB construction area and may be temporarily disturbed during construction activities. Coastal wetlands may also be considered waters of the state. Approximately 1.5 acres of the wetlands within the EPB construction area support vegetation characteristic of "Pacific silverweed marsh," which is identified as sensitive on the Department's *Natural Communities List* (Department, 2010). Approximately 0.1 acre of wetlands will be permanently removed for the placement of the EPB. Additionally, approximately 2.1 acres of wetlands (1.1 acres of which support vegetation characteristic of "Pacific silverweed marsh") will be isolated from the other portions of the lagoon by the EPB.

The exact results of this isolation on wetland resources cannot be characterized because the combination of precipitation, runoff, infiltration, evaporation, and other environmental factors above interact in a unique and independent way for any given year. Balance Hydrologics (2015) provided a summary of the estimated hydrologic conditions on the interior side of the EPB, which identified that surface and shallow groundwater flows from the upland drainage would be the primary contributor to ponding on the landward side of the EPB during the rainy season. The summary estimated that during wetter than average years, water landward of the EPB would likely remain at or slightly above the proposed culvert invert and pump trigger elevation of 10.5 feet over extended periods of time (weeks or months); during periods of drought, water levels may recede below seven feet in elevation, leaving the landward side of the EPB completely dry for short periods of time (days or weeks). During the dry season, groundwater would be the primary source of inflow to the landward side of the EPB; water levels are anticipated to track very closely to water levels in the lagoon with a head differential expected to be less than one foot during periods of relatively static WSE. Ponding depths during the dry season are expected to be similar to those during periods of drought during the rainy season, as described above, which is comparable to existing conditions. Therefore, because the EPB will impound water on the north side of the wall from precipitation and runoff, it is unlikely that a loss of wetlands will result from the isolation from the lagoon. However, there may be a habitat type conversion in this area as the water impounded will be freshwater instead of brackish. Additionally, some areas may pond for longer durations, resulting in areas of unvegetated open water.

Although the function of the EPB has the potential to increase the depth of the lagoon by approximately two feet in the fall/early winter when the lagoon is filling prior to first breach, which may increase and improve the area of wetlands within the Project Study Area, the impacts identified above are considered potentially significant. These impacts can be reduced to a less-than-significant

[14] Please note that the area of each of these types of sensitive habitat overlaps spatially; however, the acreage of each sensitive habitat type is provided in order to identify the areas potentially under the jurisdiction of each regulatory agency.

level with implementation of the mitigation measures Bio-1a identified above and Bio-2 identified below.

Riparian

Approximately 0.1 acre of riparian habitat is present within the EPB construction area and may be temporarily disturbed during construction. Although the function of the EPB has the potential to increase the depth of the lagoon by approximately two feet in the fall/early winter when the lagoon is filling prior to first breach, which may increase the area of riparian vegetation within the Project Study Area, this is considered a potentially significant impact. This impact can be reduced to a less-than-significant level with implementation of mitigation measures Bio-1a identified above and Bio-2 identified below.

CRLF Critical Habitat

Approximately 4.3 acres of CRLF critical habitat is present within the construction area for the EPB and may be temporarily disturbed during construction activities. Approximately 0.1 acre of CRLF critical habitat will be permanently removed for the placement of the EPB. Additionally, approximately 3.1 acres of CRLF critical habitat will be isolated from the other portions of the lagoon by the EPB, which may result in the loss of CRLF critical habitat. However, the purpose of the EPB is to promote improvement in ecological function of the lagoon, including natural floodplain function and improvement of habitat for federally listed species (including CRLF) associated with the lagoon, by allowing the lagoon to breach naturally. As such, the impacts identified above are less-than-significant in light of the overall benefits of the EPB.

S-CCC Critical Habitat

Approximately 4.3 acres of S-CCC steelhead critical habitat is present within the construction area for the EPB and may be temporarily disturbed during construction activities. Approximately 0.1 acre of S-CCC steelhead critical habitat will be permanently removed for the placement of the EPB. Additionally, approximately 3.1 acres of S-CCC steelhead critical habitat will be isolated from the other portions of the lagoon by the EPB, which may result in the loss of S-CCC steelhead critical habitat. However, the purpose of the EPB is to promote improvement in ecological function of the lagoon, including natural floodplain function and improvement of habitat for federally listed species (including S-CCC steelhead) associated with the lagoon, by allowing the lagoon to breach naturally. As such, the impacts identified above are less-than-significant in light of the overall benefits of the EPB.

SRPS

Other waters of the U.S. potentially under the jurisdiction of the USACE and waters of the state potentially under the jurisdiction of the RWQCB are present within the construction area for the SRPS. These areas are also considered federal critical habitat for CRLF and S-CCC steelhead. Active beach (which includes coastal strand, coastal dune scrub, dune swale wetland, and ruderal coastal dune areas) area also present within the SRPS construction area and may be considered ESHA by the CCC. Additionally, the host plant species (dune buckwheat) for SBB is present within the coastal dune scrub habitat within the SRPS construction area. Impacts to these sensitive habitats may include direct and indirect impacts associated with heavy equipment and construction activities that could result in disturbance of habitat, soil compaction, dust, erosion, and introduction and spread of non-native, invasive species. These are considered potentially significant impacts that can be reduced to a less-than-significant level with implementation of the mitigation measures identified below. The

following identifies the area of potential direct impact to each of these sensitive habitats that may result from construction of the SRPS.

Other Waters of the U.S. & Waters of the State

Approximately 0.3 acre of potential other waters of the U.S. are present within the SRPS construction area that may be temporary impacted during construction activities. This area may also be considered waters of the state. Construction of the SRPS will not result in permanent loss of potentially other waters of the U.S. or waters of the state; however, indirect impacts associated with erosion may occur. This is considered a potentially significant impact that can be reduced to less-than-significant with implementation of mitigation measures Bio-1a identified above and Bio-2 identified below.

Active Beach

Approximately 2.4 acres of active beach is present within the SRPS construction area and may be temporarily impacted during construction activities. This is considered a less-than-significant impact.

SBB Habitat

Approximately 0.2 acre of the host plant species (dune buckwheat) for SBB is present within the coastal dune scrub habitat within the SRPS construction area. Loss of SBB habitat may occur if dune buckwheat plants are damaged or removed during construction. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a and Bio-1i identified above.

CRLF Critical Habitat

Approximately 0.3 acre of CRLF critical habitat is present within the construction area for the SRPS and may be temporarily disturbed during construction activities. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a and Bio-1e identified above.

S-CCC Critical Habitat

Approximately 0.3 acre of S-CCC critical habitat is present within the construction area for the SRPS and may be temporarily disturbed during construction activities. This is considered a potentially significant impact that can be reduced to a less-than-significant level with implementation of the mitigation measures Bio-1a and Bio-1g identified above.

ISMP

Other waters potentially under the jurisdiction of the USACE and RWQCB are present within the implementation area for the ISMP. Active beach (which includes coastal strand, coastal dune scrub, dune swale wetland, and ruderal coastal dune areas), which may be considered ESHA by the CCC and critical habitat for CRLF and S-CCC steelhead are present within the ISMP implementation area. Impacts to sensitive habitat may include direct and indirect impacts associated with mechanical sandbar breaching, such as loss of suitable breeding habitat for CRLF and S-CCC steelhead. The ISMP is focused specifically to avoid and minimize, to the greatest extent feasible, potential impacts to CRLF and S-CCC steelhead habitat. As such, these impacts are less-than-significant.

MITIGATION MEASURES FOR CONSTRUCTION IMPACTS TO SENSITIVE HABITATS

Bio-2: Avoid and Minimize Impacts to Federal and Coastal Wetlands, Other Waters of the U.S. and State, Riparian, and Seasonal Emergent Marsh

The following measure reduces impacts to Federal and coastal wetlands, other waters of the U.S., waters of the State, riparian habitat, and seasonal emergent marsh:

A 404 permit shall be obtained from the USACE, a 401 permit shall be obtained from the RWQCB, and a coastal development permit shall be obtained from the CCC prior to any ground disturbance or other construction activities. All requirements of the permits shall be followed. The project applicant shall comply with all applicable local, State, and Federal regulations related to impacts to the sensitive habitat types of riparian habitat and seasonal emergent marsh, including local tree removal ordinances and/or Section 1602 of California Fish and Game Code. All permits and/or authorizations will be required prior to issuance of a grading permit.

Impacts to Federal and coastal wetlands, other waters of the U.S., waters of the State, riparian habitat, and emergent marsh shall be avoided to the greatest extent possible. Issuance of the permits identified above typically requires the preparation and implementation of a Habitat Mitigation and Monitoring Plan (HMMP) to mitigate for the impacts to Federal and coastal wetlands and/or other sensitive habitat including riparian and seasonal emergent marsh. The HMMP shall detail mitigation for temporary and permanent impacts to Federal and coastal wetlands, which are typically replaced at a 3:1 ratio for in-kind, on-site mitigation (e.g., higher mitigation ratios may be required for out-of-kind, off-site mitigation). Impacted riparian habitat would be mitigated at a 1:1 replacement-to-loss ratio. The final mitigation amounts will be determined during the design phase. The HMMP generally includes the following:

- Details of the engineering and hydrological components necessary to maintain and/or recreate wetland function in the designated mitigation area;
- Applicable planting details which include the use of local native plant species and the location and planting size of all planting stock;
- Procedures to control non-native species invasion;
- Provisions to ensure compliance with the requirements of the mitigation plan;
- An irrigation plan, if necessary;
- Description of a 5-year monitoring program, including specific methods of vegetation monitoring, data collection and analysis, restoration goals and objectives, success criteria, adaptive management if the criteria are not met, and a funding mechanism; and
- An outline of the specific content for monitoring reports that will be submitted to the resource agencies annually.

The HMMP will provide sufficient content and information to ensure implementation of restoration measures will reduce identified significant impacts to Federal and coastal wetlands, riparian habitat, and seasonal emergent marsh to a less-than-significant level. The HMMP shall be finalized as part of the regulatory permitting process and must be approved by the USACE, CDFW, CCC, and RWQCB prior to issuance of the grading permit. The HMMP shall be prepared by a qualified biologist and implemented by the project applicant or its contractor(s) under the supervision of a qualified restoration practitioner/biologist. This HMMP could be combined with the revegetation plan included in Mitigation Measure BIO-1a, as determined appropriate.

Impact 3: Construction Impacts to Movement of Native Wildlife and Native Wildlife Nursery Sites. Proposed Project construction would not adversely affect native wildlife corridors and wildlife nursery sites. (Criterion d) (Less-than-Significant)

EPB

Direct impacts to S-CCC steelhead and CRLF nursery sites are the same as those identified above in the Sensitive Habitat impact section. Implementation of mitigation measures Bio-1a, Bio-1e, Bio-1g, and Bio-2 shall be implemented to reduce impacts to S-CCC steelhead and CRLF movement and nursery sites resulting from construction of the EPB.

SRPS

Direct impacts to S-CCC steelhead and CRLF nursery sites are the same as those identified above in the Sensitive Habitat impact section. Implementation of mitigation measures Bio-1a, Bio-1e, Bio-1g, and Bio-2 shall be implemented to reduce impacts to S-CCC steelhead and CRLF movement and nursery sites resulting from construction of the SRPS.

ISMP

Direct impacts to S-CCC steelhead and CRLF nursery sites resulting from implementation of the ISMP are less-than-significant.

6.4. Operational Impacts and Mitigation Measures

Impact 4: Operational Impacts to Special-Status Species and Habitat. Proposed Project operations would not adversely affect, either directly or through habitat modification, special-status plant and wildlife species and their habitat within the Project Study Area. (Criteria a, b, c, and d) (Beneficial Impact)

EPB

The function of the EPB is intended to improve and increase habitat for special-status wildlife species known or with the potential to occur in the Project Study Area. The EPB is expected to result in the following impacts:

- Higher frequency of natural sandbar breaches.
- A reduction in frequency of annual mechanical breaching.
- Increased depth and duration of inundation within the lagoon.

A more naturally functioning lagoon ecosystem will result in a higher WSE for longer periods of time within the lagoon. This may also increase the amount of emergent marsh, riparian, and other sensitive vegetation types influenced by hydrology that provide habitat for many common and special-status species. Special-status species that may occur within areas affected by an increase in WSE include Monterey-dusky-footed woodrat, tricolored blackbird, California horned lark, white-tailed kite, sharp-shinned hawk, nesting raptors and migratory bird species, California legless lizard, western pond turtle, CRLF, S-CCC steelhead, and SBB. This is a beneficial impact.

SRPS

The function of the SRPS is intended to improve and increase habitat for special-status wildlife species known or with the potential to occur in the Project Study Area. The function of the SRPS is expected to result in the following:

- More northerly breaches of the barrier beach during the rainy season than the existing condition will result in relatively long channel alignments and drawdown over a longer period, resulting in a higher WSE that will increase the amount of aquatic habitat and may reduce the potential for lagoon species to be drawn out into the ocean.
- A more naturally functioning lagoon ecosystem resulting in a higher ratio of fresh water to salt water.
- A more naturally functioning lagoon ecosystem

This is a beneficial impact.

ISMP

The ISMP does not have an operational component because it will be discontinued subsequent to the completion of construction of the EPB and SRPS.

Impact 5: Operational Impacts to Sensitive Habitats. Proposed Project operations would not adversely affect sensitive habitats (including riparian, wetlands, and/or other sensitive natural communities) within and adjacent to the Project Study Area. (Criteria b and c) (Beneficial Impact)

EPB

The function of the EPB is intended to improve and increase sensitive habitats within the Project Study Area. The EPB is expected to result in the following impacts:

- Higher frequency of natural sandbar breaches.
- A reduction in frequency of annual mechanical breaching.
- Increased depth and duration of inundation within the lagoon.

A more naturally functioning lagoon ecosystem will result in a higher WSE for longer periods of time within the lagoon. This may also increase the amount of emergent marsh, riparian, habitat for special-status species, and other sensitive habitat types influenced by hydrology. This is a beneficial impact.

SRPS

The function of the SRPS is intended to improve and increase sensitive habitats within the Project Study Area. The function of the SRPS is expected to result in the following:

- More northerly breaches of the barrier beach during the rainy season than the existing condition will result in relatively long channel alignments and drawdown over a longer period, resulting in a higher WSE that will increase the amount of aquatic habitat and may reduce the potential for lagoon species to be drawn out into the ocean.
- A more naturally functioning lagoon ecosystem resulting in a higher ratio of fresh water to salt water.
- A more naturally functioning lagoon ecosystem

This is a beneficial impact.

ISMP

The ISMP does not have an operational component because it will be discontinued subsequent to the completion of construction of the EPB and SRPS.

Impact 6: Operational Impacts to Movement of Native Wildlife and to Native Wildlife Nursery Sites. Proposed Project operations would not adversely affect native wildlife corridors and wildlife nursery sites. (Criterion d) (Beneficial Impact)

EPB

Function of the EPB improves and increases movement and nursery sites for native wildlife within the lagoon. This is a beneficial impact.

SRPS

Function of SRPS improves native wildlife movement and nursery sites. This is a beneficial impact.

ISMP

No operational impacts native wildlife movement or nursery sites are associated with the ISMP.

Chapter 7. References

Arnold, R.A., 1983. Ecological studies of six endangered butterflies (Lepidoptera: Lycaenidae): Island biogeography, patch dynamics, and design of habitat preserves. University of California Publications in Entomology, Vol. 99. Pp. 1-161.

Balance Hydrologics, Inc. 2014. The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report.

Balance Hydrologics, Inc. 2015. Draft Summary of Estimated Interior Side Hydrologic Conditions, EPB Project, County of Monterey, August 2015.

Baldwin, B. G., D.H. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti, and D.H. Wilken (eds.). 2012. The Jepson Manual – Vascular Plants of California, Second Edition, Thoroughly Revised and Expanded. University of California Press. Berkeley, CA. 1600 pp.

Bulger, J.B., N.J. Scott Jr., and R.B. Seymour. 2003. Terrestrial activity and conservation of adult California red-legged frog *Rana aurora draytonii* in coastal forests and grasslands. Biological Conservation, Vol. 110. Pp. 85-95.

Bury, R.B. and J.H. Wolfheim. 1973. Aggression in free-living pond turtles (Clemmys marmorata). Bio-Science, Vol. 23. Pp. 659-662.

California Department of Fish and Wildlife (Department). 2008. California Wildlife Relationships System: Life History Accounts. Database Version 8.2.

Department. 2009. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities

Department. 2010. List of California terrestrial natural communities recognized by the Natural Diversity Database.

Department. 2016a. Special Animals List. Available online at: https://www.dfg.ca.gov/wildlife/nongame/list.html

Department. 2016b. California Natural Diversity Database Rare Find 5 Report. Available online at: https://www.dfg.ca.gov/biogeodata/cnddb/mapsanddata.asp

California Department of Parks and Recreation (State Parks). 2002a. Draft Initial Study/Mitigated Negative Declaration, Carmel River State Beach Lagoon Restoration Project, June 2002.

State Parks. 2002b. Final Initial Study/Mitigated Negative Declaration, Carmel River State Beach Lagoon Restoration Project, October 2002.

State Parks. 2007. Riparian Habitat Restoration, Carmel River Lagoon, Wildlife Conservation Board Grand Number – WC-3048SC, Final [monitoring] Report.

State Parks. 2008a.Carmel River Lagoon Enhancement Project [monitoring report].

State Parks. 2008b. Draft Initial Study/Mitigated Negative Declaration, Carmel River Beach Lagoon Water Level Management Project, July 2008.

State Parks. 2008c. Final Initial Study/Mitigated Negative Declaration, Carmel River Beach Lagoon Water Level Management Project, September 2008.

State Parks, 2009. 2009 Carmel River Enhancement Project Report [monitoring report].

California Department of Transportation (Caltrans). 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Available online at: http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf

California Native Plant Society (CNPS). 2001. CNPS Botanical Survey Guidelines

CNPS. 2015. Inventory of Rare and Endangered Plants (online edition, v8-02). California Native Plant Society, Sacramento, CA. Available online at: http://www.rareplants.cnps.org/

Casagrande, J. 2006. Wetland Habitat Types of the Carmel River Lagoon. The Watershed Institute, California State University Monterey Bay, Report No. WI-2006-05. Pp. 15.

Denise Duffy & Associates, Inc. (DD&A). 2015. Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project Draft Delineation of Jurisdictional Wetlands and Other Waters Under Section 404 of the Clean Water Act and the California Coastal Act.

Dixon, Dave. 1999. Dunes Alive-The endangered Smith's blue and marina blue butterflies. A closer look at coastal dune wildlife of south Monterey Bay. Tideline, Vol. 19 (3). Pp. 1-3.

D.W. ALLEY & Associates. 2014. Fisheries Analysis for the Carmel River Lagoon Biological Assessment Report.

Ernst, C.H. and R.W. Barbour. 1972. Turtles of the United States. University Kentucky Press, Lexington, KY. 347 pp.

Grinnell, J and A.H. Miller. 1944. The Distribution of Birds of California. Pacific Coast Avifauna No. 27.

Holland, D. C. 1994. The Western Pond Turtle: Habitat and History. Final Report. Portland, OR: U.S. Department of Energy, Bonneville Power Administration. Available online at: http://www.efw.bpa.gov/Environment/EW/EWP/DOCS/REPORTS/WILDLIFE/W62137-1.pdf

H.T. Harvey & Associates. 2013. Memorandum To Whitson Engineers for Feasibility Report: Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues.

Information Center for the Environment (University of California, Davis). 2016. Tricolored Blackbird Portal. Available online at: http://tricolor.ice.ucdavis.edu/

Jennings, M.R. and M.P. Hayes. 1986. Decline of ranid frog species in western North America: are bullfrogs (*Rana catesbeiana*) responsible? Journal of Herpetology Vol. 20 (4).Pp. 490-509.

Jennings, M.R. and M.P. Hayes. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana draytonii*) and the foothill yellow-legged frog (*Rana boylii*): implications for management. Proceedings form Management of Amphibians, Reptiles and Small Mammals in North America Symposium 1988.

Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final report to the California Department of Fish and Game, Inland Fisheries Division.255 pp.

Jennings, M.R. and M.P. Hayes, and D.C. Holland. 1993. A petition to the US Fish and Wildlife Service to place the California red-legged frog and the Western pond turtle (*Clemmys marmorata*) on the list of endangered and threatened wildlife and plants.

Moffatt & Nichol. 2013. Carmel River Lagoon Biological Assessment Coastal Engineering Analysis.

MPWMD. 2005. Technical Memorandum 05-01, Surface Water Dynamics at the Carmel River Lagoon, Water Years 1991 through 2005.

Moyle, P.B. 1973. Effects of introduced bullfrogs, Rana catesbeiana, on the native frogs of the San Joaquin Valley, California. Copeia 1973. Pp. 18-22.

National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS). 2005. Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California; Final Rule. Federal Register, Vol. 70(170). Pp. 52487-52627.

NMFS. 2006. Endangered and Threatened Species; Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead; Final Rule. Federal Register, Vol. 71(3). Pp. 833-862.

Pacific Geotechnical Engineering. 2013. Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California.

Parham, J.F. and T.J. Papenfuss. 2008. High genetic diversity among fossorial lizard populations (*Anniella pulchra*) in a rapidly developing landscape (Central California). Conservation Genetics, Vol 10. Pp. 169-176.

Rathbun, G.B., M.R. Jennings, T.G. Murphey, and N.R. Siepel. 1993. Status and ecology of sensitive aquatic vertebrates in lower San Simeon and Pico Creeks, San Luis Obispo County, California. Unpublished report, National Ecology Research Center, Piedras Blancas Research Station, San Simeon, California.103 pp.

Reis, D. 1999. Habitat Characteristics of California Red-Legged Frogs (*Rana aurora draytonii*) Ecological Differences Between Eggs, Tadpoles, and Adults in Coastal Brackish and Freshwater System. A thesis presented to The Faculty of the Department of Biology San Jose State University. Pp. 58.

Remsen, J.V. Jr. 1978. Bird species of special concern in California. California Dept. of Fish and Game, Nongame Wildlife Investigations, Wildlife Management Branch Administrative Report No. 78-1.

Roberson, D. 2002. Monterey Birds. Monterey Peninsula Audubon Society, Monterey, CA. 536 pp.

Sawyer, J.O., T. Keeler-Wolf, and J.M. Evens. 2009. A manual of California vegetation 2nd Edition. California Native Plant Society, Sacramento, CA. 1300 pp.

Stebbins, R.C. 1972. California amphibians and reptiles. University of California Press, Berkeley, CA. 152 pp.

Stebbins, R.C. 1985. Western reptiles and amphibians. Houghton Mifflin Company, Boston, MA.336 pp.

Thelander, C. (ed.). 1994. Life on the edge: A guide to California's endangered natural resources: wildlife. BioSystems Books, Santa Cruz, CA.

U.S. Army Corps of Engineers (USACE). 2011. Preliminary Jurisdictional Determination of Carmel River Lagoon, Monterey County, California, October 18, 2011. File Number 19089S.

USACE, County of Monterey (County), and NMFS. 2013. Memorandum of Understanding (MOU) regarding Flood Prevention and Habitat Protection at the Carmel Lagoon; including Exhibit A: Interim Plan and Criteria for Flood Control and Summer Management of the Carmel River Lagoon.

United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS). 2003. Soil Survey Geographic (SSURGO) Database.

USDA – NRCS. 2014. Hydric Soils of the United States, March 2014. Available online at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/

U.S. Fish and Wildlife Service (Service). 1976. Determination That Six Species of Butterflies are Endangered Species; 41 FR 22041 22044 (Lotis blue, Lycaeides argyrognomon lotis; El Segundo blue, Shijimiaeoides battoides allyni; Smith's blue, Shijimiaeoides enoptes smithi; Mission blue, Icaricia icarioides missionensis; San Bruno elfin, Callophrys mossi bayensis; Lange's metalmark, Apodemia mormo langei). Federal Register, Vol. 41(106). Pp. 22041-22044.

Service. 1984. Smith's Blue Butterfly Recovery Plan. Pp. 87.

Service. 1993. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Pacific Coast Population of the Western Snowy Plover. Federal Register, Vol. 58 (42). Pp. 12864-12874.

Service. 1996. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the California Red-legged Frog; Final Rule. Federal Register, Vol. 61(101). Pp. 25813-25833.

Service. 1998. Endangered and Threatened Wildlife and Plants; Withdrawal of Proposed Rule to List the Black Legless Lizard, Proposed Rule. Federal Register, Vol. 69(149). Pp. 47211-47248.

Service. 2000. Guidelines for Conducting and Reporting Botanical Inventories for Federally listed, Proposed and Candidate Plants.

Service. 2002. Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii)*.

Service. 2006. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the California Red-legged Frog and Special Rule Exemption Associated with Final Listing for Existing Routine Ranching Activities; Final rule. Federal Register, Vol. 71(71). Pp. 19244-19292.

Service. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover. Available online at: http://ecos.fws.gov/docs/recovery_plan/070924_2.pdf

Service. 2010a. Birds Protected by the Migratory Bird Treaty Act. Available online at: http://www.fws.gov/migratorybirds/RegulationsPolicies/mbta/mbtintro.html

Service. 2010b. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the California Red-legged Frog; Final rule. Federal Register, Vol. 75(51). Pp. 12816-12959.

Service. 2016. List of Threatened and Endangered Species with the potential to be affected by the Carmel Lagoon project acquired from the Service's Information, Planning, and Conservation System. Available online at: http://ecos.fws.gov/ipac/

Whitson Engineers. 2013. Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report

Williams, D. 1986. Mammalian species of special concern in California. California Department of Fish and Game Report 86-1. 112 pp.

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White (eds.). 1988. California's wildlife, Volume I: Amphibians and reptiles. California Department of Fish and Game, Sacramento, CA. 272 pp.

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White (eds.). 1990. California's Wildlife, Volume II: Birds. California Department of Fish and Game, Sacramento, CA. 731 pp.

Appendix A List of Threatened and Endangered Species with the Potential to be Affected by the Proposed Project

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
PLANTS							
Allium hickmanii Hickman's onion	-- / -- / 1B	Closed-cone coniferous forests, maritime chaparral, coastal prairie, coastal scrub, and valley and foothill grasslands at elevations of 5-200 meters. Bulbiferous perennial herb in the Alliaceae family; blooms March-May.	**Not Present:** Suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats; however, this species was not observed during surveys in March and June 2014, or March, April and May 2015. The CNDDB reports 15 occurrences within the quads evaluated, the nearest of which is approximately 0.4 mile from the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos edmundsii Little Sur manzanita	-- / -- / 1B	Coastal bluff scrub and chaparral on sandy soils at elevations of 30-105 meters. Evergreen shrub in the Ericaceae family; blooms November-April.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos hookeri ssp. *hookeri* Hooker's manzanita	-- / -- / 1B	Closed-cone coniferous forest, chaparral, cismontane woodland, and coastal scrub on sandy soils at elevations of 85-536 meters. Evergreen shrub in the Ericaceae family; blooms January-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos montereyensis Toro manzanita	-- / -- / 1B	Maritime chaparral, cismontane woodland, and coastal scrub on sandy soils at elevations of 30-730 meters. Evergreen shrub in the Ericaceae family; blooms February-March.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos pajaroensis Pajaro manzanita	-- / -- / 1B	Chaparral on sandy soils at elevations of 30-760 meters. Evergreen shrub in the Ericaceae family; blooms December-March.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arctostaphylos pumila Sandmat manzanita	-- / -- / 1B	Openings of closed-cone coniferous forests, maritime chaparral, cismontane woodland, coastal dunes, and coastal scrub on sandy soils at elevations of 3-205 meters. Evergreen shrub in the Ericaceae family; blooms February-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. The CNDDB reports one non-specific occurrence that includes a portion of the Action Area however, no suitable habitat is present.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Arenaria paludicola marsh sandwort	FE / SE / 1B	Known from only two natural occurrences in Black Lake Canyon and at Oso Flaco Lake. Sandy openings of freshwater of brackish marshes and swamps at elevations of 3-170 meters. Stoloniferous perennial herb in the Caryophyllaceae family; blooms May-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat is present; however, the Action Area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present; however, the Action Area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the implementation area is outside of highly endemic range for the species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Astragalus tener var. *titi* coastal dunes milk-vetch	FE / SE / 1B	Sandy soils in coastal bluff scrub, coastal dunes, coastal prairie (mesic); elevation 3-164 feet. Annual herb in the Fabaceae family; blooms March-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Bryoria spiralifera twisted horsehair lichen	-- / -- / 1B	California North Coast coniferous forest at elevations of 0–30 meters. Often found on conifers, including *Picea sitchensis*, *Pinus contorta* var. *contorta*, *Pseudotsuga menziesii*, *Abies grandis*, and *Tsuga heterophylla*. Fruticose lichen in the Parmeliaceae family.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Castilleja ambigua var. *insalutata* Pink johnny-nip	-- / -- / 1B	Coastal prairie and coastal scrub at elevations of 0-100 meters. Annual herb in the Orobanchaceae family; blooms May-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area, or in areas affected by an increased WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Centromadia parryi ssp. *congdonii* Congdon's tarplant	-- / -- / 1B	Valley and foothill grassland on alkaline soils at elevations of 0-230 meters. Annual herb in the Asteraceae family; blooms May-November.	**Not Present:** No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** No suitable habitat is present within or adjacent to the construction area.	**Not Present:** No suitable habitat is present within area affected by a change in WSE.	**Not Present:** No suitable habitat is present within or adjacent to the construction area.	**Not Present:** No suitable habitat is present within or adjacent to the implementation area.
Chorizanthe pungens ssp. *pungens* Monterey spineflower	FT / -- / 1B	Maritime chaparral, cismontane woodland, coastal dunes, coastal scrub, and valley and foothill grassland on sandy soils at elevations of 3-450 meters. Annual herb in the Polygonaceae family; blooms April-July.	**Not Present:** Suitable habitat is present within the coastal dune scrub habitat; however, this species was not observed during surveys in March and June 2014, or March, April and May 2015. The CNDDB reports nine occurrences within the quads evaluated, the nearest of which is approximately 2.6 miles from the Action Area.	**Not Present:** Construction area lacks microhabitat requirements, and this species was not observed in adjacent areas during surveys in March and June 2014, and March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Construction area lacks microhabitat requirements and this species was not observed in adjacent areas during surveys in March and June 2014, and March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Implementation area lacks microhabitat requirements for the species.
Clarkia jolonensis Jolon clarkia	-- / -- / 1B	Cismontane woodland, chaparral, riparian woodland, and coastal scrub at elevations of 20-660 meters. Annual herb in the Onagraceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Collinsia multicolor San Francisco collinsia	-- / -- / 1B	Closed-cone coniferous forest and coastal scrub, sometimes on serpentinite soils, at elevations of 30-250 meters. Annual herb in the Plantaginaceae family; blooms March-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present within the coastal scrub habitat; however the Action Area is outside of the currently known range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the currently known range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. I

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Cordylanthus rigidus ssp. *littoralis* Seaside bird's-beak	-- / SE / 1B	Closed-cone coniferous forests, maritime chaparral, cismontane woodlands, coastal dunes, and coastal scrub on sandy soils, often on disturbed sites, at elevations of 0-425 meters. Annual hemi-parasitic herb in the Orobanchaceae family; blooms April-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Delphinium californicum ssp. *interius* Hospital Canyon California larkspur	-- / -- / 1B	Openings in chaparral, coastal scrub, and mesic areas of cismontane woodland at elevations of 230-1095 meters. Perennial herb in the Ranunculaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Delphinium hutchinsoniae Hutchinson's larkspur	-- / -- / 1B	Broadleaved upland forest, chaparral, coastal scrub, and coastal prairie at elevations of 0-427 meters. Perennial herb in the Ranunculaceae family; blooms March-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Ericameria fasciculata Eastwood's goldenbush	-- / -- / 1B	Openings in closed-cone coniferous forest, maritime chaparral, coastal dunes, and coastal scrub on sandy soils at elevations of 30-275 meters. Evergreen shrub in the Asteraceae family; blooms July-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat is present within the coastal scrub habitat; however, the Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present; however, the area affected by a change in WSE is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Eriogonum nortonii Pinnacles buckwheat	-- / -- / 1B	Chaparral and valley and foothill grassland on sandy soils, often on recent burns, at elevations of 300-975 meters. Annual herb in the Polygonaceae family; blooms May-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Erysimum ammophilum Sand-loving wallflower	-- / -- / 1B	Openings in maritime chaparral, coastal dunes, and coastal scrub on sandy soils at elevations of 0-60 meters. Perennial herb in the Brassicaceae family; blooms February-June.	**Not Present:** Suitable habitat is present within the coastal dune scrub habitat; however, this species was not observed during surveys in March and June 2014, or March, April and May 2015. No occurrences are known within the Action Area.	**Not Present:** Suitable habitat is present adjacent to the construction area; however, this species was not observed during surveys in March and June 2014, or March, April, and May 2015.	**Not Present:** Suitable habitat is present; however, this species was not observed during surveys in March and June 2014, or March, April, and May 2015.	**Not Present:** Suitable habitat is present adjacent to the construction area; however, this species was not observed during surveys in March and June 2014, or March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Erysimum menziesii Menzie's wallflower	FE / SE / 1B	Coastal dunes at elevations of 0-35 meters. Perennial herb in the Brassicaceae family; blooms March-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Fritillaria liliacea Fragrant fritillary	-- / -- / 1B	Cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland, often serpentinite, at elevations of 3-410 meters. Bulbiferous perennial herb in the Liliaceae family; blooms February-April.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. The CNDDB reports one non-specific occurrence that includes a portion of the Action Area; however, this occurrence is likely extirpated and no suitable habitat is present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Gilia tenuiflora ssp. *arenaria* sand gilia	FE / ST / 1B	Openings in maritime chaparral, cismontane woodland, coastal dunes, and coastal scrub on sandy soils at elevations of 0-45 meters. Annual herb in the Polemoniaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Hesperocyparis goveniana Gowen cypress	FT / -- / 1B	Closed-cone coniferous forest and maritime chaparral at elevations of 30-300 meters. Evergreen tree in the Cupressaceae family. Natively occurring only at Point Lobos near Gibson Creek and the Huckleberry Hill Nature Preserve near Highway 68.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. The Action Area is outside of the highly endemic range and elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of the highly endemic range for this species.
Hesperocyparis macrocarpa Monterey cypress	-- / -- / 1B	Closed-cone coniferous forest at elevations of 10-30 meters. Evergreen tree in the Cupressaceae family. Natively occurring only at Cypress Point in Pebble Beach and Point Lobos State Park; widely planted and naturalized elsewhere.	**Not Present:** Monterey cypress trees are present within the Action Area. However, these individuals are likely planted and from unknown genetic stock, and are therefore not considered native.	**Not Present:** Monterey cypress trees are present adjacent to the construction area. However, these individuals are likely planted and from unknown genetic stock, and are therefore not considered native.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Monterey cypress trees are present within and adjacent to the construction area. However, these individuals are likely planted and from unknown genetic stock, and are therefore not considered native.	**Not Present:** No suitable habitat is present within or adjacent to the implementation area.
Horkelia cuneata ssp. *sericea* Kellogg's horkelia	-- / -- / 1B	Openings of closed-cone coniferous forests, maritime chaparral, coastal dunes, and coastal scrub on sandy or gravelly soils at elevations of 10-200 meters. Perennial herb in the Rosaceae family; blooms April-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Horkelia marinensis Point Reyes horkelia	-- / -- / 1B	Coastal dunes, coastal prairie, and coastal scrub on sandy soils at elevations of 5-755 meters. Perennial herb in the Rosaceae family; blooms May-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present within the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Lasthenia conjugens Contra Costa goldfields	FE / -- / 1B	Mesic areas of valley and foothill grassland, alkaline playas, cismontane woodland, and vernal pools at elevations of 0-470 meters. Annual herb in the Asteraceae family; blooms March-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Layia carnosa beach layia	FE / SE / 1B	Coastal dunes and coastal scrub on sandy soils at elevations of 0-60 meters. Annual herb in the Asteraceae family; blooms March-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present adjacent to the construction area; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Lupinus tidestromii Tidestrom's lupine	FE / SE / 1B	Coastal dunes at elevations of 0-100 meters. Perennial rhizomatous herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area. Construction area is outside of highly endemic range for the.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area. Implementation area is outside of highly endemic range for the species.
Malacothamnus palmeri var. involucratus Carmel Valley bush-mallow	-- / -- / 1B	Chaparral, cismontane woodland, and coastal scrub at elevations of 30-1100 meters. Perennial deciduous shrub in the Malvaceae family; blooms May-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however, the Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present; however, the area affected by a change in WSE is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Malacothamnus palmeri var. palmeri Santa Lucia bush-mallow	-- / -- / 1B	Chaparral on rocky soils at elevations of 60-360 meters. Perennial deciduous shrub in the Malvaceae family; blooms May-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. The CNDDB reports one non-specific occurrence that includes a portion of the Action Area; however, no suitable habitat is present and the Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Malacothrix saxatilis var. arachnoidea Carmel Valley malacothrix	-- / -- / 1B	Chaparral and coastal scrub on rocky soils at elevations of 25-1036 meters. Perennial rhizomatous herb in the Asteraceae family; blooms June-December.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Microseris paludosa Marsh microseris	-- / -- /1B	Closed-cone coniferous forest, cismontane woodland, coastal scrub, and valley and foothill grassland at elevations of 5-300 meters. Perennial herb in the Asteraceae family; blooms April-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present within the disturbed herbaceous mosaic habitat. One non-specific CNDDB occurrence includes a portion of the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Monardella sinuata ssp. *nigrescens* Northern curly-leaved monardella	-- / -- /1B	Chaparral, coastal dunes, coastal scrub, and lower montane coniferous forest (ponderosa pine sandhills) on sandy soils at elevations of 0-300 meters. Annual herb in the Lamiaceae family; blooms April-September.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Monolopia gracilens Woodland wollythreads	-- / -- / 1B	Openings of broadleaved upland forest, chaparral, cismontane woodland, North Coast coniferous forest, and valley and foothill grassland on serpentinite soils at elevations of 100-1200 meters. Annual herb in the Asteraceae family; blooms February-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Pinus radiata Monterey pine	-- / -- / 1B	Closed-cone coniferous forest and cismontane woodland at elevations of 25-185 meters. Evergreen tree in the Pinaceae family. Only three native stands in CA at Ano Nuevo, Cambria, and the Monterey Peninsula; introduced in many areas.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Piperia yadonii Yadon's rein orchid	FE / -- / 1B	Sandy soils in coastal bluff scrub, closed-cone coniferous forest, and maritime chaparral at elevations of 10-510 meters. Annual herb in the Orchidaceae family; blooms February-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Plagiobothrys uncinatus Hooked popcorn-flower	-- / -- / 1B	Chaparral, cismontane woodlands, and valley and foothill grasslands on sandy soils at elevations of 300-760 meters. Annual herb in the Boraginaceae family; blooms April-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Potentilla hickmanii Hickman's cinquefoil	FE / SE / 1B	Coastal bluff scrub, closed-cone coniferous forests, vernally mesic meadows and seeps, and freshwater marshes and swamps at elevations of 10-149 meters. Perennial herb in the Rosaceae family; blooms April-August.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. Suitable habitat may be present; however Action Area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Construction area lacks microhabitat requirements for the species. Construction area is outside of highly endemic range for the.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the area affected by a change in WSE is outside of the highly endemic range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Implementation area lacks microhabitat requirements for the species. Implementation area is outside of highly endemic range for the species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Ramalina thrausta Angel's hair lichen	-- / -- / 2B	North coast coniferous forest on dead twigs and other lichens. Epiphytic fructose lichen in the Ramalinaceae family. In northern CA it is usually found on dead twigs, and has been found on *Alnus rubra*, *Calocedrus decurrens*, *Pseudotsuga menziesii*, *Quercus garryana*, and *Rubus spectabilis*. In Sonoma County it grows on and among dangling mats of *R. menziesii* and *Usnea* spp.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Rosa pinetorum Pine rose	-- / -- / 1B	Closed-cone coniferous forest at elevations of 2-300 meters. Perennial shrub in the Rosaceae family; blooms May-July. Possible hybrid of *R. spithamea, R. gymnocarpa*, or others; further study needed.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Stebbinsoseris decipiens Santa Cruz microseris	-- / -- / 1B	Broadleaved upland forest, closed-cone coniferous forest, chaparral, coastal prairie, coastal scrub, and openings in valley and foothill grassland, sometimes on serpentinite, at elevations of 10-500 meters. Annual herb in the Asteraceae family; blooms April-May.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Tortula californica California screw moss	-- / -- / 1B	Valley and foothill grassland and chenopod scrub on sandy soils at elevations of 10-1460 meters. Moss in the Pottiaceae family.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Trifolium buckwestiorum Santa Cruz clover	-- / -- / 1B	Gravelly margins of broadleaved upland forest, cismontane woodland, and coastal prairie at elevations of 105-610 meters. Annual herb in the Fabaceae family; blooms April-October.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Trifolium hydrophilum Saline clover	-- / -- / 1B	Marshes and swamps, mesic and alkaline valley and foothill grassland, and vernal pools at elevations of 0-300 meters. Annual herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present within the disturbed herbaceous mosaic habitat. The CNDDB reports one occurrence within the quads evaluated, located approximately 4.6 miles from the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area; however, suitable habitat present within areas affected by an increased WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
Trifolium polyodon Pacific Grove clover	-- / SR / 1B	Mesic areas of closed-cone coniferous forest, coastal prairie, meadows and seeps, and valley and foothill grassland at elevations of 5-120 meters. Annual herb in the Fabaceae family; blooms April-July.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. Suitable habitat is present within the disturbed herbaceous mosaic habitat. The CNDDB reports 12 occurrences within the quads evaluated, the nearest of which is located approximately 0.9 mile from the Action Area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area; however, suitable habitat is present within areas affected by an increased WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Trifolium trichocalyx Monterey clover	FE / SE / 1B	Sandy openings and burned areas of closed-cone coniferous forest at elevations of 30-240 meters. Annual herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No occurrences are known within the Action Area. No suitable habitat present within the Action Area. Action Area is outside of the elevation range for this species.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within area affected by a change in WSE.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the construction area.	**Not Present:** Not identified during focused rare plant surveys conducted in March, April, and May 2015. No suitable habitat is present within or adjacent to the implementation area.
MAMMALS							
Arctocephalus townsendi Guadalupe fur seal	FT/ST & CFP/--	Tropical waters of Southern California/Mexico region. During breeding season, they are found in coastal rocky habitats and caves. Breeds on Guadalupe Island off Mexico and some individuals are seen on the Channel Islands. This species occurs infrequently in the MBNMS. A juvenile male was reported off of the beach at former Fort Ord in April 1977 and in San Mateo County in May 1984.	**Unlikely:** Although this species has been observed twice in the MBNMS historically, the Action Area does not provide breeding habitat for this species and is likely too populated to be used as a haul-out site.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Corynorhinus townsendii Townsend's big-eared bat	-- / SC / --	Found primarily in rural settings from inland deserts to coastal redwoods, oak woodland of the inner Coast Ranges and Sierra foothills, and low to mid-elevation mixed coniferous-deciduous forests. Typically roost during the day in limestone caves, lava tubes, and mines, but can roost in buildings that offer suitable conditions. Night roosts are in more open settings and include bridges, rock crevices, and trees.	**Low:** The CNDDB does not report any occurrences of this species within quads evaluated; however, suitable foraging and roosting habitat is present within the Action Area. No suitable breeding habitat is present within the Action Area.	**Low:** This species may forage over the construction area; however, no suitable roosting habitat is present within or adjacent to the construction area. This species may also forage over areas affected by an increased WSE.	**Low:** Suitable foraging and roosting habitat is present within the area affected by a change in WSE; however, no suitable breeding habitat is present.	**Low:** This species may forage over the construction area; however, no suitable roosting habitat is present within or adjacent to the construction area.	**Low:** This species may forage over the implementation area; however, no suitable roosting habitat is present within or adjacent to the implementation area.
Enhydra lutris nereis southern sea otter	FT / CFP / --	Generally found inhabiting nearshore coastal waters of less than 117 feet in depth. *E. lutris* can be found in association with both rocky and soft-bottom habitats. Typical haunts of the sea otter are characterized by precipitous rocky shores, barrier reefs, tidewater stones, and dense kelp forests.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species may be present within the Carmel Bay portion of the Action Area and may utilize the coastal strand as a haul-out site on occasion.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** This species may utilize the construction area as a haul-out site on occasion.	**Low:** This species may utilize the implementation area as a haul-out site on occasion.
Eumetopias jubatus Steller sea lion (Eastern DPS)	FT / -- / --	Colder temperate to sub-arctic waters of North Pacific Ocean. Ano Nuevo Island is the southernmost breeding area for this species; rarely seen at other haul-out sites in the MBNMS. Formerly abundant at Point Lobos State Reserve, but no longer occurs there.	**Unlikely:** This species is known to breed north of the project site; however, it has not been observed south of Ano Nuevo and there are not documented occurrences within the Carmel Bay.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Lasiurus cinereus Hoary bat	-- / CNDDB / --	Prefers open habitats or habitat mosaics with access to trees for cover and open areas or edge for feeding. Generally roost in dense foliage of trees; does not use buildings for roosting. Winters in California and Mexico and often migrates towards summer quarters in the north and east during the spring. Young are born and reared in summer grounds, which is unlikely to occur in California.	**Low:** Suitable foraging and roosting habitat is present within the Action Area; however, this species is unlikely to breed within the Action Area. The CNDDB reports two occurrences within the quads evaluated, the nearest of which is approximately 0.5 mile from the Action Area.	**Low:** This species may forage over the construction area; however, no suitable roosting or breeding habitat is present within or adjacent to the construction area. This species may also forage over areas affected by an increased WSE.	**Low:** Suitable foraging and roosting habitat is present within the area affected by a change in WSE; however, this species is unlikely to breed in this area.	**Low:** This species may forage over the construction area; however, no suitable roosting or breeding habitat is present within or adjacent to the construction area.	**Low:** This species may forage over the construction area; however, no suitable roosting or breeding habitat is present within or adjacent to the construction area.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Neotoma macrotis luciana Monterey dusky-footed woodrat	-- / CSC / --	Forest and oak woodland habitats of moderate canopy with moderate to dense understory. Also occurs in chaparral habitats.	**Present:** The CNDDB does not report any occurrences of this species within quads evaluated; however, this species is known to occur throughout Monterey County. Woodrat nests were observed within the riparian habitat within the Action Area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species; however, this species may be present within areas affected by an increased WSE.	**Present:** Woodrat nests were observed within the riparian habitat within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Phoca vitulina Harbor seal	MMPA / -- / --	California coast in subtidal and intertidal habitat. Hauls out in small to moderate-sized groups on emergent offshore and tidal rocks, mudflats, sandbars, and sandy beaches.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species may be present within the Carmel Bay portion of the Action Area and may utilize the coastal strand as a haul-out site on occasion.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** This species may utilize the construction area as a haul-out site on occasion.	**Low:** This species may utilize the implementation area as a haul-out site on occasion.
Reithrodontomys megalotis distichlis Salinas harvest mouse	-- / CNDDB / --	Known only to occur from the Monterey Bay region. Occurs in fresh and brackish water wetlands and probably in the adjacent uplands around the mouth of the Salinas River.	**Unlikely:** Suitable habitat may be present; however, the Action Area is out of the currently known range for this species.	**Unlikely:** Suitable habitat may be present; however, the construction area is outside of highly endemic range for the.	**Unlikely:** Suitable habitat may be present; however, the area affected by a change in WSE is out of the currently known range for this species.	**Unlikely:** Suitable habitat may be present; however, the construction area is outside of highly endemic range for the species.	**Unlikely:** No suitable habitat within the Implementation Area. Implementation area is outside of highly endemic range for the species.
Taxidea taxus American badger	-- / CSC / --	Dry, open grasslands, fields, pastures savannas, and mountain meadows near timberline are preferred. The principal requirements seem to be sufficient food, friable soils, and relatively open, uncultivated grounds.	**Low:** Suitable habitat may be present; however, this species is not known to occur on adjacent public lands. The nearest CNDDB occurrence is approximately six miles from the Action Area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat may be present; however, this species is not known to occur on adjacent public lands.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Zalophus californianus California sea lion	MMPA / -- / --	California coast in pelagic, nearshore, and surf zones. Hauls out on offshore rocks, sloping outcrops, sandy and cobblestone beaches, jetties, and buoys.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species may be present within the Carmel Bay portion of the Action Area and may utilize the coastal strand as a haul-out site on occasion.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** This species may utilize the construction area as a haul-out site on occasion.	**Low:** This species may utilize the implementation area as a haul-out site on occasion.
BIRDS							
Accipiter striatus Sharp-shinned hawk	-- / CNDDB / --	Uses dense stands in close proximity to open areas. Roosts in intermediate to high-canopy forest. Nests in dense, even-aged, single-layered forest canopy. Winters in woodlands.	**Moderate:** The CNDDB does not report any occurrences of this species within quads evaluated; however, this species is known to occur at the lagoon (State Parks, 2002) and historically bred within the vicinity (Roberson, 2002). Suitable nesting and foraging habitat is present within the Action Area.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Agelaius tricolor Tricolored blackbird (nesting colony)	-- / SC / --	Nest in colonies in dense riparian vegetation, along rivers, lagoons, lakes, and ponds. Forages over grassland or aquatic habitats.	**Moderate:** No CNDDB occurrences are known within the Action Area. Roberson (2002) reports that this species occurs at the Carmel Lagoon; however, breeding has not been documented within the area (Roberson, 2002; Information Center for the Environment [University of California, Davis], 2016).	**Moderate:** Suitable habitat is present within the construction area; however, nesting colonies are not expected to occur within the construction area.	**Moderate:** Suitable habitat is present within the area affected by a change in WSE; however, nesting colonies are not expected to occur within the construction area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Athene cunicularia Burrowing owl (burrow sites & some wintering sites)	-- / CSC / --	Year round resident of open, dry grassland and desert habitats, and in grass, forb and open shrub stages of pinyon-juniper and ponderosa pine habitats. Frequent open grasslands and shrublands with perches and burrows. Use rodent burrows (often California ground squirrel) for roosting and nesting cover. Pipes, culverts, and nest boxes may be substituted for burrows in areas where burrows are not available.	**Moderate:** No CNDDB occurrences are known within the Action Area. Roberson (2002) reports that this species occurs during the winter on the south side of the Carmel River mouth; however, breeding has not been documented within the area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Brachyramphus marmoratus marbled murrelet	FT / SE / --	Occur year-round in marine subtidal and pelagic habitats from the Oregon border to Point Sal. Partial to coastlines with stands of mature redwood and Douglas-fir. Require dense old growth forests of redwood and/or Douglas-fir in higher elevations for breeding and nesting.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Buteo regalis Ferruginous hawk (wintering)	-- / CNDDB / --	An uncommon winter resident and migrant at lower elevations and open grasslands in the Modoc Plateau, Central Valley, and Coast Ranges and a fairly common winter resident of grassland and agricultural areas in southwestern California. Frequent open grasslands, sagebrush flats, desert scrub, low foothills surrounding valleys, and fringes of pinyon-juniper habitats. Does not breed in California.	**Moderate:** No CNDDB occurrences are known within the Action Area. This species has been documented at the lagoon (State Parks, 2002) and suitable foraging habitat is present within the Action Area. The Action Area is not within the breeding range for this species.	**Moderate:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, this area is not within the breeding range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Charadrius nivosus nivosus western snowy plover	FT / CSC / --	Sandy beaches on marine and estuarine shores, also salt pond levees and the shores of large alkali lakes. Requires sandy, gravelly, or friable soil substrates for nesting.	**Present:** No CNDDB occurrences are known within the Action Area. Roberson (2002) reports that this species may winter at the beach near the mouth of the lagoon; however, they are not known to breed within this area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**High:** Roberson (2002) reports that this species may winter at the beach near the mouth of Carmel Lagoon; however, they are not known to breed within the construction area.	**High:** Roberson (2002) reports that this species may winter at the beach near the mouth of Carmel Lagoon; however, they are not known to breed within the implementation area.
Circus cyaneus Northern harrier	-- / CSC / --	Generally found in flat open areas with tall, dense grasses, shrubs, and edges for cover and breeding. Use tall grasses in wetlands or at wetland borders for nesting.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002). Suitable foraging and breeding habitat is present within the Action Area; however, this species is not known to breed at the lagoon (Roberson, 2002).	**Moderate:** Suitable foraging and nesting habitat is present within the construction area and/or immediate vicinity.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Cypseloides niger Black swift (nesting)	-- / CSC / --	Regularly nests in moist crevice or cave on sea cliffs above the surf, or on cliffs behind, or adjacent to, waterfalls in deep canyons. Forages widely over many habitats.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Elanus leucurus White-tailed kite (nesting)	-- / CFP / --	Open groves, river valleys, marshes, and grasslands. Prefer such area with low roosts (fences etc.). Nest in shrubs and trees adjacent to grasslands.	**High:** This species was observed by DD&A biologists in the southern portion of the Action Area over the annual grassland/non-native herb areas. Suitable nesting habitat is present and the Action Area is within the known breeding range for the species in Monterey County (Roberson, 2002).	**Moderate:** Trees present adjacent to the construction area may provide suitable nesting habitat for this species.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Moderate:** Trees present adjacent to the construction area may provide suitable nesting habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Empidonax traillii extimus southwestern willow flycatcher	FE / SE / --	Dense willow thickets are required for nesting and roosting. Low, exposed branches are used for singing posts and hunting perches. Open, cup nest is placed in an upright fork of willow or other shrub, or occasionally on a horizontal limb. Most numerous where extensive thickets of low, dense willows edge on wet meadows, ponds, or backwaters.	**Unlikely:** No occurrences are known within the Action Area. Suitable habitat is present within the riparian habitat; however, the Action Area is very likely outside of the currently known range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species. Construction area is very likely outside the current range of the species.	**Unlikely:** Suitable habitat is present within the riparian habitat; however, the area affected by a change in WSE is very likely outside of the currently known range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species. Construction area is very likely outside the current range of the species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species. Implementation area is very likely outside the current range of the species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Eremophila alpestris actia California horned lark	-- / CNDDB / --	Variety of open habitats, usually where large trees and/or shrubs are absent. Found from grasslands along the coast to deserts at sea-level and alpine dwarf-shrub habitats are higher elevations. Builds open cup-like nests on the ground.	**Moderate:** No occurrences are reported within the Action Area; however suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats. The nearest CNDDB occurrence is approximately 13 miles from the Action Area.	**Moderate:** Construction area and/or immediate vicinity does not provide habitat for this species; however, this species may be present within areas affected by an increased WSE.	**Moderate:** Suitable nesting and foraging habitat is present within the area affected by a change in WSE.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species. Adjacent trees may provide nesting habitat.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Falco columbarius Merlin	-- / CNDDB / --	Uses a variety of habitats in both winter and during migration. Frequents coastlines, open grasslands, savannahs, woodlands, lakes, wetland edges, and early successional stages. Does not breed in California.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002) and suitable foraging habitat is present within the Action Area. The Action Area is not within the breeding range for this species.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, this area is not within the breeding range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Falco peregrinis anatum American peregrine falcon	-- / CFP / --	Forages for other birds over a variety of habitats. Breeds primarily on rocky cliffs.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002). Suitable foraging habitat is present within the Action Area; however, no suitable nesting habitat is present.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, no suitable nesting habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Gymnogyps californianus California condor	FE / SE /--	Roosting sites in isolated rocky cliffs, rugged chaparral, and pine covered mountains 2000-6000 feet above sea level. Foraging area removed from nesting/roosting site (includes rangeland and coastal area - up to 19 mile commute one way). Nest sites in cliffs, crevices, potholes.	**Unlikely:** No occurrences are reported within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species
Oceanodroma homochroa Ashy storm-petrel (nesting colony)	-- / CSC / --	Tied to land only to nest, otherwise remains over open sea. Nests in natural cavities, sea caves, or rock crevices on offshore islands and prominent peninsulas of the mainland.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Pandion haliaetus Osprey	-- / CNDDB / --	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats. Uses large trees, snags, and dead-topped trees in open forest habitats for cover and nesting. Breeds in northern California from the Cascade Ranges, south to Lake Tahoe and along the coast south to Marin County and is an uncommon winter visitor along the coast of Southern California.	**Moderate:** The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species has been observed at the lagoon (State Parks, 2002) and suitable foraging habitat is present within the Action Area. The Action Area is not within the breeding range for this species.	**Low:** Suitable foraging habitat is present within the construction area and/or immediate vicinity; however, no suitable nesting habitat is present for this species.	**Moderate:** Suitable foraging habitat is present within the area affected by a change in WSE; however, this area is not within the breeding range for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Pelecanus occidentalis californicus California brown pelican (nesting colony & communal roosts)	-- / CFP / --	Found in estuarine, marine subtidal, and marine pelagic waters along the California coast. Usually rests on water or inaccessible rocks, but also uses mudflats, sandy beaches, wharfs, and jetties.	**Present:** No CNDDB occurrences are known within the Action Area. This species has been observed at the lagoon (State Parks, 2002); however nesting and communal roosting habitat is not present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Present:** This species has been observed within the area affected by a change in WSE; however nesting and communal roosting habitat is not present.	**High:** This species may be found on the beach within the construction area and/or immediate vicinity. However, no nesting or communal roosting habitat is present.	**High:** This species may be found on the beach within the implementation area and/or immediate vicinity. However, no nesting or communal roosting habitat is present.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Rallus longirostris obsoletus California clapper rail	FE/SE & CFP/--	Salt and brackish marshes.	**Unlikely:** No CNDDB occurrences are known within the Action Area. Suitable habitat is present within the Action Area; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present in the immediate vicinity; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.	**Unlikely:** Suitable habitat is present; however, Roberson (2002) identifies that although this species was occasionally observed at Carmel Lagoon prior to 1950, it has not been observed there since 1972.
Riparia riparia Bank swallow (nesting)	-- / ST / --	Nest colonially in sand banks. Found near water; fields, marshes, streams, and lakes.	**Unlikely:** No occurrences are known within the Action Area. No suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Sterna antillarum browni California least tern	FE / SE / --	Prefers undisturbed nest sites on open, sandy/ gravelly shores near shallow-water feeding areas in estuaries. Sea beaches, bays, large rivers, bars.	**Unlikely:** No occurrences are known within the Action Area. Possible habitat is present; however, the Action Area is very likely outside of the current range for this species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the area affected by a change in WSE; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the implementation area; however, very likely outside the current range of the species.
Vireo bellii pusillus Least bell's Vireo	FE / SE / --	Riparian areas and drainages. Primarily found south of the Action Area.	**Unlikely:** No occurrences are known within the Action Area. Suitable habitat is present; however, the Action Area is very likely outside of the current range for this species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Suitable habitat is present; however, the area affected by a change in WSE is very likely outside of the current range for this species.	**Unlikely:** Possible habitat in the vicinity of the construction area; however, very likely outside the current range of the species.	**Unlikely:** Possible habitat in the vicinity of the implementation area; however, very likely outside the current range of the species.
REPTILES AND AMPHIBIANS							
Ambystoma californiense California tiger salamander	FT / ST /--	Annual grassland and grassy understory of valley-foothill hardwood habitats in central and northern California. Need underground refuges and vernal pools or other seasonal water sources.	**Not Present:** No occurrences are known within the Action Area and no suitable habitat is present.	**Not Present:** Construction area and/or immediate vicinity does not provide habitat for this species. No known breeding locations within 2.2 km.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Not Present:** Construction area and/or immediate vicinity does not provide habitat for this species. No known breeding locations within 2.2 km.	**Not Present:** Implementation area and/or immediate vicinity does not provide habitat for this species. No known breeding locations within 2.2 km.
Anniella pulchra California legless lizard (includes *A. p. nigra* and *A. p. pulchra* as recognized by the Department)	-- / CSC / --	Requires moist, warm habitats with loose soil for burrowing and prostrate plant cover, often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas.	**Present:** The CNDDB includes 11 non-specific occurrences that include the entire Action Area. Within the Action Area, this species has been observed at the CRMB (State Parks, 2002) and within the foredunes at the beach (State Parks, 2007). Suitable habitat for this species is present within the Action Area where suitable soil conditions are present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Present:** This species has been observed within the area affected by a change in WSE and suitable habitat is present.	**Present:** This species has been observed within the construction area and suitable habitat is present.	**Not Present:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Emys marmorata Western pond turtle	-- / CSC / --	Associated with permanent or nearly permanent water in a wide variety of habitats including streams, lakes, ponds, irrigation ditches, etc. Require basking sites such as partially submerged logs, rocks, mats of vegetation, or open banks.	**Present:** The CNDDB reports one occurrence within the Action Area. Suitable habitat is present within the Action Area.	**High:** Suitable habitat for this species is present within the construction area and within areas affected by an increased WSE.	**Present:** This species has been observed within the area affected by a change in WSE and suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Phrynosoma blainvillii Coast horned lizard	-- / CSC / --	Associated with open patches of sandy soils in washes, chaparral, scrub, and grasslands.	**Unlikely:** No occurrences are known within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Rana draytonii California red-legged frog	FT / CSC / --	Lowlands and foothills in or near permanent or late-season sources of deep water with dense, shrubby, or emergent riparian vegetation. During late summer or fall adults are known to utilize a variety of upland habitats with leaf litter or mammal burrows.	**Present:** The CNDDB reports one occurrence within the Action Area. Additionally, multiple occurrence records of CRLF tadpoles and adults are known in the south arm of the lagoon	**Present:** CRLF are known to occur within the lagoon. Suitable upland and dispersal habitat are present within the construction area. Suitable breeding and non-breeding habitat are present in the immediate vicinity.	**Present:** CRLF are known to occur within the lagoon. Suitable aquatic breeding and non-breeding, upland, and dispersal habitat are present area affected by a change in WSE.	**Unlikely:** CRLF are known to occur within the lagoon; however, the beach habitat within the construction area is unlikely to support this species.	**Present:** CRLF are known to occur within the lagoon, which supports suitable upland, breeding, aquatic non-breeding, and dispersal habitat.
Taricha torosa torosa Coast Range newt	-- / CSC / --	Occur mainly in valley-foothill hardwood, valley-foothill hardwood-conifer, coastal scrub, and mixed chaparral, but is known to occur in grasslands and mixed conifer types. Seek cover under rocks and logs, in mammal burrows, rock fissures, or man-made structures such as wells. Breed in intermittent ponds, streams, lakes, and reservoirs.	**Low:** Suitable habitat may be present within the Carmel River and adjacent riparian habitat, and freshwater areas of the lagoon. The CNDDB does not report any occurrences of this species within the quads evaluated; however, this species is known to occur approximately three miles from the Action Area at the Santa Lucia Preserve.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat may be present within the Carmel River and adjacent riparian habitat, and freshwater areas of the lagoon.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
FISH							
Acispenser medirostris Green sturgeon - southern DPS	FT / CSC / --	San Francisco Bay, San Pablo Bay, and the lower San Joaquin River and Delta (Radtke, 1966). Spawning locations are uncertain, an anadromous fish that spends most of its life in salt water and returns to spawn in fresh water.	**Unlikely:** No suitable habitat present within the Action Area.	**Unlikely:** Construction area does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area does not provide habitat for this species.	**Unlikely:** Implementation area does not provide habitat for this species.
Eucyclogobius newberryi tidewater goby	FE / CSC / --	Brackish water habitats, found in shallow lagoons and lower stream reaches. Tidewater gobies appear to be naturally absent (now and historically) from three large stretches of coastline where lagoons or estuaries are absent and steep topography or swift currents may prevent tidewater gobies from dispersing between adjacent localities. The southernmost large, natural gap occurs between the Salinas River in Monterey County and Arroyo del Oso in San Luis Obispo County.	**Unlikely:** Suitable habitat is present; however, no occurrences of this species have been identified within the Action Area (State Parks, 2002). The Action Area is present within the southernmost gap where this species is currently and historically absent.	**Unlikely:** Construction area does not provide habitat for this species. Species is not known to occur in adjacent habitat (State Parks, 2002).	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area does not provide habitat for this species. Species is not known to occur in adjacent habitat (State Parks, 2002).	**Unlikely:** Suitable habitat is present; however, no occurrences of this species have been identified within the Action Area (State Parks, 2002).
Oncorhynchus mykiss irideus Steelhead – south/central California coast DPS	FT / -- / --	Cold headwaters, creeks, and small to large rivers and lakes; anadromous in coastal streams.	**Present:** The CNDDB reports one occurrence within the Action Area, located within the Carmel River and Lagoon.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon. Appropriate habitat for this species exists adjacent to the construction area.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon. Appropriate habitat for this species exists within the area affected by a change in WSE when inundated.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon; however, the beach habitat within the construction area is unlikely to support this species.	**Present:** S-CCC steelhead are known to occur within the Carmel Lagoon. Appropriate habitat for this species exists within the implementation area.
INVERTEBRATES							
Branchinecta lynchi vernal pool fairy shrimp	FT / -- / --	Require ephemeral pools with no flow. Associated with vernal pools/grasslands from near Red Bluff (Shasta County), through the central valley, and into the south Coast Mountains region.	**Unlikely:** No occurrences are known within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Species	Status (Service/ Department/ CNPS)	General Habitat Description	Action Area	EPB		SRPS	ISMP
				Construction Area	*Area Affected by WSE*		
Bombus caliginosus Obscure bumble bee	-- / CNDDB / --	Native to the West Coast of the United States. Occurs primarily along the coast in grassy prairies and meadows within the Coast Range. This species can nest both under and above ground. When nesting above ground the species may utilize abandoned bird nests. Found in areas that are relatively humid including areas that are frequently foggy. Select food genera include *Baccharis, Cirsium, Lupinus, Lotus, Grindelia*, and *Phacelia* (Pollinator Partnership and USFS, 2012).	**Low:** The CNDDB includes an occurrence from 1925 approximately 235 feet from the Action Area. Suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats within the Action Area. This species has a low potential to occur as CNDDB reported occurrences of this species within and adjacent to the proposed project site are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat is present within the area affected by a change in WSE; however, the CNDDB reported occurrences of this species in the within the proposed project area or the immediate vicinity are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Bombus occidentalis Western bumble bee	-- / CNDDB / --	Occurs in open grassy areas, urban parks, urban gardens, chaparral, and meadows. This species generally nests underground. Select food plant genera include *Melilotus, Cirsium, Trifolium, Centaurea, Chrysothamnus*, and *Eriogonum* (Pollinator Partnership and USFS 2012).	**Low:** The CNDDB includes an occurrence from 1972 approximately 235 feet from the Action Area. Suitable habitat is present within the non-native annual grassland and disturbed herbaceous mosaic habitats within the Action Area; however, this species has a low potential to occur, as CNDDB reported occurrences of this species within and adjacent to the proposed project site are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Low:** Suitable habitat is present within the area affected by a change in WSE; however, the CNDDB reported occurrences of this species in the within the proposed project area or the immediate vicinity are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Coelus globosus Globose dune beetle	-- / CNDDB / --	Coastal dunes. These beetles are primarily subterranean, tunneling through sand underneath dune vegetation.	**Low:** The CNDDB includes an occurrence from 1947 along the beach within the Action Area; however, State Parks reports that this species is not known within the beach (2007). Suitable habitat is present within the coastal strand habitat; however, this species has a low potential to occur, as CNDDB reported occurrences of this species within and adjacent to the proposed project site are historic.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Low:** Suitable habitat for this species is present within and adjacent to the construction area; however, the CNDDB reported occurrences of this species in the within the proposed project area or the immediate vicinity are historic.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Danaus plexippus Monarch butterfly-California Overwintering Population #1	-- / CNDDB / --	Overwinters in coastal California using colonial roosts generally found in Eucalyptus, pine and acacia trees. Overwintering habitat for this species within the Coastal Zone represents ESHA. Local ordinances often protect this species as well.	**Low:** The CNDDB reports seven non-specific occurrences, which include the entire Action Area. Low quality habitat is present within the eucalyptus grove within the Project Study Area, near the CAWD WTP.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Euphilotes enoptes smithi Smith's blue butterfly	FE / -- / --	Most commonly associated with coastal dunes and coastal sage scrub plant communities in Monterey and Santa Cruz Counties. Plant hosts are *Eriogonum latifolium* and *E. parvifolium*.	**Present:** No occurrences are known within the Action Area. *E. parvifolium* is present adjacent to the Carmel River State Park parking lot. Presence of SBB is inferred based on the presence of the host plant species.	**Not Present:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Assumed Present:** *E. parvifolium* is present within the area affected by a change in WSE. Presence of SBB is inferred based on the presence of the host plant species.	**Assumed Present:** *E. parvifolium* is present adjacent to the Carmel River State Park parking lot. Presence of SBB is inferred based on the presence of the host plant species.	**Not Present:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Haliotis cracherodii Black abalone	FE / -- / --	Abalones live in areas with rocky reef because they require hard substrate for attachment. Black abalone live on coastal rocks from the high intertidal zone out to 6 m depth, though they are most abundant intertidally.	**Unlikely:** No suitable habitat within Action Area.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.
Linderiella occidentalis California linderiella (fairy shrimp)	-- / CNDDB / --	Ephemeral ponds with no flow. Generally associated with hardpans.	**Unlikely:** No occurrences are known within the Action Area and no suitable habitat is present.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Area affected by a change in WSE does not provide habitat for this species.	**Unlikely:** Construction area and/or immediate vicinity does not provide habitat for this species.	**Unlikely:** Implementation area and/or immediate vicinity does not provide habitat for this species.

Federal

FE = listed as Endangered under ESA
FT = listed as Threatened under ESA
MMPA = Marine Mammal Protection Act
-- = not listed

State

SE = listed as Endangered under CESA
ST = listed as Threatened under CESA
SR = listed as Rare under CESA
SC = candidate for listing under CESA
CSC = California Department of Fish and Wildlife Species of Special Concern
CFP = California Fully Protected Species
CNDDB = This designation is being assigned to animal species that are not assigned any of the other status designations defined in this table. These animal species are included in the Department's CNDDB "Special Animals" list (2010), which includes all taxa the CNDDB is interested in tracking, regardless of their legal or protection status. This list is also referred to as the list of "species at risk" or "special-status species." The Department considers the taxa on this list to be those of greatest conservation need.
-- = not listed

California Native Plant Society

1A = California Rare Plant Rank 1A species; plants presumed extinct in California
1B = California Rare Plant Rank 1B species; plants rare, threatened, or endangered in California and elsewhere
2B = California Rare Plant Rank 2B species; plants rare, threatened, or endangered in California, but more common elsewhere
-- = no listing

POTENTIAL TO OCCUR

Present – known occurrence of species within the site; presence of suitable habitat conditions; or observed during field surveys
High – known occurrence of species in the vicinity from the CNDDB or other documentation; presence of suitable habitat conditions
Moderate – known occurrence of species in the vicinity from the CNDDB or other documentation; presence of marginal habitat conditions
Low – species known to occur in the vicinity from the CNDDB or other documentation; presence of low quality habitat conditions
Unlikely – species not known to occur in the vicinity from the CNDDB or other documentation; no suitable habitat is present
Not Present – species not observed during surveys

Appendix B Technical Reports

- *Carmel River Lagoon Biological Assessment Coastal Engineering Analysis*, prepared by Moffatt & Nichol, August 2013
- *The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report* prepared by Balance Hydrologics, Inc, January 2014
- *Fisheries Analysis for the Carmel River Lagoon Biological Assessment Report* prepared by D.W. ALLEY & Associates (DWA Associates), March 2014

PROGRESS DRAFT

CARMEL RIVER LAGOON BIOLOGICAL ASSESSMENT

COASTAL ENGINEERING ANALYSIS



Prepared Under Contract to Denise Duffy & Associates, Inc. for:

Monterey County Water Resources Agency
893 Blanco Circle, Salinas, CA 93901-4455

Prepared by:

moffatt & nichol
2185 No California Blvd., Ste. 500
Walnut Creek, CA 94596

August 2, 2013
M&N Job No: 8116

CONTENTS

1. INTRODUCTION 1
   1.1 Background 1
2. Data Summary 4
   2.1 Beach Morphology 4
   2.2 Bathymetry 5
   2.3 Astronomical Tides 5
   2.4 Waves 5
   2.5 River Discharge and Lagoon Water Levels 6
3. Wave Analysis 7
   3.1 Model Development 7
   3.2 Model Results 7
4. Coastal Processes 9
   4.1 Littoral Transport 9
   4.2 Beach Morphology 9
   4.3 River Breaching 10
5. Inlet Morphology 12
   5.1 Fall Wave Overtopping 12
   5.2 Fall and Winter Intermittent Breaches 12
   5.3 Winter and Spring Intermittent Closings 13
   5.4 Summer Closures 13
6. REFERENCES 14

APPENDICES

A. Carmel River Breaching and Relevant Processes, Monthly Figures, Water Years 2013, 2010, 2009
B. Monterey County Aerial Photographs
C. Monterey County Carmel River Mouth Surveys 2001 - 2012

FIGURES

Figure 1-1. Project Site Overview
Figure 2-1. Depths (in fathoms, MLLW) near project site (NOAA Chart)
Figure 2-2. Nearshore Bathymetry (in ft., MLLW)
Figure 2-3. Location of NDBC Wave Measurement Buoys
Figure 2-4. Significant Wave Height Rose at Monterey Bay NDBC Wave Buoy
Figure 2-5. Significant Wave Height Rose at Point Sur NDBC Wave Buoy
Figure 3-1. Mike21-SW Swell Transformation Model Domain
Figure 3-2. Mike21-SW Model Mesh and Bathymetry in Project Vicinity
Figure 3-3. Mike21-SW Model Output Points
Figure 3-4. Example Model Output – Transformation of Unit Wave Height, 16 sec, 270° Swell
Figure 3-5. Example Model Output – Transformation of Unit Wave Height, 16 sec, 315° Swell
Figure 3-6. Swell Transformation from Offshore – H_s Roses at Selected Output Points
Figure 3-7. Wave Roses at Points along Carmel River State Beach
Figure 5-1. Water Year 2013, Annual – Carmel River Breaching and Relevant Processes
Figure 5-2. Water Year 2012, Annual – Carmel River Breaching and Relevant Processes
Figure 5-3. Water Year 2011, Annual – Carmel River Breaching and Relevant Processes
Figure 5-4. Water Year 2010, Annual – Carmel River Breaching and Relevant Processes
Figure 5-5. Water Year 2009, Annual – Carmel River Breaching and Relevant Processes
Figure 5-6. Water Year 2012, Oct. – Nov. – Carmel River Breaching and Relevant Processes
Figure 5-7. Water Year 2012, Dec. – Jan. – Carmel River Breaching and Relevant Processes
Figure 5-8. Water Year 2012, Feb. – Mar. – Carmel River Breaching and Relevant Processes
Figure 5-9. Water Year 2012, Apr. – Jun. – Carmel River Breaching and Relevant Processes
Figure 5-10. Water Year 2011, Oct. – Nov. – Carmel River Breaching and Relevant Processes
Figure 5-11. Water Year 2011, Dec. – Jan. – Carmel River Breaching and Relevant Processes
Figure 5-12. Water Year 2011, Feb. – Mar. – Carmel River Breaching and Relevant Processes
Figure 5-13. Water Year 2011, Apr. – May. – Carmel River Breaching and Relevant Processes
Figure 5-14. Water Year 2011, Jun. – Jul. – Carmel River Breaching and Relevant Processes

1. INTRODUCTION

1.1 Background

The Carmel River drains an approximate 250 square mile watershed. Like many California streams entering the Pacific, there is a very productive estuary at the mouth, called the Carmel River Lagoon, which serves as rearing habitat for juvenile steelhead. The Carmel River Lagoon supports threatened species such as the South-Central California Coast (S-CCC) steelhead, California red-legged frog, Western snowy plover, and Smith's blue butterfly. The Carmel River was also designated as critical habitat for S-CCC steelhead in September 2005 (County of Monterey et. al, 2012). Figure 1-1 gives an overview of the project site location.

The lagoon is not connected to the ocean during times of low or no river flow, when waves build a barrier beach across the mouth of the river. When the mouth of the river is closed, lagoon water levels rise between late fall and spring seasons and threaten private properties along the northern edges of the lagoon, the County wastewater treatment plant, as well as a parking lot and restroom facility operated by the State Parks. Since 1973, the County mechanically breaches the sandbar to prevent flooding. Evidence shows that the barrier beach has been breached since at least the early 20th century (Final Study Plan, 2007). Historically, the breaches were created such that the river would flow directly west out to the Pacific Ocean; however, the river meanders north or south along the beach in response to beach build-up from wave action. Often numerous breaches are mechanically and naturally formed over the winter and early spring, depending on variable ocean and river conditions (James, 2005). Beginning in 2005, the sandbar has also been mechanically closed in the spring when the river flows have subsided in order to maintain adequate water levels for steelhead throughout the summer. A larger, deeper lagoon during the summer and fall increases the quality and quantity of fish and wildlife habitat until river flows resume during the winter (County of Monterey et. al, 2012).

The rate of the lagoon drawdown after a breach and the post-breach lagoon water surface elevation are dependent on several factors, including breach location, channel length and width, tidal conditions, and the presence or absence of a rock sill along the outflow channel. Breaches which result in the lagoon reaching relatively low elevations reduce the available aquatic habitat area for fish and wildlife. Breaches directly west out to the ocean also have swift stream flows that push juvenile steelheads out to sea prematurely. When the river channel migrates along the northern or southern beach, a longer, meandering path is taken which extends the hydraulic gradient slowing the water exit. Local fisheries groups and agencies have preferred a northern meandering outlet channel alignment because, in the past, when the river channel migrated northwards, it reduced the rate and amount of *drawdown* (drop in lagoon water levels before and after a breach to the ocean) and subsequent loss of threatened juvenile steelhead that get flushed out to sea, as compared to when the channel flows along the southerly and westerly outlet channel (James, 2005).

Scenic Road is located immediately north of the Carmel River mouth in Monterey County. It is a publicly maintained road that is threatened by erosion when the river takes a northerly route along the beach before discharging into the Pacific Ocean. The road runs around the northern headlands of Stewart's Cove, southwest to intersect with Carmelo Street near the Carmel River State Beach parking lot and restrooms. Scenic Road provides recreational access to the State Beach, sole access to six private homes, and has a sanitary sewer pipe under the roadway. Bluff stabilization methods to protect the road, sewer infrastructure, and homes are also being investigated as part of this work effort.

In November 2011, the County applied for permits from the US Army Corps of Engineers (Corps), Regional Water Quality Control Board (RWQCB), California Coastal Commission (CCC), and the California Department of Fish and Wildlife (CDFW) to manage lagoon water levels and install a sand ramp for public beach access. The Corps consulted with the NMFS and the US Fish and Wildlife Service (USFWS) as part of permit review. In September 2012, the County and the Corps, in consultation with NMFS, drafted a Memorandum of Understanding (MOU) regarding the management of the Carmel River Lagoon. The MOU lays out a long-term plan to balance protection of private property with protection of federally listed species. The MOU parties also recognize that mechanically managing the Carmel River Lagoon over the long run is not in the best interest of the County, Corps, and NMFS (County of Monterey et. al, 2012). So the MOU identified two long-term solutions as alternatives to performing sandbar management: the Ecosystem Protective Barrier (EPB) and the Scenic Road Protection and Preservation Project (this project).

The Scenic Road Protection Project is proposed for the purpose of protecting Scenic Road and the State Parks parking lot and restrooms from erosion when the river is allowed to naturally breach along a northern alignment. The purpose of the EPB is to protect nearby residential property by constructing a flood wall around portions of the lagoon, which would allow a higher lagoon water level, significantly reducing, if not eliminating, the need for sandbar management. Once installed, the expectation is that the EPB will positively impact the management of the Carmel River Lagoon by reducing the number of mechanical breaches per year.

The potential reduction in number of mechanical breaches per year and the potential for erosion of the bluffs along Scenic Road can only be determined after a better understanding of the coastal processes in the area is achieved, which is described in this report.

The EPB and Scenic Road Protection Projects are anticipated to be completed by 2018 or earlier. Meanwhile, the Interim Sandbar Management Plan (County of Monterey et. al, 2012) provides well-established protocols on sandbar management. These include:

- The use of sandbags, public outreach, sandbar breaching and closure, and sand relocation for access purposes;
- Mobilizing equipment and personnel when the water level in the lagoon reaches +12.77 feet NAVD88[1], or when the projected water level is expected to reach this elevation within hours, or when the flow in the river reaches 200 cfs;
- Mechanical sandbar breaching when the Lagoon water level reaches +13.27 feet NAVD88, or high river inflows and/or wave overtopping is expected to raise the water level to +12.77 feet in less than 6 hours, or if the predicted tides are unusually high;
- Managing the breach in the winter to maintain a minimum lagoon elevation of +6 feet NAVD88, or closing the breach if excessive scouring is observed;
- Managing the breach, and conducting beach grooming as required, in the summer with the intent of achieving a +12.77 feet pool elevation in the lagoon.

[1] All elevations in this report reference the North American Vertical Datum (NAVD) of 1988, unless specifically stated otherwise. The conversion factor between NAVD and the National Geodetic Vertical Datum (NGVD) of 1929 is 2.77 feet, with the NGVD datum being higher (add 2.77 feet to NGVD elevations to obtain NAVD elevations)

This is a change to the County's historic practice, which in general, was to mobilize at +10.27 feet and breach at +11.55 feet (James 2005). In reality, the average lagoon elevation at breaching was +11.83 feet for the 1992-1998 period, and +13.57 feet for the 1999-2005 period. This change over time was likely due to the Federal listing of the Carmel River Steelhead as a threatened species in 1997, which increased the involvement of resource agencies such as the National Marine Fisheries Service (NMFS).

2. DATA SUMMARY

The project reach is within a crenulate-shaped bay, anchored by the rocky Carmel Point headland (south of Stewart's Cove) to the north and a bedrock outcrop to the south. Consistent with typical headland-bay beaches, the shoreline shape is oriented parallel to the wave crests as they refract and diffract around the headland. There is also a wave energy gradient along the beach such that during the winter, when waves are predominantly from the northwest direction, the energy decreases from south to north.

The estuarine morphology (beach, lagoon and nearshore bathymetry), coupled with oceanographic conditions (tides and wave conditions) and the hydrologic components (river discharge and lagoon water level) of the Carmel River Estuary result in the annual and seasonal variation in the response of the system. Each of these components is described below.

2.1 Beach Morphology

The slope of the beach progressively becomes flatter from the south to the north. Field observations by Prof. Ed Thornton of the Naval Postgraduate School show that the beach slope varies from about 8H:1V (12%) at the north end of the beach, to about 3.6H:1V (28%) at the south end of the beach (Thornton, 2005). Sand grain size, and therefore wave energy, also increases from the north to the south end of the beach. Sand is deposited on the beach berm by wave action, and at high tides, waves overtop the berm depositing sand and debris on the back beach (nearest the lagoon). Prof. Thornton also determined that the beach is relatively stable and has not migrated over the past 130 years (Thornton, 2006).

The beach topography is seasonally variable and dependent on numerous factors including river flow, wave height, period and direction, tide, mechanical or natural breaching, wind direction and strength, and river sediment deposition. After reviewing the available surveys of the Carmel River mouth and beach along Scenic Drive, it is evident that the beach is heavily managed and mechanical breaching significantly alters the beach topography. By mechanically breaching in different locations each year, the beach to the north, south and middle of the river mouth are unnaturally modified, eliminating the ability to decipher the "natural" beach topography and breaching process. If natural breaching predictability is desired, cross sections for multiple years would have to be surveyed along the beach at specific locations to maintain congruency in the data. Surveys would have to be completed prior to, and after, sand management on the beach (after final closure and before first breaching) over several years to remove inter-annual variability to decipher a natural signal.

A preliminary analysis of beach berm elevations from the County provided surveys for the 2003 to 2012 period indicates the following:

- The *low point* of the beach berm is generally about +14 feet and is to the south of the river mouth in most of the surveys (5 out of 7 surveys reviewed). The highest elevation of this low point was about 15.5 feet in Dec 2004.
- The *high point* is generally in the middle of the beach, and ranges from +16 to +17 feet (5 of the 7 surveys reviewed).
- The beach immediately north of the entrance is generally between the above two range of elevations and was as low as the southern portion in 2 of the 7 surveys reviewed, and actually was the high point in 2 of the 7 surveys.

The above observations indicate that the low point in the beach berm is about 1 to 2 feet higher than the +13.3 feet elevation which is the current trigger for breaching the sandbar by the County under the Interim Management Plan.

2.2 Bathymetry

The sea floor offshore of the Carmel River Beach is relatively steep, quickly dropping off to depths greater than 100 ft. in the Carmel Canyon; however, very little detailed information exists on the nearshore bathymetry within the surf zone. Figure 2-1 below gives a detail from the NOAA navigation chart of the area, but survey dates are unknown and there is still a lack of detail in the direct project vicinity.

A bathymetric survey performed in the early 1970's, with the locations of 20 to 100 feet depth contours, is provided in Figure 2-2 (Howell, 1972). Rock outcroppings at the northern and southern headlands are evident in the figure, with the sea floor between the two headlands reported to be mantled by over 5 feet of fine to coarse sand.

In January 2013, Whitson Engineers obtained new aerial topographic mapping and performed a lagoon stage-volume-area analysis (Whitson Engineers, 2013). Lagoon bathymetry data from a previous 2007 RMC study was used for the ground below the water surface at the time of the aerial mapping (RMC, 2007).

2.3 Astronomical Tides

Typical tidal water levels at the site can be characterized using measurements from the Monterey, CA tide gage, located approximately 7 miles north of the project site on the opposite side of the Monterey Peninsula. The lag time between water levels over this distance is less than 5 minutes, and differences in water levels are negligible (Laudier, 2009). Table below gives the tidal datums at the project site referenced to Mean Lower Low Water (MLLW), NGVD29, and NAVD88 datums.

Table 2-1: Tidal Datums at Monterey, CA (NOAA CO-OPS #9413450)*

Tidal Plane	Elevation (ft.)		
	MLLW Datum	NGVD29 Datum	NAVD88 Datum
Mean Higher High Water (MHHW)	5.34	2.74	5.48
Mean High Water (MHW)	4.64	2.04	4.78
Mean Tide Level (MTL)	2.87	0.27	3.01
National Geodetic Vertical Datum 1929 (NGVD29)	2.6	0	2.74
Mean Low Water (MLW)	1.1	-1.5	1.24
Mean Lower Low Water (MLLW)	0	-2.6	0.14
National Geodetic Vertical Datum 1988 (NAVD88)	-0.14	-2.74	0

* Note that the difference between NAVD88 and NGVD29 datums of 2.74 ft. is provided at the Monterey tide gage and is used in this report. At the project site, the County uses a conversion of 2.77 ft. (County of Monterey et. al, 2012).

2.4 Waves

The wave climate offshore of the project site is characterized by long-period, energetic swell that typically approaches from the west through northwest (clockwise) directions. The location of the two

closest wave measurement buoys, one approximately 50 miles NW and one approximately 30 miles south of the project site, are shown in Figure 2-3. Figure 2-4 and Figure 2-5 show wave height roses for, which show the predominance of the west through northwesterly swells. The data measured at the Point Sur buoy will be used in this analysis to represent the offshore wave conditions affecting the site. Directional wave height and period information at this buoy were only available from 2008 to present.

The wave climate varies seasonally to a high degree. During the fall and winter seasons, North Pacific storms generate long period swells that propagate from the west though northwest directions, though infrequent southerly swells can occur as well (James, 2005). During the summer months, shorter period (local seas) waves predominate from the northwest; infrequent southern hemisphere swells are also present. Carmel River Beach is largely protected from the predominant wave directions by both the southern end of the Monterey Peninsula and the rocky headland directly north of the beach. As long period NW waves propagate towards shore, they undergo refraction due to changes in bathymetry and diffract to a large degree by the protecting headlands, filtering out higher-frequency wave energy so that mostly low-frequency swell impacts the beach. The beach is exposed to the rare, westerly storms, where wave focusing can amplify approaching waves (Thornton, 2005). At the northern portion of the beach, diffraction of wave energy from the sheltering headland results in further diminished waves that approach the curved portion of the beach at a northerly direction.
Lagoon Stage

2.5 River Discharge and Lagoon Water Levels

Carmel River Lagoon water surface elevations from the south arm gage, and Carmel River flow data measured at the Highway 1 gage, are not described in detail in this report; a Lagoon Hydrology report is being prepared separately by Balance Hydrologics. A summary of the data, relevant to coastal processes, is discussed in section 5 of this report.

3. WAVE ANALYSIS

The MIKE-21 Spectral Wave (SW) model was used to investigate wave propagation and wave transformation from deep water to shallow water, offshore of the Carmel River Lagoon. The model includes important wave phenomena, such as shoaling and refraction due to depth variations, diffraction and reflection near artificial structures, wave breaking in the surf zone, wave dissipation, and non-linear wave-current interactions (DHI 2011). The SW model uses unstructured meshes to conduct numerical calculations with the advantage of flexible resolutions (or densities) based on the area of interest. Typically, the offshore area of the model domain has less mesh elements, whereas in the vicinity of the site the mesh elements are dense and in higher resolution.

3.1 Model Development

The model domain was chosen to encompass the project site and surrounding shorelines, nearshore, and offshore areas that affect the propagation of swell waves to the beach (Figure 3-1). The offshore boundary was placed near to the NDBC Point Sur buoy so that swell wave data measured at the buoy could be used for model boundary conditions. Figure 3-2 shows the model computational mesh and bathymetry in the vicinity of the project site. The variable shoreline in the area that influences wave conditions at the beach through diffraction and refraction is represented with sufficient detail. The flexible-mesh (FM) capabilities of the Mike21-SW model allow the high-resolution representation of wave transformation and diffraction processes in the shallow areas directly offshore of the Carmel River Beach without imposing the same resolutions in offshore areas where it is not needed.

Time series of wave parameters were output at specific points in the model domain so that both the variation along the beach and across the domain from offshore to nearshore could be assessed. The locations and ID's of the output points, referred to in discussions of the model results, are given in Figure 3-3.

3.2 Model Results

The wave model was run for 180 cases representing offshore unit amplitude swell boundary conditions with varying peak periods and directions. The results for the unit amplitude cases were used to develop transformation matrices at each output point, describing the reduction/amplification of the significant wave height for each peak period and direction case. The matrices were used along with the swell measurement time series at the NDBC Point Sur buoy to develop time series of swell wave parameters at the model output points, assuming that the wave transformation factors are constant for varying boundary condition wave amplitude.

The parameters of interest included the significant wave height (H_s), peak wave period (T_p), and wave power, a parameter that represents that transport of wave energy and can be an analogue for potential sediment transport. Figures 3-4 and 3-5 give example model outputs of significant wave height and wave velocity vectors for unit amplitude swell of 16 seconds and directions of 270° and 315°, respectively. The pattern of refraction and diffraction that alters the swell direction is evident as it propagates towards the shoreline. Table 3-1 below presents the transformation coefficients computed at the beach shoreline (output point carmel_03) for several peak period classes and each offshore incident direction. For each direction and period class, the value represents the ratio of the wave height near the shore to the offshore boundary swell wave height.

Table 3-1: Swell Transformation Coefficients at Carmel River State Beach (model output point carmel_03)

Offshore Swell Tp (s)	Offshore Swell Direction												
	180	195	210	225	240	255	270	285	300	315	330	345	360
<10	0.04	0.10	0.22	0.32	0.40	0.39	0.40	0.37	0.31	0.26	0.19	0.11	0.05
10-16	0.14	0.22	0.33	0.46	0.59	0.69	0.74	0.71	0.62	0.50	0.37	0.25	0.17
16-20	0.19	0.26	0.34	0.45	0.57	0.67	0.71	0.70	0.62	0.50	0.38	0.27	0.19
>20	0.19	0.26	0.34	0.45	0.57	0.66	0.71	0.69	0.61	0.49	0.37	0.27	0.19

Wave roses were create from the significant wave height time series at each output point to demonstrate how the wave climate is altered as swell moves inshore and along the shoreline. Figure 3-6 shows wave roses for output points offshore_03, offshore_02, and carmel_03 to show how the Northwesterly and less-frequent Southwesterly swell are transformed to approach the beach primarily from due West. Figure 3-7 zooms in on the Carmel River State Beach (with roses at output points carmel_01, carmel_03, carmel_05, and carmel_07 to show how diffraction shifts the primary wave approach direction to West-Southwest from due West going from South to North along the shoreline.

The time series of wave power at the representative point carmel_03 was used in subsequent work to show the correlation of variations in the wave conditions with Carmel River Lagoon water levels and beach berm breaching events.

4. COASTAL PROCESSES

4.1 Littoral Transport

Cross-Shore Transport

The periodic, orbital motion of water under waves is important in transporting sediment up and down the beach profile (cross-shore direction). Seasonal changes in wave climate, especially in locations that have a distinct winter storm season, induce corresponding changes in the state of a beach, where sediment is transported offshore during storm events and the beach slowly recovers during less-energetic events (Bosboom & Stive, 2010).

Because the Carmel River Beach is sheltered from the predominant wave direction, very little wave energy in the form of large, storm waves reaches the northern portions of the beach; instead, swell impacts the beach for most of the year, transporting sediment shoreward and building up the beach berm (Thornton, 2005). The high seasonal variability in shoreline position common for other area beaches is not observed here, with an estimated position variation of only +/- 10 m (Thornton, 2006).

Long-Shore Transport

Waves approaching a beach at some angle away from perpendicular induce a small mean current parallel to the shoreline as they break across the surf zone. This current drives the corresponding transport of suspended sediment parallel to the beach, and gradients in this transport rate due to differences in nearshore wave height or wave incidence angle promote erosion or accretion of the beach face in different areas (Bosboom & Stive, 2010). The incident-angle driven transport gradients often alter the shoreline so that it tends to align with the predominant incident wave angle, diminishing transport rates so that an equilibrium condition exists.

Due to the shape of the Carmel River Beach system, long-shore transport is most likely northward in the north portion of the beach and southward in the south portion of the beach, serving to distribute sediment brought to the coast by the river along the length of the beach. This hypothesis was also verified in studies performed for Carmel Beach (Howell 1972). The concave shape of the beach is largely aligned with the crests of the refracted and diffracted breaking waves, suggesting the beach is close to an equilibrium shape and transport magnitudes are relatively low (Thornton, 2005). The shift in predominate wave angle is evident in the wave roses produced with spectral wave model results in Figure 3-7.

An additional mechanism other than oblique wave incidence may drive long-shore transport northwards toward the anchoring headland. Waves breaking across the surf zone induce a heightening of the mean water level known as wave setup, and larger waves produce setup of greater magnitude. Because of the sheltering effect of the northern headland, wave heights decrease northward along the beach resulting in a water level gradient that drives a northward flowing current (Thornton, 2005). While the magnitude of the transport due to this gradient is unknown, research at the more-exposed Ocean Beach in San Francisco shows that a setup-gradient induced longshore current can greatly exceed that produced by oblique incidence or tide (Barnard, Hansen, & Erikson, 2012).

4.2 Beach Morphology

The Carmel River Beach is steep, reflective, and composed of fairly coarse sand delivered to the beach by the river (Rich & Keller, 2013). Beach face slopes typically vary along the length of the beach, ranging from as low as 8% at the north to 28% to the south (Laudier, 2009; Thornton, 2005). The mean

grain sizes also increase to the south, corresponding to the increased wave energy along the less-sheltered portion (Thornton, 2005).

The shape of the beach shoreline is typical of crenulate or headland-bay beaches where the equilibrium condition can be described by one of several mathematical shape functions, usually log-spiral in form. These equilibrium beach shapes are typically present where a headland fixes the shape at one beach end and waves approach from a predominant direction (Moreno & Kraus, 1999). Waves approaching the beach both refract and diffract into the sheltered zone behind the upcoast headland, and differential long-shore transport shapes the beach so that it is perpendicular to the resulting wave rays at equilibrium (Silvester & Ho, 1972). While littoral transport is limited at the beach, the differences in wave energy reaching the different beach sections has resulted in alongshore variation in beach berm heights with lower berm elevations to the north (Rich & Keller, 2013).

4.3 River Breaching

The Carmel River Beach forms a barrier between the Pacific Ocean and the adjacent Carmel River Lagoon that is seasonally breached (either naturally or artificially) when high rainfall events increase the water level in the lagoon (Kraus, Patsch, & Munger, 2008). Because the Carmel river is ephemeral and the beach is subjected to swell for most of the year, wave run-up rebuilds the berm and closes off the barrier beach when river outflows are low or absent (Laudier, 2009).

During the early fall, the lagoon mouth usually remains closed to the sea, but occasional overtopping of the beach berm by long period ocean swell can raise the lagoon water level over the typical low, summer levels. Major fall overtopping-induced water level increases have usually been associated with high waves in conjunction with higher tide levels (James, 2005). During late fall/early winter, rainfall in the Carmel river watershed is usually sufficient to advance the flowing river to the lagoon and fill up the available storage. At this point, the beach berm has historically been mechanically breached to prevent flooding of roads and homes along the northern edge of the lagoon. Lagoon outflow through the breach quickly scours a channel sufficient to release most of the stored lagoon water into the ocean. Based on 13 years of observations, the berm breach remains open approximately 85% of the time, with river inflows of 100 cubic feet per second, usually ensuring that the breach will not be closed by predominant wave-transported sand. Because lower flows or large waves encourage breach closure (and then an increase in water level as the lagoon fills), the water level in the lagoon is not directly correlated to river inflow (James, 2005).

Historically, the initial artificial breach channel has been excavated straight offshore near the southern end of the beach, though the breach management strategy has varied considerably over the past decade, and has included northerly and southerly managed breaches. Bedrock sills underlie the beach along both the north and south edges, so scour by migrating channels or channels intentionally opened in these sections is less than that when channels are excavated through the central beach portion. With the relatively long channel alignments, further limited by the sills north and south of the river mouth, river outflow is extending over a longer period (drawdown), which is beneficial for threatened species (County of Monterey et. al, 2012; Thornton, 2005). In 2005, the berm was breached toward the north with the unintended consequence of severe erosion along the backing bluff which supports road and wastewater infrastructure (Thornton, 2005).

An elongated channel forms to the north along the beach in half of the years of observation (James, 2005) and either natural breaching or channel migration is expected to tend towards the northern alignment since the antecedent, lowered beach alignment has not recovered to typical berm heights and widths (Thornton, 2005). The lower berm elevations, due to milder beach slope and finer sediment, also favor natural breaching or channel migration towards the northern portion of the

beach; however, this varies greatly on a year to year basis and depends on wave energy arriving over the winter/spring seasons.

5. INLET MORPHOLOGY

The lagoon water surface elevation, Carmel River discharge, tide, and wave power are plotted in Figures 5-1 through 5-5 for water years 2009 through 2013. These four components of the beach berm system demonstrate the complex interactions that cause berm breaches and closures. Water years 2009 and 2010 are considered above normal flow in Carmel River, as determined by MPWMD. Water years 2011 through 2013 are considered dry. Significant seasonal events are described below.

5.1 Fall Wave Overtopping

Typically in September of any given water year, James (2005) noted a large increase of water surface elevation in the lagoon due to seawater overwash. In Figures 5-2 to 5-5 (WY2009 – 2012), this annual event is apparent, and is correlated with the first large wave event of the winter season during a spring tide. Table 5-1 below summarizes the overtopping events. In general, the higher the wave power, the more seawater overtops the berm and enters the lagoon.

Table 5-1: Fall Wave Overtopping Events WYs 2009 - 2013

Date	Water Surface Elevation Increase (start-end) (ft. NAVD88)	Volume Increase* (acre-feet)	Peak Daily Mean Wave Power (kW/m)	Tide (ft., NAVD88)
Sept. 20 - 25, 2012	+2.5 (5.8 – 8.3)	68	16.3	5.5 – 5.8 HHW
Sept. 20 - 22, 2011	+1.2 (8.3 – 9.5)	63	15.9	5.1 – 5.2 HHW
Sept. 20 - 28, 2010	+2.5 (6.4 – 8.9)	85	26.5	4.8 – 5.4 HHW
Sept. 11 - 14, 2009	+1.7 (6.5 – 8.2)	51	14.2	5.7 – 5.9 HHW

* Volume increase calculated using Whitson Engineer's Stage-Volume-Area table (Whitson 2013).

After the initial overtopping, continued wave overwash occurs on the berm slowly increasing the lagoon water surface elevation. In water year 2009, this period of periodic overwash occurred until the first river discharge in February 2010 (Figure 5-5).

5.2 Fall and Winter Intermittent Breaches

Prior to significant river discharge, the dominant force on the lagoon water surface elevation is believed to be wave events. Figure 5-6 shows small increases in water surface elevation that correlate with wave events in early October, mid-October, and mid- and late November. Also evident is the larger influence on water surface elevation when wave events and spring tides are combined. The wave event on November 5, 2011 was over 20 kW/m, however it's occurrence at a neap tide did not increase the water surface elevation in the lagoon noticeably. The length of the wave event (over a span of days), not only its peak wave power, is relevant when determining the seawater overwash over a wide and high berm. Similar trends are visible in Figure 5-10 and Appendix A figures.

As the water rises in the lagoon, eventually a mechanical or natural breach releases the water into the ocean. During these periods of low river discharge and high wave activity, the lagoon enters a phase of rising waters and intermittent breachings. Peak water surface elevations occur during this period, when river discharge is insufficient to keep the outflow channel open. Figure 5-8 shows this scenario from February through mid-March 2012, and Figure 5-12 in early February.

5.3 Winter and Spring Intermittent Closings

As the river discharge increases during the winter months, the high river flow maintains a deep and wide outflow channel open to the ocean. The water surface elevation appears to fluctuate significantly, and is maintained at a lower elevation because of the constant, deep and wide outflow channel. The fluctuating, lower water surface elevation during high river discharge is evident in Figures 5-9, 5-11, 5-13, as well as others.

Also apparent during this period is a stronger tidal influence on the opened lagoon. The water surface elevation fluctuates with the daily and monthly tidal ranges. The month of June in Figure 5-14 is a good example of this phenomenon.

James (2005) noted that discharges over 200, 100, and 20 cfs keep the river mouth open 100%, 90%, and 20% of the time, respectively. Flows ranging from 10-20 cfs indicate a closed outflow channel. These are consistent with observations from water years 2009 – 2013.

When river inputs decrease into the lagoon and intermittent closings begin to occur, the lagoon water surface elevation fluctuates with the opening and closing of the beach berm similar to patterns seen at the beginning of the rainy season.

5.4 Summer Closures

In the summer months, Carmel River has little to minimal flow and ocean wave conditions are such to promote beach building, rather than berm breaching. Initially after the season closure of the lagoon (mechanical or natural), the water surface elevation quickly increases up to 9 – 11.5 ft. NAVD88 due to the last of the seasonal river discharge (Figures 5-2 to 5-5). After the water surface elevation peaks, the lagoon slowly decreases over the summer months due to evaporation and seepage losses. Closure dates since water year 2009, and as interpolated from water surface elevations, includes:

- May 17, 2012
- July 25, 2011
- July 9, 2010
- May 18, 2009

The wave power, as seen in Figures 5-2 through 5-5, rarely exceeds 10 kW/m during the summer closure period. Once wave power events increase up to 15-20 kW/m, there is wave overtopping of the berm and seawater washes in, beginning the annual cycle again.

6. REFERENCES

1. Barnard, P. L., Hansen, J. E., & Erikson, L. H. (2012). Synthesis Study of an Erosion Hot Spot, Ocean Beach, California. Journal of Coastal Research, 283, 903–922. doi:10.2112/JCOASTRES-D-11-00212.1
2. Bosboom, J., & Stive, M. J. F. (2010). Coastal Dynamics 1: Lecture notes CT4305. Delft, the Netherlands: Delft University of Technology, Faculty of Civil Engineering and Geosciences, Section of Hydraulic Engineering.
3. County of Monterey, U.S. Army Corps of Engineers, & National Marine Fisheries Service. (2012). Memorandum of Understanding regarding Flood Prevention and Habitat Protection at the Carmel Lagoon.
4. Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon. (2007). (Author unknown)
5. Howell, Buford F., Naval Postgraduate School. (1972) Sand Movement Along Carmel River State Beach, Carmel, California. Naval Postgraduate School. September.
6. James, G. W. (2005). Monterey Peninsula Water Management District, Technical Memorandum 05-01: Surface Water Dynamics at the Carmel River Lagoon, Water Years 1991 through 2005.
7. Kraus, N. C., Patsch, K., & Munger, S. (2008). Barrier beach breaching from the lagoon side, with reference to Northern California. Shore and Beach, 76(2), 33–43.
8. Laudier, N. A. (2009). Wave Overtopping of a Barrier Beach. thesis submitted to Naval Postgraduate School, Monterey, CA.
9. Monterey County Public Works (MCPW). (2005). Sand Bar Survey. May 25.
10. MCPW. (2005). Sand Bar Survey. October 4.
11. MCPW. (2006). Sand Bar Survey. April 18.
12. MCPW. (2007). Sand Bar Survey. October 2.
13. MCPW. (2008). Sand Bar Survey. October 30.
14. MCPW. (2010). Sand Bar Survey. January 15.
15. Moreno, L. J., & Kraus, N. C. (1999). Equilibrium Shape of Headland-Bay Beaches for Engineering Design. Coastal Sediments ’99 (pp. 860–875). ASCE.
16. NOAA Navigation Chart #18686, Pfeiffer Point to Cypress Point, 13th edition, July 17, 1999.
17. Rich, A., & Keller, E. A. (2013). A Hydrologic and Geomorphic Model of Estuary Breaching and Closure. in review.
18. RMC Water and Environment. (2007). Hydrographic Survey and Stage-Volume Relationship. November 29.
19. Silvester, R., & Ho, S. K. (1972). Use of crenulate shaped bays to stabilize coasts. 13th Coastal Eng. Conf. (pp. 1347–1365). ASCE.
20. Thornton, E. B. (2005). Littoral Processes and River Breachings at Carmel River Beach. Naval Postgraduate School, Monterey, CA.

21. Thornton, E. B. (2006). Carmel River Beach Shoreline History. Naval Postgraduate School, Monterey, CA. April 9.

22. Whitson Engineers. (2013). Carmel River Lagoon Ecosystem Protective Barrier Lagoon Stage-Volume-Area Analysis. January 29.

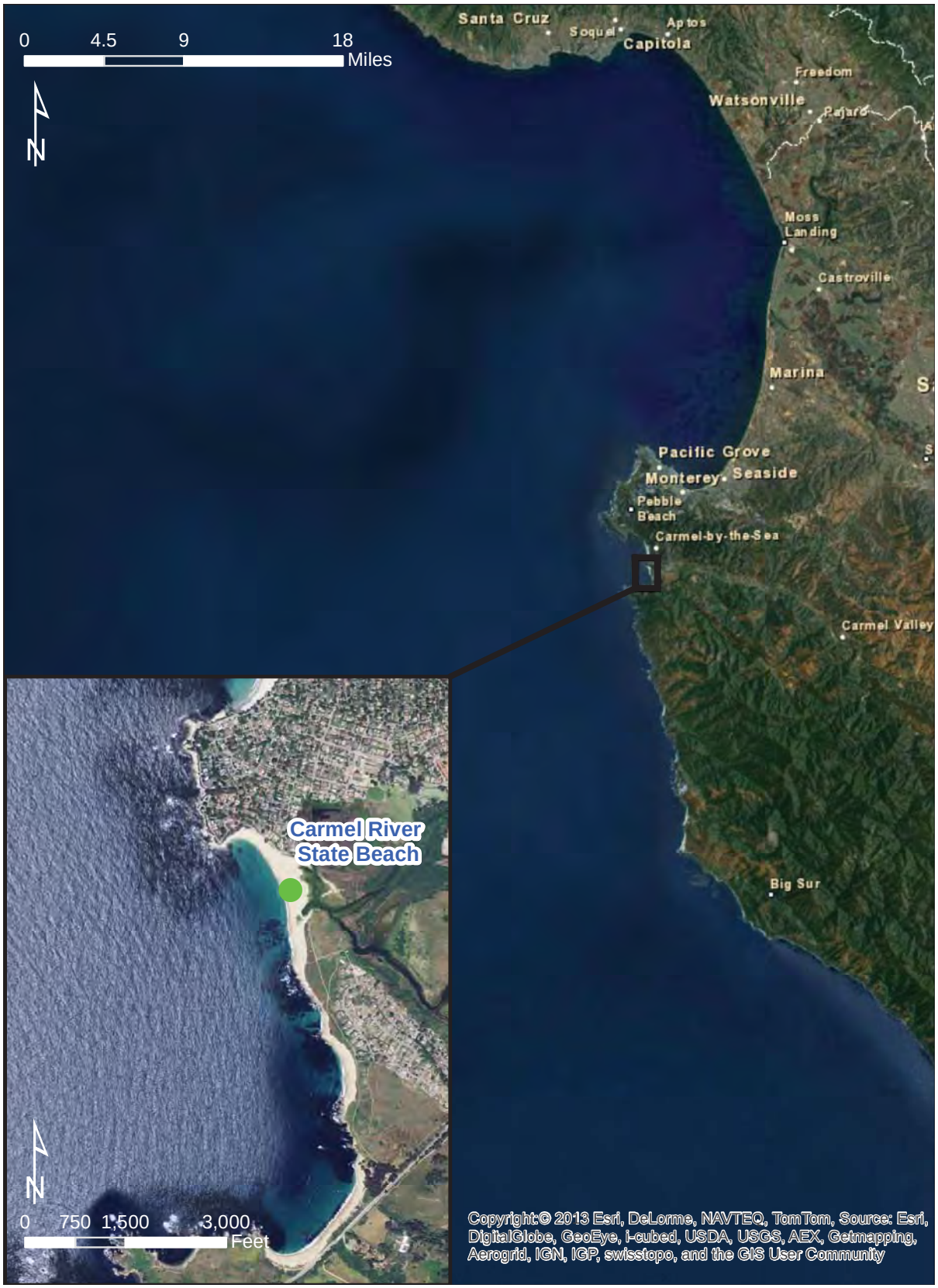


Figure 1-1: Project Site Overview

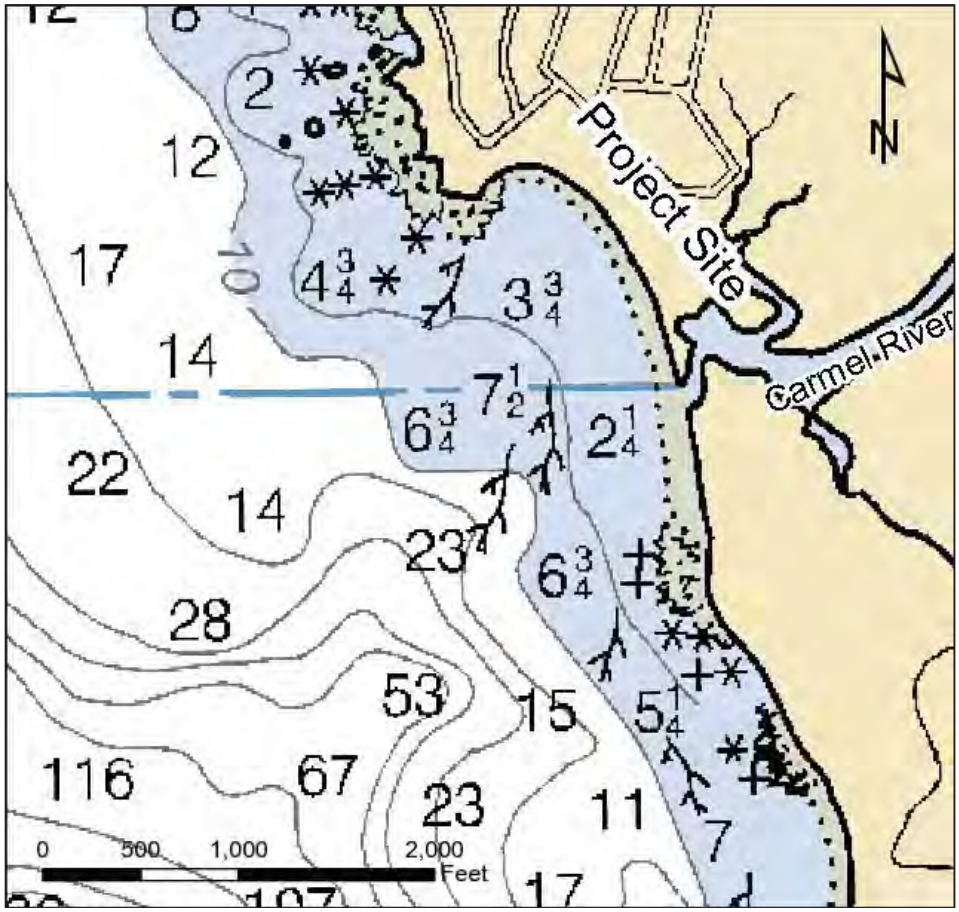


Figure 2-1: Depths (in fathoms, MLLW) near project site (NOAA Chart)

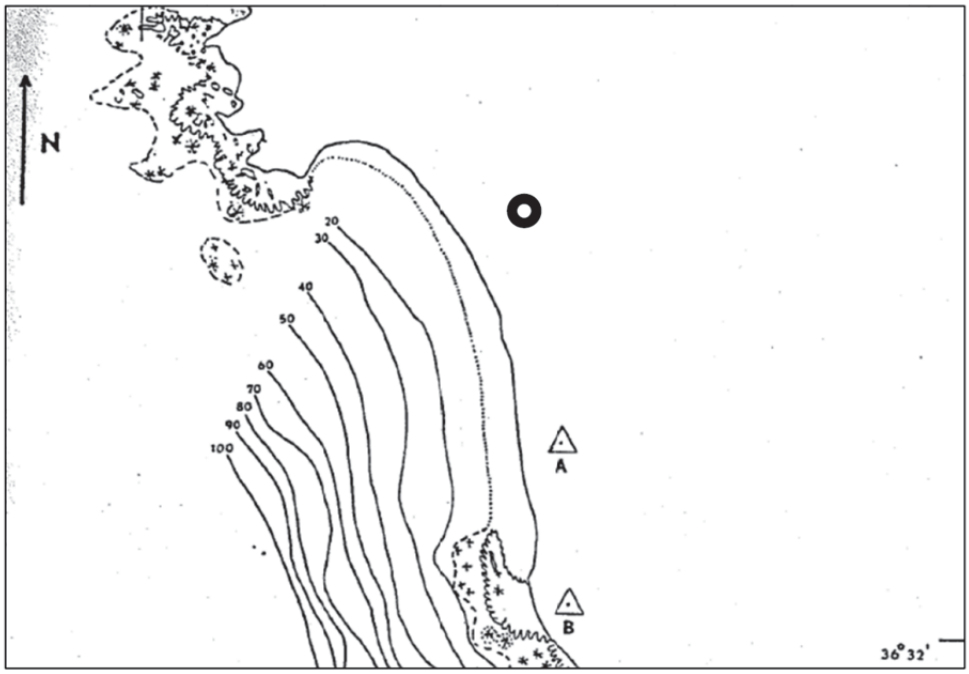


Figure 2-2: Nearshore Bathymetry (in ft, MLLW)
(Source: Howell, 1972)

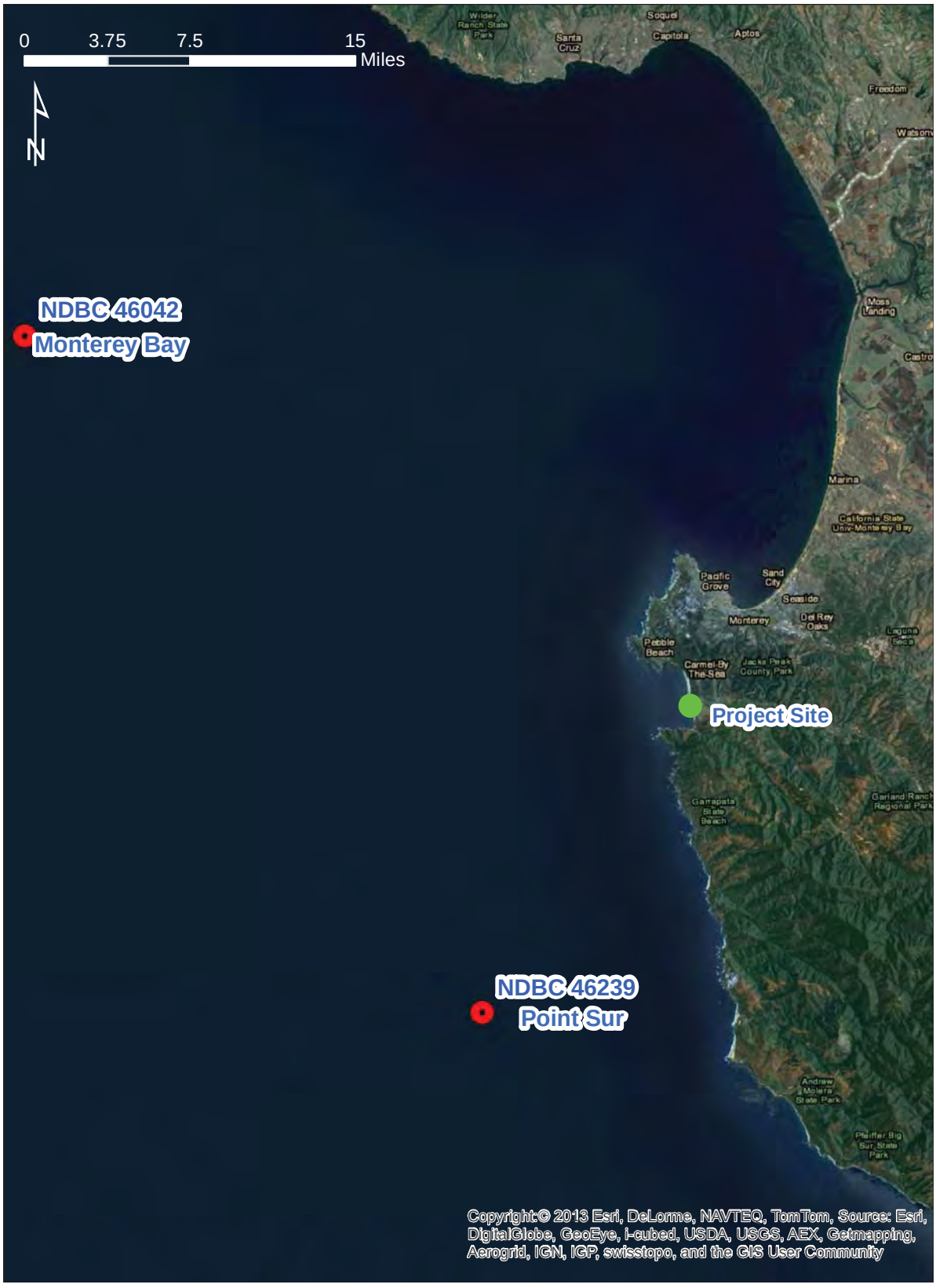
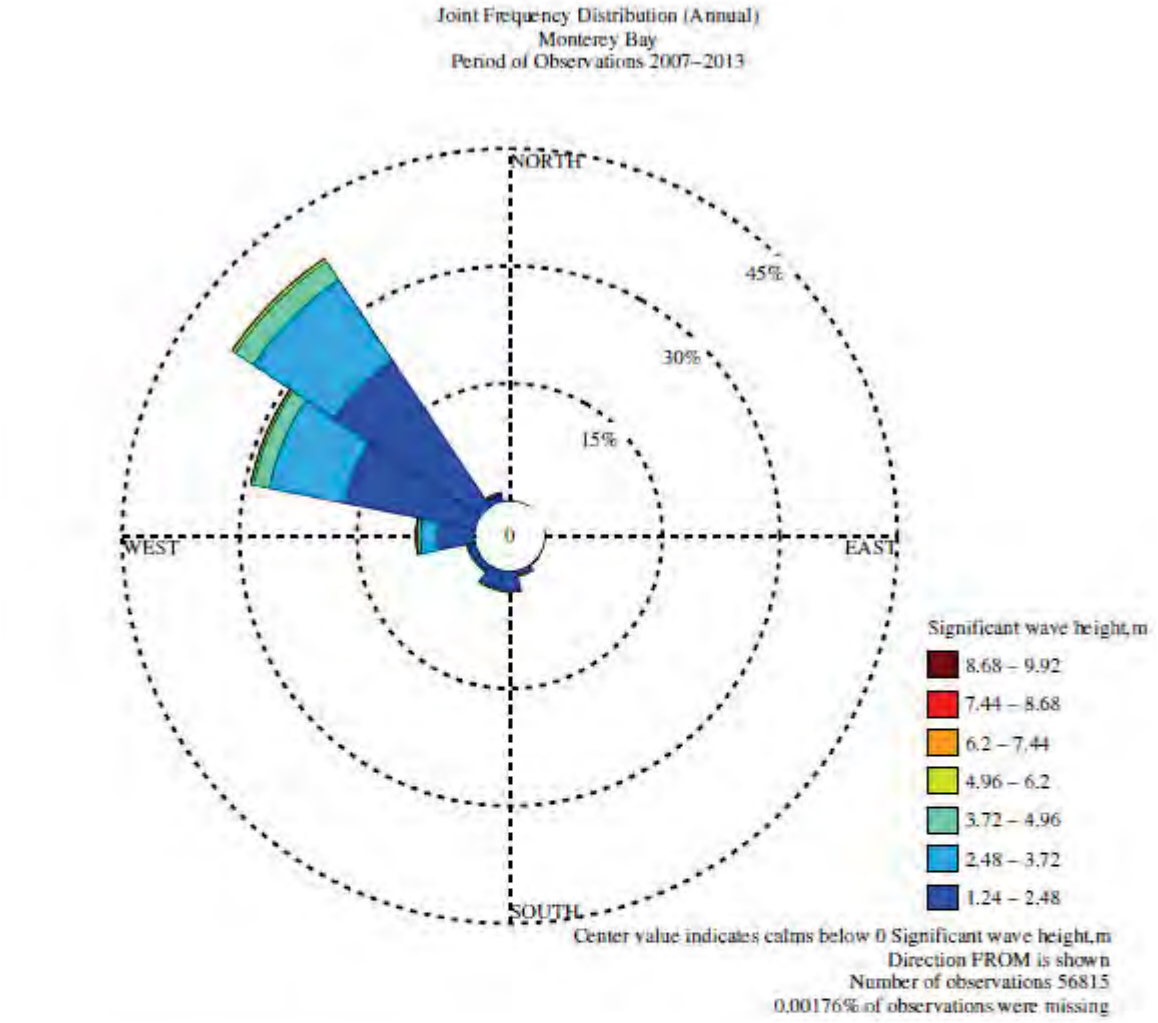


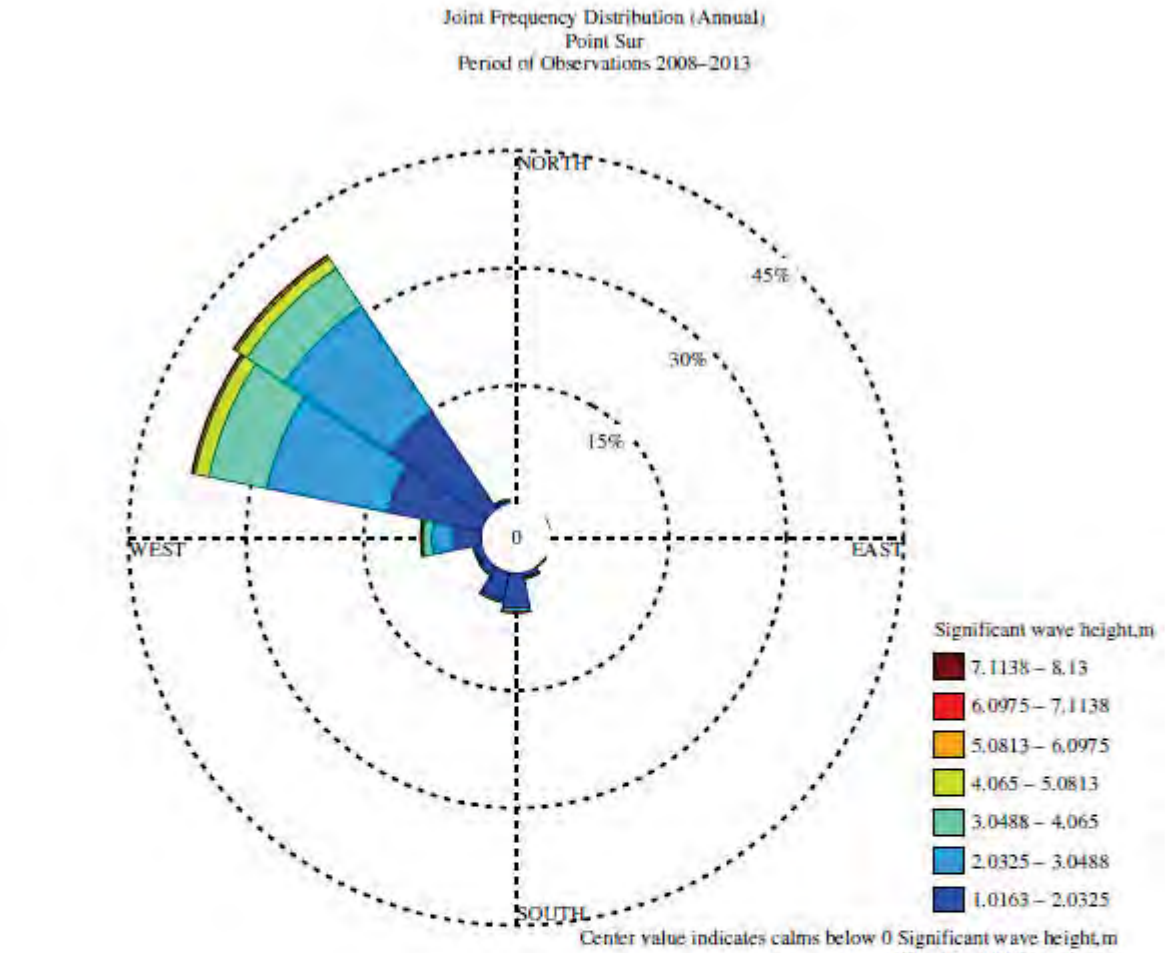
Figure 2-3: Location of NDBC Wave Measurement Buoys



Percentage of Occurrence

Significant wave height, m	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	0.04						0.08	1.06	4.78	4.94	1.82	1.45	8.79	33.3	42.4	1.33	100
9.92																	
8.68																	
7.44													0.01				0.01
6.2													0.05	0.05	0.06		0.16
4.96								0.03	0.05				0.09	0.37	0.47		1.03
3.72								0.04	0.09	0.05	0.02	0.02	0.43	2.12	2.92	0.05	5.75
2.48								0.12	0.31	0.14	0.12	0.16	2.23	10.4	13.2	0.27	27
1.24	0.02						0.05	0.57	2.39	2.49	0.9	0.91	5.09	17.9	23.6	0.89	54.9
0	0.01						0.02	0.29	1.93	2.25	0.78	0.35	0.88	2.46	2.1	0.11	11.2

Figure 2-4: Significant Wave Height Rose at Monterey Bay NDBC Wave Buoy



Percentage of Occurrence

Significant wave height,m	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total							0.08	0.85	5.63	4.78	1.45	1.24	7.95	38.2	39.2	0.6	100
8.13													0.02	0.01			0.03
7.114													0.05	0.1	0.08		0.23
6.098								0.01	0.03				0.09	0.32	0.37		0.83
5.081									0.04				0.23	1.82	1.55		3.67
4.065							0.02	0.07	0.08	0.02	0.04	0.09	1.04	7.53	5.81	0.05	14.7
3.049							0.02	0.18	0.48	0.34	0.16	0.2	2.74	15.8	16.3	0.17	36.4
2.033							0.04	0.55	4.43	3.55	1.09	0.87	3.57	12.2	14.8	0.38	41.5
1.016								0.03	0.57	0.86	0.16	0.08	0.21	0.42	0.26		2.6
0																	

Figure 2-5: Significant Wave Height Rose at Point Sur NDBC Wave Buoy



Figure 3-1: Mike21-SW Swell Transformation Model Domain

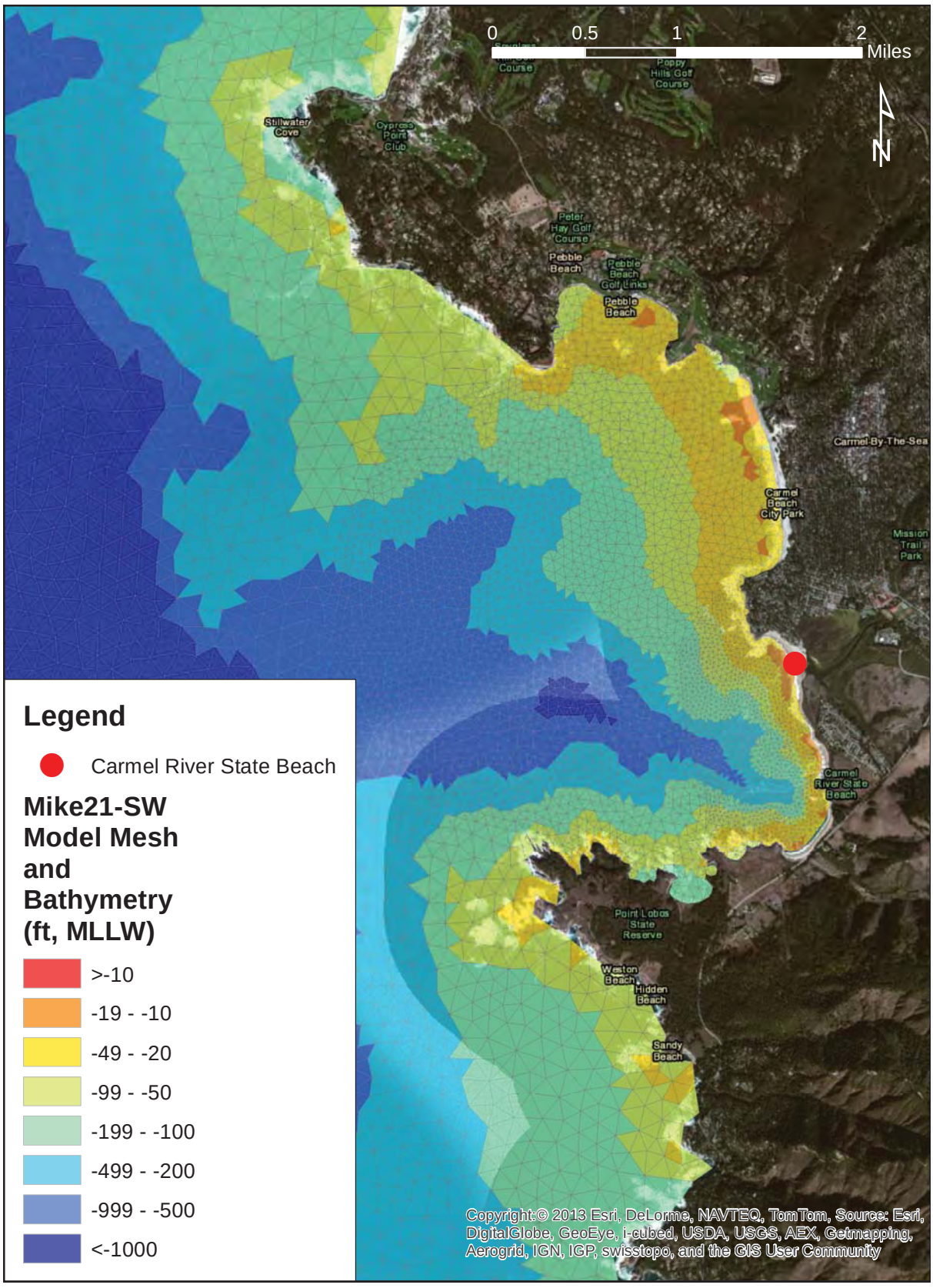


Figure 3-2: Mike21-SW Model Mesh and Bathymetry in Project Vicinity

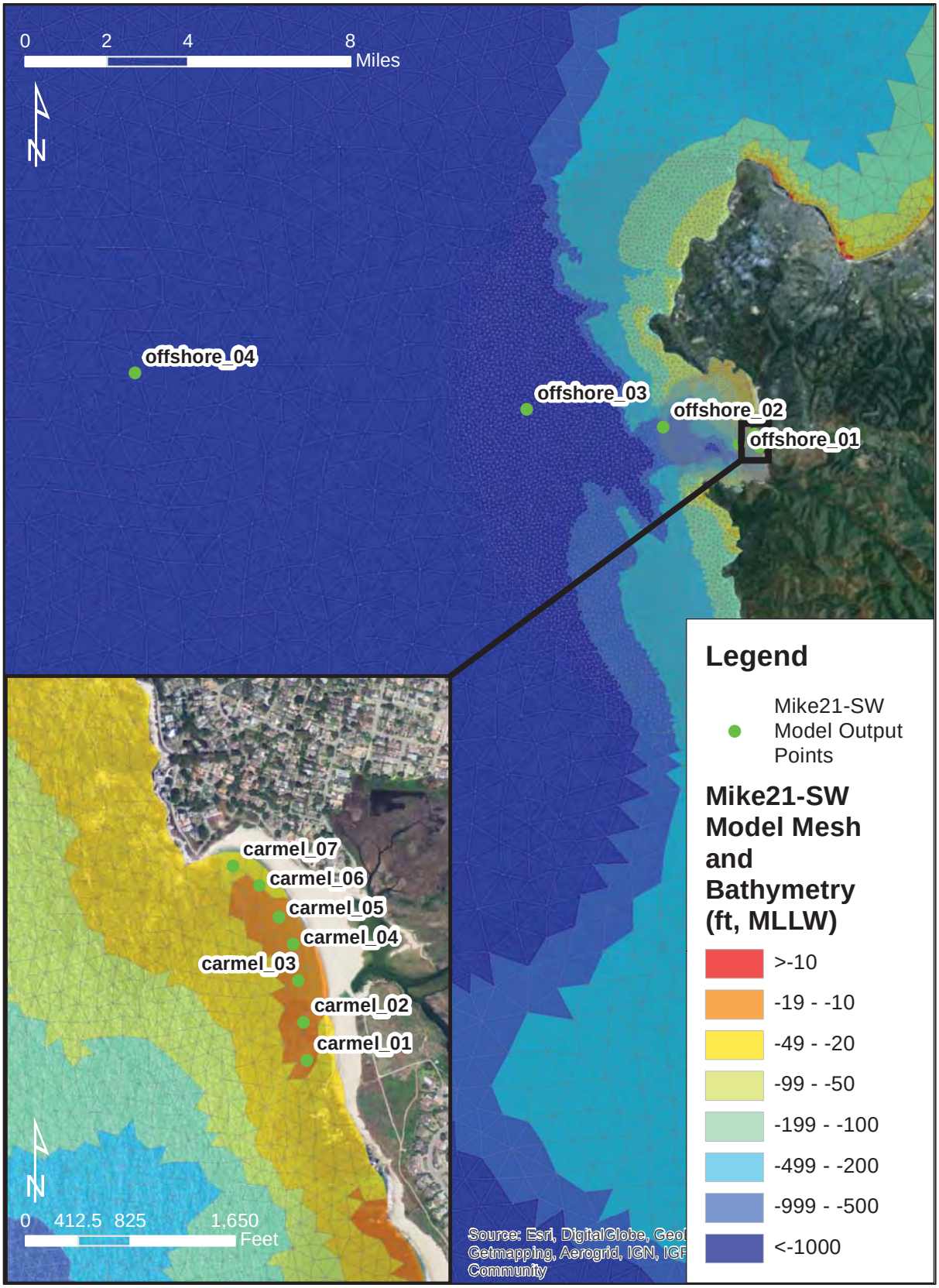


Figure 3-3: Mike21-SW Model Output Points

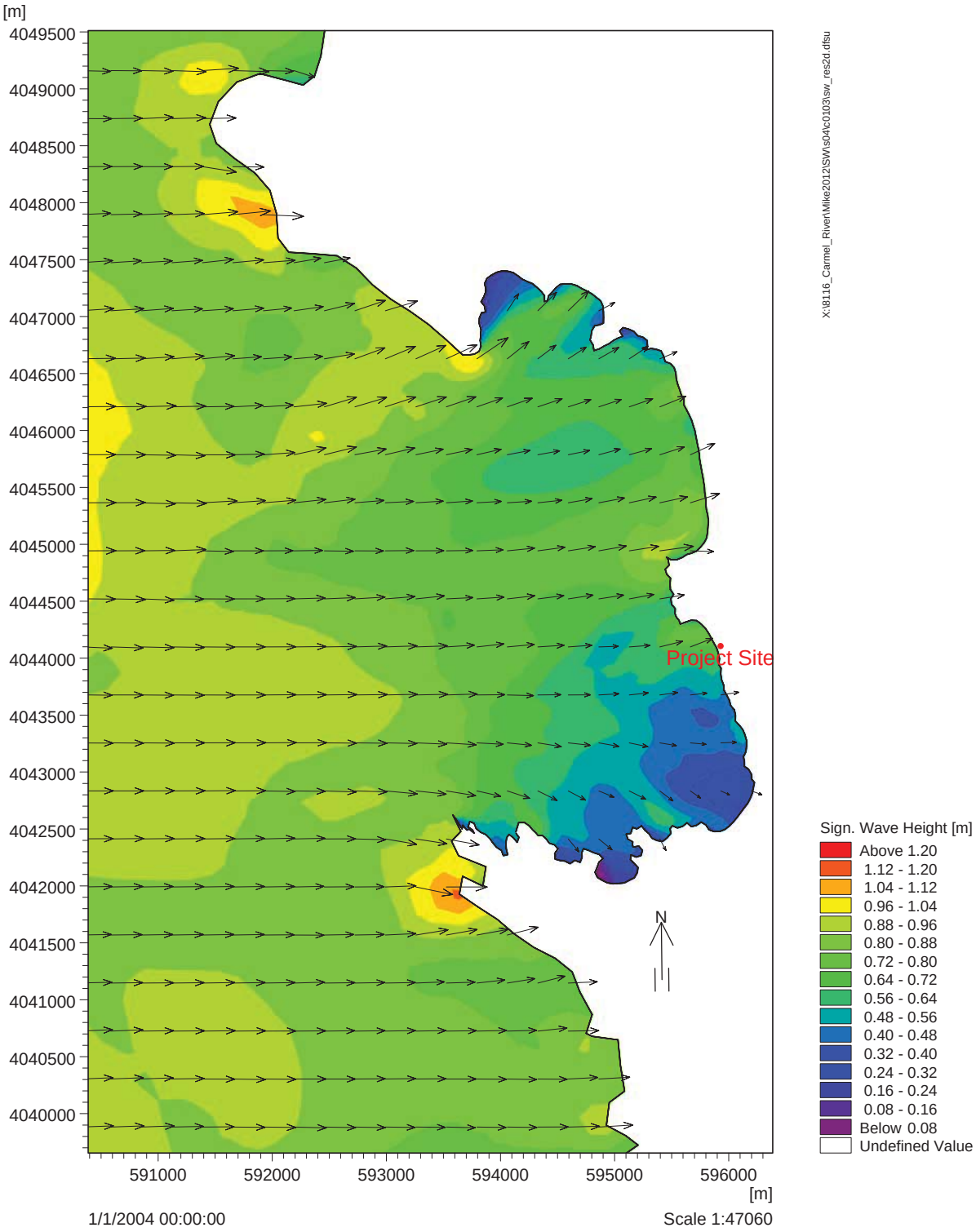


Figure 3-4: Example Model Output – Transformation of Unit Wave Height, 16 sec, 270° Swell

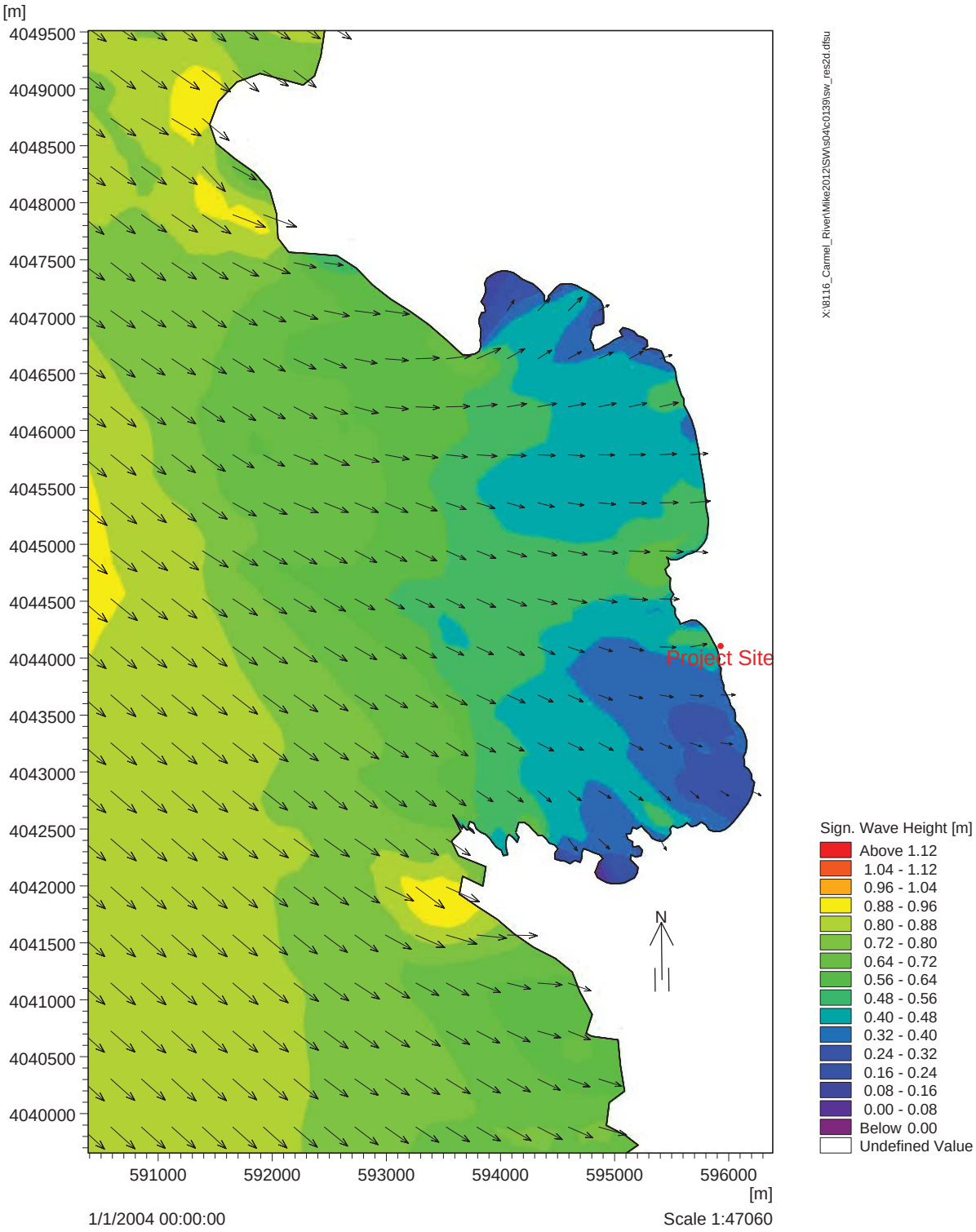


Figure 3-5: Example Model Output – Transformation of Unit Wave Height, 16 sec, 315° Swell

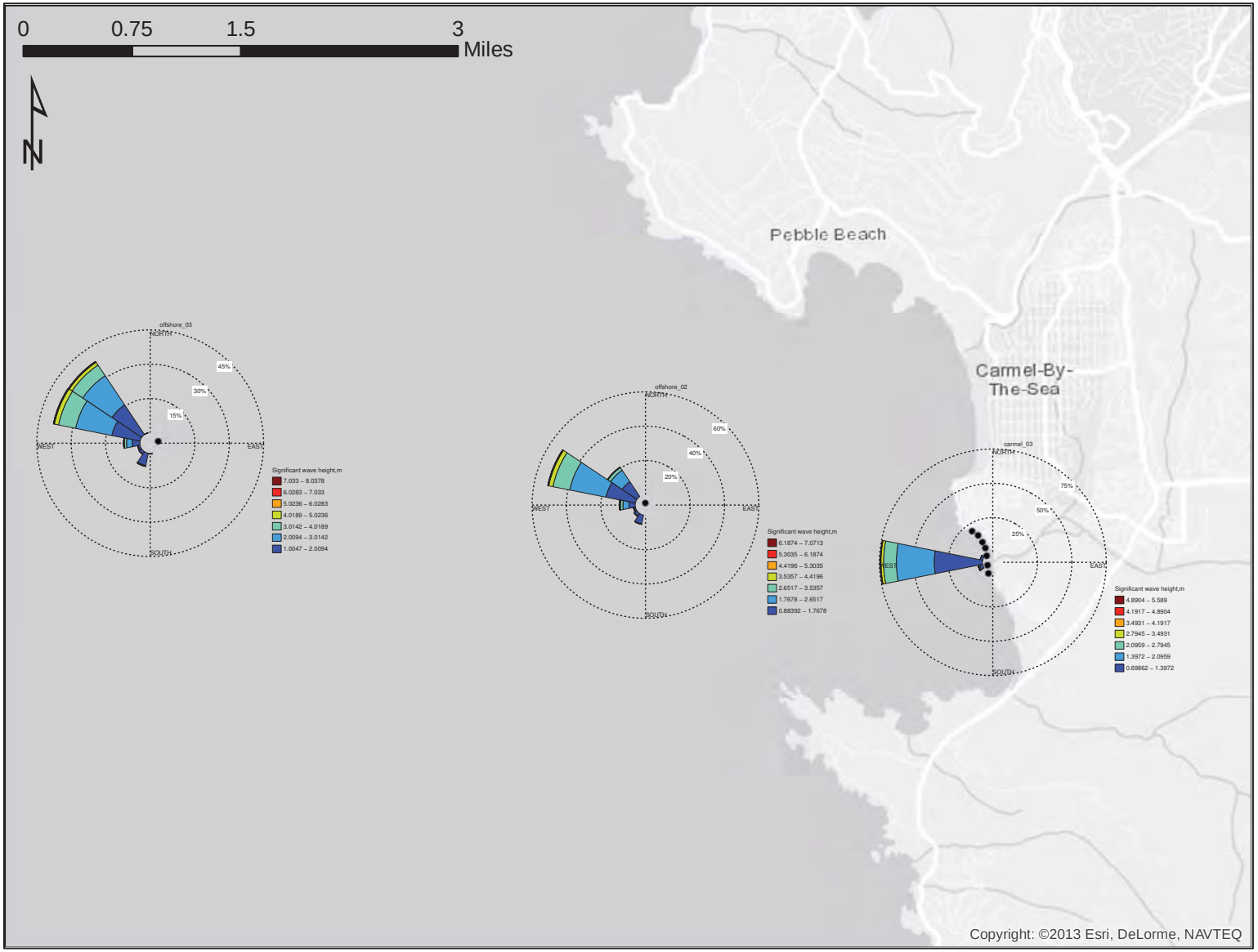


Figure 3-6: Swell Transformation from Offshore – H_s Roses at Selected Output Points

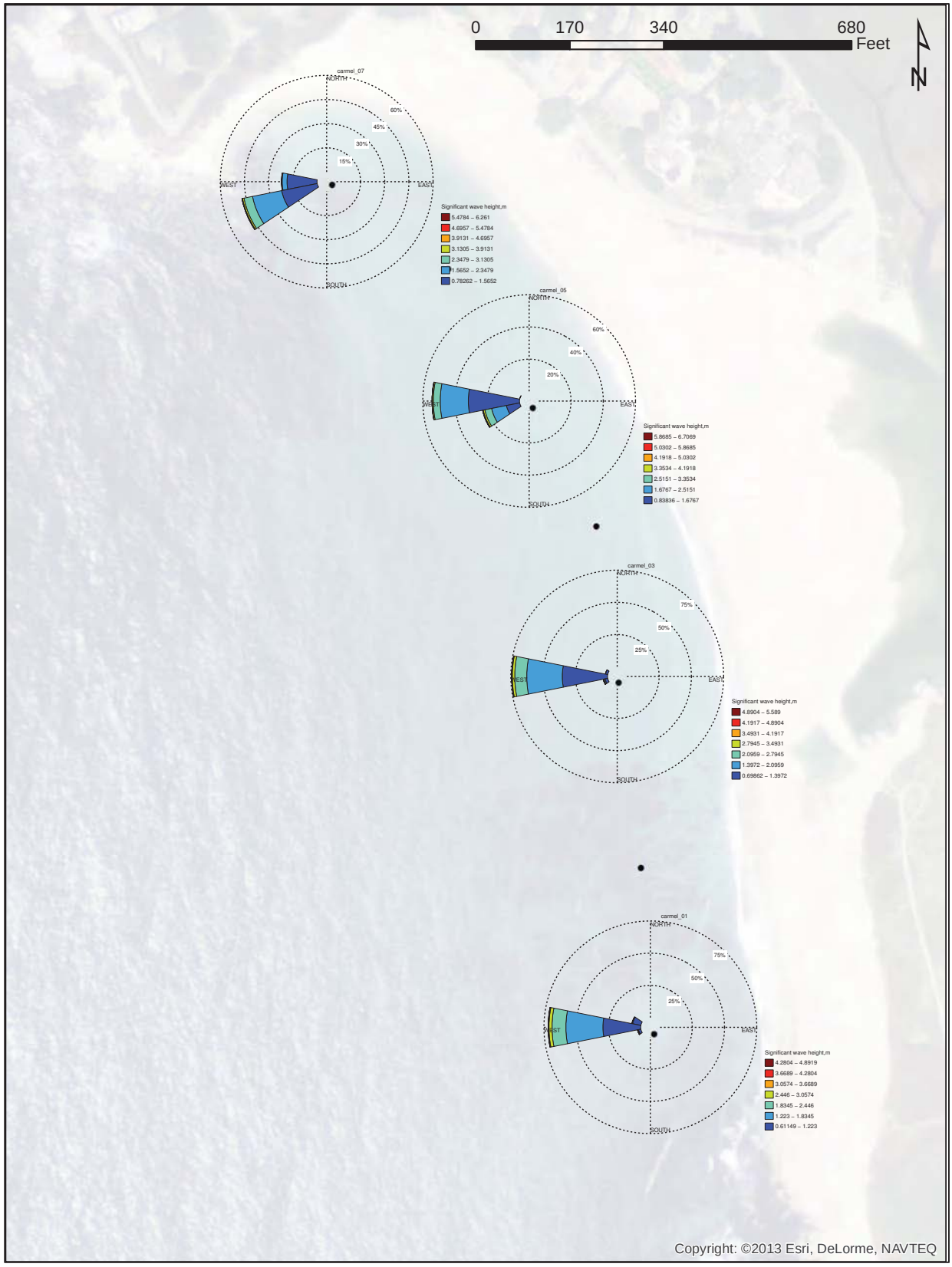


Figure 3-7: Wave Roses at Points along Carmel River State Beach

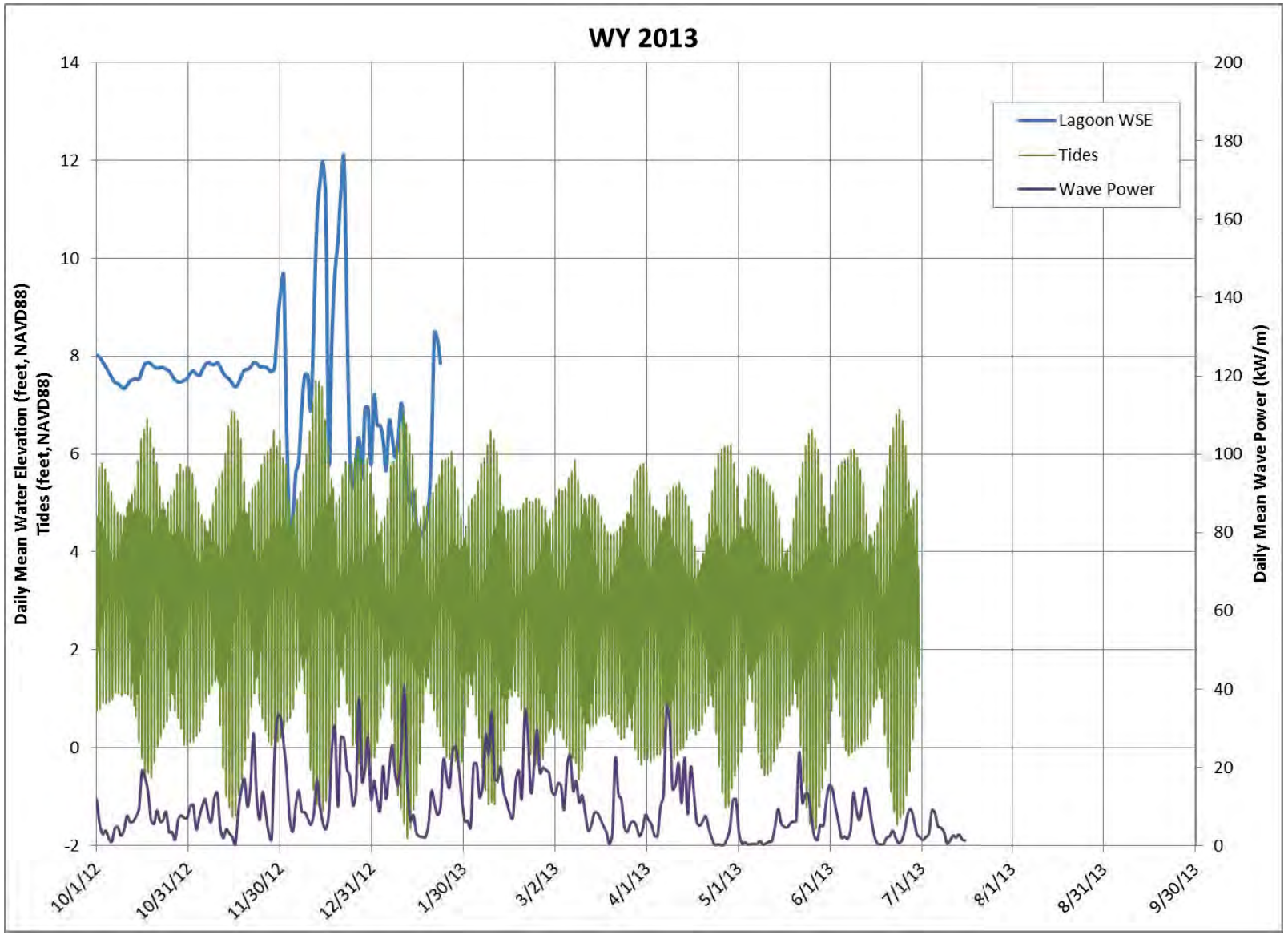


Figure 5-1: Water Year 2013, Annual – Carmel River Breaching and Relevant Processes

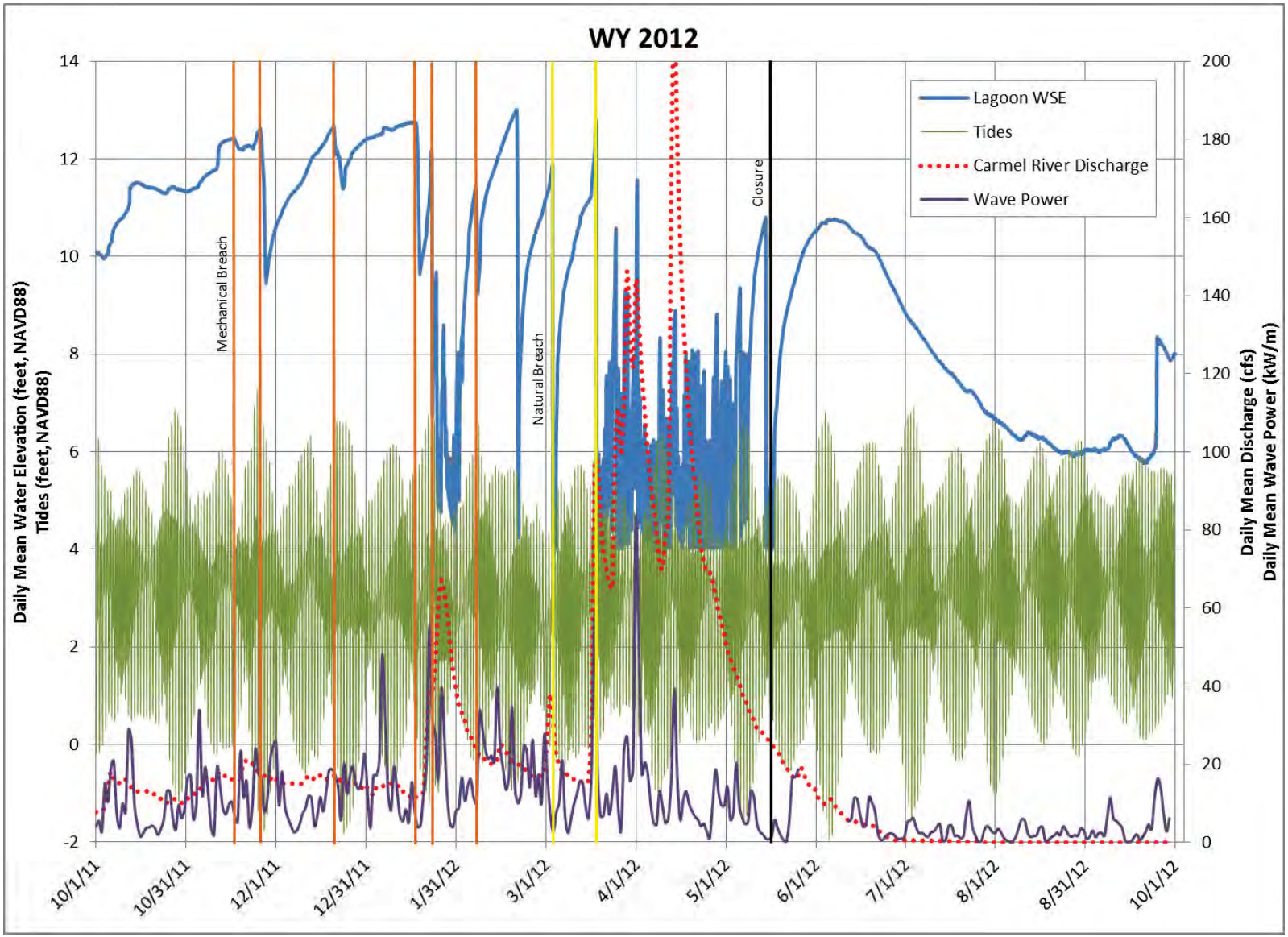


Figure 5-2: Water Year 2012, Annual – Carmel River Breaching and Relevant Processes

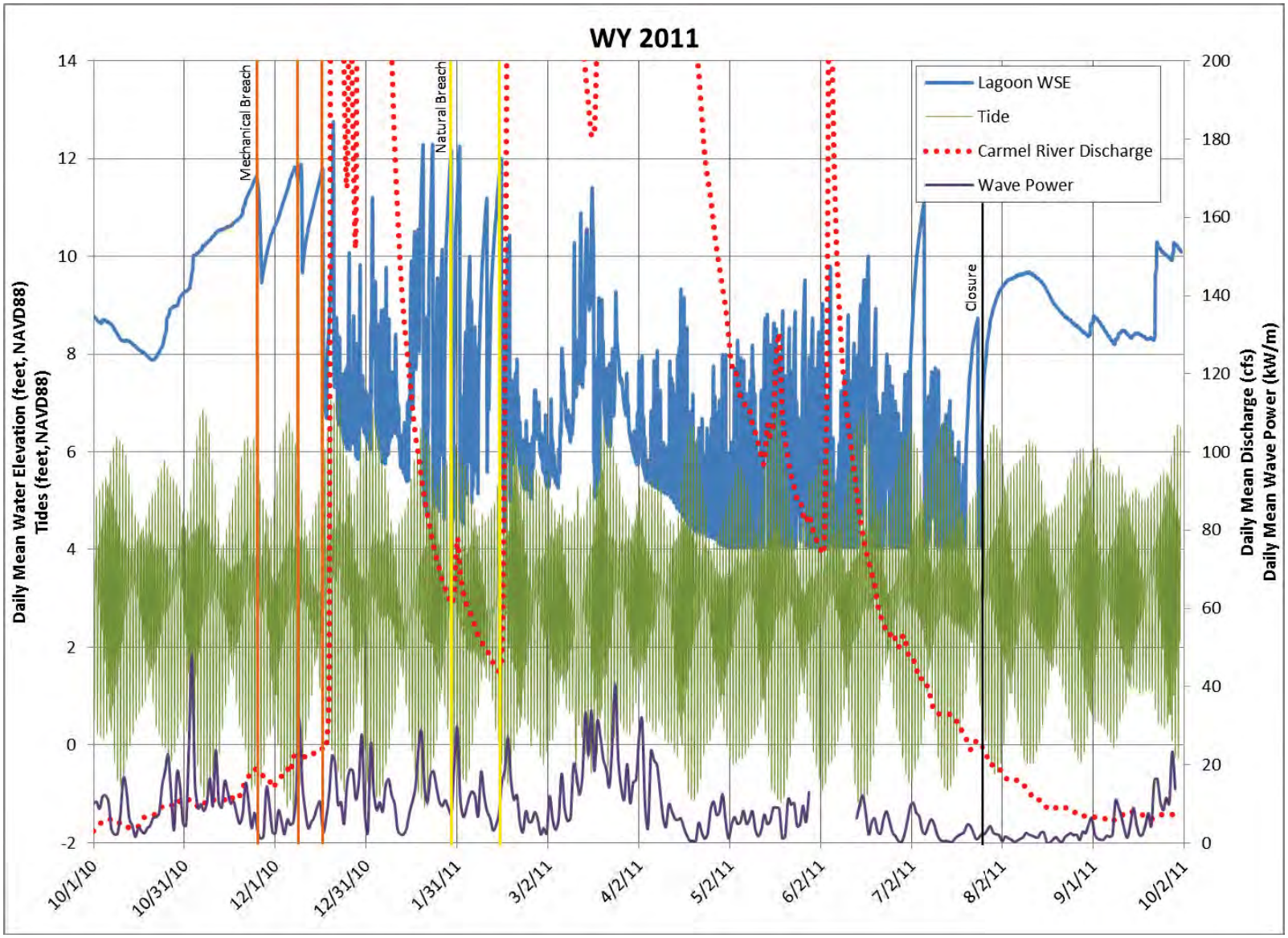


Figure 5-3: Water Year 2011, Annual – Carmel River Breaching and Relevant Processes

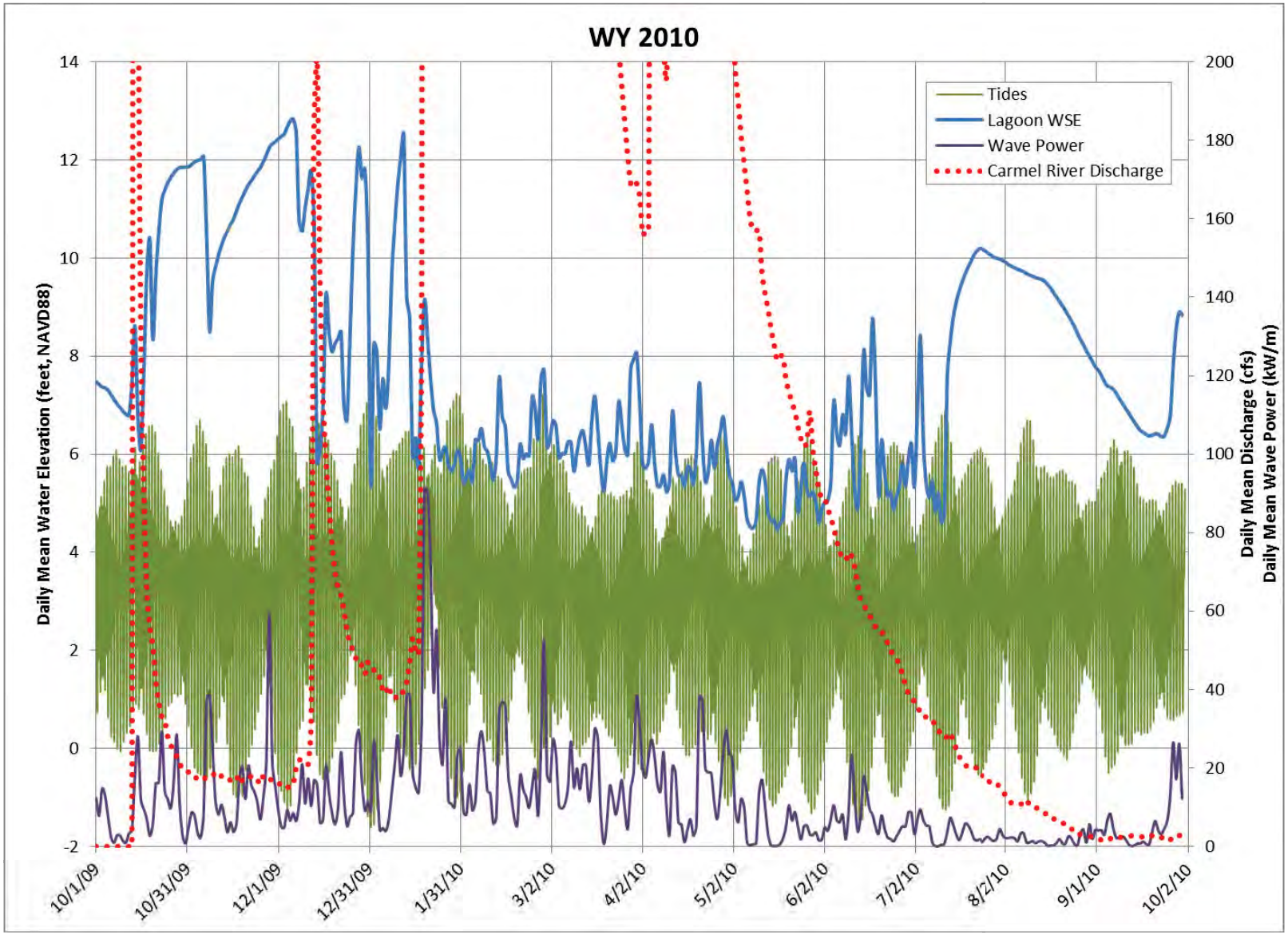


Figure 5-4: Water Year 2010, Annual – Carmel River Breaching and Relevant Processes

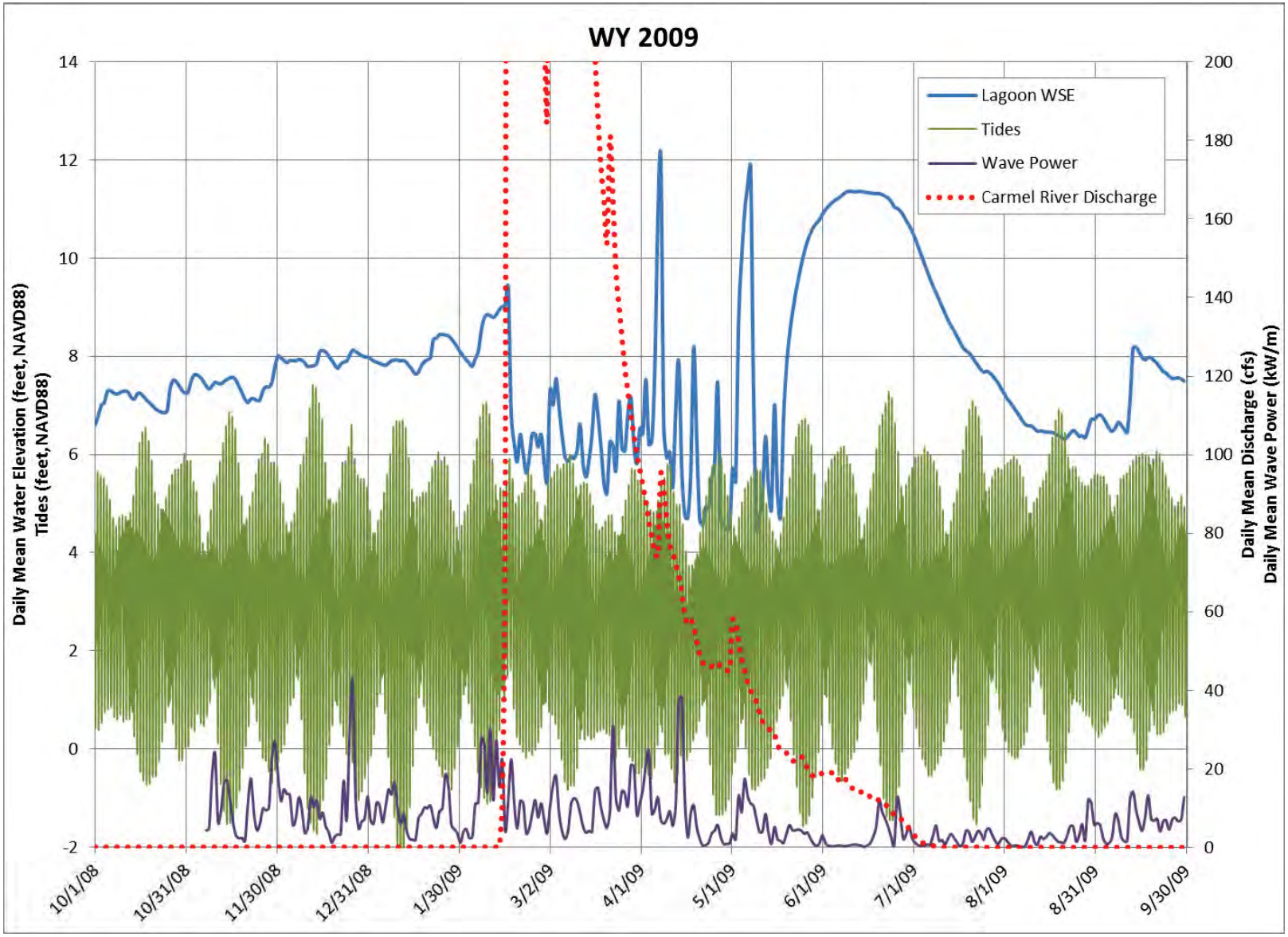


Figure 5-5: Water Year 2009, Annual – Carmel River Breaching and Relevant Processes

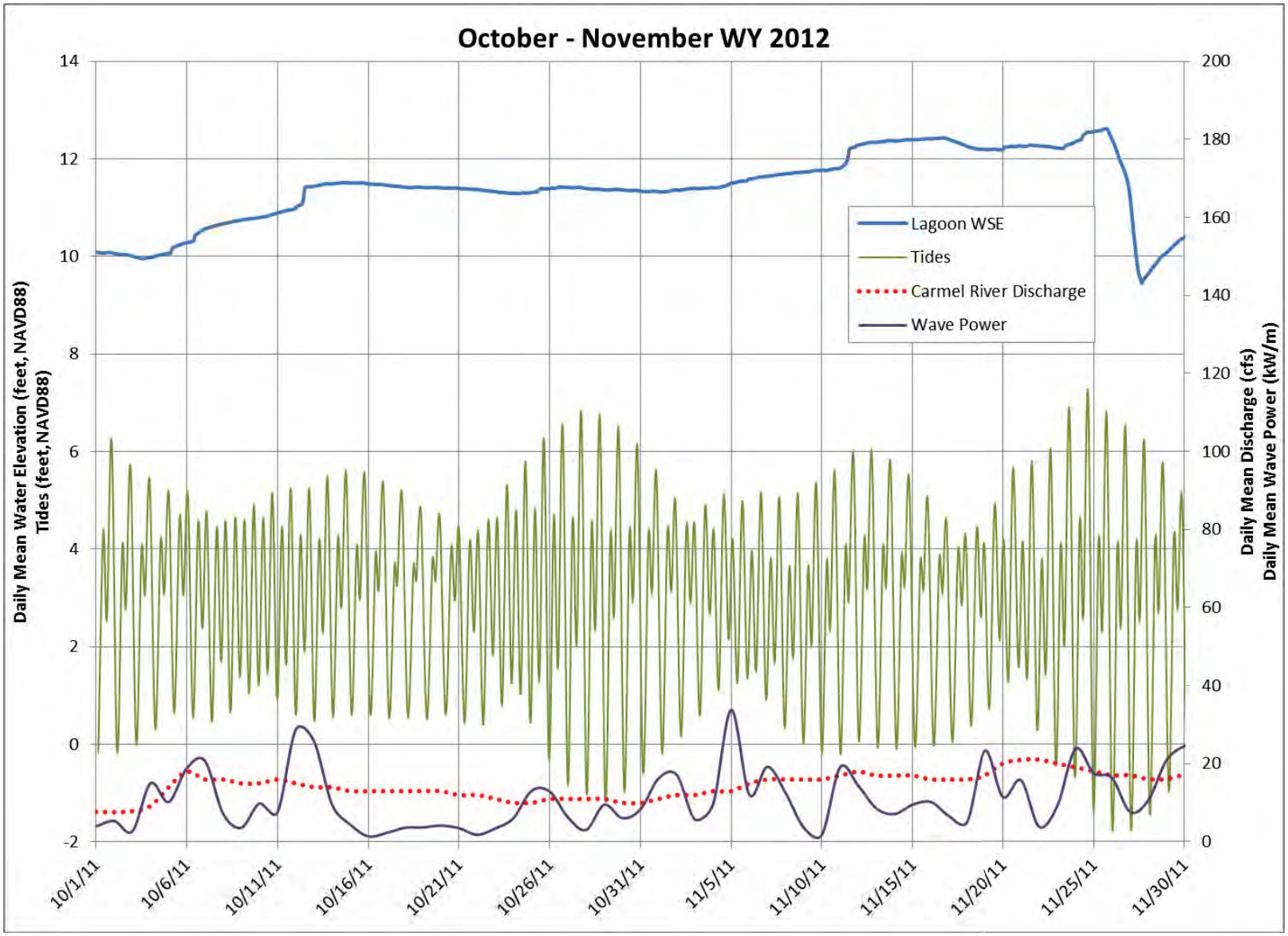


Figure 5-6: Water Year 2012, Oct-Nov – Carmel River Breaching and Relevant Processes

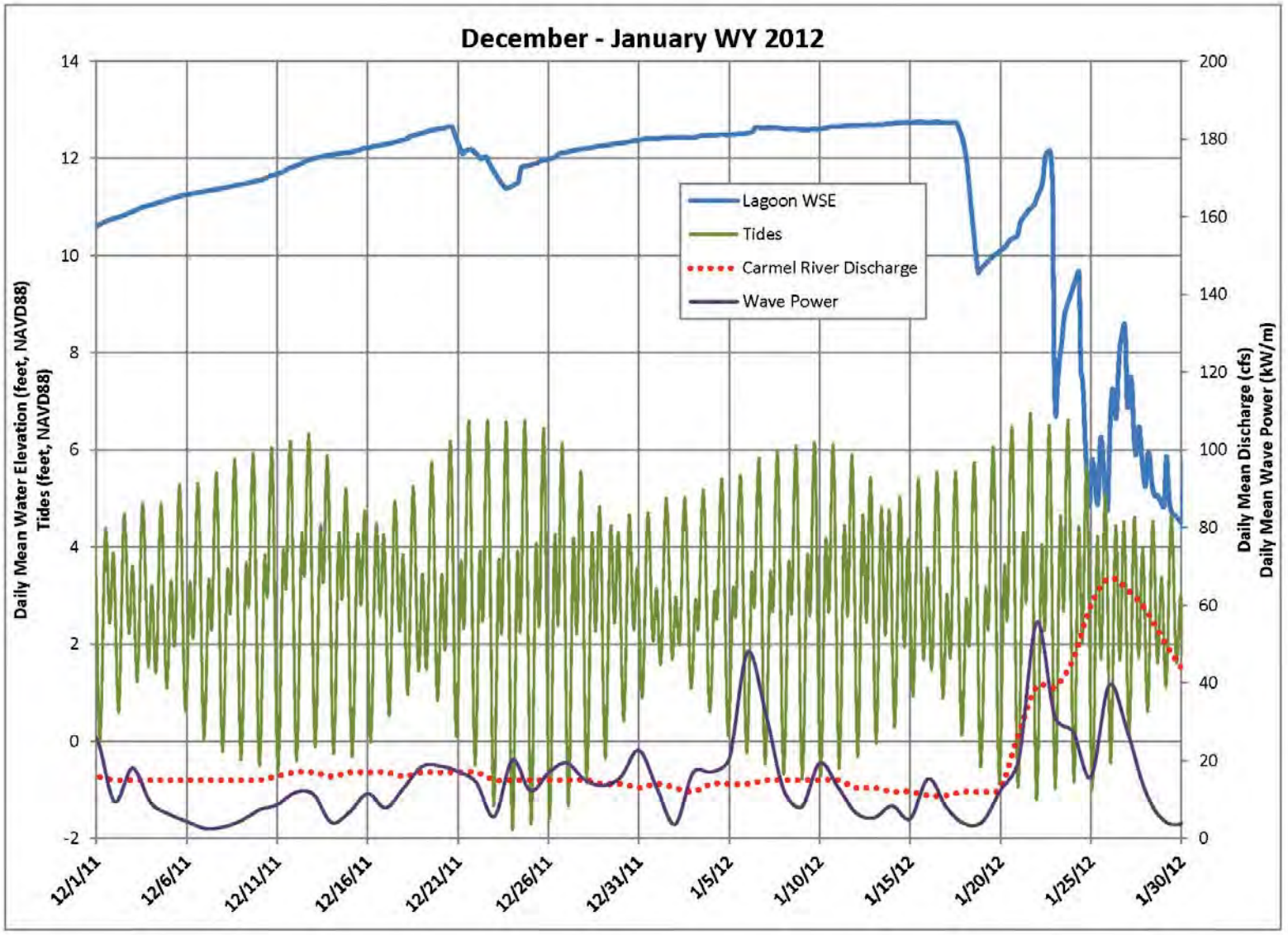


Figure 5-7: Water Year 2012, Dec-Jan – Carmel River Breaching and Relevant Processes

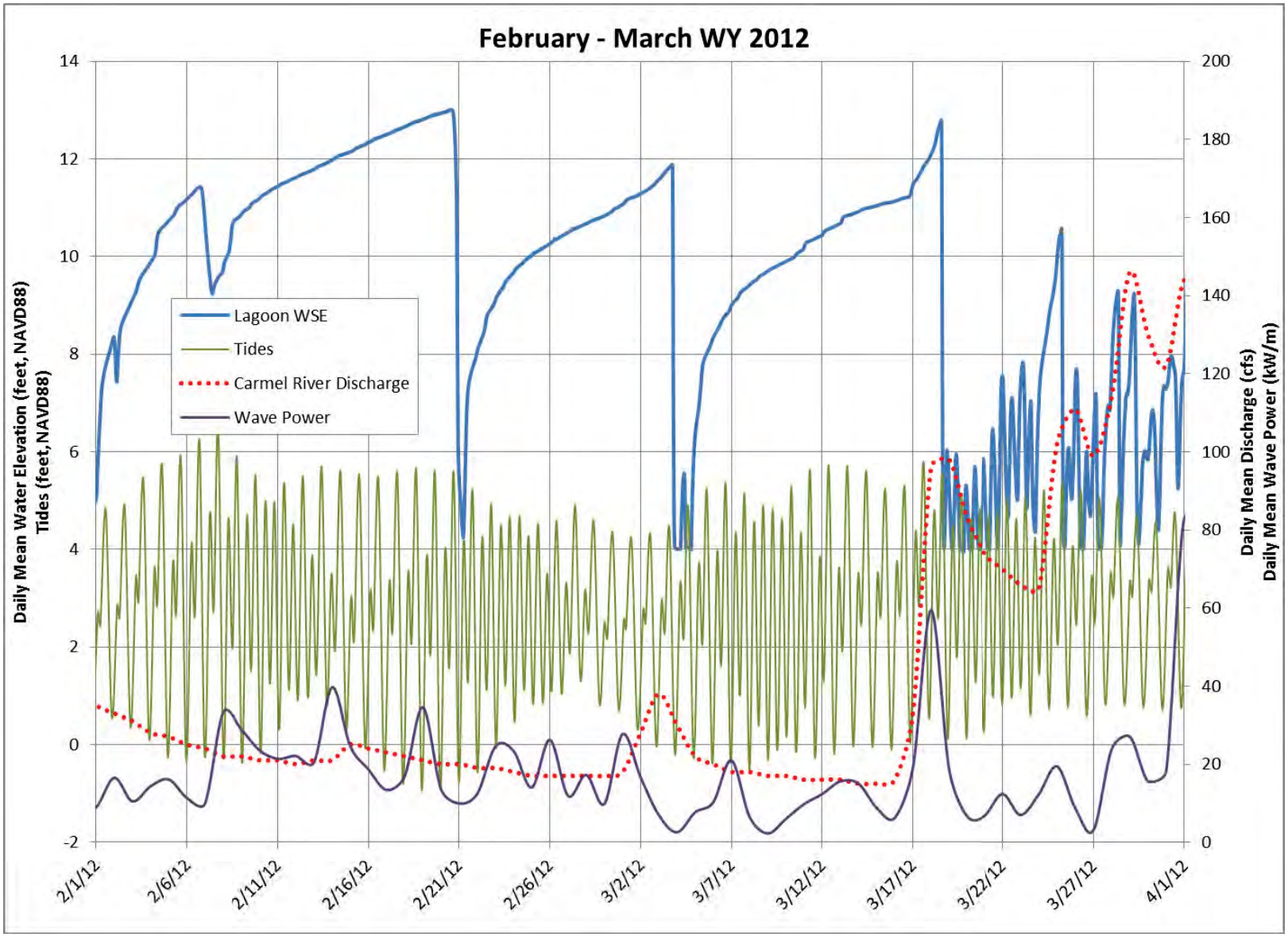


Figure 5-8: Water Year 2012, Feb-Mar – Carmel River Breaching and Relevant Processes

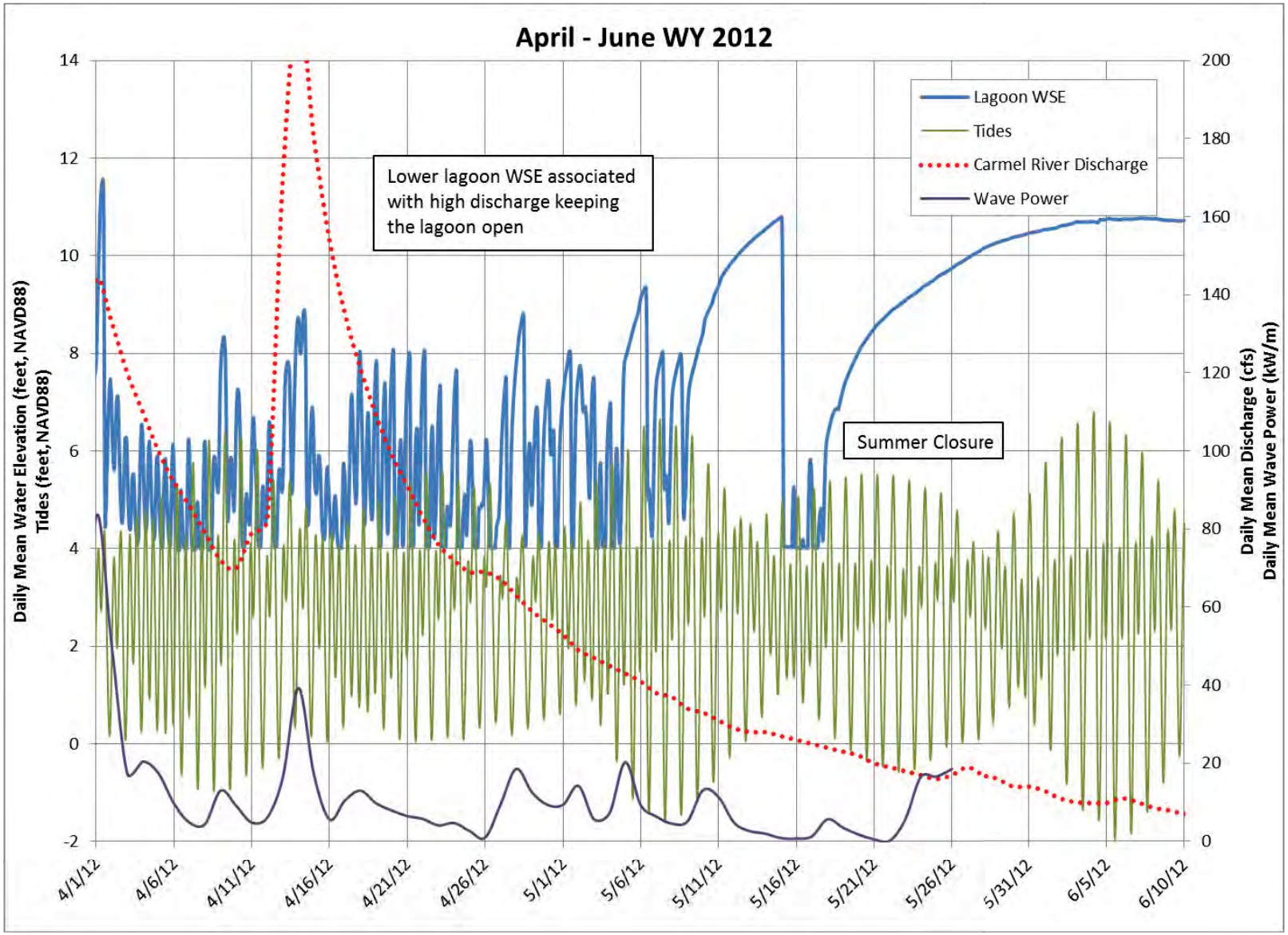


Figure 5-9: Water Year 2012, Apr-Jun – Carmel River Breaching and Relevant Processes

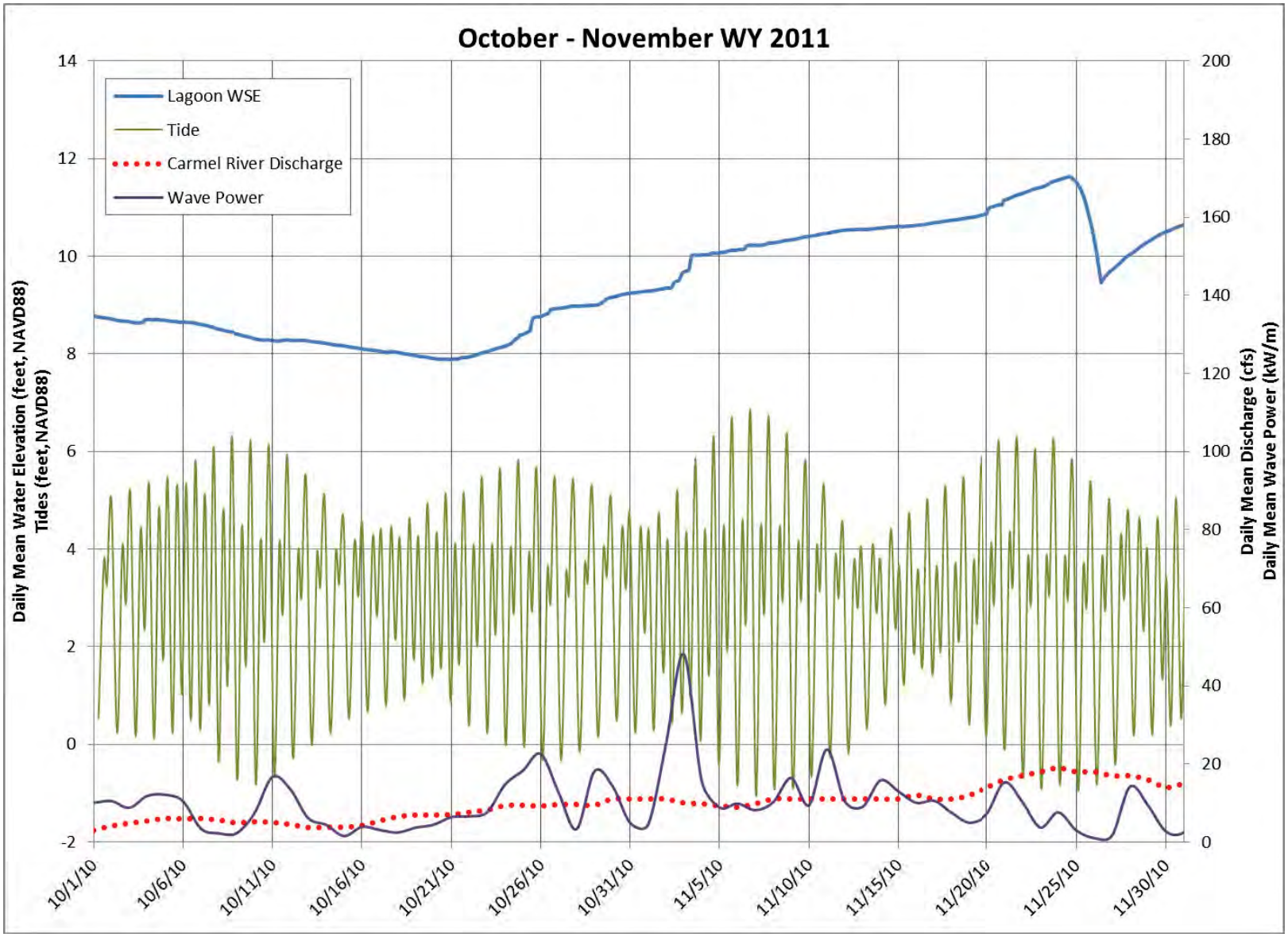


Figure 5-10: Water Year 2011, Oct-Nov – Carmel River Breaching and Relevant Processes

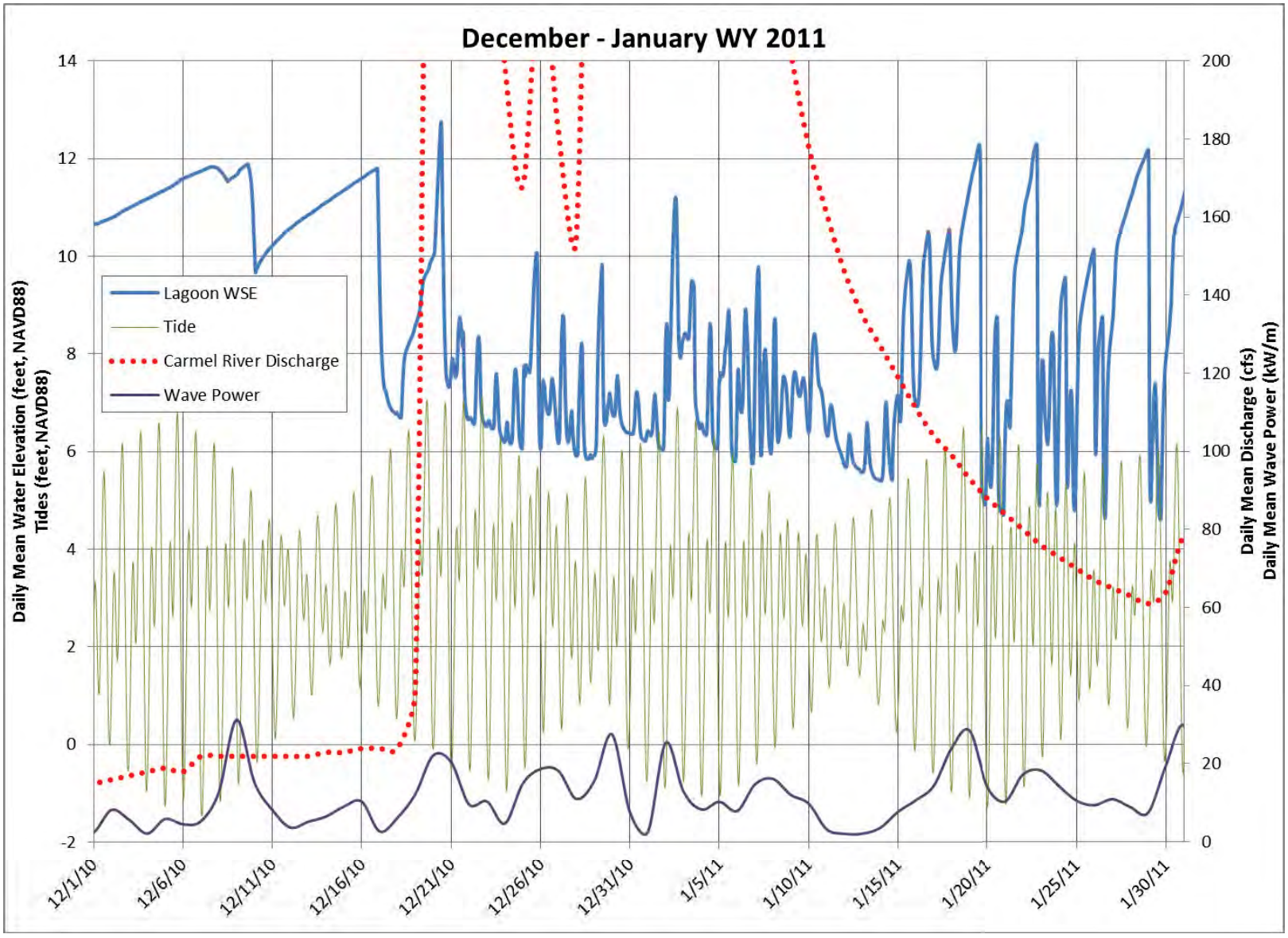


Figure 5-11: Water Year 2011, Dec-Jan – Carmel River Breaching and Relevant Processes

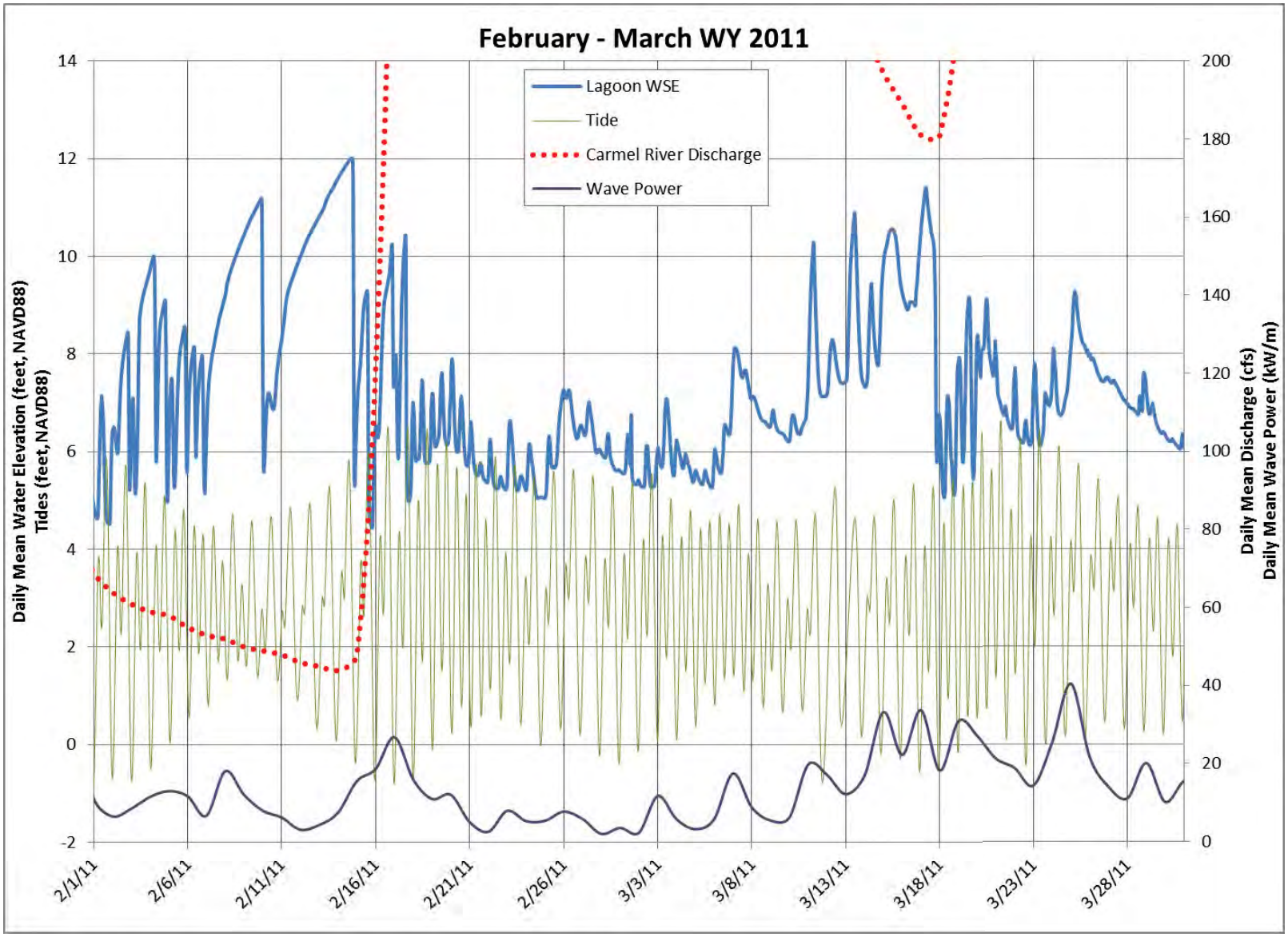


Figure 5-12: Water Year 2011, Feb-Mar – Carmel River Breaching and Relevant Processes

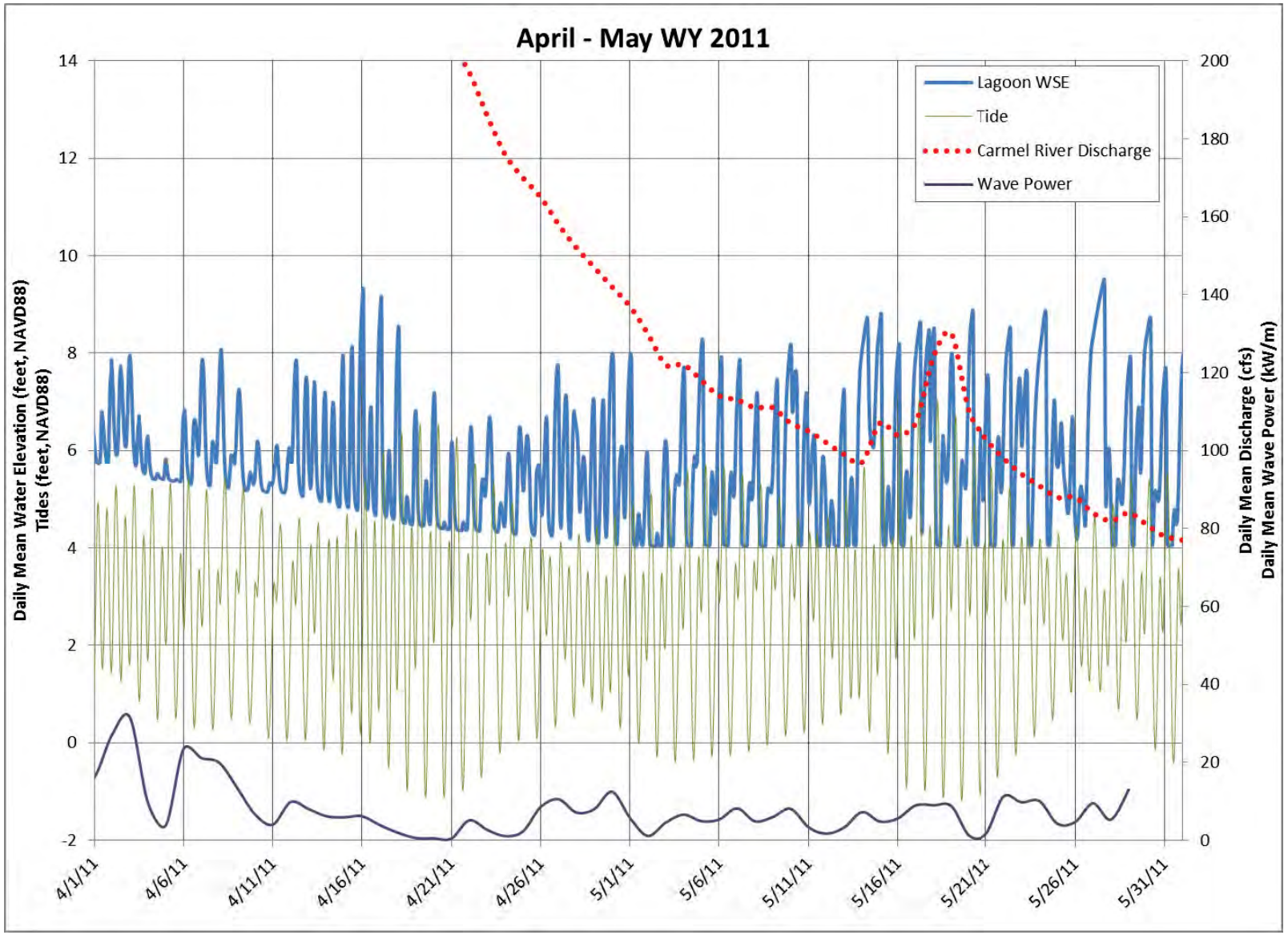


Figure 5-13: Water Year 2011, Apr-May – Carmel River Breaching and Relevant Processes

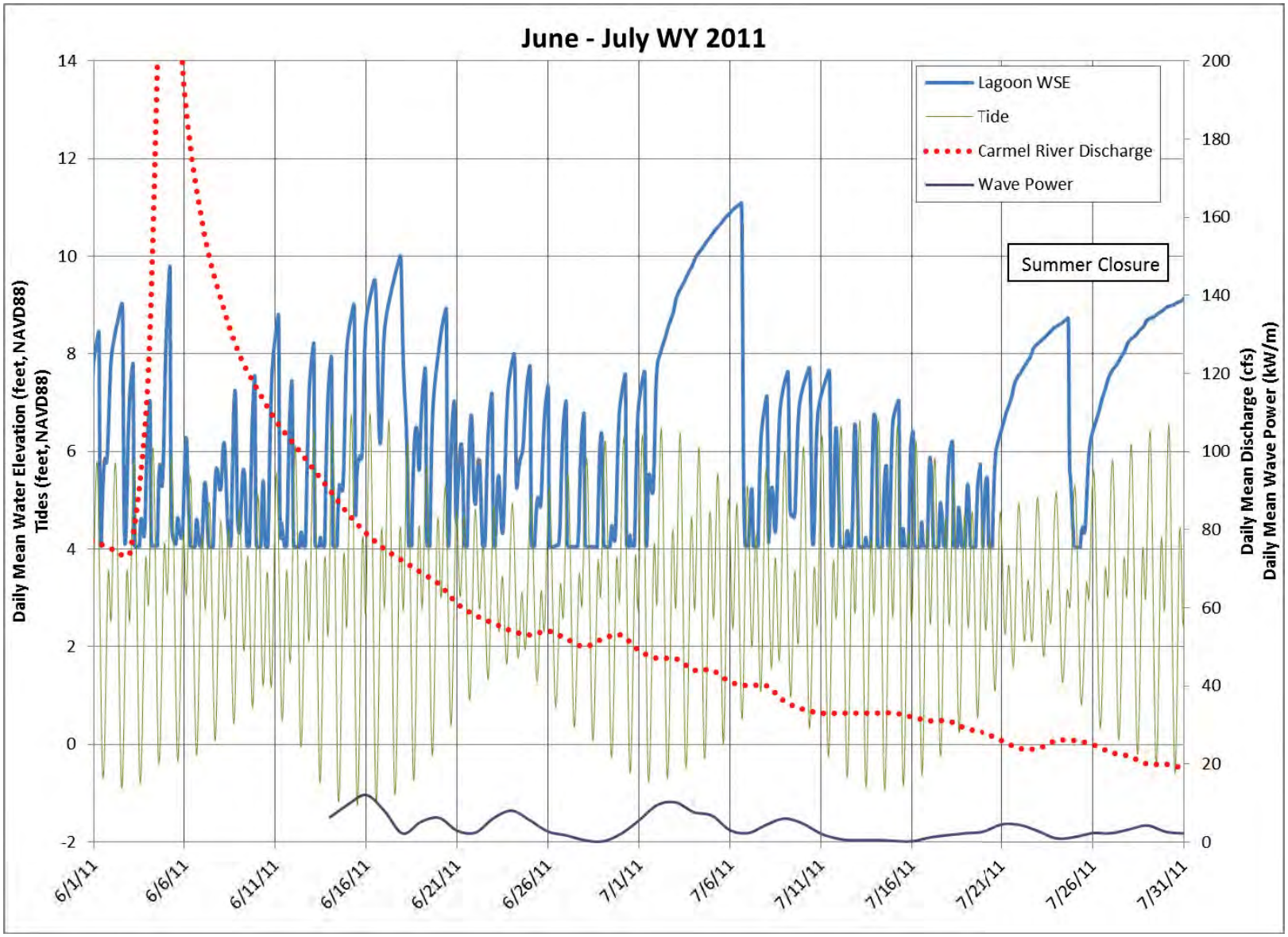
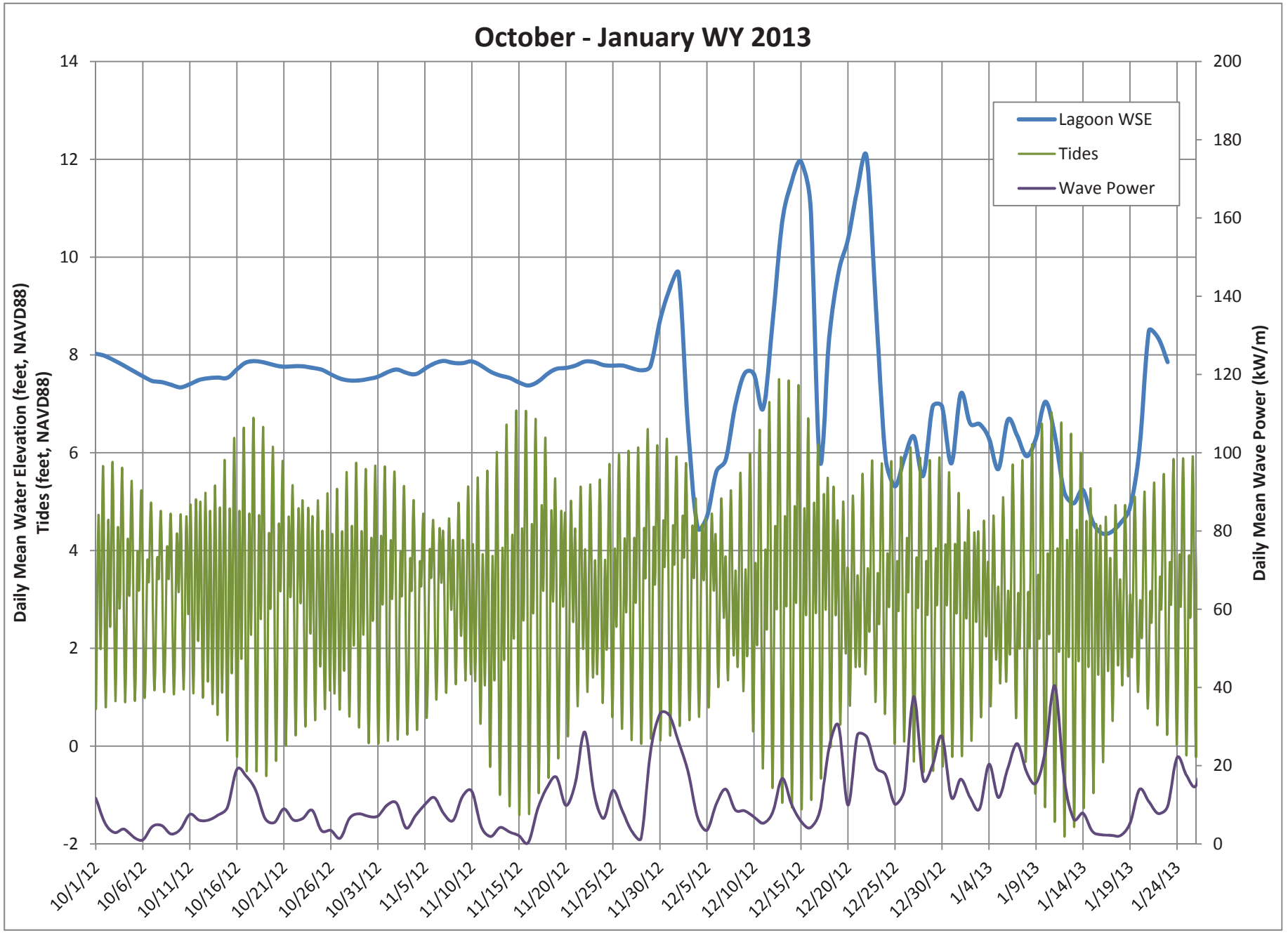


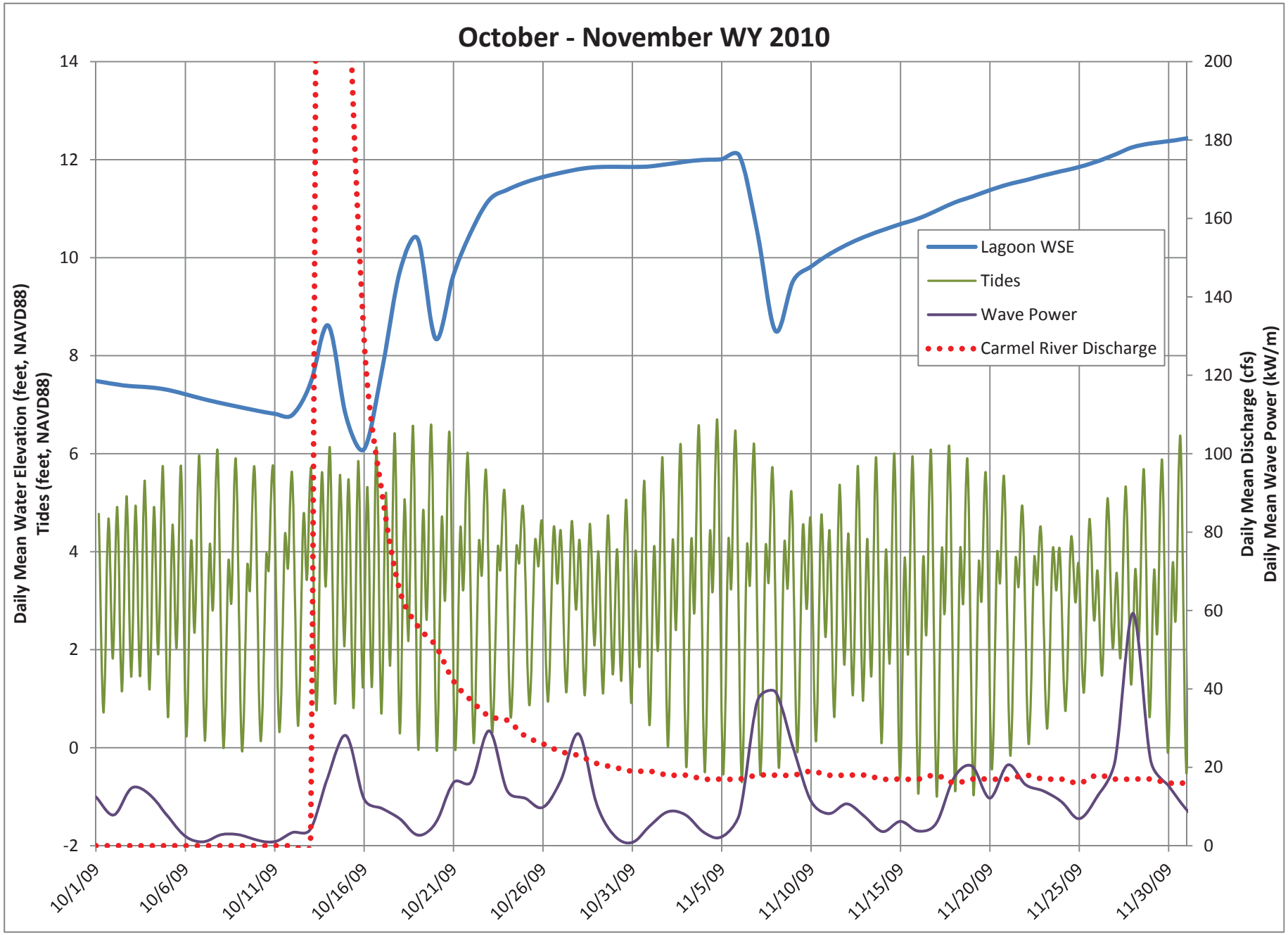
Figure 5-14: Water Year 2011, June-July – Carmel River Breaching and Relevant Processes

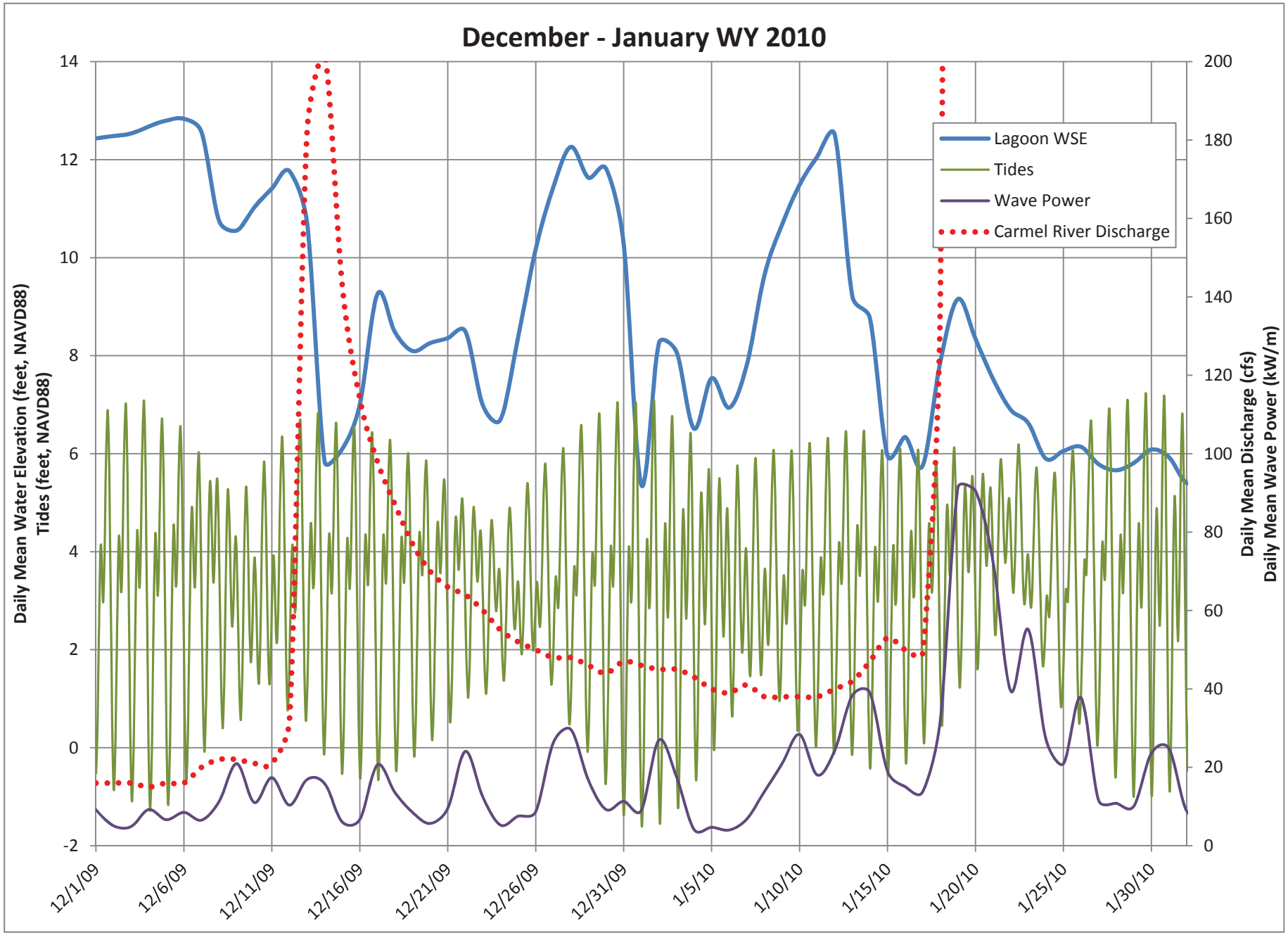
APPENDIX A

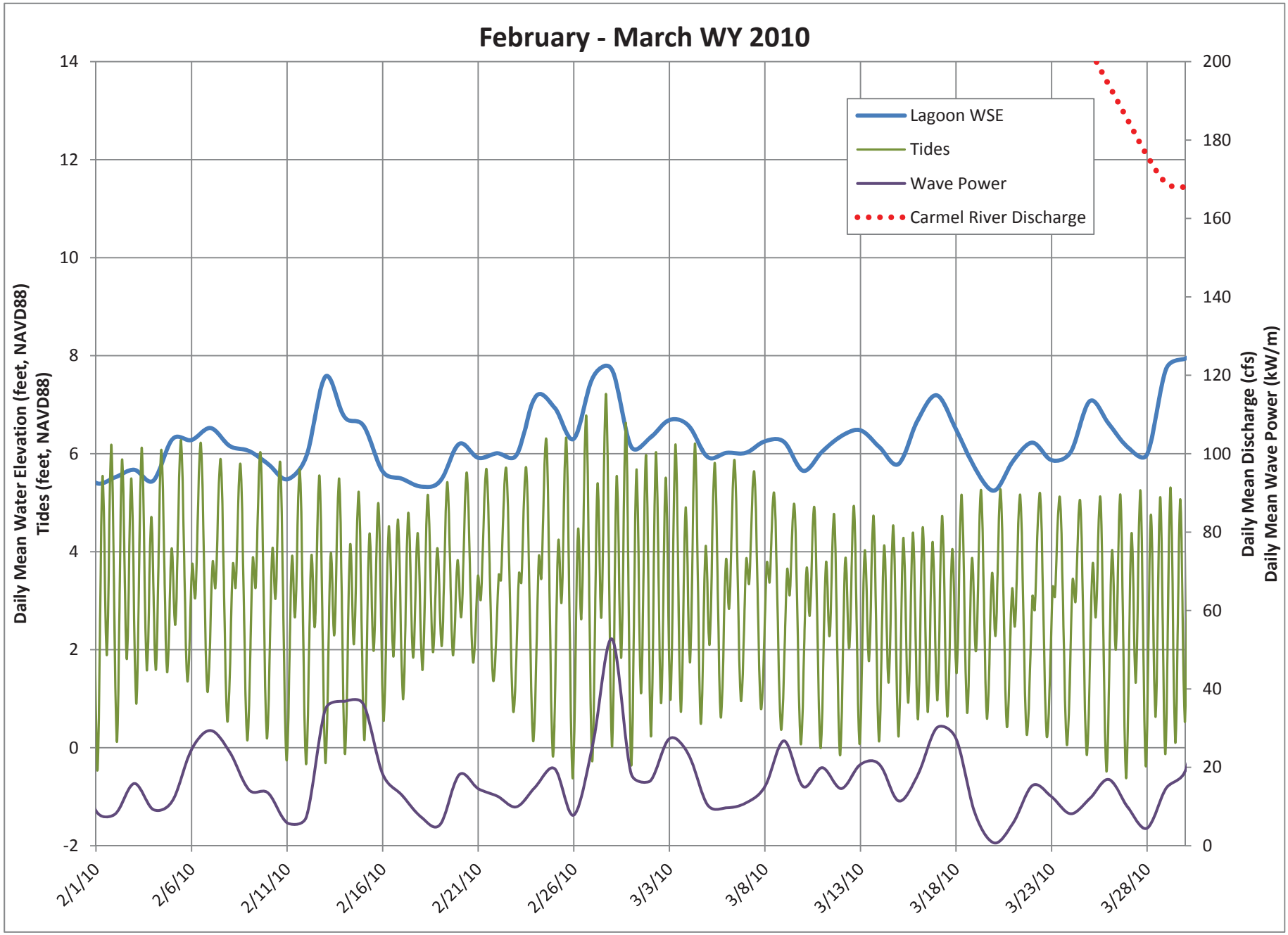
Carmel River Breaching and Relevant Processes

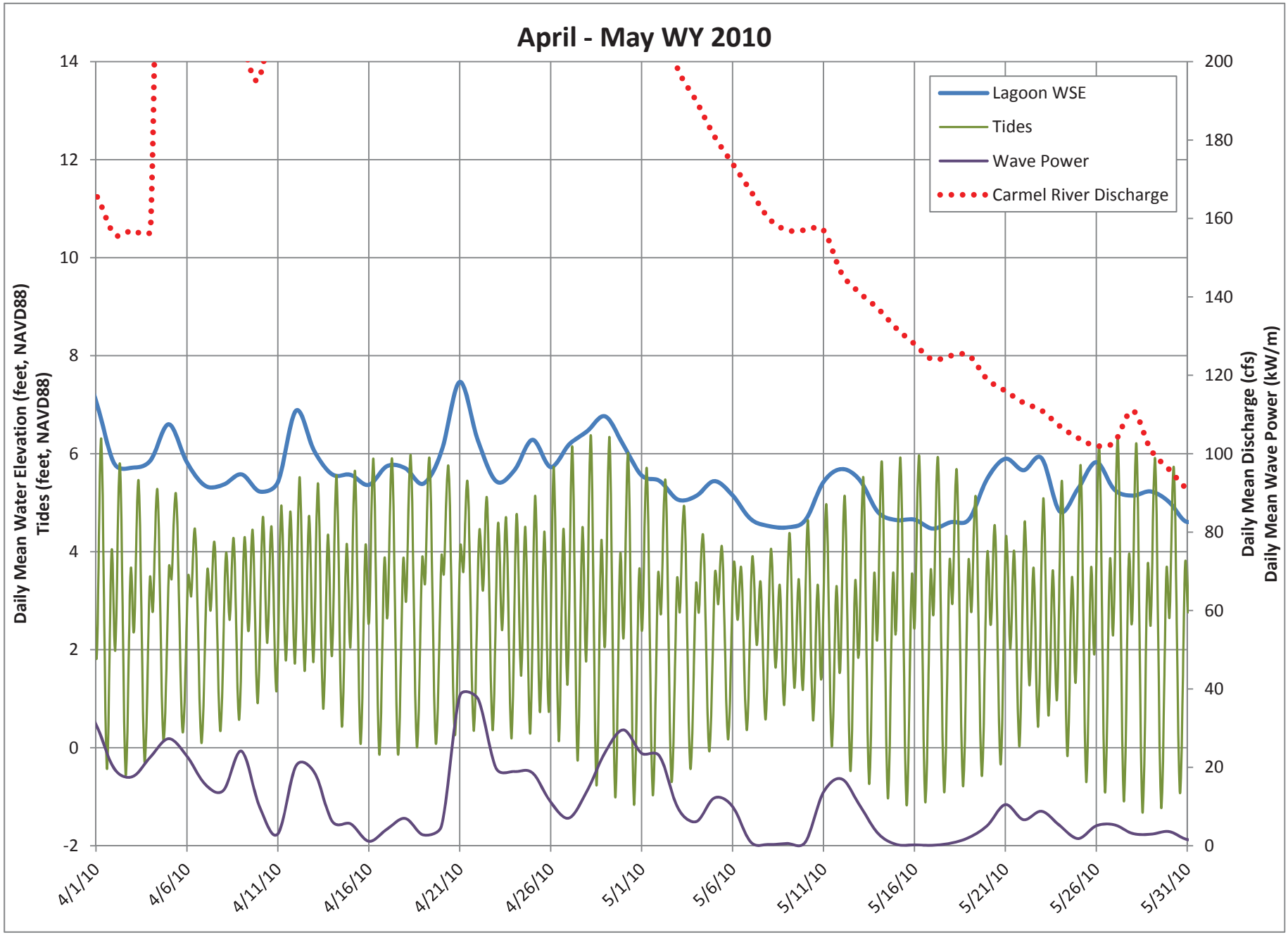
Monthly Figures Water Years 2013, 2010, 2009

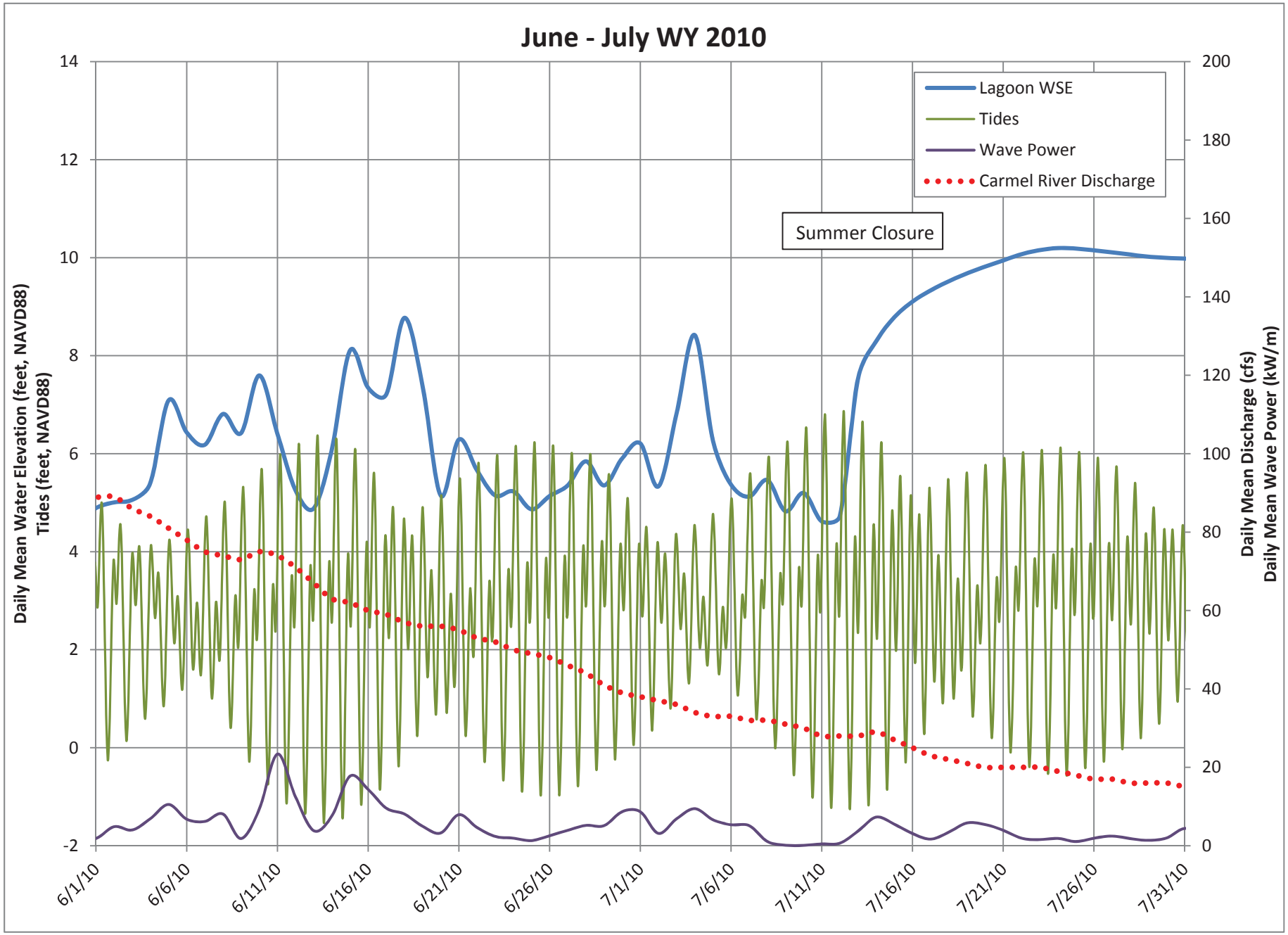

October - January WY 2013
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
10/1/12
10/6/12
10/11/12
10/16/12
10/21/12
10/26/12
10/31/12
11/5/12
11/10/12
11/15/12
11/20/12
11/25/12
11/30/12
12/5/12
12/10/12
12/15/12
12/20/12
12/25/12
12/30/12
1/4/13
1/9/13
1/14/13
1/19/13
1/24/13

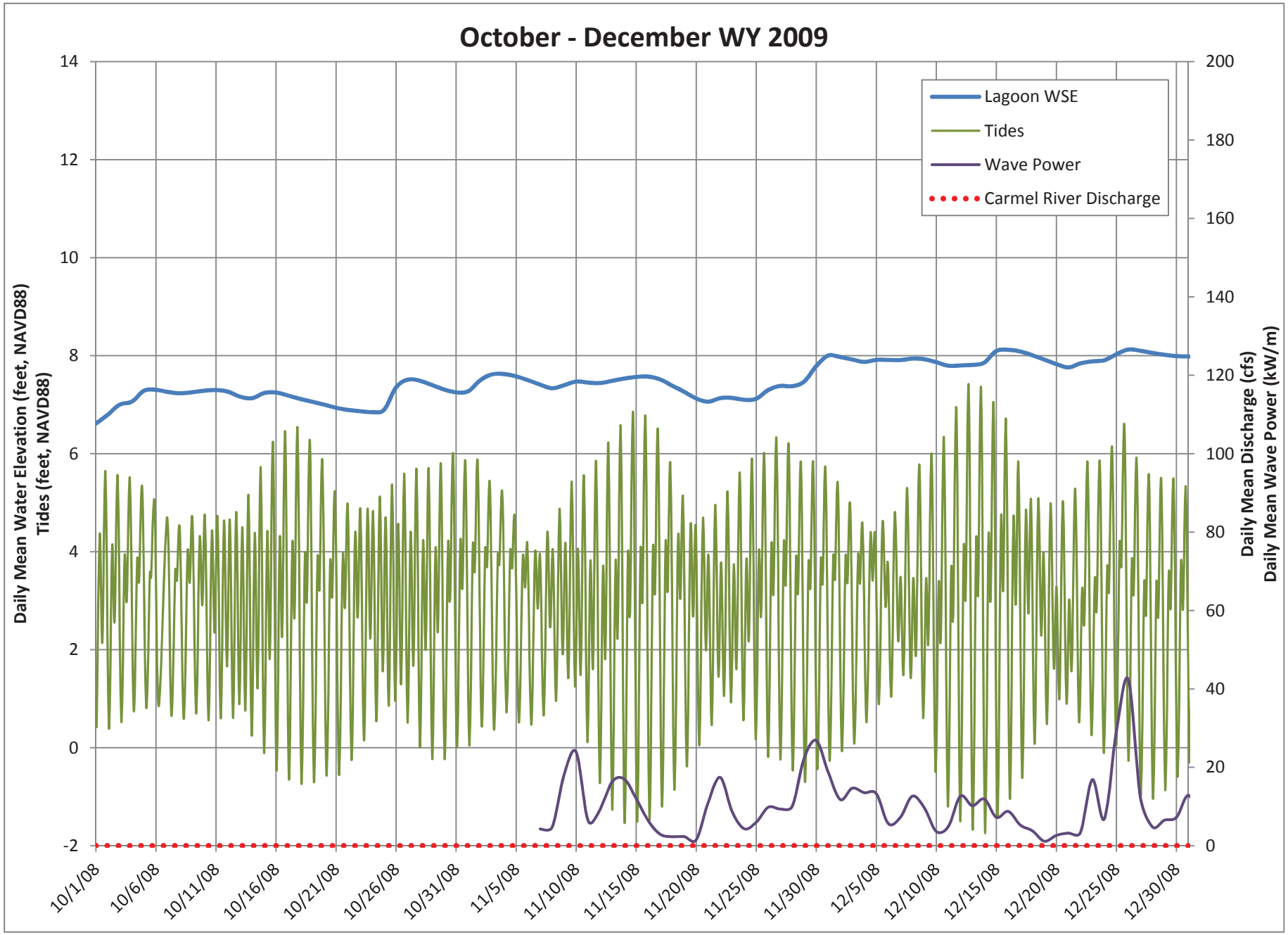

October - November WY 2010
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
10/1/09
10/6/09
10/11/09
10/16/09
10/21/09
10/26/09
10/31/09
11/5/09
11/10/09
11/15/09
11/20/09
11/25/09
11/30/09

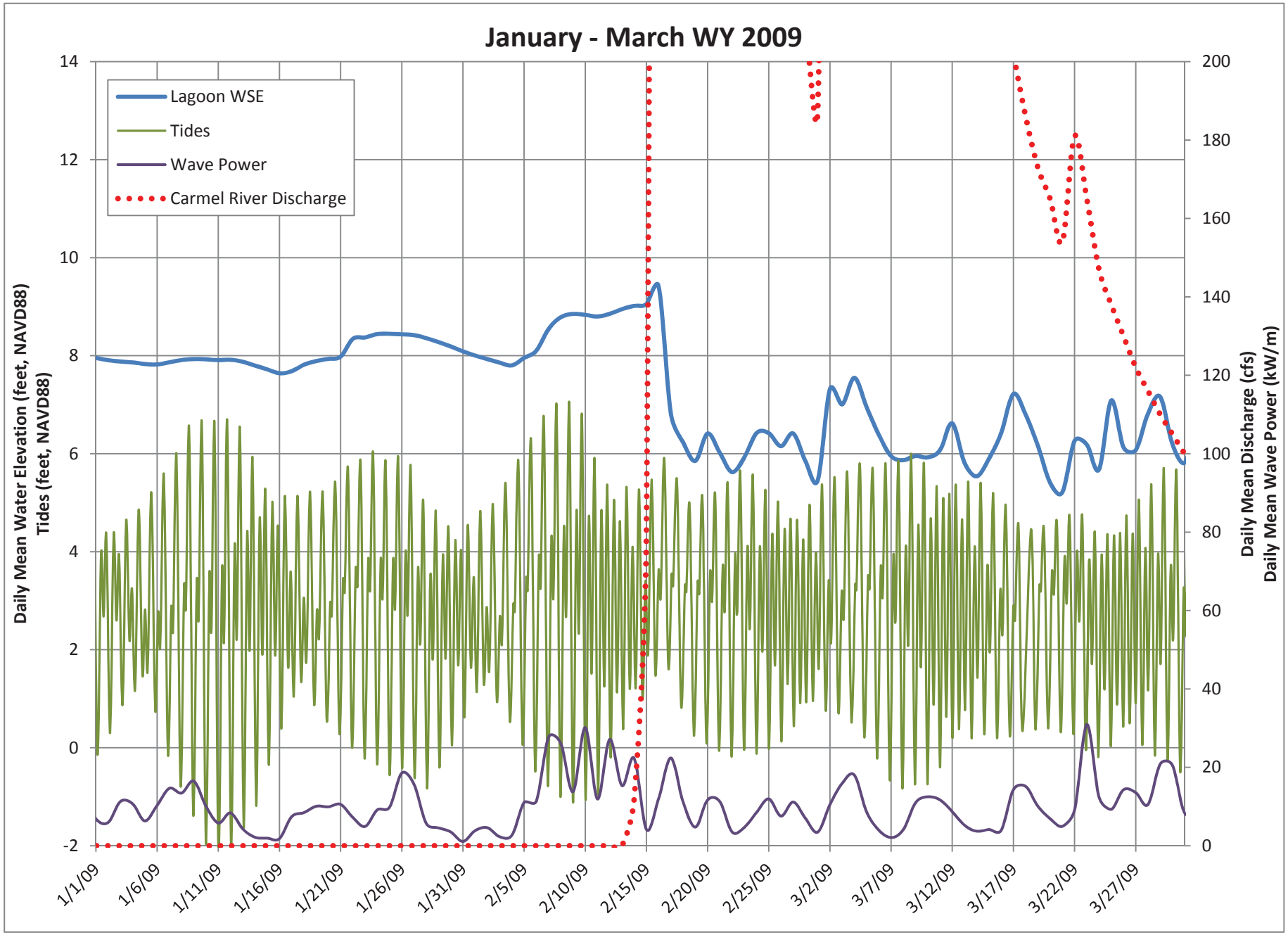

December - January WY 2010
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
12/1/09
12/6/09
12/11/09
12/16/09
12/21/09
12/26/09
12/31/09
1/5/10
1/10/10
1/15/10
1/20/10
1/25/10
1/30/10

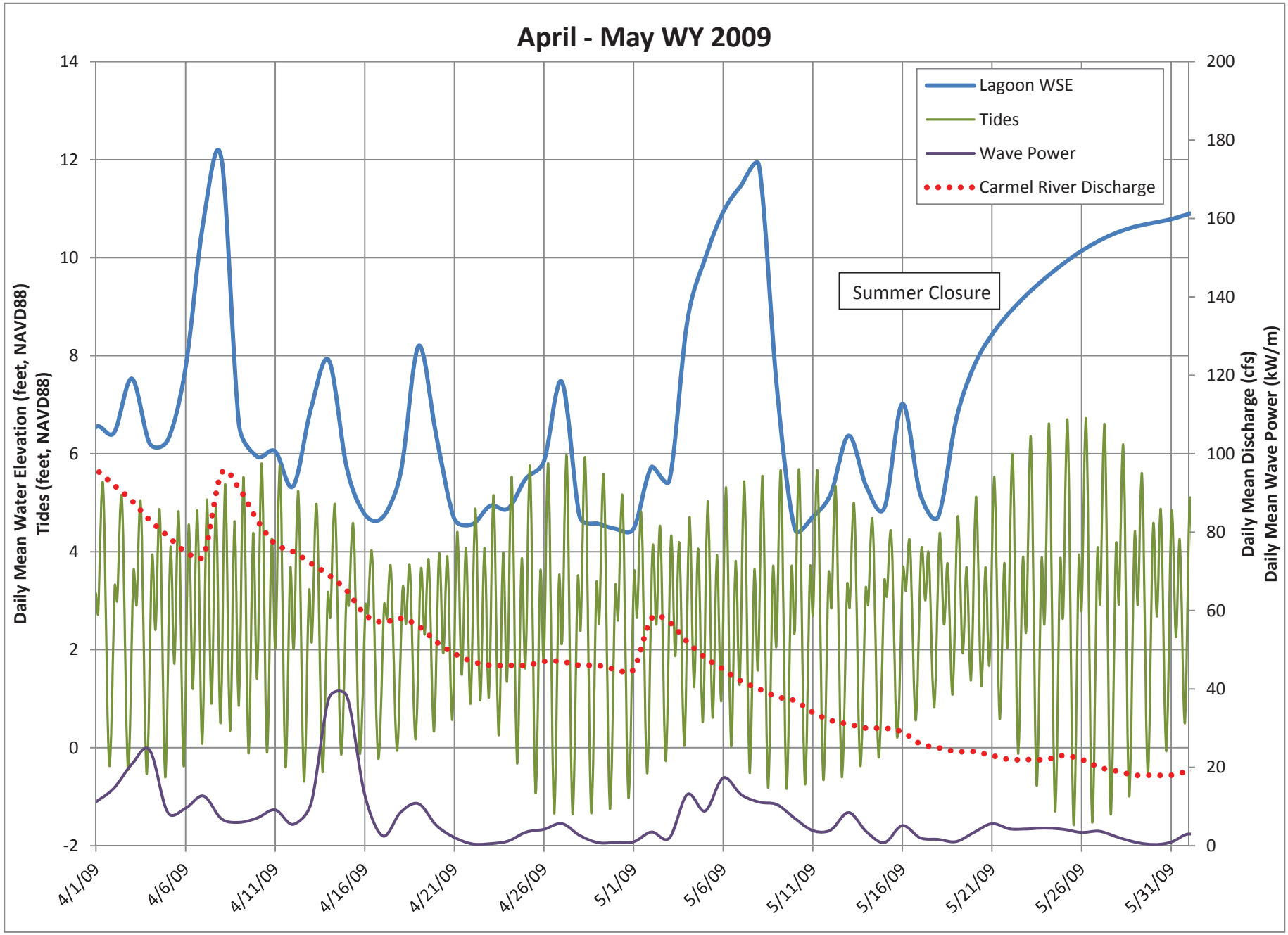

February - March WY 2010
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
2/1/10
2/6/10
2/11/10
2/16/10
2/21/10
2/26/10
3/3/10
3/8/10
3/13/10
3/18/10
3/23/10
3/28/10


April - May WY 2010
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
4/1/10
4/6/10
4/11/10
4/16/10
4/21/10
4/26/10
5/1/10
5/6/10
5/11/10
5/16/10
5/21/10
5/26/10
5/31/10


June - July WY 2010
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Summer Closure
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
6/1/10
6/6/10
6/11/10
6/16/10
6/21/10
6/26/10
7/1/10
7/6/10
7/11/10
7/16/10
7/21/10
7/26/10
7/31/10


October - December WY 2009
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
10/1/08
10/6/08
10/11/08
10/16/08
10/21/08
10/26/08
10/31/08
11/5/08
11/10/08
11/15/08
11/20/08
11/25/08
11/30/08
12/5/08
12/10/08
12/15/08
12/20/08
12/25/08
12/30/08

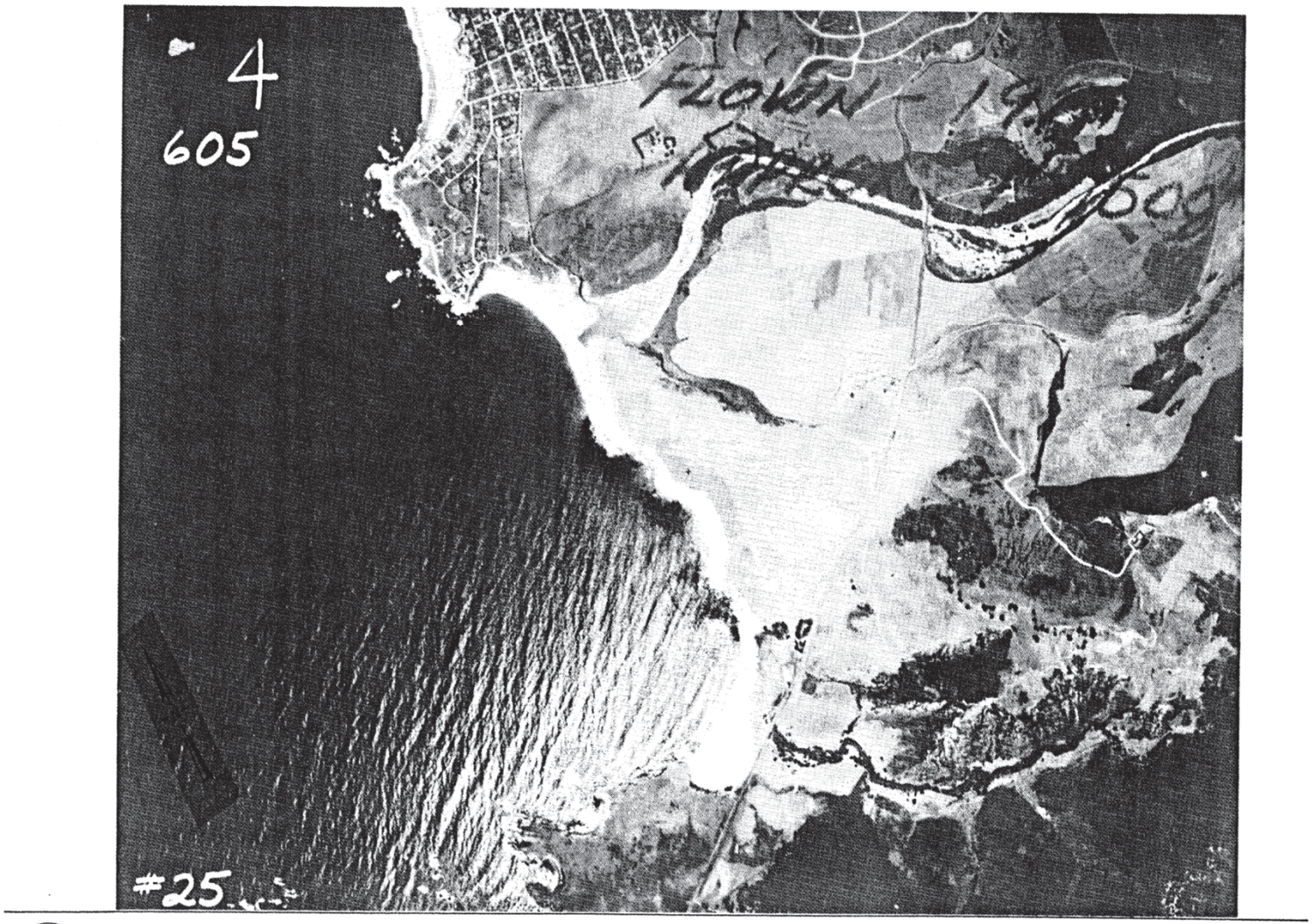

January - March WY 2009
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
1/1/09
1/6/09
1/11/09
1/16/09
1/21/09
1/26/09
1/31/09
2/5/09
2/10/09
2/15/09
2/20/09
2/25/09
3/2/09
3/7/09
3/12/09
3/17/09
3/22/09
3/27/09


April - May WY 2009
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Summer Closure
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
4/1/09
4/6/09
4/11/09
4/16/09
4/21/09
4/26/09
5/1/09
5/6/09
5/11/09
5/16/09
5/21/09
5/26/09
5/31/09

APPENDIX B

Monterey County Aerial Photographs

1929



Philip Williams & Associates, Ltd.
Consultants in Hydrology

Aerial View of the Lagoon, 1929

FIGURE
5-6

Source: Williams, J. and Philip Williams & Associates. (1992). Carmel River Lagoon Enhancement Plan.

1972



Source: Unknown. Provided by Whitson Engineers.

April 30, 1979



Source: Unknown. Provided by Whitson Engineers.

June 1982



Source: Unknown. Provided by Whitson Engineers.

March 1993





Source: Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon (2007)

September 6, 1998



October 1, 2002



August 12, 2003



Source: CaliforniaCoastaline.org

July 30, 2004


7/30/2004
17th Ave
Carmelo St
Scenic Rd
Image USDA Farm Service Agency
© 2013 Google
903 ft
Google earth
Imagery Date: 6/30/2004
1998
10 S 596001.78 m E 4044059.70 m N elev 14 ft
Eye alt 3612 ft

August 25, 2005



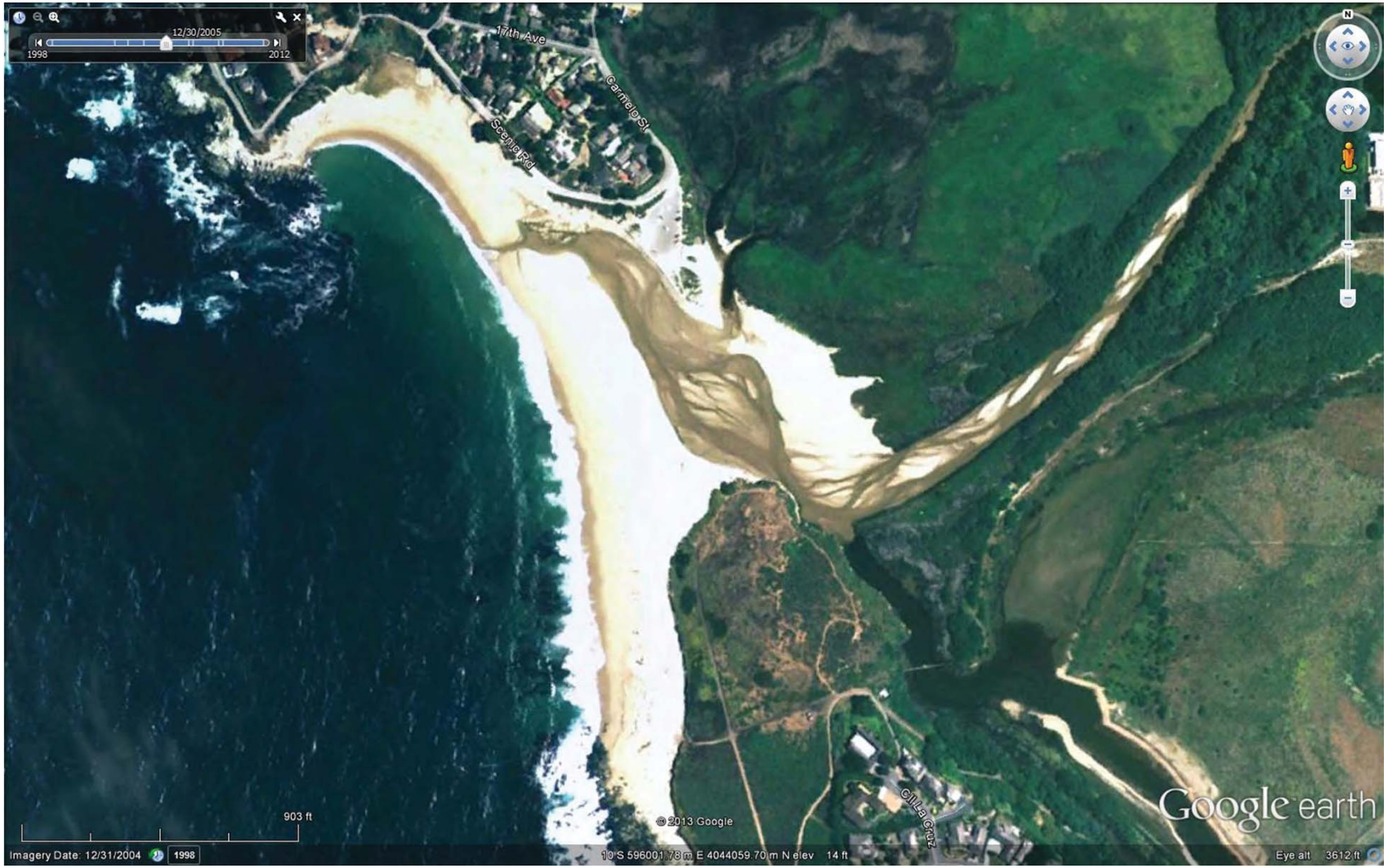
Source: James, G. (2005). Surface Water Dynamics at the Carmel River Lagoon Water Years 1991 through 2005; Technical Memorandum 05-01

October 28, 2005



Source: CaliforniaCoastline.org

December 30, 2005



July 3, 2006



Source: Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon (2007)

June 29, 2007


6/29/2007
1998
2012
17th Ave
Carmelo St
Scenic Rd
903 ft
1998
©2013 Google
10 S 596001.78 m E 4044059.70 m N elev 14 ft
Eye alt 3612 ft
Google earth

October 6, 2007

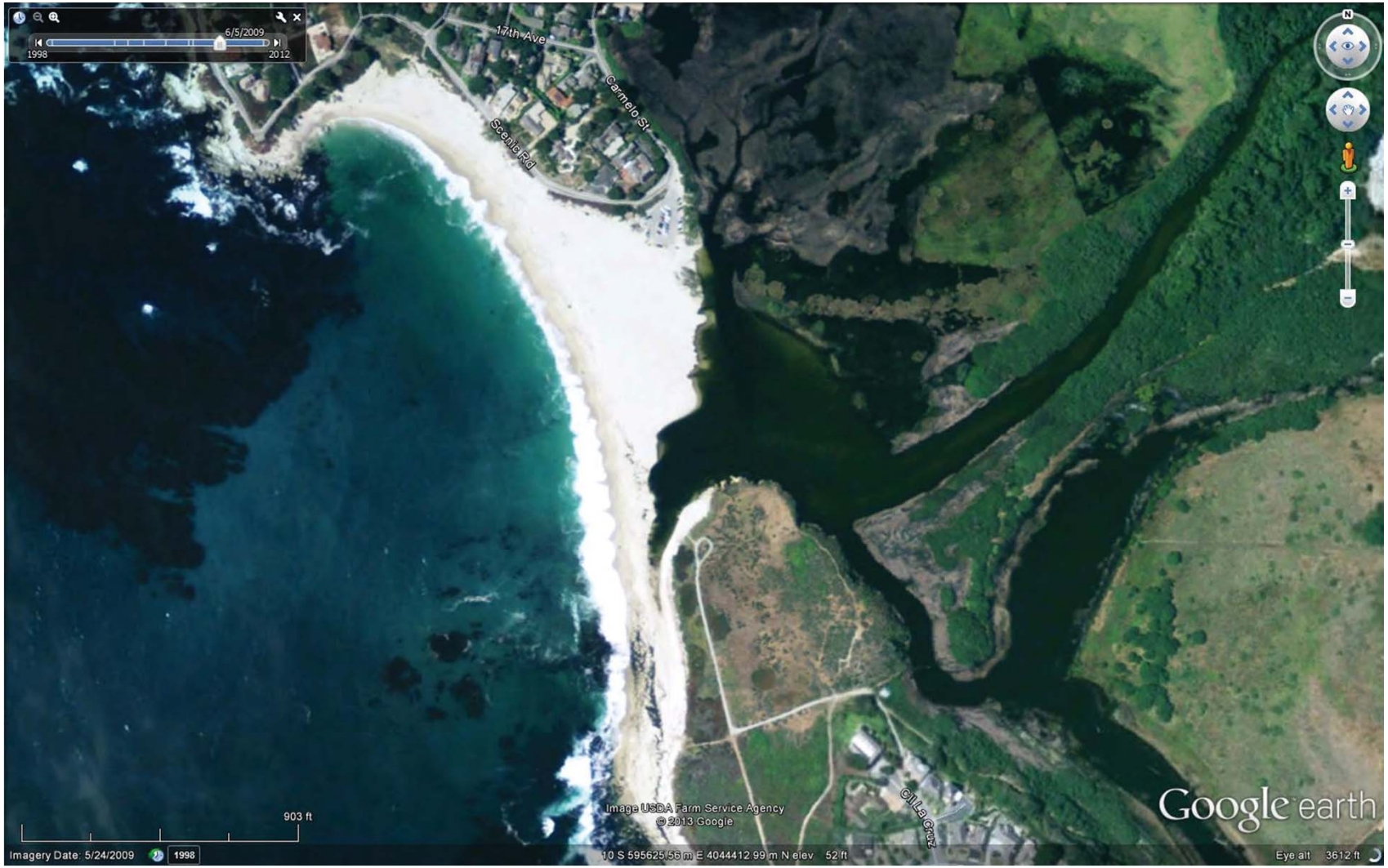


May 2008



Source: CaliforniaCoastline.org

June 5, 2009


6/5/2009
1998
2012
17th Ave
Camelo St
Scenic Rd
Image USDA Farm Service Agency
© 2013 Google
903 ft
Imagery Date: 5/24/2009
1998
10 S 595625.56 m E 4044412.99 m N elev 52 ft
Eye alt 3612 ft
Google earth

September 29, 2009



2011



Photo courtesy of Monterey County

May 5, 2012


5/5/2012
17th Ave
Carmelo St
Scenic Rd
Google earth
© 2013 Google
903 ft
Imagery Date: 5/5/2012
1998
10 S 595633.03 m E 4044361.62 m N elev 49 ft
Eye alt 3612 ft

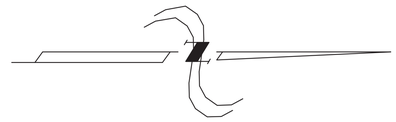
APPENDIX C

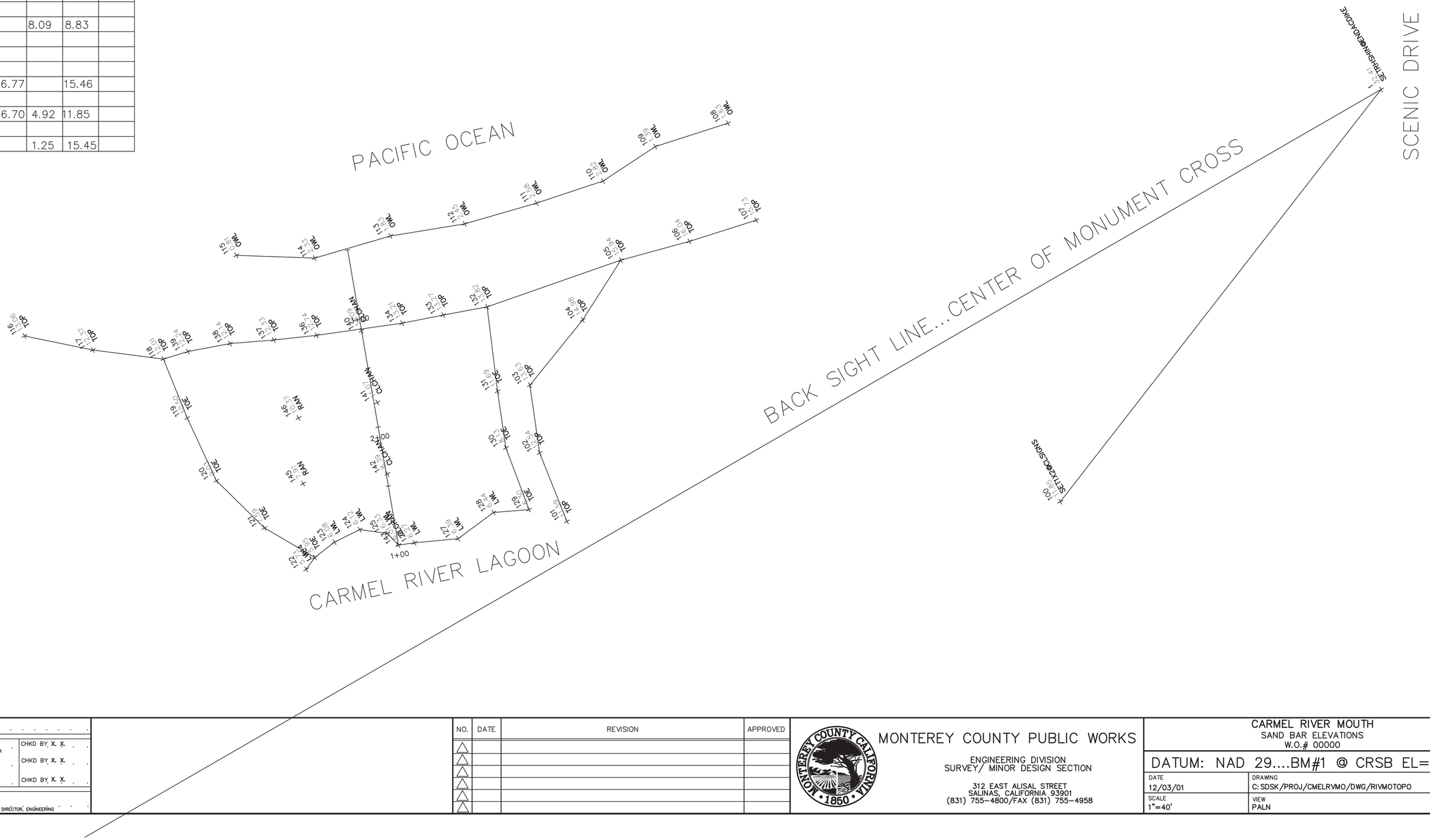
Monterey County Carmel River Mouth Surveys

2001 - 2012

SHEET NUMBER	TOTAL SHEETS
1	1

STA.	+	HI	–	ELEV.	
BM#1	4.55	20.01		15.46	
0	2.24	18.69	3.56	16.45	
SETRHSH	7.12	18.61	7.20	11.49	
0	3.59	20.04	2.16	16.45	
BM#1			4.58	15.46	
SETRHSH	5.43	16.92		11.49	
BOT RED			8.09	8.83	
BM#1	1.31	16.77		15.46	
SET 100	4.85	16.70	4.92	11.85	
BM#1			1.25	15.45	





SUBMITTED BY X. X. XXXXX	
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.
DRAWN BY K.A.PEAKE	CHKD BY X. X.
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.
APPROVAL RECOMMENDED BY X. X. XXXXX (DEPUTY PUBLIC WORKS DIRECTOR, ENGINEERING)	

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

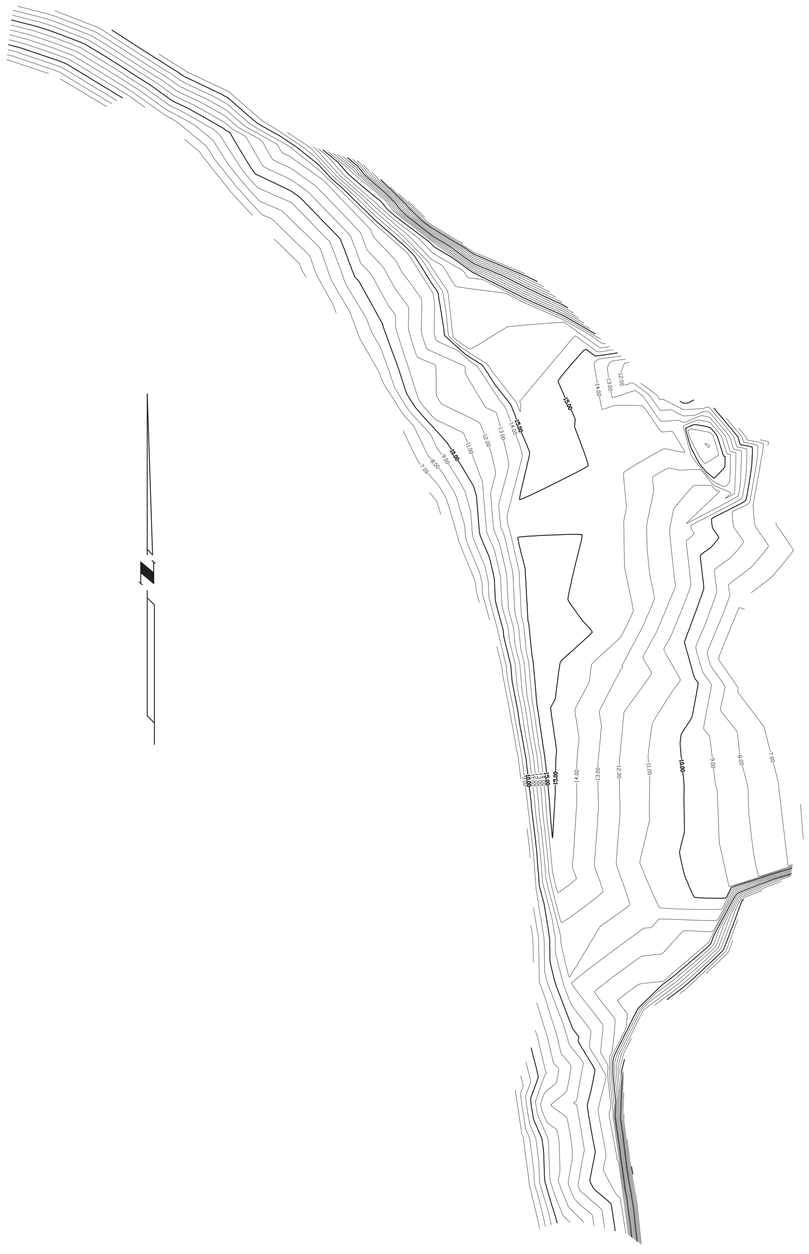
CARMEL RIVER MOUTH

SAND BAR ELEVATIONS
W.O.# 00000

DATUM: NAD 29....BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
12/03/01	C:SDSK/PROJ/CMELRVMO/DWG/RIVMOTOPO	1
SCALE 1"=40'	VIEW PALN	OF 1

SHEET NUMBER	TOTAL SHEETS
XX	XX



SUBMITTED BY X. X. XXXXX	
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.
DRAWN BY X. X. XXXXX	CHKD BY X. X.
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.
APPROVAL RECOMMENDED BY X. X. XXXXX (DEPUTY PUBLIC WORKS DIRECTOR, ENGINEERING)	

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

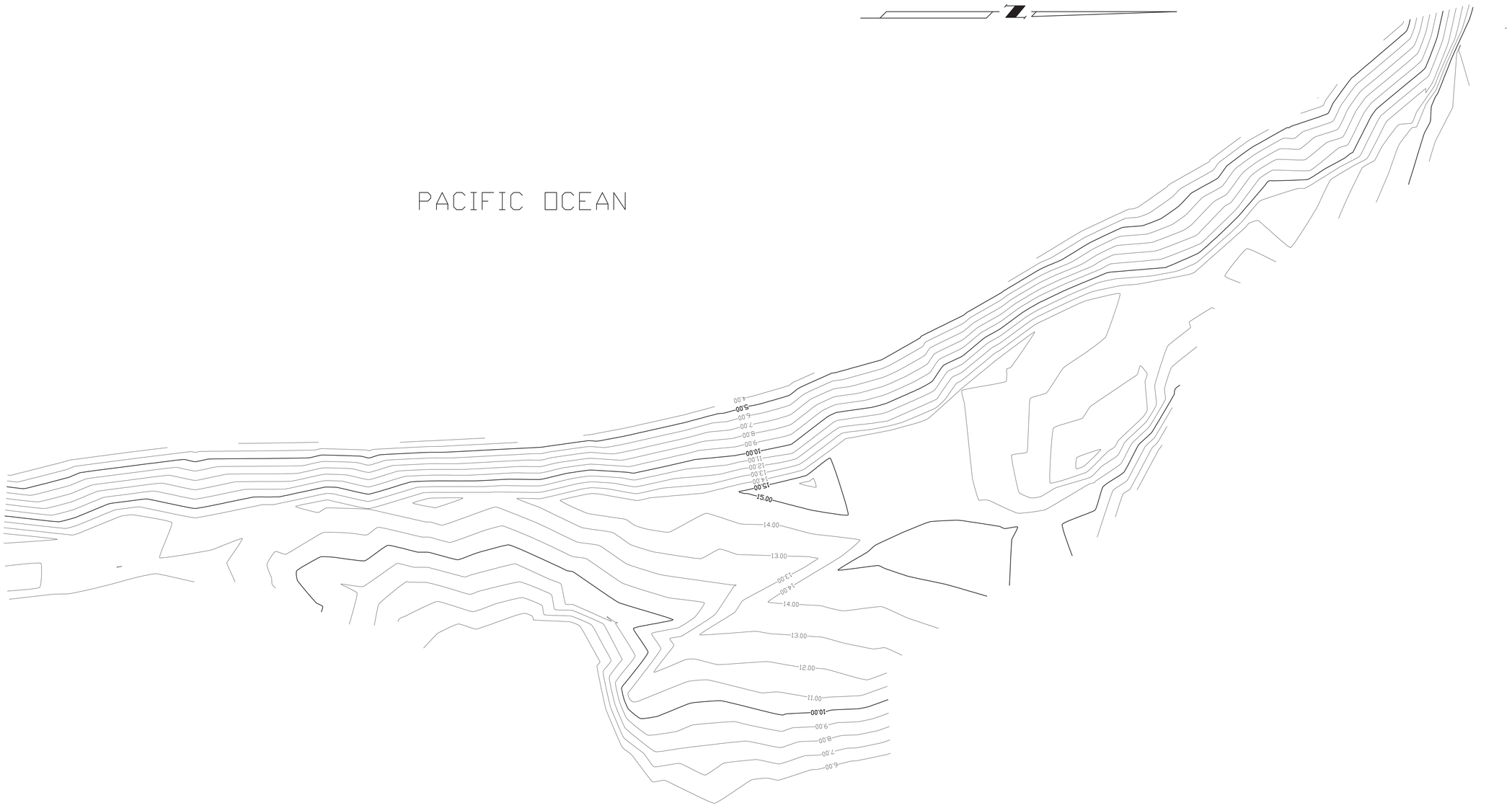
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

PROJECT TITLE
TITLE LINE 2
CONTRACT NO.

SHEET TITLE

DATE	DRAWING	SHEET
xx/xx/xx	DRAWING PATH	SHEET# OF TOTAL
SCALE: SCALE	VIEW: VIEW NAME	

SHEET NUMBER	TOTAL SHEETS
1	1



SUBMITTED BY X. X. XXXXX	
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.
DRAWN BY K.A.PEAKE	CHKD BY X. X.
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.
APPROVAL RECOMMENDED BY X. X. XXXXX (DEPUTY PUBLIC WORKS DIRECTOR, ENGINEERING)	

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

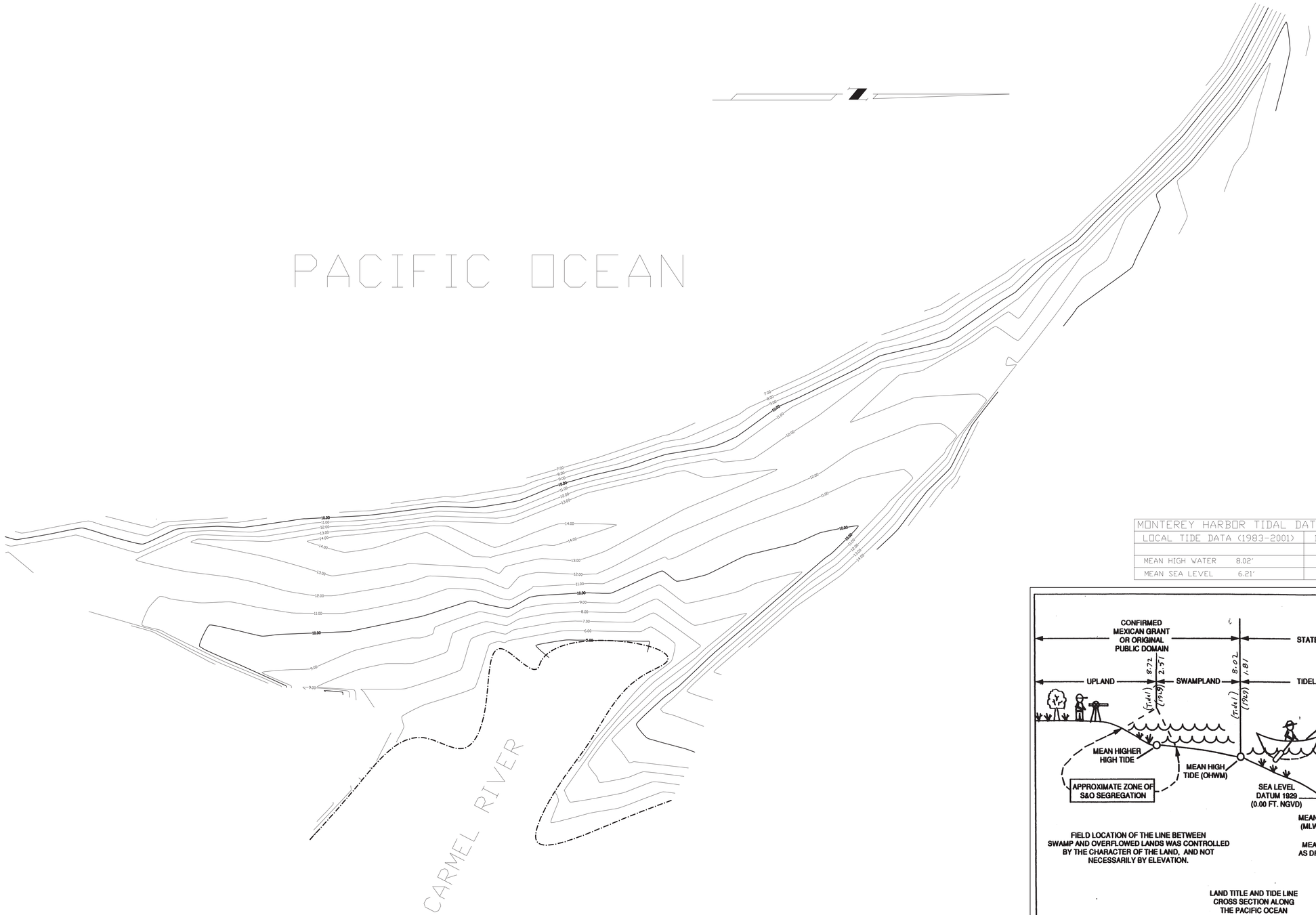
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
W.O.# 000000

DATUM: NAD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
11/18/03	C:\Land Projects 3\CRM03LDD	1
SCALE 1"=60'	VIEW extopo111803	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



MONTEREY HARBOR TIDAL DATUM EPOCH		
LOCAL TIDE DATA (1983-2001)		1929 ELEV.
MEAN HIGH WATER	8.02'	1.81'
MEAN SEA LEVEL	6.21'	0.00'

SUBMITTED BY X. X. XXXXX

DESIGN BY X. X. XXXXX PROJECT ENGINEER — CHKD BY X. X.

DRAWN BY K.A.PEAKE — CHKD BY X. X.

SPECIFICATIONS WRITTEN BY X. X. XXXXX — CHKD BY X. X.

APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR

NOTE: BOTTOM OF RED ON PADDLE / ELEV.= 8.81'
READING ON SCALE NEXT TO PADDLE / ELEV.= 8.91'

ELEV. 1.81', N.G.V.D. 1929 DATUM, IS THE STATE BOUNDARY LINE

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

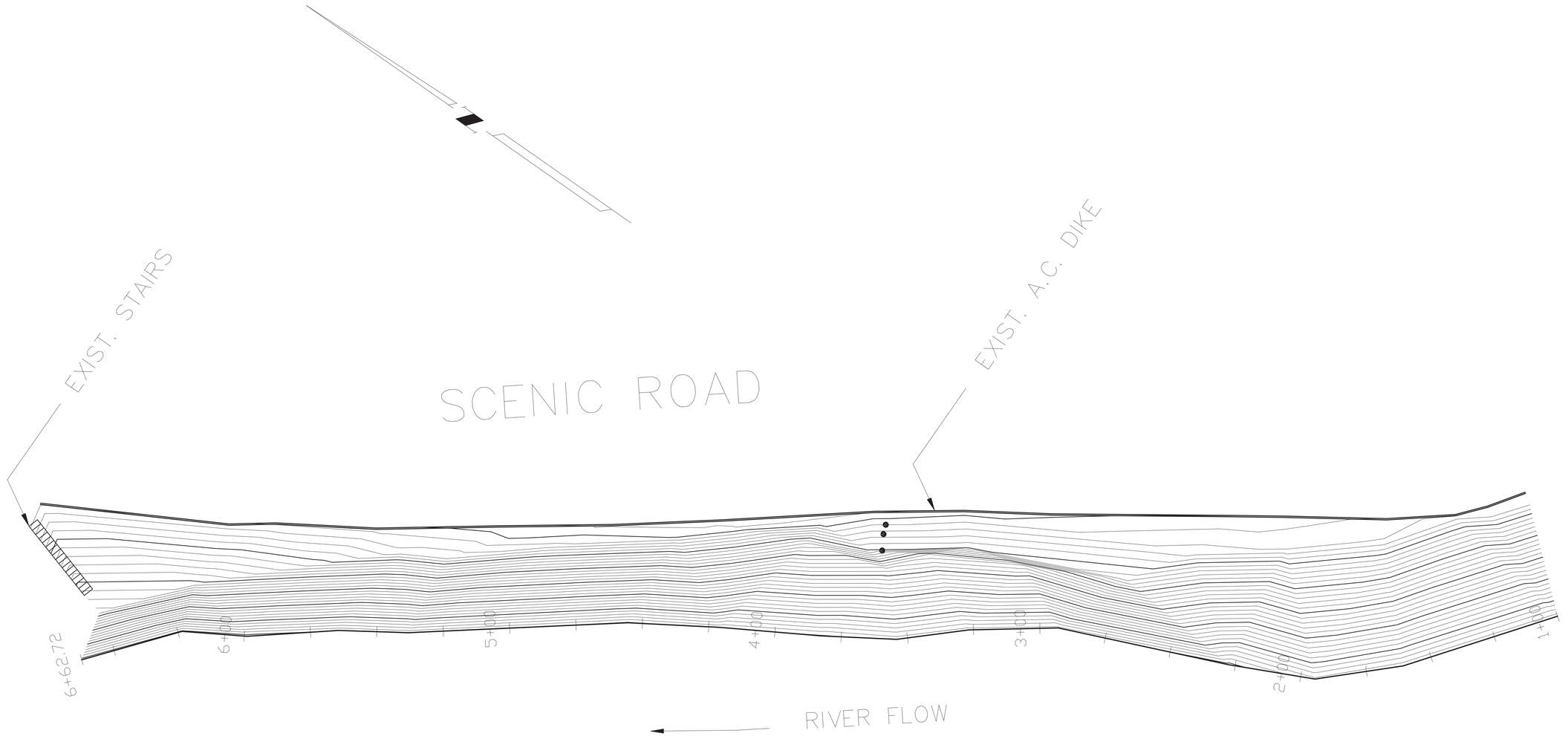
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
W.O.# 873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
12/03/04	C\Land Projects 2004\CRMO2004	1
SCALE	VIEW	OF
1"=60'	extopo120204.dwg	1

SHEET NUMBER	TOTAL SHEETS
1	3



SUBMITTED BY X. X. XXXXX

DESIGN BY X. X. XXXXX (PROJECT ENGINEER) | CHKD BY X. X.

DRAWN BY KAPEAKE | CHKD BY X. X.

SPECIFICATIONS WRITTEN BY X. X. XXXXX | CHKD BY X. X.

APPROVAL RECOMMENDED BY X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

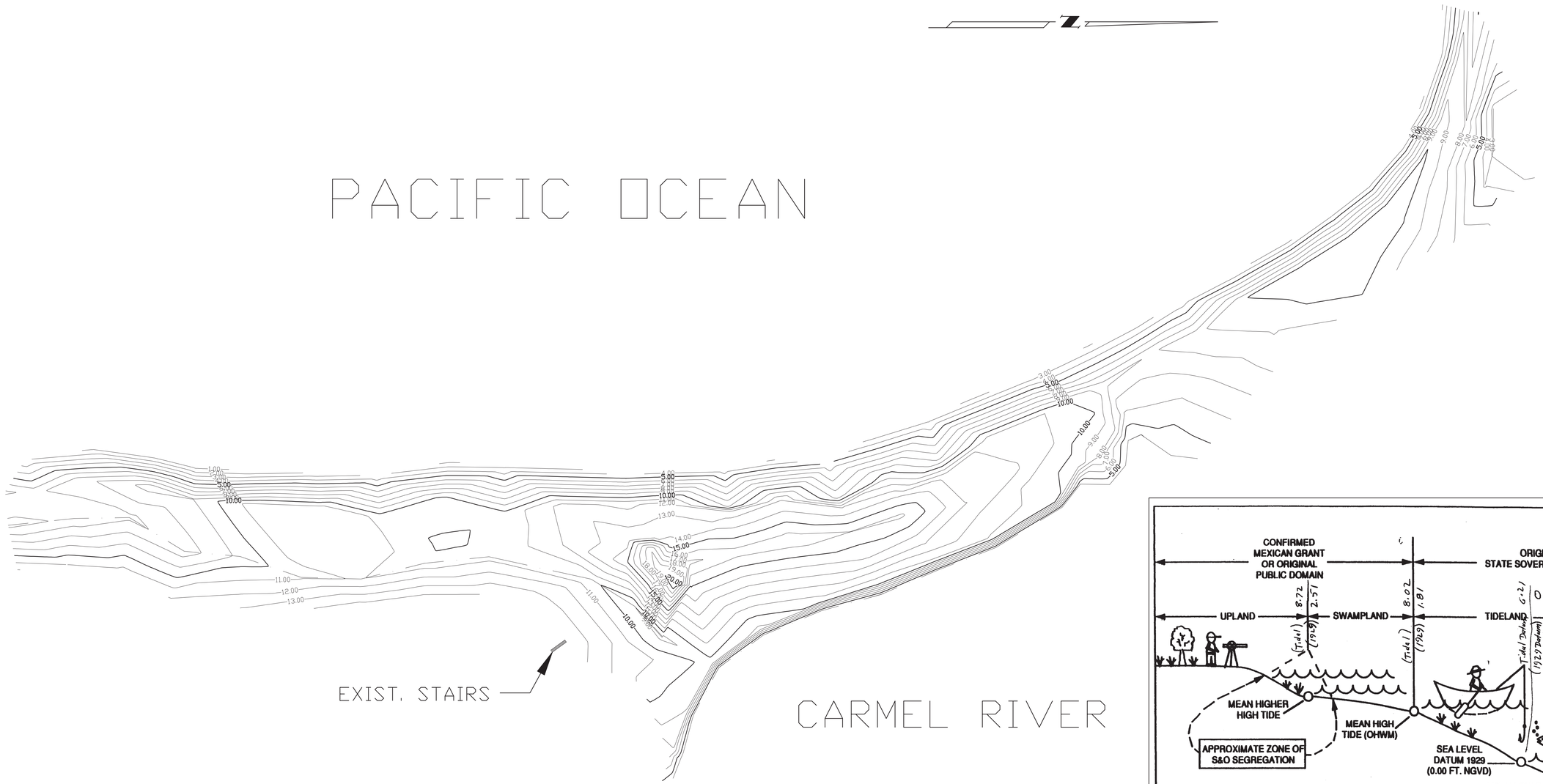
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

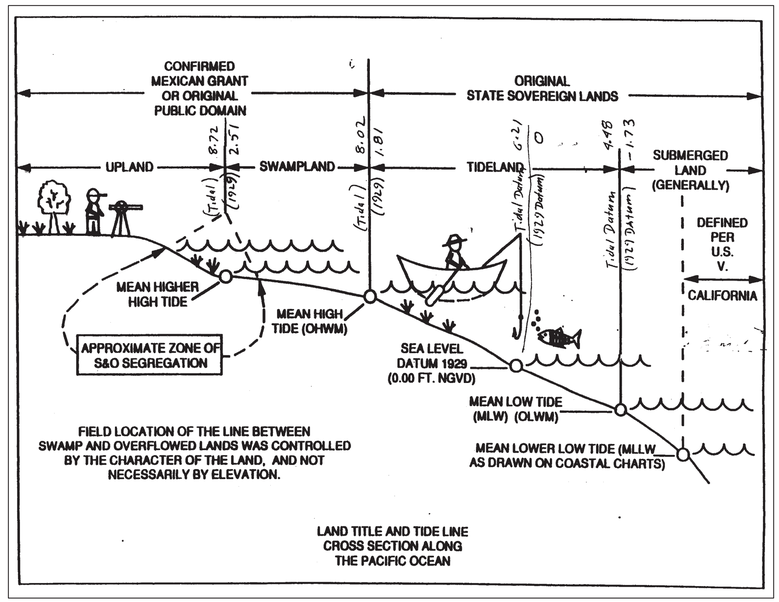
CARMEL RIVER MOUTH
EMERGENCY ROAD DAMAGE
W.O.# 520001

PLAN

DATE	DRAWING	SHEET
05/25/05	C\Land Projects 2005\CRMO2005	1
SCALE 1"=20'	VIEW CRMO052405.dwg	OF 3

SHEET NUMBER	TOTAL SHEETS
1	1





SUBMITTED BY	X. X. XXXXX
DESIGN BY (PROJECT ENGINEER)	X. X. XXXXX
CHKD BY	X. X.
DRAWN BY	K.A.PEAKE
CHKD BY	X. X.
SPECIFICATIONS WRITTEN BY	X. X. XXXXX
CHKD BY	X. X.
APPROVAL RECOMMENDED BY (ASSISTANT PUBLIC WORKS DIRECTOR)	X. X. XXXXX

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

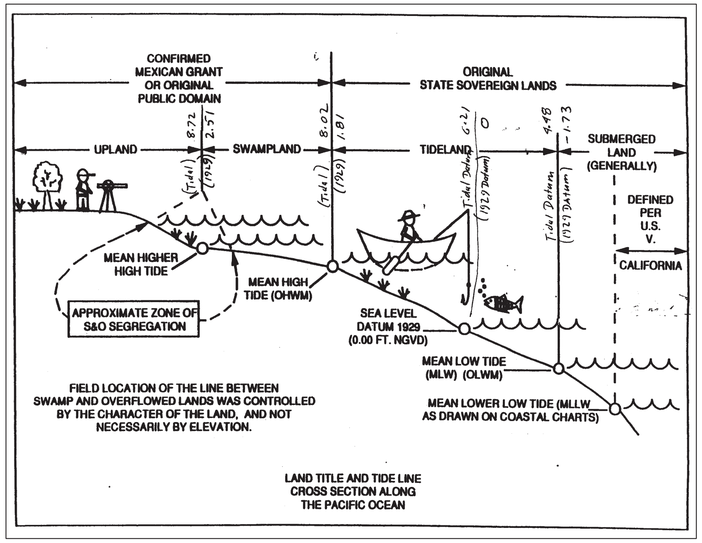
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
10/04/05	C:\Land Projects 2005\CRRM100405	1
SCALE 1"=80'	VIEW CRMO100405.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



LAND TITLE AND TIDE LINE
CROSS SECTION ALONG
THE PACIFIC OCEAN

SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX PROJECT ENGINEER	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

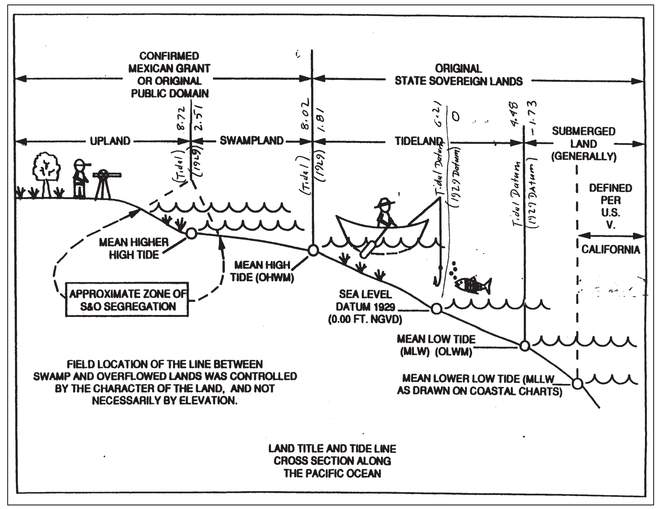
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

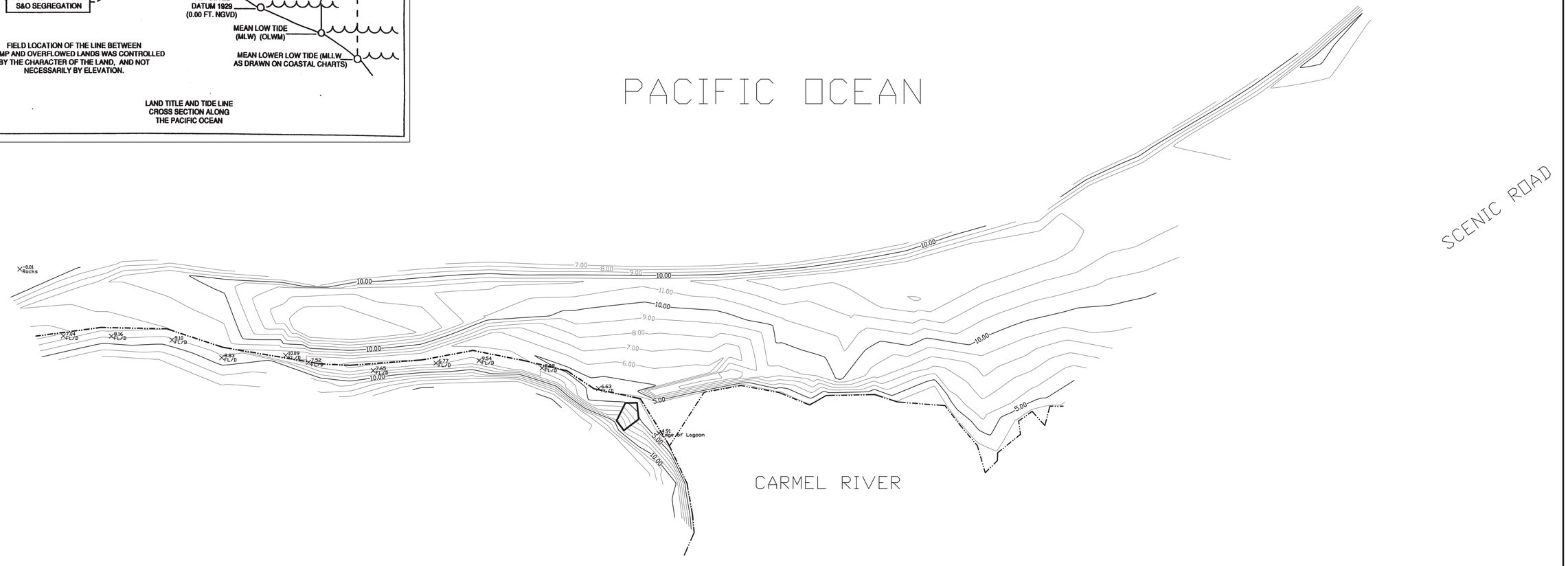
CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
04/18/06	C:\Land Projects 2005\CRM02006	1
SCALE 1"=60'	VIEW CRM0012606add041806.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1





SUBMITTED BY	X. X. XXXXX
DESIGN BY (PROJECT ENGINEER)	X. X. XXXXX
CHKD BY	X. X.
DRAWN BY	K.A.PEAKE
CHKD BY	X. X.
SPECIFICATIONS WRITTEN BY	X. X. XXXXX
CHKD BY	X. X.
APPROVAL RECOMMENDED BY (ASSISTANT PUBLIC WORKS DIRECTOR)	X. X. XXXXX

NO.	DATE	REVISION	APPROVED

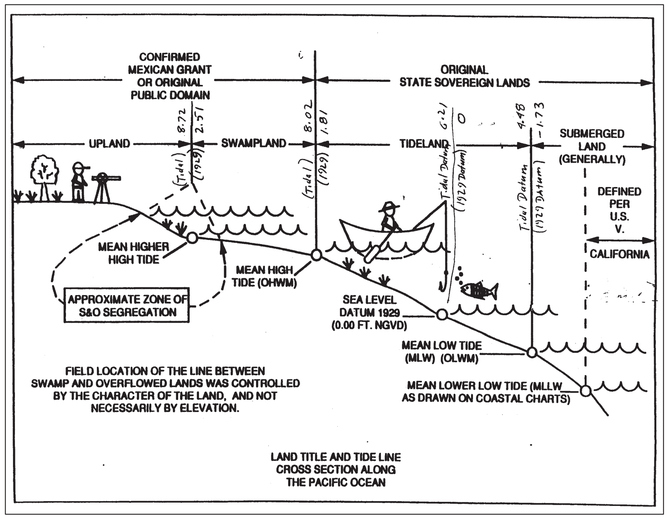
MONTEREY COUNTY PUBLIC WORKS
ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

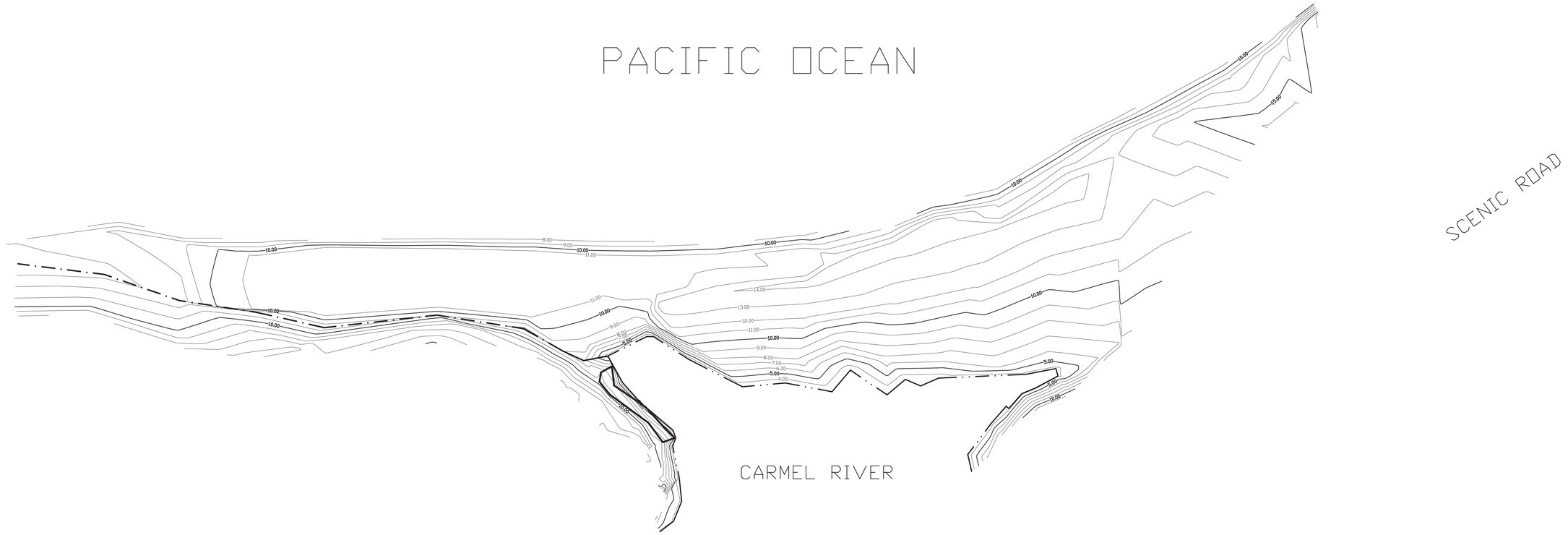
CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
11/20/06	C:\Land Projects 2005\CRM02007	1
SCALE 1"=80'	VIEW CRM0101206ADD112006.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1





SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX PROJECT ENGINEER	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

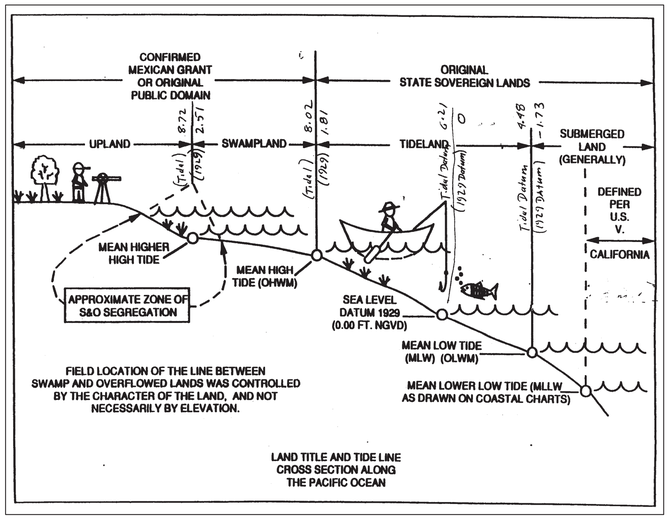
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

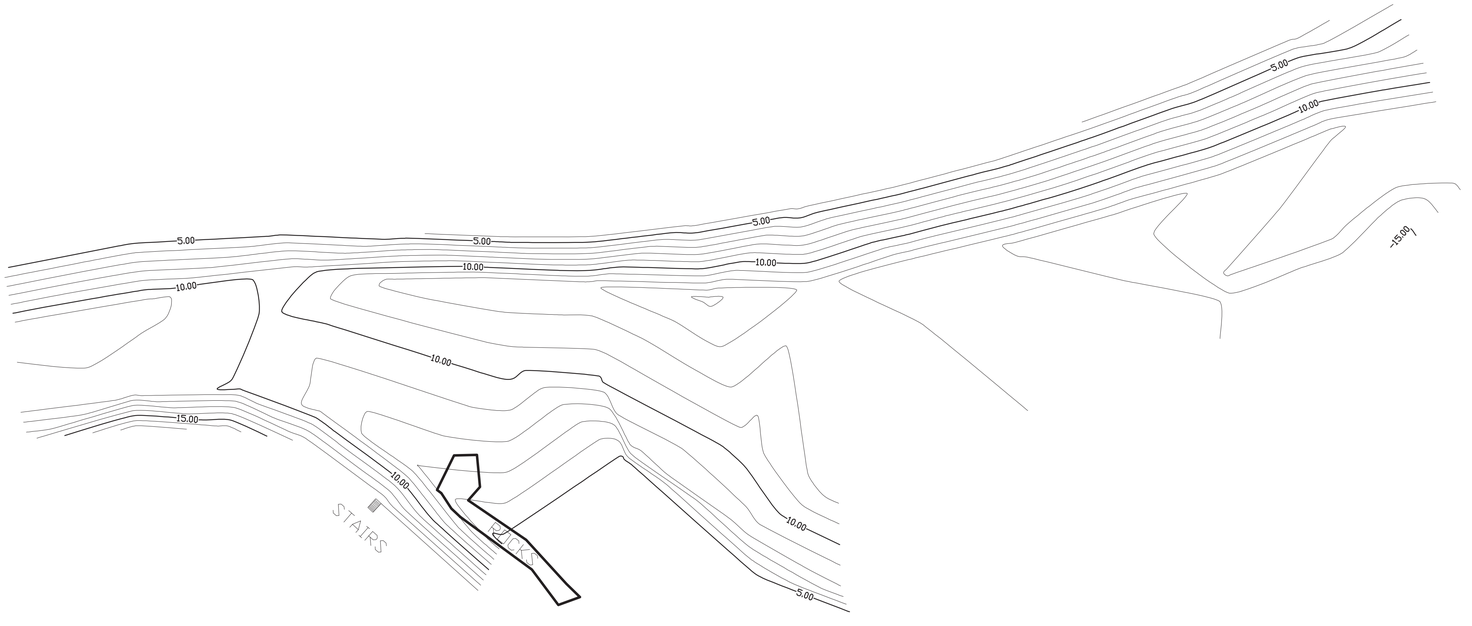
DATE	DRAWING	SHEET
10/02/07	C:\Land Projects 2005\CRM0100207\dwg	1
SCALE 1"=80'	VIEW CRM0100207.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



LAND TITLE AND TIDE LINE CROSS SECTION ALONG THE PACIFIC OCEAN

PACIFIC OCEAN



CARMEL RIVER

SCENIC ROAD

SUBMITTED BY . X. X. XXXXX			
DESIGN BY . X. X. XXXXX PROJECT ENGINEER	CHKD BY. X. X.		
DRAWN BY . K.A.PEAKE	CHKD BY. X. X.		
SPECIFICATIONS WRITTEN BY . X. X. XXXXX	CHKD BY. X. X.		
APPROVAL RECOMMENDED BY . X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

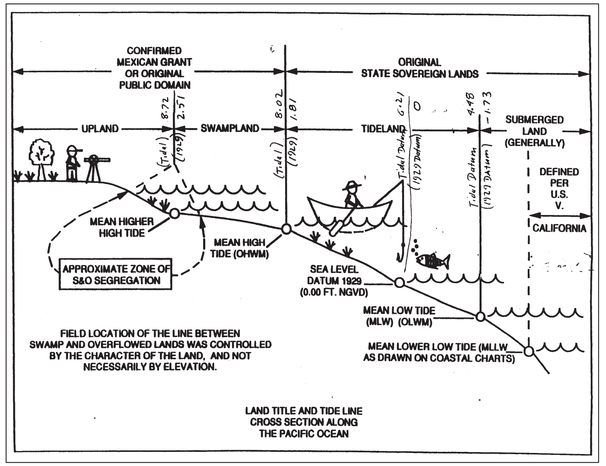
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

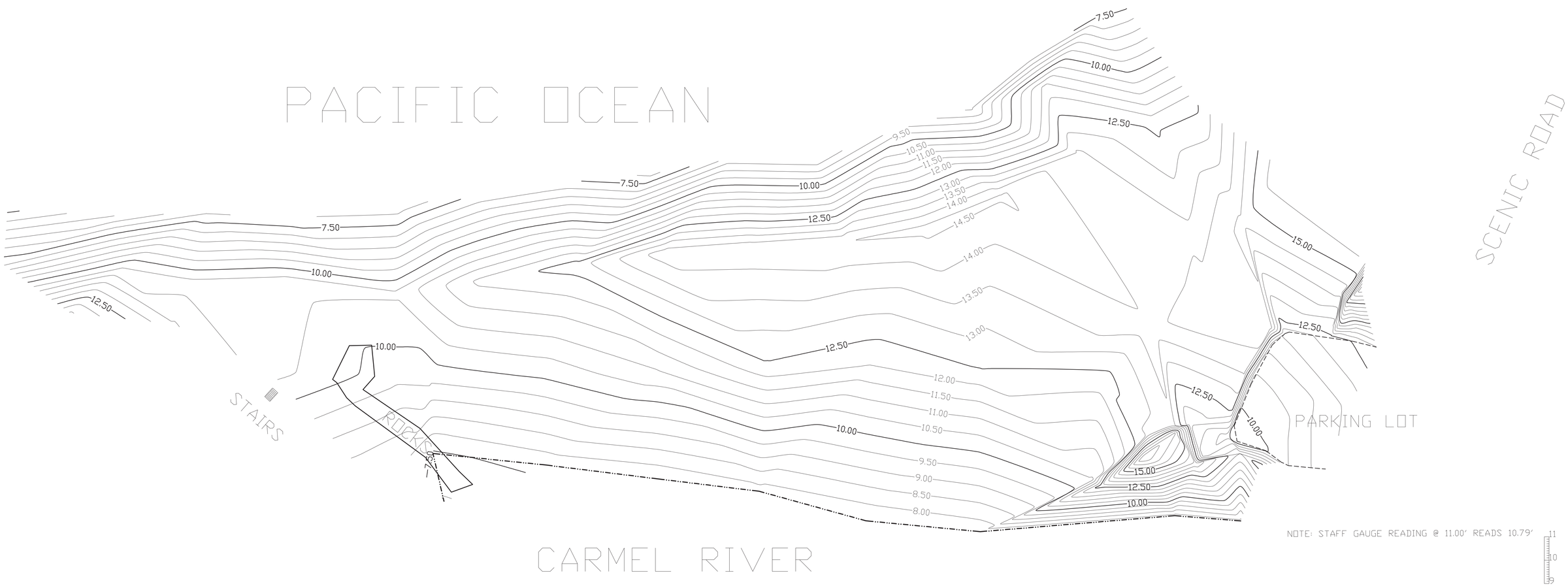
DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
10/30/08	C:\Land Projects 2008 \CRM103008	1
SCALE 1"=60'	VIEW CRM103008.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



LAND TITLE AND TIDE LINE
CROSS SECTION ALONG
THE PACIFIC OCEAN



NOTE: STAFF GAUGE READING @ 11.00' READS 10.79'

11
10
9

SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

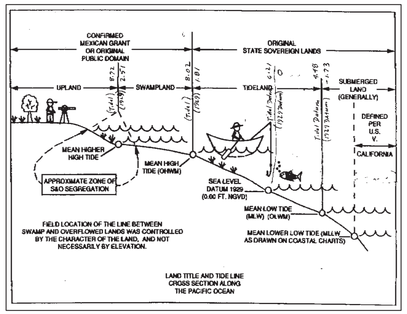
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

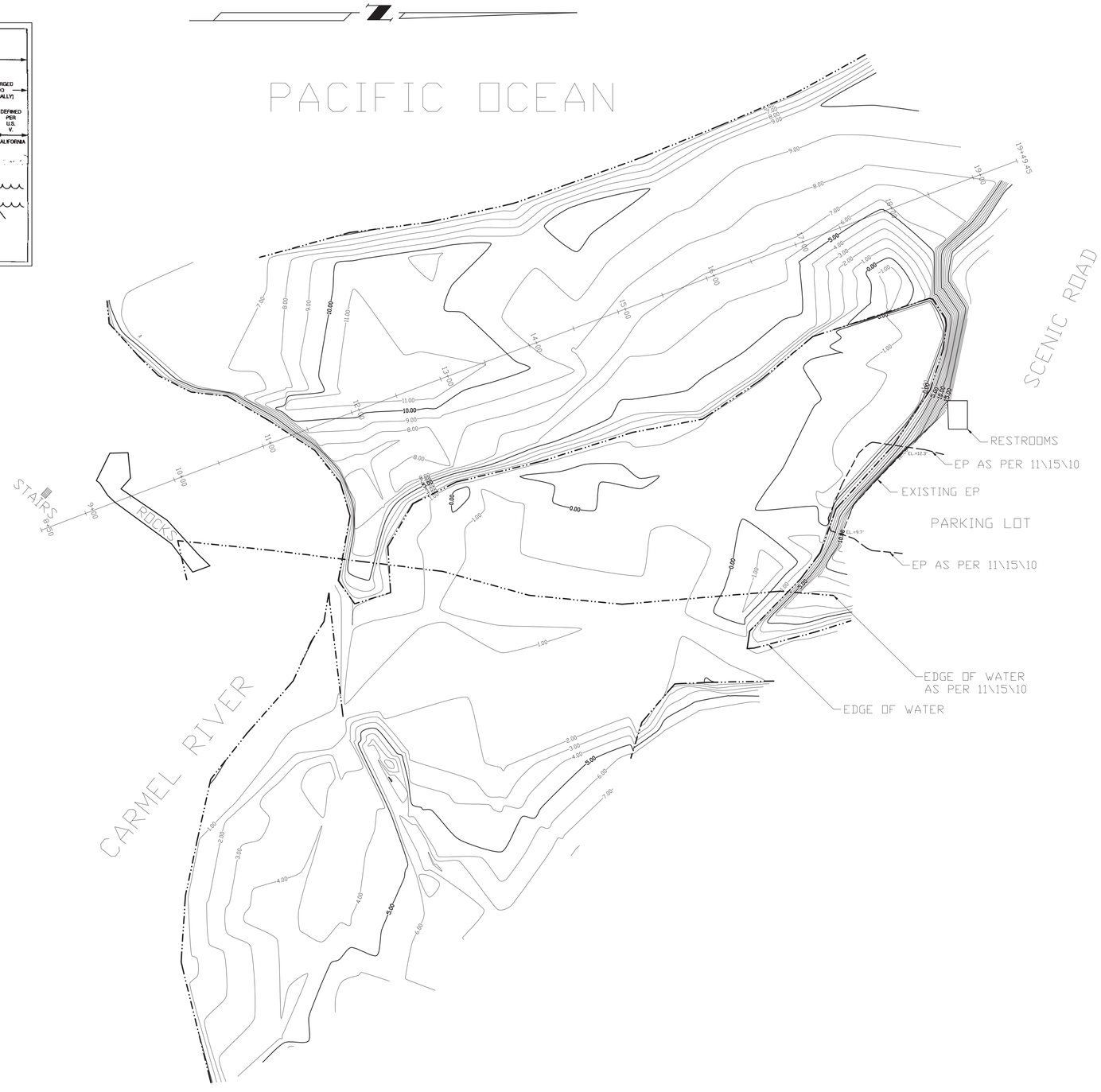
CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
11/15/10	C:\Land Projects 2008\CRM111510	1
SCALE 1"=40'	VIEW CRM111510.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	2





SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

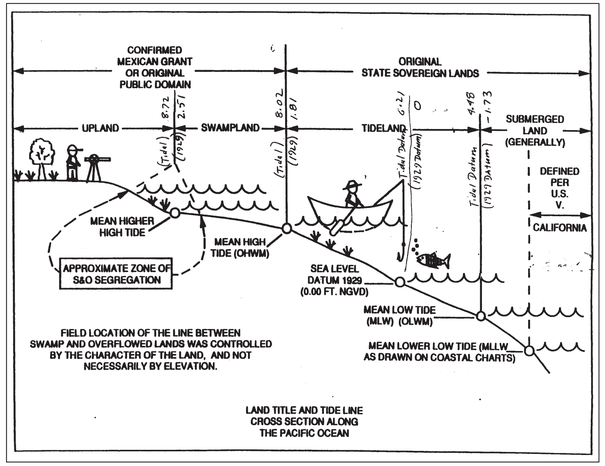
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
05\18\11	C:\Land Projects 2008\CRM0050611	1
SCALE 1"=60'	VIEW PLAN	OF 2

SHEET NUMBER	TOTAL SHEETS
1	2



LAND TITLE AND TIDE LINE
CROSS SECTION ALONG
THE PACIFIC OCEAN

SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX PROJECT ENGINEER	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

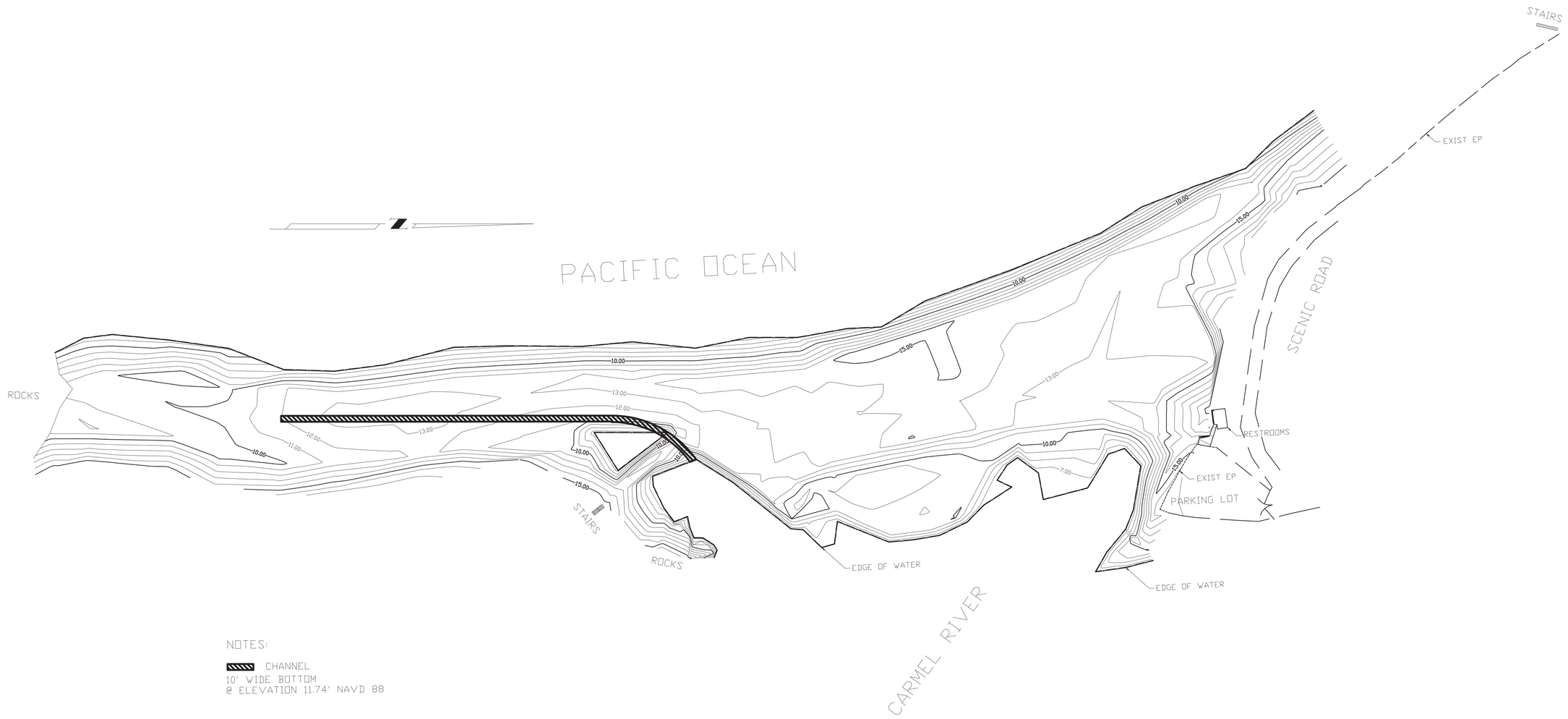
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
09\26\11	C:\Land Projects 2008\CRM092611	1
SCALE	VIEW	OF
1"=80'	extopo092611add050611survey	2

SHEET NUMBER	TOTAL SHEETS
1	1



NOTES:

CHANNEL
10' WIDE BOTTOM
@ ELEVATION 11.74' NAVD 88

SUBMITTED BY	X. X. XXXXX		
DESIGN BY	X. X. XXXXX (PROJECT ENGINEER)	CHKD BY	X. X.
DRAWN BY	K.A.PEAKE	CHKD BY	X. X.
SPECIFICATIONS WRITTEN BY	X. X. XXXXX	CHKD BY	X. X.
APPROVAL RECOMMENDED BY	X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)		

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NAVD 88...BM#2 @ CRSB EL=62.14'

DATE	DRAWING	SHEET
09/25/12	C:\Land Projects 2011\CRM0091212LDD11	1
SCALE 1"=80'	VIEW extopo091212revdatum092812	OF 1



The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report

Prepared for:

Monterey County Resource Management Agency

Prepared by:

Edward D. Ballman, P.E. and Anne E. Senter

January 2014

Balance Hydrologics, Inc.®

TABLE OF CONTENTS

1 INTRODUCTION **1**

1.1 Project Description *1*

1.2 Purpose and Objectives of this Report *2*

1.3 Literature Review *2*

2 NATURALLY FUNCTIONING LAGOONS ALONG THE CALIFORNIA COAST **3**

2.1 Natural Sand Barrier Breaching Behavior *3*

2.2 Natural Perched Lagoon Morphology *4*

2.3 Natural Closed Lagoon Conditions *4*

2.4 Natural Surface Water-GW Interactions *5*

2.5 Ecosystem Benefits of a Naturally Functional Lagoon *6*

3 IMPLICATIONS OF IMPAIRED LAGOON BEHAVIOR **8**

3.1 Impaired Sand Bar Breaching Behavior *8*

3.2 Impaired Lagoon Morphology during Open Conditions *9*

3.3 Impaired Conditions during Lagoon Closure *9*

3.4 Impaired GW-Surface Water Interactions *10*

3.5 Ecosystem Effects of an Impaired Lagoon *10*

4 IMPAIRED PROCESSES IN CARMEL LAGOON **12**

4.1 Deleterious Impacts Related to Artificial Sand Bar Breaching Behavior *16*

4.2 Impaired Conditions Related to Artificial Sand Bar Breaching Behavior *16*

4.3 Impaired Lagoon Morphology during Open Conditions *21*

4.4 Impaired Conditions at Lagoon Closure *25*

4.5 Impaired GW-Surface Water Interactions *28*

4.6 Impaired Conditions Related to Carmel Lagoon Ecosystem Health *30*

5 ANTICIPATED RESPONSE OF CARMEL LAGOON TO PROJECT IMPLEMENTATION **32**

5.1 Anticipated Sand Bar Dynamics without Artificial Breaching *33*

5.2 Anticipated Lagoon Morphology *34*

5.3 Anticipated Conditions at Lagoon Closure *34*

5.4 Anticipated GW-Surface Water Interactions *35*

5.5 Anticipated Ecosystem Effects *35*

6 REFERENCES **36**

TABLE OF TABLES

Table 1. Carmel Lagoon first seasonal breach of each year 18
Table 2. Carmel Lagoon breaching events and days open to ocean 22
Table 3. Carmel Lagoon water surface elevations and estuary surface areas pre- and post-breaching 25
Table 4. Carmel Lagoon final season closure dynamics 26
Table 5. Carmel Lagoon perched morphology dynamics 27

LIST OF FIGURES

Figure 1. Carmel Lagoon WSE and streamflow, WY2012 15

APPENDICES

Appendix A. Water surface elevations in Carmel Lagoon and streamflow in Carmel River at Highway 1 gage, WYs 1993-2012.

Appendix B. Compilation tables of riverine dynamics of breaches and closures, WYs 1993-2012.

1 INTRODUCTION

1.1 Project Description

Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sand bar Management Plan (ISMP) Project

The Carmel River Lagoon, located at the mouth of the Carmel River, is a very productive estuary which serves as rearing habitat for juvenile, federally listed South-Central California Coast steelhead. The Carmel River was designated as critical habitat for South-Central California Coast steelhead in September 2005. The ecosystem in and around the Carmel River Lagoon also supports other federally listed species such as the California red-legged frog, western snowy plover, and Smith's blue butterfly, and numerous other special-status species.

The Carmel River drains approximately 255 square miles of the Santa Lucia and Sierra de Salinas Mountains into the Carmel Bay. About 270 acres of the Carmel River Beach and Lagoon are owned by the State of California/California Department of Parks and Recreation (State Parks). Other property owners within the Lagoon include Carmel Area Wastewater District (16 acres), Carmel Unified School District (9 acres), City of Carmel-by-the-Sea (6 acres), and Homestead Inn/Mission Ranch (16 acres). Public and private stakeholders have worked together over the past decade to identify best management practices that would maintain the Carmel Lagoon in a more natural state (MPWMD, 2007).

The Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sand bar Management Plan (ISMP) Project (hereafter referred to as Project) is a comprehensive plan meant to promote improvement in ecological function of the Carmel Lagoon, including natural floodplain function and improvement of habitat for threatened and endangered species within the existing lagoon. The goal is to allow the lagoon to breach naturally, without increasing flood risk to private structures and public facilities. The EPB would provide protection from flooding to low-lying homes and other local Carmel-by-the-Sea infrastructure along the north edge of the Lagoon. The SRPS would provide protection along the northern sand cliffs from erosion associated with lagoon-ocean processes that might occur if sand bar management were to cease. The ISMP is an interim sand bar management plan meant to provide a short-term solution to potential flooding issues with select sand bar breaching actions that allow additional natural function in the lagoon while still protecting properties and infrastructure, with the understanding that the development

of the EPB and SRPS lead to potential long-term solutions that return the Lagoon, its sand bar, and associated riverine and ocean dynamics to more natural cycles.

1.2 Purpose and Objectives of this Report

The main objective of this report is to summarize both natural and impaired processes associated with the Carmel River Lagoon ecosystem from a riverine perspective. To do so, we present a descriptive hydrologic characterization of (1) how lagoon systems function naturally in Coastal California, (2) how current and past management practices impair Coastal California lagoon systems, (3) a quantitative and qualitative assessment of recent Carmel Lagoon function, and (4) an assessment of how implementation of the Project will work to restore more-natural functions in Carmel Lagoon. The term lagoon will be used in this report to represent both lagoonal and estuarine functions (i.e., systems closed and open to the ocean, respectively). Quantitative measures will be identified where possible to supplement qualitative findings from this and other lagoon systems.

1.3 Literature Review

Existing literature was reviewed to understand how naturally functioning lagoon systems along Coastal California promote healthy ecosystems for aquatic species, including steelhead. Further literature review revealed information on how management practices can negatively affected lagoon habitat.

2 NATURALLY FUNCTIONING LAGOONS ALONG THE CALIFORNIA COAST

Lagoons found along Coastal California have unique qualities with respect to semi-arid Mediterranean climate conditions, geologically active tectonics, relatively small watershed areas, and riverine processes associated with frequency and duration of lagoon openings and closures (Jacobs, et al., 2011). Streamflow plays a critical role via seasonal and episodic variability in the temporal pattern of lagoon openings and closures, and thus has a large effect on specific geomorphic and environmental conditions such as sand bar breaching behavior, lagoon morphology during open and closed conditions, groundwater-surface water interactions, and habitat quality. Such conditions are key drivers in the ability of aquatic and terrestrial species to successfully survive and thrive within this environment.

2.1 Natural Sand Barrier Breaching Behavior

The dynamics associated with a natural sand bar breach depend on the morphology of the sand bar itself, river discharge, and wave dynamics (Smith, 1990). In a naturally functioning lagoon ecosystem on the California coast, sand bar breaching occurs during the winter rainy season. Streamflows increase as rains begin. Depending on the watershed and precipitation patterns, flows may fill the lagoon to the point where riverine forces overcome sand bar stability and an outflow channel breach is created that releases impounded waters into the ocean.

Sand bar breaching can occur via an accumulation of low flows or from an abruptly larger flood flow. The outflow channel, once open, additionally provides a route for tidal flows to enter the lagoon. The morphology and elevation of the outflow channel to the ocean are important factors in the availability of lagoon habitat (NMFS, 2008; Alley, 2013), while water surface elevation (WSE), volume and depth of the lagoon are functions of streamflow as well as tidal fluctuations and ocean swells.

When low flows fill a lagoon to its full volume and then breach the sand bar, a sinuous outflow channel can develop, creating a pathway based on beach slope, sediment size, and longshore wave patterns (Smith, 1990; Thornton, 2005). Large flow events on the other hand, may create a breach at a point perpendicular to the bar resulting in a shorter and more direct outlet to the sea. But once a flood flow diminishes, it is likely that the outlet will migrate toward a pathway based on beach slope, sediment size, and longshore wave patterns.

2.2 Natural Perched Lagoon Morphology

Perched lagoon morphology is defined by NMFS (2008) as a lagoon with a WSE above mean high tide, and can refer to fresh water lagoons with closed sand bars as well as to lagoons where fresh water flows out to the ocean over the sand bar at the lagoon's mouth. Summer wave action that tends to deposit sand onto beaches helps build up beach berms (Jacobs et al., 2011). This elevational increase can create perched lagoon morphology by formation of a high berm combined with an outflow channel that provides the greatest ratio of fresh water to saline water during open-bar dynamics, as well as providing the highest lagoon WSE upon closure.

2.3 Natural Closed Lagoon Conditions

In Coastal California environments, with their associated dry-Mediterranean summers, streamflow generally decreases through the spring and into the summer months. As flow recedes, riverine processes are progressively less able to overcome the opposing ocean forces driving sand up and onto the bar. Eventually, this leads to the seasonal closure of the barrier bar at a point when river and any (generally small) groundwater (GW) inflows to the lagoon system are not sufficient enough to maintain an open outflow channel. The WSE associated with the final lagoon closure of the year is related to the morphology of the lagoon and whether the outlet channel is in a perched or non-perched state. When the outflow channel is perched (i.e. at a higher elevation and in an advantageous position that maximizes fresh water lagoon habitat), the initial WSE will be higher, thus accumulating an increasingly higher ratio of fresh water to brackish water while river discharge continues.

Because tidal exchange occurs until a sand bar closes, saline waters are generally present within the lagoon at closing. Salt water is denser than fresh water and thus tends to stratify into the lower layers of a lagoon. Conversion from highly saline conditions to more fresh water conditions occurs when fresh water river discharge forces salt waters against the inland side of the closed sand bar (Coates and Guo, 2003; NMFS, 2008). Because of stratification, a forcing mechanism exists at the boundary between the two layers. The upper wedge of fresh water pushes the salt water wedge against the porous sand bar. If there are enough fresh water flows, three processes can occur: entrainment, which carries a mixture of fresh water and salt water into the ocean if a shallow or intermittent channel remains open to the ocean; mixing, which de-stratifies the lagoon and blends the stratified layers together, moderating salinity values; and seepage of salt water through the permeable sand bar and out of the lagoon (Smith, 1990; Debler and Imberger, 1996; NMFS, 2008; Zhang et al, 2008). All of these processes can play a role in the conversion of a lagoon to fresh water. The

conversion can take more than a month after sand bar closure (Smith, 1990), and generally depends on continuation of fresh water flows into the lagoon.

An additional element in these complex systems is that of ocean waters entering the lagoon while the sand bar is closed. This occurs primarily through wave overtopping, but also through seepage into the lagoon through the sand bar—seepage can occur in either direction and is mainly a function of tides (Watson and Casagrande, 2004). Seepage out of the lagoon may happen when tides are out, while seepage into the lagoon may happen when tides bring waves onto the beach and against the sand bar.

Overtopping is a function of wave energy. Higher energy waves crash onto a sand bar and overtop it, adding small to large volumetric quantities of salt water to the lagoon (Thornton, 2005; Moffatt and Nichols, 2013). Along the California coast, wave energy decreases in the late spring and summer and increases in the fall and winter. The addition of salt water into the lagoon in late summer/early fall while the lagoon remains closed increases WSEs and salinity values in the lagoon, generally lowering water quality shortly before rains begin to contribute streamflows, which then provide relief with better water quality (Hayes et al., 2011).

2.4 Natural Surface Water-GW Interactions

Once a coastal lagoon is in a closed configuration, WSEs and water quality are governed by a balance of outflows (seepage through the bar and evaporation), the aforementioned salt water inflows, and fresh water inflows (stream baseflow and GW inflows).

With the degree of variability in Mediterranean climate conditions in California, most lagoon systems experience some degree of closure under natural conditions (Jacobs et al., 2011). From a fresh water fisheries perspective, ideal summer conditions would occur when waters of a closed lagoon system convert to fresh water before streamflows stop, be it in late spring or over the summer, depending on flow persistence. When streamflows cease, GW inflows from the local aquifer become the single source of additional fresh water influxes into the lagoon system, and must partially counteract evaporation rates and barrier bar seepage rates, at least to some degree, if fresh water conditions are to be maintained over the course of lagoon closure.

GW aquifer storage levels are predicated on antecedent hydrologic conditions of the previous and current year, and potentially over a longer time frame following drought conditions or excessive GW pumping. In a best-case scenario, there would be no GW

pumping or instream diversions, and aquifer storage capacities would be at potential maximums depending on precipitation and runoff. In many Coastal California settings, GW storage has been greatly reduced by mechanical pumping of water for agriculture and municipal uses. At the bottom of a coastal watershed, salt water and fresh water 'compete', such that salt water can encroach landward into fresh water aquifers. When fresh water aquifers are full enough, gradients that push seaward generally keep salt water intrusions from encroaching into fresh GW supplies (Jacobs et al., 2011). When excessive GW pumping creates over-drafting of the aquifer, a fresh water gradient reversal can occur, and seawater intrusions can infiltrate into local coastal water supplies. Such dynamics are of great concern to coastal communities (e.g. Johnson, 2007). GW inflows into lagoons become important particularly once surface flows cease for the summer, and are the only counteractive to evapotranspiration in terms of fresh water inflows.

Persistent GW seepage likely occurred in lagoons along the coast prior to GW extractions and continues today in some systems, potentially providing fresh water supplies for good quality habitat during yearly lagoon closures. Pumping likely has reduced GW contributions to lagoon ecosystems, depending on local conditions (PWA, 2007). A comparison of two instances showed that a GW gradient indicating a small but valuable GW input rate relative to the potentially progressive decline in water quality through the dry summer months has been found in Carmel Lagoon (Larson et al., 2006), while numerous springs and seeps in the vicinity of Elkhorn Slough have disappeared since the 1940's, likely due to GW pumping (Van Dyke and Wasson, 2005).

2.5 Ecosystem Benefits of a Naturally Functional Lagoon

Naturally functioning lagoon ecosystems provide myriad, year-round benefits to aquatic and terrestrial species, including high habitat diversity, abundant invertebrate food sources, and refugia from predators and other environmental stressors (Cannatta, 1998). Steelhead thrive in conditions where abundant invertebrates are found (Larson et al., 2005). Tolerance capability of invertebrates to salinity provides a good indicator of the ability of the system to support good rearing habitat for steelhead (NMFS, 2008; pers. comm. J. Pearson-Meyer, 2013).

In California when lagoons are opened in the winter season by river discharge, full mixing of fresh water and salt water can provide opportunities for fish to thrive (Smith, 1990). When lagoons close at the beginning of the dry season, river discharge generally is still flowing at low rates, in which case with enough end-of-season inflow the lagoon can naturally convert from stratified saline conditions to fresh water conditions. In fresh water conditions, studies have shown that steelhead smolts have a higher survival rate

and greater growth rates (Smith, 1990) as well as greater densities in lagoon systems (NMFS, 2008, Table 12). Steelhead smolt growth rates in Scott Creek Lagoon, California were higher than those rearing in the upper watershed, leading to conclusions that lagoon habitat conditions that promoted steelhead growth and survival were strong predictors of ocean survival (Hayes et al., 2008; Bond et al., 2008).

3 IMPLICATIONS OF IMPAIRED LAGOON BEHAVIOR

Lagoon ecosystems found along Coastal California have experienced high degrees of modification due to human interactions. Development of towns and cities and associated infrastructure has had multiple negative effects on these ecosystems (Van Dyke and Wasson, 2005). Impaired lagoon/estuarine ecosystems are not able to provide the full range of benefits to aquatic and terrestrial species that are required for healthy ecosystem function. Modifications leading to impaired lagoon ecosystem function include: alteration of the natural cyclical opening and closure of the lagoon by breaching and closing the sand bar artificially; encroachment onto the lagoon floodplain via infill, built structures, and agricultural uses; channelization of the river; diversions of streamflow; GW pumping; and loss of sediment supply via hardening of channel banks and damming.

Although each modification could be discussed in depth, this chapter will focus on alteration of the natural cyclical opening and closure of the lagoon by breaching and closing the sand bar artificially. The negative impacts associated with manipulation of natural barrier bar processes can propagate through each water year and potentially beyond, producing negative effects to bar morphology, sediment transport, water quality, and water volume in the coastal lagoons.

3.1 Impaired Sand Bar Breaching Behavior

Artificial barrier bar breaching can negatively affect lagoon health by promoting formation of a wide and deep outflow channel that removes large quantities of sand from the beach. This can cause fresh water to flush from a lagoon into the ocean prematurely and at a rapid rate, likely opening the lagoon earlier than if a natural breaching regime were in place. Once fresh water has been flushed, the often deep and direct outlet channel allows large quantities of seawater into the lagoon, which results in an abrupt increase in salinity levels that may not be tolerated by aquatic organisms, particularly juvenile fish.

Salinity gradients drive other water quality parameters such as temperature and dissolved oxygen. When salinity concentrations are high, lagoons stratify and the saline layer sinks to the bottom. Dissolved oxygen concentrations decrease, and high salinity promotes heat absorption, raising temperatures (NMFS, 2008). In Pescadero Creek, artificial sand bar breaching has led to steelhead die-offs, likely caused by very low dissolved oxygen concentrations (Smith, 1990; Sloan, 2006). Increased salinity can drive fish into shallower waters, exposing them to increased predation and potential

stranding, forcing out-migration of fish before they are ready for the ocean environment, and decreasing productive lagoon habitat (Smith, 1990; NMFS, 2008).

3.2 Impaired Lagoon Morphology during Open Conditions

Since wave action continually moves sand onto and off of beaches, and streamflows may not be large enough to keep a breach open, there are instances where artificial breaching is performed multiple times a year in order to promote an open lagoon condition (Smith, 1990; e.g. MPWMD, 2013). This intermittent disruption of lagoon waters suggests that what should be equilibrium conditions within the lagoon prior to natural opening are instead punctuated with large spikes of abruptly changing water quality. Eventually, streamflows may be large enough to keep an outlet channel open, yet if the channel has been artificially placed, it is unknown where a natural channel would have formed, where it potentially would have moved to, or what geometry such channels would have had in the case where natural breaching occurred.

When artificial breaches are cut across a beach directly perpendicular to the river mouth, this practice could affect any further evolving morphology of the outflow channel and the remaining beach berm. This action could propagate through the year, leading to a situation where the outflow channel is at a low elevation and ocean water tidal flows are able to move freely into and out of the lagoon. Fresh waters that form a lens on top of saline waters could then be carried out to sea when tides recede. This process could continue throughout the yearly open cycle until the sand bar closes for the summer (J. Pearson-Meyers, pers. comm., 2013).

3.3 Impaired Conditions during Lagoon Closure

Salinity measures provide strong evidence of whether a lagoon has converted to fresh water after bar closure. If the outflow channel geometry brought about by artificial sand bar breaching is wide and deep, fresh water accumulating in the lagoon is largely flushed with each tidal cycle, precluding the ability of the lagoon to retain high quality aquatic habitat. This flushing occurs because fresh water is less dense than salt water, so if the outlet elevation is low, more of the stratified fresh water lens is preferentially removed. Atkinson (2010) found that artificial breaching in the San Gregorio Lagoon consistently raised salinity values at sampling stations.

If streamflows are low at lagoon closure, high salinity concentrations can create very poor quality habitat conditions very quickly, which can lead to fish die-offs (Sloan, 2006). Persistent flows are needed over a long enough period of time to convert the lagoon to relatively fresh water after seasonal closure. However, when beginning at a deficit compared to what natural conditions might provide conversion of the lagoon to

a relatively fresh water condition may not be possible depending on a particular water year's streamflow condition and how long low flows persist upon closure.

Additional salinity impacts can emerge due to preferential evaporation of the fresh water lens and wave overtopping events, which occur regularly in fall and winter months along the California coast. GW becomes the only potential fresh water source once streamflows cease, a source that may be muted depending on local consumptive use and GW extraction practices. If so, an impaired GW condition can potentially magnify water quality impacts associated with outflow channel geometry brought about by artificial sand bar breaching.

3.4 Impaired GW-Surface Water Interactions

Lagoon WSEs are controlled by a number of factors when the barrier bar is closed including timing of riverine flow cessation, initial WSE at closure, GW supply in aquifer storage at the beginning of each dry-summer season, anticipated regional GW pumping, the hydraulic gradient of the GW aquifer and its relationship to sea level, through-bar seepage rates, and evaporation.

Lagoon WSE at the time of seasonal closure can have a direct effect on potential GW inflows, due to hydraulic gradient conditions at the coast between infiltrating seawater and fresh water aquifer storage (Johnson, 2007). If seawater intrusions are occurring, there is little chance that fresh water GW will be able to percolate out of the substrate. Lagoon stage and GW levels have been shown to have a strong correlation, as reported via Feeney (2002) in Watson and Casagrande (2004).

GW pumping can have negative effects on the overall watershed flow regime. These effects may manifest as early cessation of streamflows in early summer. A consequence may be diminished GW gradients, resulting in a reduction in GW flow into coastal lagoons if GW elevations were impaired by pumping. These considerations show that high WSE at lagoon closure is important because GW flows may not be consistent enough or of sufficient volume to help maintain lagoon water quality through a dry season.

3.5 Ecosystem Effects of an Impaired Lagoon

Artificial breaching at the beginning of the rainy season results in significant habitat losses that can reduce lagoon volume and area by as much as 80 percent of pre-breach values (Whitson, 2013). Depending on streamflow volume and breach timing, artificial breaching can occur hours to weeks prior to natural breaching. In all cases where artificial breaching occurs, aquatic habitat conditions are negatively affected. If

an artificial breach creates high rates of lagoon emptying, juvenile steelhead can be pushed into the ocean prematurely (Allen, 2013). Smith (1990) found that after artificial breaching, some steelhead were flushed from lagoons but some also remained; differences in lagoon morphology and topography may play a role in the ability of fish to find refugia under these circumstances.

In San Gregorio Lagoon, California, a sampling program showed that water quality declined when the barrier bar was breached repeatedly in the summer, preventing maintenance of the lagoon as a body of relatively fresh water. Survival rates declined; seining found reduced numbers of steelhead from early summer to late fall, and dead threespine stickleback fishes were found stranded in dewatered sections of the lagoon (Atkinson, 2010).

In a study covering water quality and habitat conditions in lagoon ecosystems along California's Central Coast, Smith (1990) concluded that the two most important management recommendations to promote high degrees of water and habitat quality were: (1) to pay close attention to the amount of streamflow diverted from the system, as a decrease in flows impacts the ability of lagoons to convert to fresh water conditions during the summer dry months, and (2) noted that in the case of the lagoon systems under study, Pescadero Creek, San Gregorio Creek, and Waddell Creek, artificial opening of the lagoons severely altered habitat conditions, adversely affecting steelhead abundance and growth rates.

This brief review of a small number of concepts and case studies is but an indication of the damage that has occurred in lagoon ecosystems due to modification and alteration of dynamic natural ecosystem regimes.

4 IMPAIRED PROCESSES IN CARMEL LAGOON

Having gained an appreciation of natural and impaired processes associated with Coastal California lagoons, a focused examination is now needed to understand how the Carmel River Lagoon ecosystem has been impacted by various management actions. Many studies have been conducted over the past 10 to 20 years to better grasp ecological conditions in the Carmel River watershed and the Carmel Lagoon (e.g. Watson et al., 2001; Watson and Casagrande, 2004; James, 2005; Thornton, 2005; Urquhart, 2013). Studies have been initiated in part by the Water Allocation Program Final Environmental Impact Report, prepared in 1990 for the Monterey Peninsula Water Management District (MPWMD), by subsequent California Environmental Quality Act monitoring requirements, which sought to insure compliance with mitigation measures (MPWMD, 2013), by the Caltrans mitigation bank project in 1997 that excavated the South Arm of the lagoon, and in order to document the Carmel River Lagoon Enhancement Project that excavate the South Arm an additional 3,000 feet toward Highway 1 in what is called the Odello West area (James, 2005).

The Carmel River Watershed has large variations in seasonal and yearly discharge rates, brought about in large part by the unique nature of the coastal California geographic location within a Mediterranean climate zone, as well as by the size, vertical extent, geology, and geomorphic structure of the watershed. Carmel Lagoon, located at the bottom of the watershed, serves as an ecological interface zone between the watershed and the ocean. The Lagoon is generally not connected to the ocean during times of very low or zero streamflow, when ocean waves build a barrier beach (sand bar) across the mouth of the lagoon and close the outflow channel. When river inflow is relatively low and the Lagoon is not open to the ocean, a dynamic equilibrium is reached between streamflow and groundwater inflows, outflow through the barrier beach, evapotranspiration, and ocean wave overtopping. In summer this leads to lower WSEs and in the fall prior to opening, abrupt increases in WSE can occur due to overtopping. As streamflows increase in the fall and early winter, Lagoon WSEs can rise to flood stage depending on precipitation patterns. When flooding does occur, infrastructure along the northern edge of the lagoon and within the Lagoon floodplain, are threatened before the sand bar would typically open naturally.

In response to the flooding scenario, since at least the early 20th century the sand bar has been mechanically managed (breached) in order to lower WSEs to below flood stage. Since 1973, emergency sand bar management has been carried out by the County of Monterey (County), Monterey County Water Resources Agency (MCWRA), and State Parks. On average in recent years, at least one artificial breach has occurred yearly, with as many as three or four management breaching actions occurring in some

years. When the annual rainy season ends and the sand bar may have not yet closed off naturally, the decision may be made to mechanically close the sand bar before streamflows subside entirely, in order to maximize the volume of water in the lagoon for the dry season. This practice seeks to mitigate early-season artificial breaches that opened the Lagoon and promoted deeper, wider outflow channels than might otherwise have formed.

Following the designation of the Carmel Lagoon as critical habitat for South-Central California Coast steelhead in 2005, concern has grown about adverse impacts in Carmel Lagoon associated with artificial breaching activities that, while serving to protect local infrastructure, also dramatically alter natural ecosystem functions in the lagoon. The National Marine Fisheries Service (NMFS) suggested a northerly sand barrier breach in winter 2005, as this pathway is known to maintain a higher WSE in the lagoon, thus providing better habitat (MPWMD, 2007). The northerly outflow channel was considered a success in that WSEs in the Lagoon were maintained at a higher elevation at high river flows that reached upwards of 5,000 cfs. An unintended consequence of the northerly outlet path was that erosion occurred along the toe of the local bluff, potentially threatening homes and the Scenic Road in Carmel-by-the-Sea. The erosion of the bluff likely occurred because of the confluence of high flood flows and ocean wave activity creating waves 22 to 26 feet in elevation. The bluffs experienced sloughing once the waves receded. A similar event occurred in 2008 when the outlet channel was directed to the south. In that case, the northern bluffs were eroded in a similar fashion independent of flood flows and outlet channel position.

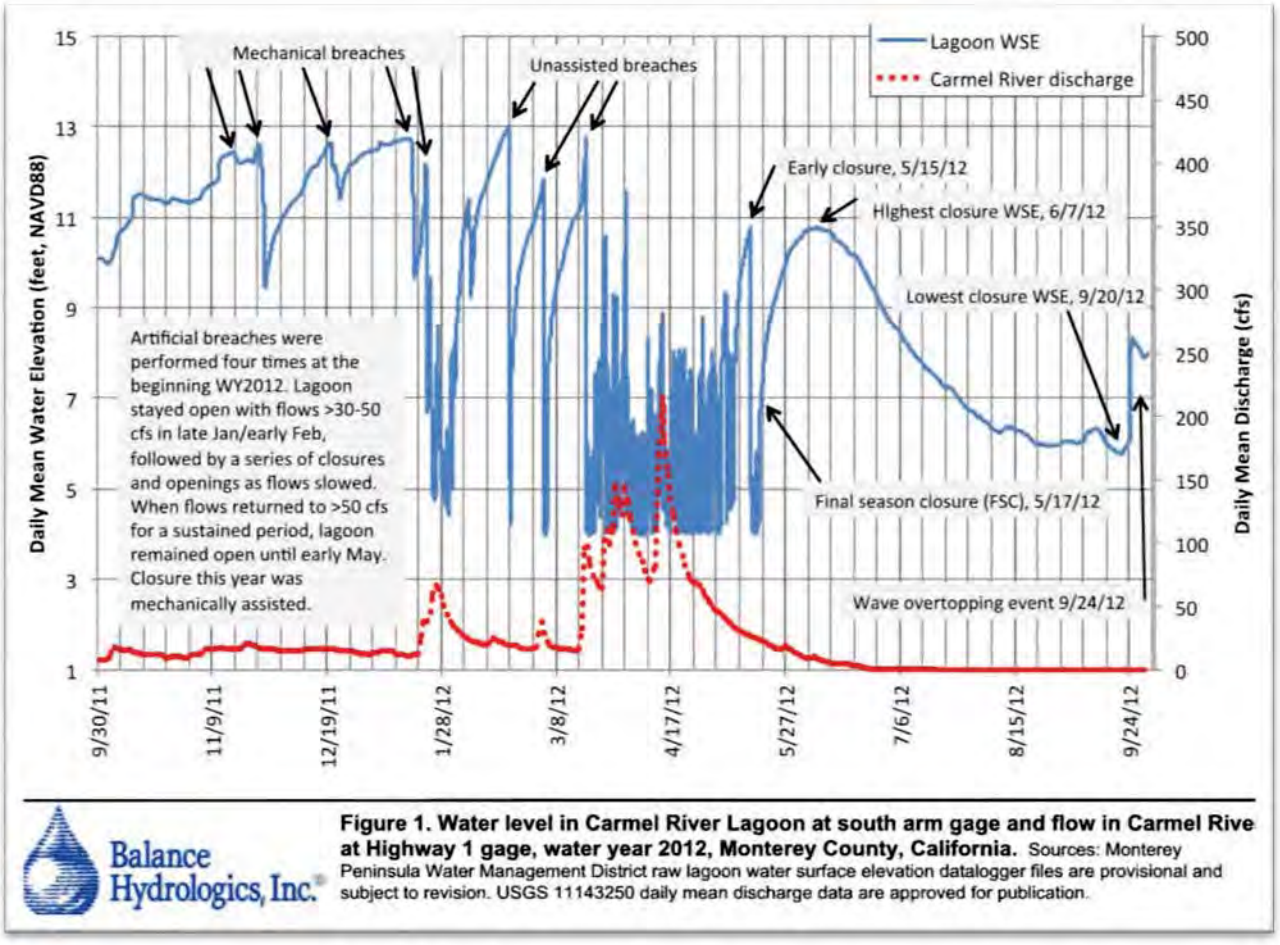
A technical advisory committee was formed to address maintaining the current level of protection for built infrastructure within the context of complying with the Endangered Species Act's requirements of reducing impacts to endangered species and returning the lagoon to a natural function state. The committee subsequently produced a long-term adaptive management plan for Carmel River State Beach and Lagoon (MPWMD, 2007). This document set in motion the development of potential solutions that would return the Lagoon to a more natural state that provides necessary ecological functionality for steelhead and other species that inhabit and depend on the system, while also ameliorating the potential increase in flood risk to surrounding infrastructure that could result from compliance with federal law. The current set of potential solutions is termed the Project in this document, as explained in the introduction. Technical studies including this one are addressing the complex natural, physical processes and interactions of the lagoon, beach, and ocean in order to provide the necessary studies needed for stakeholder to make informed decisions (e.g. Alley, 2013; Moffatt and Nichols, 2013; Whitson Engineers, 2013a,b).

From a riverine perspective, data associated with a 20-year record of Carmel River streamflows and Carmel Lagoon WSEs encompassing water years[1] (WY) 1993-2012, are presented in Appendices A and B. **Appendix A** contains WSE and streamflow data in graphical form. These figures and associated data in **Appendix B** can be used to compare general WY conditions, but should not be considered as an unimpaired dataset, as the Carmel River-Lagoon watershed has been heavily managed for decades, including within the timeframe of these data.

Summary statistics were collected into a series of tables and are reported herein as Tables 1-4. The tables consist of (1) flow and WSE values and relationships with lagoon breaching behavior, (2) WSE and lagoon surface area relationships pre- and post-breaching, (3) breaching events and days open to the ocean, (4) and lagoon closure dynamics.

Figure 1 of Appendix A, the WY2012 WSE and flow graphic, was annotated to help orient the reader with the information available in the 20 years of data found in Appendix A[2].

[1] Water years (WYs) are defined as October 1 of the preceding calendar year through September 30 of the named year. For example, WY 2012 encompassed October 1, 2011 through September 30, 2012.
[2] Figure 1 annotation data on artificial breaching dates and closure dates were taken from the 2011-2012 Annual Report for the MPWMD Mitigation Program (MPWMD, 2013).



Balance Hydrologics, Inc.

Figure 1. Water level in Carmel River Lagoon at south arm gage and flow in Carmel Rive at Highway 1 gage, water year 2012, Monterey County, California. Sources: Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.

Appendix B contains specific date, time, and WSEs related to all breaches and closures as defined below. When compiling Appendix B, thresholds were defined in order to produce a consistent dataset. All referenced WSEs are reported in the NAVD88 datum[3]. Definitions are provided in the notes section of each WY summary table in Appendix B, and are explained here as follows:

- "Sustained closure" is from October 1st of each WY until the first breach.
- In a "temporary breach", the lagoon remains open to tidal influences for < 7 consecutive days.

[3] Water surface elevations (WSEs) in this study are based on the North American Vertical Datum of 1988 (NAVD88). Lagoon WSE is recorded in NGVD29, so all WSE records were adjusted upward by +2.74 feet based on information from the National Geodetic Survey. For instance, an NGVD29 elevation of 10.00 feet was adjusted to an NAVD88 elevation of 12.74 feet. Mean tide level in nearby Monterey Bay is 3.01 feet NAVD88.

- In a "sustained breach", the lagoon remains open to tidal influences for > 7 consecutive days.
- "In-season closures" occur when lagoon WSE > 11 feet persists for > 24 consecutive hours during the winter-spring time period in each WY when the lagoon is generally persistently open to the ocean rather than in a dry-summer closed state.
- "Early closures" occur when the lagoon is mostly closed and WSEs increase to a point that would be considered a final closure, but then the lagoon opens up again briefly for about a week to a month prior to final closure.
- "Final seasonal closure" (FSC) is when the lagoon closes for the last time with receding river flow and does not open again until the following WY. The date chosen is when obvious tidal influences cease.
- A "significant increase" in WSE occurs only in the dry season, and is almost always associated with a wave-overtopping event, but can also occur due to river flow. In either case, a rapid increase in lagoon WSE of 1-foot was selected as 'significant'.
- "Total days of closure" was calculated as the sum of the number of days between the start of a WY on October 1st and the initial breach, plus the number of days between final season closure and the end of the WY on September 30th, plus the number of days of temporary closures.

4.1 Deleterious Impacts Related to Artificial Sand Bar Breaching Behavior

The primary impacts related to the lagoon environment due to sand bar management and the artificial timing of lagoon breaching, are as follows: Impacted lagoon WSEs throughout the year during both open and closed conditions; rapidity and magnitude of lagoon drainage; extent of salt water intrusion; stratification dynamics in the lagoon; water quality in the lagoon; and habitat loss and deterioration for steelhead and California red-legged frogs, as well as other aquatic and terrestrial species. Further, physical impacts to the sand bar have a profound effect on: where the outlet channel forms and subsequently moves over the course of the open-lagoon condition; where river sediments transport offshore and deposit; where beach sands transport offshore and deposit. This leads to loss of sand necessary for the formation of the beach, bluffs and sand bars, and causes the breakdown or non-formation of natural protective barriers at the beach, bluffs and along the shoreline. All of these impacts will be discussed in greater detail in the following sections.

4.2 Impaired Conditions Related to Artificial Sand Bar Breaching Behavior

In the Carmel River-Lagoon ecosystem, among other similar Coastal California systems, riverine dynamics play an important role in lagoon dynamics and, at least to some

degree, drive "whether, when, and for how long" the lagoon is open, while the formation of the sand bar beach and configuration of the outlet channel are somewhat more wave-dominated processes (Jacobs et al., 2011). The dual role of river processes and ocean dynamics can be seen in the Carmel Lagoon during California's summer dry season, as streamflows dry up (in part due to GW extractions and streamflow diversions), and ocean forces deposit sands onto the beach that are structurally capable of keeping the lagoon closed. Likewise in the winter season, streamflows can gradually fill the lagoon and breach the sand barrier, or suddenly generate fresh water forces strong enough to overcome ocean forces for extended periods, depending on the timing, duration, and quantity of rainfall and runoff.

In the Carmel River Lagoon, artificial breaching has disrupted seasonal flow and sediment dynamics for decades, directly impacting aquatic and terrestrial habitat (PWA, 2007). Historical, artificial breaching actions have had consistently deleterious effects on Carmel Lagoon habitat conditions, which differ significantly from what would have occurred with a natural opening and closing regime (e.g., MPWMD, 2011).

Table 1 shows that in WYs 1993-2012, the first breach of each WY was mechanically assisted with the exception of WY2008. In WY2008the combination of flow conditions and wave action compromised safety. In WYs 1993-2000, management action generally occurred when WSE exceeded 11.5 feet (L. Hampson, pers. comm.), which assured that adjacent properties would not flood. From 2000-2010, management activities were not generally undertaken until lagoon WSE and streamflow forecasts showed that WSEs were likely to exceed 12.8 feet, the elevation at which houses would begin to flood. This threshold has gone up in recent years due to the adoption of adaptive management techniques including sandbag placement. Currently (WYs 2011 and 2012), a WSE of about 13.2 feet triggers breaching, with some room for maneuvering based on anticipated flow and/or wave action (CL-MOU-2012).

Table 1. Carmel Lagoon first seasonal breach of each year

Water Year[1]	Wate Year Type[2]	Date of first breach[3]	Days into WY	Mechanical or Natural[4]	Daily Mean Flow on day of breach	Date of assumed natural breach[5]	Days into WY	Days between mechancial breach and assumed natural opening of the lagoon outlet channel[6]	Number of days from first breach until lagoon summer closure[7]
		(date)	*(days)*		*(cfs)*	*(date)*	*(cfs)*		
2012	Dry	11/25/2011	56	Mechanical	18	12/16/2011	77	21	174
2011	Above Normal	11/24/2010	55	Mechanical	19	12/19/2010	80	25	238
2010	Above Normal	10/14/2009	14	Mechanical	759	10/14/2009	14	0	271
2009	Normal	2/16/2009	139	Mechanical	749	2/16/2009	139	0	91
2008	Normal	1/5/2008	97	Natural	509	1/5/2008	97	0	114
2007	Critically Dry	2/11/2007	134	Mechanical	29	2/16/2007	139	5	37
2006	Wet	12/28/2005	89	Mechanical	81	12/31/2006	92	3	170
2005	Wet	12/30/2004	91	Mechanical	532	12/30/2004	91	0	194
2004	Below Normal	12/30/2003	91	Mechanical	416	12/30/2003	91	0	120
2003	Normal	12/16/2002	77	Mechanical	1250	12/16/2002	77	0	197
2002	Below Normal	12/3/2001	64	Mechanical	402	12/3/2001	64	0	178
2001	Normal	1/11/2001	103	Mechanical	148	1/11/2001	103	0	141
2000	Above Normal	1/24/2000	116	Mechanical	1000	1/24/2000	116	0	100
1999	Normal	11/3/1998	34	Mechanical	21	11/23/1998	54	20	233
1998	Extremely Wet	12/6/1997	67	Mechanical	112	12/6/1997	67	0	270
1997	Above Normal	12/9/1996	70	Mechanical	27	12/10/1996	71	1	154
1996	Above Normal	12/13/1995	74	Mechanical	36	12/21/1995	82	8	184
1995	Extremely Wet	1/9/1995	101	Mechanical	445	1/9/1995	101	0	201
1994	Critically Dry	2/17/1994	140	Mechanical	106	2/18/1994	141	1	404
1993	Wet	1/3/1993	95	Mechanical	85	1/7/1993	99	4	173
Summary Statistics									
Average			85		337		90	4	182
Median			90		130		91	0	176
Maximum			140		1250		141	25	404
Minimum			14		18		14	0	37
Standard Deviation			33		367		30	8	79

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.
2. WY type as designated by MPWMD.
3. Date of first breach is defined as that in which the lagoon area > 2 feet in depth declines by > 20%.
4. The lagoon has been breached since the 1930's (CCoWS, Fall 2007), and in recent decades to prevent infrastructure flooding.
5. Date of assumed natural breach used an assumed seepage rate and known inflows that traced predicted changes in lagoon WSE and volume (Whitson Engineers, 2013b), and then calculating date of assumed breach, using a WSE of 15 feet as the arbitrary elevation at which breaching would occur.
6. Number of days where artificial breaching opened lagoon earlier than natural processes. Calculations were not performed in increments of less than a day.
7. First breach was mechanically initiated in each year of this analysis (with one exception in 2008 due to safety issues), even when days between mechanical and assumed natural opening of the outlet channel were zero.

An analysis of the day of mechanical breaching versus calculations estimating the day of natural breaching over WYs 1993-2012 showed that in nine of the 20 years analyzed (45% of the time), the lagoon was artificially breached at least one day earlier than the predictions calculated for the day of natural breaching. In three of those years artificial breaching occurred earlier than predicted by 20 days or more (Table 1). WYs 2011 and 2012 may have been anomalous, as alternative breaching techniques were being used

to create shallow, pre-graded outlet channels rather than a wide and deep outlet channel, resulting in lagoon WSEs staying above 9 feet upon the initial breach, as shown in Figure 1 (MPWMD, 2013). Alternatively, in WY1993, 1994, 1996, and 1999 WSEs initially fell to about 5 feet, resulting in essentially full evacuation of the lagoon. Artificial breaching significantly reduces lagoon volume, which has a negative effect on volumetric and surface area habitat that remains following emptying (Casagrande et al., 2002). Whitson Engineers (2013b) calculated a volume of 13.7 acre-feet at 4.74 feet of WSE versus a 382 acre-foot estimate for total volume when WSEs are at 12.74 feet (i.e. near the current artificial breaching threshold; CL-MOU-2012). At elevations of 15.74 feet, which would allow higher WSEs than typical breaching patterns now but well below a 17.5-foot Project EPB top of wall, lagoon volume is estimated as 804 acre-feet. This suggests that the implementation of the project could more than double the volume of the lagoon at a maximum WSE of 15.74 feet, providing an example of the significant increase in WSE during closed conditions, and likely additional days of closed lagoon habitat.

Review of mean daily flow on the day of breaching (Table 1) shows that in the nine years in which artificial breaches were performed at least one day prior to calculated predictions of natural breaches, flows were less than 110 cfs in each case. For the Carmel River-Lagoon system, a conservative estimate was calculated by James (2005) suggesting that natural breach events would occur when flows were 200 cfs or greater. According to NMFS, analyses showed that in the years 1989-2010, approximately 80% of the time artificial breaching occurred at flows lower than 200 cfs, providing an indication that the lagoon has been prevented from functioning naturally during those times.

One might conclude from reviewing Table 1 that as long as flows are above approximately 200 cfs, there are no negative impacts associated with artificial breaching. This conclusion would be incorrect. Artificial breaching creates effects to the beach that may last for months to years, and which affect natural processes year-round. When the barrier bar is artificially breached in high-flow years, the breach is often made at the shortest distance between the lagoon and the ocean, generally due west (James, 2005). This initial opening may 'set' the beach with a structurally altered bar morphology, causing evacuation of sand via sediment transport mechanisms that may have otherwise remained on the beach. These altered physical processes and the associated inherent instability likely cannot be reinstated quickly by new sand filling in the breach. Consequently, this may alter the beach for the entire year, and potentially beyond.

As specified in Section 4.1, there are numerous deleterious effects from artificial sand bar breaching that extend far beyond the simple act of mechanically opening the sand bar. For instance, once the sand bar is mechanically breached, all subsequent lagoon WSE fluctuations and sand bar opening-closure scenarios could be considered impaired. In most years, this impairment causes the lagoon to empty rapidly due to the initial position of the mechanically created outlet channel. For example, when the outlet channel position and orientation is mid-bar and straight out to the ocean (a condition that would not have occurred naturally), salt water intrusion into the lagoon is extensive during the upper spikes in tidal fluctuations. This behavior is easily seen in the magnitude in WSE differences on a daily basis in the figures in Appendix A. Lowest recorded WSEs have shifted slightly over the years, likely due to new equipment placement. In recent years, the water surface drops below the pressure transducer at the gage station in the southern arm of the lagoon at about 4 feet NAVD (James, 2013, pers. comm.). Water volume evacuation from the lagoon is very extensive at these levels (Whitson Engineers, 2013b). These intense cycles create significant disturbances to stratification dynamics as the lagoon begins to close, with higher ratios of salt water intrusion preventing important oligohaline conditions (where a gradient of fresh water to saline conditions establishes appropriate salinity and habitat conditions for aquatic species at more than one shallow depth) to form at the appropriate time, as should happen when perched-lagoon conditions prevail and tidal influences are muted. Stratification rather than oligohaline conditions leads to poor water quality for steelhead, California red-legged frogs, and other aquatic and terrestrial species that depend upon fresh water conditions within the lagoon over the summer months.

Impairment caused by a reduction in the fresh water lens can eliminate the fresh water habitat provided by the lagoon and can create an inhospitable environment because of low water levels, high salinities and low dissolved oxygen concentrations. The influx of seawater creates a salinity-stratified lagoon and alters potential lagoon productivity as well as water quality because the availability of fresh water may become compromised. When the denser seawater that has breached into the lagoon naturally sinks within the water column, it pushes fresh water to the surface, creating a narrow, shallow fresh water lens. Then, during subsequent breaches or tidal fluctuations of inflow and outflow in those times when the lagoon is not in a perched configuration, there is a greater likelihood that the heavier salt water will remain in place while the upper fresh water lens gets mixed or drains away. This type of situation leads to poor habitat and water quality conditions, and the only area in the lagoon that remains viable steelhead habitat is the small, shallow fresh water lens at the lagoon surface coupled with what amount may be replenished via fresh water groundwater influx (Casagrande and others, 2002; Watson and Casagrande, 2004). These conditions do not lead to the

oligohaline lagoon environment necessary to provide suitable habitat for steelhead and other aquatic species that over-summer in Carmel Lagoon.

From a physical perspective, mechanical breaching impacts the development and direction of an outlet channel that responds to ocean wave, longshore transport and riverine dynamics in its formation. Mechanical breaching does not allow natural development of the outlet channel in a physically-driven direction. With respect to a northerly position of the outlet channel, westerly mechanical breaching prevents delivery of riverine sediments just off-shore where such sediments might build up to attenuate wave dynamics against the northern bluffs. In addition, sand bar 'blow-out' results in loss of sand and gravels into the offshore canyon, rather than shoaling just off shore in the northerly direction. Removing or preventing offshore natural barriers to form increases the risk of ocean swells to the bluff and surrounding infrastructure. Lagoon seepage rates to the ocean may also be affected during the dry season due to removal of hardened sands on the lagoon side of the barrier bar that could potentially form. Mechanical breaching likely eliminates some of the potential for hardening of barrier beach sand on the lagoon side of the beach. Considering decades of artificial breaching—as illustrated very clearly over the last 20 years (Table 1)—it may take a number of years after artificial breaching ceases before the sand bar begins to behave naturally.

4.3 Impaired Lagoon Morphology during Open Conditions

Carmel Lagoon is primarily open to the ocean during each winter season (**Table 2**). The period of opening is directly related to flow conditions as well as to ocean dynamics (James, 2005; Jacobs et al., 2007). Occasional closures may occur as flows decrease near the end of the falling limb of a specific hydrograph (Appendix A), but this process is also dependent on the prevailing wet-season baseflow condition (which differs significantly from the dry season baseflow condition of 'no flow') and ocean dynamics. If average wet season baseflows are relatively elevated, closures are temporary, generally on the order of 2-7 days (Appendix B), but can occur multiple times a year depending on water year type and streamflow regime (Tables 1 and 2).

Table 2. Carmel Lagoon breaching events and days open to ocean

Water Year[1]	Number of artificial breaching events[2]	Number of other breaching events[3]	Wet season days open[4]	Wet season days closed[5]	Percent of time lagoon open to the ocean[6]
	(days)	*(days)*	*(days)*	*(days)*	*(%)*
2012	5	4	153	21	42
2011	5	0	227	12	62
2010	6	0	224	48	61
2009	1	2	87	5	24
2008	0	2	111	3	30
2007	1	3	21	17	6
2006	1	2	151	20	41
2005	1	0	193	2	53
2004	1	3	111	9	30
2003	1	1	197	1	54
2002	2	0	177	2	48
2001	1	0	142	0	39
2000	1	0	92	8	25
1999	8	0	196	38	54
1998	2	0	267	4	73
1997	1	0	155	0	42
1996	3	0	180	4	49
1995	1	0	202	0	55
1994	1	2	35	5	10
1993	1	1	172	2	47
Summary Statistics					
Average	2	1	155	10	42
Median	1	0	164	5	45
Maximum	8	4	267	48	73
Minimum	0	0	21	0	6
Standard Deviation	2	1	63	13	17

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.
2. Artificial breaching events were counted as (a) first breach of the year unless reported otherwise, and (b) when reports indicated additional mechanical breaches.
3. Other breaching events were counted when wet season lagoon closures were (a) > 1-2 days and (b) when flows were > 50 cfs prior to next opening (generally unassisted openings when later in the year)
4. Wet season days open is defined as number of days from first breach to final closure, not counting wet season days closed.
5. Wet season days closed is defined as those days when WSE remained > 11 feet (NAVD88) for longer than 24 hours.
6. Percent of time WY lagoon open to the ocean is defined as wet season days open minus wet season days closed divided by 365 days per year times 100.

In an unimpaired state, one might expect the days of open lagoon conditions to have the two following characteristics: (1) a long, sinuous outlet channel that prevents tides from rushing in and out of the lagoon and creating large WSE fluctuations that have adverse effects on water quality, and (2) a perched WSE condition in the lagoon such that the lower limit of WSE remains above the mean high tide elevation. Combined, these two states allow important fluxes (i.e. flow, sediment, salt water) to move into and out of the lagoon at a rate and intensity that is within the natural variability of the system, unlike those to which the lagoon has been subjected with sand bar management techniques of the past decades. When the conditions are such that the outlet channel is mechanically created in a pathway that would not have happened naturally and thus the lagoon is not in a perched state, the deleterious effects as enumerated in Section 4.1 and discussed in the last two paragraphs of Section 4.2

greatly affect natural lagoon functions. The fact that the lagoon is open to the ocean on average about 40-45% of each WY (Table 2) provides an indication of the proportion of the year when open-lagoon conditions that may be negatively affected by mechanical breaching. Further, impaired open conditions need directly to impaired closed conditions, a topic of discussion in Section 4.4.

Streamflows can be large enough to fill the lagoon rapidly (see Appendix A for a visual depiction of streamflows and lagoon WSEs for each WY 1993-2000), and then depending on continuing streamflows (whether large or small, both can be drivers of openings), the outflow channel stays open or ocean forces begin to overcome riverine processes. The sand bar can remain in place for some period of time or can open up and then reform when flows are low, as it takes a longer period of time to increase lagoon volumes and WSE to the point of the next breaching. This process is illustrated most clearly in the critically dry WYs of 1994 and 2007 (Appendix A, Figures 19 and 6, respectively). In WY2007, peak flow was low and overall yearly discharge was low, so lagoon openings were limited in duration and largely dominated by ocean processes working to deposit sand and close the lagoon. A slightly different pattern can be seen in WY1994, where the peak flow was large but quite short in duration and with total yearly discharge low also, resulting in a very similar short seasonal opening pattern for the lagoon.

The ideal lagoon morphology during open conditions would be to retain a perched condition, where lagoon WSEs of greater than about 6 feet persist when mean high tides are in, providing a minimum of about 41 acre-feet of volume (Whitson Engineers, 2013b). WY2005 (Appendix A, Figure 8) is an example of the ability of the lagoon to retain a WSE of greater than 6 feet. WY2005 represents the only WY in which WSEs remained above 6 feet for the entire lagoon opening, so in 19 of 20 years, perched conditions in the lagoon were not achieved.

In WY2005, Monterey County graded an outlet channel along a "non-traditional" north-northwesterly alignment based on consultation with National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS). The intent was that channel alignment would result in a decrease in both the rate of lagoon draw-down and a reduction in the total drop in lagoon level, thereby reducing impacts to the newly federally listed steelhead and the lagoon habitat that provides critical ecosystem functions for them. The longer more sinuous breach channel moderated flow rates and limited the total volume of lagoon draw-down. The project was a success, as lagoon WSEs maintained an extra foot or so in elevation throughout the entire lagoon open period, improving habitat quality and volume. In at least five years over the period 1993-2005, the outflow channel has been intentionally directly away

from the north end of the beach to avoid exposing the bluff area along Scenic Drive to erosive forces (MPWMD, 2007). This type of intervention would not be necessary with the Project SRPS in place, which would be intended to provide protection from erosion to Scenic Drive and local properties that sit atop the bluff.

When a perched morphology is not maintained and WSEs dip to 5 feet, approximately 14 acre-feet of lagoon water volume remains, a 65 percent reduction in volume compared to an elevation of 6 feet associated with a perched morphology. This reduction occurs when habitat quality is likely tenuous due to large quantities of fresh water evacuating the lagoon and flowing out to the ocean. Conversely, as tides come in, the outlet channel provides a pathway for salt water ingress. When fresh water streamflows are adequate, thorough mixing of the two—fresh water and salt water—prevents stratification and provides good quality habitat (Smith, 1990). When fresh water flows are not adequate, salt water influx raises salinity concentrations to levels that juvenile steelhead may not be able to tolerate (NMFS, 2008).

Another impact of the inability of the lagoon to maintain a perched morphology due to artificial breaching is that as much as 80 percent of lagoon surface area > 3 feet in depth is flushed from the system when the sand bar breach runs directly westward (**Table 3**). This depth within the lagoon habitat zone is particularly important for juvenile steelhead, as they become more susceptible to predation and thermal stress in shallow waters.

The rate of lagoon draining presents additional issues for salmonids and other aquatic organisms (**Table 3**). Rapid evacuation of lagoon waters can force fish into shallower waters, exposing them to increased predation and potential stranding in addition to forcing out-migration of fish before they are ready for the ocean environment (Smith, 1990; NMFS, 2008; Atkinson, 2010).

Table 3. Carmel Lagoon water surface elevations and estuary surface areas pre- and post-breaching

Water Year[1]	WSE before breaching, NAVD88[2]	Estuary surface area before breaching	WSE after breaching, NAVD88	Estuary surface area after breaching[3]	Rate of lagoon draining
	(ft)	*(acres)*	*(ft)*	*(acres)*	*(ft/hr)*
2012	12.2	69.9	6.7	8.6	0.7
2011	11.8	63.8	6.7	8.6	0.2
2010	13.3	89.3	6.1	5.7	1.5
2009	13.1	86.7	6.1	5.6	2.2
2008	15.4	135.1	5.9	5.6	1.2
2007	11.5	58.3	8.8	25.3	0.3
2006	11.4	56.8	6.4	7.1	0.0
2005	13.0	85.2	7.3	12.1	0.0
2004	13.2	88.7	6.1	5.6	0.7
2003	13.6	95.1	7.1	11.3	2.1
2002	13.4	92.0	5.6	3.9	0.9
2001	14.8	120.9	5.5	3.3	2.2
2000	14.1	105.2	6.9	9.5	0.4
1999	12.8	80.0	5.0	2.1	0.4
1998	12.4	73.1	6.6	7.9	0.4
1997	12.3	72.8	8.3	20.5	0.3
1996	11.7	61.9	5.7	3.9	1.1
1995	10.5	44.8	6.4	7.0	0.1
1994	11.7	62.1	6.5	7.3	0.1
1993	12.7	79.8	6.2	6.2	0.8
Summary Statistics					
Average	12.7	81.1	6.5	8.4	0.8
Median	12.7	79.9	6.4	7.1	0.6
Maximum	15.4	135.1	8.8	25.3	2.2
Minimum	10.5	44.8	5.0	2.1	0.0
Standard Deviation	1.2	22.1	0.9	5.6	0.7

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.
2. First breach of the year.
3. Surface area with depth > 3 feet, suitable for steeelhead habitat.

4.4 Impaired Conditions at Lagoon Closure

Carmel Lagoon has exhibited an impaired condition at lagoon closure in at least 17 of 20 years between WYs 1993-2012 (**Table 4 and 5**; Appendix A) because perched lagoon morphology was not present at that time, thus impeding the development and maintenance of high quality habitat for steelhead and other species during closed conditions in the lagoon.

NMFS and CDFW have indicated that a lagoon WSE of 6.74 NAVD88 (4 feet NGVD29) to 12.74 feet (10 feet NGVD29) is an optimal range for good quality habitat for steelhead (MPWMD, 2011), whereas in most of the recent years between WYs 1993-2012, closure WSEs have measured within the 4-foot to 5-foot range. Table 5 presents the lowest WSE prior to final season closure for these years. If the threshold of 6.74 feet is considered as the minimum WSE to qualify closure conditions as perched, then only one year, WY1998, would qualify as having closed with a perched condition. Conversations with NMFS have indicated that WY2005 exhibited a perched condition for the entire open cycle, so if that lowest WSE prior to closure would be selected as defining a perched condition, the WSE threshold would be 5.89 feet. To provide for uncertainties in WSE measures, it may be reasonable to set a WSE threshold of 5.75 feet as potentially qualifying as a perched condition at closing, although it is important to note that this value is 1 foot below the optimal range indicated by NMFS and CDFW. Using this criterion—defining 5.75 feet as lowest WSE prior to closing to constitute perched lagoon morphology—only three WYs qualify as perched: WYs 1998, 2000, and 2005.

Table 4. Carmel Lagoon final season closure dynamics

Water Year[1]	Date of final seasonal closure[2]	Days into WY	Daily Mean Flow at Closure	Highest WSE During Seasonal Closure	Lowest WSE During Seasonal Closure	Time Lagoon Closed in Dry Season	Annual Time Closed[3]
	(date)	*(days)*	*(cfs)*	*(ft)*	*(ft)*	*(days)*	*(%)*
2012	5/17/2012	229	25	10.8	5.8	191	58
2011	7/20/2011	292	28	9.7	8.2	126	38
2010	7/12/2010	284	28	10.2	6.3	93	39
2009	5/18/2009	229	25	11.4	6.3	273	76
2008	4/28/2008	210	17	11.0	5.9	251	70
2007	3/20/2007	170	27	12.3	5.3	327	94
2006	6/16/2006	258	46	10.1	6.3	194	59
2005	7/12/2005	284	15	8.7	5.8	170	47
2004	4/28/2004	210	15	10.0	5.1	245	70
2003	7/1/2003	273	10	8.0	5.4	167	46
2002	5/30/2002	241	12	10.0	5.3	186	52
2001	6/1/2001	243	14	9.9	5.6	223	61
2000	5/3/2000	215	73	10.7	5.7	265	75
1999	6/24/1999	266	17	10.5	5.4	131	46
1998	9/2/1998	336	18	8.9	7.2	94	27
1997	5/12/1997	223	24	9.9	5.5	210	58
1996	6/14/1996	257	13	10.4	5.5	181	51
1995	7/29/1995	301	15	9.4	5.6	163	45
1994	3/28/1995	178	19	10.7	5.4	325	90
1993	6/25/1993	267	18	8.8	5.5	191	53
Summary Statistics							
Average		248	23	10.1	5.8	200	58
Median		250	18	10.1	5.6	191	55
Maximum		336	73	12.3	8.2	327	94
Minimum		170	10	8.0	5.1	93	27
Standard Deviation		42	14	1.0	0.7	66	17

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.

2. Date of final seasonal closure is the latest date in the WY on which the lagoon is no longer subject to tidal influences.

3. Annual time closed is defined as the sum of time lagooon closed in dry season plus the number of days closed in the wet season (see Table 2 also).

Table 5. Carmel Lagoon perched morphology dynamics

Date of lowest WSE before closing	Lowest WSE (ft) before closing	Mean daily flow (cfs) at lowest WSE before closing
(date)	*(ft)*	*(cfs)*
5/17/2012	4.01	25
7/25/2011	4.04	26
7/12/2010	4.07	28
5/17/2009	4.10	26
4/27/2008	4.11	19
3/20/2007	4.13	27
6/14/2006	4.41	51
7/11/2005	5.89	16
4/28/2004	5.52	15
6/28/2003	5.06	13
5/29/2002	5.27	15
5/31/2001	5.00	16
4/16/2000	5.76	78
6/18/1999	5.27	26
6/9/1998	6.91	190
5/10/1997	5.59	25
6/11/1996	5.37	16
6/20/1995	5.38	85
3/28/1994	5.71	19
6/25/1993	5.56	18
Summary Statistics		
Average	5.1	37
Median	5.3	25
Maximum	6.9	190
Minimum	4.0	13
Standard Deviation	0.8	41

Considering the three qualifying WYs more closely (see Appendix A for graphical representation), WY1998 was dominated by riverine processes very late into the spring with a mean daily flow rate of 190 cfs on the day of lowest WSE prior to closure. Flows did not cease the entire summer, so it is very likely that fresh water conditions and a mixed lagoon environment prevailed through the dry closure season. In WY2000, a late flow peak likely helped fill the lagoon with fresh water as the sand bar closed, providing a perched condition and relatively large ratio of fresh water to salt water at time of closure. Flows in this year continued into late July, so it is likely that a mixed lagoon environment prevailed through at least the beginning of the dry closure season.

What makes WY2005 notable in terms of perched conditions is that WSEs were maintained at elevated levels for the entire open condition of the WY, as well as closing at a high WSE, thus providing a much enhanced fresh water condition for steelhead through the year. This season-long condition was very likely a direct result of the lagoon outflow pathway being directed to the north, thus maintaining an elevated WSE with sand bar morphology playing a primary role in this condition.

In an effort to address other primary water balance parameters related to hydrologic processes in the lagoon, a few points related to seepage and evaporation follow. Seepage rates from the lagoon into the barrier bar have been estimated as 8 and 12 cfs, which convert to 8 and 12 acre-feet of outflow per day if considering tides are out 50 percent of the time. These values were calculated for WY2005 and WY2009, respectively, when lagoon WSEs were on the order of 10.5 to 11.5 feet (MPWMD, 2011). The increase in seepage flow rates was conjectured to be due to artificial closure of the lagoon barrier bar at a higher elevation in WY2009, and possibly aided by additional lagoon storage capacity after the two South Arm phases of lagoon restoration were completed. Seepage rates of ocean water into the lagoon are unknown; overtopping events are the largest water influx into the lagoon in late fall (Appendix A and B).

Evaporation from the exposed areal water surface contributes to lower WSEs and potentially higher salinity concentrations. Carmel River Lagoon and the Lower Carmel Valley are classified in the evapotranspiration zone of upland central coast and Los Angeles basin in the California Irrigation Management Information System (CIMIS, 2010). Evapotranspiration rates for this zone average from a high of 6.51 inches/month in July to a low of 1.86 inches/month in January, for a total rate of 49.7 inches/year. Losses via seepage were estimated to be about 10 times greater than evaporation rates (Watson and Casagrande, 2004), so while this is a water balance output, it is relatively small.

4.5 Impaired GW-Surface Water Interactions

GW is pumped from the Lower Carmel River aquifer for consumptive uses. In past years, the shallow water aquifer has been pumped at a rate of about 11,000 acre-feet per year (PWA, 2007), while current GW withdrawals in the Lower Carmel Valley are on the order of 8,000-10,000 acre-feet per year from source areas AS3 and AS4 (MPWMD, 2011; MPWMD, 2013). AS3 and AS4 are the areas which correspond to the aquifer near the lagoon. Monitoring wells are located at three elevations within the near-shore aquifer and near the salt water-fresh water interface (Watson and Casagrande, 2004).

GW-surface water interactions are necessary to provide fresh water additions to the lagoon during closed conditions, as there are no other fresh water sources available once flows cease in the river. The ability of the aquifer to fill to a higher GW elevation is impaired if the lagoon has been mechanically breached throughout the wet season, as more fresh water is directed seaward rather than backwatering within and upstream of the lagoon, and percolating into the aquifer. Thus, the effects of breaching may lead to 2 or more feet of loss to GW elevation in the local aquifer, depending on position, and can cause the lower Carmel River surface flow to dry back and go subsurface at an earlier date. Lowered GW elevations can significantly reduce the amount of GW

flow into the lagoon after surface flows have ceased, thus effecting summer habitat conditions. NOAA staff worked up an approximate estimate of the GW lost due to mechanical breaching from storage in the aquifer by using a storativity value (percent of water stored per unit of volume) for the local aquifer along with lower aquifer acreage and a conservative change in aquifer elevation. For Carmel Lagoon, the GW aquifer surrounding and upstream of the lagoon potentially affected by lagoon levels was approximated as 1,400 acres. The storativity value for the local aquifer was roughly estimated as 0.2, or 20% of the volume (NOAA staff pers. comm. with Martin Feeney, 2003). A 2 feet of loss in aquifer elevation in the wet season was used by NOAA as potential GW losses. Thus, NOAA developed a calculation of 1400 acres * 0.2 storativity * 2 feet in aquifer elevation loss = 560 acre-feet of potential GW loss due to mechanical breaching activities, with potentially different magnitudes of loss if any of the variables are different than this assumed set. Further, as the fresh water lens diminishes due to evaporation and seepage, a higher initial GW elevation provides a more robust fresh water supply throughout the dry summer months and into late fall and early winter until rains begin again. A more robust GW-surface water connection provides higher water quality during closed conditions.

A restoration project to create additional lagoon volume by digging out the Odello West extension of the South Arm of Carmel Lagoon uncovered a fresh water spring in the far-eastern finger of the project site (Larson et al., 2006, see Fig. 4-5, Fig. 4-6). Subsequent salinity sampling showed that a strong linear relationship exists between increases in salinity and distance from the spring. A similar linear relationship was found from the South Arm to the river channel.

Varying degrees of fresh water lens development have been documented in studies conducted in recent years (i.e. Larson et al., 2006). In Anderson et al. (see Figure 3, 2007), a longitudinal profile of salinity and other water quality parameters from data collected in late October to early November, 2007, showed that the freshest water, at an acceptable salinity concentration of 2 ppt, was found only in the far-eastern corner of the Odello West South Arm. In Castorini et al. (see Figure 8, 2008), a longitudinal profile of salinity and other water quality parameters from data collected on October 9, 2008, indicated that a fresh water lens with a salinity concentration of 2 ppt was found spread over a larger area than in 2007, extending almost to the pipe in the South Arm. In both years a small fresh water lens was detected in the far North Arm also, suggesting that GW springs may exist at both ends of the lagoon, potentially providing some measure of refugia during the dry season.

Although fresh water has been documented as present in the lagoon late in the dry season, the areas in which it is found are small, likely leading to increased competition

between and among species for available food sources. It is quite possible that higher initial closure elevations (as was the case in WY2007 and WY2008), persistent streamflows further into the summer, and more GW inflows would result in greater volumes of fresh water throughout the dry season, creating high quality over-summer habitat by promoting growth of invertebrates that are primary steelhead food sources.

4.6 Impaired Conditions Related to Carmel Lagoon Ecosystem Health

Carmel Lagoon has been altered and modified for decades. Built infrastructure encroaches onto the lagoon floodplain as well as along much of the Carmel River corridor within the Lower Carmel Valley. The sand bar barrier between the lagoon and ocean is artificially manipulated on a consistent, yearly basis, causing evacuation of lagoon waters early in the WY. This results in tidally-open conditions that significantly increase flushing of fresh water from the system on a daily tidal basis, and closure conditions where a high ratio of highly saline ocean waters are present. Further, mechanical breaching disrupts formation of the outlet channel and sediment transport. Reestablishment of the natural beach-river transport regime is particularly important in order for sands to replenish the longshore bar to the north, which will then provide natural protection via wave energy dissipation especially during long period, large swell events. Such build-up of the longshore bar will eventually help to attenuate bluff erosion.

Upon closure, stratification of the lagoon persists until and if conversion to fresh water is achieved (NMFS, 2008). GW pumping is prevalent, extracting more water than is replenishing via infiltration and percolation into the aquifer on a yearly basis, and thus the aquifer is unable to supply as much GW inflow to the lagoon as in an unimpaired situation.

During the onset of stratified conditions, some habitat is present for juvenile steelhead in the shallow fresh water lens situated on top of the more saline lower lens. The ability of juveniles to utilize the entire water column in the lagoon is restricted by the highly saline, low dissolved oxygen, and higher temperature conditions in the lower lens. Aquatic invertebrate densities, the prey base for juvenile steelhead, are negatively correlated with increasing salinity. When conversion of a lagoon to fresh water is complete, steelhead have more abundant space and a broader prey-base leading to greater survival and growth rates (NMFS, 2008).

Steelhead run numbers are low in the Carmel River. The impact of current sand bar management activities lowers the quality of critically needed S-CCC steelhead habitat, negatively affecting the likelihood of S-CCC steelhead survival and recovery.

Restructuring the management of the lagoon sand bar to more closely resemble the natural physical processes and hydrologic cycle of the lagoon is necessary to minimize and avoid adverse effects to critical habitat in the lagoon year-round, as well as to minimize the direct loss of S-CCC steelhead juveniles when the lagoon drains quickly to the ocean.

5 ANTICIPATED RESPONSE OF CARMEL LAGOON TO PROJECT IMPLEMENTATION

In 2010, the MCWRA submitted an application to the USACE for a permit to manage the sand bar. In September 2011, Monterey County (RMA/Public Works) assumed a lead role for the Carmel Lagoon management. The USACE consulted with NMFS through the required section 7 consultation process under the federal ESA. During the consultation process, the NMFS affirmed that annual artificial breaching as proposed in the permit application would likely adversely affect S-CCC steelhead and destroy and adversely modify its critical habitat, and, therefore, a Jeopardy Opinion (JO) would be issued. A meeting with the NMFS and USACE to better define a solution to artificial breaching identified that the EPB and SRPS projects are viewed as their preferred projects with a means to achieving the following objectives:

- To improve the functions and values of the ecosystem in and around the Lagoon by allowing lagoon levels to rise and the lagoon to breach naturally (versus mechanically breaching the Lagoon)

- To reduce potential flood risks for existing public facilities and private structures in the low-lying developed areas located immediately to the north of, and within, the Lagoon as a result of predicted sea level rise during the next 50 years and reduction in mechanical breaching.

- To protect public infrastructure (e.g., Scenic Road embankment, State Parks restroom and parking facilities) from storm surge and scour resulting from a northerly-aligned channel.

The USACE and NMFS informed the MCWRA and County that issuance of a JO could be avoided if the application was withdrawn and a new application was filed for the EPB and SRPS projects. Therefore, the County withdrew its application for long-term sand bar management, and submitted new applications to all permitting agencies for approval of the EPB and SRPS projects, as well as a 5-year Interim Sand bar Management Plan, while the County and MCWRA completes the plans and construction of the projects. These applications were deemed incomplete pending technical studies, which are being completed as part of a feasibility study (completed June 2013) and this environmental review process.

In an effort to demonstrate the commitment to assess these projects and implement a long-term solution to mechanical breaching, the RMA worked with the USACE to develop a draft Memorandum of Understanding (MOU) that would include the USACE,

County, and NMFS as signatory agencies. This document was reviewed by the USFWS as a consulting agency to the USACE. In September 2011, a draft MOU was completed for management of the Carmel River Lagoon. The MOU:

- Establishes a long-term plan to balance protection of private property with protection of federally listed species
- Recognizes that mechanical managing the Carmel River Lagoon over the long run was not in the best interest of the County, USACE, and NMFS' protected resources
- Identifies two long-term solutions as alternatives to performing sand bar management: the EPB and the SRPS
- Agrees to allow an Interim Sand bar Management Plan (ISMP) for temporary (5 years) management of the sand bar while the County develops the EPB and SRPS projects (design, environmental review, and construction)
- Establishes a target schedule to complete the projects by 2018.

Because the County has managed the sand bar only under approved emergency permits, and due to the time necessary to assess the various options, the timeframe identified in the MOU for obtaining a non-emergency permit was extended to October 2013. The County is working to complete the required environmental documents consistent with the expectations of the permitting agencies. The MOU was approved by the Board of Supervisors (BOS) on June 11, 2013.

5.1 Anticipated Sand Bar Dynamics without Artificial Breaching

When river flows surpass about 30-50 cfs and remain within or above that flow range, it becomes much more likely that riverine processes are the driving mechanism of bar breaching (Rich and Keller, 2013). The tendency of breach location is likely related to the architecture of the barrier beach sand bar, sand supply, wind dynamics, and wave form and shape. The cessation of artificial breaching will allow for a more natural sediment transport regime. This would be manifest when the annual cycles of barrier bar building and opening experience more of the natural dynamics associated with river outflow, tides, wave action, cross-shore, and littoral and longshore transport (Moffatt and Nichol, 2013; J. Pearson-Meyers, pers. comm., 2013).

5.2 Anticipated Lagoon Morphology

Breach outflow channel width and depth are primarily a function of wave and littoral transport processes as well as inflow rate and lagoon volume prior to opening, so affects naturally-occurring channel widths and depths would vary according to ocean and flow conditions. Data from WY2005 indicates that perched lagoon morphology will occur in Carmel Lagoon when the outflow channel runs to the north (Appendix A, Figure 8). There is a tendency for outflows to migrate north, as determined in WYs 1993, 1996, 1997, and 2000 by Thornton's (2005) littoral processes study of existing data and aerial photos, and in 2005 as reported by MPWMD (2007). It is expected that a northerly route will likely develop more often than currently occurs once artificial breaching ceases. A natural channel might form to the south in some years, as outlet formation is dependent on the longshore current. Ocean wave patterns can change in some years, although an outlet channel to the south should occur with a lower frequency than to the north.

NMFS and CDFW have indicated that a lagoon WSE in the range of 6.74 to 12.74 feet NAVD88 (4 to 10 feet NGVD29) is an optimal range for steelhead (MPWMD, 2011) while a threshold value of 5.75 feet was used in Table 5 to assess the probability of perched conditions in recent years. Conditions in WY2005 provide evidence of a perched morphology that would promote a WSE that might be achieved regularly with a northerly configuration to the outflow channel. The northern beach has smaller sand grain-sizes and a lower slope than the southern portion of the beach (Moffat and Nichol, 2013), while longshore currents tend to carry sand to the north due to diffraction of waves around Steward's Cove (Thornton, 2005). Slopes on the northern portion of the beach are much lower than those on the south end of the beach: 12 percent versus 28 percent, respectively (Thornton, 2005). These observations provide an indication of why the lagoon outlet might tend to migrate to the north, as there may be less resistance in the architecture of smaller grain sizes, and the lower slopes may provide a path of least resistance to the ocean.

When higher WSEs prevail in the lagoon over the course of an open-lagoon winter season, the lagoon WSE should remain high upon closure and with a higher ratio of fresh water because tidal inflow cannot negotiate the sinuous outflow pathway easily, thus less salt water will enter and remain in the lagoon (J. Pearson-Meyers, pers. comm., 2013).

5.3 Anticipated Conditions at Lagoon Closure

Carmel Lagoon geology includes a bedrock sill at the northern and southern ends of the river mouth. This sill may play a role in maintaining lagoon WSE, particularly when the

outflow path is oriented to the north and a long and sinuous channel can form. Meandering outflow channels that flow across this bedrock sill, such as in Carmel Lagoon in water year 2005, are able to retain higher WSEs in the lagoon.

The higher WSE and continuing inflows until those dry up should provide a perched, fresh water lagoon at the beginning of the summer dry season that will remain as a fresh water system throughout the closure season and year-round.

5.4 Anticipated GW-Surface Water Interactions

There are a number of projects in progress associated with the Lower Carmel River and Lagoon, including Odello East floodplain restoration, retrofit of San Clemente Dam in the upper watershed, and GW infiltration into the floodplain aquifer on the Odello West floodplain area of the lower watershed at the lagoon (PWA, 2007). These projects will likely have effects on the Lagoon and its interaction with streamflow and local GW, and should provide net positive benefits to lagoon ecosystem health.

5.5 Anticipated Ecosystem Effects

The purpose of Project implementation is to restore the natural function of the lagoon by reducing the necessity to artificially breach the sand bar. Anticipated ecosystem effects should subsequently help restore the natural function of the lagoon and protect surrounding infrastructure. These effects include (1) more natural breaching cycles, (2) increased WSE in the lagoon while open in a northerly direction, (3) a higher ratio of fresh water to salt water, (4) conversion of the lagoon into a fresh water system during closure via the higher ratio of fresh water and streamflow prior to drying up in the summer, and (5) greater connectivity between the lagoon and the local GW. A return to naturally functioning lagoon ecosystem conditions should allow for steelhead and other aquatic and terrestrial species to thrive within a highly productive lagoon ecosystem.

6 REFERENCES

Alley, D.W., 2013, Fishery biological assessment of the effects upon steelhead in Carmel River Lagoon from Implementation of the Ecological Protection Barrier, Scenic Road Protection Structure and the Draft Interim Sand bar Management Plan (Discussion Draft 9/8/2013), 47 p.

Anderson, T., Clark, C., Croyle, Z., Maas-Baldwin, J., Urquhart, K., and Watson, F., 2007, Carmel lagoon water quality and steelhead soundings: Fall 2007, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2007-04, 26 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Atkinson, K.A., 2010, Habitat conditions and steelhead abundance and growth in a California lagoon, Master's thesis, San Jose State University, 123 p.

California Irrigation Management Information System (CIMIS), 2010, Reference evapotranspiration rates, prepared for the California Department of Water Resources, 4 p.

Carmel Lagoon Memorandum of Understanding (CL-MOU-2012), 2012, Flood prevention and habitat protection at the Carmel Lagoon, 20 p.

Casagrande, J., Watson, F., Anderson, T., and Newman, W., 2002, Hydrology and water quality of the Carmel and Salinas Lagoons, Monterey Bay, California 2001/2002, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2002-04, 111 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Coates, M.J., and Guo, Y, 2003, The salt wedge position in a bar-clocked estuary subject to pulsed inflows, Estuarine, Coastal and Shelf Science, 58: 187-196.

County of Monterey, U.S. Army Corps of Engineers, and National Marine Fisheries Service (CL-MOU-2012), 2012, (Draft) Flood prevention and habitat protection at the Carmel Lagoon, Memorandum of Understanding, 20 p.

Debler, W., and Imberger, J., 1996, Flushing criteria in estuarine and laboratory experiments, Journal of Hydraulic Engineering, Vol. 122, No. 12, p. 728-734.

Feeney, M., 2003, personal communication with NMFS personnel.

Hampson, L., 2013, Monterey Peninsula Water Management District personnel, personal communications.

Hayes, S.A., Bond, M.H., Hanson, C.V., Freund, E.V., Smith, J.J., Anderson, E.C., Ammann, A.J., and MacFarlane, R.B., 2008, Steelhead growth in a small Central California watershed: upstream and estuarine rearing patterns, Transactions of the American Fisheries Society, 137: 114-128. DOI: 10.1577/T07-043.1.

Jacobs, D.K., Stein, E.D., and Longcore, T., 2011, Classification of California estuaries based on natural closure patterns: templates for restoration and management: technical report 619.a prepared for Southern California Coastal Water Research Project, 72 p.

James, G.W., 2005, Surface water dynamics at the Carmel River lagoon, water years 1991 through 2005, Monterey Peninsula Water Management District, 152 p.

James, G.W., 2013, Monterey Peninsula Water Management District personnel, personal communications.

Johnson, T., 2007, Battling seawater intrusion in the Central and West Coast Basins, Technical bulletin 13, Water replenishment district of Southern California, p. 2. Accessed on September 29, 2013 at http://www.wrd.org/engineering/reports/TB13_Fall07_Seawater_Barriers.pdf.

Larson, J., Watson, F., Casagrande, J., and Pierce, B., 2006, Carmel River Lagoon enhancement project: water quality and aquatic wildlife monitoring 2005-06, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, 102 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Larson, J., Watson, F,. Masek, J., Watts, M., Casagrande, J., 2005, Carmel River Lagoon enhancement project: water quality and aquatic wildlife monitoring 2004-05, report to California Department of Parks and Recreation from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, 134 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Moffatt and Nichol, 2013, Carmel River Lagoon Biological Assessment, Coastal Engineering Analysis: Draft report prepared for Monterey County Department of Public Works, 21 p.

Monterey Peninsula Water Management District (MPWMD), 2013, 2010-2011 annual report for the MPWMD mitigation program, 170 p. Accessed on July 25, 2013 at http://www.mpwmd.net/programs/mitigation_program/annual_report/annual_reportrev1.htm.

Monterey Peninsula Water Management District (MPWMD), 2011, 2009-2010 annual report for the MPWMD mitigation program, 161 p. Accessed on July 25, 2013 at http://www.mpwmd.net/programs/mitigation_program/annual_report/annual_reportrev1.htm.

Monterey Peninsula Water Management District (MPWMD), 2007, Study plan for long term adaptive management of the Carmel River State Beach and Lagoon, 40 p. Accessed on September 25, 2013 at http://www.mpwmd.dst.ca.us/Mbay_IRWM/IRWM_library/CarmelBay/LongTermStudyPlanFinal2007-04-17.pdf

National Marine Fisheries Service (NMFS), 2008, Biological Opinion for water supply, flood control operations, and channel maintenance conducted by the US Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservations Improvement District in the Russian River watershed, F/SWR/2006/07316, 386 p.

Philip Williams and Associates, Ltd., and Ecosystem Management International (PWA), 2007, Supplemental Carmel River watershed action plan, prepared for the Planning and Conservation League Foundation in partnership with the Carmel River Watershed Conservancy, p. 106.

Rich, A., and Keller, E.A., 2013, A hydrologic and geomorphic model of estuary breaching and closure. Geomorphology, vol. 191, p. 64-74. DOI: 10.1016/j.geomorph.2013.03.003.

Smith, J.J., 1990, the effects of sand bar formation and inflows on aquatic habitat and fish utilization in Pescadero, San Gregorio, Waddell and Pomponio Creek estuary/lagoon

systems, 1985-1989. Report prepared under Interagency Agreement 84-04-324, between Trustees for California State University and the California Department of Parks and Recreation, 47 p. + 4 tables and 52 figures.

Thornton, E.B., 2005, Littoral processes and river breachings at Carmel River Beach, prepared for the Monterey Peninsula Water Management District,12 p.

Urquhart, K.U., 2013, Carmel River fisheries reports for water year 2012 and October through December water year 2013, Monterey Peninsula Water Management District, 34 p.

Van Dyke, E., and Wasson, K., 2005, Historical ecology of a Central California estuary: 150 years of habitat change, Estuaries, Vol. 28, No. 2, p. 173-189.

Watson, F., Newman, W., Anderson, T., Alexander, S., Kozlowski, D., 2001, Winter water quality of the Carmel and Salinas Lagoons, Monterey Bay, California 2000/2001, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2001-01, 42 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Watson F., and Casagrande, J., 2004, Potential effects of GW extractions on Carmel Lagoon, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2001-01, 42 p.

Whitson Engineers, 2013a, Carmel River Lagoon ecosystem protective barrier (EPB) and scenic road protection structure (SRPS) projects feasibility report, prepared for Monterey County Water Resources Agency and Monterey County Department of Public Works, 43 p.

Whitson Engineers, 2013b, Carmel River Lagoon EPB, SRPS, and ISMP updated stage-volume-area analysis, p. 4.

Zhang, J., Guo, Y., Shen, Y., Zhang, L., 2008, Numerical simulation of flushing of trapped slat water from a bar-blocked estuary, Journal of Hydraulic Engineering, 134:11(1671), DOI: 10.1061/(ASCE)0733-9429.

A report prepared for:

January 24, 2014

Monterey County Resource Management Agency
168 West Alisal Street, 2nd Floor
Salinas, California 93901

by

Edward D. Ballman, P.E.
Principal Civil Engineer

Anne E. Senter
Geomorphologist/Hydrologist

Balance Hydrologics, Inc.®

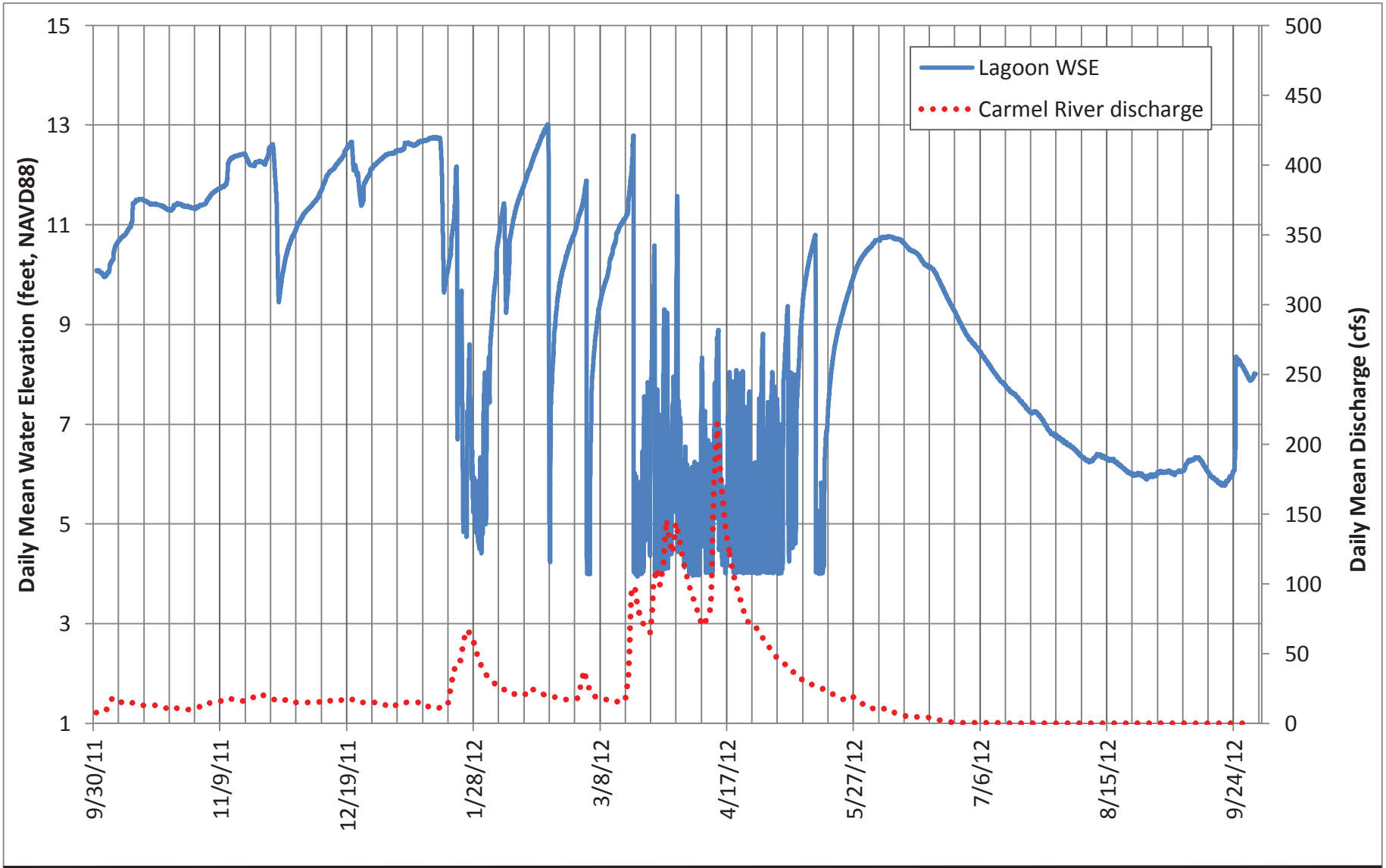
© 2014 Balance Project Assignment: 212151

800 Bancroft Way, Suite 101 ~ Berkeley, California 94710-2800 ~ (510) 704-1000 ~ *office@balancehydro.com*

APPENDICES

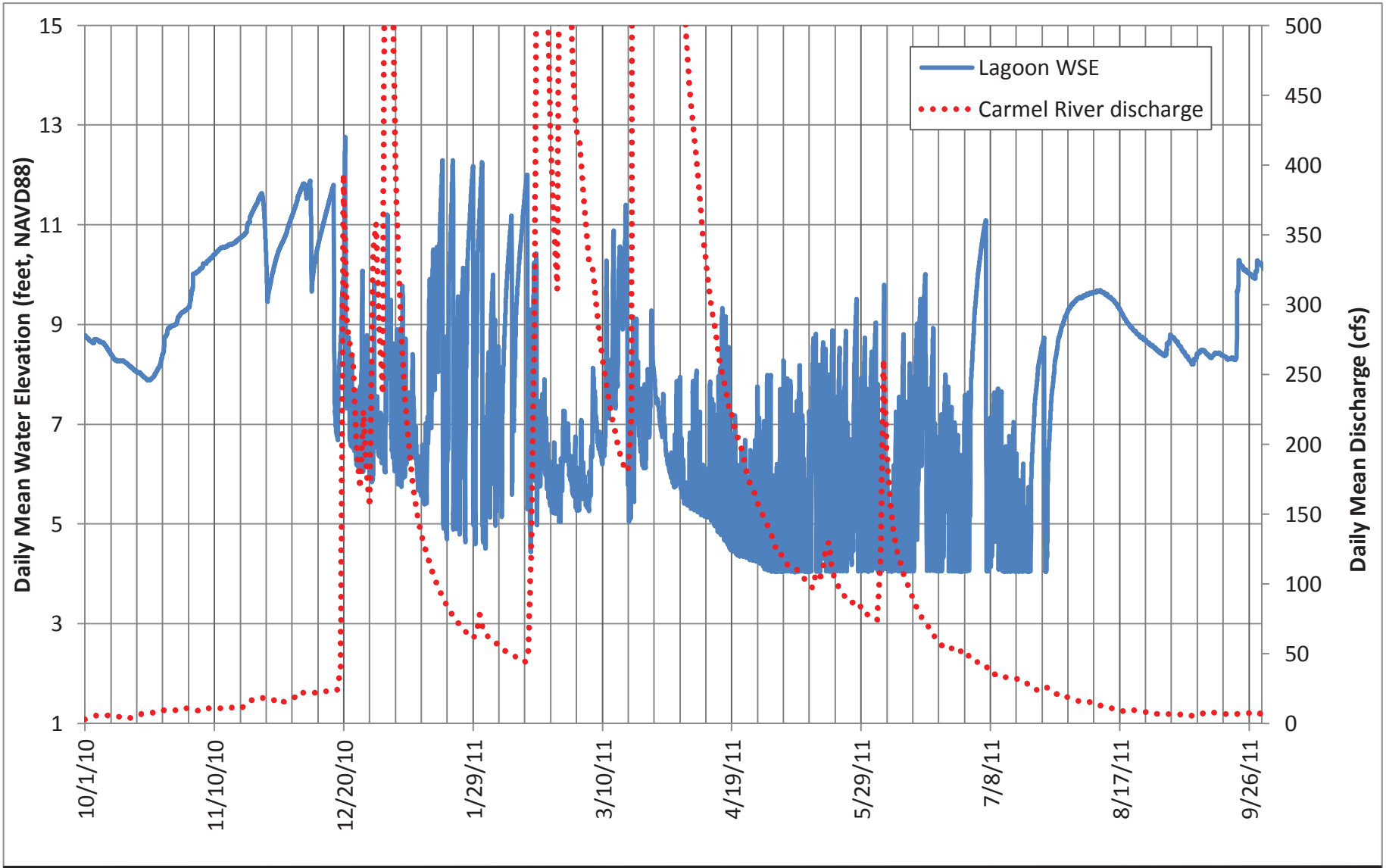
APPENDIX A

Water surface elevations in Carmel Lagoon and streamflow in Carmel River at Highway 1 gage, WYs 1993-2012



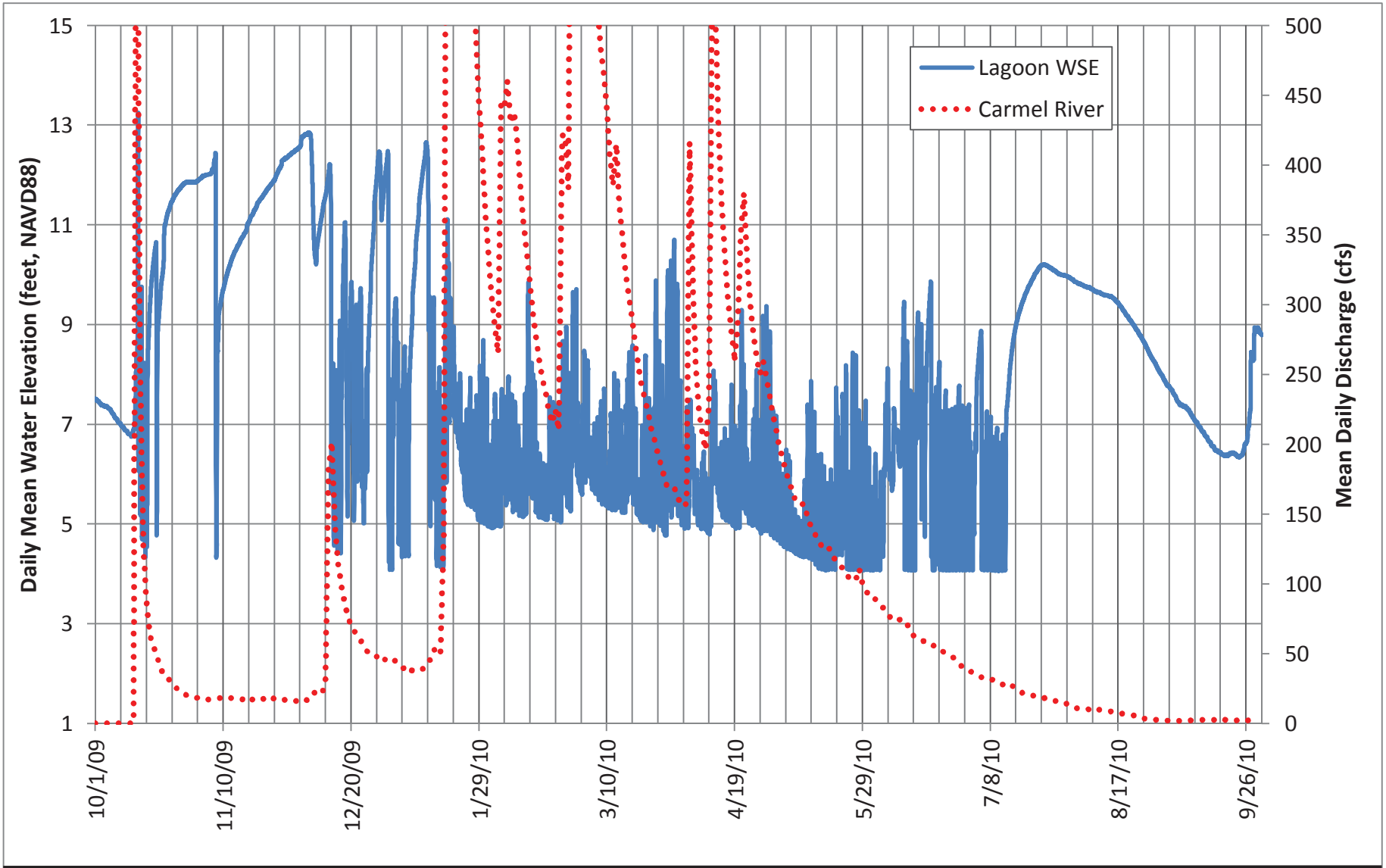
Balance Hydrologics, Inc.®

Figure 1. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2012, Monterey County, California. Sources: Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



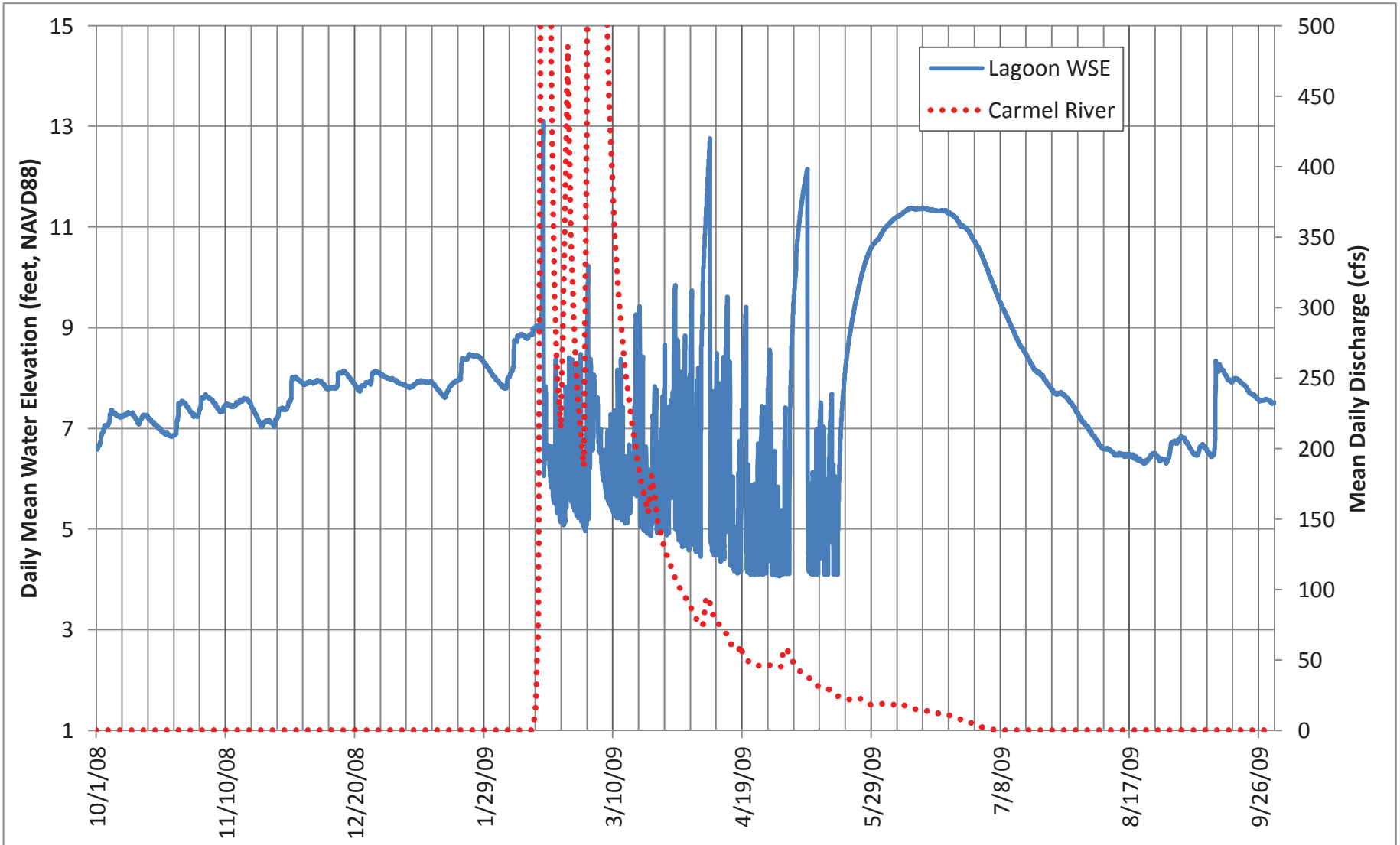
Balance Hydrologics, Inc.®

Figure 2. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2011, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



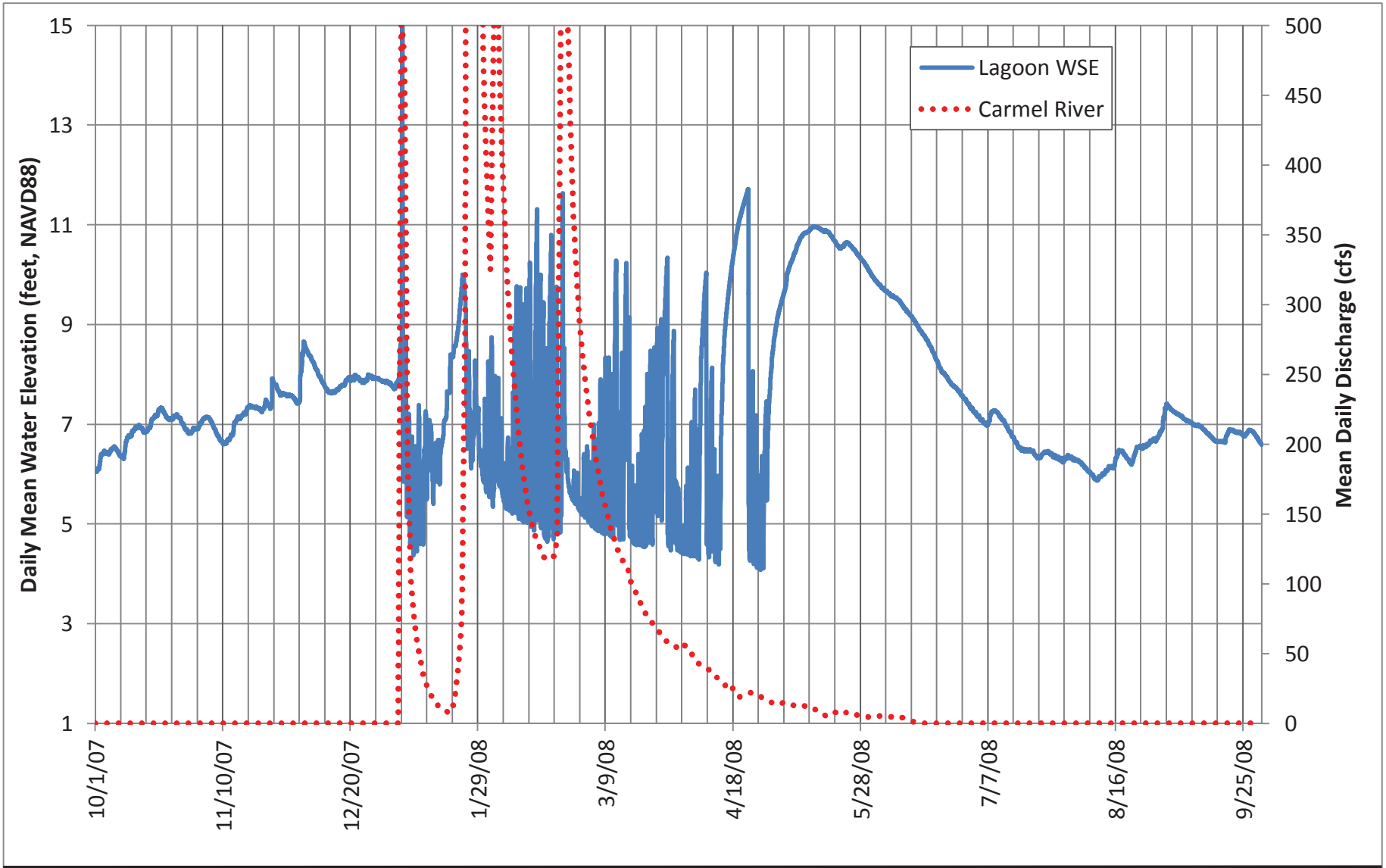
Balance Hydrologics, Inc.®

Figure 3. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2010, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



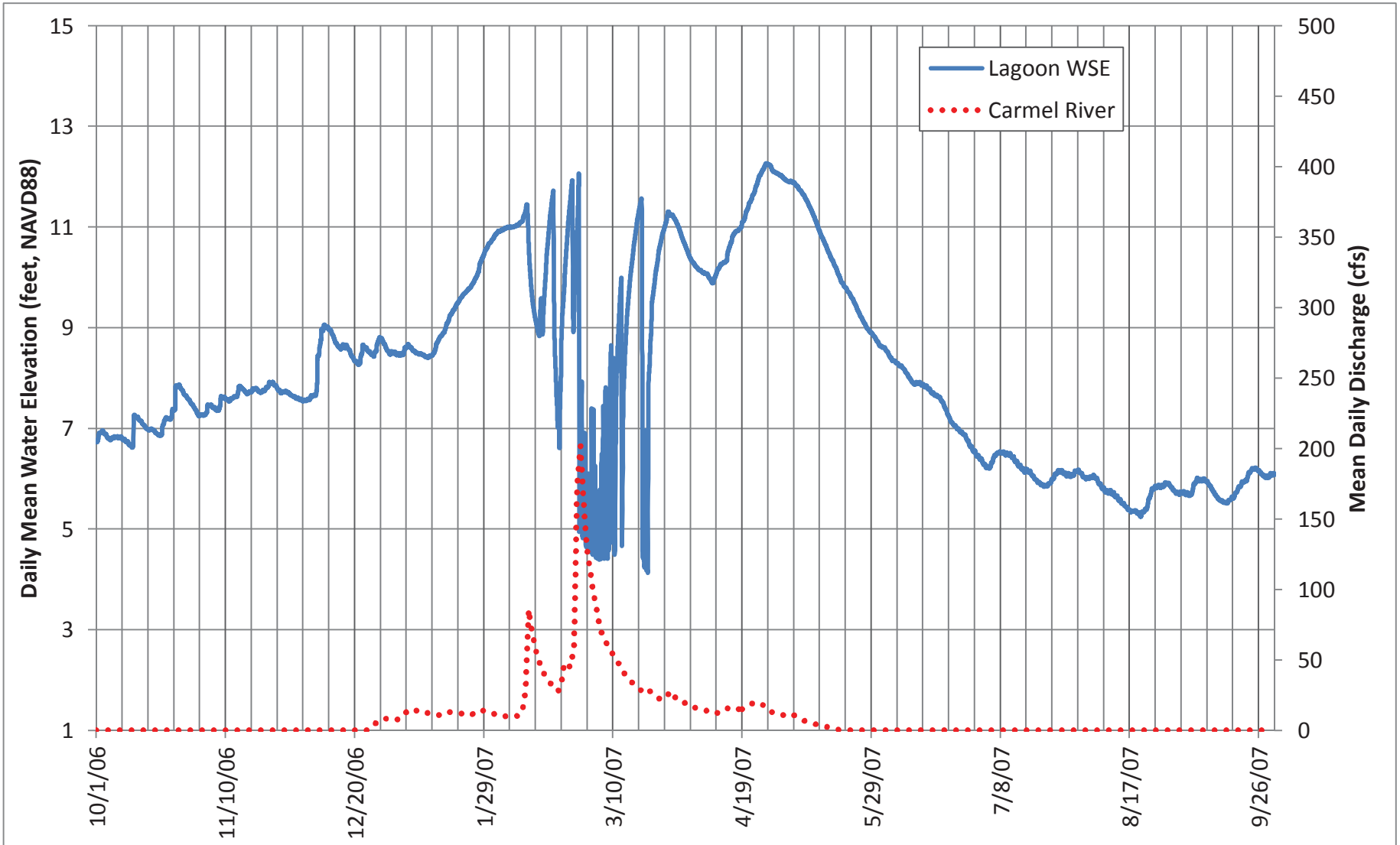
Balance Hydrologics, Inc.®

Figure 4. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2009, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



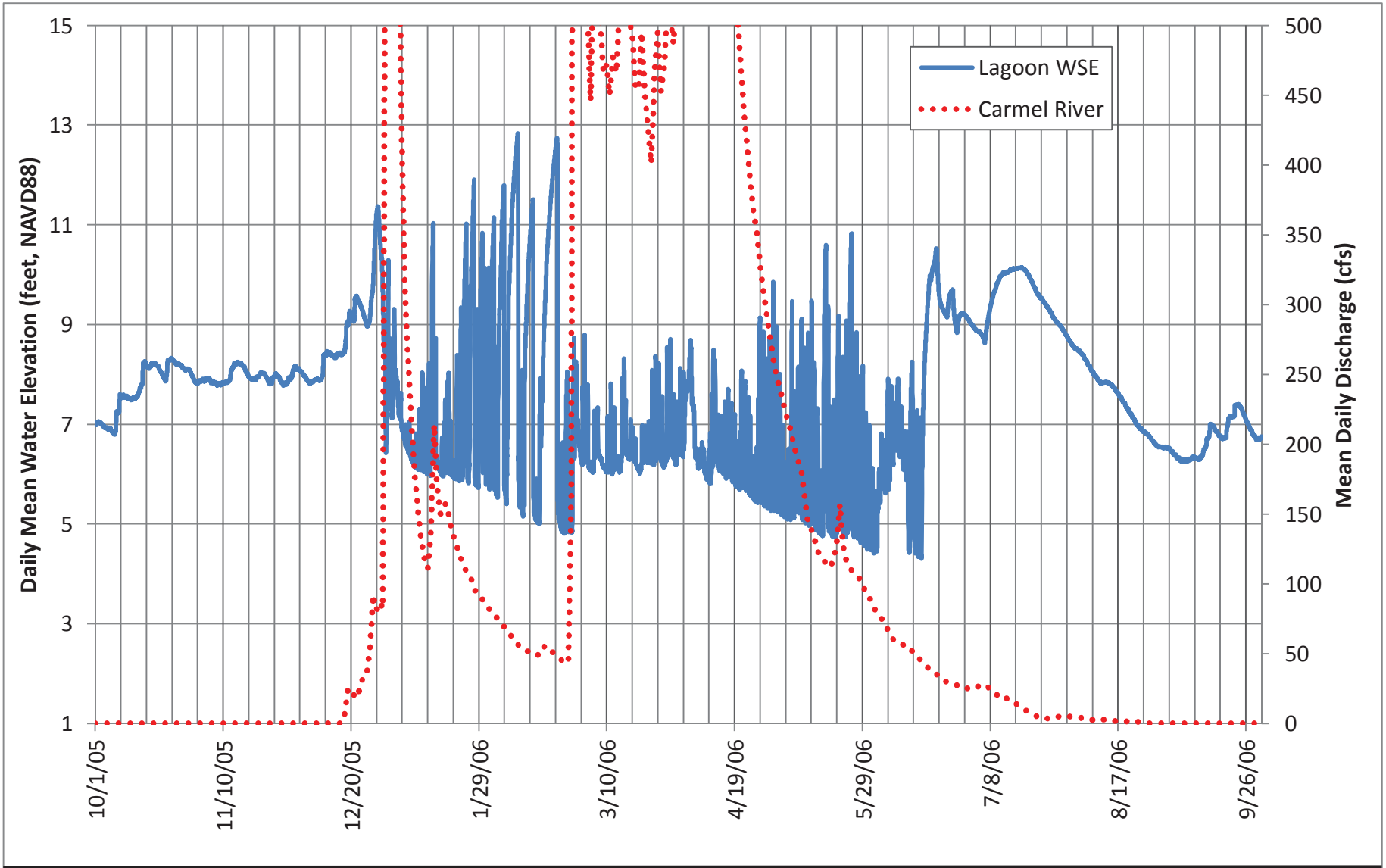
Balance Hydrologics, Inc.®

Figure 5. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2008, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



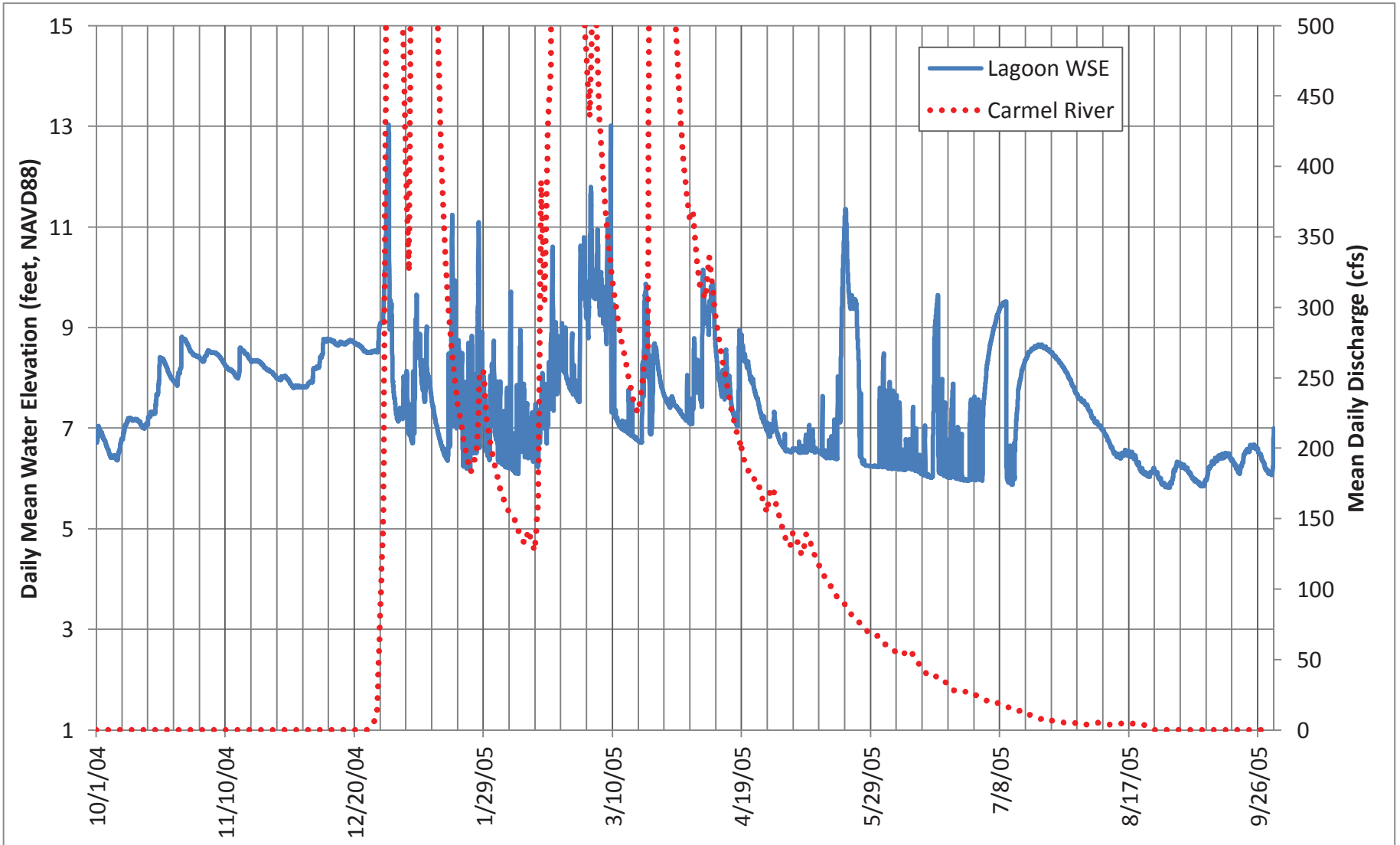
Balance Hydrologics, Inc.®

Figure 6. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2007, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



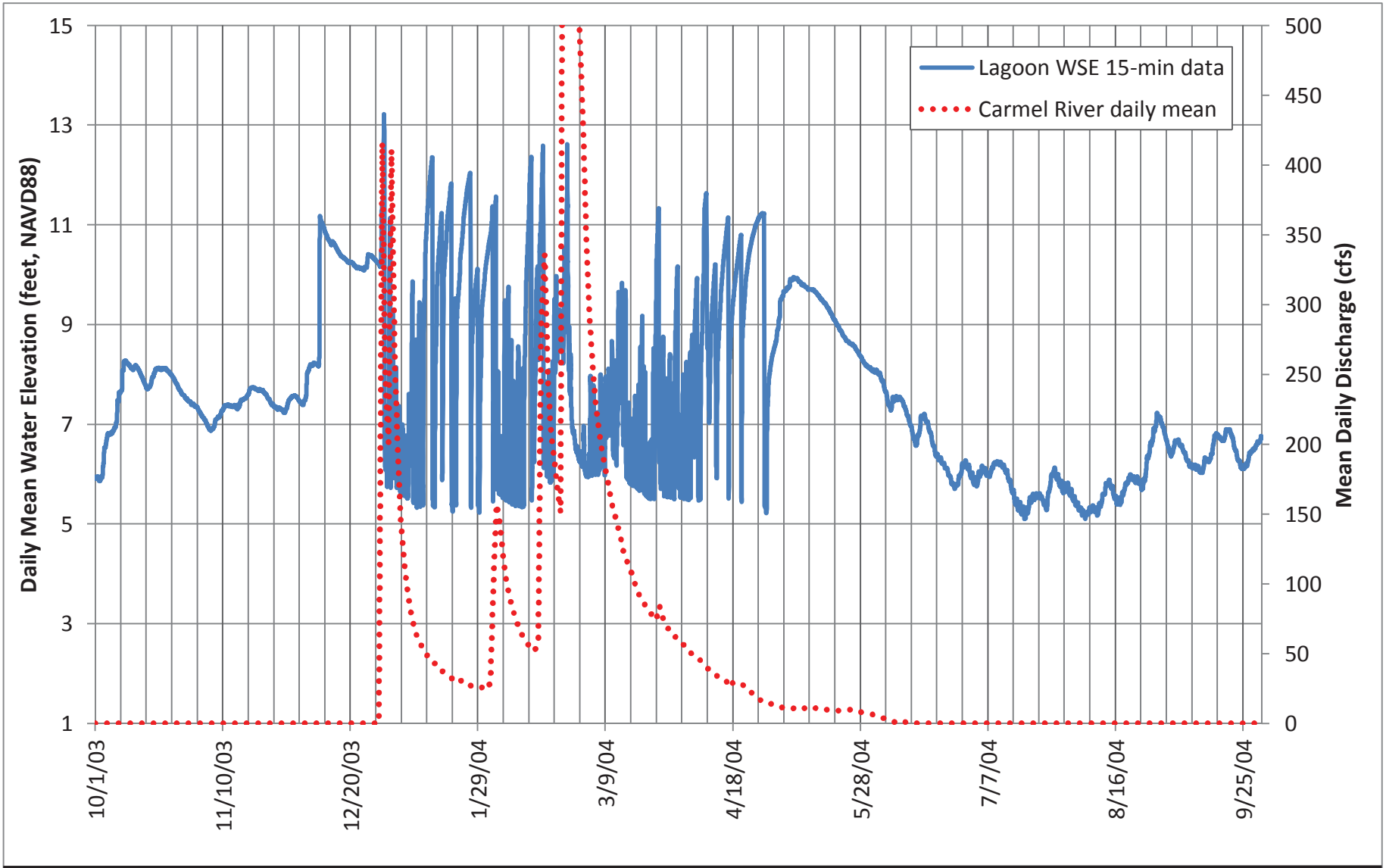
Balance Hydrologics, Inc.®

Figure 7. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2006, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



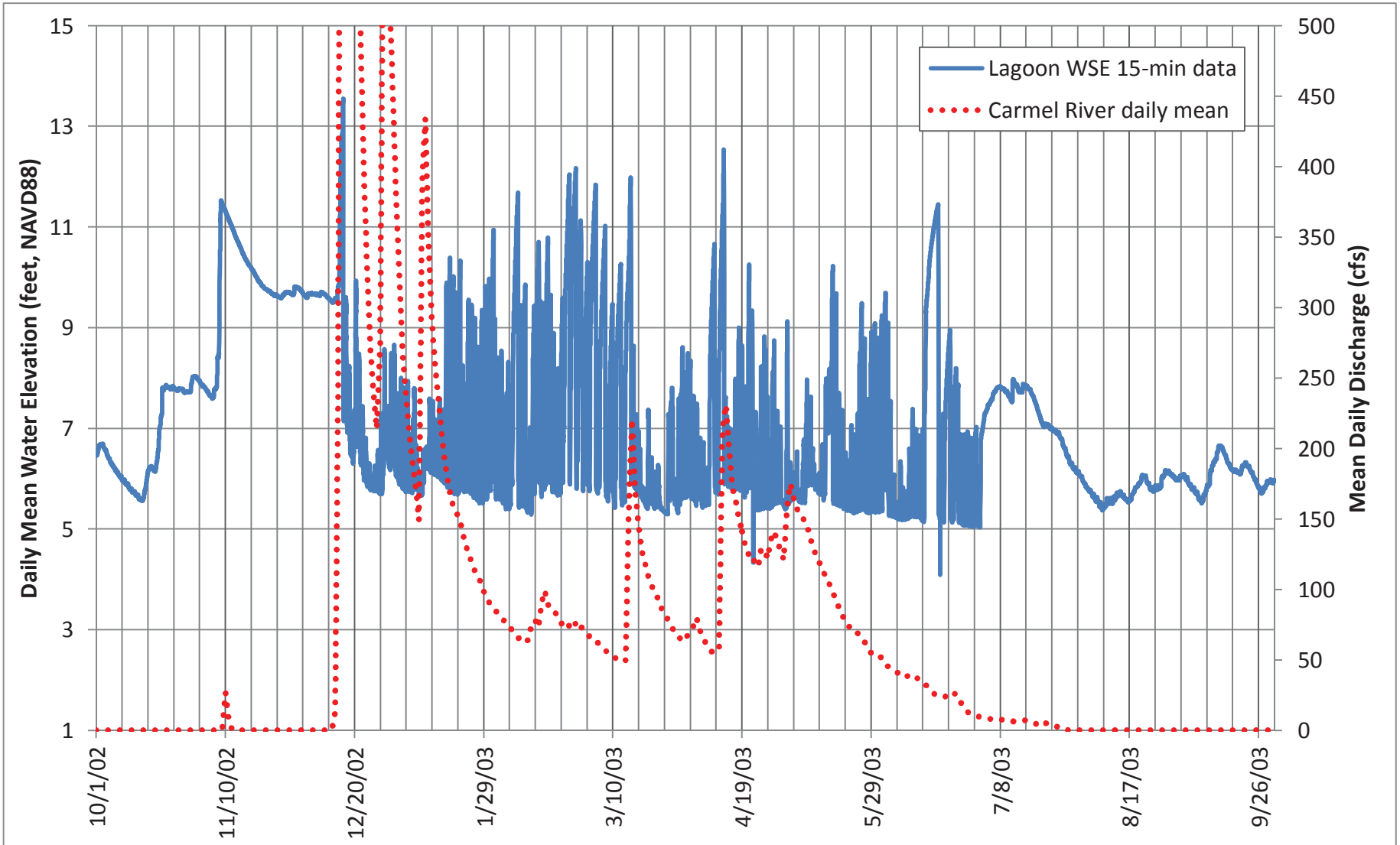
Balance Hydrologics, Inc.®

Figure 8. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2005, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



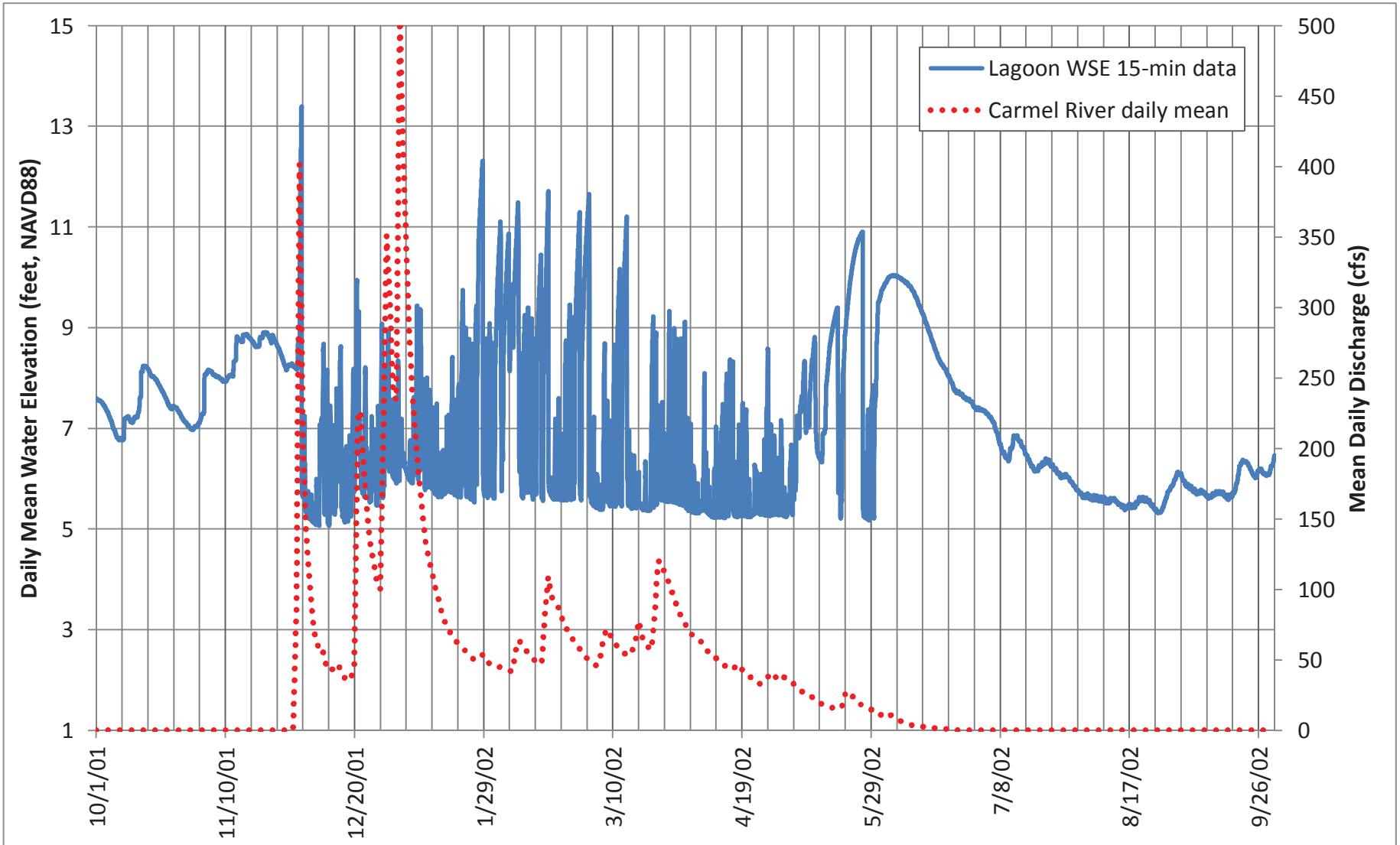
Balance Hydrologics, Inc.®

Figure 9. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2004, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



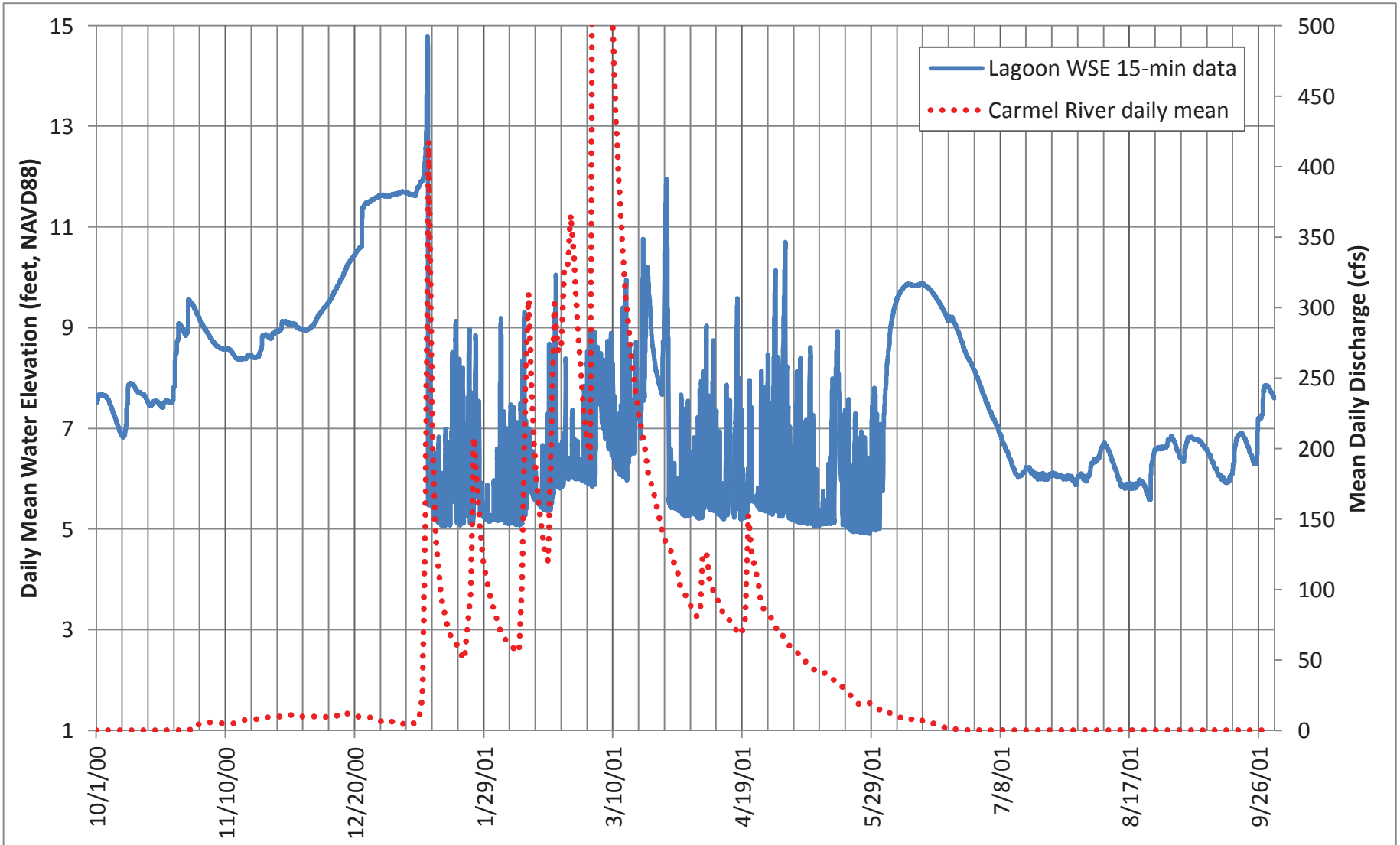
Balance Hydrologics, Inc.®

Figure 10. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2003, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



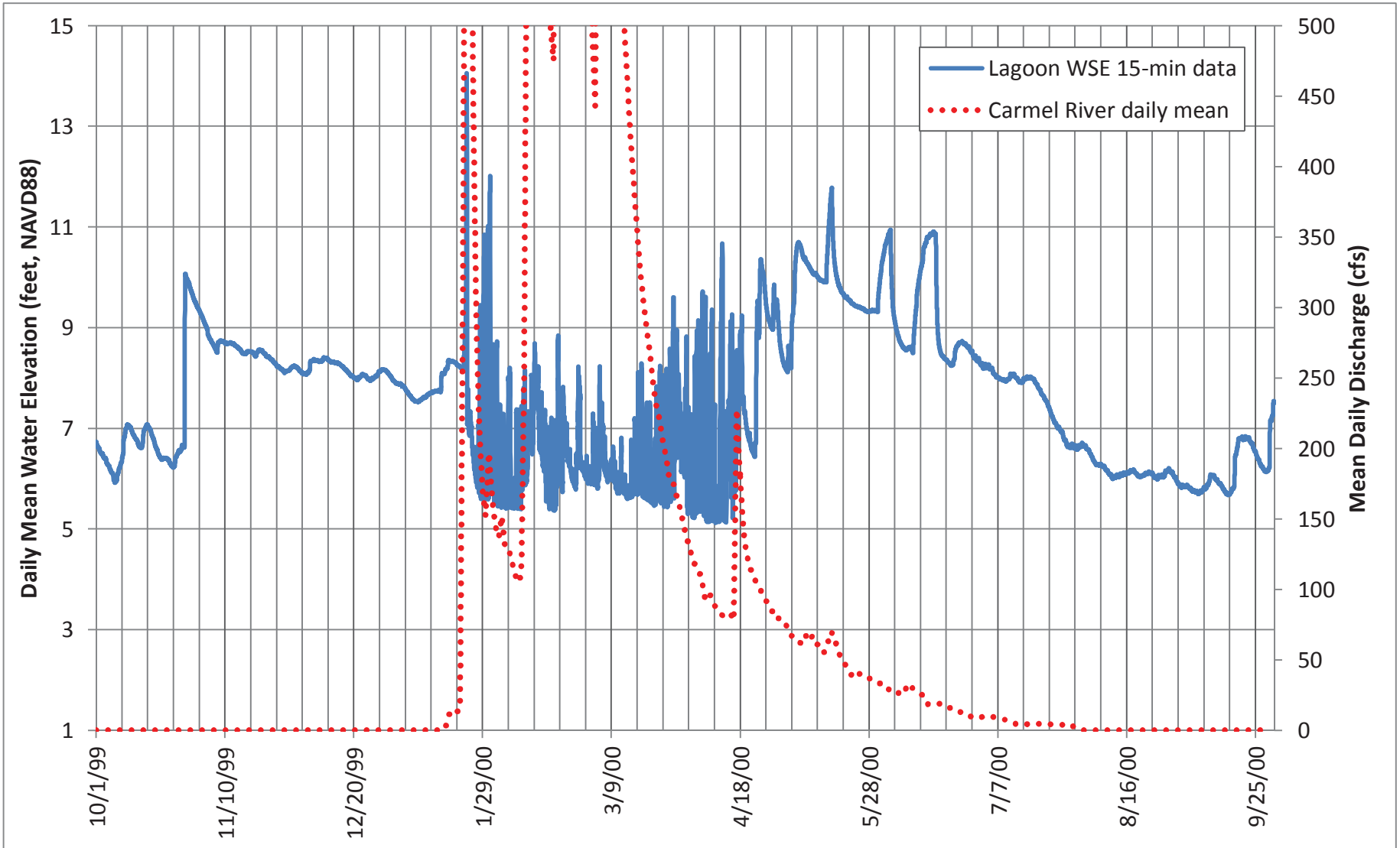
Balance Hydrologics, Inc.®

Figure 11. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2002, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



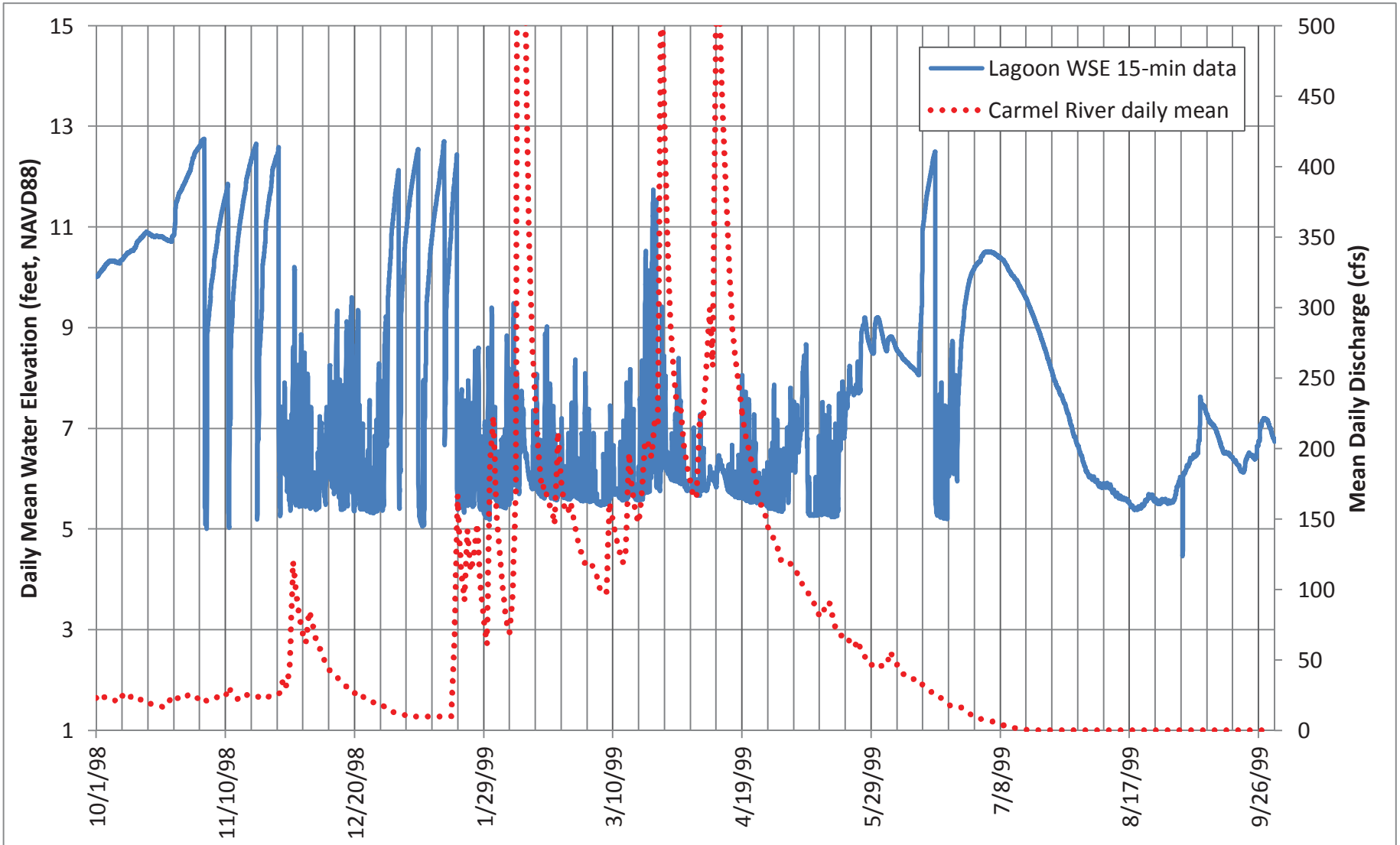
Balance Hydrologics, Inc.®

Figure 12. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2001, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



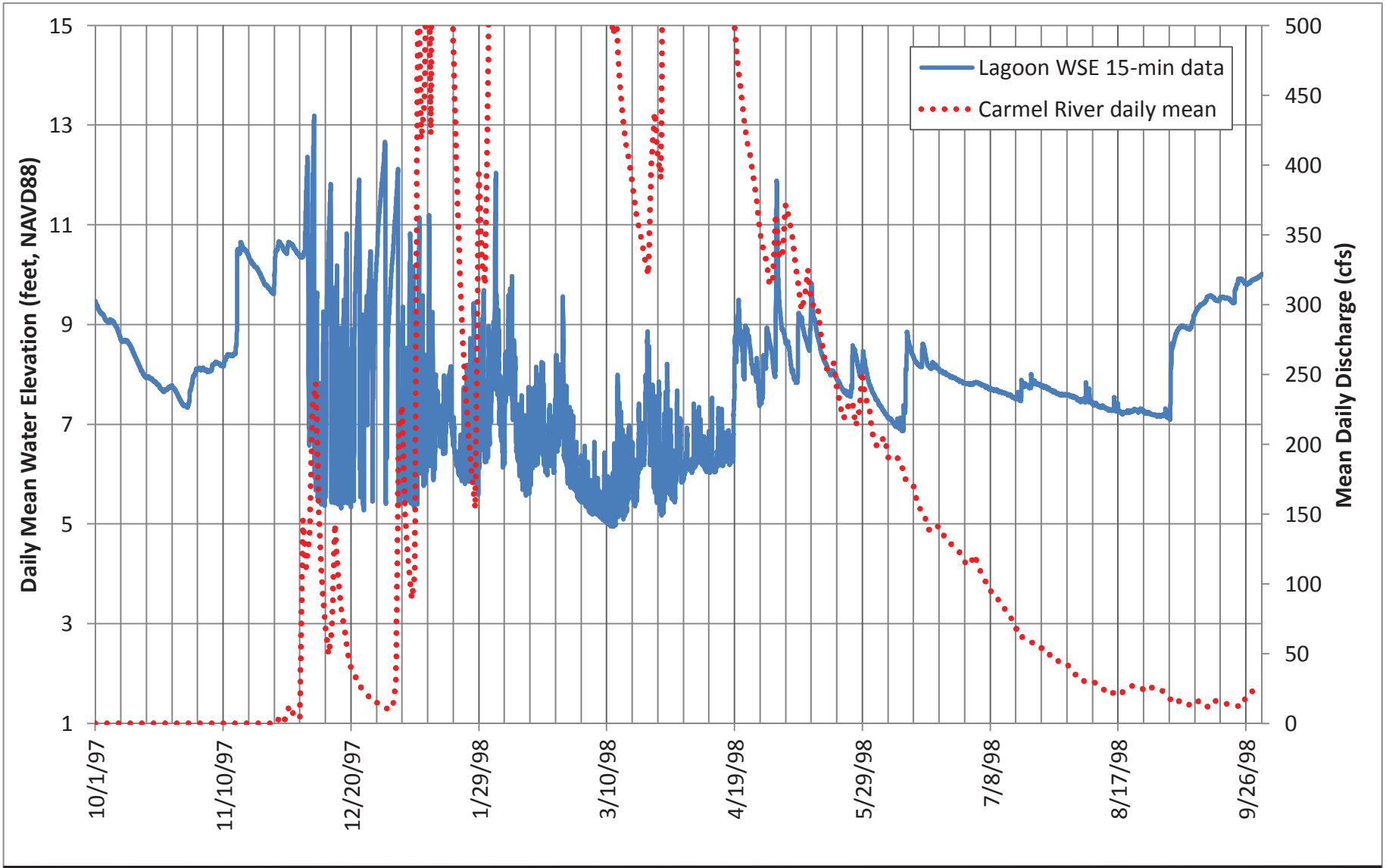
Balance Hydrologics, Inc.®

Figure 13. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2000, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



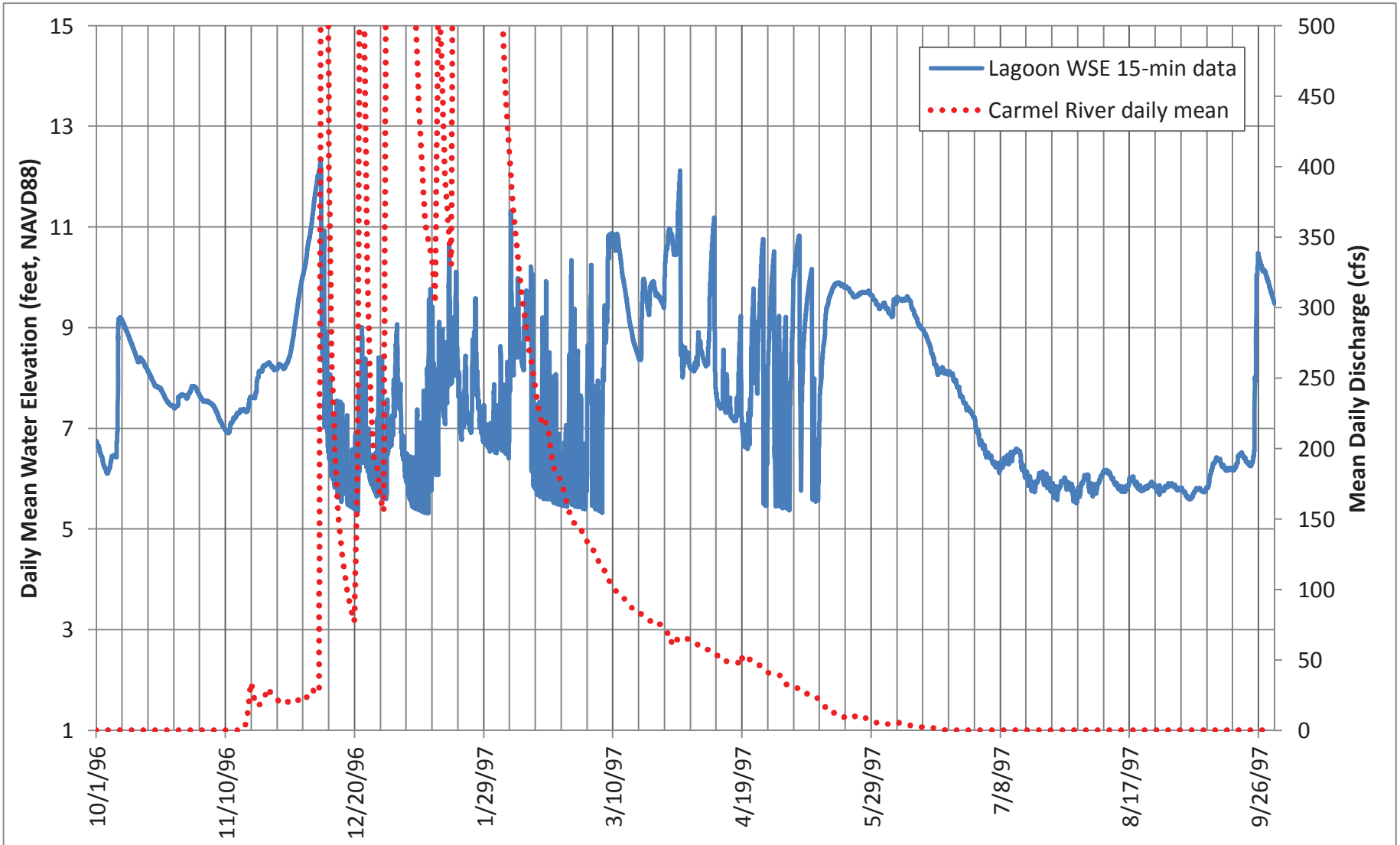
Balance Hydrologics, Inc.®

Figure 14. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1999, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



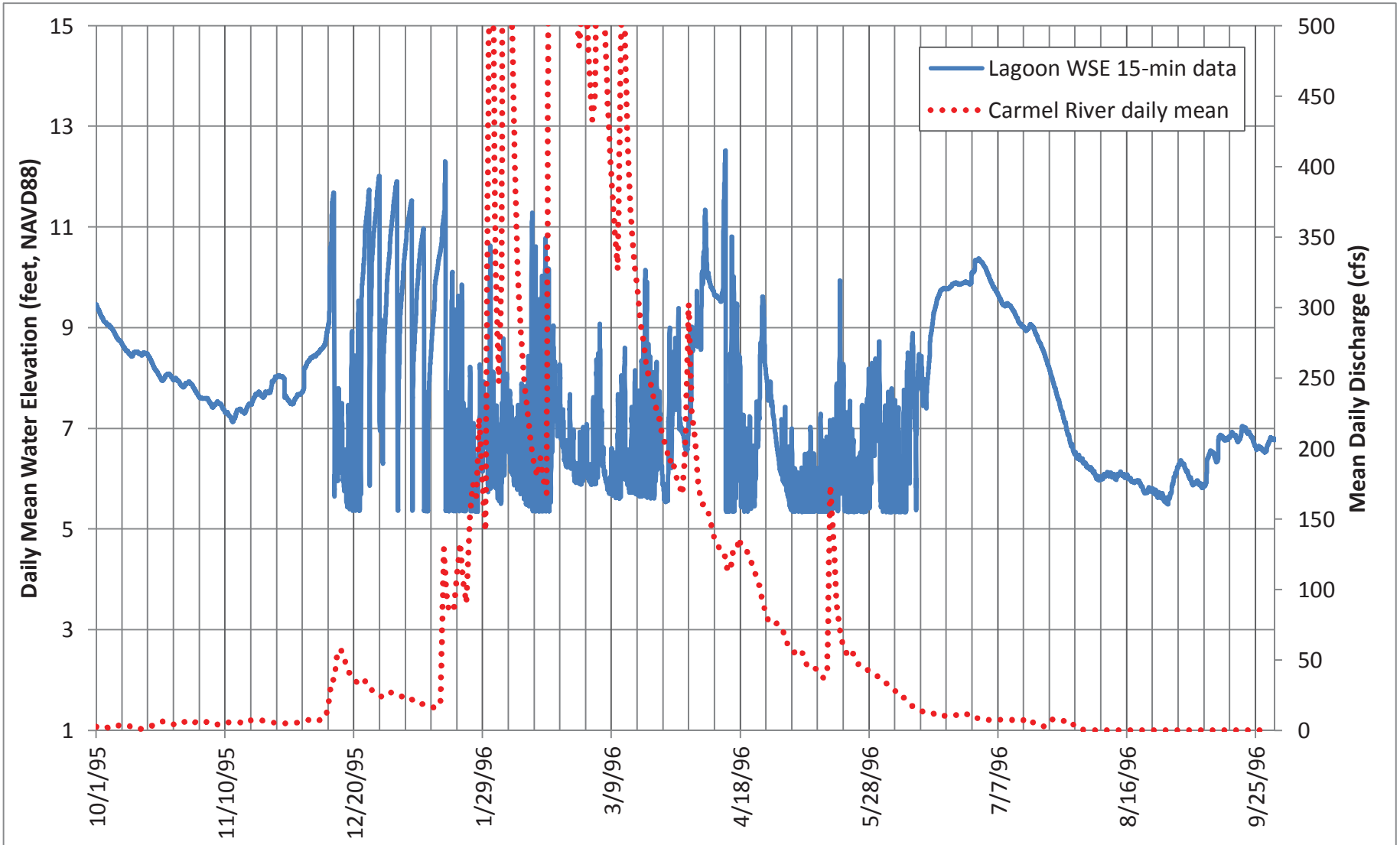
Balance Hydrologics, Inc.®

Figure 15. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1998, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



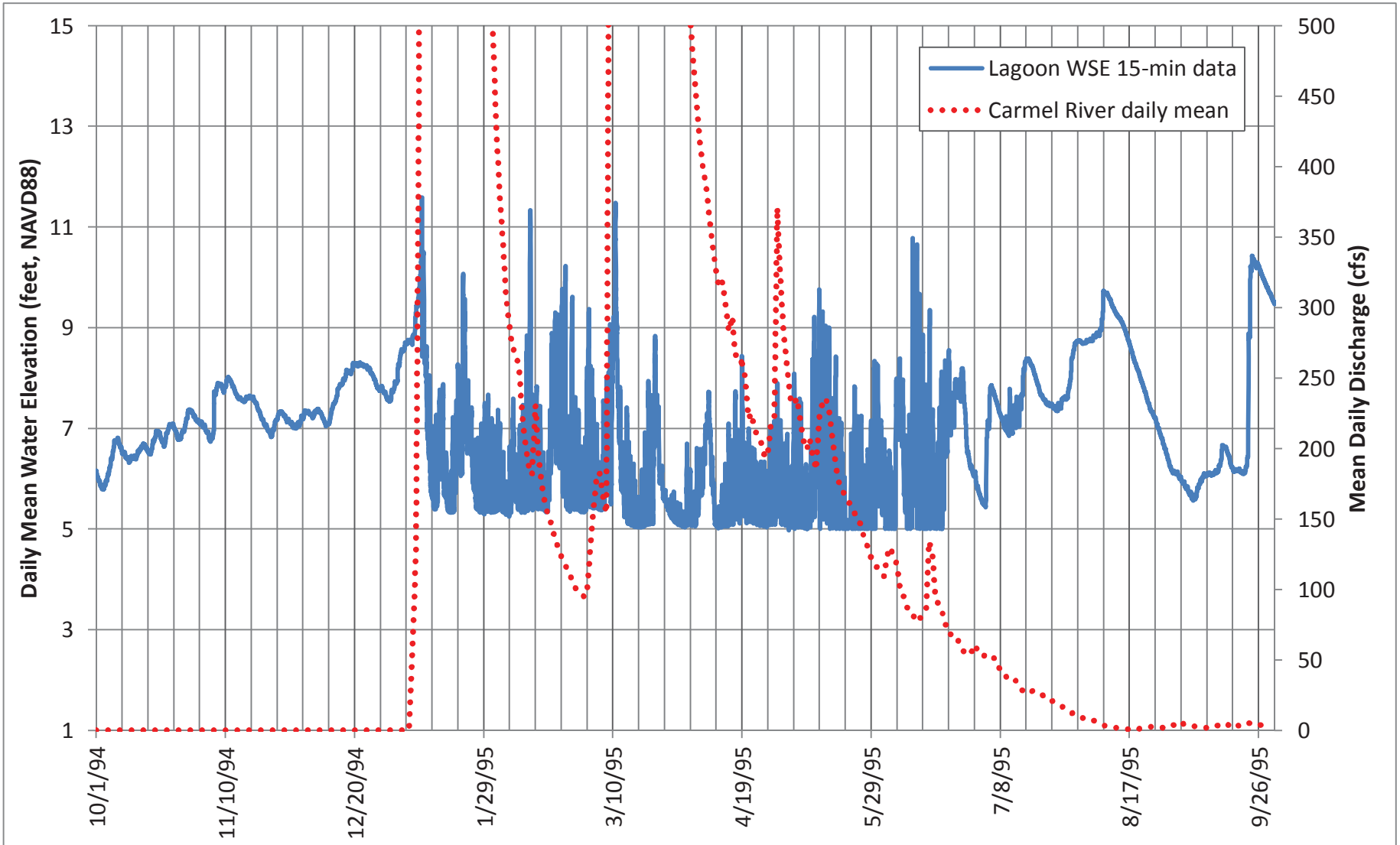
Balance Hydrologics, Inc.®

Figure 16. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1997, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



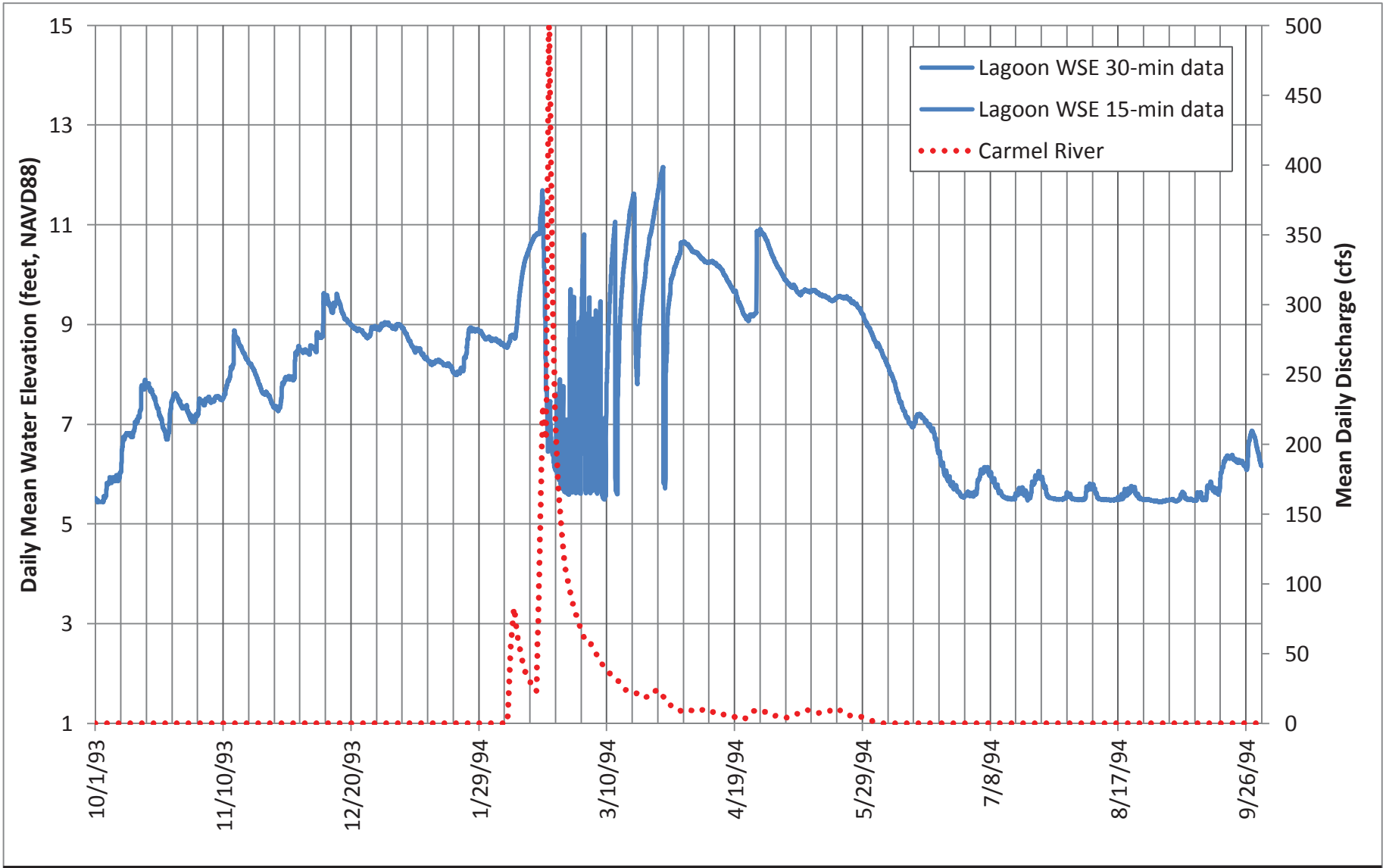
Balance Hydrologics, Inc.®

Figure 17. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1996, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



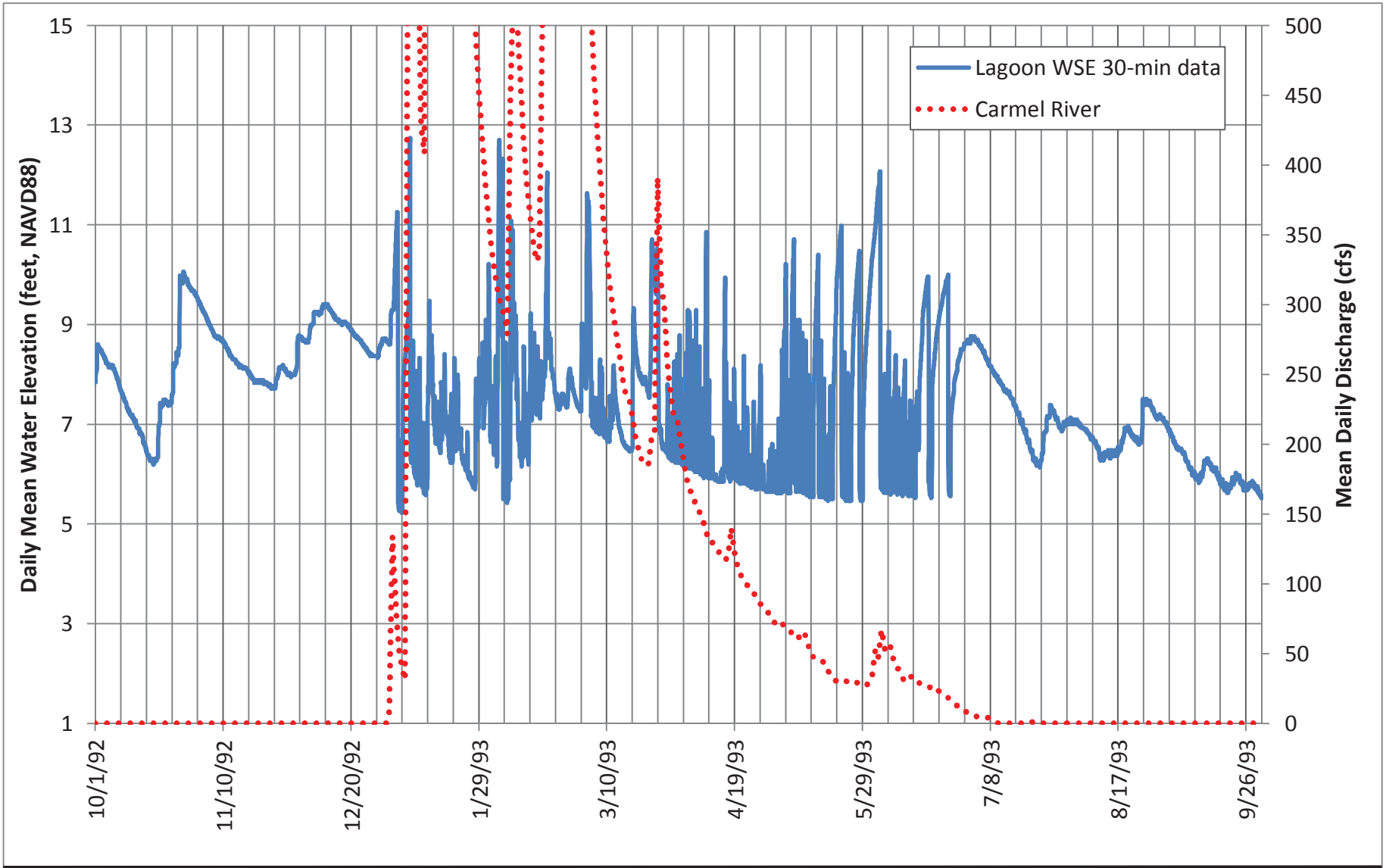
Balance Hydrologics, Inc.®

Figure 18. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1995, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



Balance Hydrologics, Inc.®

Figure 19. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1994, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



Balance Hydrologics, Inc.®

Figure 20. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1993, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.

APPENDIX B

Compilation tables of riverine dynamics of breaches and closures, WYs 1993-2012

Table 1. WY 2012, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Temporary breach	Temporary breach	In-season closure	Temporary breach	Temporary breach	In-season closure	Sustained breach*	In-season closure	Temporary breach	In-season closure	Sustained breach	In-season closure	Sustained breach	In-season closure	Sustained breach	Early closure	Final Closure	WSE increase while closed
Mechnical, Natural, or Unknown		Mechanical	Mechanical		Mechanical	Mechanical		Mechanical		Natural		Natural		Natural		Natural	Mechanical	Mechanical	
Dry Season Events	10/1/2011 0:00																		
Date-Time of lowest lagoon WSE prior to breach	10/3/2011 15:30																		
Lowest lagoon WSE during closure, this WY	9.95																		
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach																			
Date-Time of lowest WSE prior to significant increase in WSE																			9/21/12 9:15
WSE (ft)																			5.78
Date-Time of highest WSE post-increase																			9/24/12 21:15
WSE (ft)																			8.36
Increase in WSE (ft)																			2.58
Likely mechanism with greatest influence on WSE increase process																			Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE																			0
Date-Time of most recent WSE > 11 ft prior to breach, this WY	11/16/2011 20:15																		
Time (days) between start of WY and first seasonal breach	46.8																		
Breachs and Closures during rainy season																			
Date-Time of highest WSE at time of breach		11/16/2011 20:15	11/25/2011 17:45		12/20/2011 16:00	1/17/2012 11:30		1/22/2012 17:30		2/6/2012 18:30		2/20/2012 14:30		3/3/2012 17:30		3/18/2012 13:30			
WSE (ft)		12.43	12.62		12.66	12.74		12.17		11.43		13.01		11.89		12.79			
Date-Time of lowest WSE directly following breach		11/19/2011 13:30	11/27/2011 15:30		12/23/2011 15:00	1/18/2012 18:15		1/23/2012 1:30		2/7/2012 9:15		2/21/2012 5:30		3/4/2012 0:15		3/18/2012 17:15			
WSE (ft)		12.19	9.45		11.38	9.64		6.69		9.24		4.24		4.00		4.03			
WSE pre-breach minus post-breach (ft)		0.23	3.17		1.28	3.10		5.47		2.19		8.77		7.88		8.76			
Time difference (days)		2.72	1.91		2.96	1.28		0.33		0.61		0.63		0.28		0.16			
Time difference (hours)		65.25	45.75		71.00	30.75		8.00		14.75		15.00		6.75		3.75			
Rate of WSE decline (ft/hr)		0.00	0.07		0.02	0.10		0.68		0.15		0.58		1.17		2.34			
Mean daily flow rate (cfs) on day of breach		16	18		17	11		39		25		20		38		96			
Mean daily flow rate (cfs) on day of lowest WSE following breach		17	17		15	12		39		24		20		30		96			
Likely mechanism with greatest influence on breaching process		Mechanical	Mechanical		Mechanical	Mechanical		Mechanical/Riverine		Mechanical		Unknown		Riverine		Riverine			
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				11/27/2011 15:30			1/18/2012 18:30		2/2/2012 3:15		2/7/2012 9:45		2/21/2012 5:30		3/4/2012 18:45				
WSE (ft)				9.45			9.64		7.43		9.23		4.24		3.99				
Date-Time of lagoon WSE fills to > 11 feet				12/3/2011 13:00			1/21/2012 17:45		2/5/2012 11:15		2/9/2012 10:00		2/29/2012 16:30		3/14/2012 11:00				
WSE (ft)				11.00			11.00		11.00		11.00		11.00		11.00				
Date-Time of lagoon falls below WSE > 11 feet				1/18/2012 9:00			1/22/2012 21:30		2/6/2012 22:30		2/20/2012 20:45		3/3/2012 18:30		3/18/2012 14:30				
WSE (ft)				10.97			10.83		10.99		10.93		10.85		9.76				
Time (days) of WSE > 11 feet				45.83			1.16		1.47		11.45		3.08		4.15				
Time (hours) of WSE > 11 feet				1100.0			27.8		35.3		274.8		74.0		99.5				
Mean daily flow rate (cfs) on day lowest WSE				17			12		33		24		20		30				
Mean daily flow rate (cfs) on day WSE > 11 feet				15			27		27		22		17		15				
Mean daily flow rate (cfs) on day WSE < 11 feet				12			39		25		20		38		96				
Likely mechanism with greatest influence on closure process				Ocean			Ocean		Ocean		Ocean		Ocean		Ocean				
Dry Season Closure																			
Date-Time of highest WSE at WY closure																	5/15/2012 1:15	6/7/2012 2:15	
WSE (ft)																	10.80	10.77	
Date-Time of lowest WSE during WY closure																	5/15/2012 16:15	9/20/2012 13:00	
WSE (ft)																	4.02	5.77	
Time (days) difference highest minus lowest WSE																	0.63	105.45	
Time (hours) difference highest minus lowest WSE																	15.00	2530.75	
Highest WSE at closure minus lowest WSE during closure in this WY																	6.77	5.00	
Rate of decrease in WSE (ft/day)																	0.452	0.002	
Mean daily flow rate (cfs) on day of highest WSE at closure																	27	27	
Mean daily flow rate (cfs) on day of lowest WSE of dry season																	n/a	0	
Likely mechanism with greatest influence on process																	Mechanical	Ocean	
End of WY																		9/30/2012 23:45	
Time (days) between final season closure and end of WY																		115.9	
Total days of lagoon closure in this WY (pre- and post-rainy season)																		162.7	
Totel days of closure including all partial closures																		184.0	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as temporary lagoon closing due to mechanical or ocean processes approximately 1 month to 1 week before than final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included the sum of days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the MPWMD WY 2012 fisheries report (Urquhart, 2013)

Table 2. WY 2011, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Temporary breach	In-season closure	Temporary breach	In-season closure	Sustained breach*	In-season closure	Sustained breach	In-season closure	Sustained breach	Final Closure
Natural, Mechanical or Unknown		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	Mechanical
Dry Season Events	10/1/2010 0:00										
Date-Time of lowest lagoon WSE prior to breach	10/21/2010 8:15										
Lowest lagoon WSE during closure, this WY	7.89										
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach											
Date-Time of lowest WSE prior to significant increase in WSE											
WSE (ft)											
Date-Time of highest WSE post-increase											
WSE (ft)											
Increase in WSE (ft)											
Likely mechanism with greatest influence on WSE increase process											
Mean daily flow rate (cfs) on day of highest WSE											
Date-Time of most recent WSE > 11 ft prior to breach, this WY	11/24/2010 16:00										
Time (days) between start of WY and first seasonal breach	54.7										
Breachs and Closures during rainy season											
Date-Time of highest WSE at time of breach		11/24/2010 16:00		12/9/2010 15:15		12/16/2010 20:45		1/29/2011 0:15		2/14/2011 17:45	
WSE (ft)		11.63		11.89		11.80		12.18		12.01	
Date-Time of lowest WSE directly following breach		11/26/2010 9:30		12/10/2010 1:30		12/18/2010 3:30		1/29/2011 3:30		2/14/2011 21:15	
WSE (ft)		9.46		9.66		6.69		4.97		5.30	
WSE pre-breach minus post-breach (ft)		2.16		2.22		5.11		7.21		6.71	
Time difference (days)		1.73		0.43		1.28		0.14		0.15	
Time difference (hours)		41.50		10.25		30.75		3.25		3.50	
Rate of WSE decline (ft/hr)		0.05		0.22		0.17		2.22		1.92	
Mean daily flow rate (cfs) on day of breach		19		15		17		51		21	
Mean daily flow rate (cfs) on day of lowest WSE following breach		17		15		16		51		21	
Likely mechanism with greatest influence on breaching process		Mechanical		Mechanical		Mechanical		Riverine		Mechanical	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours			11/26/2010 9:30		12/10/2010 1:30		1/26/2011 14:15		2/3/2011 5:30		
WSE (ft)			9.46		9.66		4.63		5.13		
Date-Time of lagoon WSE fills to > 11 feet			12/3/2010 0:45		12/13/2010 14:15		1/27/2011 21:00		2/13/2011 6:00		
WSE (ft)			11.00		11.00		11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet			12/9/2010 21:45		12/16/2010 22:15		1/29/2011 1:15		2/14/2011 19:30		
WSE (ft)			10.99		10.94		10.48		10.70		
Time (days) of WSE > 11 feet			6.88		3.33		1.18		1.56		
Time (hours) of WSE > 11 feet			165.0		80.0		28.3		37.5		
Mean daily flow rate (cfs) on day lowest WSE			18		22		67		61		
Mean daily flow rate (cfs) on day WSE > 11 feet			15		17		64		21		
Mean daily flow rate (cfs) on day WSE < 11 feet			15		17		51		21		
Likely mechanism with greatest influence on closure process			Ocean		Ocean		Ocean		Unknown		
Dry Season Closure											
Date-Time of highest WSE at WY closure											8/11/2011 1:45
WSE (ft)											9.69
Date-Time of lowest WSE during WY closure											9/8/2011 12:00
WSE (ft)											8.20
Time (days) difference highest minus lowest WSE											28.43
Time (hours) difference highest minus lowest WSE											682.25
Highest WSE at closure minus lowest WSE during closure in this WY											1.48
Rate of decrease in WSE (ft/day)											0.002
Mean daily flow rate (cfs) on day of highest WSE at closure											13
Mean daily flow rate (cfs) on day of lowest WSE of dry season											0
Likely mechanism with greatest influence on process											Ocean
End of WY											9/30/2011 23:45
Time (days) between final season closure and end of WY											50.9
Total days of lagoon closure in this WY (pre- and post-rainy season)											105.6
Totel days of closure including all partial closures											118.5

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD, 2010-2011 annual mitigation report

Table 3. WY 2010, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Sustained breach*	In-season closure	Sustained breach	In-season closure	Temporary breach	In-season closure	Sustained breach	In-season closure	Sustained breach	In-season closure	Sustained breach	Final Closure
Natural, Mechanical or Unknown		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	Natural
Dry Season Events	10/1/2009 0:00												
Date-Time of lowest lagoon WSE prior to breach	10/12/2009 5:00												
Lowest lagoon WSE during closure, this WY													
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach													
Date-Time of lowest WSE prior to significant increase in WSE	--												
WSE (ft)													
Date-Time of highest WSE post-increase													
WSE (ft)													
Increase in WSE (ft)													
Likely mechanism with greatest influence on WSE increase process													
Mean daily flow rate (cfs) on day of highest WSE													
Date-Time of most recent WSE > 11 ft prior to breach, this WY	10/14/2009 9:45												
Time (days) between start of WY and first seasonal breach	13.4												
Breachs and Closures during rainy season													
Date-Time of highest WSE at time of breach		10/14/2009 9:45		11/7/2009 15:30		12/7/2009 0:15		12/13/2009 10:15		12/31/2009 14:30		1/12/2010 14:45	
WSE (ft)		13.25		12.44		12.85		12.21		12.48		12.65	
Date-Time of lowest WSE directly following breach		10/14/2009 14:30		11/7/2009 22:15		12/9/2009 2:30		12/14/2009 3:15		12/31/2009 22:15		1/13/2010 20:00	
WSE (ft)		6.10		4.32		10.21		5.88		4.24		4.95	
WSE pre-breach minus post-breach (ft)		7.15		8.12		2.64		6.33		8.24		7.69	
Time difference (days)		0.20		0.28		2.09		0.71		0.32		1.22	
Time difference (hours)		4.75		6.75		50.25		17.00		7.75		29.25	
Rate of WSE decline (ft/hr)		1.51		1.20		0.05		0.37		1.06		0.26	
Mean daily flow rate (cfs) on day of breach		759		18		20		182		47		40	
Mean daily flow rate (cfs) on day of lowest WSE following breach		759		18		22		202		47		42	
Likely mechanism with greatest influence on breaching process		Mechanical/Riverine		Mechanical		Mechanical		Mechanical/Riverine		Riverine		Unknown	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours			10/20/2009 6:00		11/7/2009 22:15		12/9/2009 4:00		12/24/2009 1:30		1/7/2010 0:30		
WSE (ft)			4.78		4.32		10.21		5.01		4.35		
Date-Time of lagoon WSE fills to > 11 feet			10/22/2009 20:15		11/17/2009 14:15		12/10/2009 9:45		12/27/2009 5:00		1/9/2010 22:15		
WSE (ft)			11.00		11.00		11.00		11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet			11/7/2009 18:15		12/8/2009 7:00		12/13/2009 18:15		12/31/2009 17:30		1/13/2010 6:00		
WSE (ft)			10.39		10.98		10.44		10.42		10.79		
Time (days) of WSE > 11 feet			15.92		20.70		3.35		4.52		3.32		
Time (hours) of WSE > 11 feet			382.0		496.7		80.5		108.5		79.7		
Mean daily flow rate (cfs) on day lowest WSE			51		18		22		55		41		
Mean daily flow rate (cfs) on day WSE > 11 feet			37		18		21		48		38		
Mean daily flow rate (cfs) on day WSE < 11 feet			18		22		182		47		42		
Likely mechanism with greatest influence on closure process			Ocean		Ocean		Ocean		Unknown		Unknown		
Dry Season Closure													
Date-Time of highest WSE at WY closure													7/25/2010 2:45
WSE (ft)													10.21
Date-Time of lowest WSE during WY closure													9/23/2010 19:00
WSE (ft)													6.34
Time (days) difference highest minus lowest WSE													60.68
Time (hours) difference highest minus lowest WSE													1456.25
Highest WSE at closure minus lowest WSE during closure in this WY													3.86
Rate of decrease in WSE (ft/day)													0.003
Mean daily flow rate (cfs) on day of highest WSE at closure													18
Mean daily flow rate (cfs) on day of lowest WSE of dry season													2.3
Likely mechanism with greatest influence on process													Ocean
End of WY													9/30/2010 23:45
Time (days) between final season closure and end of WY													67.9
Total days of lagoon closure in this WY (pre- and post-rainy season)													81.3
Totel days of closure including all partial closures													129.1

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD, 2009-2010 annual mitigation report

Table 4. WY 2009, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Sustained breach*	In-season closure	Sustained breach	In-season closure	Sustained breach	Final closure	WSE increase while closed
Mechnical, Natural, or Unknown		Mechanical		Natural		Natural	Natural	
Dry Season Events	10/1/2008 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/1/2008 0:15							
Lowest lagoon WSE prior to breach, in current WY	6.59							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach								
Date-Time of lowest WSE directly prior to overtopping	--							9/11/2009 11:15
WSE (ft)								6.44
Date-Time of highest WSE post-wave overtopping								9/12/2009 18:45
WSE (ft)								8.34
Increase in WSE (ft)								1.90
Likely mechanism with greatest influence on WSE increase process								Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE								
Date-Time of most recent WSE > 11 ft prior to breach, in current WY	none							
Time (days) between start of WY and first seasonal breach	138.6							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach		2/16/2009 13:30		4/9/2009 3:15		5/9/2009 7:30		
WSE (ft)		13.11		12.76		12.15		
Date-Time of lowest WSE directly following breach		2/16/2009 16:45		4/9/2009 9:45		5/9/2009 18:45		
WSE (ft)		6.08		4.71		4.15		
WSE pre-breach minus post-breach (ft)		7.03		8.05		7.99		
Time difference (days)		0.14		0.27		0.47		
Time difference (hours)		3.25		6.50		11.25		
Rate of WSE decline (ft/hr)		2.16		1.24		0.71		
Mean daily flow rate (cfs) on day of breach		749		91		38		
Mean daily flow rate (cfs) on day of lowest WSE following breach		749		91		38		
Likely mechanism with greatest influence on process		Mechanical/Riverine		Riverine		Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet			4/5/2009 18:00		5/3/2009 16:00			
WSE (ft)			4.53		4.11			
Date-Time of lagoon WSE fills to > 11 feet			4/7/2009 16:15		5/6/2009 14:45			
WSE (ft)			11.00		11.01			
Date-Time of lagoon falls below WSE > 11 feet			4/9/2009 4:00		5/9/2009 8:00			
WSE (ft)			11.44		11.95			
Time (days) of WSE > 11 feet			1.5		2.7			
Time (hours) of WSE > 11 feet			35.75		65.25			
Mean daily flow rate (cfs) on day lowest WSE			79		57			
Mean daily flow rate (cfs) on day WSE > 11 feet			74		45			
Mean daily flow rate (cfs) on day WSE < 11 feet			91		38			
Likely mechanism with greatest influence on process			Ocean		Ocean			

Dry Season Closure	
Date-Time of highest WSE at final WY closure	6/10/2009 4:15
WSE (ft)	11.37
Date-Time of lowest WSE during WY closure	8/21/2009 12:15
WSE (ft)	6.30
Time (days) difference highest minus lowest WSE	72.3
Time (hours) difference highest minus lowest WSE	1736
Highest WSE at closure minus lowest WSE during closure in this WY	5.07
Rate of decrease in WSE (ft/day)	0.003
Mean daily flow rate (cfs) on day of highest WSE at closure	16
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/2009 23:45
Time (days) between final season closure and end of WY	112.8
Total days of lagoon closure, from previous WY closure to this WY 1st breach	251.4
Totel days of closure including all partial closures	255.6

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD, 2008-2009 annual mitigation report

Table 5. WY 2008, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	In-season closure	Sustained breach	Final closure
Mechnical, Natural, or Unknown			Natural		Natural	Natural
Dry Season Events	10/1/2007 0:00					
Date-Time of lowest lagoon WSE prior to breach	10/1/2007 10:00					
Lowest lagoon WSE during closure, this WY	6.04					
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0					
Date-Time of lowest WSE directly prior to significant overtopping		12/3/2007 16:00				
WSE (ft)		7.41				
Date-Time of highest WSE post-wave overtopping		12/5/2007 10:15				
WSE (ft)		8.66				
Increase in WSE (ft)		1.25				
Likely mechanism with greatest influence on WSE increase process		Wave overtopping				
Mean daily flow rate (cfs) on day of highest WSE		0				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none					
Time (days) between start of WY and first seasonal breach	96.0					
Breachs and Closures during rainy season						
Date-Time of highest WSE at time of breach			1/5/2008 9:15		4/22/2008 20:30	
WSE (ft)			15.40		11.71	
Date-Time of lowest WSE directly following breach			1/5/2008 17:30		4/23/2008 9:30	
WSE (ft)			5.85		4.26	
WSE pre-breach minus post-breach (ft)			9.55		7.44	
Time difference (days)			0.34		0.54	
Time difference (hours)			8.25		13.00	
Rate of WSE decline (ft/hr)			1.16		0.57	
Mean daily flow rate (cfs) on day of breach			509		21	
Mean daily flow rate (cfs) on day of lowest WSE following breach			509		22	
Likely mechanism with greatest influence on process			Riverine		Unknown	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				4/13/2008 16:00		
WSE (ft)				4.19		
Date-Time of lagoon WSE fills to > 11 feet				4/19/2008 18:45		
WSE (ft)				11.00		
Date-Time of lagoon falls below WSE > 11 feet				4/22/2008 21:45		
WSE (ft)				10.99		
Time (days) of WSE > 11 feet				3.1		
Time (hours) of WSE > 11 feet				75.00		
Mean daily flow rate (cfs) on day lowest WSE				33		
Mean daily flow rate (cfs) on day WSE > 11 feet				21		
Mean daily flow rate (cfs) on day WSE < 11 feet				21		
Likely mechanism with greatest influence on process				Ocean		

Dry Season Closure	
Date-Time of highest WSE at final WY closure	5/13/2008 22:30
WSE (ft)	10.96
Date-Time of lowest WSE during WY closure	8/10/2008 6:45
WSE (ft)	5.87
Time (days) difference highest minus lowest WSE	88.34
Time (hours) difference highest minus lowest WSE	2120.25
Highest WSE at closure minus lowest WSE during closure in this WY	5.09
Rate of decrease in WSE (ft/day)	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure	11
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/2008 23:45
Time (days) between final season closure and end of WY	140.1
Total days of lagoon closure in this WY (pre- and post-rainy season)	236.0
Totel days of closure including all partial closures	239.1

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD 2007-2008 annual mitigation report

Table 6. WY 2007, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	WSE increase while closed	Temporary breach	In-season closure	Temporary breach	In-season closure	Sustained breach*	In-season closure	Temporary breach	Early closure	Final Closure
Mechnical, Natural, or Unknown				Mechanical		Natural		Natural		Natural	Natural	Natural
Dry Season Events	10/1/2006 0:00											
Date-Time of lowest lagoon WSE prior to breach	10/12/2006 3:45											
Lowest lagoon WSE during closure, this WY	6.61											
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0											
Date-Time of lowest WSE prior to significant increase in WSE		12/5/2006 23:45	1/10/2007 20:45									
WSE (ft)		7.56	8.43									
Date-Time of highest WSE post-increase		12/10/2006 16:00	2/11/2007 10:30									
WSE (ft)		9.06	11.45									
Increase in WSE (ft)		1.51	3.02									
Likely mechanism with greatest influence on WSE increase process		Wave overtopping	Riverine									
Mean daily flow rate (cfs) on day of highest WSE		0										
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none											
Time (days) between start of WY and first seasonal breach	133.4											
Breachs and Closures during rainy season												
Date-Time of highest WSE at time of breach				2/11/2007 10:30		2/19/2007 14:30		2/25/2007 10:45		3/18/07 22:45		
WSE (ft)				11.45		11.72		11.92		11.57		
Date-Time of lowest WSE directly following breach				2/15/2007 6:30		2/21/2007 12:00		2/25/2007 19:30		3/19/07 9:15		
WSE (ft)				8.84		6.61		8.92		4.42		
WSE pre-breach minus post-breach (ft)				2.62		5.11		3.01		7.15		
Time difference (days)				3.83		1.90		0.36		0.44		
Time difference (hours)				92.00		45.50		8.75		10.50		
Rate of WSE decline (ft/hr)				0.03		0.11		0.34		0.68		
Mean daily flow rate (cfs) on day of breach				29		32		45		30		
Mean daily flow rate (cfs) on day of lowest WSE following breach				50		28		45		28		
Likely mechanism with greatest influence on breaching process				Mechanical		Unknown		Riverine		Ocean		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					2/16/2007 7:30		2/20/2007 22:30		3/12/2007 20:15			
WSE (ft)					8.86		7.05		4.67			
Date-Time of lagoon WSE fills to > 11 feet					2/18/2007 8:30		2/24/2007 3:00		3/17/2007 8:30			
WSE (ft)					11.01		11.00		11.01			
Date-Time of lagoon falls below WSE > 11 feet					2/19/2007 16:15		2/25/2007 13:30		3/19/2007 0:00			
WSE (ft)					10.89		10.91		10.93			
Time (days) of WSE > 11 feet					1.3		1.4		1.6			
Time (hours) of WSE > 11 feet					31.75		34.50		39.50			
Mean daily flow rate (cfs) on day lowest WSE					44		29		47			
Mean daily flow rate (cfs) on day WSE > 11 feet					36		46		32			
Mean daily flow rate (cfs) on day WSE < 11 feet					32		45		28			
Likely mechanism with greatest influence on closure process					Ocean		Ocean		Ocean			
Dry Season Closure												
Date-Time of highest WSE at WY closure										3/27/2007 3:45	4/26/2007 22:45	
WSE (ft)										11.30	12.25	
Date-Time of lowest WSE during WY closure										4/8/2007 0:15	8/20/2007 11:45	
WSE (ft)										10.07	5.25	
Time (days) difference highest minus lowest WSE										11.85	115.54	
Time (hours) difference highest minus lowest WSE										284.50	2773.00	
Highest WSE at closure minus lowest WSE during closure in this WY										1.24	7.01	
Rate of decrease in WSE (ft/day)										0.004	0.003	
Mean daily flow rate (cfs) on day of highest WSE at closure										25	17	
Mean daily flow rate (cfs) on day of lowest WSE of dry season										14	0	
Likely mechanism with greatest influence on process										Ocean	Mechanical	
End of WY											9/30/2007 23:45	
Time (days) between final season closure and end of WY											157.0	
Total days of lagoon closure in this WY (pre- and post-rainy season)											290.5	
Totel days of closure including all partial closures											306.7	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD 2006-2007 annual mitigation report and Perry et al. 2006-07 CCoWS report

Table 7. WY 2006, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained breach*	In-season closure	Temporary breach	In-season closure	Sustained breach	Early Closure	Final Closure
Breach Type									
Mechnical, Natural, or Unknown			Mechanical		Natural		Natural	Natural	Natural
Dry Season Events	10/1/2005 0:00								
Date-Time of lowest lagoon WSE prior to breach	10/4/2005 9:00								
Lowest lagoon WSE during closure, this WY	6.91								
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0								
Date-Time of lowest WSE prior to significant increase in WSE		12/9/2005 4:15							
WSE (ft)		7.89							
Date-Time of highest WSE post-increase		12/21/05 15:30							
WSE (ft)		9.58							
Increase in WSE (ft)		1.69							
Likely mechanism with greatest influence on WSE increase process		Wave overtopping							
Mean daily flow rate (cfs) on day of highest WSE		20							
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none								
Time (days) between start of WY and first seasonal breach	88.5								
Breachs and Closures during rainy season									
Date-Time of highest WSE at time of breach			12/28/2005 11:45		2/10/2006 5:45		2/22/2006 12:15		
WSE (ft)			11.35		12.83		12.74		
Date-Time of lowest WSE directly following breach			12/30/2005 22:45		2/10/2006 20:15		2/23/2006 1:30		
WSE (ft)			6.42		5.33		5.06		
WSE pre-breach minus post-breach (ft)			4.93		7.49		7.68		
Time difference (days)			2.46		0.60		0.55		
Time difference (hours)			59.00		14.50		13.25		
Rate of WSE decline (ft/hr)			0.08		0.52		0.58		
Mean daily flow rate (cfs) on day of breach			81		57		49		
Mean daily flow rate (cfs) on day of lowest WSE following breach			82		57		47		
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Riverine		Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				2/6/2006 17:15		2/15/2006 21:00			
WSE (ft)				5.40		5.08			
Date-Time of lagoon WSE fills to > 11 feet				2/8/2006 6:00		2/19/2006 23:00			
WSE (ft)				11.01		11.00			
Date-Time of lagoon falls below WSE > 11 feet				2/10/2006 6:45		2/22/2006 14:00			
WSE (ft)				10.75		11.35			
Time (days) of WSE > 11 feet				2.0		2.6			
Time (hours) of WSE > 11 feet				48.75		63.00			
Mean daily flow rate (cfs) on day lowest WSE				69		49			
Mean daily flow rate (cfs) on day WSE > 11 feet				63		55			
Mean daily flow rate (cfs) on day WSE < 11 feet				57		49			
Likely mechanism with greatest influence on closure process				Ocean		Ocean			
Dry Season Closure									
Date-Time of highest WSE at WY closure							6/21/2006 5:15	7/17/2006 9:00	
WSE (ft)							10.53	10.14	
Date-Time of lowest WSE during WY closure							7/6/2006 7:30	9/4/2006 18:45	
WSE (ft)							8.63	6.31	
Time (days) difference highest minus lowest WSE							15.09	49.41	
Time (hours) difference highest minus lowest WSE							362.25	1185.75	
Highest WSE at closure minus lowest WSE during closure in this WY							1.89	3.83	
Rate of decrease in WSE (ft/day)							0.005	0.003	
Mean daily flow rate (cfs) on day of highest WSE at closure							36	13	
Mean daily flow rate (cfs) on day of lowest WSE of dry season							27	0	
Likely mechanism with greatest influence on process							Mechanical	Ocean	
End of WY								9/30/2006 23:45	
Time (days) between final season closure and end of WY								75.6	
Total days of lagoon closure in this WY (pre- and post-rainy season)								164.1	
Totel days of closure including all partial closures								183.9	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD 2005-2006 annual mitigation report and the Larson et al. 2005-06 CCoWS report

Table 8. WY 2005, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained breach*	Early closure	Final closure
Breach Type					
Mechnical, Natural, or Unknown			Mechanical	Natural	Natural
Dry Season Events	10/1/2004 0:00				
Date-Time of lowest lagoon WSE prior to breach	10/7/2004 11:30				
Lowest lagoon WSE during closure, this WY	6.37				
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0				
Date-Time of lowest WSE prior to significant increase in WSE		10/16/2004 0:15			
WSE (ft)		6.99			
Date-Time of highest WSE post-increase		38281.36			
WSE (ft)		8.39			
Increase in WSE (ft)		1.39			
Likely mechanism with greatest influence on WSE increase process		Wave overtopping			
Mean daily flow rate (cfs) on day of highest WSE					
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none				
Time (days) between start of WY and first seasonal breach	90.7				
Breachs and Closures during rainy season					
Date-Time of highest WSE at time of breach			12/30/2004 16:00		
WSE (ft)			13.03		
Date-Time of lowest WSE directly following breach			1/2/2005 0:45		
WSE (ft)			7.27		
WSE pre-breach minus post-breach (ft)			5.76		
Time difference (days)			2.36		
Time difference (hours)			56.75		
Rate of WSE decline (ft/hr)			0.10		
Mean daily flow rate (cfs) on day of breach			532		
Mean daily flow rate (cfs) on day of lowest WSE following breach			642		
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					
WSE (ft)					
Date-Time of lagoon WSE fills to > 11 feet					
WSE (ft)					
Date-Time of lagoon falls below WSE > 11 feet					
WSE (ft)					
Time (days) of WSE > 11 feet					
Time (hours) of WSE > 11 feet					
Mean daily flow rate (cfs) on day lowest WSE					
Mean daily flow rate (cfs) on day WSE > 11 feet					
Mean daily flow rate (cfs) on day WSE < 11 feet					
Likely mechanism with greatest influence on closure process					
Dry Season Closure					
Date-Time of highest WSE at WY closure				7/10/2005 0:45	7/20/2005 1:45
WSE (ft)				9.52	8.66
Date-Time of lowest WSE during WY closure				7/11/2005 23:30	8/29/2005 13:00
WSE (ft)				5.87	5.81
Time (days) difference highest minus lowest WSE				1.95	40.47
Time (hours) difference highest minus lowest WSE				46.75	971.25
Highest WSE at closure minus lowest WSE during closure in this WY				3.64	2.85
Rate of decrease in WSE (ft/day)				0.08	0.003
Mean daily flow rate (cfs) on day of highest WSE at closure					8.6
Mean daily flow rate (cfs) on day of lowest WSE of dry season					0
Likely mechanism with greatest influence on process					Ocean
End of WY					9/30/2005 23:45
Time (days) between final season closure and end of WY					72.9
Total days of lagoon closure in this WY (pre- and post-rainy season)					163.6
Totel days of closure including all partial closures					165.5

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Larson et al. 2004-05 CCoSW report

Table 9. WY 2004, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	In-season Closure	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Sustained breach	Early Closure	Final Closure	WSE increase while closed
Mechnical, Natural, or Unknown			Mechanical		Natural		Natural		Natural	Natural	Natural	
Dry Season Events	10/1/2003 0:00											
Date-Time of lowest lagoon WSE prior to breach	10/2/2003 12:00											
Lowest lagoon WSE during closure, this WY	5.86											
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0											
Date-Time of lowest WSE prior to significant increase in WSE		12/8/2003 6:00										8/24/04 14:15
WSE (ft)		8.17										5.71
Date-Time of highest WSE post-increase		12/10/2003 12:45										8/29/04 2:15
WSE (ft)		11.18										7.23
Increase in WSE (ft)		3.01										1.53
Likely mechanism with greatest influence on WSE increase process		Wave overtopping										Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE		0										0
Date-Time of most recent WSE > 11 ft prior to breach, this WY	12/11/2003 9:15											
Time (days) between start of WY and first seasonal breach	90.6											
Breachs and Closures during rainy season												
Date-Time of highest WSE at time of breach			12/30/2003 15:00		1/14/2004 17:30		1/20/2004 17:30		1/26/2004 15:30			
WSE (ft)			13.22		12.35		11.82		12.0			
Date-Time of lowest WSE directly following breach			12/31/2003 1:00		1/15/2004 0:30		1/21/2004 4:00		1/26/2004 22:30			
WSE (ft)			6.09		5.36		5.25		5.3			
WSE pre-breach minus post-breach (ft)			7.13		6.99		6.57		6.72			
Time difference (days)			0.42		0.29		0.44		0.29			
Time difference (hours)			10		7		10.5		7			
Rate of WSE decline (ft/hr)			0.71		1.00		0.63		0.96			
Mean daily flow rate (cfs) on day of breach			416		45		34		28			
Mean daily flow rate (cfs) on day of lowest WSE following breach			249		44		32		28			
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Riverine		Unknown		Unknown			
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				1/11/2004 21:00		1/17/2004 21:00		1/22/2004 4:45		4/20/2004 19:00		
WSE (ft)				5.37		5.88		5.4		5.44		
Date-Time of lagoon WSE fills to > 11 feet				1/13/2004 1:00		1/19/2004 8:30		1/24/2004 11:00		4/25/2004 6:30		
WSE (ft)				11.0		11.01		11.0		11.00		
Date-Time of lagoon falls below WSE > 11 feet				1/14/2004 19:00		1/20/2004 18:30		1/26/2004 18:15		4/27/2004 20:30		
WSE (ft)				9.9		10.57		8.77		10.88		
Time (days) of WSE > 11 feet				1.75		1.42		2.30		2.58		
Time (hours) of WSE > 11 feet				42.0		34.0		55.25		62.0		
Mean daily flow rate (cfs) on day lowest WSE				57		41		30		29		
Mean daily flow rate (cfs) on day WSE > 11 feet				49		36		29		20		
Mean daily flow rate (cfs) on day WSE < 11 feet				45		34		28		16		
Likely mechanism with greatest influence on closure process				Ocean		Ocean		Ocean		Ocean		
Dry Season Closure												
Date-Time of highest WSE at WY closure											5/7/2004 3:30	
WSE (ft)											9.95	
Date-Time of lowest WSE during WY closure or following break											7/18/2004 13:45	
WSE (ft)											5.10	
Time (days) difference highest minus lowest WSE											72.43	
Time (hours) difference highest minus lowest WSE											1738.25	
Highest WSE at closure minus lowest WSE during closure in this WY											4.85	
Rate of decrease in WSE (ft/day)											0.003	
Mean daily flow rate (cfs) on day of highest WSE at closure											11	
Mean daily flow rate (cfs) on day of lowest WSE of dry season											0	
Likely mechanism with greatest influence on process											Ocean	
End of WY											9/30/2004 23:45	
Time (days) between final season closure and end of WY											146.8	
Total days of lagoon closure in this WY (pre- and post-rainy season)											237.5	
Totel days of closure including all partial closures											245.5	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events as reported in the Smith et al. 2003-04 CCoSW report

Table 10. WY 2003, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	WSE increase while closed	Sustained breach*	In-season Closure	Sustained breach	Final Closure
Mechnical, Natural, or Unknown				Mechanical		Natural	Natural
Dry Season Events	10/1/2002 0:00						
Date-Time of lowest lagoon WSE prior to breach		10/15/2002 9:30					
Lowest lagoon WSE during closure, this WY		5.56					
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach		0					
Date-Time of lowest WSE prior to significant increase in WSE		10/15/2002 9:30	11/6/2002 0:30				
WSE (ft)		5.56	7.59				
Date-Time of highest WSE post-increase		10/22/2002 16:00	11/8/2002 17:15				
WSE (ft)		7.86	11.53				
Increase in WSE (ft)		2.30	3.94				
Likely mechanism with greatest influence on WSE increase process		Wave overtopping	Wave overtopping				
Mean daily flow rate (cfs) on day of highest WSE		0	0				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	11/12/2002 1:45						
Time (days) between start of WY and first seasonal breach	76.5						
Breachs and Closures during rainy season							
Date-Time of highest WSE at time of breach				12/16/2002 12:15		6/18/2003 19:45	
WSE (ft)				13.55		11.45	
Date-Time of lowest WSE directly following breach				12/16/2002 15:15		6/19/2003 0:15	
WSE (ft)				7.14		5.29	
WSE pre-breach minus post-breach (ft)				6.41		6.16	
Time difference (days)				0.13		0.19	
Time difference (hours)				3.00		4.50	
Rate of WSE decline (ft/hr)				2.14		1.37	
Mean daily flow rate (cfs) on day of breach				1250		25	
Mean daily flow rate (cfs) on day of lowest WSE following breach				1250		25	
Likely mechanism with greatest influence on breaching process				Mechanical/Riverine		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					6/14/2003 8:45		
WSE (ft)					5.1		
Date-Time of lagoon WSE fills to > 11 feet					6/17/2003 11:45		
WSE (ft)					11.0		
Date-Time of lagoon falls below WSE > 11 feet					6/18/2003 20:45		
WSE (ft)					10.7		
Time (days) of WSE > 11 feet					1.4		
Time (hours) of WSE > 11 feet					33.0		
Mean daily flow rate (cfs) on day lowest WSE					33		
Mean daily flow rate (cfs) on day WSE > 11 feet					27		
Mean daily flow rate (cfs) on day WSE < 11 feet					25		
Likely mechanism with greatest influence on closure process					Ocean		
Dry Season Closure							
Date-Time of highest WSE at WY closure							7/11/2003 22:30
WSE (ft)							7.98
Date-Time of lowest WSE during WY closure or following break							8/8/2003 15:45
WSE (ft)							5.37
Time (days) difference highest minus lowest WSE							27.72
Time (hours) difference highest minus lowest WSE							665.25
Highest WSE at closure minus lowest WSE during closure in this WY							2.61
Rate of decrease in WSE (ft/day)							0.004
Mean daily flow rate (cfs) on day of highest WSE at closure							6.8
Mean daily flow rate (cfs) on day of lowest WSE of dry season							0
Likely mechanism with greatest influence on process							Ocean
End of WY							9/30/2003 23:45
Time (days) between final season closure and end of WY							81.1
Total days of lagoon closure in this WY (pre- and post-rainy season)							157.6
Totel days of closure including all partial closures							158.9

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Casagrande and Watson 2002-03 CCoSW report

Table 11. WY 2002, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	WSE increase while closed	Sustained breach*	In-season Closure	Sustained breach	Early Closure	Final Closure
Breach Type								
Mechnical, Natural, or Unknown				Mechanical		Mechanical	Natural	Natural
Dry Season Events	10/1/2001 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/8/2001 2:30							
Lowest lagoon WSE during closure, this WY	6.76							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0							
Date-Time of lowest WSE prior to significant increase in WSE		10/8/2001 2:30	10/31/2001 0:15					
WSE (ft)		6.76	6.97					
Date-Time of highest WSE post-increase		10/16/2001 0:45	11/4/2001 17:00					
WSE (ft)		8.24	8.16					
Increase in WSE (ft)		1.48	1.19					
Likely mechanism with greatest influence on WSE increase process		Wave overtopping	Wave overtopping					
Mean daily flow rate (cfs) on day of highest WSE		0	0					
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none							
Time (days) between start of WY and first seasonal breach	63.6							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach				12/3/2001 14:15		1/28/2002 16:45		
WSE (ft)				13.39		12.32		
Date-Time of lowest WSE directly following breach				12/3/2001 22:30		1/29/2002 6:45		
WSE (ft)				5.64		5.65		
WSE pre-breach minus post-breach (ft)				7.75		6.67		
Time difference (days)				0.34		0.58		
Time difference (hours)				8.25		14.0		
Rate of WSE decline (ft/hr)				0.94		0.48		
Mean daily flow rate (cfs) on day of breach				402		53		
Mean daily flow rate (cfs) on day of lowest WSE following breach				402		54		
Likely mechanism with greatest influence on breaching process				Mechnical/Riverine		Mechnical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					1/26/2002 21:00			
WSE (ft)					5.88			
Date-Time of lagoon WSE fills to > 11 feet					1/27/2002 15:45			
WSE (ft)					11.00			
Date-Time of lagoon falls below WSE > 11 feet					1/28/2002 18:30			
WSE (ft)					10.56			
Time (days) of WSE > 11 feet					1.11			
Time (hours) of WSE > 11 feet					26.75			
Mean daily flow rate (cfs) on day lowest WSE					50			
Mean daily flow rate (cfs) on day WSE > 11 feet					53			
Mean daily flow rate (cfs) on day WSE < 11 feet					53			
Likely mechanism with greatest influence on closure process					Ocean			
Dry Season Closure								
Date-Time of highest WSE at WY closure						5/26/2002 9:15	6/4/2002 11:15	
WSE (ft)						10.90	10.04	
Date-Time of lowest WSE during WY closure or following break						5/26/2002 20:15	8/25/2002 21:45	
WSE (ft)						5.25	5.31	
Time (days) difference highest minus lowest WSE						0.46	82.44	
Time (hours) difference highest minus lowest WSE						11.00	1978.50	
Highest WSE at closure minus lowest WSE during closure in this WY						5.65	4.73	
Rate of decrease in WSE (ft/day)						0.514	0.002	
Mean daily flow rate (cfs) on day of highest WSE at closure						18	11	
Mean daily flow rate (cfs) on day of lowest WSE of dry season						18	0	
Likely mechanism with greatest influence on process						Ocean	Ocean	
End of WY							9/30/2002 23:45	
Time (days) between final season closure and end of WY							118.5	
Total days of lagoon closure in this WY (pre- and post-rainy season)							182.1	
Totel days of closure including all partial closures							183.7	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Casagrande et al. 2001-02 CCoSW report

Table 12. WY 2001, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained breach*	Final Closure
Breach Type				
Mechnical, Natural, or Unknown			Mechanical	Natural
Dry Season Events	10/1/2000 0:00			
Date-Time of lowest lagoon WSE prior to breach	10/9/2000 10:30			
Lowest lagoon WSE during closure, this WY	6.82			
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0			
Date-Time of lowest WSE prior to significant increase in WSE		10/21/2000 16:30		
WSE (ft)		7.41		
Date-Time of highest WSE post-increase		10/26/2000 15:30		
WSE (ft)		9.08		
Increase in WSE (ft)		4.96		
Likely mechanism with greatest influence on WSE increase process		Wave overtopping		
Mean daily flow rate (cfs) on day of highest WSE		0		
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none			
Time (days) between start of WY and first seasonal breach	102.68			
Breachs and Closures during rainy season				
Date-Time of highest WSE at time of breach			1/11/2001 16:15	
WSE (ft)			14.78	
Date-Time of lowest WSE directly following breach			1/11/2001 20:30	
WSE (ft)			5.47	
WSE pre-breach minus post-breach (ft)			9.31	
Time difference (days)			0.18	
Time difference (hours)			4.25	
Rate of WSE decline (ft/hr)			2.19	
Mean daily flow rate (cfs) on day of breach			148	
Mean daily flow rate (cfs) on day of lowest WSE following breach			148	
Likely mechanism with greatest influence on breaching process			Mechnical/Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				
WSE (ft)				
Date-Time of lagoon WSE fills to > 11 feet				
WSE (ft)				
Date-Time of lagoon falls below WSE > 11 feet				
WSE (ft)				
Time (days) of WSE > 11 feet				
Time (hours) of WSE > 11 feet				
Mean daily flow rate (cfs) on day lowest WSE				
Mean daily flow rate (cfs) on day WSE > 11 feet				
Mean daily flow rate (cfs) on day WSE < 11 feet				
Likely mechanism with greatest influence on closure process				
Dry Season Closure				
Date-Time of highest WSE at WY closure				6/13/2001 5:30
WSE (ft)				9.87
Date-Time of lowest WSE during WY closure or following break				8/23/2001 5:45
WSE (ft)				5.58
Time (days) difference highest minus lowest WSE				71.01
Time (hours) difference highest minus lowest WSE				1704.25
Highest WSE at closure minus lowest WSE during closure in this WY				4.29
Rate of decrease in WSE (ft/day)				0.003
Mean daily flow rate (cfs) on day of highest WSE at closure				8.5
Mean daily flow rate (cfs) on day of lowest WSE of dry season				0
Likely mechanism with greatest influence on process				Ocean
End of WY				9/30/2001 23:45
Time (days) between final season closure and end of WY				109.8
Total days of lagoon closure in this WY (pre- and post-rainy season)				212.4
Totel days of closure including all partial closures				212.4

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Watson et al. 2000-01 CCoSW report

Table 13. WY 2000, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained breach*	Early Closure	Final Closure
Breach Type					
Mechnical, Natural, or Unknown			Mechanical	Natural	Natural
Dry Season Events	10/1/1999 0:00				
Date-Time of lowest lagoon WSE prior to breach	10/6/1999 18:00				
Lowest lagoon WSE during closure, this WY	5.93				
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0				
Date-Time of lowest WSE prior to significant increase in WSE		10/25/1999 4:45			
WSE (ft)		6.23			
Date-Time of highest WSE post-increase		10/28/1999 18:00			
WSE (ft)		10.07			
Increase in WSE (ft)		3.84			
Likely mechanism with greatest influence on WSE increase process		Wave overtopping			
Mean daily flow rate (cfs) on day of highest WSE		0			
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none				
Time (days) between start of WY and first seasonal breach	115.1				
Breachs and Closures during rainy season					
Date-Time of highest WSE at time of breach			1/24/2000 2:15		
WSE (ft)			14.05		
Date-Time of lowest WSE directly following breach			1/24/2000 22:30		
WSE (ft)			6.85		
WSE pre-breach minus post-breach (ft)			7.2		
Time difference (days)			0.84		
Time difference (hours)			20.25		
Rate of WSE decline (ft/hr)			0.36		
Mean daily flow rate (cfs) on day of breach			1000		
Mean daily flow rate (cfs) on day of lowest WSE following breach			1000		
Likely mechanism with greatest influence on breaching process			Mechnical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					
WSE (ft)					
Date-Time of lagoon WSE fills to > 11 feet					
WSE (ft)					
Date-Time of lagoon falls below WSE > 11 feet					
WSE (ft)					
Time (days) of WSE > 11 feet					
Time (hours) of WSE > 11 feet					
Mean daily flow rate (cfs) on day lowest WSE					
Mean daily flow rate (cfs) on day WSE > 11 feet					
Mean daily flow rate (cfs) on day WSE < 11 feet					
Likely mechanism with greatest influence on closure process					
Dry Season Closure					
Date-Time of highest WSE at WY closure				4/24/2000 11:15	5/6/2000 2:30
WSE (ft)				10.35	10.70
Date-Time of lowest WSE during WY closure or following break				5/2/2000 18:45	9/16/2000 10:45
WSE (ft)				8.11	5.67
Time (days) difference highest minus lowest WSE				8.31	133.34
Time (hours) difference highest minus lowest WSE				199.50	3200.25
Highest WSE at closure minus lowest WSE during closure in this WY				2.24	5.03
Rate of decrease in WSE (ft/day)				0.011	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure				102	65
Mean daily flow rate (cfs) on day of lowest WSE of dry season				75	0
Likely mechanism with greatest influence on process				Ocean	Ocean
End of WY					9/30/2000 23:45
Time (days) between final season closure and end of WY					147.9
Total days of lagoon closure in this WY (pre- and post-rainy season)					263.0
Totel days of closure including all partial closures					271.3

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 2000

Table 14. WY 1999, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Sustained breach*	In-season Closure	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Sustained breach	Early Closure	Temporary breach	Final Closure
Mechnical, Natural, or Unknown			Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	Natural	Natural	Natural
Dry Season Events	10/1/1998 0:00																	
Date-Time of lowest lagoon WSE prior to breach	10/1/1998 0:00																	
Lowest lagoon WSE during closure, this WY	10.01																	
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	23																	
Date-Time of lowest WSE prior to significant increase in WSE		10/24/1998 9:45																
WSE (ft)		10.71																
Date-Time of highest WSE post-increase		11/3/1998 12:00																
WSE (ft)		12.75																
Increase in WSE (ft)		2.04																
Likely mechanism with greatest influence on WSE increase process		Riverine																
Mean daily flow rate (cfs) on day of highest WSE		22																
Date-Time of most recent WSE > 11 ft prior to breach, this WY	10/25/1998 9:15																	
Time (days) between start of WY and first seasonal breach	33.5																	
Breachs and Closures during rainy season																		
Date-Time of highest WSE at time of breach			11/3/1998 12:00		11/10/1998 18:15		11/19/1998 13:00		11/26/1998 13:00		1/2/1999 15:45		1/8/1999 17:45		1/16/1999 18:45		6/17/1999 20:00	
WSE (ft)			12.75		11.86		12.65		12.59		12.13		12.55		12.70		12.50	
Date-Time of lowest WSE directly following breach			11/4/1998 6:30		11/11/1998 4:30		11/19/1998 22:00		11/27/1998 0:30		1/2/1999 22:45		1/10/1999 1:00		1/16/1999 23:30		6/18/1999 13:30	
WSE (ft)			5.00		5.02		5.19		5.26		5.40		5.05		6.67		5.27	
WSE pre-breach minus post-breach (ft)			7.75		6.84		7.46		7.33		6.73		7.50		6.03		0.73	
Time difference (days)			0.77		0.43		0.38		0.48		0.29		1.30		0.20		17.50	
Time difference (hours)			18.50		10.25		9.00		11.50		7.00		31.25		4.75		7.23	
Rate of WSE decline (ft/hr)			0.42		0.67		0.83		0.64		0.96		0.24		1.27		0.41	
Mean daily flow rate (cfs) on day of breach			21		24		24		25		13		10		10		27	
Mean daily flow rate (cfs) on day of lowest WSE following breach			21		31		24		27		13		10		10		26	
Likely mechanism with greatest influence on breaching process			Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				11/4/1998 6:30		11/11/1998 4:30		11/19/1998 22:00		12/28/1998 1:45		1/2/1999 22:45		1/10/1999 1:00				
WSE (ft)				5.00		5.02		5.19		5.40		5.40		5.05				
Date-Time of lagoon WSE fills to > 11 feet				11/8/1998 2:15		11/14/1998 9:30		11/22/1998 13:15		12/31/1998 16:15		1/5/1999 4:45		1/13/1999 8:00				
WSE (ft)				11.00		11.00		11.02		11.00		11.00		11.00				
Date-Time of lagoon falls below WSE > 11 feet				11/10/1998 20:15		11/19/1998 15:00		11/26/1998 14:00		1/2/1999 17:15		1/8/1999 18:45		1/16/1999 21:00				
WSE (ft)				10.80		10.98		8.60		9.97		9.46		10.89				
Time (days) of WSE > 11 feet				2.75		5.15		3.99		1.98		3.54		3.45				
Time (hours) of WSE > 11 feet				66.00		123.50		95.75		47.50		85.00		82.75				
Mean daily flow rate (cfs) on day lowest WSE				21		31		24		17		13		10				
Mean daily flow rate (cfs) on day WSE > 11 feet				24		22		22		15		11		10				
Mean daily flow rate (cfs) on day WSE < 11 feet				24		24		25		13		10		10				
Likely mechanism with greatest influence on closure process				Ocean		Ocean		Ocean		Ocean		Ocean		Ocean				
Dry Season Closure																		
Date-Time of highest WSE at WY closure																5/27/1999 0:00		7/4/1999 6:00
WSE (ft)																9.20		10.52
Date-Time of lowest WSE during WY closure or following break																6/12/1999 17:30		8/18/1999 13:00
WSE (ft)																8.06		5.38
Time (days) difference highest minus lowest WSE																16.73		45.29
Time (hours) difference highest minus lowest WSE																401.50		1087.00
Highest WSE at closure minus lowest WSE during closure in this WY																1.14		5.14
Rate of decrease in WSE (ft/day)																0.003		0.005
Mean daily flow rate (cfs) on day of highest WSE at closure																53		7.2
Mean daily flow rate (cfs) on day of lowest WSE of dry season																34		0
Likely mechanism with greatest influence on process																Unknown		Ocean
End of WY																		9/30/1999 23:45
Time (days) between final season closure and end of WY																		88.74
Total days of lagoon closure in this WY (pre- and post-rainy season)																		122.2
Totel days of closure including all partial closures																		159.8

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1999

Table 15. WY 1998, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	In-season Closure	Temporary breach	In-season Closure	Sustained breach	Final Closure
Mechnical, Natural, or Unknown			Mechanical		Mechanical		Mechanical	Unknown
Dry Season Events	10/1/1997 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/29/1997 21:00							
Lowest lagoon WSE during closure, this WY	7.34							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0							
Date-Time of lowest WSE prior to significant increase in WSE		11/9/1997 17:45						
WSE (ft)		8.16						
Date-Time of highest WSE post-increase		11/15/1997 12:00						
WSE (ft)		10.65						
Increase in WSE (ft)		2.49						
Likely mechanism with greatest influence on WSE increase process		Ocean						
Mean daily flow rate (cfs) on day of highest WSE		0						
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none							
Time (days) between start of WY and first seasonal breach	66.4							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach			12/6/1997 10:15		12/30/1997 16:45		1/3/1998 17:30	
WSE (ft)			12.36		12.66		12.12	
Date-Time of lowest WSE directly following breach			12/7/1997 0:45		12/30/1997 22:15		1/3/1998 23:30	
WSE (ft)			6.57		5.40		5.36	
WSE pre-breach minus post-breach (ft)			5.79		7.26		6.76	
Time difference (days)			0.60		0.23		0.25	
Time difference (hours)			14.5		5.5		6	
Rate of WSE decline (ft/hr)			0.40		1.32		1.13	
Mean daily flow rate (cfs) on day of breach			112		12		29	
Mean daily flow rate (cfs) on day of lowest WSE following breach			135		12		29	
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Mechanical		Mechanical	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				12/26/1997 18:45		12/30/1997 22:15		
WSE (ft)				5.45		5.40		
Date-Time of lagoon WSE fills to > 11 feet				12/28/1997 14:30		1/2/1998 15:45		
WSE (ft)				11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet				12/30/1997 18:30		1/3/1998 18:45		
WSE (ft)				9.88		10.10		
Time (days) of WSE > 11 feet				2.17		1.07		
Time (hours) of WSE > 11 feet				52.0		25.7		
Mean daily flow rate (cfs) on day lowest WSE				18		12		
Mean daily flow rate (cfs) on day WSE > 11 feet				15		11		
Mean daily flow rate (cfs) on day WSE < 11 feet				12		29		
Likely mechanism with greatest influence on closure process				Ocean		Ocean		
Dry Season Closure								
Date-Time of highest WSE at WY closure								6/12/1998 0:00
WSE (ft)								8.85
Date-Time of lowest WSE during WY closure or following break								8/31/1998 2:30
WSE (ft)								7.16
Time (days) difference highest minus lowest WSE								80.10
Time (hours) difference highest minus lowest WSE								1922.50
Highest WSE at closure minus lowest WSE during closure in this WY								1.69
Rate of decrease in WSE (ft/day)								0.001
Mean daily flow rate (cfs) on day of highest WSE at closure								172
Mean daily flow rate (cfs) on day of lowest WSE of dry season								23
Likely mechanism with greatest influence on process								Unknown
End of WY								9/30/1998 23:45
Time (days) between final season closure and end of WY								110.99
Total days of lagoon closure in this WY (pre- and post-rainy season)								177.4
Totel days of closure including all partial closures								180.7

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1998

Table 16. WY 1997, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	Final closure	WSE increase while closed
Mechnical, Natural, or Unknown			Mechanical	Natural	
Dry Season Events	10/1/1996 0:00				
Date-Time of lowest lagoon WSE prior to breach	10/4/1996 11:15				
Lowest lagoon WSE during closure, this WY	6.10				
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0				
Date-Time of lowest WSE prior to significant increase in WSE		10/4/1996 11:15			9/17/1997 23:45
WSE (ft)		6.10			6.16
Date-Time of highest WSE post-increase		10/8/1996 9:30			9/25/1997 22:00
WSE (ft)		9.20			10.48
Increase in WSE (ft)		3.10			4.32
Likely mechanism with greatest influence on WSE increase process		Ocean			Ocean
Mean daily flow rate (cfs) on day of highest WSE		0			0
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none				
Time (days) between start of WY and first seasonal breach	69.6				
Breachs and Closures during rainy season					
Date-Time of highest WSE at time of breach			12/9/1996 13:15		
WSE (ft)			12.34		
Date-Time of lowest WSE directly following breach			12/10/1996 4:30		
WSE (ft)			8.34		
WSE pre-breach minus post-breach (ft)			4		
Time difference (days)			0.64		
Time difference (hours)			15.25		
Rate of WSE decline (ft/hr)			0.26		
Mean daily flow rate (cfs) on day of breach			27		
Mean daily flow rate (cfs) on day of lowest WSE following breach			879		
Likely mechanism with greatest influence on breaching process			Mechanical		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					
WSE (ft)					
Date-Time of lagoon WSE fills to > 11 feet					
WSE (ft)					
Date-Time of lagoon falls below WSE > 11 feet					
WSE (ft)					
Time (days) of WSE > 11 feet					
Time (hours) of WSE > 11 feet					
Mean daily flow rate (cfs) on day lowest WSE					
Mean daily flow rate (cfs) on day WSE > 11 feet					
Mean daily flow rate (cfs) on day WSE < 11 feet					
Likely mechanism with greatest influence on closure process					

Dry Season Closure	
Date-Time of highest WSE at WY closure	5/18/1997 23:00
WSE (ft)	9.89
Date-Time of lowest WSE during WY closure or following break	7/31/1997 16:00
WSE (ft)	5.51
Time (days) difference highest minus lowest WSE	73.71
Time (hours) difference highest minus lowest WSE	1769.00
Highest WSE at closure minus lowest WSE during closure in this WY	4.38
Rate of decrease in WSE (ft/day)	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure	13
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/1997 23:45
Time (days) between final season closure and end of WY	135.0
Total days of lagoon closure in this WY (pre- and post-rainy season)	204.6
Totel days of closure including all partial closures	204.6

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1997

Table 17. WY 1996, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Sustained breach*	In-season closure	Temporary breach	In-season closure	Temporary breach	In-season closure	Sustained breach	Final closure
Mechnical, Natural, or Unknown		Mechanical		Mechanical		Mechanical		Natural	Natural
Dry Season Events	10/1/1995 0:00								
Date-Time of lowest lagoon WSE prior to breach	11/12/1995 10:15								
Lowest lagoon WSE during closure, this WY	7.12								
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	2.50								
Date-Time of lowest WSE prior to significant increase in WSE									
WSE (ft)									
Date-Time of highest WSE post-increase									
WSE (ft)									
Increase in WSE (ft)									
Likely mechanism with greatest influence on WSE increase process									
Mean daily flow rate (cfs) on day of highest WSE									
Date-Time of most recent WSE > 11 ft prior to breach, this WY	12/13/1995 2:45								
Time (days) between start of WY and first seasonal breach	73.8								
Breachs and Closures during rainy season									
Date-Time of highest WSE at time of breach		12/13/1995 18:30		12/24/1995 19:30		12/27/1995 22:30		1/2/1996 9:45	
WSE (ft)		11.68		11.74		12.01		11.91	
Date-Time of lowest WSE directly following breach		12/14/1995 0:15		12/24/1995 22:30		12/28/1995 2:15		1/2/1996 14:30	
WSE (ft)		5.65		5.86		6.95		5.37	
WSE pre-breach minus post-breach (ft)		6.03		5.88		5.06		6.54	
Time difference (days)		0.24		0.13		0.16		0.20	
Time difference (hours)		5.75		3		3.75		4.75	
Rate of WSE decline (ft/hr)		1.05		1.96		1.35		1.38	
Mean daily flow rate (cfs) on day of breach		36		35		28		25	
Mean daily flow rate (cfs) on day of lowest WSE following breach		36		35		24		25	
Likely mechanism with greatest influence on breaching process		Mechanical		Riverine		Riverine		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours			12/21/1995 19:30		12/24/1995 22:30		12/29/1995 0:15		
WSE (ft)			5.36		5.86		6.30		
Date-Time of lagoon WSE fills to > 11 feet			12/23/1995 15:00		12/26/1995 10:00		12/31/1995 16:45		
WSE (ft)			11.00		11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet			12/24/1995 20:45		12/28/1995 0:00		1/2/1996 12:30		
WSE (ft)			10.64		10.69		10.77		
Time (days) of WSE > 11 feet			1.24		1.58		1.82		
Time (hours) of WSE > 11 feet			29.8		38.0		43.8		
Mean daily flow rate (cfs) on day lowest WSE			34		35		24		
Mean daily flow rate (cfs) on day WSE > 11 feet			35		28		27		
Mean daily flow rate (cfs) on day WSE < 11 feet			35		24		25		
Likely mechanism with greatest influence on closure process			Ocean		Ocean		Ocean		
Dry Season Closure									
Date-Time of highest WSE at WY closure									7/1/1996 0:15
WSE (ft)									10.37
Date-Time of lowest WSE during WY closure or following break									8/28/1996 19:00
WSE (ft)									5.49
Time (days) difference highest minus lowest WSE									58.78
Time (hours) difference highest minus lowest WSE									1410.75
Highest WSE at closure minus lowest WSE during closure in this WY									4.88
Rate of decrease in WSE (ft/day)									0.003
Mean daily flow rate (cfs) on day of highest WSE at closure									8.5
Mean daily flow rate (cfs) on day of lowest WSE of dry season									0
Likely mechanism with greatest influence on process									Ocean
End of WY									9/30/1996 23:45
Time (days) between final season closure and end of WY									91.98
Total days of lagoon closure in this WY (pre- and post-rainy season)									165.8
Totel days of closure including all partial closures									170.4

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1996

Table 18. WY 1995, Riverine Dynamics of Breaches and Closures

	Sustained closure	Sustained breach*	Final Closure	WSE increase while closed
Breach Type				
Mechnical, Natural, or Unknown		Mechanical	Natural	
Dry Season Events	10/1/1994 0:00			
Date-Time of lowest lagoon WSE prior to breach	10/1/1994 21:15			
Lowest lagoon WSE during closure, this WY	5.96			
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0			
Date-Time of lowest WSE prior to significant increase in WSE				9/6/1995 9:30
WSE (ft)				5.59
Date-Time of highest WSE post-increase				9/24/1995 0:30
WSE (ft)				10.43
Increase in WSE (ft)				4.84
Likely mechanism with greatest influence on WSE increase process				Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none			
Time (days) between start of WY and first seasonal breach	101.3			
Breachs and Closures during rainy season				
Date-Time of highest WSE at time of breach		1/10/1995 6:15		
WSE (ft)		10.51		
Date-Time of lowest WSE directly following breach		1/12/1995 1:15		
WSE (ft)		6.39		
WSE pre-breach minus post-breach (ft)		4.12		
Time difference (days)		1.79		
Time difference (hours)		43		
Rate of WSE decline (ft/hr)		0.10		
Mean daily flow rate (cfs) on day of breach		6070		
Mean daily flow rate (cfs) on day of lowest WSE following breach		746		
Likely mechanism with greatest influence on breaching process		Mechanical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				
WSE (ft)				
Date-Time of lagoon WSE fills to > 11 feet				
WSE (ft)				
Date-Time of lagoon falls below WSE > 11 feet				
WSE (ft)				
Time (days) of WSE > 11 feet				
Time (hours) of WSE > 11 feet				
Mean daily flow rate (cfs) on day lowest WSE				
Mean daily flow rate (cfs) on day WSE > 11 feet				
Mean daily flow rate (cfs) on day WSE < 11 feet				
Likely mechanism with greatest influence on closure process				
Dry Season Closure				
Date-Time of highest WSE at WY closure			8/9/1995 0:00	
WSE (ft)			9.73	
Date-Time of lowest WSE during WY closure or following break			9/6/1995 9:30	
WSE (ft)			5.59	
Time (days) difference highest minus lowest WSE			28.40	
Time (hours) difference highest minus lowest WSE			681.50	
Highest WSE at closure minus lowest WSE during closure in this WY			4.14	
Rate of decrease in WSE (ft/day)			0.006	
Mean daily flow rate (cfs) on day of highest WSE at closure			3.7	
Mean daily flow rate (cfs) on day of lowest WSE of dry season			3	
Likely mechanism with greatest influence on process			Ocean	
End of WY			9/30/1995 23:45	
Time (days) between final season closure and end of WY			52.99	
Total days of lagoon closure in this WY (pre- and post-rainy season)			154.3	
Totel days of closure including all partial closures			154.3	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Mechanical breach on January 9, 1995 in anticipation of flood flows, James, 2005 (p 10)

Table 19. WY 1994, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained Breach*	In-season closure	Temporary breach	In-season closure	Temporary breach	Final closure
Breach Type								
Mechnical, Natural, or Unknown			Mechanical		Natural		Natural	Natural
Dry Season Events	10/1/1993 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/3/1993 12:00							
Lowest lagoon WSE during closure, this WY	5.44							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0							
Date-Time of lowest WSE prior to significant increase in WSE		11/6/1993 8:15						
WSE (ft)		7.43						
Date-Time of highest WSE post-increase		11/13/1993 10:45						
WSE (ft)		8.87						
Increase in WSE (ft)		1.44						
Likely mechanism with greatest influence on WSE increase process		Ocean						
Mean daily flow rate (cfs) on day of highest WSE		0.00						
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none							
Time (days) between start of WY and first seasonal breach	139.9							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach			2/17/1994 22:15		3/18/1994 15:00		3/27/1994 17:00	
WSE (ft)			11.69		11.62		12.15	
Date-Time of lowest WSE directly following breach			2/19/1994 15:45		3/19/1994 14:30		3/27/1994 20:00	
WSE (ft)			6.45		7.80		5.81	
WSE pre-breach minus post-breach (ft)			5.24		3.82		6.34	
Time difference (days)			1.73		0.98		0.13	
Time difference (hours)			41.5		23.5		3	
Rate of WSE decline (ft/hr)			0.13		0.16		2.11	
Mean daily flow rate (cfs) on day of breach			106		22		20	
Mean daily flow rate (cfs) on day of lowest WSE following breach			203		22		20	
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Riverine		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				3/13/1994 9:00		3/19/1994 15:45		
WSE (ft)				5.6		7.8		
Date-Time of lagoon WSE fills to > 11 feet				3/16/1994 20:30		3/24/1994 7:45		
WSE (ft)				11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet				3/18/1994 17:45		3/27/1994 18:00		
WSE (ft)				10.93		10.05		
Time (days) of WSE > 11 feet				1.89		3.39		
Time (hours) of WSE > 11 feet				45.3		81.3		
Mean daily flow rate (cfs) on day lowest WSE				31		22		
Mean daily flow rate (cfs) on day WSE > 11 feet				24		20		
Mean daily flow rate (cfs) on day WSE < 11 feet				22		20		
Likely mechanism with greatest influence on closure process				Ocean		Ocean		
Dry Season Closure								
Date-Time of highest WSE at WY closure								4/3/1994 3:45
WSE (ft)								10.66
Date-Time of lowest WSE during WY closure or following break								8/29/1994 16:45
WSE (ft)								5.44
Time (days) difference highest minus lowest WSE								148.54
Time (hours) difference highest minus lowest WSE								3565.00
Highest WSE at closure minus lowest WSE during closure in this WY								5.22
Rate of decrease in WSE (ft/day)								0.001
Mean daily flow rate (cfs) on day of highest WSE at closure								8.2
Mean daily flow rate (cfs) on day of lowest WSE of dry season								0
Likely mechanism with greatest influence on process								Ocean
End of WY								9/30/1994 23:45
Time (days) between final season closure and end of WY								180.83
Total days of lagoon closure in this WY (pre- and post-rainy season)								320.8
Totel days of closure including all partial closures								326.0

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1994

Table 20. WY 1993, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained Breach*	In-season Closure	Sustained Breach	Final Closure
Breach Type						
Mechnical, Natural, or Unknown			Mechanical		Natural	Natural
Dry Season Events	10/1/1992 0:00					
Date-Time of lowest lagoon WSE prior to breach	10/19/1992 6:00					
Lowest lagoon WSE during closure, this WY	6.19					
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0					
Date-Time of lowest WSE prior to significant increase in WSE		10/24/1992 8:30				
WSE (ft)		7.38				
Date-Time of highest WSE post-increase		10/28/1992 17:00				
WSE (ft)		10.06				
Increase in WSE (ft)		2.68				
Likely mechanism with greatest influence on WSE increase process		Wave overtopping				
Mean daily flow rate (cfs) on day of highest WSE		0				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none					
Time (days) between start of WY and first seasonal breach	98.5					
Breachs and Closures during rainy season						
Date-Time of highest WSE at time of breach			1/7/1993 11:00		6/3/1993 13:30	
WSE (ft)			12.74		12.07	
Date-Time of lowest WSE directly following breach			1/7/1993 19:30		6/3/1993 19:30	
WSE (ft)			6.23		5.71	
WSE pre-breach minus post-breach (ft)			6.51		6.36	
Time difference (days)			0.35		0.25	
Time difference (hours)			8.5		6	
Rate of WSE decline (ft/hr)			0.77		1.06	
Mean daily flow rate (cfs) on day of breach			697		47	
Mean daily flow rate (cfs) on day of lowest WSE following breach			697		47	
Likely mechanism with greatest influence on breaching process			Mechanical		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				5/28/1993 15:00		
WSE (ft)				5.46		
Date-Time of lagoon WSE fills to > 11 feet				6/2/1993 3:30		
WSE (ft)				11.02		
Date-Time of lagoon falls below WSE > 11 feet				6/3/1993 14:50		
WSE (ft)				8.66		
Time (days) of WSE > 11 feet				1.47		
Time (hours) of WSE > 11 feet				35.3		
Mean daily flow rate (cfs) on day lowest WSE				28		
Mean daily flow rate (cfs) on day WSE > 11 feet				53		
Mean daily flow rate (cfs) on day WSE < 11 feet				47		
Likely mechanism with greatest influence on closure process				Ocean		

Dry Season Closure	
Date-Time of highest WSE at WY closure	7/3/1993 1:00
WSE (ft)	8.77
Date-Time of lowest WSE during WY closure or following break	9/30/1993 23:30
WSE (ft)	5.52
Time (days) difference highest minus lowest WSE	89.94
Time (hours) difference highest minus lowest WSE	2158.50
Highest WSE at closure minus lowest WSE during closure in this WY	3.25
Rate of decrease in WSE (ft/day)	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure	4.9
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/1993 23:45
Time (days) between final season closure and end of WY	89.95
Total days of lagoon closure in this WY (pre- and post-rainy season)	188.4
Totel days of closure including all partial closures	189.9

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1993

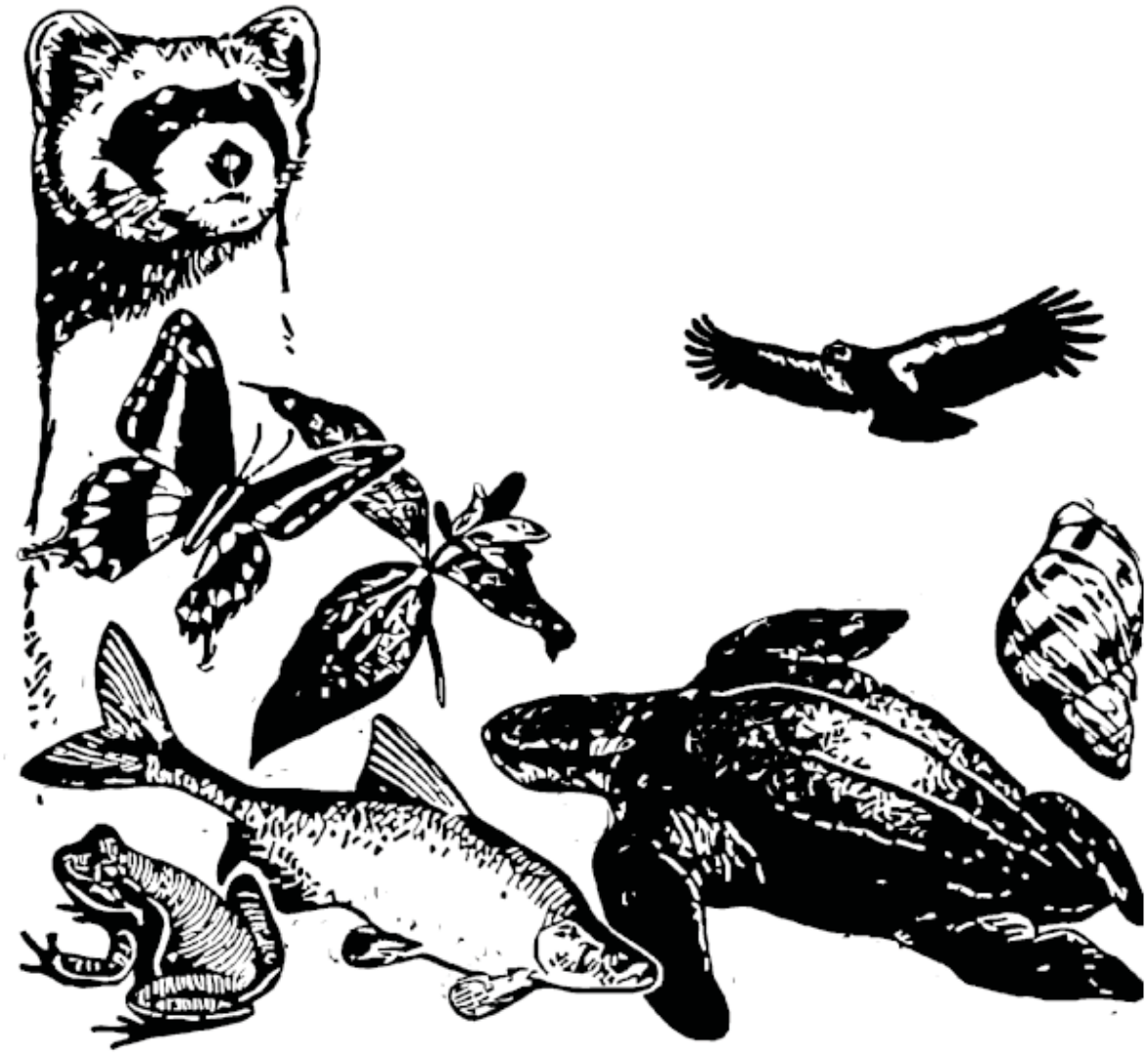
Appendix C Service IPaC Report

Carmel Lagoon EPB, SRPS, & ISMP Project

IPaC Trust Resource Report

Generated February 25, 2016 11:08 AM MST, IPaC v2.3.2

This report is for informational purposes only and should not be used for planning or analyzing project level impacts. For project reviews that require U.S. Fish & Wildlife Service review or concurrence, please return to the IPaC website and request an official species list from the Regulatory Documents page.



IPaC - Information for Planning and Conservation (http://ecos.fws.gov/ipac/): A project planning tool to help streamline the U.S. Fish & Wildlife Service environmental review process.

US Fish & Wildlife Service

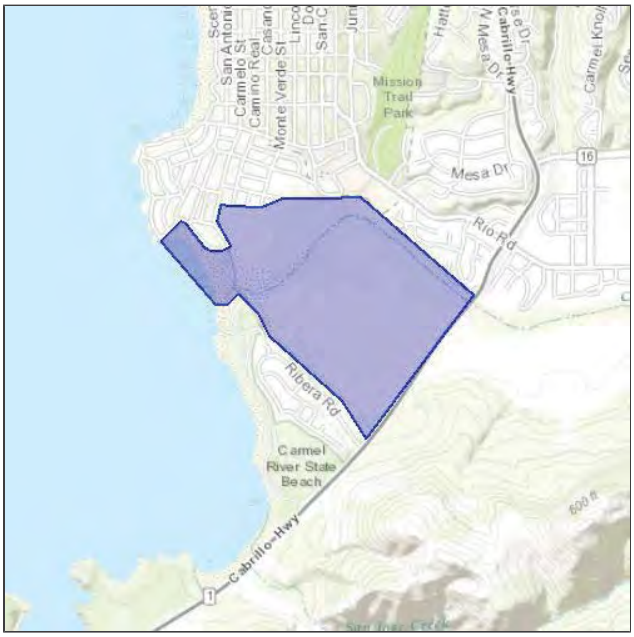
IPaC Trust Resource Report

NAME

Carmel Lagoon EPB, SRPS, & ISMP Project

LOCATION

Monterey County, California



DESCRIPTION

Carmel Lagoon, Monterey County, CA The Proposed Project is a comprehensive plan meant to promote improvement in ecological function of the lagoon, including natural floodplain function and improvement of habitat for special status species within the lagoon, by allowing the lagoon to breach naturally without increasing flood risk to private structures and public facilities.

IPAC LINK

http://ecos.fws.gov/ipac/project/OGYXZ-4YRGJ-BCVKY-YTGEI-L5NGPI

U.S. Fish & Wildlife Contact Information

Trust resources in this location are managed by:

Ventura Fish And Wildlife Office
2493 Portola Road, Suite B
Ventura, CA 93003-7726
(805) 644-1766

Endangered Species

Proposed, candidate, threatened, and endangered species are managed by the Endangered Species Program of the U.S. Fish & Wildlife Service.

This USFWS trust resource report is for informational purposes only and should not be used for planning or analyzing project level impacts.

For project evaluations that require FWS concurrence/review, please return to the IPaC website and request an official species list from the Regulatory Documents section.

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 the Regulatory Documents section in IPaC.

The list of species below are those that may occur or could potentially be affected by activities in this location:

Amphibians

California Red-legged Frog Rana draytonii — Threatened

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=D02D

California Tiger Salamander Ambystoma californiense — Threatened

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=D01T

Birds

California Condor Gymnogyps californianus — Endangered

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B002

California Least Tern Sterna antillarum browni — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B03X

Least Bell's Vireo Vireo bellii pusillus — Endangered

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B067

Marbled Murrelet Brachyramphus marmoratus — Threatened

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B08C

Southwestern Willow Flycatcher Empidonax traillii extimus — Endangered

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B094

Western Snowy Plover Charadrius alexandrinus nivosus — Threatened

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B07C

Conifers and Cycads

Gowen Cypress Cupressus goveniana ssp. goveniana — Threatened

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=R00A

Crustaceans

Vernal Pool Fairy Shrimp Branchinecta lynchi — Threatened

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=K03G

Fishes

Tidewater Goby Eucyclogobius newberryi — Endangered

CRITICAL HABITAT

There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E071

Flowering Plants

Beach Layia Layia carnosa — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q34T

Clover Lupine Lupinus tidestromii — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q2DD

Coastal Dunes Milk-vetch Astragalus tener var. titi — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q07J

Hickman's Potentilla Potentilla hickmanii — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q1J8

Marsh Sandwort Arenaria paludicola — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q25H

Menzies' Wallflower Erysimum menziesii — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q29W

Monterey Clover Trifolium trichocalyx — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q23C

Monterey Gilia Gilia tenuiflora ssp. arenaria — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q2AJ

Monterey Spineflower Chorizanthe pungens var. pungens — Threatened

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q271

Yadon's Piperia Piperia yadonii — Endangered

CRITICAL HABITAT
There is **final** critical habitat designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q3FA

Insects

Smith's Blue Butterfly Euphilotes enoptes smithi — Endangered

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=I00R

Mammals

Southern Sea Otter Enhydra lutris nereis — Threatened

CRITICAL HABITAT
No critical habitat has been designated for this species.

https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=A0A7

Critical Habitats

This location overlaps all or part of the critical habitat for the following species:

California Red-legged Frog Critical Habitat Final designated
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=D02D#crithab

Steelhead Critical Habitat Final designated
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E08D#crithab

Migratory Birds

Birds are protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Any activity which results in the take of migratory birds or eagles is prohibited unless authorized by the U.S. Fish and Wildlife Service (1). There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured.

Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures.

Additional information can be found using the following links:

- Birds of Conservation Concern
  http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Conservation measures for birds
  http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Year-round bird occurrence data
  http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/akn-histogram-tools.php

The following species of migratory birds could potentially be affected by activities in this location:

Allen's Hummingbird Selasphorus sasin — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0LI

Ashy Storm-petrel Oceanodroma homochroa — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0AV

Bald Eagle Haliaeetus leucocephalus — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B008

Black Oystercatcher Haematopus bachmani — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0KJ

Black Swift Cypseloides niger — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0FW

Black-chinned Sparrow Spizella atrogularis — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0IR

Black-vented Shearwater Puffinus opisthomelas — Bird of conservation concern
Season: Wintering

Burrowing Owl Athene cunicularia — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0NC

California Spotted Owl Strix occidentalis occidentalis — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B08L

Cassin's Auklet Ptychoramphus aleuticus — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0FP

Costa's Hummingbird Calypte costae — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JE

Flammulated Owl Otus flammeolus — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0DK

Fox Sparrow Passerella iliaca — Bird of conservation concern
Season: Wintering

Lawrence's Goldfinch Carduelis lawrencei — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0J8

Lesser Yellowlegs Tringa flavipes — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0MD

Lewis's Woodpecker Melanerpes lewis — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0HQ

Long-billed Curlew Numenius americanus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B06S

Marbled Godwit Limosa fedoa — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JL

Nuttall's Woodpecker Picoides nuttallii — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0HT

Oak Titmouse Baeolophus inornatus — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0MJ

Olive-sided Flycatcher Contopus cooperi — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0AN

Peregrine Falcon Falco peregrinus — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0FU

Pink-footed Shearwater Puffinus creatopus — Bird of conservation concern
Year-round

Rufous-crowned Sparrow Aimophila ruficeps — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0MX

Short-billed Dowitcher Limnodromus griseus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JK

Short-eared Owl Asio flammeus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0HD

Snowy Plover Charadrius alexandrinus — Bird of conservation concern
Season: Breeding

Tricolored Blackbird Agelaius tricolor — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B06P

Western Grebe aechmophorus occidentalis — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0EA

Whimbrel Numenius phaeopus — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JN

Yellow Warbler dendroica petechia ssp. brewsteri — Bird of conservation concern
Season: Breeding
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0EN

Yellow-billed Magpie Pica nuttalli — Bird of conservation concern
Year-round
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0N8

Red Knot Calidris canutus ssp. roselaari — Bird of conservation concern
Season: Wintering
https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0G6

Refuges

Any activity proposed on National Wildlife Refuge lands must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuges in 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.

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.

This location overlaps all or part of the following wetlands:

Estuarine And Marine Deepwater

M1UBL	2330000.0 acres
E1UBL	6.24 acres

Estuarine And Marine Wetland

M2USP	12.2 acres
M2RSN	6.69 acres
M2USN	4.06 acres
E2USN	2.68 acres

Freshwater Emergent Wetland

PEMR	10.0 acres
PEM/SSR	3.26 acres
PEMS	0.614 acre

Freshwater Forested/shrub Wetland

PFO/SSS	6.39 acres
PFO/SSR	4.63 acres
PSSR	1.26 acres

Freshwater Pond

PUBT	8.87 acres
PUSS	6.76 acres
PUSR	2.25 acres

Riverine

R1UBV	1.46 acres
R4SBAx	0.217 acre
R1USS	0.0543 acre

A full description for each wetland code can be found at the National Wetlands Inventory website: http://107.20.228.18/decoders/wetlands.aspx

Appendix D CNDDB Rare Find Report

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Taxonomic Group is (Fish or Amphibians or Reptiles or Birds or Mammals or Mollusks or Arachnids or Crustaceans or Insects or Ferns or Gymnosperms or Monocots or Dicots or Lichens or Bryophytes) and Quad is (Marina (3612167) or Monterey (3612158) or Mt. Carmel (3612147) or Seaside (3612157) or Soberanes Point (3612148))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	None	G2G3	S1S2	SSC
Allium hickmanii Hickman's onion	PMLIL02140	None	None	G2	S2	1B.2
Ambystoma californiense California tiger salamander	AAAAA01180	Threatened	Threatened	G2G3	S2S3	SSC
Anniella pulchra nigra black legless lizard	ARACC01011	None	None	G3G4T2T3Q	S2	SSC
Anniella pulchra pulchra silvery legless lizard	ARACC01012	None	None	G3G4T3T4Q	S3	SSC
Arctostaphylos edmundsii Little Sur manzanita	PDERI04260	None	None	G2?	S2?	1B.2
Arctostaphylos hookeri ssp. hookeri Hooker's manzanita	PDERI040J1	None	None	G3T2	S2	1B.2
Arctostaphylos montereyensis Toro manzanita	PDERI040R0	None	None	G2?	S2?	1B.2
Arctostaphylos pajaroensis Pajaro manzanita	PDERI04100	None	None	G1	S1	1B.1
Arctostaphylos pumila sandmat manzanita	PDERI04180	None	None	G1	S1	1B.2
Astragalus tener var. titi coastal dunes milk-vetch	PDFAB0F8R2	Endangered	Endangered	G2T1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC
Bombus caliginosus obscure bumble bee	IIHYM24380	None	None	G4?	S1S2	
Bombus occidentalis western bumble bee	IIHYM24250	None	None	G2G3	S1	
Bryoria spiralifera twisted horsehair lichen	NLTEST5460	None	None	G3	S1S2	1B.1
Buteo regalis ferruginous hawk	ABNKC19120	None	None	G4	S3S4	WL
Castilleja ambigua var. insalutata pink Johnny-nip	PDSCR0D403	None	None	G4T2	S2	1B.1
Centromadia parryi ssp. congdonii Congdon's tarplant	PDAST4R0P1	None	None	G3T2	S2	1B.1
Charadrius alexandrinus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S2	SSC

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Chorizanthe pungens var. pungens Monterey spineflower	PDPGN040M2	Threatened	None	G2T2	S2	1B.2
Clarkia jolonensis Jolon clarkia	PDONA050L0	None	None	G2	S2	1B.2
Coelus globosus globose dune beetle	IICOL4A010	None	None	G1G2	S1S2	
Collinsia multicolor San Francisco collinsia	PDSCR0H0B0	None	None	G2	S2	1B.2
Cordylanthus rigidus ssp. littoralis seaside bird's-beak	PDSCR0J0P2	None	Endangered	G5T2	S2	1B.1
Corynorhinus townsendii Townsend's big-eared bat	AMACC08010	None	Candidate Threatened	G3G4	S2	SSC
Cypseloides niger black swift	ABNUA01010	None	None	G4	S2	SSC
Danaus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	None	None	G4T2T3	S2S3	
Delphinium californicum ssp. interius Hospital Canyon larkspur	PDRAN0B0A2	None	None	G3T3	S3	1B.2
Delphinium hutchinsoniae Hutchinson's larkspur	PDRAN0B0V0	None	None	G2	S2	1B.2
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Eremophila alpestris actia California horned lark	ABPAT02011	None	None	G5T3Q	S3	WL
Ericameria fasciculata Eastwood's goldenbush	PDAST3L080	None	None	G2	S2	1B.1
Eriogonum nortonii Pinnacles buckwheat	PDPGN08470	None	None	G2	S2	1B.3
Erysimum ammophilum sand-loving wallflower	PDBRA16010	None	None	G2	S2	1B.2
Erysimum menziesii Menzies' wallflower	PDBRA160R0	Endangered	Endangered	G1	S1	1B.1
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	SSC
Euphilotes enoptes smithi Smith's blue butterfly	IILEPG2026	Endangered	None	G5T1T2	S1S2	
Fritillaria liliacea fragrant fritillary	PMLIL0V0C0	None	None	G2	S2	1B.2
Gilia tenuiflora ssp. arenaria Monterey gilia	PDPLM041P2	Endangered	Threatened	G3G4T2	S2	1B.2
Hesperocyparis goveniana Gowen cypress	PGCUP04031	Threatened	None	G1	S1	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Hesperocyparis macrocarpa Monterey cypress	PGCUP04060	None	None	G1	S1	1B.2
Horkelia cuneata var. sericea Kellogg's horkelia	PDROS0W043	None	None	G4T2	S2?	1B.1
Horkelia marinensis Point Reyes horkelia	PDROS0W0B0	None	None	G2	S2	1B.2
Lasiurus cinereus hoary bat	AMACC05030	None	None	G5	S4	
Lasthenia conjugens Contra Costa goldfields	PDAST5L040	Endangered	None	G1	S1	1B.1
Layia carnosa beach layia	PDAST5N010	Endangered	Endangered	G2	S2	1B.1
Linderiella occidentalis California linderiella	ICBRA06010	None	None	G2G3	S2S3	
Lupinus tidestromii Tidestrom's lupine	PDFAB2B3Y0	Endangered	Endangered	G1	S1	1B.1
Malacothamnus palmeri var. involucratus Carmel Valley bush-mallow	PDMAL0Q0B1	None	None	G3T3Q	S3	1B.2
Malacothamnus palmeri var. palmeri Santa Lucia bush-mallow	PDMAL0Q0B5	None	None	G3T2Q	S2	1B.2
Malacothrix saxatilis var. arachnoidea Carmel Valley malacothrix	PDAST660C2	None	None	G5T2	S2	1B.2
Microseris paludosa marsh microseris	PDAST6E0D0	None	None	G2	S2	1B.2
Monardella sinuata ssp. nigrescens northern curly-leaved monardella	PDLAM18162	None	None	G3T2	S2	1B.2
Monolopia gracilens woodland woollythreads	PDAST6G010	None	None	G3	S3	1B.2
Oceanodroma homochroa ashy storm-petrel	ABNDC04030	None	None	G2	S2	SSC
Oncorhynchus mykiss irideus steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	G5T2Q	S2	
Pelecanus occidentalis californicus California brown pelican	ABNFC01021	Delisted	Delisted	G4T3	S3	FP
Phrynosoma blainvillii coast horned lizard	ARACF12100	None	None	G3G4	S3S4	SSC
Pinus radiata Monterey pine	PGPIN040V0	None	None	G1	S1	1B.1
Piperia yadonii Yadon's rein orchid	PMORC1X070	Endangered	None	G2	S2	1B.1
Plagiobothrys uncinatus hooked popcornflower	PDBOR0V170	None	None	G2	S2	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Potentilla hickmanii Hickman's cinquefoil	PDROS1B0U0	Endangered	Endangered	G1	S1	1B.1
Ramalina thrausta angel's hair lichen	NLLEC3S340	None	None	G5	S2?	2B.1
Rana draytonii California red-legged frog	AAABH01022	Threatened	None	G2G3	S2S3	SSC
Reithrodontomys megalotis distichlis Salinas harvest mouse	AMAFF02032	None	None	G5T1	S1	
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
Rosa pinetorum pine rose	PDROS1J0W0	None	None	G2Q	S2	1B.2
Sidalcea malachroides maple-leaved checkerbloom	PDMAL110E0	None	None	G3	S3	4.2
Stebbinsoseris decipiens Santa Cruz microseris	PDAST6E050	None	None	G2	S2	1B.2
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Tortula californica California screw moss	NBMUS7L090	None	None	G2G3	S2S3	1B.2
Trifolium buckwestiorum Santa Cruz clover	PDFAB402W0	None	None	G2	S2	1B.1
Trifolium hydrophilum saline clover	PDFAB400R5	None	None	G2	S2	1B.2
Trifolium polyodon Pacific Grove clover	PDFAB402H0	None	Rare	G1	S1	1B.1
Trifolium trichocalyx Monterey clover	PDFAB402J0	Endangered	Endangered	G1	S1	1B.1

Record Count: 75

Appendix E Plant Species Observed within Project Study Area

Plant Species Observed within the Project Study Area

Species Name	Common Name
Acacia longifolia	golden wattle
Acer negundo	box elder
Achillea millefolium	common yarrow
Acmispon glaber	deerweed
Acmispon heermannii var. *orbicularis*	wooly lotus
Aesculus californica	California buckeye
Allium triquetrum	three-cornered onion
Amsinckia vernicosa	common fiddleneck
Artemisia californica	California sagebrush
Artemisia douglasiana	mugwort
Atriplex sp.	goosefoot
Avena barbata	slender oat
Avena fatua	wild oat
Baccharis douglasii	Douglas' baccharis
Baccharis pilularis	coyote brush
Baccharis salicifolia	mule fat
Brassica nigra	black mustard
Bromus carinatus	California brome
Bromus diandrus	rip-gut brome
Bromus hordeaceus	soft chess
Carduus pycnocephalus	Italian thistle
Carex barbarae	Santa Barbara sedge
Carex praegracilis	field sedge
Carex sp.	sedge
Carpobrotus edulis	hottentot fig
Ceanothus thyrsiflorus	blue blossom
Cirsium vulgare	bull thistle
Conium maculatum	poison hemlock
Convolvulus sp.	bindweed
Cornus sericea ssp. *occidentalis*	western red dogwood
Cortaderia jubata	jubata grass
Cotula coronopifolia	brass buttons
Cyperus eragrostis	tall sedge
Delairea odorata	cape ivy
Distichlis spicata	salt grass
Eleocharis palustris	marsh spike-rush
Elymus glaucus	blue wild rye
Ericameria ericoides	mock heather
Eriogonum parvifolium	dune Buckwheat
Eriophyllum staechadifolum	seaside wooly sunflower
Erodium cicutarium	red-stemmed filaree
Eschscholzia californica	California poppy
Eucalyptus globulus	blue gum
Euphorbia ocellata Durand & Hilg. subsp. ocellata	valley spurge
Festuca perennis	Italian ryegrass
Foeniculum vulgare	fennel

Plant Species Observed within the Project Study Area

Species Name	Common Name
Frangula californica	coffeeberry
Fumaria officinalis	fumitory
Genista monspessulana	French broom
Geranium dissectum	cut-leaf geranium
Geranium molle	dove's foot geranium
Grindelia stricta	Pacific gum-plant
Hedera helix	English ivy
Helenium puberulum	sneeze weed
Helminthotheca echioides	bristly ox-tongue
Hesperocyparis macrocarpa	Monterey cypress
Holcus lanatus	velvet grass
Hordeum brachyantherum	meadow barley
Hordeum murinum ssp. *leporinum*	barnyard foxtail
Hypochaeris glabra	smooth cat's ear
Hypochaeris radicata	hairy cat's ear
Ilex sp.	holly
Iris douglasiana	douglas iris
Jaumea carnosa	fleshy jaumea
Juncus balticus ssp. *ater*	Baltic rush
Juncus effusus	common rush
Juncus patens	spreading Rush
Lepidium draba	hoary cress
Leymus condensatus	giant ryegrass
Lonicera sp.	honeysuckle
Lotus corniculatus	bird's foot trefoil
Lupinus albifrons	bush lupine
Lysimachia arvensis	scarlet pimpernel
Malva parviflora	cheeseweed
Marah fabaceus	wild cucumber/manroot
Matricaria discoidea	pineapple weed
Medicago polymorpha	bur clover
Melilotus indicus	Indian melilot
Mimulus aurantiacus	sticky monkey flower
Myoporum laetum	lollypop tree
Oxalis pes-caprae	Bermuda-buttercup
Pennisetum clandestinum	kikuyu grass
Persicaria punctata	dotted smartweed
Phalaris minor	Mediterranean canary grass
Pinus muricata	Bishop Pine
Plantago coronopus	cut-leaf plantain
Plantago lanceolata	English plantain
Platanus racemosa	western sycamore
Polypogon monspeliensis	rabbitfoot grass
Populus trichocarpa	black cottonwood
Potentilla anserina ssp. *pacifica*	Pacific silver-weed
Pseudognaphalium californicum	California Cudweed

Plant Species Observed within the Project Study Area

Species Name	Common Name
Pseudognaphalium luteo-album	weedy cudweed
Quercus agrifolia	coast live oak
Raphanus sativus	wild radish
Ribes sp.	gooseberry
Rosa gymnocarpa	wood rose
Rubus armeniacus	Himalayan blackberry
Rubus ursinus	California blackberry
Rumex crispus	curly dock
Salix laevigata	red willow
Salix lasiolepis	Arroyo willow
Schoenoplectus californicus	California bulrush
Schoenoplectus pungens	three-square bulrush
Silybum marianum	milk thistle
Solanum sp.	nightshade
Sonchus asper ssp. *Asper*	prickly sow thistle
Sonchus oleraceus	common sow thistle
Spergularia villosa	villous sand spurry
Stachys bullata	wood mint
Stipa pulchra	purple needle grass
Symphoricarpus albus	common snowberry
Tetragonia tetragonioides	New Zealand spinach
Toxicodendron diversilobum	poison Oak
Trifolium hirtum	rose clover
Tropaeolum majus	garden nasturtium
Typhaceae sp.	cat-tail
Urtica dioica	hoary nettle
Verbena lasiostachys	robust vervain
Veronica persica	persian speedwell
Vicia sativa	spring vetch
Vinca major	periwinkle
Vulpia myuros	rat-tail fescue
Xanthium strumarium	cockle bur

Appendix F Wetland Delineation

Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Managemet Plan (ISMP) Project

DRAFT

Delineation of Jurisdictional Wetlands and Other Waters Under Section 404 of the Clean Water Act and the California Coastal Act

January 2015



Prepared For:

U.S. Army Corps of Engineers
135 Market Street, 6th Floor
San Francisco, California 94105

Prepared By:

Denise Duffy & Associates, Inc.
Contact: Josh Harwayne
947 Cass Street, Suite 5
Monterey, CA 93940

On Behalf Of:

County of Monterey
Resource Management Agency
168 W. Alisal Street, 2nd Floor
Salinas, CA 93901

Table of Contents

1.0 Introduction 1
1.1. Regulatory Background 4
2.0 Methods 7
2.1. Field Methods 7
2.2. Analysis 8
3.0 Action Area Description 9
3.1. Vegetation 9
3.2. Soils 13
3.3. Hydrology 16
4.0 Results 17
4.1. Vegetation 17
4.2. Soils 17
4.3. Hydrology 17
4.5 Ordinary High Water 18
5.0 Potential Jurisdiction 19
5.1. ACOE Jurisdiction 19
5.2. CCC Jurisdiction 19
6.0 References 20
Appendix A: Wetland Delineation Map
Appendix B: Wetland Determination Data Forms
Appendix C: NOAA Tide Predictions

List of Figures

Figure 1. Action Area 2
Figure 2. Proposed Action 3
Figure 3. Vegetation Types Within the Action Area 10
Figure 4. Soils Within the Action Area 14
Figure 5. Site Geologic Map 15

List of Tables

Table 2-1: Wetland Vegetation Classification System 7

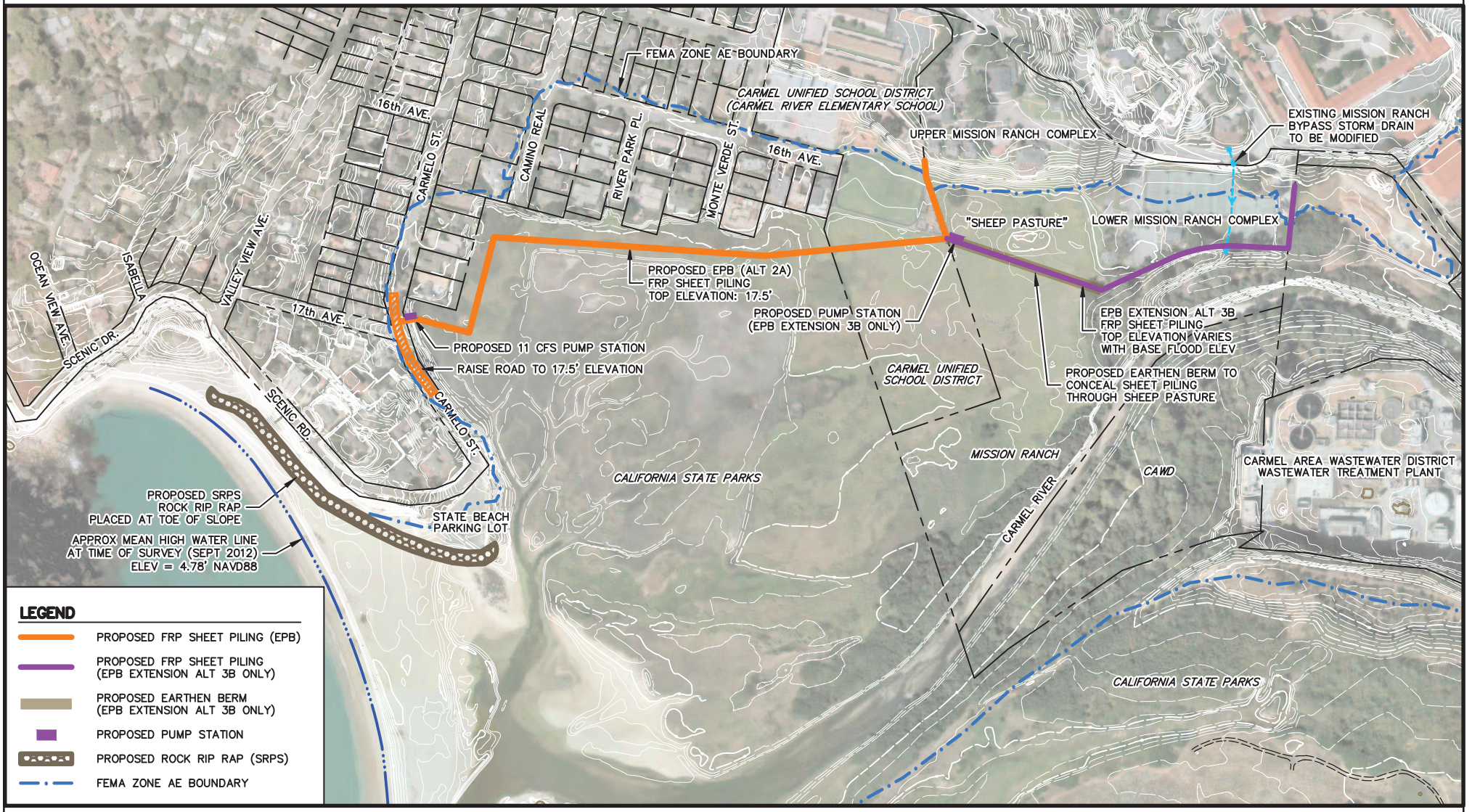
1.0 Introduction

This wetland delineation report was prepared for the Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project Action Area (Project), which includes the Carmel Lagoon in Monterey County, California (Figures 1 and 2). The Federal procedure to delineate wetlands is based on identifying indicators to evaluate whether a site meets all three of the specified parameters; vegetation, soils and hydrology. This Federal process is typically used to delineate coastal wetlands as well, with the difference being that a coastal wetland can be delineated by meeting only one of the three parameters. For this delineation, data was collected and procedures followed in conformance with *The Field Guide for Wetland Delineation: 1987 Corps of Engineers Manual* (Wetland Manual) (Wetland Training Institute, 1995) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (Supplement) (ACOE, 2008). The presence of one or more parameters (vegetation, soils, or hydrology, as defined by the ACOE) was used to delineate wetlands potentially under the California Coastal Commission's (CCC's) jurisdiction, and the presence of all three parameters was used to delineate wetlands potentially under the U.S. Army Corps of Engineers' (ACOE's) jurisdiction.

The Carmel Lagoon (lagoon), located at the mouth of the Carmel River, is a very productive estuary that serves as habitat for the federally listed South-Central California Coast steelhead (*Oncorhynchus mykiss irideus*) and California red-legged frog (*Rana draytonii*), as well as other special-status wildlife species and sensitive habitats. Sandbar management activities at the lagoon have historically been conducted at the Carmel River State Beach to mitigate flooding impacts to low-lying properties when river flow increases in the fall and early winter. Lagoon water levels can rise to flood stage with the result that public and private properties are threatened with flooding before the sandbar would open naturally. Breaching dynamics directly affect lagoon stage (water surface elevation), which in turn determines aquatic habitat volume and area, as well as water quality.

The Proposed Action is a comprehensive plan meant to promote improvement in ecological function of the lagoon, including natural floodplain function and improvement of habitat for listed and special-status species associated with the lagoon, by allowing the lagoon to breach naturally, without increasing flood and erosion risk to private structures and public facilities. The Action Area includes the Carmel Lagoon and adjacent wetland, riparian and coastal strand habitats. The Proposed Action involves implementing three project components: 1) Ecosystem Protective Barrier (EPB); 2) Scenic Road Protection Structure (SRPS); and 3) Interim Sandbar Management Plan (ISMP). The EPB would maintain existing flood protection to low-lying homes and other local Carmel-by-the-Sea infrastructure along the north edge of the lagoon while the frequency of mechanical management of the sandbar is reduced in compliance with regulatory requirements. The SRPS would provide protection from erosion along the northern sand cliffs and the undermining of Scenic Road resulting from northerly river flows and/or large ocean swells. The ISMP is intended to provide a short-term solution to potential flooding issues with select sandbar breaching actions that allow additional natural function in the lagoon while still protecting properties and infrastructure, with the understanding that the development of the EPB and SRPS will reduce mechanical management of the sandbar and lead to potential long-term solutions that return the lagoon, its sandbar, and associated riverine and ocean dynamics to more natural cycles. The Proposed Action is intended to provide a long-term solution to flooding and habitat impact issues that avoids unauthorized take of listed and special-status species in compliance with state and federal law, while maintaining the existing level of protection to properties and infrastructure.


Legend
Action Area
Carmel Lagoon
North Arm
Carmel River
Carmel Area Wastewater
District Wastewter
Treatment Plant
Carmel River
State Beach
Carmel Bay
Carmel Lagoon
South Arm
Stewart Way
Isabella Ave
Valley View Ave
Rio Ave
Camino Real
Walker Ave
16th Ave
Carmelo St
Ladera Dr
Atherton Dr
Mesa Dr
Lazarro Dr
Rio Rd
Riverside Way
Sycamore Pl
Willow Pl
Oliver Rd
Fisher Pl
Mission Fields Rd
Birch Pl
Aspen Pl
Fisher Dr
The Crossroads Blvd
CA-1
Pradera Rd
Ribera Rd
Cuesta Way
N
0
0.1
0.2 mi
0
0.2
0.4 km
PACIFIC GROVE
MONTEREY
SEASIDE
Pebble Beach
Monterey Peninsula
Carmel-by-the-Sea
Action Area
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date
07-15-2014
Scale
1 in=0.1 mi
Figure
1
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Wetland Delineation Maps\Action Area Map.mxd



Source: Whitson Engineers, Inc., August 7, 2013



Proposed Action

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 03-27-2014
Scale 1 in=1.3 mi
Figure 2

1.1. Regulatory Background

1.1.1 Federal Regulation

The ACOE is the primary federal agency responsible for regulating wetlands and other waters of the United States (other waters). The ACOE and the Environmental Protection Agency (EPA) define wetlands as:

> *Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (ACOE, 1982 and EPA, 1980)*

The Field Guide for Wetland Delineation: 1987 Corps of Engineers Manual (Wetland Manual) (Wetland Training Institute, 1995) describes the three environmental parameters used in delineating jurisdictional wetlands. The three parameters are:

> ***Vegetation.*** *The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in the definition of a wetland above. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s),have the ability to grow effectively, compete, reproduce, and/or persist in anaerobic soil conditions;*
>
> ***Soil.*** *Soils are present and have been classified as hydric or they possess characteristics that are associated with reducing soil conditions; and*
>
> ***Hydrology.*** *The area is inundated either permanently or periodically at mean water depths of ≤ 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.*

The Wetland Manual states that "evidence of a minimum of one positive wetland indicator from each parameter…must be found in order to make a positive wetland determination." However, climatic and hydrologic conditions in the Arid West often make it difficult to identify wetland indicators. Therefore, on December 18, 2006, the San Francisco District of the ACOE distributed a public notice requiring that, as of January 1, 2007, any new delineation work within their jurisdiction follow the guidance contained in the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (Interim Supplement) (ACOE, 2006). In September 2008, the ACOE released the final version of the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (Supplement) to replace the Interim Supplement. The Supplement provides both indicators for each parameter that are specific to the Arid West region and guidance on difficult wetland situations where indicators may be lacking.

Waters of the U.S. are defined as:

1. *All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;*
2. *All interstate waters including interstate wetlands;*
3. *All "other waters" such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:*

i. Which are or could be used by interstate or foreign travelers for recreational or other purposes; or

ii. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

iii. Which are used or could be used for industrial purpose by industries in interstate commerce;

4. All impoundments of waters otherwise defined as waters of the United States under the definition;

5. Tributaries of waters identified in paragraphs [1-4] of this section;

6. The territorial seas;

Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs [1-6] of this section. (ACOE, 1982)

As identified above, all waters subject to the ebb and flow of the tide are subject to ACOE jurisdiction. In tidal waters, the landward limits of ACOE jurisdiction extend to the "high tide line" (HTL). The HTL is defined by the ACOE as:

> *The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. (ACOE, 1982)*

A standard approach to determine an appropriate HTL is to use the highest predicted annual astronomical tide as identified in the National Oceanic and Atmospheric Administration (NOAA) Tide Predictions.

Additionally, as identified above, "other waters," including lakes, ponds, and streams, are subject to ACOE jurisdiction. "Other waters" are characterized by an ordinary high water (OHW) mark, which is defined as:

> *…that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the characteristics of the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas. (ACOE, 1982)*

In the field, "other waters" are identified by the presence of a defined river or stream bed, a bank, and evidence of the flow of water.

On June 5, 2007, the ACOE and the EPA developed a Memorandum Regarding *Clean Water Act Jurisdiction Following Rapanos v. United States* which states that the agencies will assert jurisdiction over the following categories of water bodies:

- *TNWs [traditional navigable waters] and wetlands adjacent to TNWs and*
- *Non-navigable tributaries of TNWs that are relatively permanent (i.e., the tributaries typically flow year-round or have continuous flow at least seasonally) and wetlands that directly abut such tributaries*

In addition, the following waters will also be found jurisdictional based on a fact-specific analysis that they have a significant nexus with a TNW:

- *Non-navigable tributaries that do not typically flow year-round or have continuous flow at least seasonally;*

- *Wetlands adjacent to such tributaries; and*
- *Wetlands adjacent to but that do not directly abut a relatively permanent non-navigable tributary*

A significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or an insubstantial effect on the chemical, physical, and/or biological integrity of a TNW. Principal considerations when evaluating significant nexus include the volume, duration, and frequency of the flow of water in the tributary and the proximity of the tributary to a TNW, plus the hydrologic, ecologic, and other functions performed by the tributary and all of its adjacent wetlands. (ACOE & EPA, 2007)

The term "navigable waters of the U.S." is defined to include:

…all those waters that are subject to the ebb and flow of the tide, and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. (ACOE, 1982)

1.1.2. Coastal Regulation

Although wetlands are typically under the jurisdiction of the ACOE, wetlands found in the coastal zone may also be regulated under the California Coastal Act (CCA) of 1976 and the federal Coastal Zone Management Act (CZMA) under the jurisdiction of the CCC. Under the CCA, wetlands are defined as:

land within the coastal zone which may be covered periodically or permanently with shallow water and include saltwater marshes, freshwater marshes, open or closed brackish water marshes, swamps, mudflats, and fens. (Pub. Res. Code §30121).

The CCC Administrative Regulations (California Code of Regulations Title 14 [14 CCR]) provides an expanded definition:

…Wetlands are lands where the water table is at, near, or above the land surface long enough to promote the formation of hydric soils or to support the growth of hydrophytes, and shall also include those types of wetlands where vegetation is lacking and soil is poorly developed or absent as a result of frequent or drastic fluctuations of surface water levels, wave action, water flow, turbidity or high concentrations of salt or other substance in the substrate. Such wetlands can be recognized by the presence of surface water or saturated substrate at some time during each year and their location within, or adjacent to, vegetated wetlands or deepwater habitats… (14 CCR, Section 13577).

The Federal procedures to identify indicators and evaluate whether a site meets any of the three parameters is typically used to delineate coastal wetlands. For this delineation, data was collected and procedures followed in conformance with the ACOE's Wetland Manual and the Supplement. The presence of one or more parameters (vegetation, soils, or hydrology, as defined by the ACOE) was used to delineate wetlands under CCC jurisdiction.

2.0 Methods

This wetland delineation was conducted in accordance with the requirements set forth in the Wetland Manual and Supplement. Prior to conducting the field survey, available reference materials were reviewed, including the Web Soil Survey Database (USDA-NRCS, 2013), National Wetlands Inventory Wetland Mapper (Service, 2014), aerial photographs of the site, and technical documents prepared for the project, including *The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report* prepared by Balance Hydrologics, Inc, January 2014 (Hydrology Report); Memorandum To Whitson Engineers for Feasibility Report: *Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues*, prepared by H.T. Harvey & Associates (HTH), May 2013; and *Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California*, Pacific Geotechnical Engineering, May 2013 (Geotechnical Report). Field surveys were conducted on June 9, 10, 11, 13, and 17, 2014 by Associate Environmental Scientists, Matt Johnson and Jami Davis. The methods for evaluating the presence of wetlands and waters are described in detail below.

2.1. Field Methods

A total of 74 sampling points were taken (Appendix A). The data collected during the field surveys were recorded on Wetland Determination Data Forms for the Arid West Region (Appendix B). Each sampling point was mapped using a Trimble Pro XH GPS unit and a picture was taken of the area immediately surrounding the point. All points were subsequently displayed in GIS using ArcGIS software.

Indicators described in the ACOE manual that were used to make wetland determinations at each sampling point are described below.

2.1.1. Vegetation

Vegetation was broken into four strata for evaluation: tree, sapling/shrub, herb, and woody vines. Dominant plant species and their approximate percent cover within five feet of the sampling point were recorded for sapling/shrub, herb, and woody vine layers, and within 10-20 feet for the tree layer. Plant species were identified using *The Jepson Manual: Vascular Plants of California, Second Edition, Thoroughly Revised and Expanded* (Baldwin et. al., 2012) and *An Illustrated Field Key to the Flowering Plants of Monterey County* (Matthews, 2006), and were assigned a wetland status according to the *Arid West 2014 Regional Wetland Plant List* (ACOE, 2014). This wetland classification system is based on the expected frequency of occurrence in wetlands as described in Table 2-1.

Table 2-1: Wetland Vegetation Classification System

Symbol	Indicator Category	Definition	Frequency of Occurrences
OBL	Obligate Wetland Plants	Always found in wetlands	>99%
FACW	Facultative Wetland Plants	Most often occur in wetlands	67-99%
FAC	Facultative Plants	Equal likelihood of occurring in wetlands and non-wetlands	33-67%
FACU	Facultative Upland Plants	Most often occur in non-wetlands	1-33%
UPL	Obligate Upland Plants	Always found in non-wetlands	<1%
NL	Not Listed (Assumed Upland)		

The "dominance test," as described in the Supplement, was applied for each survey point. If greater than 50 percent of the dominant plant species across all strata were rated OBL, FACW, or FAC, then the plant community "passed" the dominance test and the vegetation was determined to be hydrophytic. Neither the prevalence test or morphological adaptations indicator were used as the conditions described in the manual for each were absent (i.e., plant community failing the dominance test with presence of both hydric soil and wetland hydrology)

2.1.2. Soils

The National Technical Committee for Hydric Soils (NTCHS) defines a hydric soil as:

> *A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. (USDA-NRCS, 1995)*

The soil at each survey point was evaluated by digging a 20-inch hole, when possible, and identifying soil horizons, color, and texture, as well as any hydric soil indicators (as described in the Supplement). Soil color was evaluated by comparing a small wetted piece of soil to Munsell Soil Color Charts (Munsell, 2000). The last digit of the Munsell Soil Notation refers to the chroma of the sample. This notation consists of numbers beginning with 0 for neutral grays and increasing at equal intervals to a maximum of about 20. Chroma values of the soil matrix which are one or less, or of two or less if mottling is present, are typical of soils which have developed under anaerobic conditions and indicate hydric soils, unless otherwise noted in the Supplement for certain soil types.

2.1.3. Hydrology

The Wetland Manual defines "wetland hydrology" as:

> *Encompassing all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season. Areas with evident characteristics of wetland hydrology are those where the presence of water has an overriding influence on characteristics of vegetation and soils due to anaerobic and reducing conditions, respectively. Such characteristics are usually present in areas that are inundated or have soils that are saturated to the surface for sufficient duration to develop hydric soils and support vegetation typically adapted for life in periodically anaerobic soil conditions.*

Each survey point was evaluated for wetland hydrology using the indicators described in the Supplement. Evidence of one Primary Indicator sufficiently identified wetland hydrology; however, two or more Secondary Indicators were necessary if no Primary Indicators were observed. As stated in the Supplement, the Arid West is characterized by extended dry seasons in most years and by extreme temporal and special variability in rainfall, which causes many wetlands in the region to be dry for much of the year. At these times, hydrology indicators may be lacking altogether. Therefore, a "lack of an indicator is not evidence for the absence of wetland hydrology." Guidance is provided in the supplement for difficult wetland situations such as this.

2.2. Analysis

Data collected at each sampling point was analyzed to determine if wetlands and other waters were present. As described above, evidence of a minimum of one primary wetland indicator from all three parameter was necessary in order to make a positive determination of wetlands potentially under the jurisdiction of the ACOE, while only one was necessary for the coastal wetlands. The data were then displayed on an aerial photograph using ArcGIS software (Appendix B).

3.0 Action Area Description

3.1. Vegetation

Vegetation types present within portions of the Action Area were described by HTH (2013) and Casagrande (2006). Additional field surveys were conducted by DD&A staff biologists to confirm, update, and complete the vegetation mapping and descriptions. The survey results include mapping and quantification of the acreage of 12 vegetation types within the Action Area (Figure 3): riparian, emergent marsh (semi-permanent), emergent marsh (seasonal), non-native annual grassland, disturbed herbaceous mosaic, ruderal grassland, coastal scrub, coastal dune scrub, ruderal coastal dune, coast live oak woodland, and eucalyptus grove. Additionally, three unvegetated areas are present: coastal strand, aquatic, and developed. The following is a brief description of these vegetation types.

3.1.1. Riparian

Two types of riparian vegetation are supported within the lagoon. Dense riparian forest is present along the Carmel River, upstream of the main embayment, and is dominated by Arroyo willow (*Salix lasiolepis*) and black cottonwood (*Poplus trichocarpa*) trees with and understory dominated by California blackberry (*Rubus ursinus*). Riparian scrub-shrub is present immediately adjacent to the confluence of the Carmel River and the main embayment, adjacent to the Carmelo Road roadway embankment, and in areas slightly higher in elevation throughout the south arm of the lagoon. Vegetation within the riparian scrub-shrub consists of willows, various shrubs, and vines, such as California blackberry, often in the form of dense thickets less than 20 ft. in height. The total area of riparian vegetation within the Action Area is approximately 89.5 acres.

3.1.2. Semi-Permanent Emergent Marsh

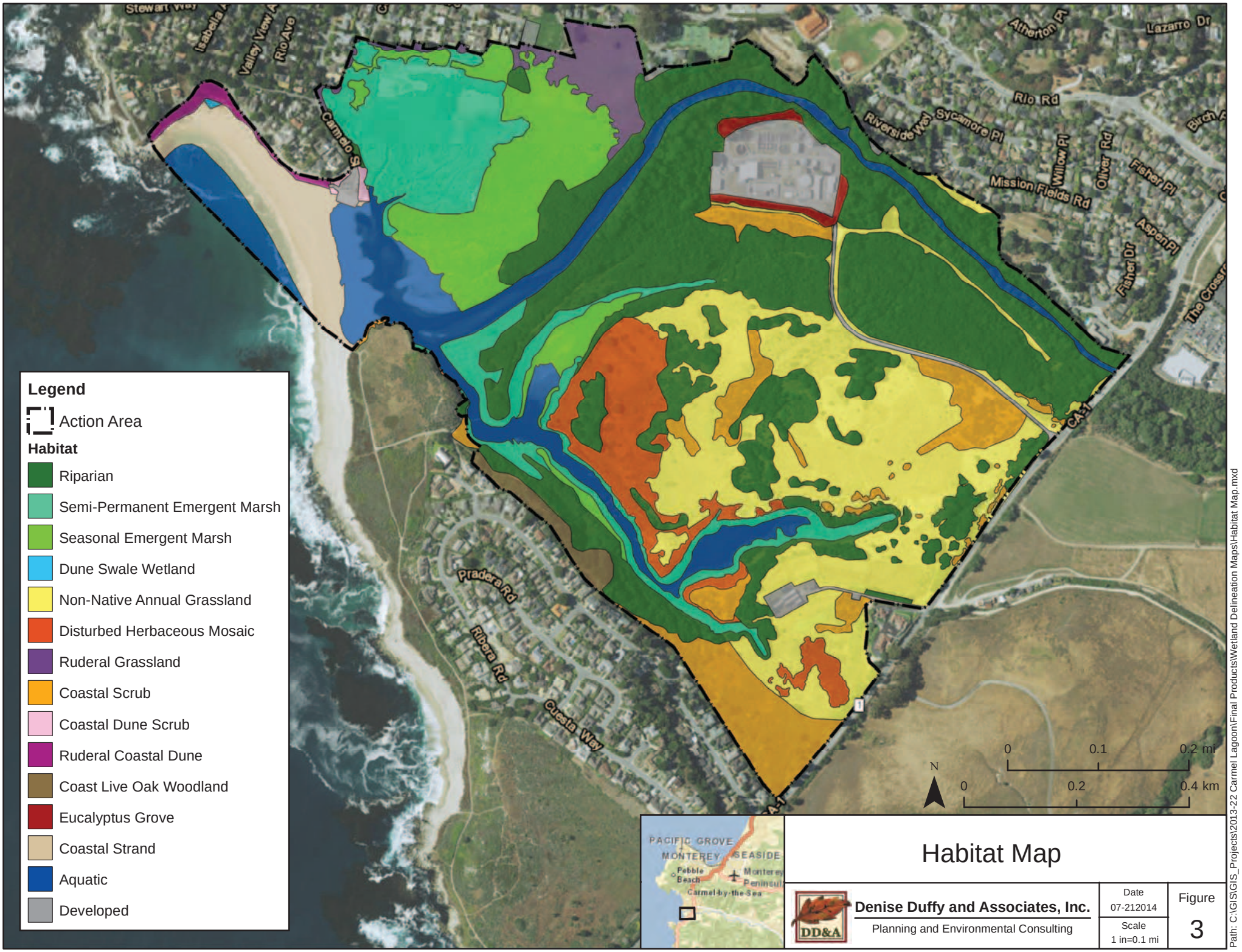
Siltation has resulted in a narrowing of the main body of the lagoon, more pronounced on the north side, where up to 350 ft. of the old active channel in now vegetated wetland. The majority of these wetlands, while experiencing seasonal fluctuation, remain flooded for significant portions of the year, when the sandbar is closed and stream flow entering the lagoon is present. These semi-permanent emergent wetlands are dominated by California bulrush (*Schoenoplectus californicus*), with few associated species. Within the action area, this habitat type covers approximately 28.3 acres.

3.1.3. Seasonal Emergent Marsh

At higher elevations in the lagoon, where flooding is less frequent, the vegetation shifts from the tall California bulrush to areas dominated by Baltic rush (*Juncus balticus* subsp. *ater*) and Pacific silverweed (*Potentilla anserina* subsp. *pacifica*), intergrading with dotted smartweed (*Persicaria punctata*), brass buttons (*Cotula coronopifolia*), marsh spike-rush (*Eleocharis macrostachya (palustris*)), and three-square bulrush (*Schoenoplectus pungens*). Approximately 22.2 acres of seasonal emergent marsh are present within the Action Area.

3.1.4. Dune Swale Wetland

An approximately 0.1 acre freshwater coastal dune swale wetland is located at the north end of the coastal strand near the headlands, at the base of the bluff. Likely this wet depression is a remnant of past scouring in this region. Sufficient urban runoff exists to support wetland plants including California bulrush, common three-square bulrush, and dotted smartweed.


Legend
Action Area
Habitat
Riparian
Semi-Permanent Emergent Marsh
Seasonal Emergent Marsh
Dune Swale Wetland
Non-Native Annual Grassland
Disturbed Herbaceous Mosaic
Ruderal Grassland
Coastal Scrub
Coastal Dune Scrub
Ruderal Coastal Dune
Coast Live Oak Woodland
Eucalyptus Grove
Coastal Strand
Aquatic
Developed
Stewart Way
Isabella Ave
Valley View Ave
Rio Ave
Carmelo St
Atherton Pl
Lazarro Dr
Rio Rd
Riverside Way
Sycamore Pl
Willow Pl
Oliver Rd
Fisher Pl
Mission Fields Rd
Aspen Pl
Fisher Dr
The Crossroads
CA-1
Pradera Rd
Ribera Rd
Cuesta Way
N
0
0.1
0.2 mi
0
0.2
0.4 km
PACIFIC GROVE
MONTEREY
SEASIDE
Pebble Beach
Monterey Peninsula
Carmel-by-the-Sea
Habitat Map
Denise Duffy and Associates, Inc.
Planning and Environmental Consulting
Date
07-212014
Scale
1 in=0.1 mi
Figure
3
Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Wetland Delineation Maps\Habitat Map.mxd

3.1.5. Disturbed Herbaceous Mosaic

Approximately 13.8 acres of the Action Area are dominated by a mosaic of native and non-native herbaceous vegetation, where one or two species dominate in patches smaller than the scale utilized for this mapping effort. This habitat type is present in areas that were historically used for agriculture and were subsequently graded in 2004 as a part of the restoration of the south arm of the lagoon. The mosaic nature of this habitat type is a likely result of historic disturbance, the subsequent planting and colonization of native species, and the persistence of non-native ruderal species from farming activities.

The elevation at which most of this habitat occurs allows the area to be intermittently inundated during periods of high water surface elevation (WSE) within the lagoon. This habitat type is also present in the southern corner of the Action Area, adjacent to SR1, in areas where the water from a culvert under the highway and seepage from the adjacent hillside intermittently inundate the nearly flat landscape. As such, this habitat type is dominated by plant species adapted to mesic conditions. The dominant species include Pacific gum plant (*Grindelia stricta*), perennial rye grass (*Lolium perenne*), mule fat (*Baccharis salicifolia*), sneeze weed (*Helenium puberulum*), bristly ox-tongue (*Picris echioides*), cut-leaved plantain (*Plantago coronopus*), tall sedge (*Cyperus eragrostis*), curly dock (*Rumex crispus*), and Santa Barbara sedge (*Carex barbarae*).

3.1.6. Non-Native Annual Grassland

Approximately 49.8 acres of non-native annual grassland are present within the Action Area. Similar to the disturbed herbaceous mosaic habitat, these areas were historically used for agriculture and were graded in 2004 as part of the restoration of the south arm of the lagoon. However, this habitat type is present at a somewhat higher elevation and is not inundated as frequently. Dominant grass species within this vegetation type include slender oat (*Avena barbata*), ripgut brome (*Bromus diandrus*), soft chess (*B. hordeaceus*), and rattail fescue (*Vulpia myuros*). Dense patches of non-native poison hemlock (*Conium maculatum*) and summer mustard (*Raphanus sativus*) are also present within this area; however, they are smaller than the scale utilized for this mapping effort.

3.1.7. Ruderal Grassland

Approximately 6.5 acres of ruderal grassland are present within the Action Area. The field owned by Mission Ranch and the Carmel USD supports a monoculture area of kikuyu grass (*Pennisetum clandestinum*) in areas higher in elevation than the adjacent emergent marsh. This area is currently being grazed by sheep and is highly disturbed. Additionally, between the north/northwestern sides of the lagoon and the Fourth Addition neighborhood, there is a relatively narrow (up to approximately 15 ft. wide) strip dominated by kikuyu grass and weedy herbs, including wild radish (*Raphanus sativus*) and naturalized garden nasturtium (*Tropaeolum majus*). A number of landscape trees, including Monterey cypress (*Hesperocyparis macrocarpa*), have also been planted at the development edge.

3.1.8. Coastal Scrub

Approximately 19.6 acres of coastal scrub are present within the Action Area. The slope adjacent to the Carmel Meadows residential development supports dense coyote brush (*Baccharis pilularis*) and poison oak (*Toxicodendron diversilobum*). Coyote brush has also been planted in the upland areas surrounding the south arm of the lagoon as part of the restoration by State Parks. In these areas, the coyote brush is less dense and annual grass species, indicative of the adjacent non-native annual grassland, are present in the understory.

3.1.9. Coastal Dune Scrub

The parking lot at the Carmel River State Beach has been placed on fill material. The sandy slopes bordering the parking lot are stable enough to support species characteristic of coastal dune scrub in the

region. The slope is dominated by the native species California sagebrush (*Artemisia californica*) and coyote brush, with subdominants including dune buckwheat (*Eriogonum parvifolium*), seaside woolly sunflower (*Eriophyllum staechadifolium*), and mugwort (*Artemisia douglasiana*). The non-native species wild radish and New Zealand spinach (*Tetragonia tetragonioides*) are also present. Approximately 0.3 acres of coastal dune scrub is present within the Action Area.

3.1.10. Ruderal Coastal Dune

The bluff bordering Scenic Road is very steep and sandy. Non-native hottentot fig (*Carpobrotus edulis*), a type of iceplant, often planted for erosion control on sandy slopes, dominates in a majority of the area; however, at the north end of the bluff, California sagebrush co-occurs with the hottentot fig. Large areas of the bluff are also devoid of vegetation, especially near the toe of the slope and where there has been slope failure. This ruderal coastal dune area covers approximately 1.5 acres of the Action Area.

3.1.11. Coast Live Oak Woodland

Approximately 2.5 acres of Coast live oak (*Quercus agrifolia*) woodland is present within the Action Area, located south of the lagoon on the slope adjacent to the Carmel Meadows residential development. The canopy is quite dense with an understory dominated by poison oak.

3.1.12. Eucalyptus Grove

An approximately 2.0 acre grove of eucalyptus trees (*Eucalyptus globulus*) is present within the Action Area. This small grove is present surrounding the Carmel Area Water District (CAWD) Water Treatment Plant (WTP) and has a maintained understory.

3.1.13. Coastal Strand

A broad unvegetated stretch of beach occurs bordering Scenic Road, at the base of the bluff. The coastal strand area extends from the mouth of the Carmel River north to where the beach abruptly ends at a bedrock headland and south towards Monastery State Beach. Within the Action Area, approximately 11.1 acres of coastal strand are present. Coastal strand areas are typically dynamic, responding to seasonal shifts in wind and wave energy and storm events. The coastal strand bordering Scenic Road is subject to extreme seasonal and annual changes in morphology in response to storm frequency and intensity, changes in wind and wave energy, river flow intensity and duration, and the frequency of sandbar management for flood protection. This highly dynamic system precludes the development of vegetation along the strand.

3.1.14. Aquatic

Approximately 26.8 acres of aquatic habitat is present within the Action Area. The South Arm and a small portion of the North Arm are permanently flooded areas of the lagoon. Portions of the main embayment are also perennial; however, the boundary of the permanent water varies both seasonally and annually with changes in the lagoon water volume, sediment accumulation, stream flow, and the river's opening to the ocean, which ultimately depend on the timing of the sandbar breaching and closure. When the sandbar is closed, water accumulates in the main embayment of the lagoon creating semi-permanent open water habitat. When the sandbar is open, and the water subsides, mudflats or other open shore habitat is present. The main embayment lacks emergent vegetation; however, portions of the South Arm support beds of submerged pondweed (*Potamogeton* sp.).

3.1.15. Developed

Approximately 9.9 acres of developed area occur within the Action Area. These include the CAWD WTP, the State Parks parking lot and facilities, and the associated access roads. Most of the developed

areas within in the Action Area are completely devoid of vegetation. However, some areas, such as the area surrounding the State Parks facilities in the southern portion of the Action Area, include vegetation dominated by annual grasses, poison hemlock, and summer mustard.

3.2. Soils

The Web Soil Survey (USDA-NRCS, 2013) identifies 14 map units within the Action Area (Figure 4): Alviso silty clay loam (Ac), Aquic xerofluvents, Coastal beaches (Cm), Elder very fine sandy loam, 2-9 % slopes (EbC), Metz fine sandy loam (Mf), Narlon loamy fine sand, 2-9% slopes (NcC), Oceano loamy sand, 2-15% slopes (OaD), Pacheco clay loam (Pa), Pico fine sandy loam (Pf), Salinas clay loam, 0-2% slopes (SbA), Santa Ynez fine sandy loam, 9-15% slopes (ShD), Sheridan coarse sandy loam, 15-30% slopes (SoE), Water (W), and Xerothents, dissected (Xd). The National Hydric Soils List (USDA, 2007) identifies Alviso silty clay loam, Aquic xerofluvents, coastal beaches, Metz fine sandy loam, Narlon loamy fine sand, Pacheco clay loam, Pico fine sandy loam, an Salinas clay loam as hydric soils. Please note that the National Hydric Soils List cannot be used in the field to determine hydric soils as it is only a list of soils that are *likely* to by hydric.

The geology of the Action Area was described in a Geotechnical Report prepared for the project (Pacific Geotechnical Engineering, 2013).

Pleistocene and Holocene coastal dunes lap across and overlie the coastal terrace deposits in the SRPS vicinity (Figure 5). Dune deposits consist of "unconsolidated, well-sorted, fine- to medium-grained sand" locally up to about 75 feet thick. Beach sand is mapped along the shore of Stewart's Cove, and makes up the seasonal barrier across the mouth of the Carmel River. Texturally, beach sand is typically "unconsolidated, well-sorted, medium- to coarse-grained sand with local layers of pebbles and cobbles and thin discontinuous lenses of silt in back-beach areas.

Flood-plain deposits occur to the north and south of the Carmel River (Figure 5). The oldest of these flood-plain deposits is mapped along a swath a few hundred feet north of, and roughly paralleling, the EPB. Texturally, these sediments consist of "unconsolidated, relatively fine-grained, heterogeneous deposits of sand and silt commonly including relatively thin layers of clay." Inset into these older flood-plain deposits are younger flood-plain deposits, which generally underlie the proposed EPB alignment. Texturally, these are very similar to older flood-plain deposits, with variable gravel content. These younger flood-plain deposits are generally less than about 20 ft. (6 m) thick.

Basin deposits are mapped in the area of the lagoon (Figure 5). Basin deposits are described as "unconsolidated, plastic clay and silty clay containing much organic material, and locally contain[ing] interbedded thin layers of silt and silty sand."

Developed and graded sites typically have discontinuous fill deposits, particularly at the outboard edges of graded pads on sloping ground, and the outboard shoulders of roads on sloping ground. The outboard edge of Scenic Road currently has a sloping sandy ramp that descends to the beach. Department of Public Works personnel indicate that this ramp is underlain by a prism of rip-rap.

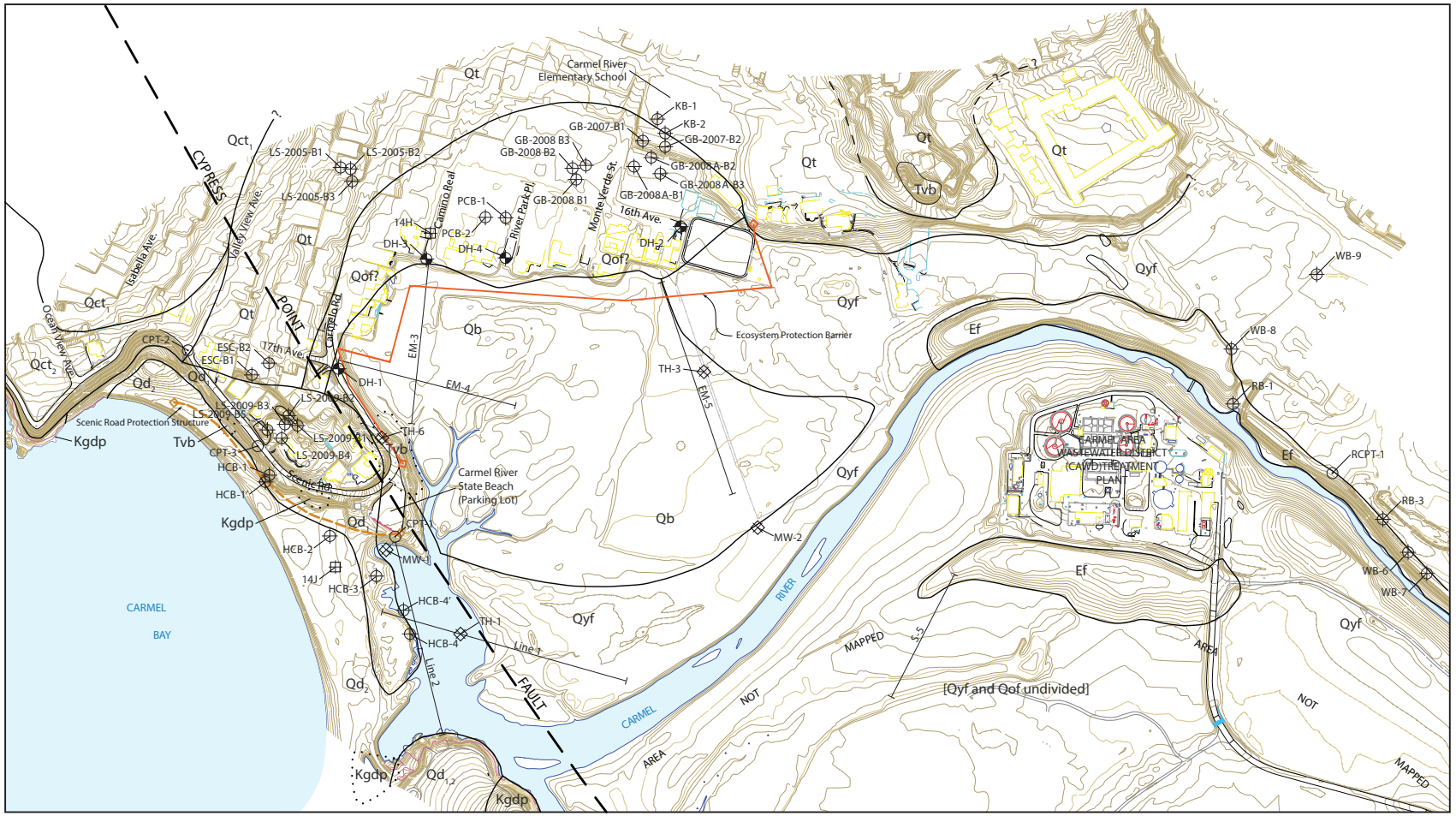


Soils within Action Area

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date 07-15-2014
Scale 1 in=0.1 mi
Figure 4

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Wetland Delineation Maps\Soils Map.mxd



EXPLANATION

Earth Materials

- Ef — Earth fill - various textures. Fill prisms along roads not mapped for legibility
- Qd — Dune sand - locally subdivided into Qd_1 (older) and Qd_2 (younger)
- Qb — Basin deposits - plastic clay and silty clay
- Qyf — Younger floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qof — Older floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qt — Alluvial terrace deposits - silt, silty clay, sand and gravel; locally subdivided
- Qct — Coastal terrace deposits - sand with thin, discontinuous gravelly layers
- Tvb — Volcanic rocks - basaltic andesite flows and flow breccia
- Kgdp — Granodiorite (porphyritic granodiorite of Monterey of Ross (1976))

Symbols

- Geologic contact, dashed where approximate, queried where uncertain, dotted where concealed
- Inferred, buried fault
- DH-4 — Exploratory drill hole (this investigation)
- CPT-2 — CPT sounding (this investigation)
- Exploratory drill hole (investigations by others)
  - KB-2 (Kleinfelder, 2011)
  - GB-2008A-B3 (Grice, 2008A)
  - GB-2008 B3 (Grice, 2008B)
  - PCB-2 (Pacific Crest, 2008)
  - LS-2009-B5 (Landset, 2009)
  - LS-2005-B5 (Landset 2005)
  - ESC-B2 (Earth Systems Consultants, 2010)
  - HCB-4 (Hydro-Search, 1981)
  - WB-9 (Wahler, 1989; compiled in Raas [2000])
  - RB-3 (Raas, 2000)
- MW-3 — MW-2 (Staal, Gardner, Dunne, 1989b)
- TH-6 — TH-6 (Staal, Gardner, Dunne, 1989b)
- 14H (Previous borings compiled by Staal, Gardner, Dunne, 1989b)
- RCPT-3 — CPT sounding (Raas, 2000)
- Geophysical transects (Staal, Gardner, Dunne, 1989)
- Proposed Ecosystem Protection Barrier
- Scenic Road Protection Structure

Notes:

1. Base provided by Whitson Engineers
2. Geologic interpretation modified from Clark, Dupre and Rosenberg (1997), with additions
3. Scenic Road Protection Structure preliminary alignment provided by Moffat & Nichol
4. Ecosystem Protection Barrier preliminary alignment provided by Whitson Engineers



Source: Pacific Geotechnical Engineers, 2013

Site Geologic Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date	Figure
02-24-2016	5
Scale	
N/A	

Scale in feet: 100 0 100 200

Path: P:\DDA Current Projects\2013-22 Carmel Lagoon\EIR EA\Admin Draft EIR EA\Figures\Indesign\ 8.5x11 landscape

3.3. Hydrology

The Carmel River Watershed has large variations in seasonal and yearly discharge rates, brought about in large part by the unique nature of the coastal California geographic location within a Mediterranean climate zone, as well as by the size, vertical extent, geology, and geomorphic structure of the watershed. Carmel Lagoon, located at the bottom of the watershed, serves as an ecological interface zone between the watershed and the ocean. The lagoon is generally not connected to the ocean during times of very low or zero streamflow, when ocean waves build a barrier beach (sandbar) across the mouth of the lagoon and close the outflow channel. When river inflow is relatively low and the lagoon is not open to the ocean, a dynamic equilibrium is reached between streamflow and groundwater inflows, outflow through the barrier beach, evapotranspiration, and ocean wave overtopping. In summer this leads to lower WSEs and in the fall prior to opening, abrupt increases in WSE can occur due to overtopping. As river flow increases in the fall and early winter, lagoon WSEs can rise to flood stage depending on precipitation patterns.

The hydrology of the Action Area was described in a Geotechnical Report prepared for the project (Balance Hydrologics, 2014).

In the lagoon ecosystem, among other similar Coastal California systems, riverine dynamics play an important role in lagoon dynamics and, at least to some degree, drive "whether, when, and for how long" the lagoon is open, while the formation of the sandbar beach and configuration of the outlet channel are somewhat more wave-dominated processes. The dual role of river processes and ocean dynamics can be seen in the lagoon during California's summer dry season, as streamflows dry up (in part due to groundwater extractions and streamflow diversions), and ocean forces deposit sands onto the beach that are structurally capable of keeping the lagoon closed. Likewise in the winter season, river flows can gradually fill the lagoon and breach the sand barrier, or suddenly generate fresh water forces strong enough to overcome ocean forces for extended periods, depending on the timing, duration, and quantity of rainfall and runoff.

WSE at the south arm gage in the lagoon has been monitored since 1992. The approximate average highest WSE within the lagoon lasting at least 18 days during the growing season (5% of the 365 day growing season on the central coast) is roughly 10 feet (NAVD88).[1] As this is a measure of surface water, it is expected that soil saturation within 12 inches of the surface lasting at least 18 days may occur up to approximately 10 feet in elevation. As such, an approximate elevation of 10 feet is the expected level of wetland hydrology within the Carmel Lagoon.

As identified above, the landward limits of ACOE jurisdiction in tidal waters extend to the HTL. The HTL is located at 6.66 feet (NAVD88), as identified by the NOAA Tide Predictions for Monterey, California, Station #9413450 (NOAA, 2014a; Appendix C[2]).

[1] Estimate calculated from visual evaluation of Figures 1-20: Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water years 1993-2013 (Balance, 2014), and is an approximation only, not a statistically derived value.

[2] The Datum utilized in the NOAA Tide Predictions is mean lower low water (MLLW). The conversion from MLLW to NAVD88 for the Monterey, California station is -0.14 feet (NOAA, 2014b). Therefore, the highest tide reported in the NOAA Tide Predictions, 6.8 feet MLLW, is equal to 6.66 feet NAVD 88.

4.0 Results

The Action Area is approximately 283.9 acres. Approximately 81.0 acres of the Action Area are potentially under the jurisdiction of the ACOE (Appendix A). This includes approximately 49.0 of wetlands and approximately 32.0 acres of other waters. Approximately 152.9 acres of the Action Area are potentially under the jurisdiction of the CCC (Appendix A).

A total of 74 sampling points were taken to make this determination. Wetland indicators from all three parameters were identified at 26 of the sampling points; wetland indicators from only one or two parameters were identified at 39 sampling points; and no wetland indicators were identified at nine of the sampling points. A summary of the wetland indicators identified at the sampling points is provided below.

4.1. Vegetation

The majority (59) of the sampling points within the Action Area were dominated by hydrophytic vegetation. Within the emergent marsh habitats most species were obligate (OBL), including California bulrush, fleshy juamea, Pacific silverweed, three-square bulrush, brass buttons, and marsh spike-rush; however, Baltic rush, a facultative wetland (FACW) species, was also a dominant in some of these areas. Areas on the fringe between the emergent marsh and riparian or other upland habitats were dominated by FACW species such as Pacific gum plant, cut-leaved plantain, sneezeweed, and rabbit-foot grass (*Polypogon monspeliensis*), and facultative (FAC) species, such as Santa Barbara sedge, salt grass (*Distichlis spicata*), bur clover (*Medicago polymorpha*), mule fat, perennial ryegrass, and California blackberry. As identified above, riparian areas were dominated by Arroyo willow (FACW), black cottonwood (FAC), and California blackberry (FAC).

Six of the sampling points were completely unvegetated or had less than 5% cover of vegetation. These points were located within the Carmel River channel and within an area that supports open water for most of the year. The remaining nine sampling points were dominated by upland (UPL or not listed) or facultative upland (FACU) species, such as kikuya grass, slender oat, ripgut brome, coyote brush, and wild radish.

4.2. Soils

Hydric soil indicators were identified at 26 of the sampling points. Hydric soil indicators observed included Depleted Matrix (F3) and Sandy Redox (S5).

4.3. Hydrology

Wetland hydrology indicators were identified at 32 of the sampling points. Within the Carmel River area, these indicators included presence of surface water (A1), high water table (A2), saturation (A3), and water-stained leaves (B9). In most other areas, the hydrologic indicator was inundation visible on aerial imagery (B7); however, indicators found at a few sampling points included water marks (B1), drift deposits (B3), salt crusts (B11), and oxidized rhizospheres along living roots (C3).

As identified above, the average highest WSE within the lagoon lasting at least 18 days during the growing season is roughly 10 feet. This elevation is consistent with the data collected and was used in many cases to map wetlands that met the criteria for soils and vegetation, as all sampling points exhibiting indicators of all three parameters were located at or below 10 feet in elevation.

4.4 Problem Area

As one moves east and up-slope from the deepest portion of the north arm the vegetation transitions from semi-permanent marsh dominated by bulrush to seasonal marsh dominated by pacific silverweed and then to upland dominated by kikuyu grass. Pacific silverweed is an obligate wetland plant species and is expected to occur within wetlands 99% of time. While a significant portion of the area dominated by pacific silverweed also has hydric soils and wetland hydrology, hydric soils are not present in a portion of this area. The result is a portion of seasonal marsh, dominated by the obligate species pacific silverweed, that does not meet the three parameter approach and is therefore, not likely under ACOE jurisdiction. However, because this area meets two of the wetland parameters, this area is potentially under CCC jurisdiction.

4.5 Ordinary High Water

Where present within the lagoon, wetlands are used to determine the extent of potential ACOE jurisdiction. However, in areas where only waters are present, ACOE jurisdiction is defined by the OHWM. In certain places, the OHWM may be difficult to identify. In such cases, Regulatory Guidance Letter No. 05-05 (ACOE, 2005) provides the following guidance:

> "Where the physical characteristics are inconclusive, misleading, unreliable, or otherwise not evident, districts may determine the OHWM by using other appropriate means that consider the characteristics of the surrounding areas, provided those other means are reliable. Such other reliable methods that may be indicative of the OHWM include, but are not limited to, lake and stream gage data, elevation data, spillway height, flood predictions, historic records of water flow, and statistical evidence."
>
> "In some cases, the physical characteristics may be misleading and would not be reliable for determining the OHWM. For example, water levels or flows may be manipulated by human intervention for power generation or water supply. For such cases, districts should consider using other appropriate means to determine the OHWM."

The extent of ACOE jurisdiction throughout the lagoon is dependent on the identification of the OHWM in a number of locations; specifically, within the channel of the Carmel River and along the barrier beach. Within the river channel there is a clear line that displays physical characteristics including shelving, destruction of vegetation, and the presence of liter and debris. However, there is no such line along the barrier beach. The lagoon barrier beach is a very dynamic environment that is subject to multiple factors that determine its size, shape, and physical characteristics. Ocean waves, wind, riverine scour, and mechanical breaching all influence the geomorphic condition of the beach at any given time. The beach is made of sand which does not retain physical characteristics for any significant amount of time that can be used as indicators of hydrologic fluctuations. Scour and other indicators which may occur at a given location along the beach may be completely obscured by shifting sand within the year. In addition, mechanical breaching obscures the natural or ordinary interaction of high water elevations and the barrier beach. Sand management also contributes to the disruption of natural physical characteristics that might otherwise be used as indicators of the OHWM along the barrier beach.

For the purposes of this delineation, an OHW elevation for the barrier beach was established by averaging the annual highest water surface elevation of the lagoon over the previous 20 years for which data exists (Balance, 2014). This approach yields an OHW elevation of 12.7 feet (NAVD88).

5.0 Potential Jurisdiction

5.1. ACOE Jurisdiction

Approximately 49.0 acres of wetlands potentially under the jurisdiction of the ACOE were identified within the Action Area. Additionally, approximately 32.0 acres of other waters potentially under ACOE jurisdiction were identified within the Action Area. An OHW elevation of 12.7 (NAVD88) was used to map the extent of potential ACOE jurisdiction on the lagoon side of the Carmel Lagoon barrier beach. This elevation was not applied to built environments, such as residential areas or the California Department of Parks and Recreation parking lot, when mapping potential jurisdiction. The HTL, located at elevation 6.66 feet (NAVD88), was used to map the extent of potential ACOE jurisdiction on the ocean side of the Carmel Lagoon barrier beach[3]. The extent of the barrier beach included in the Action Area reflects an approximation of area potentially physically affected by the Carmel River. Adjacent wetlands meeting the ACOE three parameter criteria were used to map the extent of ACOE potential jurisdiction for the remaining portions of the project Action Area within and adjacent to the lagoon.

5.2. CCC Jurisdiction

Approximately 153.1 acres of wetlands potentially under the jurisdiction of the CCC were identified within the Action Area. This number includes potentially federally jurisdictional wetlands and additional areas that met only one or two parameters.

[3] While it is understood that federal jurisdiction continues three miles from shore within the territorial seas, the proposed Action Area boundary on the marine side of the barrier beach is arbitrary and consists of a straight line between the assumed southern and northern most points of effect on the beach. As a result, the acreage of potentially jurisdictional other waters of the U.S. identified on the delineation map is a function of the Action Area boundary and is open to interpretation in regard to actual area of waters affected by the Project into the territorial seas.

6.0 References

Balance Hydrologics, Inc. 2014. The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report.

Baldwin, B. G, et. al. 2012. The Jepson Manual – Vascular Plants of California, Second Edition, Thoroughly Revised and Expanded. University of California Press. Berkeley, CA. 1600 pp.

California Coastal Commission (CCC). 1994. Procedural Guidance for the Review of Wetland Projects in California's Coastal Zone. Available online at: http://www.coastal.ca.gov/wetrev/wettitle.html

Casagrande, J. 2006. Wetland Habitat Types of the Carmel River Lagoon. The Watershed Institute, California State University Monterey Bay, Report No. WI-2006-05. Pp. 15.

Environmental Protection Agency (EPA). 1980. 40 CFR Part 230: Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material. Federal Register Vol. 45 (249). Pp. 85352-85353.

H.T. Harvey & Associates. 2013. Memorandum To Whitson Engineers for Feasibility Report: Carmel River Lagoon Ecosystem Protective Barrier and Scenic Road Protection Project, Environmental Assessment Focusing on Biological Evaluations and Permitting Issues.

Matthews, M.A. 2006. An Illustrated Field Key to the Flowering Plants of Monterey County. California Native Plant Society, Sacramento, California. 394 pp.

Moffatt & Nichol. 2013. Carmel River Lagoon Biological Assessment Coastal Engineering Analysis.

Munsell. 2000. Munsell Soil Color Charts. GretagMacbeth. New Windsor, NY.

National Oceanic and Atmospheric Administration (NOAA). 2014a. NOAA Tide Predictions, Monterey, California, Station # 9413450. Available online at: http://tidesandcurrents.noaa.gov/tide_predictions

NOAA. 2014b. National Geodetic Survey, Tidal Elevation for PID: GU2090. Available online at: http://www.ngs.noaa.gov/Tidal_Elevation/index.jsp

Pacific Geotechnical Engineering. 2013. Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California.

U.S. Army Corps of Engineers (ACOE). 1982. Title 33: Navigation and Navigable Waters; Chapter II, Part 328: Definition of Navigable Waters of the United States to Part 329: Definition of Navigable Waters of the United States. Available online at: http://www.gpo.gov/

ACOE. 2005. Regulatory Guidance Letter No. 05-05. Subject: Ordinary High Water Mark Identification.

ACOE. 2006. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region. Ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-06-16. Vicksburg, MS: U.S. Army Engineer Research and Development Center. 109 pp.

ACOE. 2008. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region. ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-08-28. Vicksburg, MS: U.S. Army Engineer Research and Development Center. 123 pp.

ACOE. 2014. Arid West 2014 Regional Wetland Plant List. ed. R.W. Lichvar, M. Butterwick, N.C. Melvin, and W.N. Kirchner. Available online at: http://wetland_plants.usace.army.mil/

ACOE and EPA. 2007. Jurisdictional Determination Form Instructional Guidebook. Available online at: http://www.usace.army.mil/cw/cecwo/reg/cwa_guide/cwa_guide.htm

U.S. Department of Agriculture (USDA) – Natural Resources Conservation Service (NRCS). 1995. *Changes in Hydric Soils of the United States.* Federal Register 60 (37): 10349.

USDA-NRCS. 2007. Hydric Soils of the United States, February 2007. Available online at: http://soils.usda.gov/use/hydric/

USDA-NRCS. 2013. Web Soil Survey Database. Available online at: http://websoilsurvey.nrcs.usda.gov/app/

U.S. Fish and Wildlife Service (Service). 2014. National Wetlands Inventory Wetland Mapper. Available online at: http://www.fws.gov/wetlands/Data/Mapper.html

Wetland Training Institute, Inc. 1995. Field Guide for Wetland Delineation: 1987 Corps of Engineers Manual. Glenwood, NM. WTI 02-1. 143 pp.

Appendix A: Wetland Delineation Map

Legend

- Action Area
- Sampling Points
- Potential Federal & Coastal Wetland
- Potential Other Waters of the U.S.
- Potential Coastal Wetland

*The High Tide Line location (6.66 ft NAVD88) was approximated by extrapolating past the topographic data collected on August 29, 2013. Note that the beach topography is variable over time and the location of the High Tide Line will also vary. While it is understood that federal jurisdiction continues three miles from shore within the territorial seas, the proposed Action Area boundary on the marine side of the barrier beach is arbitrary and consists of a straight line between the assumed southern and northern most points of effect on the beach. As a result, the acreage of potentially jurisdictional other waters of the U.S. identified is a function of the Action Area boundary and is open to interpretation in regard to actual area of waters affected by the Project into the territorial seas.

N

0 0.05 0.1 mi

0 0.1 0.2 km

PACIFIC GROVE
MONTEREY
SEASIDE
Pebble Beach
Carmel-by-the-Sea

Wetland Delineation Map

Denise Duffy and Associates, Inc.
Planning and Environmental Consulting

Date: 01-22-2015
Scale: 1 in=0.1 mi

Path: C:\GIS\GIS_Projects\2013-22 Carmel Lagoon\Final Products\Wetland Delineation Maps\Wetland Delineation Map Fed and State 11x17.mxd

Appendix B: Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 1

Investigator(s): Sam Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%):

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Elder Very Fine Sandy Loam 2-9% slopes NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
3rd year of statewide drought
1st bench of riverchannel
Meets State definition of wetland
Riparian

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10m x 20L)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	95%	Y	FACW
2.			
3.			
4.			
	95	= Total Cover	
Sapling/Shrub Stratum (Plot size: 10m x 2)			
1. Rubus ursinus	70	Y	FAC
2.			
3. Toxicodendron diversilobum	5	N	FAC
4. Hedera helix	1	N	FACU
5.			
	71%	= Total Cover	
Herb Stratum (Plot size: 10m x 10)			
1. Cyperus eragrostis	2	N	FACW
2. Helenium puberulum	1	N	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	3%	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:
50% = 35 2016:14

SOIL

Sampling Point: 1

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
0-18	10YR 5/1						Sand	Coarse

[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 X

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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 2-0

Applicant/Owner: County of Monterey State: CA Sampling Point: 2

Investigator(s): Ian Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): channel Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: (Water) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
In channel @ edge

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10w x 20L)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis		N*	
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 10 x 10)			
1. Unknown #1	2	N	(FAC)
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	2 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (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 X

Remarks:
*Willows are overhanging; not rooted in plot

SOIL

Sampling Point: ~

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
0-6	2.5 3/1						Sand	Coarse
6-?	10YR 4/2						Sand	Coarse

[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 X

Remarks:

hole fills in as you dig but only 2 layers are present

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- X 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 X No _____ Depth (inches): 3in

Water Table Present? Yes X No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 3

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): channel Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: (Water) NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
in channel - waters of the U.S. ~50ft wide - ponding at edges (see #2) but no significant vegetation in lows overhang edges

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
	= 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 ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (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 X

Remarks:
No vegetation

SOIL

Sampling Point: 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
0-1	N/A						lg. cobbles	
1-12	10YR4/2						cobbles + sand	Coarse

[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 X

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X 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 X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 8in

Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): 7in

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 4

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Channel Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: (Waters) NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
In channel - waters of the U.S.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (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 X

Remarks:
No vegetation

SOIL

Sampling Point: 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
0-6	2.5 3/1						Sand	Coarse
6-?	10YR 4/2						Sand	Coarse

[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 X

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X 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 X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 4in

Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): 3in

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No GPS - 10x20 plot in r parallel

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 5

Investigator(s): Sam Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): _____

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco clay loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil Y, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
On 1st bench above channel

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus balsamifera	95	Y	FAC
2.			
3.			
4.			
	95	= Total Cover	
Sapling/Shrub Stratum (Plot size: 10x20)			
1. Rubus ursinus	5	Y	FAC
2.			
3.			
4.			
5.			
	5	= Total Cover	
Herb Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____	= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____	= Total Cover	

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 5

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
0-12	10YR5/3						sand	fine

[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 X

Remarks:

erosion fabric 1/2 inch from surface - potential fill soil
lots of rocks - can't dig to 18in

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)
- X 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**)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 6

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): _____

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Elder Very Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:
1st bench above low flow but not as steep slope up to bench as pt #1 or 5

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 10x10)			
1. Rubus ursinus	5	Y	FAC
2.			
3.			
4.			
5.			
	5 = Total Cover		
Herb Stratum (Plot size: 10x10)			
1. Equisetum hyemale	70	Y	FACW
2. Mentha x piperita	1	N	FACW
3. Unknown #1	1	N	(FAC)
4.			
5.			
6.			
7.			
8.			
	72 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 10

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
0-3	10YR 4/3						90% roots 10% sand	
3-12	10YR 4/3						Sand	coarse

[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 X

Remarks:

first 3in very dense roots

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)
- X 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 X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

within river channel

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 7

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 2%

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Alviso silty clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
On bank ~3A above water level

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: ____)			
1. Juncus balticus	20	Y	FACW
2. Potentilla anserina ssp. pacifica	15	Y	OBL
3. Jaumea carnosa	5	N	OBL
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 7

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
0-5	10YR 2/2						80% roots	20% sand
5-16	10YR 4/2						Sand	Coarse

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

May be innundated or have a high water table when lagoon levels are high

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 8

Investigator(s): Jon Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): concave Slope (%): 2%

Subregion (LRR): LRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Alviso silty clay loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
bank above water level, gradual slope

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 10x10)			
1. Schoenoplectus californicus	100%	Y	OBL
2.			
3.			
4.			
5.			
	100% = Total Cover		
Herb Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No _____

Remarks:

SOIL

Sampling Point: F

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
0-18	10YR 4/1	97%	2.5YR 4/6	3%	C	PL	Sandy 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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 12

Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): 12

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 10-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 9

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRLC Lat: Long: Datum:

Soil Map Unit Name: Alviso silty clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5 x 5)			
1. Polypogon monspeliensis	5	N	FACW
2. Juncus patens	5	N	FACW
3. Potentilla anserina ssp pacifica	5	N	OBL
4. Falcaria vulgaris	15	N	OBL
5. Cotula coronopifolia	55	Y	OBL
6. Schoenoplectus californicus	15	N	OBL
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

SOIL

Sampling Point: 9

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
0-2							roots 80% organic 20%	
2-7	2.5Y 3/1	100%					silty clay loam	
7-18	10YR 4/1	75%	2.5YR 3/6	25%	C	M	silty 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)
- ___ Loamy Gleyed Matrix (F2)
- X 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 X 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)
- X Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- X 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**)
- X 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 X Depth (inches): _____

Water Table Present? Yes ____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-9-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 10

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Alviso silty clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: 5x5)			
1. Juncus balticus	35	Y	FACW
2. Potentilla anserina ssp pacifica	65	Y	OBL
3.			
4.			
5.			
6.			
7.			
8.			
100 = Total Cover			
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
= Total Cover			

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 10

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
0-2							Organic + roots	
2-7	10YR 3/2	95%	5YR 3/4	5%	C	PL	silty clay loam	
7-18	10YR 4/1	75%	5YR 3/4	25%	C	PL	silty clay 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)
- ___ Loamy Gleyed Matrix (F2)
- X 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 X 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)
- X 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**)
- X 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 X Depth (inches): _____

Water Table Present? Yes ___ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel lagoon City/County: Carmel/Monterey Co Sampling Date: 10-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 11

Investigator(s): Sam Davis, Mark Enriquez Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Alviso silty clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 Y	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20 x 20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acacia? (horticultural)	80	Y	—
2.			
3.			
4.			
	80 = Total Cover		

Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		

Herb Stratum (Plot size: 5x5)			
1. Potentilla anserina ssp pacifica	40	Y	OBL
2. Tropaeolum majus	1	N	UPL
3. Cenchrus clandestinum	25	Y	FACU
4. Schoenoplectus californicus	25	Y	OBL
5. Bromus carinatus	1	N	NL
6. Persicaria punctata	1	N	OBL
7.			
8.			
	93 = Total Cover		

Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (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 X

Remarks:

50% = 46% 20% = 18.4%

SOIL

Sampling Point: 11

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
0-12	10YR3/4							

[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 X

Remarks:

Soil dry

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 12

Investigator(s): [illegible] Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Alviso silty clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Acacia? (Huntington*)	40	N	—
2.			
3.			
4.			
	40 = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 10x10)			
1. Schoenoplectus californicus	95	Y	OBL
2. Potentilla anserina ssp. pacifica	5	N	OBL
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

* tree not rooted in plot

SOIL

Sampling Point: 1

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
0-10	10YR 4/3						Silty Clay Loam	
10-18	10YR 4/2	97%	5YR 3/4	3%	C	M	Silty Clay 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)
- ___ Loamy Gleyed Matrix (F2)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes ___ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey/Co Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 13

Investigator(s): Jon Davis Mark Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Alviso Silty Clay loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. plot			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. Potentilla anserina ssp. pacifica	45	Y	OBL
2. Eleocharis palustris	40	Y	OBL
3. Sonchus oleraceus	8	N	OBL
4. Persicaria punctata	1	N	OBL
5.			
6.			
7.			
8.			
	93 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

50% = 46.5 20% = 18.6%

SOIL

Sampling Point: 13

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
0-5	10YR3/4							
5-16	10YR4/1	98%	5YR3/4	2				

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 14

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Aquic Xerofluvents NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Eleocharis palustris	10	N	OBL
2. Potentilla anserina ssp pacifica	60	Y	OBL
3. Juncus balticus	5	N	FACW
4. Schoenoplectus pungens	3	N	OBL
5.			
6.			
7.			
8.			
	78 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No _____

Remarks:

50%-37% 20%=15.6%

SOIL

Sampling Point: 14

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
0-5	10YR2/2							
5-12	10YR2/1		5YR3/4	10	C	M		
12-16	10YR4/5		5YR3/4	25	C	M		

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 15

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Cenchrus clandestinum	81	Y	FACU
2. Potentilla anserina ssp. pacifica	19	N	OBL
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (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 X

Remarks:

SOIL

Sampling Point: 15

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
0-16	10YR 2/2							

[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 X

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): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 1W

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): top of berm Local relief (concave, convex, none): convex Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Oceano Loamy Sand 2-15% slopes NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No (X)	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 5 x 10)			
1. Rubus ursinus	95	Y	FAC
2.			
3.			
4.			
5.			
	95 = Total Cover		
Herb Stratum (Plot size: 5 x 10)			
1. Cenchrus clandestrum	5	Y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (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 X

Remarks:

SOIL

Sampling Point: 111

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

[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 X

Remarks:

No soil pit dug Vegetation too dense & deep. On top of berm close lagoon - assume no hydric soils

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 X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

on top of berm

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 17

Investigator(s): [illegible] Section, Township, Range:

Landform (hillslope, terrace, etc.): Slight depression Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pico Fine Sandy Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
Slight depression in landscape

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20x20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	90	Y	FACW
2.			
3.			
4.			
	90	= Total Cover	
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
		= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

SOIL

Sampling Point: 17

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
0-12	2.5Y 3/3							

[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 X

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): _____

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:

Slight depression in overall landscape

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 18

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pico Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 10x10)			
1. Carex barbarae	100	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No _____

Remarks:

SOIL

Sampling Point: X

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
0-10	10YR4/3							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: _____ Sampling Point: 19

Investigator(s): Jim Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Near top of bank Local relief (concave, convex, none): concave Slope (%): 5

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pico Fine Sandy Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Salix lasiolepis	3	N	FACW
2.			
3.			
4.			
5.			
	3 = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Carex barbarae	45	Y	FAC
2. Distichlis spicata	40	Y	FAC
3. Grindelia stricta var angustifolia	4	N	FACW
4. Plantago coronopus	5	N	FACW
5.			
6.			
7.			
8.			
	94 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

50% = 40 20% = 18.8

SOIL

Sampling Point: 14

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
0-15	10YR6/2						sand	
15-18	10YR3/1	85%	2.5YR3/4	15%	C	M	sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 20

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 3

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: PICO Fine Sandy Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Jaumea carnosa	60	Y	OBL
2. Potentilla anserina ssp. pacifica	3	N	OBL
3. Schoenoplectus californicus	8	N	OBL
4. Eleocharis palustris	20	Y	OBL
5.			
6.			
7.			
8.			
	91 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

50% - 45.5% 20% = 18.5

SOIL

Sampling Point: 20

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
0-8	10YR 5/2	85%	2.5YR 3/6	15%		PL	Sand	
8-18	10YR 5/2	97%	2.5YR 3/6	3%		PL	Sand	

[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)
- X 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 X 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)
- X 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)

- X 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 X Depth (inches): _____

Water Table Present? Yes X No ___ Depth (inches): 17

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 17

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel Monterey Co Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 21

Investigator(s): Jan Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pico Fine Sandy Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5x20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	5	Y	FACW
2.			
3.			
4.			
	5 = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Distichlis spicata	45	Y	FAC
2. Schoenoplectus pungens	15	N	OBL
3. Potentilla anserina ssp. pacifica	40	Y	OBL
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 21

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
0-3	10YR3/2						Silt loam	
3-11	10YR4/1	80%	2.5YR3/6	20%	C	M/PL	Silt loam	
11-18	10YR5/2						Sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes ____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-11-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 22

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Narlon loamy fine sand 2-9% slopes NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes _____ No _____	
Wetland Hydrology Present?	Yes _____ No _____	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Salix lasiolepis	10	Y	FACW
2.			
3.			
4.			
5.			
	10 = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Schoenoplectus californicus	35	Y	OBL
2. Potentilla anserina ssp. pacifica	3	N	OBL
3. Juamea carnosa	50	Y	OBL
4.			
5.			
6.			
7.			
8.			
	86 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 22

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
0-5	10YR4/1	97%	2.5YR3/6	3%	C	PL/M	Silty clay loam	
5-10	10YR4/1	75%	2.5YR3/6	15%	C	M	silty clay 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)
- ___ Loamy Gleyed Matrix (F2)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-11-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 23

Investigator(s): Jami Davis, Matt Jonson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Narlon loamy fine sand NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:
State wetland

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x15)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	75	Y	FACW
2.			
3.			
4.			
	75 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. Potentilla anserina ssp. Pacifica	1	N	OBL
2. Juncea carnosa	1	N	OBL
3.			
4.			
5.			
6.			
7.			
8.			
	2 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No _____

Remarks:

SOIL

Sampling Point: 23

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	10YR4/3							
4-16	10YR4/3	75%	2.5YR3/6	25%	C	M	Silty clay 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)
- ___ 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 X

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): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-11-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 24

Investigator(s): Jan Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Narlon loamy fine sand 2-9% slopes NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Avena barbata	20	Y	NL
2. Bromus hordeaceus	30	Y	FACU
3. Lolium perenne	10	N	FAC
4. Bromus carinatus	5	N	NL
5. Vulpia myuros	30	Y	FACU
6. Avena fatua	3	N	NL
7.			
8.			
	98 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (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 X

Remarks:

50% = 47 20% = 19.6

SOIL

Sampling Point: 24

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
0-10	10YR 4/2						Silty clay 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)
- ___ 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 X

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): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-11-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 25

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): ~flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Narlon loamy fine sand NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: Polygon)			
1. Bromus carinatus			NL
2. Juncus patens			FACW
3. Elymus glaucus			FACU
4. Helminthotheca echioides			FACU
5. Helenium puberlum			FACW
6. Cirsium vulgare			FACU
7. Cyperus eragrostis			FACW
8. Rumex crispus			FAC
Baccharis salicifolia			FAC
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (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 X No _____

Remarks:

FAC & FACW plants listed above occur in patches where 1-2 species dominate. Contiguous patches were mapped as one polygon to identify the state wetland boundary. % cover of species was not estimated but all were dominants in some area

SOIL

Sampling Point: 25

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
0-10	10YR 4/2						Silty clay 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Some small shallow depressions that support some amount of H2O during the rainy season

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-11-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 26

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: _____ NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil _____, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil _____, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Medicago polymorpha	20	Y	FAC
2. Plantago coronopus	50	Y	FACW
3. Polypogon monspeliensis	1	N	FACW
4.			
5.			
6.			
7.			
8.			
	71 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 30% % 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 X No _____

Remarks:

50% = 35.5 20% = 14

SOIL

Sampling Point: _____

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
0-8	10YR 4/3	95	2.5YR 3/6	5	C	M	Sandy loam	
8-15	10YR 5/2						Sand	

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 27

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pico fine sandy loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Bromus carinatus	45	Y	NL
2. Vulpia myuros	25	Y	FACU
3. Geranium molle	1	N	NL
4. Malva parviflora	1	N	NL
5.			
6.			
7.			
8.			
	72 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (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 X

Remarks:

50% = 30 20% = 14

SOIL

Sampling Point: 27

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
0-12	10YR4/3						Sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 28

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pico fine sandy loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Lolium perenne	60	Y	FAC
2. Bromus carinatus	3	N	NL
3. Helminthotheca echioides	2	N	FACU
4. Cirsium vulgare	1	N	FACU
5. Geranium molle	1	N	NL
6.			
7.			
8.			
	67 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (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 X

Remarks:

50% = 32.5 20% = 13

SOIL

Sampling Point: 28

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
0-16	10YR4/3						sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 29

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Flat Slope (%):

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pico Fine Sandy Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
State wetland

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 3x5)			
1. Rubus ursinus	50	Y	
2. Salix lasiolepis	10	N	
3. Baccharis pilularis	3	N	
4.			
5.			
	103 = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Artemisia douglasiana	25	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	25 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:
50% = 31.5 20% = 12.6

SOIL

Sampling Point: 29

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
0-18	10YR 4/3							

[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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 30

vestigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pico fine sandy loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Baccharis pilularis	25	Y	
2.			
3.			
4.			
5.			
	25 = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Vulpia myuros	5	N	FACU
2. Lolium perenne	10	Y	FAC
3. Avena barbata	8	Y	NL
4. Bromus carinatus	5	N	NL
5.			
6.			
7.			
8.			
	28 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33% (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 X

Remarks:

50% = 14 20% = 5.6

SOIL

Sampling Point: 30

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
0-16	10YR 4/3							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 31

vestigator(s): Jan Bavis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5×5)			
1. Bromus carinatus	15	Y	NL
2. Ruppia cirrhosa	25	Y	NL
3. Helminthotheca echioides	30	Y	FACU
4. Lolium perenne	3	N	FAC
5.			
6.			
7.			
8.			
	73 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 30 % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (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 X

Remarks:

50% = 31.5 20% = 14.6

SOIL

Sampling Point: 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
0-12	10YR4/3						Sandy 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)
- ___ 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 X

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): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 32

vestigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco clay loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: _____)			
1. Lolium perenne	80	Y	FAC
2. Helminthotheca echioides	8	N	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	88 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 15 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No _____

Remarks:

SOIL

Sampling Point: 32

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
0-12	10YR4/3						Sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 33

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Schoenoplectus pungens	3	N	OBL
2. Potentilla anserina ssp. pacifica	40	Y	OBL
3. Juncus balticus	35	Y	OBL
4. Eleocharis palustris	15	N	OBL
5.			
6.			
7.			
8.			
	93 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

50% = 46.5 20% = 18.6

SOIL

Sampling Point: 33

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	10YR5/2						Organic tsand	
4-18	10YR5/2	85	2.5YR4/6	15			Sand	

[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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey/Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 34

Investigator(s): Sami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Polypogon monspeliensis	2	N	FACW
2. Juncus balticus	5	N	FACW
3. Lolium Perenne	1	N	FAC
4. Eleocharis palustris	70	Y	OBL
5. Potentilla anserina ssp pacifica	5	N	OBL
6. Schoenoplectus pungens	15	N	OBL
7.			
8.			
	98 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

50% = 47 20% = 19.6

SOIL

Sampling Point: 34

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	10YR5/2						roots + sand	
4-10	10YR4/2	75	25 YR 3/6	25	C	M	loamy sand	
10-18	10YR5/2						sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 35

vestigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): _____

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Gnaphalium (luteoalbum or stram)	40	Y	FAC
2. Polypogon monspeliensis	40	Y	FACW
3. Distichlis spicata	20	Y	FAC
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 35

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
0-18	10YR 5/2	80	2.5YR 4/6	20	C	M	SAND	
	10YR 2/1		2.5YR 3/6	5%	C	M		Inclusions

[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)
- X 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 X No _____

Remarks:

Unsure where inclusions start but at least 10in or more from surface

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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 36

Investigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. Juncus balticus	35	Y	OBL
2. Polypogon monspeliensis	3	N	FACW
3. Potentilla anserina ssp pacifica	40	Y	OBL
4. Schoenoplectus pungens	20	Y	OBL
5.			
6.			
7.			
8.			
	98 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

50% = 47 20% = 19.6

SOIL

Sampling Point: 36

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
0-2							roots / loamy sand	
2-10	10YR 4/2	75	25YR 3/6	25	C	M	loamy sand	
10-18	10YR 5/2						sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes ___ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 37

vestigator(s): Jami Davis Mat Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Juncus balticus	25	Y	OBL
2. potentilla anserina ssp pacifica	70	Y	OBL
3. Schoenoplectus pungens	5	N	OBL
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 37

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	10YR3/2	85	2.5YR4/6	15	C	M	loamy sand	
4-12	10YR2/1		2.5YR4/6	3			loamy sand	
12-14	10YR4/1						sand	
14-15	2.5YR4/6	70	10YR3/2	30	C	M	Sand	
15-18	10YR4/1						Sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 38

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco clay loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 5×5)			
1. Salix lasiolepis	10	Y	FACW
2.			
3.			
4.			
5.			
	10 = Total Cover		
Herb Stratum (Plot size: 5×5)			
1. Lotus corniculatus	10	N	FAC
2. Carex barbarae	15	Y	FAC
3. Potentilla anserina ssp pacifica	2	N	OBL
4. Grindelia stricta var angustifolia	4	N	FACW
5. Plantago coronopus	25	Y	FACW
6. Juncus patens	10	N	FACW
7. Achillea millefolium	1	N	FACU
8. Distichlis spicata	5	N	FAC
	72 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

50% = 36 20% = 14.1

SOIL

Sampling Point: 38

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
0-12	10YR 4/3							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 39

Investigator(s): Jami Davis - Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Schoenoplectus californicus	20	Y	OBL
2. Potentilla anserina ssp. pacifica	45	Y	OBL
3. Eleocharis palustris	25	Y	OBL
4. Schoenoplectus pungens	10	N	OBL
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 39

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
0-10	10YR4/2	90	2.5YR3/6	10	C	M	sandy loam	
10-16	10YR5/2	70	2.5YR3/6	30	C	M	sand	

[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)
- X 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 X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 40

Investigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	60	Y	FACW
2.			
3.			
4.			
	60	= Total Cover	

Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
		= Total Cover	

Herb Stratum (Plot size: 5x5)			
1. Potentilla anserina ssp pacifica	5	Y	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	5	= Total Cover	

Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 40

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
0-12	10YR4/3							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 1

vestigator(s): Dami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Convex Slope (%): 1

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Salix lasiolepis	25	Y	FACW
2.			
3.			
4.			
5.			
	25 = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Juncus balticus	40	Y	OBL
2. Lotus corniculatus	5	N	FAC
3. Potentilla anserina ssp. pacifica	25	Y	OBL
4. Schoenoplectus californicus	25	Y	OBL
5.			
6.			
7.			
8.			
	95 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

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 ____	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 X No ____

Remarks:

50% = 47.5 20% = 19

SOIL

Sampling Point: 41

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
0-7	10YR 5/2	95	2.5YR 3/6	5	C	M	Sandy loam	
7-16	10YR 3/2	85	2.5YR 2.5/4	15	C	M	loamy sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 42

Investigator(s): Jani Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Xerothents NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10×10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	80	Y	FACW
2.			
3.			
4.			
	80 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5×5)			
1. Carex barbarae	50	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	50 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 42

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
0-12	10YR5/2	85	2.5-YR5/6	15			sandy 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)
- X 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 X 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**)
- X 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 X Depth (inches): _____

Water Table Present? Yes ____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 43

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10 x 10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	85	Y	FACW
2.			
3.			
4.			
	85 = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Carex barbarae	100	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 43

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
0-6	7.5YR 3/2						loam	
6-15	10YR 4/1	75	25YR 4/6	25	C	M	sandy loam	
15-18	10YR 5/2	85	25YR 4/6	15	C	M	sand	

[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)
- X Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X 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 X 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**)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 44

Investigator(s): Jami Davis Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	80	Y	FACW
2.			
3.			
4.			
	80	= Total Cover	
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
		= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No _____

Remarks:

SOIL

Sampling Point: 44

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
0-6	10YR 2/2						loamy sand	
6-16	10YR 5/4						Sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-13-14
Applicant/Owner: County of Monterey State: CA Sampling Point: 45
Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:
Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%):
Subregion (LRR): LRR C Lat: Long: Datum:
Soil Map Unit Name: Pacheco clay loam NWI classification:
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	10	Y	FACW
2.			
3.			
4.			
	10 = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Carex barbarae	55	Y	FAC
2. Juncus carnosa	35	Y	OBL
3. Schoenoplectus californicus	8	N	OBL
4.			
5.			
6.			
7.			
8.			
	98 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 45

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
0-2								
2-14	10YR5/2	75	2.5YR3/6	25	C	M	Sandy 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)
- X 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)
- X 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:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 46

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pacheco clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No Y
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	70	Y	FACW
2.			
3.			
4.			
	70	= Total Cover	
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Rubus ursinus	30	Y	FAC
2.			
3.			
4.			
5.			
	30	= Total Cover	
Herb Stratum (Plot size: 5x5)			
1. Baccharis salicifolia	20	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	20	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____	= Total Cover	

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 46

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
0-10	10YR 5/4						Sandy 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)
- ___ 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 X

Remarks:

Compacted - near road

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 47

Investigator(s): Sam Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Schoenoplectus californicus	60	Y	OBL
2. Juncus balticus	50	Y	OBL
3. Carex barbarae	10	N	FAC
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

50% = 51 20% = 20:1

SOIL

Sampling Point: 47

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
0-2							roots + loamy sand	
2-16	10YR4/1	85	2.5YR3/6	15			loamy sand	

[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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 48

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____	No X	
Wetland Hydrology Present?	Yes ____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Distichlis spicata	90	Y	FAC
2. Juncus balticus	10	N	OBL
3.			
4.			
5.			
6.			
7.			
8.			
	100% = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

SOIL

Sampling Point: 48

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
0-16	10YR4/3							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: _____ Sampling Point: 49

Investigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:
Pictures are out of order 49/50

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	10	Y	FACW
2. Cornus alba	35	Y	FACW
3.			
4.			
	45	= Total Cover	
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Rubus ursinus	35	Y	FAC
2. Cornus alba	2	N	FACW
3.			
4.			
5.			
	37	= Total Cover	
Herb Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____	= Total Cover	
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____	= Total Cover	

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 49

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
0-6	10YR2/2						loamy sand	
6-100	10YR5/4						sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: SD

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	40	Y	FACW
2.			
3.			
4.			
	40	= Total Cover	
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Rubus ursinus	10	Y	FAC
2.			
3.			
4.			
5.			
	10	= Total Cover	
Herb Stratum (Plot size: 5x5)			
1. Carex barbarae	30	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	30	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: SD

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
0-12	10YR 5/2	85	2.5YR 3/6	15	C	M	Sandy 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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: S1

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20x20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus balsamifera	20	Y	FAC
2. Salix lasiolepis	45	Y	FACW
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 10x10)			
1. Salix lasiolepis	20	Y	FACW
2. Toxicodendron diversilobum	10	Y	FACU
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: 20x20)			
1. Toxicodendron Diversilobum	10	Y	FACU
2.			
	10 = Total Cover		

% Bare Ground in Herb Stratum ____ % 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: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60% (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 X No ____

Remarks:

SOIL

Sampling Point: 51

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
0-10	10YR 2/2						loamy sand	
10-18	10YR 6/4						sand	

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: S2

Investigator(s): Kami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Metz Fine Sandy Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil ____, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20×20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Cornus alba	10	N	FACW
2. Salix lasiolepis	20	Y	FACW
3. Populus balsamifera	40	Y	FAC
4.			
	70	= Total Cover	

Sapling/Shrub Stratum (Plot size: 10×10)			
1. Toxicodendron diversilobum	5	N	FACU
2. Symphoricarpus albus	15	Y	FACU
3. Cornus alba	10	Y	FACW
4.			
5.			
	30	= Total Cover	

Herb Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	____	= Total Cover	

Woody Vine Stratum (Plot size: ____)			
1. None			
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: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (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 X No ____

Remarks:

SOIL

Sampling Point: S2

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
0-18	10YR3/2						Sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: S3

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Convex Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Metz Fine Sandy Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20x20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus balsamifera	40	Y	FAC
2. Cornus alba	10	N	FACW
3. Salix lasiolepis	25	Y	FACW
4.			
	75	= Total Cover	

Sapling/Shrub Stratum (Plot size: 20x20)			
1. Toxicodendron diversilobum	10	N	FACU
2. Rubus ursinus	50	Y	FAC
3. Cornus alba	3	N	FACW
4. Baccharis pilularis	5	N	NL
5. Rosa californica	2	N	FAC
	70	= Total Cover	

Herb Stratum (Plot size: 5x5)			
1. Juncus balticus	3	N	OBL
2. Euphorbia peplus	25	Y	NL
3.			
4.			
5.			
6.			
7.			
8.			
	28	= Total Cover	

Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____ % 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: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (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 X No ____

Remarks:

SOIL

Sampling Point: 53

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
0-18	10YR3/2						sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: S4

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Metz Fine Sandy Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 20x20)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	65	Y	FACW
2.			
3.			
4.			
	65	= Total Cover	
Sapling/Shrub Stratum (Plot size: 20x20)			
1. Rubus ursinus	20	Y	FAC
2.			
3.			
4.			
5.			
	20	= Total Cover	
Herb Stratum (Plot size: 5x5)			
1. Euphorbia peplus	70	Y	NL
2. Galium aparine	2	N	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	72	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____ % 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: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66% (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 X No ____

Remarks:

SOIL

Sampling Point: 54

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
0-18	10YR3/2						Sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 55

Investigator(s): Jan. Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
1st bench above river channel

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	50	Y	FACW
2.			
3.			
4.			
	50 = Total Cover		
Sapling/Shrub Stratum (Plot size: 5x5)			
1. Rubus ursinus	30	Y	FAC
2. Toxicodendron diversilobum	2	N	FACU
3. Ribes divaricatum	2	N	FAC
4.			
5.			
	34 = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Equisetum hyemale	20	Y	FACW
2. Juncus balticus	5	N	OBL
3. Berula erecta	20	Y	OBL
4. Epipactus helleborine	1	N	FACU
5.			
6.			
7.			
8.			
	46 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

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 ____	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 X No ____

Remarks:

SOIL

Sampling Point: 55

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
0-12	10YR5/4						sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 5b

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic XeroFluvent3 NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____	No ____	
Wetland Hydrology Present?	Yes X	No ____	

Remarks:
Waters of the U.S. – No vegetation rooted in channel

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	40	N	FACW
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:
Willow over hanging, not rooted in channel

SOIL

Sampling Point: 56

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

[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:

Unable to dig hole ~8-12in of water in channel

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- X 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 X No _____ Depth (inches): 0

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

~8-12 in of water in channel

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: S7

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
Area grazed by sheep, overgrown w/ Kikuya

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5×5)			
1. Cenchrus clandestinum	87	Y	FACU
2. Juncus effusus	8	N	FACW
3. Cirsium vulgare	5	N	FACU
4.			
5.			
6.			
7.			
8.			
	100% = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (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 X

Remarks:

SOIL

Sampling Point: 57

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
0-16	10YR3/2						Sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 58

Investigator(s): Jami Davis Natt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic XeroFluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
Vegetation grazed

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Distichlis Spicata	70	Y	FAC
2. Juncus effusus	20	Y	FACW
3. Cenchrus clandestinum	10	N	FACU
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 58

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							NOT3	
4-15	10YR3/2							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 59

Investigator(s): Jenni Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Aquic Xerofluvents NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No _____ (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes _____ No _____

Are Vegetation N, Soil N, or Hydrology N 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 X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes _____ No X	

Remarks:
Vegetation grazed

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Gnaphalium sp.	30	Y	FACW
2. Polypogon monspeliensis	10	N	FACW
3. Juncus patens	3	N	FACW
4. Juncus effusus	5	N	FACW
5. Unknown grass	30	Y	
6. Cirsium vulgare	2	N	FACU
7.			
8.			
	80 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (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:
50% = 40 20% = 10

SOIL

Sampling Point: 59

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
0-16	10YR3/3	90	7.5YR 5/6	10	C	M	Sandy	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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 60

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic XeroFluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Juncus balticus	90	Y	OBL
2. Unknown grass	10	N	
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

SOIL

Sampling Point: 10

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
0-16	10YR3/3	90	7.5YR5/6	10	C	M	Sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: V1

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%):

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic XeroFluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Potentilla anserina ssp pacifica	70	Y	OBL
2. Juncus balticus	25	Y	OBL
3. Persicaria punctata	5	N	OBL
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: b1

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
0-8	10YR3/4						sandy loam	
8-14	10YR4/2	95	5YR3/4	5	C	M	loamy sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 62

Investigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Aquic Xerofluvents NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
Area grazed but not as heavily as kikuya areas

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Juncus balticus	20	Y	OBL
2. Polypogon monspeliensis	60	Y	FACW
3.			
4.			
5.			
6.			
7.			
8.			
	80 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. NONE			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % 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 X No _____

Remarks:

SOIL

Sampling Point: 02

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
0-10	10YR3/4						Sandy loam	
10-16	10YR4/2	95	5YR3/4	5	C	M	loamy sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes ____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Sampling Date: 6-7-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 63

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
Area grazed but not as heavily as areas w/ kikuya

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		

Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		

Herb Stratum (Plot size: ____)			
1. Elymus triticoides	95	Y	FAC
2. Distichlis spicata	1	N	FAC
3. Potentilla anserina ssp pacifica	1	N	OBL
4. Juncus balticus	3	N	OBL
5.			
6.			
7.			
8.			
	95 = Total Cover		

Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

SOIL

Sampling Point: 63

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
0-16	10YR3/2						sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: U4

Investigator(s): Jami Davis, Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
Area grazed

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Cotula coronopifolia	5	N	OBL
2. Juncus balticus	15	N	OBL
3. Polypogon monspeliensis	60	Y	OBL
4. Unknown grass	15	N	
5.			
6.			
7.			
8.			
	95 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

SOIL

Sampling Point: 64

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
0-10	10YR3/4						sandy loam	
10-16	10YR4/2	95	5YR3/4	5	C	M	loamy sand	

[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)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes ___ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: U5

Investigator(s): Jami Davis Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:
Area grazed

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Elymus triticoides	80	Y	FAC
2. Juncus balticus	20	Y	OBL
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 65

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
0-10	10YR3/3						Sandy loam	
10-15	10YR4/3		10YR4/6	3			loamy sand	

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: U6

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: ____)			
1. Carex barbarae	95	Y	FAC
2. Urtica dioca	5	N	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No ____

Remarks:

SOIL

Sampling Point: 106

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
0-1								
1-18	10YR3/1	90	2.5YR2.5/4	10	C	M	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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: W7

Investigator(s): Tami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Aquic xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Potentilla anserina ssp. pacifica	40	Y	OBL
2. Juncus balticus	20	Y	OBL
3. Eleocharis palustris	20	Y	OBL
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 67

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
0-12	10YR4/1	90	5YR4/6	10			Sandy Clay Loam	
12-16	10YR5/2	90	5YR4/6	10			Sand	

[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)
- X Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X 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 X 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)
- X 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 X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No X Depth (inches): ___

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 68

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): convex Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic Xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Potentilla anserina ssp. pacifica	80	Y	OBL
2. Juncus balticus	20	Y	OBL
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 68

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
0-8	10YR 2/2						sandy loam	
8-15	10YR 3/2							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes ____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): _____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-10-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 69

Investigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Alviso silty clay loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 10x10)			
1. Schoenoplectus californicus	100%	Y	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (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 X No _____

Remarks:

SOIL

Sampling Point: 69

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
0-5	10YR 4/3						Silty clay loam	
5-18	10YR 4/2	95%	5YR 3/4	5%	C	M	Silty clay 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)
- ___ Loamy Gleyed Matrix (F2)
- X 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 X 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)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel / Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: TO

Investigator(s): Jami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Aquic xerofluvents NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____	No X	
Wetland Hydrology Present?	Yes _____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Cenchrus clandestinum	100%	Y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	100% = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (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 X

Remarks:

SOIL

Sampling Point: TD

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
0-16	10YR3/2						sandy 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)
- ___ 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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: T1

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): LRRC Lat: Long: Datum:

Soil Map Unit Name: Aquic xerofluvents NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes ____ No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 5x5)			
1. Cenchrus clandestinum	100%	Y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	____ = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0% (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 X

Remarks:

SOIL

Sampling Point: 71

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
0-18	10YR2/2							

[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 X

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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: T2

Investigator(s): Sami Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRC Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Pacheco Clay Loam NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes _____ No X	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
Waters of the U.S.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (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 X

Remarks:

SOIL

Sampling Point: 72

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
0-1	N/A						Cobbles	
1-12	10YR 5/3						Cobbles & coarse sand	

[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 X

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X 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 X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 5in

Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): 4in

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 10-17-14

Applicant/Owner: County of Monterey State: CA Sampling Point: T3

Investigator(s): Jami Davis Matt Johnson Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Concave Slope (%): 2

Subregion (LRR): LRR C Lat: Long: Datum:

Soil Map Unit Name: Pacheco Clay Loam NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation N, Soil N, or Hydrology N 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 X No ____	**Is the Sampled Area within a Wetland?** Yes ____ No X
Hydric Soil Present?	Yes ____ No X	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
1st bench of river channel - Riparian - state wetland

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 10x10)	Absolute % Cover	Dominant Species?	Indicator Status
1. Salix lasiolepis	80	Y	FACW
2.			
3.			
4.			
	80%	= Total Cover	
Sapling/Shrub Stratum (Plot size: 10x10)			
1. Rubus Ursinus	50	Y	FAC
2.			
3.			
4.			
5.			
	50%	= Total Cover	
Herb Stratum (Plot size: ____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	____	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1. None			
2.			
	____	= Total Cover	

% Bare Ground in Herb Stratum ____ % 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 X No ____

Remarks:

SOIL

Sampling Point: 73

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
0-18	10YR5/1						Sand	

[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 X

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**)
- X Sediment Deposits (B2) (**Riverine**)
- X 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 X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Carmel Lagoon City/County: Carmel/Monterey Co Sampling Date: 6-13-14

Applicant/Owner: County of Monterey State: CA Sampling Point: 74

Investigator(s): Levi Davis Matt Johnson Section, Township, Range: _____

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): flat Slope (%): 2

Subregion (LRR): LRR C Lat: _____ Long: _____ Datum: _____

Soil Map Unit Name: Water NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation N, Soil N, or Hydrology N 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 X	**Is the Sampled Area within a Wetland?** Yes _____ No X
Hydric Soil Present?	Yes X No _____	
Wetland Hydrology Present?	Yes X No _____	

Remarks:
Waters of the U.S.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	_____ = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1. None			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: _____ (A)

Total Number of Dominant Species Across All Strata: _____ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: _____ (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 X

Remarks:
No vegetation

SOIL

Sampling Point: 74

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
0-18	10YR 5/2	80	2.5YR 4/6	20	C	M	sand	

[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)
- X 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 X 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)
- X 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 X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Appendix C: NOAA Tide Predictions

NOAA Tide Predictions

MONTEREY,California,2014

The NOAA Tide Predictions application provides predictions in both graphical and tabular formats, with many user selected options, for over 3000 stations broken down by key areas in each state. Users can also access stations via the Google map interface. Additional information can be found in the help page.

Station Types: The NOAA Tide Predictions application provides predictions from 2 distinct categories of stations at over 3000 locations:
Harmonic - The predicted height values for Harmonic stations are conducted by combining the harmonic constituents into a single tide curve.
Subordinate - The high and low height values for Subordinate stations are obtained by means and differences, and ratios applied to the full harmonic constant predictions at a specific Harmonic station (a Reference station).

Disclaimer: The official Tide prediction tables are published annually on October 1, for the following calendar year. Tide predictions generated prior to the publishing date of the official tables are subject to change. The predictions from the web based NOAA Tidal Predictions are based upon the latest information available as of the date of your request. Tide predictions generated may differ from the official published predictions if information for the station requested has been updated since the publishing date of the official published tables.

StationId:9413450
Source:NOAA/NOS/CO-OPS
Station Type:Harmonic
Time Zone:LST/LDT
Datum:mean lower low water (MLLW) which is the chart datum of soundings

NOAA Tide Predictions

MONTEREY,California,2014

Times and Heights of High and Low Waters

January

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 W ●	03:13 AM	2.2 67	**16** Th ○	03:52 AM	2.5 76
	09:23 AM	6.8 207		09:50 AM	5.5 168
	04:40 PM	-1.5 -46		05:02 PM	-0.3 -9
	11:19 PM	4.4 134		11:44 PM	4.1 125
2 Th	04:08 AM	2.1 64	**17** F	04:31 AM	2.5 76
	10:13 AM	6.6 201		10:24 AM	5.4 165
	05:25 PM	-1.5 -46		05:32 PM	-0.2 -6
3 F	12:05 AM	4.6 140	**18** Sa	12:14 AM	4.2 128
	05:05 AM	2.1 64		05:11 AM	2.5 76
	11:04 AM	6.3 192		10:59 AM	5.1 155
	06:10 PM	-1.2 -37		06:01 PM	0.0 0
4 Sa	12:52 AM	4.8 146	**19** Su	12:45 AM	4.3 131
	06:07 AM	2.0 61		05:56 AM	2.4 73
	11:58 AM	5.7 174		11:36 AM	4.8 146
	06:56 PM	-0.7 -21		06:31 PM	0.3 9
5 Su	01:41 AM	5.0 152	**20** M	01:17 AM	4.4 134
	07:16 AM	2.0 61		06:46 AM	2.4 73
	12:57 PM	5.0 152		12:18 PM	4.4 134
	07:42 PM	-0.1 -3		07:02 PM	0.7 21
6 M	02:32 AM	5.1 155	**21** Tu	01:52 AM	4.5 137
	08:32 AM	1.8 55		07:46 AM	2.2 67
	02:05 PM	4.3 131		01:08 PM	3.9 119
	08:31 PM	0.5 15		07:35 PM	1.0 30
7 Tu	03:24 AM	5.3 162	**22** W	02:30 AM	4.6 140
	09:55 AM	1.6 49		08:55 AM	2.0 61
	03:27 PM	3.7 113		02:14 PM	3.4 104
	09:23 PM	1.1 34		08:12 PM	1.4 43
8 W ◐	04:17 AM	5.4 165	**23** Th	03:12 AM	4.8 146
	11:16 AM	1.2 37		10:12 AM	1.7 52
	05:01 PM	3.3 101		03:42 PM	3.1 94
	10:18 PM	1.6 49		08:57 PM	1.8 55
9 Th	05:10 AM	5.5 168	**24** F ◑	04:00 AM	5.1 155
	12:26 PM	0.7 21		11:25 AM	1.1 34
	06:35 PM	3.3 101		05:24 PM	3.0 91
	11:17 PM	2.1 64		09:54 PM	2.1 64
10 F	05:59 AM	5.6 171	**25** Sa	04:52 AM	5.4 165
	01:24 PM	0.3 9		12:26 PM	0.5 15
	07:51 PM	3.4 104		06:51 PM	3.2 98
				11:02 PM	2.4 73
11 Sa	12:16 AM	2.4 73	**26** Su	05:46 AM	5.7 174
	06:45 AM	5.6 171		01:20 PM	-0.1 -3
	02:12 PM	0.0 0		07:54 PM	3.5 107
	08:50 PM	3.6 110			
12 Su	01:09 AM	2.5 76	**27** M	12:10 AM	2.4 73
	07:27 AM	5.7 174		06:40 AM	6.1 186
	02:53 PM	-0.3 -9		02:08 PM	-0.6 -18
	09:35 PM	3.7 113		08:44 PM	3.8 116
13 M	01:55 AM	2.6 79	**28** Tu	01:13 AM	2.3 70
	08:06 AM	5.7 174		07:32 AM	6.4 195
	03:29 PM	-0.4 -12		02:53 PM	-1.0 -30
	10:12 PM	3.8 116		09:28 PM	4.1 125
14 Tu	02:37 AM	2.6 79	**29** W	02:11 AM	2.1 64
	08:42 AM	5.7 174		08:24 AM	6.6 201
	04:02 PM	-0.4 -12		03:36 PM	-1.3 -40
	10:44 PM	3.9 119		10:09 PM	4.4 134
15 W	03:15 AM	2.6 79	**30** Th ●	03:07 AM	1.9 58
	09:16 AM	5.6 171		09:15 AM	6.6 201
	04:33 PM	-0.4 -12		04:19 PM	-1.3 -40
	11:14 PM	4.0 122		10:49 PM	4.7 143
			31 F	04:02 AM	1.6 49
				10:06 AM	6.4 195
				05:01 PM	-1.1 -34
				11:31 PM	4.9 149

February

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 Sa	04:58 AM	1.5 46	**16** Su	04:56 AM	1.8 55
	10:57 AM	6.0 183		10:49 AM	4.9 149
	05:42 PM	-0.7 -21		05:25 PM	0.4 12
				11:51 PM	4.5 137
2 Su	12:13 AM	5.1 155	**17** M	05:38 AM	1.6 49
	05:56 AM	1.3 40		11:28 AM	4.6 140
	11:51 AM	5.4 165		05:53 PM	0.7 21
	06:24 PM	-0.2 -6			
3 M	12:57 AM	5.2 158	**18** Tu	12:21 AM	4.6 140
	06:58 AM	1.3 40		06:24 AM	1.5 46
	12:48 PM	4.7 143		12:12 PM	4.2 128
	07:07 PM	0.4 12		06:22 PM	1.0 30
4 Tu	01:43 AM	5.3 162	**19** W	12:53 AM	4.7 143
	08:06 AM	1.2 37		07:16 AM	1.4 43
	01:54 PM	4.1 125		01:04 PM	3.8 116
	07:52 PM	1.0 30		06:54 PM	1.4 43
5 W	02:33 AM	5.3 162	**20** Th	01:30 AM	4.8 146
	09:22 AM	1.1 34		08:19 AM	1.3 40
	03:14 PM	3.5 107		02:11 PM	3.4 104
	08:41 PM	1.6 49		07:31 PM	1.8 55
6 Th ◐	03:27 AM	5.2 158	**21** F	02:15 AM	5.0 152
	10:42 AM	0.9 27		09:31 AM	1.0 30
	04:52 PM	3.2 98		03:39 PM	3.1 94
	09:39 PM	2.1 64		08:19 PM	2.2 67
7 F	04:25 AM	5.2 158	**22** Sa ◑	03:10 AM	5.1 155
	11:56 AM	0.7 21		10:46 AM	0.7 21
	06:29 PM	3.2 98		05:18 PM	3.1 94
	10:48 PM	2.5 76		09:27 PM	2.4 73
8 Sa	05:23 AM	5.2 158	**23** Su	04:13 AM	5.2 158
	12:57 PM	0.4 12		11:54 AM	0.2 6
	07:42 PM	3.4 104		06:39 PM	3.3 101
	11:58 PM	2.6 79		10:49 PM	2.5 76
9 Su	06:18 AM	5.2 158	**24** M	05:19 AM	5.5 168
	01:47 PM	0.1 3		12:52 PM	-0.2 -6
	08:33 PM	3.6 110		07:35 PM	3.6 110
10 M	12:57 AM	2.6 79	**25** Tu	12:06 AM	2.4 73
	07:06 AM	5.3 162		06:23 AM	5.7 174
	02:28 PM	0.0 0		01:43 PM	-0.5 -15
	09:10 PM	3.8 116		08:19 PM	4.0 122
11 Tu	01:46 AM	2.5 76	**26** W	01:12 AM	2.1 64
	07:49 AM	5.3 162		07:21 AM	5.9 180
	03:03 PM	-0.1 -3		02:28 PM	-0.8 -24
	09:40 PM	3.9 119		08:58 PM	4.4 134
12 W	02:27 AM	2.4 73	**27** Th	02:10 AM	1.7 52
	08:27 AM	5.4 165		08:17 AM	6.0 183
	03:34 PM	-0.1 -3		03:11 PM	-0.8 -24
	10:07 PM	4.0 122		09:36 PM	4.7 143
13 Th	03:04 AM	2.2 67	**28** F	03:05 AM	1.3 40
	09:03 AM	5.4 165		09:09 AM	6.0 183
	04:03 PM	-0.1 -3		03:52 PM	-0.7 -21
	10:33 PM	4.2 128		10:14 PM	5.0 152
14 F ○	03:41 AM	2.0 61			
	09:38 AM	5.3 162			
	04:31 PM	0.0 0			
	10:58 PM	4.3 131			
15 Sa	04:18 AM	1.9 58			
	10:13 AM	5.1 155			
	04:58 PM	0.1 3			
	11:24 PM	4.4 134			

March

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 Sa ●	03:57 AM	0.9 27	**16** Su ○	05:04 AM	1.1 34
	10:01 AM	5.8 177		11:04 AM	4.7 143
	04:32 PM	-0.4 -12		05:19 PM	0.6 18
	10:52 PM	5.3 162		11:34 PM	4.7 143
2 Su	04:49 AM	0.6 18	**17** M	05:42 AM	0.9 27
	10:53 AM	5.4 165		11:44 AM	4.5 137
	05:11 PM	0.0 0		05:47 PM	0.8 24
	11:31 PM	5.4 165			
3 M	05:43 AM	0.5 15	**18** Tu	12:01 AM	4.9 149
	11:46 AM	4.9 149		06:22 AM	0.7 21
	05:50 PM	0.5 15		12:26 PM	4.2 128
				06:16 PM	1.1 34
4 Tu	12:11 AM	5.4 165	**19** W	12:31 AM	5.0 152
	06:38 AM	0.5 15		07:06 AM	0.5 15
	12:43 PM	4.3 131		01:15 PM	3.9 119
	06:31 PM	1.1 34		06:47 PM	1.5 46
5 W	12:53 AM	5.3 162	**20** Th	01:04 AM	5.1 155
	07:38 AM	0.5 15		07:56 AM	0.4 12
	01:47 PM	3.8 116		02:11 PM	3.6 110
	07:14 PM	1.6 49		07:22 PM	1.8 55
6 Th	01:40 AM	5.1 155	**21** F	01:44 AM	5.1 155
	08:44 AM	0.6 18		08:54 AM	0.4 12
	03:05 PM	3.4 104		03:20 PM	3.4 104
	08:03 PM	2.1 64		08:06 PM	2.1 64
7 F	02:32 AM	4.9 149	**22** Sa	02:32 AM	5.0 152
	09:57 AM	0.6 18		10:00 AM	0.3 9
	04:38 PM	3.3 101		04:44 PM	3.3 101
	09:06 PM	2.5 76		09:05 PM	2.4 73
8 Sa ◐	03:33 AM	4.7 143	**23** Su	03:32 AM	5.0 152
	11:11 AM	0.6 18		11:11 AM	0.1 3
	06:09 PM	3.3 101		06:09 PM	3.4 104
	10:26 PM	2.7 82		10:26 PM	2.6 79
9 Su	05:40 AM	4.6 140	**24** M ◑	04:44 AM	5.0 152
	01:15 PM	0.5 15		12:19 PM	0.0 0
	08:13 PM	3.5 107		07:15 PM	3.6 110
				11:55 PM	2.5 76
10 M	12:45 AM	2.7 82	**25** Tu	06:00 AM	5.0 152
	06:45 AM	4.6 140		01:19 PM	-0.2 -6
	02:07 PM	0.4 12		08:05 PM	4.0 122
	08:56 PM	3.7 113			
11 Tu	01:46 AM	2.5 76	**26** W	01:12 AM	2.1 64
	07:40 AM	4.7 143		07:11 AM	5.1 155
	02:49 PM	0.3 9		02:11 PM	-0.3 -9
	09:29 PM	3.9 119		08:46 PM	4.4 134
12 W	02:34 AM	2.2 67	**27** Th	02:16 AM	1.6 49
	08:28 AM	4.8 146		08:14 AM	5.2 158
	03:24 PM	0.2 6		02:57 PM	-0.3 -9
	09:56 PM	4.0 122		09:24 PM	4.7 143
13 Th	03:14 AM	1.9 58	**28** F	03:12 AM	1.0 30
	09:10 AM	4.8 146		09:13 AM	5.2 158
	03:55 PM	0.2 6		03:40 PM	-0.2 -6
	10:20 PM	4.2 128		10:00 PM	5.1 155
14 F	03:52 AM	1.7 52	**29** Sa	04:03 AM	0.5 15
	09:48 AM	4.9 149		10:07 AM	5.1 155
	04:24 PM	0.3 9		04:20 PM	0.1 3
	10:44 PM	4.4 134		10:37 PM	5.3 162
15 Sa	04:27 AM	1.4 43	**30** Su ●	04:52 AM	0.1 3
	10:26 AM	4.8 146		11:00 AM	4.9 149
	04:51 PM	0.4 12		04:59 PM	0.4 12
	11:08 PM	4.6 140		11:13 PM	5.5 168
			31 M	05:40 AM	-0.2 -6
				11:52 AM	4.6 140
				05:38 PM	0.8 24
				11:49 PM	5.5 168

Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

StationId:9413450
Source:NOAA/NOS/CO-OPS
Station Type:Harmonic
Time Zone:LST/LDT
Datum:mean lower low water (MLLW) which is the chart datum of soundings

NOAA Tide Predictions

MONTEREY,California,2014

Times and Heights of High and Low Waters

April

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 Tu	06:29 AM	-0.3 -9	**16** W	06:08 AM	-0.3 -9
	12:45 PM	4.3 131		12:29 PM	3.9 119
	06:16 PM	1.2 37		05:41 PM	1.6 49
				11:50 PM	5.4 165
2 W	12:27 AM	5.4 165	**17** Th	06:52 AM	-0.4 -12
	07:18 AM	-0.2 -6		01:21 PM	3.8 116
	01:41 PM	4.0 122		06:18 PM	1.9 58
	06:56 PM	1.7 52			
3 Th	01:06 AM	5.2 158	**18** F	12:28 AM	5.4 165
	08:10 AM	-0.1 -3		07:41 AM	-0.5 -15
	02:43 PM	3.7 113		02:20 PM	3.6 110
	07:39 PM	2.1 64		07:02 PM	2.2 67
4 F	01:48 AM	5.0 152	**19** Sa	01:12 AM	5.3 162
	09:06 AM	0.1 3		08:36 AM	-0.5 -15
	03:55 PM	3.4 104		03:27 PM	3.5 107
	08:30 PM	2.5 76		07:56 PM	2.4 73
5 Sa	02:36 AM	4.6 140	**20** Su	02:04 AM	5.1 155
	10:09 AM	0.3 9		09:36 AM	-0.4 -12
	05:16 PM	3.4 104		04:39 PM	3.6 110
	09:37 PM	2.7 82		09:08 PM	2.5 76
6 Su	03:35 AM	4.3 131	**21** M	03:08 AM	4.9 149
	11:14 AM	0.4 12		10:40 AM	-0.3 -9
	06:31 PM	3.5 107		05:46 PM	3.8 116
	11:04 PM	2.7 82		10:37 PM	2.5 76
7 M ◐	04:46 AM	4.1 125	**22** Tu ◑	04:24 AM	4.6 140
	12:17 PM	0.5 15		11:43 AM	-0.2 -6
	07:27 PM	3.6 110		06:42 PM	4.1 125
8 Tu	12:26 AM	2.6 79	**23** W	12:04 AM	2.2 67
	05:59 AM	4.0 122		05:45 AM	4.4 134
	01:10 PM	0.5 15		12:41 PM	-0.1 -3
	08:06 PM	3.8 116		07:29 PM	4.4 134
9 W	01:28 AM	2.3 70	**24** Th	01:18 AM	1.6 49
	07:04 AM	4.0 122		07:02 AM	4.4 134
	01:55 PM	0.6 18		01:34 PM	0.1 3
	08:37 PM	4.0 122		08:10 PM	4.8 146
10 Th	02:17 AM	1.9 58	**25** F	02:19 AM	1.0 30
	07:59 AM	4.1 125		08:10 AM	4.3 131
	02:32 PM	0.6 18		02:21 PM	0.3 9
	09:03 PM	4.2 128		08:49 PM	5.2 158
11 F	02:58 AM	1.5 46	**26** Sa	03:12 AM	0.4 12
	08:47 AM	4.2 128		09:12 AM	4.3 131
	03:05 PM	0.7 21		03:05 PM	0.6 18
	09:28 PM	4.5 137		09:26 PM	5.4 165
12 Sa	03:35 AM	1.1 34	**27** Su	04:01 AM	-0.1 -3
	09:31 AM	4.2 128		10:09 AM	4.3 131
	03:36 PM	0.8 24		03:46 PM	0.9 27
	09:53 PM	4.7 143		10:01 PM	5.6 171
13 Su	04:12 AM	0.7 21	**28** M	04:47 AM	-0.5 -15
	10:14 AM	4.2 128		11:03 AM	4.2 128
	04:06 PM	0.9 27		04:26 PM	1.2 37
	10:19 PM	4.9 149		10:37 PM	5.7 174
14 M	04:48 AM	0.3 9	**29** Tu ●	05:31 AM	-0.7 -21
	10:57 AM	4.2 128		11:55 AM	4.0 122
	04:36 PM	1.1 34		05:04 PM	1.5 46
	10:47 PM	5.1 155		11:12 PM	5.6 171
15 Tu ○	05:27 AM	0.0 0	**30** W	06:15 AM	-0.8 -24
	11:41 AM	4.1 125		12:46 PM	3.9 119
	05:08 PM	1.4 43		05:43 PM	1.9 58
	11:17 PM	5.3 162		11:48 PM	5.5 168

May

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 Th	06:59 AM	-0.7 -21	**16** F	06:39 AM	-1.2 -37
	01:40 PM	3.7 113		01:22 PM	3.8 116
	06:24 PM	2.2 67		05:58 PM	2.2 67
2 F	12:25 AM	5.2 158	**17** Sa	12:05 AM	5.8 177
	07:44 AM	-0.5 -15		07:27 AM	-1.2 -37
	02:36 PM	3.6 110		02:18 PM	3.8 116
	07:08 PM	2.5 76		06:51 PM	2.3 70
3 Sa	01:04 AM	4.9 149	**18** Su	12:53 AM	5.6 171
	08:32 AM	-0.3 -9		08:18 AM	-1.0 -30
	03:37 PM	3.5 107		03:16 PM	3.9 119
	08:00 PM	2.7 82		07:55 PM	2.4 73
4 Su	01:48 AM	4.5 137	**19** M	01:49 AM	5.2 158
	09:22 AM	0.0 0		09:12 AM	-0.8 -24
	04:41 PM	3.6 110		04:15 PM	4.1 125
	09:07 PM	2.8 85		09:13 PM	2.4 73
5 M	02:40 AM	4.2 128	**20** Tu	02:53 AM	4.8 146
	10:16 AM	0.3 9		10:09 AM	-0.5 -15
	05:40 PM	3.6 110		05:12 PM	4.3 131
	10:31 PM	2.8 85		10:40 PM	2.2 67
6 Tu	03:45 AM	3.8 116	**21** W ◑	04:09 AM	4.3 131
	11:10 AM	0.5 15		11:06 AM	-0.1 -3
	06:29 PM	3.8 116		06:05 PM	4.6 140
	11:54 PM	2.5 76			
7 W ◐	05:00 AM	3.6 110	**22** Th	12:04 AM	1.8 55
	12:01 PM	0.7 21		05:33 AM	3.9 119
	07:07 PM	4.0 122		12:01 PM	0.2 6
				06:52 PM	5.0 152
8 Th	01:01 AM	2.2 67	**23** F	01:16 AM	1.2 37
	06:16 AM	3.5 107		06:55 AM	3.7 113
	12:48 PM	0.8 24		12:54 PM	0.6 18
	07:39 PM	4.3 131		07:35 PM	5.3 162
9 F	01:53 AM	1.7 52	**24** Sa	02:17 AM	0.5 15
	07:23 AM	3.5 107		08:10 AM	3.7 113
	01:29 PM	1.0 30		01:44 PM	1.0 30
	08:08 PM	4.5 137		08:16 PM	5.5 168
10 Sa	02:36 AM	1.2 37	**25** Su	03:10 AM	0.0 0
	08:22 AM	3.5 107		09:17 AM	3.7 113
	02:06 PM	1.1 34		02:30 PM	1.3 40
	08:35 PM	4.8 146		08:54 PM	5.7 174
11 Su	03:15 AM	0.6 18	**26** M	03:57 AM	-0.5 -15
	09:14 AM	3.6 110		10:16 AM	3.7 113
	02:42 PM	1.3 40		03:14 PM	1.6 49
	09:04 PM	5.1 155		09:31 PM	5.8 177
12 M	03:53 AM	0.1 3	**27** Tu	04:40 AM	-0.8 -24
	10:03 AM	3.7 113		11:09 AM	3.7 113
	03:18 PM	1.4 43		03:55 PM	1.9 58
	09:34 PM	5.4 165		10:07 PM	5.8 177
13 Tu	04:32 AM	-0.3 -9	**28** W ●	05:21 AM	-0.9 -27
	10:51 AM	3.8 116		11:58 AM	3.7 113
	03:54 PM	1.6 49		04:36 PM	2.1 64
	10:07 PM	5.6 171		10:43 PM	5.7 174
14 W ○	05:12 AM	-0.7 -21	**29** Th	06:01 AM	-0.9 -27
	11:39 AM	3.8 116		12:45 PM	3.7 113
	04:32 PM	1.8 55		05:16 PM	2.3 70
	10:42 PM	5.8 177		11:18 PM	5.5 168
15 Th	05:54 AM	-1.0 -30	**30** F	06:40 AM	-0.8 -24
	12:29 PM	3.8 116		01:31 PM	3.7 113
	05:13 PM	2.0 61		05:57 PM	2.5 76
	11:22 PM	5.9 180		11:54 PM	5.3 162
			31 Sa	07:19 AM	-0.6 -18
				02:18 PM	3.7 113
				06:41 PM	2.6 79

June

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 Su	12:31 AM	5.0 152	**16** M	12:42 AM	5.8 177
	07:59 AM	-0.4 -12		07:57 AM	-1.1 -34
	03:06 PM	3.7 113		02:48 PM	4.4 134
	07:32 PM	2.8 85		07:52 PM	2.2 67
2 M	01:12 AM	4.6 140	**17** Tu	01:39 AM	5.3 162
	08:40 AM	-0.1 -3		08:46 AM	-0.7 -21
	03:54 PM	3.8 116		03:40 PM	4.6 140
	08:34 PM	2.8 85		09:08 PM	2.1 64
3 Tu	01:57 AM	4.2 128	**18** W	02:43 AM	4.7 143
	09:22 AM	0.2 6		09:36 AM	-0.3 -9
	04:41 PM	3.9 119		04:33 PM	4.8 146
	09:48 PM	2.7 82		10:30 PM	1.9 58
4 W	02:52 AM	3.8 116	**19** Th ◑	03:58 AM	4.1 125
	10:06 AM	0.5 15		10:28 AM	0.3 9
	05:24 PM	4.1 125		05:24 PM	5.1 155
	11:09 PM	2.5 76		11:53 PM	1.4 43
5 Th ◐	04:01 AM	3.5 107	**20** F	05:24 AM	3.6 110
	10:51 AM	0.8 24		11:22 AM	0.8 24
	06:03 PM	4.3 131		06:14 PM	5.4 165
6 F	12:22 AM	2.1 64	**21** Sa	01:07 AM	0.9 27
	05:22 AM	3.2 98		06:53 AM	3.4 104
	11:36 AM	1.1 34		12:16 PM	1.3 40
	06:38 PM	4.5 137		07:02 PM	5.6 171
7 Sa	01:21 AM	1.6 49	**22** Su	02:09 AM	0.3 9
	06:44 AM	3.1 94		08:14 AM	3.4 104
	12:20 PM	1.3 40		01:10 PM	1.7 52
	07:12 PM	4.8 146		07:46 PM	5.7 174
8 Su	02:09 AM	1.0 30	**23** M	03:02 AM	-0.1 -3
	07:56 AM	3.1 94		09:23 AM	3.4 104
	01:05 PM	1.6 49		02:02 PM	2.0 61
	07:45 PM	5.2 158		08:29 PM	5.8 177
9 M	02:52 AM	0.4 12	**24** Tu	03:49 AM	-0.5 -15
	08:58 AM	3.3 101		10:21 AM	3.6 110
	01:49 PM	1.8 55		02:50 PM	2.2 67
	08:20 PM	5.5 168		09:08 PM	5.9 180
10 Tu	03:33 AM	-0.2 -6	**25** W	04:30 AM	-0.7 -21
	09:53 AM	3.4 104		11:09 AM	3.7 113
	02:33 PM	1.9 58		03:34 PM	2.4 73
	08:57 PM	5.8 177		09:46 PM	5.8 177
11 W	04:14 AM	-0.7 -21	**26** Th	05:08 AM	-0.7 -21
	10:43 AM	3.6 110		11:52 AM	3.8 116
	03:17 PM	2.0 61		04:16 PM	2.5 76
	09:36 PM	6.1 186		10:22 PM	5.7 174
12 Th	04:56 AM	-1.1 -34	**27** F ●	05:44 AM	-0.7 -21
	11:31 AM	3.8 116		12:31 PM	3.8 116
	04:04 PM	2.1 64		04:56 PM	2.5 76
	10:18 PM	6.3 192		10:57 PM	5.6 171
13 F ○	05:39 AM	-1.4 -43	**28** Sa	06:19 AM	-0.6 -18
	12:19 PM	3.9 119		01:08 PM	3.9 119
	04:53 PM	2.2 67		05:36 PM	2.6 79
	11:03 PM	6.3 192		11:32 PM	5.4 165
14 Sa	06:24 AM	-1.5 -46	**29** Su	06:52 AM	-0.4 -12
	01:08 PM	4.0 122		01:44 PM	3.9 119
	05:46 PM	2.2 67		06:19 PM	2.6 79
	11:51 PM	6.2 189			
15 Su	07:10 AM	-1.4 -43	**30** M	12:08 AM	5.1 155
	01:57 PM	4.2 128		07:26 AM	-0.2 -6
	06:45 PM	2.3 70		02:21 PM	4.0 122
				07:06 PM	2.7 82

Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

StationId:9413450
Source:NOAA/NOS/CO-OPS
Station Type:Harmonic
Time Zone:LST/LDT
Datum:mean lower low water (MLLW) which is the chart datum of soundings

NOAA Tide Predictions

MONTEREY,California,2014

Times and Heights of High and Low Waters

July

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 Tu	12:46 AM	4.8 146	**16** W	01:32 AM	5.3 162
	08:00 AM	0.1 3		08:16 AM	-0.3 -9
	02:58 PM	4.1 125		02:58 PM	5.1 155
	08:00 PM	2.7 82		08:53 PM	1.6 49
2 W	01:28 AM	4.4 134	**17** Th	02:35 AM	4.6 140
	08:34 AM	0.4 12		09:03 AM	0.3 9
	03:37 PM	4.2 128		03:48 PM	5.3 162
	09:04 PM	2.6 79		10:11 PM	1.4 43
3 Th	02:17 AM	4.0 122	**18** F	03:50 AM	4.0 122
	09:10 AM	0.7 21		09:52 AM	0.9 27
	04:16 PM	4.3 131		04:42 PM	5.4 165
	10:16 PM	2.4 73		11:32 PM	1.1 34
4 F	03:18 AM	3.5 107	**19** Sa ◑	05:19 AM	3.5 107
	09:48 AM	1.1 34		10:47 AM	1.5 46
	04:56 PM	4.5 137		05:36 PM	5.5 168
	11:32 PM	2.0 61			
5 Sa ◐	04:38 AM	3.2 98	**20** Su	12:48 AM	0.7 21
	10:30 AM	1.5 46		06:53 AM	3.3 101
	05:36 PM	4.8 146		11:46 AM	2.0 61
				06:30 PM	5.6 171
6 Su	12:40 AM	1.6 49	**21** M	01:53 AM	0.4 12
	06:10 AM	3.0 91		08:16 AM	3.4 104
	11:17 AM	1.8 55		12:48 PM	2.3 70
	06:17 PM	5.1 155		07:21 PM	5.7 174
7 M	01:36 AM	1.0 30	**22** Tu	02:47 AM	0.0 0
	07:35 AM	3.0 91		09:22 AM	3.6 110
	12:10 PM	2.0 61		01:46 PM	2.5 76
	06:59 PM	5.4 165		08:08 PM	5.7 174
8 Tu	02:25 AM	0.4 12	**23** W	03:33 AM	-0.2 -6
	08:44 AM	3.2 98		10:12 AM	3.7 113
	01:05 PM	2.2 67		02:38 PM	2.5 76
	07:43 PM	5.8 177		08:51 PM	5.8 177
9 W	03:10 AM	-0.2 -6	**24** Th	04:13 AM	-0.3 -9
	09:39 AM	3.5 107		10:53 AM	3.8 116
	02:00 PM	2.3 70		03:23 PM	2.5 76
	08:28 PM	6.2 189		09:31 PM	5.7 174
10 Th	03:53 AM	-0.7 -21	**25** F	04:48 AM	-0.3 -9
	10:27 AM	3.7 113		11:27 AM	3.9 119
	02:54 PM	2.2 67		04:04 PM	2.5 76
	09:15 PM	6.4 195		10:07 PM	5.7 174
11 F	04:36 AM	-1.1 -34	**26** Sa ●	05:21 AM	-0.3 -9
	11:12 AM	4.0 122		11:58 AM	4.0 122
	03:47 PM	2.2 67		04:42 PM	2.4 73
	10:02 PM	6.6 201		10:42 PM	5.6 171
12 Sa ○	05:19 AM	-1.3 -40	**27** Su	05:51 AM	-0.2 -6
	11:55 AM	4.2 128		12:27 PM	4.1 125
	04:42 PM	2.1 64		05:20 PM	2.4 73
	10:51 PM	6.6 201		11:17 PM	5.4 165
13 Su	06:03 AM	-1.3 -40	**28** M	06:21 AM	0.0 0
	12:39 PM	4.5 137		12:56 PM	4.2 128
	05:38 PM	2.0 61		06:00 PM	2.3 70
	11:41 PM	6.3 192		11:52 PM	5.2 158
14 M	06:46 AM	-1.1 -34	**29** Tu	06:50 AM	0.2 6
	01:23 PM	4.7 143		01:26 PM	4.3 131
	06:37 PM	1.9 58		06:43 PM	2.3 70
15 Tu	12:34 AM	5.9 180	**30** W	12:29 AM	4.8 146
	07:31 AM	-0.8 -24		07:19 AM	0.5 15
	02:09 PM	4.9 149		01:58 PM	4.4 134
	07:42 PM	1.8 55		07:30 PM	2.3 70
			31 Th	01:10 AM	4.5 137
				07:49 AM	0.8 24
				02:31 PM	4.5 137
				08:25 PM	2.2 67

August

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 F	01:57 AM	4.0 122	**16** Sa	03:46 AM	3.9 119
	08:21 AM	1.2 37		09:19 AM	1.7 52
	03:08 PM	4.6 140		03:56 PM	5.4 165
	09:29 PM	2.0 61		11:02 PM	0.9 27
2 Sa	02:56 AM	3.6 110	**17** Su ◑	05:16 AM	3.6 110
	08:55 AM	1.6 49		10:18 AM	2.2 67
	03:48 PM	4.8 146		04:55 PM	5.4 165
	10:41 PM	1.8 55			
3 Su	04:15 AM	3.3 101	**18** M	12:19 AM	0.7 21
	09:37 AM	1.9 58		06:50 AM	3.5 107
	04:35 PM	5.0 152		11:27 AM	2.5 76
	11:54 PM	1.4 43		05:57 PM	5.3 162
4 M ◐	05:51 AM	3.1 94	**19** Tu	01:25 AM	0.5 15
	10:29 AM	2.2 67		08:07 AM	3.7 113
	05:26 PM	5.2 158		12:38 PM	2.6 79
				06:57 PM	5.4 165
5 Tu	12:59 AM	0.9 27	**20** W	02:21 AM	0.3 9
	07:20 AM	3.2 98		09:03 AM	3.8 116
	11:34 AM	2.4 73		01:41 PM	2.6 79
	06:21 PM	5.5 168		07:50 PM	5.4 165
6 W	01:54 AM	0.3 9	**21** Th	03:06 AM	0.2 6
	08:27 AM	3.4 104		09:44 AM	4.0 122
	12:42 PM	2.5 76		02:32 PM	2.5 76
	07:15 PM	5.9 180		08:36 PM	5.4 165
7 Th	02:43 AM	-0.2 -6	**22** F	03:45 AM	0.2 6
	09:17 AM	3.7 113		10:18 AM	4.1 125
	01:46 PM	2.4 73		03:15 PM	2.4 73
	08:08 PM	6.2 189		09:17 PM	5.5 168
8 F	03:29 AM	-0.6 -18	**23** Sa	04:18 AM	0.2 6
	10:00 AM	4.0 122		10:46 AM	4.2 128
	02:44 PM	2.2 67		03:53 PM	2.2 67
	09:00 PM	6.5 198		09:54 PM	5.4 165
9 Sa	04:12 AM	-0.8 -24	**24** Su	04:48 AM	0.3 9
	10:41 AM	4.4 134		11:12 AM	4.3 131
	03:40 PM	1.9 58		04:29 PM	2.0 61
	09:52 PM	6.6 201		10:30 PM	5.4 165
10 Su ○	04:54 AM	-0.9 -27	**25** M ●	05:16 AM	0.4 12
	11:20 AM	4.7 143		11:38 AM	4.4 134
	04:35 PM	1.6 49		05:06 PM	1.9 58
	10:43 PM	6.5 198		11:05 PM	5.2 158
11 M	05:36 AM	-0.8 -24	**26** Tu	05:43 AM	0.6 18
	12:01 PM	5.0 152		12:03 PM	4.6 140
	05:30 PM	1.4 43		05:43 PM	1.8 55
	11:35 PM	6.2 189		11:41 PM	5.0 152
12 Tu	06:18 AM	-0.5 -15	**27** W	06:10 AM	0.8 24
	12:42 PM	5.2 158		12:30 PM	4.7 143
	06:27 PM	1.2 37		06:22 PM	1.7 52
13 W	12:29 AM	5.7 174	**28** Th	12:19 AM	4.7 143
	07:00 AM	0.0 0		06:38 AM	1.1 34
	01:25 PM	5.4 165		12:58 PM	4.7 143
	07:28 PM	1.1 34		07:06 PM	1.6 49
14 Th	01:26 AM	5.1 155	**29** F	01:02 AM	4.4 134
	07:43 AM	0.5 15		07:06 AM	1.4 43
	02:11 PM	5.5 168		01:30 PM	4.8 146
	08:33 PM	1.0 30		07:55 PM	1.5 46
15 F	02:31 AM	4.5 137	**30** Sa	01:51 AM	4.0 122
	08:28 AM	1.1 34		07:37 AM	1.8 55
	03:01 PM	5.5 168		02:05 PM	4.9 149
	09:45 PM	1.0 30		08:52 PM	1.4 43
			31 Su	02:53 AM	3.6 110
				08:13 AM	2.1 64
				02:48 PM	4.9 149
				09:59 PM	1.3 40

September

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 M	04:13 AM	3.4 104	**16** Tu ◑	06:35 AM	3.8 116
	08:59 AM	2.4 73		11:15 AM	2.8 85
	03:40 PM	5.0 152		05:19 PM	4.9 149
	11:12 PM	1.0 30			
2 Tu ◐	05:46 AM	3.3 101	**17** W	12:45 AM	0.6 18
	10:03 AM	2.7 82		07:41 AM	3.9 119
	04:43 PM	5.2 158		12:33 PM	2.8 85
				06:27 PM	4.8 146
3 W	12:21 AM	0.7 21	**18** Th	01:41 AM	0.6 18
	07:06 AM	3.5 107		08:28 AM	4.1 125
	11:22 AM	2.7 82		01:35 PM	2.6 79
	05:50 PM	5.4 165		07:26 PM	4.9 149
4 Th	01:21 AM	0.3 9	**19** F	02:26 AM	0.6 18
	08:03 AM	3.8 116		09:03 AM	4.2 128
	12:39 PM	2.6 79		02:24 PM	2.3 70
	06:54 PM	5.6 171		08:16 PM	4.9 149
5 F	02:12 AM	0.0 0	**20** Sa	03:04 AM	0.6 18
	08:47 AM	4.1 125		09:32 AM	4.4 134
	01:45 PM	2.3 70		03:04 PM	2.0 61
	07:54 PM	5.9 180		09:00 PM	5.0 152
6 Sa	02:59 AM	-0.3 -9	**21** Su	03:37 AM	0.7 21
	09:26 AM	4.5 137		09:58 AM	4.5 137
	02:43 PM	1.8 55		03:41 PM	1.7 52
	08:51 PM	6.1 186		09:39 PM	5.0 152
7 Su	03:42 AM	-0.4 -12	**22** M	04:06 AM	0.8 24
	10:04 AM	4.9 149		10:22 AM	4.7 143
	03:37 PM	1.4 43		04:16 PM	1.5 46
	09:45 PM	6.1 186		10:17 PM	4.9 149
8 M	04:24 AM	-0.3 -9	**23** Tu	04:34 AM	0.9 27
	10:42 AM	5.2 158		10:46 AM	4.8 146
	04:30 PM	0.9 27		04:51 PM	1.2 37
	10:38 PM	6.0 183		10:55 PM	4.8 146
9 Tu ○	05:04 AM	0.0 0	**24** W ●	05:01 AM	1.1 34
	11:20 AM	5.5 168		11:11 AM	5.0 152
	05:22 PM	0.6 18		05:27 PM	1.0 30
	11:31 PM	5.7 174		11:34 PM	4.6 140
10 W	05:45 AM	0.3 9	**25** Th	05:28 AM	1.4 43
	12:00 PM	5.7 174		11:37 AM	5.1 155
	06:16 PM	0.4 12		06:05 PM	0.8 24
11 Th	12:25 AM	5.2 158	**26** F	12:16 AM	4.4 134
	06:26 AM	0.8 24		05:57 AM	1.7 52
	12:41 PM	5.7 174		12:06 PM	5.2 158
	07:11 PM	0.3 9		06:46 PM	0.7 21
12 F	01:23 AM	4.7 143	**27** Sa	01:02 AM	4.2 128
	07:09 AM	1.3 40		06:27 AM	2.0 61
	01:24 PM	5.7 174		12:38 PM	5.2 158
	08:10 PM	0.4 12		07:33 PM	0.7 21
13 Sa	02:28 AM	4.3 131	**28** Su	01:56 AM	3.9 119
	07:55 AM	1.9 58		07:01 AM	2.3 70
	02:12 PM	5.5 168		01:15 PM	5.2 158
	09:15 PM	0.5 15		08:26 PM	0.6 18
14 Su	03:43 AM	3.9 119	**29** M	03:00 AM	3.7 113
	08:48 AM	2.3 70		07:43 AM	2.6 79
	03:06 PM	5.2 158		02:01 PM	5.1 155
	10:26 PM	0.6 18		09:28 PM	0.6 18
15 M	05:10 AM	3.7 113	**30** Tu	04:18 AM	3.6 110
	09:55 AM	2.7 82		08:40 AM	2.8 85
	04:09 PM	5.0 152		02:58 PM	5.1 155
	11:38 PM	0.7 21		10:35 PM	0.5 15

Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

StationId:9413450
Source:NOAA/NOS/CO-OPS
Station Type:Harmonic
Time Zone:LST/LDT
Datum:mean lower low water (MLLW) which is the chart datum of soundings

NOAA Tide Predictions

MONTEREY,California,2014

Times and Heights of High and Low Waters

October

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 W ◐	05:38 AM	3.7 113	**16** Th	07:01 AM	4.1 125
	09:59 AM	2.9 88		12:19 PM	2.8 85
	04:08 PM	5.0 152		05:45 PM	4.2 128
	11:43 PM	0.4 12			
2 Th	06:42 AM	3.9 119	**17** F	12:47 AM	0.8 24
	11:27 AM	2.8 85		07:42 AM	4.3 131
	05:25 PM	5.0 152		01:21 PM	2.4 73
				06:53 PM	4.2 128
3 F	12:43 AM	0.2 6	**18** Sa	01:33 AM	0.9 27
	07:31 AM	4.2 128		08:15 AM	4.5 137
	12:44 PM	2.4 73		02:09 PM	2.0 61
	06:39 PM	5.1 155		07:50 PM	4.2 128
4 Sa	01:36 AM	0.2 6	**19** Su	02:12 AM	1.0 30
	08:13 AM	4.6 140		08:42 AM	4.7 143
	01:48 PM	1.9 58		02:49 PM	1.6 49
	07:45 PM	5.3 162		08:39 PM	4.3 131
5 Su	02:24 AM	0.2 6	**20** M	02:46 AM	1.1 34
	08:51 AM	5.0 152		09:08 AM	4.9 149
	02:44 PM	1.2 37		03:25 PM	1.2 37
	08:45 PM	5.3 162		09:24 PM	4.3 131
6 M	03:08 AM	0.3 9	**21** Tu	03:17 AM	1.3 40
	09:27 AM	5.4 165		09:33 AM	5.1 155
	03:36 PM	0.7 21		04:00 PM	0.8 24
	09:42 PM	5.3 162		10:06 PM	4.3 131
7 Tu	03:50 AM	0.5 15	**22** W	03:47 AM	1.5 46
	10:04 AM	5.7 174		09:58 AM	5.3 162
	04:26 PM	0.2 6		04:35 PM	0.5 15
	10:36 PM	5.2 158		10:48 PM	4.3 131
8 W ○	04:30 AM	0.8 24	**23** Th ●	04:16 AM	1.7 52
	10:42 AM	5.9 180		10:25 AM	5.4 165
	05:15 PM	-0.2 -6		05:12 PM	0.2 6
	11:30 PM	5.0 152		11:30 PM	4.2 128
9 Th	05:11 AM	1.2 37	**24** F	04:47 AM	1.9 58
	11:20 AM	6.0 183		10:53 AM	5.5 168
	06:04 PM	-0.3 -9		05:50 PM	0.0 0
10 F	12:25 AM	4.7 143	**25** Sa	12:16 AM	4.1 125
	05:52 AM	1.6 49		05:19 AM	2.1 64
	11:59 AM	5.9 180		11:25 AM	5.6 171
	06:54 PM	-0.3 -9		06:31 PM	-0.1 -3
11 Sa	01:23 AM	4.4 134	**26** Su	01:05 AM	4.0 122
	06:35 AM	2.0 61		05:55 AM	2.4 73
	12:41 PM	5.7 174		12:01 PM	5.6 171
	07:47 PM	-0.2 -6		07:17 PM	-0.2 -6
12 Su	02:26 AM	4.1 125	**27** M	02:00 AM	3.9 119
	07:22 AM	2.4 73		06:36 AM	2.6 79
	01:25 PM	5.4 165		12:42 PM	5.5 168
	08:43 PM	0.1 3		08:07 PM	-0.2 -6
13 M	03:37 AM	4.0 122	**28** Tu	03:03 AM	3.9 119
	08:19 AM	2.8 85		07:28 AM	2.8 85
	02:16 PM	5.0 152		01:30 PM	5.3 162
	09:44 PM	0.3 9		09:03 PM	-0.1 -3
14 Tu	04:53 AM	3.9 119	**29** W	04:10 AM	3.9 119
	09:31 AM	3.0 91		08:37 AM	2.9 88
	03:17 PM	4.6 140		02:30 PM	5.1 155
	10:49 PM	0.5 15		10:03 PM	0.0 0
15 W ◑	06:05 AM	4.0 122	**30** Th	05:14 AM	4.1 125
	10:58 AM	3.0 91		10:04 AM	2.9 88
	04:29 PM	4.4 134		03:44 PM	4.8 146
	11:51 PM	0.7 21		11:05 PM	0.2 6
			31 F ◐	06:09 AM	4.4 134
				11:32 AM	2.5 76
				05:06 PM	4.6 140

November

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 Sa	12:03 AM	0.3 9	**16** Su	06:21 AM	4.7 143
	06:56 AM	4.7 143		12:46 PM	1.8 55
	12:48 PM	2.0 61		06:16 PM	3.6 110
	06:27 PM	4.5 137			
2 Su	12:57 AM	0.5 15	**17** M	12:09 AM	1.4 43
	06:37 AM	5.1 155		06:50 AM	4.9 149
	12:50 PM	1.3 40		01:29 PM	1.3 40
	06:40 PM	4.5 137		07:16 PM	3.6 110
3 M	12:47 AM	0.7 21	**18** Tu	12:48 AM	1.6 49
	07:16 AM	5.5 168		07:18 AM	5.1 155
	01:45 PM	0.6 18		02:07 PM	0.8 24
	07:45 PM	4.5 137		08:08 PM	3.7 113
4 Tu	01:32 AM	0.9 27	**19** W	01:24 AM	1.8 55
	07:54 AM	5.9 180		07:46 AM	5.4 165
	02:35 PM	0.0 0		02:43 PM	0.4 12
	08:45 PM	4.5 137		08:56 PM	3.8 116
5 W	02:16 AM	1.2 37	**20** Th	01:59 AM	1.9 58
	08:31 AM	6.1 186		08:15 AM	5.6 171
	03:22 PM	-0.4 -12		03:19 PM	-0.1 -3
	09:40 PM	4.5 137		09:42 PM	3.9 119
6 Th ○	02:58 AM	1.6 49	**21** F	02:34 AM	2.1 64
	09:09 AM	6.2 189		08:47 AM	5.8 177
	04:07 PM	-0.7 -21		03:56 PM	-0.4 -12
	10:34 PM	4.4 134		10:27 PM	4.0 122
7 F	03:39 AM	1.9 58	**22** Sa ●	03:10 AM	2.2 67
	09:47 AM	6.2 189		09:20 AM	6.0 183
	04:53 PM	-0.8 -24		04:35 PM	-0.7 -21
	11:27 PM	4.3 131		11:13 PM	4.0 122
8 Sa	04:21 AM	2.2 67	**23** Su	03:50 AM	2.4 73
	10:25 AM	6.0 183		09:57 AM	6.0 183
	05:38 PM	-0.7 -21		05:17 PM	-0.8 -24
9 Su	12:22 AM	4.2 128	**24** M	12:02 AM	4.0 122
	05:05 AM	2.5 76		04:33 AM	2.5 76
	11:04 AM	5.7 174		10:38 AM	6.0 183
	06:24 PM	-0.5 -15		06:01 PM	-0.9 -27
10 M	01:18 AM	4.1 125	**25** Tu	12:53 AM	4.1 125
	05:53 AM	2.8 85		05:23 AM	2.7 82
	11:46 AM	5.3 162		11:23 AM	5.8 177
	07:12 PM	-0.2 -6		06:48 PM	-0.8 -24
11 Tu	02:18 AM	4.0 122	**26** W	01:47 AM	4.1 125
	06:49 AM	3.0 91		06:23 AM	2.8 85
	12:31 PM	4.9 149		12:14 PM	5.5 168
	08:02 PM	0.1 3		07:39 PM	-0.5 -15
12 W	03:20 AM	4.0 122	**27** Th	02:43 AM	4.3 131
	08:00 AM	3.1 94		07:36 AM	2.8 85
	01:24 PM	4.5 137		01:15 PM	5.0 152
	08:54 PM	0.4 12		08:32 PM	-0.2 -6
13 Th	04:18 AM	4.1 125	**28** F	03:37 AM	4.5 137
	09:24 AM	3.0 91		09:02 AM	2.6 79
	02:29 PM	4.1 125		02:28 PM	4.5 137
	09:48 PM	0.7 21		09:27 PM	0.1 3
14 F ◑	05:07 AM	4.3 131	**29** Sa ◐	04:29 AM	4.8 146
	10:48 AM	2.7 82		10:28 AM	2.1 64
	03:47 PM	3.8 116		03:52 PM	4.1 125
	10:40 PM	1.0 30		10:23 PM	0.5 15
15 Sa	05:47 AM	4.4 134	**30** Su	05:17 AM	5.2 158
	11:55 AM	2.3 70		11:44 AM	1.5 46
	05:06 PM	3.6 110		05:20 PM	3.9 119
	11:27 PM	1.2 37		11:17 PM	0.9 27

December

	Time	Height		Time	Height
	h m	ft cm		h m	ft cm
1 M	06:02 AM	5.5 168	**16** Tu	05:55 AM	5.0 152
	12:48 PM	0.8 24		01:02 PM	1.2 37
	06:40 PM	3.8 116		06:52 PM	3.2 98
				11:46 PM	2.0 61
2 Tu	12:10 AM	1.3 40	**17** W	06:29 AM	5.3 162
	06:45 AM	5.9 180		01:44 PM	0.6 18
	01:43 PM	0.2 6		07:54 PM	3.3 101
	07:51 PM	3.8 116			
3 W	12:59 AM	1.6 49	**18** Th	12:31 AM	2.1 64
	07:26 AM	6.1 186		07:04 AM	5.6 171
	02:32 PM	-0.4 -12		02:22 PM	0.1 3
	08:53 PM	3.9 119		08:47 PM	3.5 107
4 Th	01:47 AM	1.9 58	**19** F	01:15 AM	2.3 70
	08:05 AM	6.2 189		07:40 AM	5.9 180
	03:17 PM	-0.7 -21		03:00 PM	-0.4 -12
	09:48 PM	4.0 122		09:33 PM	3.7 113
5 F	02:32 AM	2.1 64	**20** Sa	01:59 AM	2.4 73
	08:44 AM	6.2 189		08:17 AM	6.1 186
	04:00 PM	-0.9 -27		03:39 PM	-0.8 -24
	10:38 PM	4.1 125		10:17 PM	3.9 119
6 Sa ○	03:16 AM	2.4 73	**21** Su	02:44 AM	2.4 73
	09:22 AM	6.2 189		08:57 AM	6.3 192
	04:41 PM	-0.9 -27		04:19 PM	-1.1 -34
	11:26 PM	4.1 125		11:00 PM	4.0 122
7 Su	03:59 AM	2.5 76	**22** M ●	03:31 AM	2.4 73
	10:00 AM	6.0 183		09:40 AM	6.4 195
	05:21 PM	-0.8 -24		05:00 PM	-1.2 -37
				11:43 PM	4.2 128
8 M	12:12 AM	4.1 125	**23** Tu	04:21 AM	2.4 73
	04:43 AM	2.7 82		10:25 AM	6.3 192
	10:38 AM	5.7 174		05:43 PM	-1.2 -37
	06:00 PM	-0.6 -18			
9 Tu	12:58 AM	4.1 125	**24** W	12:28 AM	4.4 134
	05:29 AM	2.8 85		05:16 AM	2.4 73
	11:17 AM	5.3 162		11:13 AM	6.0 183
	06:40 PM	-0.3 -9		06:27 PM	-1.0 -30
10 W	01:44 AM	4.1 125	**25** Th	01:15 AM	4.5 137
	06:21 AM	2.9 88		06:18 AM	2.4 73
	11:57 AM	4.9 149		12:06 PM	5.5 168
	07:20 PM	0.0 0		07:12 PM	-0.6 -18
11 Th	02:31 AM	4.1 125	**26** F	02:04 AM	4.7 143
	07:21 AM	3.0 91		07:29 AM	2.3 70
	12:42 PM	4.5 137		01:07 PM	4.9 149
	08:01 PM	0.4 12		08:00 PM	-0.1 -3
12 F	03:17 AM	4.2 128	**27** Sa	02:54 AM	5.0 152
	08:35 AM	2.9 88		08:49 AM	2.0 61
	01:36 PM	4.0 122		02:18 PM	4.3 131
	08:44 PM	0.7 21		08:50 PM	0.4 12
13 Sa	04:02 AM	4.4 134	**28** Su ◐	03:46 AM	5.2 158
	09:57 AM	2.7 82		10:14 AM	1.6 49
	02:44 PM	3.6 110		03:43 PM	3.8 116
	09:28 PM	1.1 34		09:43 PM	1.0 30
14 Su	04:43 AM	4.5 137	**29** M	04:38 AM	5.5 168
	11:13 AM	2.3 70		11:32 AM	1.1 34
	04:09 PM	3.3 101		05:18 PM	3.5 107
◑	10:13 PM	1.4 43		10:40 PM	1.5 46
15 M	05:20 AM	4.8 146	**30** Tu	05:28 AM	5.7 174
	12:14 PM	1.8 55		12:40 PM	0.5 15
	05:36 PM	3.1 94		06:46 PM	3.4 104
	10:59 PM	1.7 52		11:38 PM	1.9 58
			31 W	06:17 AM	5.9 180
				01:37 PM	-0.1 -3
				08:00 PM	3.6 110

Disclaimer: These data are based upon the latest information available as of the date of your request, and may differ from the published tide tables.

Appendix G Avian Species List

CARMEL RIVER MOUTH AREA BIRD LIST

This list is compiled from all published literature, *North America Birds (NAB)* files going back in the 1950s, the Monterey Peninsula Rare Bird Alert files back to the early 1980s, and the field notes of Bill Hill, Craig Hohenberger, and myself. I have also checked a portion of Laidlaw William's field notes on file at Hasting NHR. There are several species not on the list that likely have occurred, maybe even regularly, but I know of no specific records [these include Canvasback and Horned Lark]. Additions to this list are welcome, but I do need a specific date and a specific observer to enter those data into the county database, and details may be necessary for rarities.

- Don Roberson
Field Ornithologist
NAB Regional Editor

Symbols on list:

(B) = breeds in Area
(E) = extirpated in Area (formerly resident)
(I) = non-native Introduced resident species
* = rare or vagrant to Area, report locally to the Monterey BirdBox - (831) 626-6605
** = exceptional vagrant, please document with photos or description (send to P.O. Box 985, Pacific Grove CA 93950) and report immediately to Bird Box & try to get others to confirm.

CARMEL RIVER MOUTH LIST

1 Red-throated Loon
2 Pacific Loon
3 Common Loon
4 Pied-billed Grebe (B)
5 Horned Grebe
6 Red-necked Grebe
7 Eared Grebe
8 Western Grebe
9 Clark's Grebe
10 Northern Fulmar
11 Sooty Shearwater
12 Short-tailed Shearwater
13 Black-vented Shearwater
14 American White Pelican *
15 Brown Pelican
16 Brandt's Cormorant
17 Double-crested Cormorant
18 Pelagic Cormorant
19 American Bittern
20 Great Blue Heron
21 Great Egret
22 Snowy Egret
23 Little Blue Heron *
24 Cattle Egret *
25 Green Heron
26 Black-crown'd Night-Heron
27 White-faced Ibis *
28 Turkey Vulture
29 Fulvous Whistling-Duck *
30 Gr. White-fronted Goose *
31 Snow Goose *
32 Ross' Goose *
33 Canada Goose (I pop.; wild birds rare)
34 Brant
35 Tundra Swan *
36 Wood Duck
37 Gadwall
38 Eurasian Wigeon *
39 American Wigeon
40 Mallard (B)
41 Blue-winged Teal *
42 Cinnamon Teal
43 Northern Shoveler
44 Northern Pintail
45 Green-winged Teal
46 Redhead *
47 Ring-necked Duck *

48 Greater Scaup
49 Lesser Scaup
50 Harlequin Duck *
51 Surf Scoter
52 White-winged Scoter
53 Oldsquaw *
54 Bufflehead
55 Common Goldeneye
56 Hooded Merganser *
57 Common Merganser *
58 Red-breasted Merganser
59 Ruddy Duck
60 Osprey
61 White-tailed Kite
62 Bald Eagle *
63 Northern Harrier
64 Sharp-shinned Hawk (B; once in 1901)
65 Cooper's Hawk (B)
66 Red-shouldered Hawk (B)
67 Broad-winged Hawk *
68 Swainson's Hawk *
69 Red-tailed Hawk
70 Ferruginous Hawk
71 Rough-legged Hawk *
72 Golden Eagle *
73 American Kestrel
74 Merlin
75 Peregrine Falcon
76 Prairie Falcon *
77 California Quail (B)
78 Clapper Rail *
79 Virginia Rail (B)
80 Sora
81 Common Moorhen *
82 American Coot (B)
83 Sandhill Crane **
84 Black-bellied Plover
85 American Golden-Plover *
86 Pacific Golden-Plover *
87 Snowy Plover
88 Semipalmated Plover
89 Killdeer (B)
90 Black Oystercatcher
91 American Avocet *
92 Greater Yellowlegs
93 Lesser Yellowlegs
94 Solitary Sandpiper *
95 Willet
96 Wandering Tattler *
97 Spotted Sandpiper
98 Terek Sandpiper **
99 Little Curlew **
100 Whimbrel
101 Long-billed Curlew *
102 Hudsonian Godwit **
103 Marbled Godwit
104 Black Turnstone
105 Surfbird
106 Red Knot *
107 Sanderling
108 Semipalmated Sandpiper *
109 Western Sandpiper
110 Least Sandpiper
111 White-rumped Sandpiper **
112 Baird's Sandpiper
113 Pectoral Sandpiper
114 Sharp-tailed Sandpiper *
115 Dunlin
116 Stilt Sandpiper *
117 Buff-breasted Sandpiper *
118 Ruff *
119 Short-billed Dowitcher
120 Long-billed Dowitcher
121 Wilson's Snipe
122 Wilson's Phalarope
123 Red-necked Phalarope
124 Red Phalarope *
125 Bonaparte's Gull
126 Heermann's Gull
127 Mew Gull
128 Ring-billed Gull *
129 California Gull
130 Herring Gull
131 Thayer's Gull
132 Western Gull
133 Glaucous-winged Gull
134 Glaucous Gull *
135 Sabine's Gull *
136 Black-legged Kittiwake *
137 Caspian Tern
138 Elegant Tern
139 Common Tern
140 Arctic Tern *
141 Common Murre
142 Pigeon Guillemot

143 Cassin’s Auklet
144 Rhinoceros Auklet
145 Rock Dove (I)
146 Band-tailed Pigeon
147 White-winged Dove *
148 Mourning Dove (B)
149 Black-billed Cuckoo **
150 Barn Owl
151 Great Horned Owl (B)
152 Burrowing Owl *
153 Common Nighthawak **
154 Common Poorwill *
155 Vaux's Swift
156 White-throated Swift
157 Broad-billed Hummingbird **
158 Anna's Hummingbird (B)
159 Calliope Hummingbird *
160 Rufous Hummingbird
161 Allen's Hummingbird (B)
162 Belted Kingfisher
163 Acorn Woodpecker
164 Red-naped Sapsucker *
165 Red-breasted Sapsucker
166 Nuttall's Woodpecker (B)
167 Downy Woodpecker (B)
168 Hairy Woodpecker (B)
169 Northern Flicker
170 Olive-sided Flycatcher
171 Western Wood-Pewee
172 Eastern Wood-Pewee **
173 Willow Flycatcher (B until 1974, that pop. now E; rare migrant)
174 Least Flycatcher *
175 Hammond's Flycatcher *
176 Dusky Flycatcher *
177 Pacific-slope Flycatcher (B)
178 Black Phoebe (B)
179 Eastern Phoebe *
180 Say's Phoebe
181 Vermilion Flycatcher *
182 Dusky-capped Flycatcher **
183 Ash-throated Flycatcher
184 Great Crested Flycatcher **
185 Tropical Kingbird *
186 Cassin's Kingbird *
187 Western Kingbird
188 Eastern Kingbird *
189 Loggerhead Shrike
190 Bell's Vireo *
191 Yellow-throated Vireo **
192 Plumbeous Vireo *
193 Cassin's Vireo
194 Blue-headed Vireo **
195 Hutton's Vireo (B)
196 Warbling Vireo (B)
197 Philadelphia Vireo *
198 Red-eyed Vireo *
199 Yellow-green Vireo **
200 Western Scrub-Jay (B)
201 Yellow-billed Magpie *
202 American Crow (B)
203 Common Raven *
204 Purple Martin *
205 Tree Swallow
206 Violet-green Swallow
207 N. Rough-winged Swallow (B)
208 Cliff Swallow (B)
209 Barn Swallow (B)
210 Chestnut-backed Chickadee (B)
211 Oak Titmouse
212 Bushtit (B)
213 Red-breasted Nuthatch
214 Pygmy Nuthatch (B)
215 Brown Creeper (B)
216 Bewick's Wren (B)
217 House Wren (B)
218 Winter Wren
219 Marsh Wren
220 Golden-crowned Kinglet
221 Ruby-crowned Kinglet
222 Blue-gray Gnatcatcher
223 Western Bluebird *
224 Veery **
225 Swainson's Thrush (B)
226 Hermit Thrush
227 American Robin (B)
228 Varied Thrush
229 Wrentit (B)
230 Gray Catbird **
231 Northern Mockingbird (B)
232 Sage Thrasher *
233 Brown Thrasher *
234 California Thrasher
235 European Starling (I)
236 American Pipit
237 Cedar Waxwing

238 Blue-winged Warbler *
239 Tennessee Warbler *
240 Orange-crowned Warbler
241 Nashville Warbler
242 Virginia's Warbler *
243 Lucy's Warbler *
244 Northern Parula *
245 Yellow Warbler (B)
246 Chestnut-sided Warbler *
247 Magnolia Warbler *
248 Cape May Warbler *
249 Black-thr'd Blue Warbler *
250 Yellow-rumped Warbler
251 Black-thr'd Gray Warbler
252 Black-thr'd Green Warbler *
253 Townsend's Warbler
254 Hermit Warbler
255 Blackburnian Warbler *
256 Yellow-throated Warbler *
257 Prairie Warbler *
258 Palm Warbler *
259 Bay-breasted Warbler *
260 Blackpoll Warbler *
261 Cerulean Warbler *
262 Black-and-white Warbler *
263 American Redstart *
264 Prothonotary Warbler *
265 Worm-eating Warbler *
266 Ovenbird *
267 Northern Waterthrush *
268 Connecticut Warbler *
269 Mourning Warbler *
270 MacGillivray's Warbler
271 Common Yellowthroat (B)
272 Hooded Warbler *
273 Wilson's Warbler (B)
274 Canada Warbler *
275 Yellow-breasted Chat *
276 Summer Tanager *
277 Scarlet Tanager *
278 Western Tanager
279 Spotted Towhee (B)
280 California Towhee (B)
281 American Tree Sparrow *
282 Chipping Sparrow
283 Clay-colored Sparrow *
284 Brewer's Sparrow *
285 Vesper Sparrow *
286 Lark Sparrow *
287 Lark Bunting *
288 Savannah Sparrow
289 Nelson's Sharp-tailed Sparrow *
290 Fox Sparrow
291 Song Sparrow (B)
292 Lincoln's Sparrow
293 Swamp Sparrow *
294 White-throated Sparrow *
295 Harris's Sparrow *
296 White-crowned Sparrow (B)
297 Golden-crowned Sparrow
298 Dark-eyed Junco (B)
299 Rose-breasted Grosbeak *
300 Black-headed Grosbeak (B)
301 Blue Grosbeak *
302 Lazuli Bunting
303 Indigo Bunting *
304 Painted Bunting **
305 Dickcissel *
306 Bobolink *
307 Red-winged Blackbird (B)
308 Tricolored Blackbird
309 Western Meadowlark
310 Yellow-headed Blackbird *
311 Rusty Blackbird *
312 Brewer's Blackbird (B)
313 Great-tailed Grackle *
314 Brown-headed Cowbird (B)
315 Orchard Oriole *
316 Hooded Oriole (B)
317 Baltimore Oriole *
318 Bullock's Oriole
319 Purple Finch (B)
320 House Finch (B)
321 Red Crossbill *
322 Pine Siskin (B)
323 Lesser Goldfinch
324 Lawrence's Goldfinch (B)
325 American Goldfinch (B)
326 Evening Grosbeak *
327 House Sparrow (B)
328 Lesser Goldfinch
329 Lawrence's Goldfinch (B)
330 American Goldfinch (B)
331 Evening Grosbeak *
332 House Sparrow (I)

Appendix H California Department of Fish and Wildlife Avoidance and Minimization Measures

STEELHEAD (*Oncorhynchus mykiss*)

Project work within the wetted stream shall be limited to the period between June 15 and November 1, or the first significant fall rainfall. This is to take advantage of low stream flows and to avoid the spawning and egg/alevin incubation period of steelhead. Whenever possible, the work period at individual sites shall be further limited to entirely avoid periods when salmonids are present (for example, in a seasonal creek, work will be confined to the period when the stream is dry).

No heavy equipment shall operate in the live stream, except as may be necessary to construct coffer dams to divert stream flow and isolate the work site and to excavate the stored sediments from the stream channel immediately upstream of the road crossing.

Work must be performed in isolation from the flowing stream. If there is any flow when the work is done, the operator shall construct coffer dams upstream and downstream of the excavation site and divert all flow from upstream of the upstream dam to downstream of the downstream dam. The coffer dams may be constructed with clean river gravel or sand bags, and may be sealed with sheet plastic. Upon project completion, sand bags and any sheet plastic shall be removed from the stream in such a manner that would allow for the least disturbance to the substrate. Clean river gravel may be left in the stream, but the coffer dams must be breached to return the stream flow to its natural channel.

For minor actions, where the disturbance to construct coffer dams to isolate the work site would be greater than to complete the action (for example, placement of a single boulder cluster), measures will be put in place immediately downstream of the work site to capture suspended sediment. This may include installation of silt catchment fences across the stream, or placement of a filter berm of clean river gravel. Silt fences and other non-native materials will be removed from the stream following completion of the activity. Gravel berms may be left in place after breaching, provided they do not impede the stream flow or fish passage.

The channel shall not be excavated for the purpose of isolating the workspace from flowing water.

The Operator shall obtain a biologist with all necessary State and Federal permits, to rescue any fish within work sites prior to dewatering. Rescued fish shall be moved to the nearest appropriate site on the stream outside of the work area. A record shall be maintained of all fish rescued and moved, and the record shall be provided to DFG at the completion of the work season.

A Service-approved biologist shall permanently remove from within the project work site, any individuals of exotic species, such as bullfrogs, centrarchid fishes, and non-native crayfish, to the maximum extent possible. The Operator shall have the responsibility that such removals are done in compliance with the California Department of Fish and Game Code.

If it is necessary to divert flow around the work site, either by pump or by gravity flow, the suction end of the intake pipe shall be fitted with fish screens meeting DFG and NMFS criteria to prevent entrainment or impingement of small fish. Any turbid water pumped from the work site itself to maintain it in a dewatered state shall be disposed of in an upland location where it will not drain directly into any stream channel.

Any disturbed banks shall be fully restored upon completion of construction. Revegetation shall be done using locally obtained native species. Planting techniques can include seed casting, hydroseeding, or live planting methods using the techniques in Part XI of the *California Salmonid Stream Habitat Restoration Manual*.

Suitable large woody debris removed from fish passage barriers that is not used for habitat enhancement, shall be left within the riparian zone so as to provide a source for future recruitment of wood into the stream, reduce surface erosion, contribute to amounts of organic debris in the soil, encourage fungi, provide immediate cover for small terrestrial species, and to speed recovery of native vegetation.

The following measures shall be taken to minimize injury and mortality to listed salmonids resulting from fish relocation and dewatering activities:

a) Fish relocation and dewatering activities shall only occur between June 15 and November 1 of each year,
b) The Operator shall minimize the amount of wetted stream channel that is dewatered at each individual project site to the fullest extent possible, and
c) All electrofishing shall be performed by a qualified fisheries biologist and conducted according to the National Marine Fisheries Service Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act, June 2000.

Installation of the contracted bridge(s) will be of adequate size that it will allow anadromous fish passage at all life stages and is designed to comply with current National Marine Fisheries Service (NMFS) Southwest Region fish passage guidelines.

If for some reason these mitigation measures cannot be implemented, or the project actions proposed at a specific work site cannot be modified to prevent or avoid potential impacts to anadromous salmonids or their habitat, then activity at that work site will be discontinued.

HAZARDS AND HAZARDOUS MATERIALS

The Operator shall have dependable radio or phone communication on-site to be able to report any accidents or fire that might occur.

Heavy equipment that will be used in these activities will be in good condition and will be inspected for leakage of coolant and petroleum products and repaired, if necessary, before work is started.

All equipment operators will be trained in the procedures to be taken should an accident occur. Prior to the commencement of work, the Operator shall provide DFG with a plan allowing for prompt and effective response to any accidental spills. All workers shall be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.

All activities performed in or near a stream will have absorbent materials designed for spill containment and cleanup at the activity site for use in case of an accidental spill.

All fueling and maintenance of vehicles, other equipment, and staging/storage areas shall be located at least 20 meters from any riparian habitat or water body. The Operator shall ensure contamination of habitat does not occur during such operations.

Any equipment or vehicles driven and/or operated within or adjacent to the stream shall be checked and maintained daily, to prevent leaks or materials that if introduced to water could be deleterious to aquatic life.

Staging and storage areas for equipment, materials, fuels, lubricants, and solvents shall be located outside of the stream's high water channel and associated riparian area. Stationary equipment such as motors, pumps, generators, compressors, and welders, located within the dry portion of the stream channel or adjacent to the stream, will be positioned over drip-pans.

All internal combustion engines shall be fitted with spark arrestors.

The Operator shall have an appropriate fire extinguisher(s) and fire fighting tools (shovel and axe at a minimum) present at all times when there is a risk of fire.

Vehicles shall not be parked in tall grass or any other location where heat from the exhaust system could ignite a fire.

The Operator shall follow any additional rules the landowner has for fire prevention.

HYDROLOGY AND WATER QUALITY

Work shall be conducted during the period of lowest flow.

If it is necessary to divert water around the work site, unimpeded bypass flows shall be maintained at all times to maintain downstream water quality.

When a dam (any artificial obstruction) is being constructed, maintained, or placed in operation, sufficient water shall at all times be allowed to pass downstream to maintain fishlife bellow the dam pursuant to Fish and Game Code Section 5837.

Debris, soil, silt, bark, rubbish, creosote-treated wood, raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any

other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil and/or entering the waters of the state. Any of these materials, placed within or where they may enter a stream or lake, by Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately.

Effective erosion control measures shall be in-place at all times during construction. Construction within the 5-year flood plain will not begin until all temporary erosion controls (e.g., straw bales or silt fences that are effectively keyed-in) are in-place down slope of project activities within the riparian area. Erosion control measures shall be maintained throughout the construction period.
Adequate erosion control supplies (gravel, straw bales, shovels, etc.) shall be kept at all restoration sites to ensure sediment is kept out of water bodies. Erosion control measures shall be utilized throughout all phases of operation where sediment runoff from exposed slopes threatens to enter waters of the State. At no time shall silt laden runoff be allowed to enter the stream or be placed where it may enter the stream.

Silty/turbid water from the excavation and/or project activities shall not be discharged into the stream, lake, or into storm drains. Such water shall be pumped into a holding facility or into a settling pond located in flat stable areas outside of the stream channel, or sprayed over a large area outside the stream channel to allow for natural filtration of sediments. At no time shall turbid water from the settling ponds be allowed to enter back into the stream channel until water is clear of silt.

Sediment shall be removed from sediment controls once it has reached one-third of the exposed height of the control. Whenever straw bales are used, they shall be staked and dug into the ground six (6) inches. Catch basins shall be maintained so that no more than six (6) inches of sediment depth accumulates within traps or sumps.

Sediment-laden water created by construction, washing or other activities or shall be filtered before it leaves the right-of-way or enters the stream network or an aquatic resource area. Silt fences or other detention methods shall be installed as close as possible to culvert outlets to reduce the amount of sediment entering aquatic systems.

Preparation shall be make so that runoff from steep, erodible surfaces will be diverted into stable areas with little erosion potential.

If continued erosion is likely to occur after construction is completed, then appropriate erosion prevention measures shall be implemented and maintained until erosion has subsided.

Upon project completion, all exposed soil present in and around the project site shall be stabilized within seven (7) days.

Work sites will be winterized at the end of each day when significant rains are forecast that may cause unfinished excavations to erode. Winterization procedures shall

supervised by a professional trained in erosion control techniques and involve taking necessary measures to minimize erosion on unfinished work surfaces. Winterization includes the following: smoothing unfinished surfaces to allow water to freely drain across them without concentration or ponding; compacting unfinished surfaces where concentrated runoff may flow with an excavator bucket or similar tool, to minimize surface erosion and the formation of rills; and installation of culverts, silt fences, and other erosion control devices where necessary to convey concentrated water across unfinished surfaces, and trap exposed sediment before it leave the work site.

Mulching and seeding using local native species mix is required on all exposed soil which may deliver sediment to a stream.

Poured concrete shall be excluded from the wetted channel for a period of two (2) weeks after it is poured. During that time the poured concrete shall be kept moist, and runoff shall not be allowed to enter a live stream. Commercial sealants (e.g. Deep Seal, Elasto-Deck BT Reservoir Grade) may be applied to the poured concrete surface where difficulty in excluding water flow for a long period may occur. If sealant is used, water shall be excluded from the site until the sealant is dry.

RIPARIAN VEGETATION

No more than 1/3 of any willow plant shall be harvested annually. Care shall be taken during harvest not to trample or over harvest the willow sources.

Planting of seedlings shall begin after December 1, or when sufficient rainfall has occurred to ensure the best chance of survival of the seedlings, but in no case after April 1.

Building materials and/or construction equipment shall not be stockpiled or stored where they could be washed into the water or where they will cover aquatic or riparian vegetation.

The contractor shall not dump any litter or construction debris within the riparian/stream zone. All such debris and waste shall be picked up daily and properly disposed of at an appropriate site. During all activities at project work sites, all trash that may attract predators shall be properly contained, removed from the work site, and disposed of regularly. Following construction, all trash and construction debris shall be removed from work areas.

The Operator shall retain as many trees and brush as feasible, emphasizing shade producing and bank stabilizing trees and brush.

The Operator shall ensure that the spread or introduction of invasive exotic plants shall be avoided to the maximum extent possible. When practicable, invasive exotic plants at the work site shall be removed.

Use project designs and access points that minimize riparian disturbance without affecting less stable areas, which may increase the risk of channel instability.

Minimize compaction by using equipment that either has (relative to other equipment available) less pressure per square inch on the ground or a greater reach, thus resulting in less compaction or less area overall compacted or disturbed.

At the completion of the project, soil compaction that is not an integral element of the design of a crossing should be de-compacted.

Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations.

Disturbed and compacted areas shall be revegetated with locally obtained native plant species. The species used should be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings should include both woody and herbaceous species). Plant at a ratio of two plantings to one removed plant.

Unless otherwise specified, the standard for success is 80 percent survival of plantings or 80 percent ground cover for broadcast planting of seed after a period of three (3) years. If at the end of three (3) years there is less than 80% survival, all dead plants shall be replaced.

RARE PLANTS

Prior to the commencement of work, the Operator will employ one or more of the following protective measures:

a) Fencing to prevent accidental disturbance of rare plants during construction,
b) On-site monitoring by a qualified biologist during construction to assure that rare plants are not disturbed, and
c) Redesign of proposed work to avoid disturbance of rare plants.

If it becomes impossible to implement the project at the work site without potentially significant impacts to rare plants, then activity at that work site will be discontinued.

APPENDIX F

Geotechnical Studies

This Page Intentionally Left Blank

FEASIBILITY GEOTECHNICAL INVESTIGATION
PROPOSED ECOSYSTEM PROTECTION BARRIER
AND
SCENIC ROAD PROTECTION STRUCTURE
MONTEREY COUNTY, CALIFORNIA

PROJECTS 2012.0133, 2012.0134

For
Whitson Engineers
9699 Blue Larkspur Lane, Suite 105
Monterey, California 93940

By

PACIFIC GEOTECHNICAL ENGINEERING
16055 Caputo Drive, Suite D
Morgan Hill, California 95037
(408) 778-2818

May 28, 2013

FEASIBILITY GEOTECHNICAL INVESTIGATION
PROPOSED ECOSYSTEM PROTECTION BARRIER
AND
SCENIC ROAD PROTECTION BARRIER
MONTEREY COUNTY, CALIFORNIA

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1 GENERAL 1
1.2 PROJECT DESCRIPTION 1
1.3 OBJECTIVE AND SCOPE OF INVESTIGATION 3
1.4 INFORMATION PROVIDED 4
2. SITE INVESTIGATION 5
2.1 GEOLOGIC RECONNAISSANCE AND MAPPING 5
2.2 SUBSURFACE EXPLORATION 5
2.2.1 Drill Holes 5
2.2.2 Cone Penetrometer Tests 6
2.3 LABORATORY TESTING 6
3. FINDINGS 7
3.1 GEOLOGIC SETTING 7
3.2 GEOHAZARDS MAPPING 8
3.3 EARTHQUAKE FAULTS AND SEISMICITY 8
3.4 PREVIOUS INVESTIGATIONS 9
3.5 SURFACE CONDITIONS 10
3.6 SUBSURFACE CONDITIONS 11
3.7 GEOLOGIC MODEL 14
3.8 GROUNDWATER 15
3.9 VARIATIONS IN SUBSURFACE CONDITIONS 15
3.10 TOP OF BEDROCK SURFACE 16
3.11 BATHYMETRY 16
4. DISCUSSION AND CONCLUSIONS 19
4.1 GENERAL 19
4.2 SURFACE RUPTURE AND SEISMIC GROUND SHAKING 19
4.3 LIQUEFACTION AND LATERAL SPREADING 19
4.4 SHEET PILE DRIVEABILITY 21
4.5 EXCAVATION AND DEWATERING 21
4.6 EXPANSION POTENTIAL OF NEAR-SURFACE SOILS 21
5. FEASIBILITY-LEVEL GEOTECHNICAL CONSIDERATIONS 22
5.1 FLOOD PROTECTION ALTERNATIVES 22
5.1.1 Flood Protection General Design Issues 22
5.1.2 Earthen Levee 22
5.1.3 Levee with Floodwall 23
5.1.4 Floodwall 23
5.1.5 Sheet Pile Floodwall 23
5.1.6 Vinyl Sheet Pile, FRP (Fiber Reinforced Polymer) Sheet Pile 24
5.1.7 Steel Sheet Pile 24
5.1.8 Cost Factors 25
5.1.9 FRP Sheet Pile Preliminary Cost Research 25
5.2 SCENIC ROAD PROTECTION STRUCTURE 26
5.2.1 Drilled Pier Considerations 27
5.2.2 Excavation Considerations 27
6.3 SCENIC ROAD PROTECTION STRUCTURE 31

6.3.1 Drilled Piers for Buried Secant/Tangent Pile Wall..... 32
7. DESIGN LEVEL GEOTECHNICAL INVESTIGATION..... 34
8. LIMITATIONS..... 35
9. REFERENCES..... 36

Figure 1 – Geologic Index Map

Figure 2 - Regional Fault Map

Figure 3 - Site Geologic Map

Figure 4 - Scenic Road Protection Structure
- Location of Subsurface Data Points and Cross-Sections

Figure 5 - Scenic Road Protection Structure
- Geologic Cross-Section Station 9+00

Figure 6 - Scenic Road Protection Structure
- Geologic Cross-Section Station 12+50

Figure 7 - Scenic Road Protection Structure
- Conceptual Approaches

Appendix A - SUBSURFACE EXPLORATION
Keys to Soil Classification (Fine and Coarse Grained Soils)
Log of Exploratory Drill Holes (DH-1 through DH-4)

Appendix B - CONE PENETROMETER TEST RESULTS (CPT-1 through CPT-3)

Appendix C - LABORATORY TEST RESULTS (Figures C-1 through C-17)

Appendix D - SUBSURFACE DATA FROM PREVIOUS INVESTIGATIONS

Appendix E - ADDITIONAL REFERENCE MATERIAL
- FEMA Fact Sheet: Levee Certification vs. Accreditation

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
PROPOSED CARMEL RIVER LAGOON ECOSYSTEM PROTECTION BARRIER
AND
SCENIC ROAD PROTECTION STRUCTURE
MONTEREY COUNTY, CALIFORNIA

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our feasibility-level geotechnical investigation for a proposed Ecosystem Protection Barrier (EPB in this report) and proposed Scenic Road Protection Structure (SRPS) at the mouth of the Carmel River, in Monterey County, California. The location of the project is shown on our Geologic Index Map (Figure 1), and features in the project vicinity are shown on the Site Geologic Map (Figure 3) of this report.

This report presents our conclusions and geotechnical recommendations for evaluation of geotechnical feasibility of the project and conceptual design approaches. The feasibility-level conclusions and recommendations are based on subsurface information we collected during this investigation and information from past investigations performed by other parties in the vicinity of the project area. Final design of the project will require supplemental investigation(s) once a specific project is defined.

1.2 PROJECT DESCRIPTION

As outlined in the Draft Memorandum of Understanding (MOU) between the County of Monterey, U.S. Army Corps of Engineers (USACE) and National Marine Fisheries Service (NMFS) dated September 21, 2012, a “Lagoon Project” is desired by all parties in order “to avoid mechanically managing the Carmel Lagoon.” The Lagoon Project is envisioned as consisting of project(s) that have the “coequal objectives of protecting developed properties from flood impacts while also improving environmental conditions in the Lower Carmel River and Lagoon.” One component of this is an Ecosystem Protection Barrier (EPB in this report), and a second component is a Scenic Road Protection Structure (“Bluff Armoring” in the MOU, and SRPS in this report).

The County’s desire, as expressed in Section 5.3 of the Request for Proposals, is to assess whether a proposed EPB flood wall could reduce or eliminate the necessity for mechanical management/breaching of the seasonal barrier beach that forms at the mouth of the Carmel River.

A tandem desire is to mitigate the erosive effects of the high flows that accompany the breaching of the seasonal berm, when the flow is directed northward around the bight of Stewart’s Cove. In past years, erosion has removed the seasonal beach from the water side of Scenic Road, reducing support for the road, surface drainage elements, protected cypress trees, and beach access steps.

Ecosystem Protection Barrier (EPB): The proposed EPB as currently envisioned (as provided in the Request for Proposals) would be constructed approximately along the property lines separating California State Parks land from adjacent (to the north) private properties. The terminations of the EPB necessarily must be at a point where the ground surface is at or above

the design lagoon surface elevation. The western termination of the EPB would thus be either near the intersection of Carmelo Street and 17th Avenue; or at a subtle topographic high point east of Carmelo Street and several tens of feet north of the Carmel River State Beach parking lot. Two options for the eastern EPB termination were proposed in the Carmel Lagoon Ecosystem Protective Barrier map by Monterey County Water Resources Agency (MCWRA), dated 12/5/2011. These are for the EPB to: a) turn northward and pass between Carmel River Elementary School and private property, ending on/at Carmel River Elementary School property near the end of 16th Street; or b) continue eastward past the school grounds and terminate against an existing topographic high point south of Mission Ranch.

The flood protection objective of the EPB is to reduce the potential for flooding of developed residential areas on the landward side of the EPB. We understand that two top of wall elevations are under consideration: 16' NAVD88, and 19' NAVD88 (all elevations in this report are NAVD88 unless otherwise stated). The 16' NAVD88 top-of-wall would be for a non-FEMA-compliant wall, and the 19' NAVDD wall would be for a FEMA-compliant wall that incorporates 3 feet of freeboard (these elevations are subject to verification by hydrologic analyses). The lowest-elevation ground surface along the EPB alignment is approximately 7 feet.

We understand that Monterey County Water Resources Agency (MCWRA) and Monterey County Department of Public Works (MCDPW) in particular wish to consider the use of sheet pile for construction of the EPB.

Scenic Road Protection Structure (SRPS): The proposed SRPS as currently envisioned is intended to help preserve existing bank support for Scenic Road, against the erosive effects of the Carmel River when the laterally-migrating channel mouth on occasion swings northward toward Stewart's Cove,. The SRPS is not envisioned at this time to provide protection from open-ocean swell attack. The elevation of the top of the SRPS therefore would only need to address the design water surface elevation just before natural breaching of the seasonal beach barrier.

The SRPS as preliminarily envisioned would approximately parallel the outboard shoulder of Scenic Road, from near the northern end of Stewart's Cove, southward to near the southern tip of the State Beach parking lot.

The transition between the EPB and SRPS as currently envisioned would be located near the Carmel River State Beach parking lot, where the transition from lagoon to coastal setting occurs. The SRPS has been variously proposed to skirt the southern edge of the Carmel River State Beach parking lot, or terminate against the edge-of-road prism near the existing restrooms.

Preliminary designs provided by Moffatt & Nichol include several alternatives for the SRPS; these are elaborated on in their report. A basic component of some of these alternatives is a cantilevered pile wall with a grade beam connecting the tops of the piles and a fill slope behind the wall. The top of grade beam will be at approximate elevation 12 feet. The slopes behind the wall will have a 2:1 (horizontal:vertical) to 2½:1 inclination. The piles are anticipated to have a diameter of 3 to 5 feet and be constructed as a secant or tangent pile wall.

A second variant of this pile wall component would incorporate tiebacks at the grade beam, in order to provide additional lateral support to the pile wall. The spacing and length of the tiebacks have not been determined yet.

A second basic component of SRPS alternatives consists of an armor rock (rip-rap) system with a self-launching toe. As currently conceived, the toe of the slope (key) would be at approximate elevation 0.0, or higher if rock is encountered above this elevation. The armor rock would extend up a 2:1 to 2½:1 (h:v) slope towards Scenic Road to about elevation 15 feet, and about 8 to 10 feet towards the ocean. The armor rock layer would be about 5 feet thick with 1-ton (approximately 30-inch-diameter) rocks. A separation fabric would be placed against the bottom/back of the excavation before placement of the rock. Top-of wall and top-of-riprap slope elevations are governed by modeled water surface elevations, which drop from the Lagoon to the ocean.

1.3 OBJECTIVE AND SCOPE OF INVESTIGATION

The overall objective of this feasibility-level investigation was to explore subsurface conditions in the project areas; provide geotechnical information to assist in the evaluation of whether an ecosystem protection barrier and an erosion protection structure appear to be geotechnically feasible; and to identify geotechnical considerations that may affect design concepts under consideration. These geotechnical considerations necessarily are only a subset of considerations that include hydrologic, environmental, planning/development policy. The prime consultant for the overall evaluation is Whitson Engineers. Other team-members include Balance Hydrologics, Inc. (hydrologic aspects); Moffat & Nichol (coastal engineering aspects); and H.T. Harvey & Associates (environmental aspects) and.

The following combined scope of services was performed for our investigation for the EPB and SRPS.

1. Reconnoitering of the project areas to perform independent geologic mapping and refine existing geologic mapping; observe surface conditions; and mark locations of our subsurface exploration.

2. Obtaining encroachment permits from Monterey County, and permission from California State Parks for our field exploration.

3. Coordination of our drilling with Underground Service Alert, County of Monterey, and California State Parks; and development of traffic/pedestrian access control procedures in coordination with County of Monterey and State Parks.

4. Research of existing geotechnical information in files of Monterey County that are pertinent to the project. Research also included information on topography, bathymetry, and anecdotal records of recent changes in beach character in the Stewart's Cove area.

5. Research with sheet pile manufacturers regarding geotechnical considerations, and geotechnical information needed for design and cost estimation, for the EPB sheet pile wall.

6. Exploration, sampling and classification of subsurface soils at selected locations by means of four exploratory drill holes and three Cone Penetrometer Test (CPT) probes.

7. Laboratory testing of selected soil samples recovered from our drill holes.

8. Engineering analysis of the field and laboratory data to formulate preliminary conclusions and recommendations for the project.

9. Preparation of this report summarizing our findings, feasibility-level conclusions and recommendations.

In order to make most effective use of available funding, the EPB and SCPS were proposed and performed jointly, and this report presents the results of this tandem investigation. Project costs (e.g. subsurface exploration costs) were tracked separately.

1.4 INFORMATION PROVIDED

For this investigation, the following was provided to us and used during our study. We greatly appreciate assistance by agency personnel (in particular Monterey County Dept. of Public Works, Monterey County Water Resources Agency, California State Parks, Carmel Unified School District) and team members in locating pertinent information.

- Map of Carmel Lagoon Ecosystem Protective Barrier, prepared by Monterey County Water Resources Agency, rev. 12/5/11.
- Numerous documents collected by Monterey County Department of Public Works, and made available to the project team. For our geotechnically-focused purposes, the relevant documents consisted mainly of previous geologic/geotechnical, hydrologic, geophysical reports; historic photographs of [Stewart Cove] beach conditions; and newspaper accounts of storms and beach erosion;
- Base map in CAD format, provided by Whitson Engineers via .dwg file dated 11/9/12.

2. SITE INVESTIGATION

2.1 GEOLOGIC RECONNAISSANCE AND MAPPING

Our geologic mapping included data gathering and compilation; independent analysis of aerial imagery; and field mapping to refine geologic linework.

Our compilation included previous published and unpublished geologic mapping that encompasses the lower Carmel River area and adjacent Stewart's Cove area. We modified and supplemented this mapping based on the more-detailed topographic base maps generated for this project. Review of subsurface data from this investigation and previous investigations also permitted a better three-dimensional understanding of the primary geologic materials present.

2.2 SUBSURFACE EXPLORATION

The subsurface exploration program included four drill holes (DH-1 through DH-4) and three CPT probes (CPT-1 through CPT-3). The drill holes and CPT probes were located in the field by referencing to existing site features and pacing; therefore, their locations should be considered approximate. The approximate locations of the drill holes and CPT probes are shown on Figures 3 and 4. The drill holes were backfilled with soil cuttings except for the upper roughly 5 feet which were backfilled with cement grout. The CPT probes were backfilled with cement grout.

2.2.1 Drill Holes

Drill holes DH-1 through DH-4 were advanced on November 4 and 5, 2012, to depths of 63, 58½, 46, and 50 feet (respectively) below the ground surface using a Mobile B-61 drilling rig equipped with an 8-inch diameter hollow stem auger. During drilling, an attempt was made to keep the hollow drill stem charged with water in order to maintain a hydrologic head on the sandy soil at the bottom of the drill string.

The four drill holes were located at the nearest approach of the existing street network to the proposed EPB alignment (see Figure 3): at the eastern end of 16th Avenue next to Carmel River Elementary School; the southern end of River Park Place at the lagoon margin; the southern end of El Camino Real at the lagoon margin; and the eastern shoulder of Carmelo Street at the lagoon margin.

In the field, our personnel visually classified the materials encountered in the drill holes and maintained a log of each drill hole. Samples were obtained from the drill holes by driving a 2½-inch inside diameter split spoon or a 2-inch outside diameter (1⅜ inch inside diameter) Standard Penetration Test (SPT) sampler up to a depth of 18 inches into the earth material using a 140-pound hammer falling 30 inches. The number of blows required to drive the samplers was recorded for each 6-inch penetration interval. The number of blows required to drive the sampler the last 12 inches, or the penetration interval indicated on the log where harder material was encountered, was shown as blows per foot on the drill hole logs. The hammer was operated by a hydraulic winch and pulley system.

Soil samples were collected from the drill holes at about 5-foot vertical intervals. Soil samples were sealed in the field and transported to our laboratory for further evaluation and testing. Visual classification of soils encountered in our drill holes was made in general accordance with

the Unified Soil Classification System (ASTM D2487 and D2488). The laboratory test results were used to refine our field classifications. Two Keys to Soil Classification, one for fine grained soils and one for coarse grained soils, are included in Appendix A together with the logs of the drill holes.

2.2.2 Cone Penetrometer Tests

CPT-1 through CPT-3 were performed by John Sarmiento & Associates on October 24, 2012, to depths of 70, 27½, and 30½ feet, respectively. The three CPT probes were located at: the southern tip of pavement in the Carmel River State Beach parking lot; the outboard edge-of-pavement near the intersection of Scenic Road and 17th Avenue; the outboard edge-of-pavement along Scenic Road approximately midway between 17th Avenue and the Carmel River State Beach parking lot.

CPT involves pushing a small diameter (10 cm^2 cross-sectional area) steel probe into the ground using a hydraulic jack attached to a truck mounted rig. The tip of the probe is instrumented and takes almost continuous measurements (roughly every 1 inch) of tip resistance, side friction resistance, and pore pressure. The CPT data and typical interpreted soil properties, presented at about 6-inch depth intervals, are included in Appendix B and include the following:

Symbol	Explanation
Qc	Tip bearing resistance
Qc'	Tip bearing resistance normalized for overburden
Fs	Sleeve friction resistance
Rf	Tip/sleeve friction Ratio
SPT (N)	Equivalent standard penetration blow count
SPT' (N')	Corrected equivalent standard penetration blow count
EffVtStr	Estimated effective overburden stress
PHI	Interpreted internal friction angle
Su	Interpreted undrained shear strength
Soil Behavior type	Interpreted soil behavior type
Density Range	Estimated range of total soil density

2.3 LABORATORY TESTING

Laboratory tests were performed on selected soil samples. These tests included water content, dry density, Atterberg limits, grain size analysis, and percent passing a No. 200 sieve. The laboratory test results are presented on the drill hole logs at the corresponding sample depths. The results of the Atterberg Limits and grain size analysis tests are presented as Figures C-1 through C-17 in Appendix C.

3. FINDINGS

3.1 GEOLOGIC SETTING

Regional geologic mapping by Clark, Dupre and Rosenberg (1997; Clark and others hereafter for brevity) provides the best available regional-scale geologic mapping for the project area. The local geology as depicted on Figure 3 (Geologic Site Plan) incorporates the basic framework geology of Clark and others (1997), modified based on geomorphic expression and best-fit to the detailed topographic base map, and on analysis of subsurface data from various exploratory borings (ours and those of others).

The geology of the site vicinity is dominated by two factors: offset across the Cypress Point fault, and alluvial sediments of the Carmel River.

As mapped by Clark and others (1997), the Cypress Point fault is a northwest-trending normal fault that skirts and parallels the elevated ridge of ground between Scenic Road and Carmelo Street; the fault is mapped just east of and parallel to Carmelo Road. In the project vicinity, this fault is entirely concealed by sediment, and is inferred on the basis of different bedrock types east and west of the fault. The dominant rock type west of the fault (underlying Abalone Point and Stewart's Cove) is granitic ("porphyritic granodiorite of Monterey;" map unit Kgdp). The dominant rock type east of the fault is much younger basaltic andesite (map unit Tvb). Although the fault is mapped as a single strand, it may be a more complex fault zone involving en echelon steps or anastomosing strands. This may have resulted in some differential offset of the top-of-bedrock surface.

The Cypress Point fault has experienced east-side-down relative offset of approximately 90 feet (Staal, Gardner and Dunne, 1989b). The Cypress Point fault is not considered to be active (generally defined as having experienced offset in Holocene time, or the last 11,000 years; California Geological Survey, 2010; Clark, 1989 [letter to Staal, Gardner & Dunne, in SGD, 1989b]; Clark and others, 1997; Rosenberg, 2001).

Coastal terrace deposits are deposited across wave-cut platforms that have undergone subsequent uplift. Sediments on these terraces are described as generally "semiconsolidated, moderately well sorted marine sand containing thin, discontinuous gravel-rich layers." Thickness of these deposits is variable, but typically less than about 20 feet (6 m). The coastal terrace in the Scenic Road Protection structure vicinity (map unit Qct) is mapped by Clark and others as the "Lighthouse terrace," and is probably about 124 ka in age.

Younger (Pleistocene and Holocene) coastal dunes (map unit Qd1 and Qd2) locally lap across and overlie the coastal terrace deposits in the SRPS vicinity. Dune deposits consist of "unconsolidated, well-sorted, fine- to medium-grained sand" locally up to about 75 feet thick.

Beach sand (mapped with coastal dune deposits as map unit Qd1 and Qd2) is mapped along the shore of Stewart's Cove, and makes up the seasonal barrier across the mouth of the Carmel River. Texturally, beach sand is typically "unconsolidated, well-sorted, medium- to coarse-grained sand with local layers of pebbles and cobbles…and thin discontinuous lenses of silt … in back-beach areas."

Flood-plain deposits occur to the north and south of the Carmel River. The oldest of these flood-plain deposits (map unit Qt) is mapped along a swath a few hundred feet north of, and

roughly paralleling, the EPB. Texturally, these sediments consist of "unconsolidated, relatively fine-grained, heterogeneous deposits of sand and silt commonly including relatively thin layers of clay." Inset into these older flood-plain deposits are younger flood-plain deposits (map unit Qof?), which generally underlie the proposed EPB alignment. Texturally, these are very similar to older flood-plain deposits, with variable gravel content. These younger flood-plain deposits are generally less than about 20 feet (6 m) thick.

Basin deposits (map unit Qb) are mapped in the area of the Lagoon. Basin deposits are described as "unconsolidated, plastic clay and silty clay containing much organic material, and locally contain[ing] interbedded thin layers of silt and silty sand."

Earth fill (map unit Ef) is present in many more localities than is shown on Figure 3 (for clarity reasons). Developed and graded sites typically have discontinuous fill deposits, particularly at the outboard edges of graded pads on sloping ground, and the outboard shoulders of roads on sloping ground. The southern extent of fill at the interface between developed properties and State Parks land could strongly affect the ease with which any sort of driven floodwall can constructed, especially if fill contains rubble or larger clasts.

The outboard edge of Scenic Road currently has a sloping sandy ramp that descends to the beach. We understand from Monterey County Deptment of Public Works personnel that this ramp is underlain by a prism of rip-rap.

Rosenberg (2001) compiled previous and independent geologic mapping for Monterey County that incorporated the geologic mapping of Clark and others (1997), of which he was a co-author. The linework of this compilation is more generalized than that of Clark and others, due to map scale.

Wagner and others (2002) prepared a regional geologic compilation map that encompasses the site, also at a more generalized scale than that of Clark and others.

3.2 GEOHAZARDS MAPPING

Rosenberg (2001) prepared a County-wide map of liquefaction susceptibility, as a derivative map associated with the geologic mapping described above. While this map is necessarily generalized, it maps the Holocene alluvium as having a "high" liquefaction susceptibility, while older (Pleistocene) alluvium has a "moderate" liquefaction susceptibility. Bedrock and upland areas are mapped as having a "low" liquefaction susceptibility. There are no known historic liquefaction sites from the 1906 and 1989 earthquakes.

3.3 EARTHQUAKE FAULTS AND SEISMICITY

As described above, the project vicinity is transected by the Cypress Point fault, which is not considered active.

The greater San Francisco/Monterey Bay Area is seismically dominated by the active San Andreas Fault system, the tectonic boundary between the northward moving Pacific Plate (west of the fault) and the North American Plate (east of the fault). This movement is distributed across a complex system of generally strike-slip, right-lateral, subparallel faults (see Regional Fault Map, Fig. 2).

Regional faults that have a potential to generate large magnitude earthquakes and significant ground shaking at the site are listed below, and selected faults are described in detail in Appendix D of this report. Map distances are derived from the USGS Quaternary Fault and Fold database (http://earthquake.usgs.gov/regional/qfaults/; ref. Fig. 2).

Fault	Approximate Distance	Direction from Project Site to Fault
Monterey Bay/Tularcitos	4.6 mi (7.5 km)	Northeast
Reliz	11.7 mi (18.9 km)	Northeast
Zayante-Vergeles	26 mi (42 km)	Northeast
San Andreas	30 mi (49 km)	Northeast
Sargent	34 mi (55 km)	Northeast
Calaveras	35 mi (57 km)	Northeast
Ortigalita	56 mi (90 km)	Northeast
Hayward	63 mi (102 km)	North

Ground motion parameters for design of buildings and other structures, based on current practices, are taken as the lesser value developed from probabilistic and deterministic approaches. Using the U.S. Seismic "Design Map" Web Application (accessible at the USGS web site), the latitudes and longitudes of the project area, and a Site Class D, the calculated peak ground acceleration (PGA) value is 0.45g for the Design Earthquake (DE). This PGA value is equivalent to $S_{DS}/2.5$. A Site Class D was selected based on subsurface materials encountered in our borings and CPTs, and the criteria in Table 1613A.5.2 of the 2007 CBC. For sites in the San Francisco Bay Area, the DE roughly corresponds to a PGA with a 10% probability of exceedance in a 50-year period (WGCEP, 2008).

The site would normally be Site Class F because it is underlain by potentially liquefiable soils. Site Class F would require that a site-specific ground response analysis be performed. However, if the fundamental period of vibration of the proposed structures is equal to or less than 0.5 second, a site-response analysis is not required and the site class can be determined by assuming there is no liquefaction (ASCE 7-05 Section 20.3.1). Assuming the foundation period of the structures is 0.5 second or less, Site Class D was selected for the project. The fundamental period of vibration of the proposed structures should be verified by the structural engineer during the subsequent design phase.

The combined probability of large earthquakes occurring on one of the active faults in the area has been estimated by the Working Group on California Earthquake Probabilities (1990, 1999, 2003, 2008), with probabilities refined through several iterations. The greatest changes have been in the treatment of fault segments, rupture scenarios, and in the progressive consideration of more potential seismic sources. Current estimates (WGCEP, 2003, 2008) suggest that there is a 62% probability of a large magnitude (6.7 or greater) earthquake in the San Francisco Bay Region as a whole in the 30-year period ending in 2031.

3.4 PREVIOUS INVESTIGATIONS

We assembled available subsurface geotechnical information garnered from County of Monterey files, and from unpublished files of consultants.

Geotechnical borings of particular relevance are reviewed below in the "Subsurface Conditions" section. In general, these are investigations performed for residential, commercial or other development, and thus nearly all of the data points lie on the landward (northern) side of the EPB alignment, and on the landward (eastern) side of SRPS.

In order to develop regional context and trends regarding subsurface conditions, we also assembled available information from nearby projects along the lower Carmel River. We were unable to obtain geotechnical boring logs for exploration performed at the Carmel Area Water Treatment Plant. .

3.5 SURFACE CONDITIONS

Along most of its length, the EPB as currently conceived (see Figure 3) would approximate the southern property lines of private properties fronting on the lagoon. Under Alternative 1 (see Fig. 3), the alignment would closely parallel those property lines. Under Alternative 2, the alignment would follow a slightly more generalized path set slightly southward (toward the Lagoon) of those property lines. West of Camino Real, near Carmelo Street and south to the State Park Beach, there are no residences between Carmelo Street and the lagoon, and the EPB would be sited as close to Carmelo Street as practical. The eastern terminations of both alternatives currently under consideration would lie at the northeastern corner of the Carmel River Elementary School recreational fields.

For purposes of this evaluation, property corners and property lines were not marked in the field. Where the EPB approximates the southern property lines of private properties fronting on the marsh, the limit of developed properties is generally characterized by relatively level rear yards, then a short fill slope that descends 3 to 4 feet to the lagoon/marsh ground surface.

The southern ends of Monte Verde Street, River Park Place, and Camino Real all appear to have fill associated with road construction, with subsequent vegetation overgrowth. Based on surface topography, we estimate that this fill is approximately 3 feet in thickness, and texturally resembles the underlying alluvium.

The outboard (eastern) edge of Carmelo Street consists of a fill prism that descends to lagoon/marsh grade. The southern tip of Carmelo Street transitions to a graded parking lot area; the extent of fill is unclear but the area is much modified.

As originally conceived, the transition from EPB to SRPS would occur at the outer (southern) tip of the State Beach parking lot. More recent refinements based on more detailed topography show the SRPS terminating near the southern tip of the State Beach parking lot. The western end of the EPB would be at a topographic knob into which Carmelo Street and the entrance to the State Beach parking lot are cut.

The SRPS southern end would be at the southern tip of the parking lot toward Scenic Road. From south to north, the SRPS would skirt the western side of the parking lot, then traverse the back beach, roughly paralleling Scenic Road, and ending approximately at Valley View Street, subject to hydrologic analyses. Alignment variations are presented in Moffat & Nichols' report. The road shoulder along Scenic Road is generally discontinuously covered with grasses and iceplant. There are at least two Monterey Cypress trees along this segment. Beachfront access steps descend to the beach from Scenic Road at approximately the 17th Avenue/Scenic Road intersection. Culverts discharge at the base of the bluff at various points along Scenic Road.

3.6 SUBSURFACE CONDITIONS

A brief description of the materials encountered in each boring and CPT probe is presented below, *in an east-to-west progression*, thus: DH-2; DH-3; DH-4; DH-1; CPT-1; CPT-3; CPT2. For a more detailed description of the soil conditions encountered in our drill holes and CPT probes, refer to the drill hole logs in Appendix A and the CPT results in Appendix B.

In order to facilitate evaluation of regional trends in subsurface conditions, we have included within this sequence a summary of geotechnical conditions encountered at selected nearby previous investigations.

The locations of all subsurface data points are shown on Figure 3, with detail provided for the Scenic Road area on Figure 4. The location accuracy of these borings varies widely, since the base maps used in their respective reports varies widely in quality and detail. In a general progression from eastern termination of the EPB to the northwestern termination of the SRPS, the most pertinent data points include:

Several borings were drilled in the western part of the Carmel River Elementary School property by three investigations (Kleinfelder, 2011; Grice, 2007B; Grice, 2008A). These borings in general fall slightly west of, and north of, the proposed EPB termination. Of these investigations, the highest quality data comes from the Kleinfelder borings. Kleinfelder's boring B-1 (**KB-1** on Figure 3) is typical. KB-1 encountered interbedded silty sand with gravel (SM), well-graded sand with silt and gravel (SW-SM), clayey sand with gravel (SC), and lean clay (CL) to a depth of 18.5 feet. Below 18.5 feet, generally coarser materials with less fines content were encountered: 5 feet of well-graded sand with silt (SW-SM), poorly graded sand with silt (SP-SM), silty sand (SM), and well-graded sand with clay and gravel (SW-SC). Total depth was 50 feet, with groundwater interpreted at a depth of 12 feet.

DH-2 (this investigation) encountered alluvium within its maximum explored depth of roughly 58½ feet. The surficial soil is a 3-foot thick layer of loose to medium dense sandy silt. This soil is underlain by layers of medium dense to very dense clayey sand (SC) to a depth of about 22 feet, medium dense to dense well graded sand to a depth of about 32½ feet, and dense to very dense clayey sand to the bottom of the hole. The sands are generally granitic with granitic clasts. Below a depth of about 40 feet, gravels and cobbles were reported together with harder drilling, as in DH-1. The drill hole was terminated due to refusal to sample driving, apparently on cobbles.

Groundwater was first encountered at a depth of about 16 feet bgs at the time of drilling. The groundwater level in the boring rose to a depth of about 3.7 feet bgs,, inferred to reflect seepage from the adjacent grassy school playfields.

Borings by Grice (2008B) were located on the order of 300+ feet north of the EPB alignment, and thus generally more landward in character. Although little detail is provided, these three borings (**GB 2008-B1, -B2, and -B3**) reported silt and dense sand (SW) with few granitic gravel clasts. The proportion of coarse gravel and cobbles appears to increase below a depth of about 15 feet. Maximum depth explored was 24 feet, with groundwater reported at a depth of approximately 4.2 feet.

DH-4 (this investigation) encountered alluvium within its maximum explored depth of 50 feet bgs. The surficial soil is a layer of soft sandy lean clay to sandy silt to a depth of about 5½ feet. This soil is underlain by clayey sand to a depth of about 17 feet, which is loose to a depth of about 13 feet and dense between depths of 13 and 17 feet. This sand is underlain by very stiff to hard lean clay to silt with sand to a depth of about 21½ feet, medium dense poorly graded sand and clayey sand to a depth of about 28½ feet, stiff elastic silt/organic silt/fat clay to a depth of about 32½ feet, and dense to very dense clayey sands to the bottom of the hole. Gravels and cobbles were reported in the drill hole log as shallow as 13½ feet, but more predominantly below a depth of 42 feet. The drill hole was terminated because of refusal to drilling on cobbles or boulders. Groundwater was reported at a depth of about 17 feet at the time of drilling and at completion of drilling.

Two borings by Pacific Crest (2008) were drilled on the order of 200 feet north of the EPB alignment. These borings (**PCB-1 and -2** on Figure 3) encountered variable loose to medium dense clayey sand (SC) and clayey sandy gravel (GP) to a depth of 14 feet. At 14 feet, a 5.5-foot interval of stiff clay (CI) or silt (MI and OI) was encountered. Below 19.5 feet, an 11.5-foot interval of medium dense clayey sand (SC) was encountered, with the sand being generally coarse; scattered gravel clasts are reported. At 31 feet in PCB-1, weathered, decomposed granite was described, and the hole was terminated at 31.5 feet. Groundwater was reported at a depth of 6 feet. In PCB-2, however, below 29.5 feet, no bedrock was reported. Instead, hard sandy clay (CL) with scattered gravels, very stiff sandy silt (ML), and very dense silty gravel (GM) were noted. Total depth of PCB-2 was 48½ feet. Groundwater was encountered at 10 feet depth, stabilizing at about 5.8 feet.

DH-3 (this investigation) encountered alluvium throughout its maximum explored depth of about 46 feet bgs. The upper soil is clayey sand to a depth of about 17½ feet. The upper roughly 8 feet of this sand is loose and the lower portion of the sand is medium dense to dense. This clayey sand is underlain by stiff lean clay with sand to a depth of about 21½ feet, medium dense silt and sandy silt to a depth of about 29 feet, medium dense to dense well graded sand with silt to a depth of about 34 feet, stiff peat/elastic silt/organic silt to a depth of about 39 feet, hard sandy clay to a depth of about 42 feet, and very dense clayey sand with gravel to the bottom of the hole. The drill hole was reported to be grinding on gravels/cobbles and encountered sampling refusal to a depth of about 46 feet. Groundwater was interpreted at a depth of about 6.9 feet at the time of drilling.

DH-1 (this investigation) encountered granular alluvium within its maximum explored depth of about 62½ feet bgs. These include approximately 7½ feet of loose silty sand (SM) interpreted as terrace deposits; 10 feet of loose dune sand (SM); 9½ feet of loose to medium clayey sand (SC); 15½ feet of medium dense silty or clayey sands (SC/SM), interpreted as alluvial floodplain deposits. Between a depth of about 42½ feet and the bottom of the hole, the sand and gravel soils become very dense with much harder drilling reported. The hole was terminated with essential refusal to sample driving. Groundwater was reported at approximately 8 feet bgs at the time of drilling.

TH-6 is described in Staal, Gardner, and Dunne (1989b), although the precise location is unclear from the scale of map on which it plotted. We infer that it was drilled along the outboard edge of Carmelo Street, north of the State Beach parking lot. TH-6 encountered 15 feet of loose beach sand (SW), overlying basalt (volcanic) bedrock. No groundwater was reportedly encountered. TH-6, by encountering basaltic bedrock at a shallow depth, appears to constrain the Cypress Point fault to a position west of the boring.

CPT-1 (this investigation) is close to the envisioned transition between the EPB (to the east) and SRPS (to the west). The interpreted soil behavior type consists generally of sand, silty sand, sandy silt to the maximum explored depth of about 70 feet bgs. The sands are generally medium dense to dense. Below a depth of about 50 feet, some of the material was interpreted to behave as gravelly sand to sand. Groundwater was reported at a depth of about 8.3 bgs. CPT-1 is interpreted to lie on the northern flank of the buried top-of-bedrock channel (paleochannel) linking the Lagoon with the ocean.

MW-1 was drilled by Staal, Gardner, and Dunne (1989b) for a hydrogeologic study, hence no blow counts or geotechnical data are reported. Their log describes 8 feet of loose beach sand (SW), overlying fine- to coarse-grained sand ("alluvium") with fine granitic gravel (SW). Notes indicate that materials near the 35 – 40 depth (and below?) are "predominantly coarse-grained, common fine subrounded to subangular granitic gravel." Near depths of 55 – 60 feet, "moderately well-graded, fine- to coarse-, with abundant fine-grained material…" is described. Silty clay lenses are reported near 73 feet depth, and coarser grained sand at 85 feet. Refusal on granite is described at a depth of 89 feet. The precise location of MW-1 is unclear from the scale of the map on which it is plotted, but it is likely quite close to CPT-1 of this investigation.

Hydro-Search (1981) drilled borings in the general area of the transition between the EPB and Scenic Road Protection structure for a hydrologic study at the mouth of the Carmel River. The aim of their study was to grossly characterize subsurface materials, determine the top of bedrock across the buried channel axis of the Carmel River, and identify the freshwater-seawater interface. As with MW-1, the locations of Hydro-Search's borings are unclear from details of their site plan. Distances from an unknown agency's survey benchmark can be scaled off of the site plan, however, the location of the benchmark is not clear. Borings **HCB-3, -4', and -4** (shown on Fig. 3; these are labeled CB-3, CB-4' and CB-4 in Hydro-Search's original report) are located on the order of 150 – 350 feet south of this transition, and south of CPT-1. **HCB-2** is located west-northwest of CPT-1 and likely southwest of the existing State Park Beach parking lot pavement. **HCB-1 and –1'** are located >300 feet farther northwest, and therefore appear to have been drilled from the beach.

Hydro-Search infers that their boring **HCB-3** lies at approximately the paleochannel axis (thalweg) of the Carmel River. We infer that HCB-3 is located probably about 150 feet south-southwest of CPT-1. The log for HCB-3 describes interbedded fine to coarse sand, silty sand, clayey/silty sand, and silty sand to a depth of approximately 100 feet. Several intervals of caving are described, suggesting intervals lacking in fines content. Below 100 feet to the total depth of 150 feet, recovery is problematic, and Hydro-Search (tentatively) infers that sheared or decomposed rock is present from about 100 feet depth to the total depth explored of 150 feet.

Hydro-Search infers that their boring **HCB-2** lies north of the paleochannel axis of the Carmel River. The log for HCB-2 describes interbedded fine to coarse sand, silty sand, clayey/silty sand, and silty sand with minor clay lenses to a depth of 79 feet. Caving is reported at 35 feet, suggesting an interval lacking in fines content. Bedrock is reported at 79 feet. Total depth explored is 95 feet.

Hydro-Search infers that their boring **HCB-1** lies near the northern limit of the paleochannel of the Carmel River. The log for HCB-1 describes fine silty sand to coarse sand to a depth of 19 feet, at which depth granodiorite was encountered. Total depth is 23 feet. Since the location and starting elevation of the boring is unclear, the findings are difficult to interpret. Based on findings from our CPT-2 and CPT-3, boring HCB-1 may be outside the channel, and instead located on the wave-cut platform.

CPT-3 (this investigation) encountered soils behaving generally of clayey silt to silty clay to a depth of about 4½ feet; and sand, silty sand, sandy silt and gravelly sand within the maximum explored depth of about 30½ feet bgs. The silty clay and clayey silt are generally very stiff. The sands are generally loose to dense. Below about 20½ feet, the tip resistance increased significantly and the CPT met refusal at about 30½ feet. At approximately 26 feet, the gravelly sand was interpreted to represent the basal lag deposit on the wave-cut platform. The CPT probe could be heard to split weathered cobbles as it advanced from there to the total depth of 30.5 feet. Groundwater was reported at a depth of about 8.2 feet bgs.

CPT-2 (this investigation) encountered soils behaving generally as sand, silty sand, and clayey sand within the maximum explored depth of about 27½ feet bgs. The sands are generally medium dense to dense. Below about 25½ feet, the tip resistance increased significantly and the CPT met refusal at about 27½ feet. The lowermost 2 feet of the probed interval is inferred to represent the basal lag deposit on a wave-cut platform. Groundwater was reported at a depth of about 11 bgs.

Landward of Scenic Road, borings on residential properties (Landset 2009B; Earth Systems Consultants, 2010; see Fig. 3) provide generally shallow information that may not be relevant, given the significant top-of-bedrock slope that likely mimics the modern ridge between Scenic Road and Carmelo Street. The quality of data from this area varies widely. ESC (2010) drilled borings east of CPT-2. **ESC-B1 and –B2** indicate that silty sand "terrace deposits" extend to at least 16 feet depth. **LS-2009-B1 –B5** indicate that loose (modern) dune sand extends to 15 feet depth, and overlies a 5-foot interval of older beach sand. Below 20 feet, terrace deposits consisting of sand and trace coarse gravel is described to a depth of 29 feet, where basaltic andesite bedrock is reported in the easternmost boring (LS-2009-B1).

The top of bedrock is exposed at the northwestern limit of Stewart's Cove, where granodiorite crops out.

3.7 GEOLOGIC MODEL

Based on geologic mapping, geomorphology of the Lagoon setting, subsurface data from our exploratory drill holes, and subsurface data from previous investigations, we infer that our four borings (DH-1 through DH-4) represent sedimentation in an environment not too different from the modern Lagoon setting.

Gravel-bearing, gravel- and cobble-rich deposits were encountered consistently at approximately the same depth in all 4 borings: about 42 feet in boring DH-1, 41 feet in DH-2, 42 feet in DH-3, and 42 feet in DH-4. Deposits below this depth are interpreted to represent dominantly channel deposits associated with the Carmel River. The lateral persistence and consistent elevation of this transition suggests that similarly coarse materials will likely be encountered at approximately the same elevations between borings.

Above this depth, we infer the interbedded sandy silt and silty sand layers to represent levee and overbank flood deposits the record gradual aggradation of the land surface. The occurrence of occasional organic-rich layers and wood fragments is consistent with flood-borne debris. Relatively thin, clean sand sheets within this stack may represent either alluvial sand, eolian (windblown) blankets, or (near the Lagoon mouth) beach sand washed back into the

Lagoon mouth during storm events. Gravel- and cobble-bearing lenses represent deposits from channels that infrequently ran along the northern margin of the lagoon setting.

CPT (CPT-2 and CPT-3) and boring data along most of Scenic Road appear to record a somewhat simpler story: beach and dune sand deposited across an approximately horizontal possible terrace deposit in turn deposited across a planed-off bedrock surface. CPT-2 and CPT-3 lie near, but north of, the northern margin of a deeply incised buried river channel. The amount of relief on the buried bedrock surface is still unclear. CPT-1 (near previous boring MW-1) clearly is located on the northern flank of the main buried channel cut into bedrock at the river mouth. CPT-2 and CPT-3 (and previous borings along Scenic Road) appear to document a surface dominated by wave-cut platform formation.

We note that since the elevation of the top of bedrock in some areas of the Lagoon (e.g. at the Carmel Area Wastewater Treatment Plant) is at least approximately -150 feet, the thalweg (axis) of the Carmel River channel where it cuts through the bedrock lip and exits the Lagoon must be at least that deep.

3.8 GROUNDWATER

Groundwater was encountered in our borings (DH-1, DH-2, DH-3 and DH-4) at depths of 8, 3.7, 6.9 and 17.5 feet, respectively, at the time of field exploration. These depths likely do not reflect stabilized groundwater depths, and are likely to be variable. In general, depth to groundwater will be less along the EPB alignment since the ground surface along the EPB alignment is at a lower elevation than the locations of the borings. Observations of groundwater depth during drilling were complicated by the desire to keep the drill string charged with water to reduce the potential for running/flowing sand in the bottom of the boring. Nonetheless, differences in moisture content appear to suggest that hydraulic conductivity is sufficiently variable to create semi-confined zones that at least at times are saturated.

Groundwater was encountered in our CPT s (CPT-1, CPT-2, and CPT-3) at depths of 8.3, 11.0, and 8.2 feet, respectively. Depths to groundwater at these locations are likely quite variable, and are likely influenced by tides.

Depth to groundwater for borings by others is described above under “Subsurface Conditions” where described in source documents.

Groundwater depth is subject to fluctuations depending on lagoon water level, tides, rainfall, irrigation, pumping in wells, or other factors that may not be evident at the time of our investigation.

3.9 VARIATIONS IN SUBSURFACE CONDITIONS

Our interpretations of soil and groundwater conditions, as described in this report, are based on data obtained from subsurface exploration and laboratory testing for this study, and from subsurface data obtained by others. Our feasibility-level conclusions and recommendations are based on these interpretations. The project area has undergone different phases of land usage, with associated grading. Therefore, it is likely that undisclosed variations in subsurface conditions exist within the project area, such as old foundations, abandoned utilities and localized fill deposits of unknown character.

Should variations from our interpretations be found, we should be notified to evaluate whether any revisions should be made to our recommendations. In particular, if additional subsurface data not considered by this report becomes

3.10 TOP OF BEDROCK SURFACE

The depth to the top of bedrock will affect seismic response of lagoon sediments to earthquake shaking and liquefaction potential; foundation support options for possible EPB/floodwall types; and foundation support options for a possible Scenic Road Protection structure.

Staal, Gardner and Dunne (1989b) prepared a structure contour map depicting the elevation of the top of bedrock under the entire Lower Carmel River area (Plate 1 of Staal, Gardner and Dunne, 1989b). Based on their contouring, the top of bedrock along the paleochannel of the Carmel River is at a rough elevation of -140 to -150 feet, rising to the north and south. Bedrock at the Carmel Area Water Treatment Plant is reported at elevation -151 feet. Staal Gardner and Dunne (1989a) present a number of fairly deep subsurface profiles based on geophysical data that are not reproduced in this report; locations of their transects are shown on Figure 3 for reference but are not differentiated by type.

Bedrock at TH-3 (see Fig. 3; southeast of the northeastern EPB termination) is at elevation -107 feet.

Bedrock at 14H (see Fig. 3; approximately 100 feet north of DH-3 and at least that far north of the EPB alignment) is at elevation -33 feet.

The Cypress Point Fault (see Fig. 3) is inferred by Staal, Gardner and Dunne to have resulted in a difference in bedrock elevation of 40 to 60 feet, with bedrock lying at greater depths east of the fault. Their contouring infers a bedrock elevation of approximately -60 feet along the EPB alignment near the intersection of Carmelo Street and 17th Avenue, and approximately -120 feet on the eastern side of the fault, at a point just east of the State Beach parking lot.

West of the Cypress Point Fault, Staal, Gardner and Dunne have a bedrock elevation datapoint at MW-1 (see Fig. 3), where it is -79 feet.

We are not aware of subsurface data regarding depth to bedrock northwest of MW-1 and 14J. However, there are surface exposures of granodiorite bedrock at the northwestern limit of Stewart's Cove.

3.11 BATHYMETRY

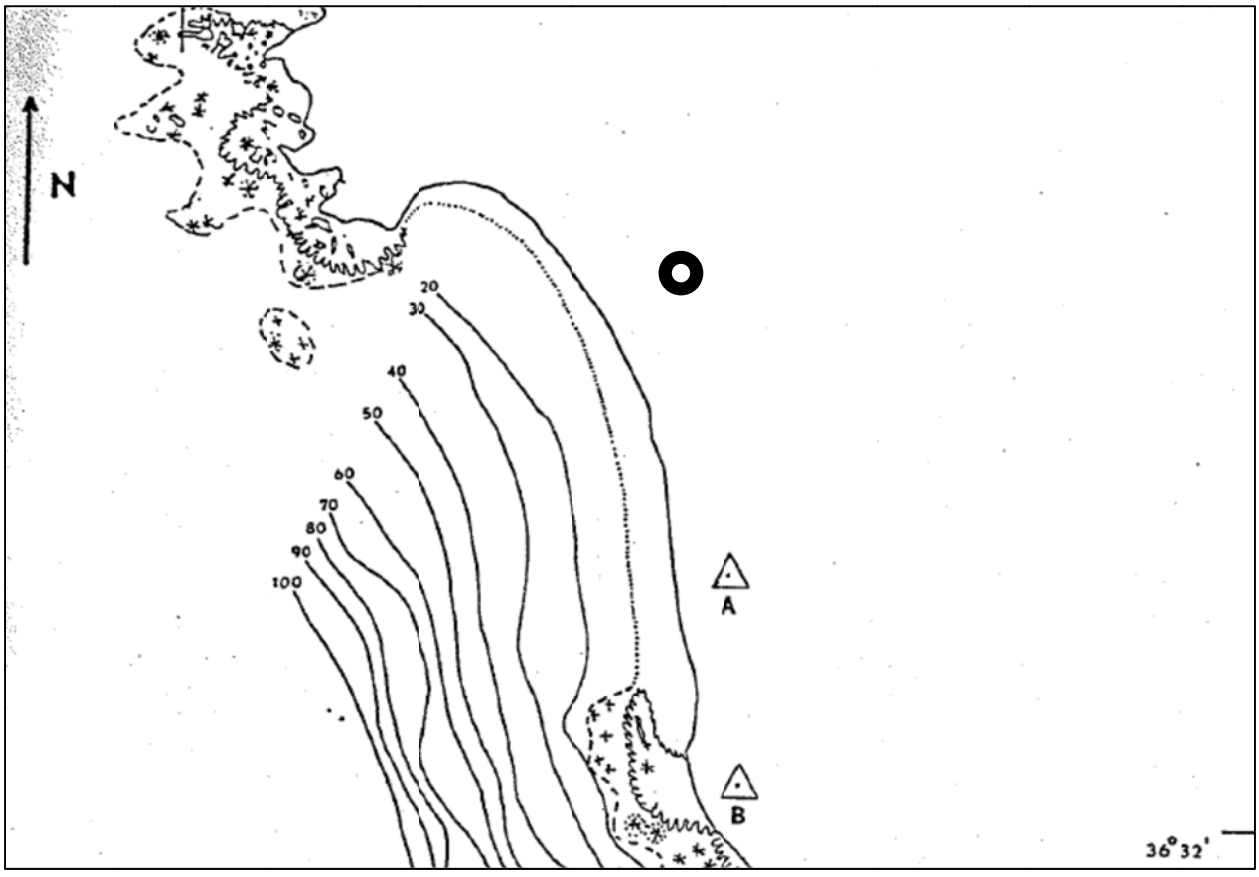
There is limited bathymetric information for the near-shore area of Stewart's Cove. The usefulness of the existing information is unclear, since seasonal response of the beach reshapes any sediment above wave base. The thickness of the sediment interval thus reshaped is limited by the elevation of top-of-bedrock. Most of the existing bathymetric information documents conditions west of the narrow, near-shore corridor of interest for the SRPS.

Thornton (date unknown) studied littoral (beach) processes at Carmel River State Beach, and describes bathymetric charts dating back to 1885, although they are not cited specifically or reproduced in his report (*Littoral Processes and River Breachings at Carmel River Beach*).

Thornton describes a "rocky reef" area associated with the point (Carmel or Abalone Point) at the northwestern limit of Stewart's Cove, and his report describes seasonal longer-term changes in beach width and profile, though no offshore data is presented. Thornton noted northward longshore drift through the Scenic Road Protection project area.

Howell (1972) studied sand movement along Carmel River State Beach in a much more intensive fashion. Howell cites previous bathymetric surveys performed for the bay, including US Coast and Geodetic Survey No. 1548a, performed in 1883; US Coast and Geodetic Survey No. H5453, performed in 1933; and Zardeskas (1971, cited in Howell). None of this previous bathymetry at a regional scale (e.g. Howell's Fig. 2) provides sufficient detail to be useful on this project. Howell cites a beach profile study by Bascom (1964) documenting seasonal beach profile changes.

Howell performed an independent bathymetric survey out to an approximate water depth of 75 feet. The resulting bathymetric chart (see inset) presents depths corrected to a mean lower low water datum with a 10-foot contour interval. Howell's data was insufficient to permit a 10 ft contour.



Excerpt of Figure 8 (Nearshore Bathymetry) of Howell (1972) – Depths in feet; insufficient data to permit 10-foot depth contour. Center of State Beach parking lot (circle) added for reference.

Diver observations by Howell indicate that the bottom offshore of the Scenic Road Protection project area is "almost entirely covered with … greater than 5 ft of fine to coarse sand." Howell

reports that "… one small granodiorite outcrop exists in approximately 25 feet of water just west of the Carmel River," but location of that outcrop is unclear from his bathymetric charts.

Howell (1972) concluded that during the interval of his study, overall longshore drift was southward through the project area, in contrast to Thornton's conclusion.

4. DISCUSSION AND CONCLUSIONS

4.1 GENERAL

General feasibility-level conclusions and feasibility-level design recommendations for the project are presented in the following sections of this report. For this feasibility-level investigation, subsurface exploration was limited to selected locations. For final design, a qualified geotechnical engineer should review the information in this report and determine the level of additional subsurface exploration, laboratory testing and engineering analysis necessary to support completion of project design and construction. This added information will more closely define depths to changes in earth materials, necessary pier and sheet pile depths, material properties, etc., and therefore modifications to the feasibility-level recommendations in this report may be necessary.

4.2 SURFACE RUPTURE AND SEISMIC GROUND SHAKING

Because the project area is not located within a State of California Earthquake Fault Zone and no mapped active faults are known to cross the project area, the probability of ground surface rupture at the project area due to displacement along a fault is remote.

The project area is in a region of high seismicity (see Fig. 2). Based on general knowledge of the local seismicity, it should be anticipated that, during its useful life, the project area will be subject to strong ground shaking. It is also anticipated that the project area will periodically experience small to moderate magnitude earthquakes. Proposed improvements should be designed accordingly.

4.3 LIQUEFACTION AND LATERAL SPREADING

Soil liquefaction is a phenomenon in which saturated granular soils, and certain fine-grained soils, lose their strength due to the build-up of excess pore water pressure during cyclic loading, such as that induced by earthquakes. Soils most susceptible to liquefaction are saturated, clean, loose, fine-grained sands and non-plastic silts. Certain gravels, plastic silts, and clays are also susceptible to liquefaction. The primary factors affecting soil liquefaction include: 1) intensity and duration of seismic shaking; 2) soil type; 3) relative density of granular soils; 4) moisture content and plasticity of fine-grained soils; 5) overburden pressure; and 6) depth to ground water.

As described above, the EPB alignment lies within zones considered by Rosenberg (2001) to have moderate to high liquefaction susceptibility. Hazard map scale limitations make it unclear how Rosenberg maps the liquefaction susceptibility of the Scenic Road Protection structure alignment.

We are not aware of reports of liquefaction effects in the site vicinity as a result of the 1906 San Francisco or 1989 Loma Prieta earthquakes.

Site-specific geotechnical information allows a more refined evaluation of liquefaction potential. Our liquefaction assessment was based on a PGA value of 0.45g (see Section 3.3), earthquake moment magnitude of 7.1, and a groundwater depth of 8 feet below ground surface except for DH-2 (at 4 feet) and DH-3 (at 7 feet). The high groundwater elevation that would likely

accompany extended lagoon impoundment of runoff was not used in the liquefaction analysis, because the likelihood of a design earthquake occurring during flood conditions is relatively low. If modeling indicates that lagoon water levels would consistently stay at high levels for extended periods of time, groundwater levels used for liquefaction analysis may need to be re-examined.

The results of our liquefaction analysis suggest that some of the sand layers encountered in our drill holes and CPT probes could liquefy when subject to the design peak ground acceleration. Estimated liquefaction-induced ground settlements are presented below. Case histories have shown that actual liquefaction-induced settlements could be 50 to 200 percent of the estimated values.

Drill Hole or CPT	Estimated Liquefaction-induced Settlement, inches
DH-1	3½-4
DH-2	¾
DH-3	0
DH-4	¾-1
CPT-1	11
CPT-2	3
CPT-3	2

Lateral spreading is horizontal movement of soil toward a free face, such as a creek bank, typically associated with liquefaction. Liquefaction-induced lateral spreading can also occur on mild slopes (flatter than 5%) underlain by loose sands and a shallow groundwater table. If liquefaction occurs, the unsaturated overburden soil can slide as intact blocks over the lower, liquefied deposit, creating fissures and scarps.

In general, the potential for liquefaction-induced lateral spreading along the EPB alignment is low, due to the lack of a nearby free face.

In general, the potential for liquefaction-induced lateral spreading along the SRPS alignment is higher than it is along the EPB alignment, due to the drop in elevation as one descends from Scenic Road across the back beach to the surf zone. The overall gradient of the top-of-bedrock surface necessarily steepens southward; there is a southward transition from the apparent wave-cut platform (near CPT-2 and CPT-3) to the deeply-incised Carmel River paleochannel (near CPT-1 and MW-1). During the final design phase, analysis should be performed to evaluate the magnitude of lateral spreading based on the selected protection structure system, and mitigation. The steepest surface slopes next to Scenic Road occur at times of maximum scour, with slopes significantly less steep once the beach has rebuilt itself.

The decision whether liquefaction and/or lateral spreading needs to be taken into account at all during design is a planning decision that takes into account factors such as facilities at risk; probabilities; and cost. Even if not specifically designed to address liquefaction effects, both SRPS concepts likely have considerable positive effects on slope behavior during seismic events.

If design for liquefaction effects is judged desirable, methods for mitigation include various ground improvement methods. Deep foundations may be practical for northerly portions of the SRPS where piers can bottom on the wave-cut bedrock platform. However, they may not be

practical near the State Park Beach parking lot, where CPT-1 and MW-1 indicate that bedrock is at least many tens of feet deep. Ground improvement techniques may include stone columns, grouting, etc. Environmental factors and considerations will also affect the selection of a suitable ground improvement method.

4.4 SHEET PILE DRIVEABILITY

Subsurface conditions along the proposed EPB alignment consist predominantly of sand of varying relative density and isolated layers of firm to hard clays/silts. The upper sand layers are generally loose to medium dense, whereas the deeper sands are generally dense to very dense. Gravels and cobbles have been reported generally below a depth of about 42 feet except in DH-2 where gravel-sized granitic fragments were reported at shallow as 13 feet.

The presence of gravels and cobbles (especially boulders, if present) must be considered when selecting the type and size of the sheet piles and the driving equipment to be used (which needs to be matched with the pile type). Pre-drilling may be considered to "loosen" the subsurface soils, thereby reducing resistance to pile driving.

Preliminary information from vinyl and FRP (fiber-reinforced polymer) sheet pile suppliers and case studies indicates that the presence of cobbly layers is more likely to be problematic for vinyl sheet piles, less so for FRP sheet piles. A mandrel or shoe is commonly used during driving (vinyl) sheet piles to address this. A mandrel or shoe ("PileClaw" is one proprietary device in the literature) is similarly used with FRP sheet piles. Some form of vibratory driving mechanism is commonly employed (as opposed to traditional hammer-driven piles).

Driveability for steel sheet piles is less of an issue, though it affects choice of sheet pile section (i.e. thickness, steel type).

4.5 EXCAVATION AND DEWATERING

As presently planned, construction of the SRPS would require excavations of up to about 10 feet for construction of the buried secant/tangent pile wall, and up to about 25 feet for construction of the buried armor rock (rip-rap) alternative. The excavations would be predominantly in sand with little or no cohesion, with granitic rock anticipated at depth. The bottom portion of the excavations would also be likely under water.

The excavations would require shoring or sloping the excavation sidewalls at a safe inclination. Dewatering would also be required to allow construction to proceed in a "dry" condition. A related consideration will also be protection of excavations from swell attack.

As currently conceived, no substantial excavations are envisioned in association with the proposed EPB.

4.6 EXPANSION POTENTIAL OF NEAR-SURFACE SOILS

The near-surface soils are generally low plasticity silts and sand. These soils generally have low expansion potential.

5. FEASIBILITY-LEVEL GEOTECHNICAL CONSIDERATIONS

5.1 FLOOD PROTECTION ALTERNATIVES

Flood protection design involves decisions regarding level of protection, with attendant decisions regarding flood insurance and development policy. The most basic decisions with respect to the proposed EPB is whether protection from a 100-year flood event is sought, since flood insurance rate maps (FIRM) are keyed to that event. FEMA procedures include: levee/structure design; levee/structure certification (by the project engineer); and levee/structure accreditation (by FEMA). For any mitigation structure, a parallel decision must be made regarding desired lifespan.

The focus of our authorized scope regarding the proposed EPB is a sheet pile wall alternative. This section begins with a brief review of the basic classes of flood protection structures, and basic geotechnical considerations. We then focus on geotechnical considerations of sheet pile walls.

5.1.1 Flood Protection General Design Issues

Flood protection structures need to reach the design flood surface elevation at a minimum. For purposes of this feasibility-level geotechnical investigation (pending results of hydrologic modeling), we understand it is about 16 feet elevation. Design per FEMA standards will involve incorporating a minimum freeboard of 3 feet in our experience, thus reaching a top-of-wall elevation of 19 feet.

In addition to simply addressing water surface elevation, flood protection measures need to address basic issues that include slope stability (for earthen components); foundation soil stability (all types); overturning/sliding (for structural components such as walls); internal seepage through the levee or structure; underseepage passing beneath the levee or structure; and potential effects of erosion, bioturbation/burrowing. Seepage and the effect on surface and subsurface water movement affect other flood protection aspects such as surface drainage control, including sizing of landside pumps.

Existing ground surface elevations vary along the proposed EPB alignment. As original conceived, ground surfaces were as low as approximately 7 feet. The portions of the floodwall with the greatest “stick-up” would be in these areas of lowest ground elevation, where the the top-of-wall would be approximately 9 feet or 12 feet above adjacent ground surface, depending on whether design per FEMA standards is pursued. Later iterations (Alternatives 1 and 2 shown on Figure 3) would have maximum wall stick-up of approximately 11 feet, again assuming a top-of-wall elevation of 19 feet.

For design per FEMA standards, it is highly likely that stability of the floodwall would need to be modeled under a water surface elevation at (or very near) the top of the freeboard interval, unless a convincing case can be made that the lagoon-mouth bar system is inherently incapable of ponding water to those elevations.

5.1.2 Earthen Levee

Applications: The simplest earthen levee would consist of a flat levee crest flanked on the land and water side by sloping banks. Water side banks are commonly at a 3:1 (h:v) slope, and landside banks at commonly at a 2:1 (h:v) or flatter slope.

Considerations include: wide footprint (structure plus toe access/maintenance); import fill likely needed for levee construction; stability/seepage behavior of on-site soils and imported soil are important; may need cutoff wall extending beneath levee.

The main modes of earthen levee failure involve: overtopping; surface erosion; internal erosion (piping); and slope/foundation failures within the levee embankment or foundation soils. These are all items addressed during design, and some variation of these considerations is shared by virtually all flood-protection measures.

5.1.3 Levee with Floodwall

Applications: This concept would employ an earthen levee of lesser height, with a floodwall extending above the levee crest, up to the design elevation. The sideslopes of such a levee would have similar gradients to a simple earthen levee concept. Since the crest elevation of the earthen portion is lower, the footprint width would be reduced commensurately. Floodwalls can take several forms (see next category).

Considerations include: wide footprint (though narrower than is needed for simple earthen levee); import fill likely needed for levee construction (though less soil than is needed for a simple earthen levee); stability/seepage behavior of on-site soils and imported soil are important; may need cutoff wall extending beneath levee. Design analysis must consider both the earthen structure and the hard structure, and their interaction.

5.1.4 Floodwall

Applications: The “floodwall” category generically describes several sorts of walls, categorized primarily by the geometry and means of support. Types include: gravity floodwalls; cantilever floodwalls (on shallow or deep foundation); buttress floodwalls; and counterfort floodwalls (FEMA, Chap. 5F). Cantilever floodwalls include the sheet pile floodwalls under consideration for the EPB.

Considerations include: narrow footprint; coarse (boulder or cobbly) alluvium affects driveability of sheet piles and limits material choices; sheet piles act as cutoff walls and therefore affect shallow groundwater flow (in both desirable and undesirable ways depending on setting and issues). Considerations include stability of the structure itself (e.g. sliding, overturning). The potential for seepage and piping needs to be carefully addressed, particularly for variants not involving deep foundations.

5.1.5 Sheet Pile Floodwall

Applications: The simplest form of sheet pile wall would take the form of a series of individual sheet piles, each interlocking with its neighbor, along a relatively straight line or long-radius curve. A sheet pile wall derives its resistance to overturning from deep embedment. This deep embedment at the same time reduces seepage potential.

For applications involving greater loads (likely not applicable to the EPB project), sheet pile wall variants include “combination” or “combi” sheet pile walls that incorporate “king” piles (steel H-beams or pipes) that are driven at intervals, with intervening more shallowly-driven sheet piles. Circular-section steel pipe may be used instead of steel H-beams. The sheet pile intervals may be arrayed in curving segments to take advantage of compression forces, or along straight lines.

Transmissivity through the sheet pile interlocks varies with the type of interlock selected. Various measures are used to reduce transmissivity, in addition to choice of interlock type. Sealants can be used (before driving) to reduce the transmissivity (seepage rate) through sheet pile wall interlocks. After driving, sealants or welds can used on the above-grade portion of sheet piles as additional measures.

Considerations include: narrow footprint (area of work as narrow as 8 feet, though more typically 15-20 feet depending on equipment required); coarse alluvium, especially boulder/cobbly alluvium can make driving some types of sheet piles difficult or infeasible. Various driving techniques are in use to address different soil conditions, including pre-drilling, and use of a mandrel or shoe. In a brackish water environment with salt air, corrosion affects lifespan (and therefore influences the design thickness, coating selected) of steel sheet piles. Exposure to ultraviolet (UV) rays can affect some manufactured materials.

5.1.6 Vinyl Sheet Pile, FRP (Fiber Reinforced Polymer) Sheet Pile

Applications: Vinyl/FRP sheet pile and steel sheet pile largely overlap in their applications, with some of their respective limitations pertinent to this project, others not. In general, steel sheet pile is used in applications involving higher walls (greater cantilever loads) and problematic driving conditions. FRP sheet pile can be used for higher cantilever walls than vinyl.

Considerations include: Better corrosion resistance than steel; likely lower materials cost, lower maintenance costs. Various esthetic treatments are available.

Limitations include: coarse alluvium, especially cobbly alluvium, can make driving sheet piles difficult or infeasible. The greater the load supported by the cantilever section, the more limited the choices are for materials and pile sections. Since the 1990's, the lifespan of vinyl sheet pile walls has been studied fairly intensively by the USACE (e.g. Dutta and Vaidya, 2003), and early reservations appear to have been addressed. There are a number of California floodwall projects employing FRP and vinyl sheet piles.

5.1.7 Steel Sheet Pile

Applications: Steel sheet pile is used extensively in floodwall and marine settings, and has a long history of use. As noted, in general, steel sheet pile (as opposed to vinyl/FRP) is used in applications involving taller walls (greater cantilever loads).

Considerations include: corrosion occurs over time, though it is essentially limited to the above-grade and oxygenated soil zone (down to the depth lowest seasonal groundwater) portions of the piles. Various coatings and surface treatments have been developed, both for corrosion protection, and for esthetics. Corrosion-related loss of strength over time is fairly well understood for various water and soil conditions, and is routinely addressed during design.

Limitations: Coarse alluvium, especially bouldery alluvium can make driving sheet piles difficult or infeasible. We are not aware of boulder conditions along the alignment, based on the information reviewed. Maintenance (of coatings/paint on above-grade portions) may be advisable to provide the longest lifespan.

5.1.8 Cost Factors

We contacted sheet pile suppliers to identify cost factors. The main cost categories are: materials; construction; and permitting.

Materials cost will be the easiest to estimate, although a number of decisions remain to be made that will affect materials cost. These include: desired level of flood protection (i.e. if FEMA accreditation is being sought, wall height, analytical methods and design standards will be governed by that choice); desired lifespan of the structure; length of alignment selected.

Once a detailed concept is selected, construction costs can be estimated. Again, there are decisions yet to be made that will affect construction cost, including: type of pile selected, which will govern the type of equipment needed to install it; and access constraints along the alignment; staging area(s) available. Permitting requirements and conditions will also affect construction cost. Our inquiries indicate that as a starting "rule of thumb," construction costs commonly approximately equal the materials cost; many caveats apply to any such generalization.

Permitting itself is a third major cost area, and probably the prime control on project schedule. Given the location of the project, there will be multiple agencies with some level of jurisdiction. Establishing which agencies have jurisdiction and what their particular concerns are will be key first step in defining feasible/acceptable ranges in project location, configuration, and means of construction. We are not qualified to comment on potential costs for this cost area.

5.1.9 FRP Sheet Pile Preliminary Cost Research

We contacted several FRP and vinyl sheet pile suppliers, with CMI (Crane Materials International) providing the most data at this stage. It must be stressed that the investigation performed to date does not provide sufficient information for full design, requiring simplifying assumptions to be made, and that these preliminary cost figures merely provide a "snapshot" of possible costs for planning purposes.

Based on discussions with CMI, three FRP pile "sections" (models) bracket the conditions encountered along the EPB alignment: UC-95; UC-75; and UC-50. In general, the UC-95 FRP sheet pile would apply to wall stick-up of over approximately 15 feet, which is a higher wall than is envisioned. Unit costs for this pile are approximately $24/sq ft. The UC-75 FRP sheet pile generally applies to situations where wall stick-up is in the range of 10 to 15 feet. Unit costs for this pile are approximately $20/sq ft. The UC-75 pile appears to be well suited to the bulk of the two EPB alignments under consideration. The UC-50 FRP sheet pile is generally used for wall applications with stick-up of less than about 8 – 10 feet. Unit costs for this pile are approximately $15/ sq ft. No corners, caps, or esthetic surface treatments are included in these figures.

Whitson Engineers prepared topographic profiles along the two EPB alignments, and we assessed wall stick-up needed along them, for a top-of-wall elevation of 19 feet. Transition between pile types is possible along an alignment, which permits a cost savings as wall height lessens. Based on our analysis, it appeared that the UC-75 and UC-50 FRP sheet piles would likely be suited to this application; we assumed UC-75 piles would be used where wall stick-up exceeded 8 feet, and the UC-50 pile would be used where wall stick-up was less than 8 feet. We then calculated linear wall footage with these two stick-up categories.

In order to calculate total square footage of the two pile types targeted, we first assumed a two-thirds:one-third embedment:stick-up ratio for the sheet wall. This ratio in actuality will be governed by results of more extensive geotechnical laboratory testing and analysis at the design level, but this ratio is likely reasonably conservative for this analysis. Thus, a wall with stick-up of 8 feet would require a pile three times as long, or 24 feet total length.

We then assumed that all sheet pile panels in an interval with wall stick-up less than 8 feet would be 24 feet total pile length; note that this overestimates the pile footage likely needed.

We similarly assumed that all sheet pile panels in the interval with wall stick-up greater than 8 feet would have the maximum stick-up (we used a 12-foot stick-up value), hence total pile lengths of 36 feet.

FRP piles can be manufactured in the lengths needed, greatly reducing cut-off wastage, and thus lowering costs. To the extent the design-level geotechnical investigation can specify necessary pile embedment along the wall alignment, the materials order can be more tightly defined.

Alternative 1 Preliminary Materials Costs - On this basis, the materials costs for FRP sheet piles along Alternative 1 would be approximately $1,357,200. Trucking to the site is preliminarily estimated at $170,000, for a total materials+trucking cost of approximately $1,527,200.

Alternative 2 Preliminary Materials Costs – Using the same approach, the materials costs for FRP sheet piles along Alternative 2 would be approximately $1,314,000. Trucking to the site is preliminarily estimated at $165,000, for a total materials+trucking cost of approximately $1,479,000.

Construction costs at this stage are extremely vague, but an industry “rule of thumb” is that they are approximately the same as the materials costs.

Alternative 1 total materials+trucking+construction costs would be approximately $2,884,000 on this basis.

Alternative 2 total materials+trucking+construction costs would be approximately $2,793,000 on this basis.

As noted above, permitting costs are not included in the above analysis. Again, we stress that these costs involve simplifying assumptions, and target only the largest typical cost factors.

5.2 SCENIC ROAD PROTECTION STRUCTURE

The geometry of a Scenic Road Protection Structure has not been determined. Presumably, it would need to incorporate a retaining function in order to provide support for Scenic Road itself. Approaches to providing such support include variants on drilled-pier walls: stitch pier walls; tangent pier walls; secant pier walls; drilled pier and lagging walls. Such walls may or may not require tiebacks extending back into the slope beneath Scenic Road. A conceptual wall configuration, as developed by Moffat & Nichol, are illustrated on Figure 7.

A second major class of protection structure would be a buried "armor-rock" (rip-rap) buttress or ballast constructed at the toe of the slope below Scenic Road. Such a concept, as developed by Moffat & Nichol, is illustrated on Figure 7.

The ocean side of any such a structure would be designed to be compatible with beach (littoral) processes and anticipated high-flow (breaching) conditions.

We understand that the structure selected would be designed so as to be buried by beach sand under normal conditions, and exposed only during high-flow conditions, after which natural/seasonal beach processes would be allowed to rebury the structure.

Based on discussions with Moffat & Nichol, the SRPS would be constructed as close to Scenic Road as construction considerations allow. We understand that it may be desirable to shape the northern terminus in plan view so as to deflect flows away from the very innermost (northerly) part of Stewart's Cove.

5.2.1 Drilled Pier Considerations

The depth to weathered bedrock along the outboard edge of Scenic Road is inferred to be approximately 27 feet, based on CPT-2 and CPT-3. This is generally consistent with the elevation of exposed reef rocks in the surf zone south of Abalone Point.

Bedrock at 26453 Scenic Road was encountered at 29 feet below ground surface (Landset, 2009; see Figures 3 and 4). The surface elevation at this boring is not clear, hence the elevation of top-of-rock in this boring is unclear. However, it is consistent with the top-of-rock elevations derived from CPT-2 and CPT-3.

Depth to bedrock at 2478 17th Avenue is constrained to be at least 17 feet below ground surface iin the rear yard of the residence (ESC, 2000; see Figures 3 and 4). The surface elevation at this boring is not clear, hence the elevation of bottom of this boring is unclear. However, does preclude a steeply west-facing top-of-bedrock slope, and shows that bedrock does not underlie this area at shallow depths.

Based on the available information, we interpret the top of bedrock throughout this area to represent a (buried) wave-cut platform that likely does not have substantial relief. There is a potential for some topographic relief on this surface, based on interpretations by Clark and others (1997) that the Cypress Point fault is an en-echelon (stepped) fault, which could result in a more complicated top-of-bedrock surface; the design-level geotechnical investigation will need to more closely define variability in the top of bedrock elevation. All available information constrains the position of the main Carmel River channel axis since at least Pleistocene time to a location south of the project, as indicated by the southward deepening of the top-of-bedrock surface documented in borings.

5.2.2 Excavation Considerations

Construction of a buried armor-rock (rip-rap) structure would involve excavations in noncohesive sands, with wet conditions lower in the excavations. Temporary construction slope stability and dewatering will be a consideration for design, possibly necessitating some sort of cofferdam such as a localized temporary sheet pile wall. Additional factors that will need to be considered include protection from ocean swell/waves.

6. FEASIBILITY-LEVEL GEOTECHNICAL RECOMMENDATIONS

The geotechnical recommendations provided in this section are intended as guidelines for use in the planning and feasibility-level evaluation and design of the project. Supplemental, design-level geotechnical investigation should be performed to augment the geotechnical recommendations presented in this report once project details have been finalized.

6.1 EARTHWORK (GENERAL)

6.1.1 Clearing and Grubbing

Clearing and grubbing should include clearing of existing structures, utility lines to be abandoned, deleterious materials, debris, obstructions, and stumps and primary roots of trees and brush (roots over 1 inch in diameter or longer than about 3 feet in length). Depressions, voids and holes that extend below the proposed finish grade should be cleaned and backfilled with engineered fill.

Surface vegetation and organic laden soils should be stripped. Organic laden soils are defined as soils with more than 3 percent by weight of organic content. The required stripping depth should be determined in the field by the Engineer at the time of construction. Stripped material may be stockpiled for use in landscape areas if approved by the project landscape architect, or otherwise removed from the site.

6.1.2 Excavations, Shoring and Dewatering

Excavations up to 25 feet are anticipated for construction of the SRPS. We are not anticipating any excavations deeper than a few feet for construction of the EPB.

The contractor is responsible for the design, installation, maintenance and removal of temporary shoring and bracing systems. The presence of nearby existing structures, pavements, and underground utilities must be incorporated in the design of the shoring and bracing systems. If drilled piers are used as soldier piles (such as for the SRPS), the presence of relatively clean sandy and gravelly soils should be taken into consideration in the design and construction of the piers, and in design of excavations in general. The pier holes may have to be cased to avoid caving of the pier holes.

Groundwater was encountered in our drill holes and CPT probes, above the anticipated depth of excavation for the SRPS. Therefore, dewatering will almost certainly be required during construction, depending on which SRPS configuration is selected. For excavations (e.g. at the toe of an armor rock (rip-rip) SRPS, dewatering should lower the groundwater level to a minimum of 3 feet below the bottom of the excavations. Pier holes may require concrete placement by tremie, and/or dewatering. The design, installation, permitting, maintenance and removal of dewatering systems are the responsibility of the contractor.

Excavations adjacent to existing or proposed foundations should be above an imaginary plane having an inclination of 1½:1 (horizontal to vertical) extending down from the top of the foundations. Otherwise, the effect of the adjacent foundations should be incorporated in the design and construction of the excavations and improvements.

6.1.3 Subgrade Preparation

Subgrade preparation would be required in areas to receive engineered fill, or to support improvements such as pavements, concrete slabs, etc. Subgrade preparation is not required in areas to support the armor rock of the SRPS, especially if the armor rocks are to be placed under water. A "self-launch" toe configuration that would allow the toe and apron of the rip-rip to adjust anticipates this.

Where subgrade preparation is required, the subgrade should be compacted to the recommendations given under the section of "Engineered Fill Placement and Compaction."

Soil with moisture content above optimum value should be anticipated during and shortly after rainy seasons, or for soils below the groundwater level. Where unstable, wet or soft soil is encountered, the soil will require processing before compaction can be achieved. When construction schedule does not allow air-drying, other means such as lime treatment of the soil or excavation and replacement may be considered. Geotextile fabrics may also be used to help stabilize the subgrade. The method to be used should be determined at the time of construction based on the actual site conditions. We recommend obtaining unit prices for subgrade stabilization during the construction bid process.

6.1.4 Material for Engineered Fill

In general, on-site soils with an organic content of less than 3 percent by weight, free of any hazardous or deleterious materials, and meeting the gradation requirements below may be used as general engineered fill to achieve project grades, except when special material is required.

In general, engineered fill material should not contain rocks or lumps larger than 3 inches in greatest dimension, should not contain more than 15 percent of the material larger than 1½ inches, and should contain at least 10 percent passing the No. 200 sieve. In addition to these requirements, import fill should have a low expansion potential as indicated by Plasticity Index of 12 or less, or Expansion Index of less than 20.

All import fills should be approved by the project geotechnical engineer prior to delivery to the site. At least five (5) working days prior to importing to the site, a representative sample of the proposed import fill should be delivered to our laboratory for evaluation.

6.1.5 Engineered Fill Placement and Compaction

Engineered fill should be placed in horizontal lifts each not exceeding 8 inches in thickness, moisture conditioned to the required moisture content, and mechanically compacted. Relative compaction or compaction is defined as the in-place dry density of the compacted soil divided by the laboratory maximum dry density as determined by ASTM Test Method D1557, latest edition, expressed as a percentage.

Moisture conditioning of soils should consist of adding water to the soils if they are too dry and allowing the soils to dry if they are too wet.

Except where 95 percent relative compaction is required, engineered fills consisting of on-site or imported soils should be compacted to a minimum of 90 percent relative compaction. The moisture content of the material should be brought to between 1 and 3 percent above the laboratory optimum value before compaction is performed.

6.1.6 Utility Trench Excavation and Backfill

Trench excavation, bedding and backfill should conform to the County of Monterey Standard Specifications. Construction, shoring and bracing of excavations should comply with the current CAL-OSHA safety standards and local jurisdiction. The stability and safety of excavations, braced or unbraced, is the responsibility of the contractor.

6.1.7 Wet Weather Construction

If site grading and construction is to be performed during the winter rainy months, the owner and contractors should be fully aware of the potential impact of wet weather. Rainstorms can cause delay to construction and damage to previously completed work by saturating compacted pads or subgrades, or flooding excavations.

Earthwork during rainy months will require extra effort and caution by the contractors. The contractor should be responsible to protect his work to avoid damage by rainwater. Standing pools of water should be pumped out immediately. Construction during wet weather conditions should be addressed in the project construction bid documents and/or specifications. We recommend the grading contractor submit a wet weather construction plan outlining procedures they will employ to protect their work and to minimize damage to their work by rainstorms.

6.2 EPB SHEET PILE WALL

We understand the EPB will consist of a sheet pile wall. Sheet pile materials under consideration include vinyl, FRP (fiber reinforced polymer), and steel. The sheet piles should be designed to resist unbalanced earth and water pressures acting on them. The following soil parameters may be used for feasibility evaluation and preliminary design of the sheet pile wall. Tiebacks, “king” piles (isolated deeper piles), and walers can be used to provide additional resistance and to improve rigidity of the sheet piles. King piles and walers also appear to provide a means to transition from sheet piles founded in deep alluvium to areas of shallow bedrock, which may be the case at the western terminus of the EPB.

Preliminary calculations and consultation with sheet pile suppliers indicates that for a 16-foot top-of-wall elevation, total sheet pile lengths of approximately 27 to 35 feet will be needed for the EPB, given an exposed length (“stick-up”) of 9 feet above grade. This figure is based on an assumed lowest ground elevation along the alignment of 7 feet, and a design flood surface elevation of 16 feet, which results in a minimum differential of 9 feet between water surface and land surface. Our communications with manufacturers indicate that this a cantilever wall of this height is near the upper bound for vinyl sheet pile, but within the bounds of applications both FRP and steel sheet pile.

For a 19-foot top-of-wall elevation, total sheet pile lengths on the order of 36 up to 45 feet may be required, in order to support loading against a full “stick-up” of 12 feet. It is our understanding that levee (and floodwall) design per FEMA standards generally requires considering a (flood) load extending to or very near the top of the freeboard interval. Our communications with manufacturers indicate that both FRP and steel piles are available and suitable for a cantilever wall of this height.

As the wall decreases toward each end of the EPB, sheet pile length can likely be decreased, and a lighter gauge of sheet pile used (for all three materials).

Installation equipment is rapidly evolving, and the choice of equipment will largely be dictated by the type of pile selected and how it typically behaves in soil of a given type. It is highly likely that vinyl and FRP piles will be driven using a mandrel, to protect the pile from damage by cobbly material. This approach appears to also provide for a more predictable schedule. A vibratory driving mechanism would likely be used.

Depth (feet)	Soil Type	Unit Weight (Total/Submerged, pcf)	Soil Friction Angle (degrees)	Cohesion (psf)	δ (degrees)
PROFILE 1 (DH-1 and DH-2)					
0-22	Sand	110/47.6	30	0	14
22-42	Sand	110/47.6	34	0	14
42-60	Sand	110/47.6	40	0	14
PROFILE 2 (DH-3)					
0-10	Sand	110/47.6	30	0	14
10-17	Sand	110/47.6	34	0	14
17-29	Clay	110/47.6	0	1500	0
29-34	Sand	110/47.6	34	0	14
34-42	Clay	110/47.6	0	2000	0
42-46	Sand	110/47.6	40	0	14
PROFILE 3 (DH-4)					
0-12	Sand	110/47.6	30	0	14
12-17	Sand	110/47.6	34	0	14
17-21	Clay	110/47.6	0	2000	0
21-28	Sand	110/47.6	32	0	14
28-33	Clay	110/47.6	0	1500	0
33-50	Sand	110/47.6	40	0	14
PROFILE 4 (CPT-1)					
0-30	Sand	110/47.6	32	0	14
30-70	Sand	110/47.6	37	0	14

6.3 SCENIC ROAD PROTECTION STRUCTURE

We understand that various alternatives of the SRPS incorporate a buried secant/tangent pile wall and a slope behind the wall. Other configurations incorporate a buried armor rock (rip-rap) system. Both would be exposed during conditions of maximum scour, and subsequently reburied by seasonal beach processes.

6.3.1 Drilled Piers for Buried Secant/Tangent Pile Wall

The secant/tangent pile wall for the SRPS will consist of drilled, cast-in-place, reinforced concrete piers with diameter of 3 to 5 feet. The piers will be structurally connected with a grade beam at the top.

Vertical compression loads on the drilled piers are expected to include the weight of the piers and grade beam, and soils that may be placed over the piers. For a preliminary estimation of the required pier embedment depth to resist vertical compression loads, an allowable adhesion value of 200 pounds per square foot may be assumed along the pier shafts, starting at a depth of 3 feet below the anticipated depth of scour in front of the wall. End bearing capacity should be ignored. Reinforcement in the piers should be determined by the structural engineer.

Lateral deflections, shears and moments in the piers should be evaluated based on loading information provided by the structural engineer during the final design phase.

The pier holes are expected to encounter sand soils, underlain by granitic bedrock at some depth. Steel casing should be provided to prevent caving in the pier holes. Water should also be expected in the pier holes, requiring concrete to be placed by the tremie method to displace the water out of the holes.

6.3.2 Lateral Soil Pressures on Secant/Tangent Pile Wall

We understand the secant/tangent pile wall will be buried under normal circumstances, with soil on both sides of the wall. Under the "eroded" condition, the ground in front of the wall would be at roughly elevation 0 feet. The secant/tangent wall would then retain up to 12 feet of soil immediately behind the wall and a 2:1 to 2½:1 (h:v) backfill slope extending up to Scenic Road. The secant/tangent wall should be designed for the unbalanced earth and water pressures acting on the wall. Active soil pressure is provided below with the assumption that lateral movement of the wall is allowed to achieve active soil condition.

The following parameters may be assumed for preliminary design of the secant/tangent pile wall.

Soil Pressure	Drained Backfill	Undrained Backfill
2:1 (horizontal:vertical) Backfill Slope or Flatter		
Active[1]	80 pcf	100 pcf
Passive[2]	300 pcf	200 pcf

Notes:

1. To develop active soil pressures, wall movements of about 0.005H to 0.01H would be necessary for cohesive soils and 0.005H for cohesionless soils.
2. To develop passive soil pressures against wall footings, movements of up to about $0.04D_f$ would be necessary for cohesive soils and $0.005D_f$ for cohesionless soils, where D_f is the footing embedment depth. Wall footings should be set back horizontally a minimum of $2D_f$ from the top of downslope creek bank.
3. Seismic force is not included because the likelihood of a design earthquake occurring concurrently with a scoured channel condition is low. Contact our office if the designer wishes to include seismic force in the design.
4. Erosion and scour protection is to be designed by others.

Design of the wall would involve various loading conditions. When the wall is buried, it is anticipated the earth pressures would be balanced on both sides of the wall. Under the "eroded" condition, the ground in front of the wall would be exposed. Pressures on the wall are anticipated to include lateral soil and water pressures acting on the land side of the wall (undrained condition).

7. DESIGN LEVEL GEOTECHNICAL INVESTIGATION

The findings, conclusions and recommendations in this report are for project feasibility-level evaluation and preliminary design of the EPB and SRPS. Our subsurface exploration program was for selected locations and our recommendations are for the currently proposed scheme. Our recommendations are based on certain assumptions which should be reviewed and refined during the subsequent project design phases. As project details are being reviewed and finalized, changes to project design, including type and location of proposed structures, are likely. Therefore, a supplemental design-level geotechnical investigation should be performed to address those changes, to provide more specific design information, to fill in data gaps, and to refine the design recommendations provided in this report.

We recommend that exploration continue to aim at FEMA certification or at least consider that alternative. Subsurface exploration at locations not along a project alignment may not provide much or any value in the event that FEMA accreditation is ultimately sought. A FEMA Factsheet (Levee Certification vs. Accreditation) that explains this process is contained in Appendix E.

8. LIMITATIONS

In preparing the feasibility-level findings and professional opinions presented in this report, we have endeavored to follow generally accepted principles and practices of the engineering geologic and geotechnical engineering professions in the area and at the time our services were provided. No warranty, express or implied, is provided.

The preliminary recommendations contained in this report are based, in part, on information that has been provided to us. In the event that the general development concept or general location and type of structures are modified, our preliminary conclusions and recommendations shall not be considered valid unless we are retained to review such changes and to make any necessary additions or changes to our recommendations. For Pacific Geotechnical Engineering to remain the geotechnical consultant of record for the proposed project, we must provide supplemental geotechnical services during final design phase, plan review and construction observation services, as outlined above under the Plan Review, Earthwork and Foundation Observation section of this report.

Subsurface exploration is necessarily confined to selected locations and conditions may, and often do, vary between these locations. Should conditions different from those assumed in this report be encountered during project development, additional exploration, testing, and analysis may be required.

Should persons concerned with this project observe geotechnical features or conditions at the site or surrounding areas which are different from those described in this report, those observations should be reported immediately to Pacific Geotechnical Engineering for evaluation.

It is important for project performance that the preliminary recommendations given in this report are made known to the design professionals involved with the project, that they be incorporated into project drawings and documents, and that the preliminary recommendations be validated and/or supplemented a design level geotechnical investigation.

Report prepared by,

PACIFIC GEOTECHNICAL ENGINEERING

Chalerm (Beeson) Liang
GE 2031

G. Reid Fisher PhD
CEG 1858

Distribution: Whitson Engineers

9. REFERENCES

Balance Hydrologics, Inc., 2007, Design Alternatives Analysis for Floodplain Restoration at the Odello Property, Lower Carmel River Valley, County of Monterey, California: BH Proj. No. 206116, dated 5/21/2007.

Balance Hydrologics, Inc., 2008, Supplemental Analyses for Floodplain Restoration at the Odello Property, Lower Carmel River Valley, County of Monterey, California: BH Proj. No. 206116, dated 6/5/2008.

California Geological Survey, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California: CGS Special Publication 117A.

Clark, J.C., Dupre, W.R., and Rosenberg, Lewis I., 1997, Geologic Map of the Monterey and Seaside 7.5-minute Quadrangles, Monterey County, California: A Digital Database: US Geological Survey OFR 97-030.

D & M Consulting Engineers, Inc., 2004a, Preliminary Geological Investigation, Central Area of the Carmel River Inn Property, Carmel-By-the-Sea, California: D&M Proj. No. 3226, dated 3/11/2004.

D & M Consulting Engineers, Inc., 2004b, Liquefaction Study, Proposed Carmel River Inn Expansion, Carmel-By-the-Sea, California: D&M Proj. No. 3226, dated 12/29/2004.

Dutta, P.K. and Vaidya, Uday, 2003, A Study of the Long-Term Applications of Vinyl Sheet Piles: US Army Corps of Engineers, ERDC/CRREL Letter Report.

Dutta, P.K. and 4 others, 2005, General Design Guide: PVC Sheet Pile; Interim Report: US Army Corps of Engineergs, ERDC/CRREL Interim Report.

Earth Systems Consultants Northern California, 2000, Preliminary soils Engineering Report, 2478 Seventeenth Avenue, Carmel, California; ESC File No. HO-07512-01, dated 5/22/2000.

FEMA, 2012, Levee Certification vs. Accreditation: FEMA Factsheet, Oct. 2012.

Geophysics Group, 1989a, A Geophysical Investigation to Map the Depth and Configuration of Granitic Bedrock Beneath the Lower Carmel River Valley, Carmel, California; dated 3/1989; appended to Staal, Gardner & Dunne, 1989b.

Grice Engineering, Inc., 2007, Geotechnical and Geological Hazards Report for the Proposed Classroom Building, Carmel River School, 2770 15th Street, Carmel, California; File No. 4929-06.12, dated 1/24/2007.

Grice Engineering, Inc., 2008a, Geotechnical and Geological Hazards Report for the Proposed Multi-Purpose Building, Carmel River School, 2770 15th Street, Carmel, California; File No. 5006-0704, dated 2/22/2008.

Grice Engineering, Inc., 2008b, Geotechnical Soils-Foundation & Geoseismic Report for the Proposed Freeman Residence 2691 16th Avenue, Carmel, California, APN 009-394-003; File No. 5112-08.01, dated 2/11/2008.

Grice Engineering, Inc., 2011, Geotechnical Report for the Proposed Remodel, Fash Residence, 26443 Scenic Drive, Carmel, California, APN 009-471-000; Grice File No. 5783-11.06, dated 6/20, 2011.

Hall, Stan, 1993, River Uncovers Lava Outcrop; Geologists Rethink Theories: article in The Weekly Sun, issue of 4/1/1993, p. 1.

Haro, Kasunich and Associates, Inc., 2002, Geotechnical Investigation, Design-Level Report for the Safeway Relocation Project, Crossroads Shopping Center, Carmel, California; HKA Proj. No. M7799, dated 3/12/2002.

Howell, B.F., 1972, Sand Movement Along Carmel River State Beach, California: MS Thesis, Naval Postgraduate School, Monterey, California, dated 9/1972.

Hydro-Search, Inc., 1981, Results of Exploration Drilling, Carmel River State Beach, California (preliminary draft); Hydro-Search Proj. No. 1205-81, dated 9/10/1981.

Kleinfelder, Inc., 2011, Geotechnical Investigation, Proposed Carmel River School Classroom Building, 15th Avenue and Monte Verde Street, Carmel, California; Kleinfelder File No. 120198, dated 8/19/2011.

Landset Engineers, Inc., 2005, Geologic and Soil Engineering Report for the Campos Residence (APN 009-403-011), 2519 16th Avenue, Monterey County, California; LE Proj. No. LSW-0425-01, dated 9/12/2005.

Landset Engineers, Inc., 2009, Geologic and Soil Engineering Report for the Peery Residence (APN 009-471-015), 26453 Scenic Road, Monterey County, California; LE Proj. No. LSW-0685-01, dated 3/23/2009.

Oliver, Joseph W., 1990, Summary of Carmel Valley Aquifer Ground Water Quality From Coastal Monitor Wells: Monterey Peninsula Water Mgmt. District Technical Memo. No. 90-04, dated 8/1990.

Pacific Crest Engineering, Inc., 2008, Geotechnical Investigation for New Residence & Guest Residence Remodel, 26334 River Park Place, Carmel, California; PCE Proj. No. 0894-M251-A55, dated 12/23/2008.

Philip Williams & Associates, Ltd., 1992, Carmel River Lagoon Enhancement Plan: PWA Proj. No. 509.

Philip Williams & Associates, Ltd., 1999, Carmel River Lagoon Enhancement and Management Plan, Conceptual Design Report: PWA Proj. No. 1250.

Rosenberg, Lew, 2004, Geology [of] The Carmel River Watershed: undated educational enlargement for Carmel River Watershed Council and Conservancy, of Rosenberg, 2001.

Rosenberg, Lew, 2001, Geologic Resources and Constraints, Monterey County, California – A Technical Report for the Monterey County 21st Century General Plan Update Program.

Sellmeijer, J.B. and 3 others, 1993, Hydraulic Resistance of Steel Sheet Pile Joints: Jour. Geotechnical Engineering.

Smith, Douglas, Newman, Wendi, Watson, Fred, Hameister, Janna, 2004, Physical and Hydrologic Assessment of the Carmel River Watershed, California: The Watershed Institute, Report No. WI-2004-05/2, dated November 1, 2004.

Soil Surveys, Inc., 2008, Geotechnical Investigation with Geologic Considerations For New Single Family Home …26478 Carmello [sic] Street, APN 009-471-024, Carmel Point Near Carmel, California, Proj. No. 5379, rev. dated 10/27/2008.

Southern California Earthquake Center (SCEC), 1999, Recommended Procedures For Implementation of DMG Special Publication 117; Guidelines for Analyzing and Mitigating Liquefaction Hazards in California: SCEC Contribution No. 462, jointly with USGS, NFS.

Staal, Gardner & Dunne, Inc., 1989b, Hydrogeologic Investigation, Carmel River Aquifer, Coastal Portion, Monterey County, California; SGD Proj. No. 88152, dated May 1989.

Steven Raas & Associates, Inc., 2000, Geotechnical Investigation for North Levee Improvement Project, Lower Carmel River, Carmel, California; SRA Proj. No. 98162-M251-C53, dated 2/8/2000.

Stuart, D.M, 2004, Project-Specific Steel Sheet Piling Applications: ASCE Practice Periodical On Structural Design and Construction, dated Nov. 2004.

Swanson Hydrology & Geomorphology, 2005, Carmel River Lagoon Management and Erosion at Scenic Road: letter to D. Butler, NMFS, dated 7/28,2005.

Technical Advisory Committee, 2007, Study Plan for Long-Term Adaptive Management of the Carmel River State Beach and Lagoon: unpublished report, 40 p.

Thornton, Edward B., date unknown (post-2005), Littoral Processes and River Breachings at Carmel River Beach: unpublished research paper, Naval Postgraduate School, Monterey, Calif.

Thornton, Edward, 2005, Carmel River Beach Shoreline History: powerpoint presentation [to?] Naval Postgraduate School, dated 4/9/2005.

Touchstone, N.E., 2010, Deflection and Creep of Polyvinyl Chloride (PVC) Sheet Piling: unpub. MS Thesis, Univ. Georgia.

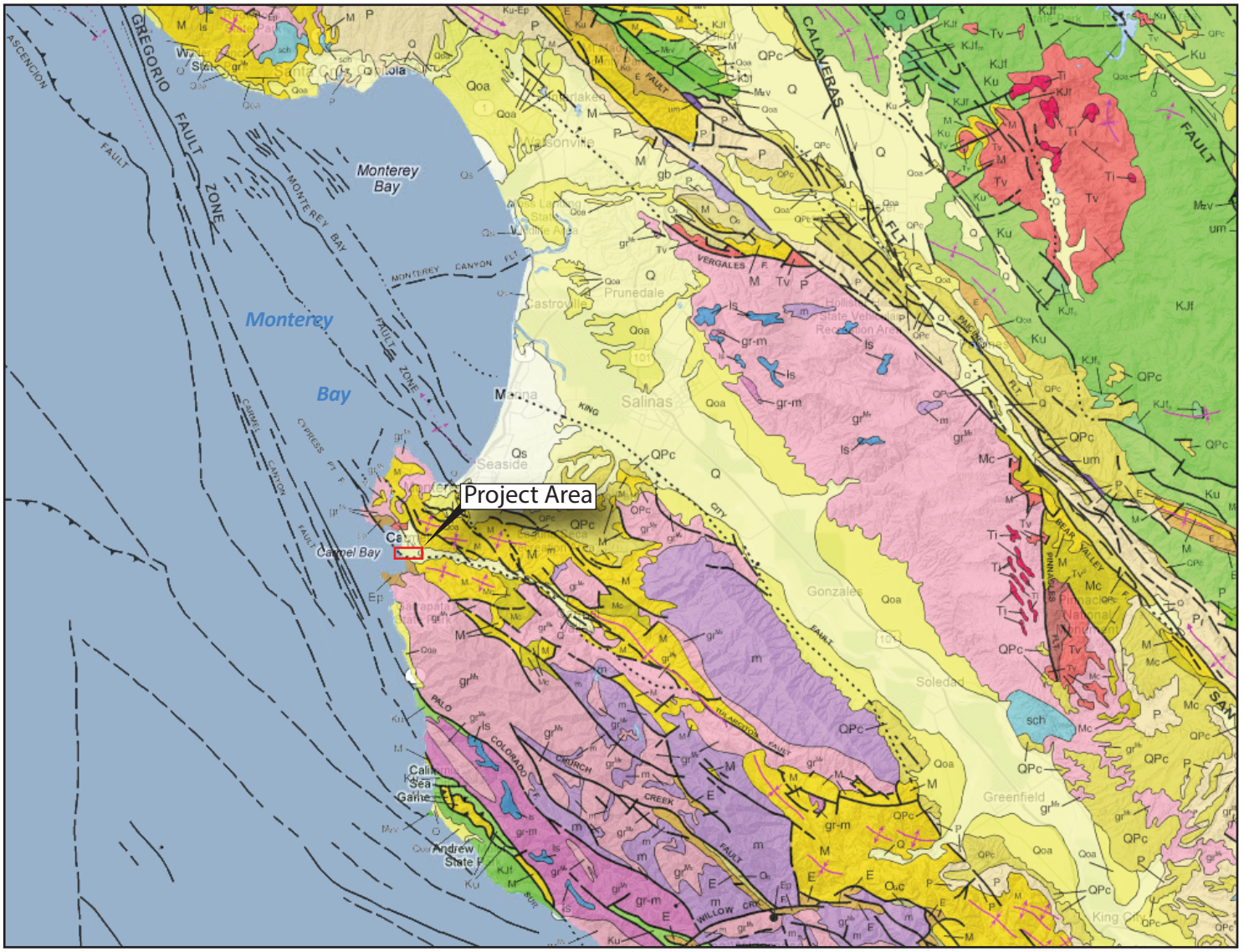
USACE, 1989, Engineering and Design, Retaining and Flood Walls: Dept. of Army, USACE Engineer Manual No. 1110-2-2502, dated 9/29/1989.

USACE, 1994, Design of Sheet Pile Walls: Dept. of Army, USACE Engineer Manual 1110-2-2504, dated 3/31/1994.

Watson, Fred, Casagrande, Joel, 2004, Potential Effects of Groundwater Extractions on Carmel Lagoon: The Watershed Institute, Report No. WI-2004-09, rev. dated 12/17/2004.

Zardeskas, R.A., 1971, A Bathymetric Chart of Carmel Bay, California: MS Thesis, Naval Postgraduate School, Monterey, California; excerpted in Howell (1972).

FIGURES



EXPLANATION

EARTH MATERIALS

Quaternary deposits
- Qs
- Q
- Qoa
- QPc

Tertiary sedimentary rocks
- M
- Ep

Tertiary volcanic rocks
- Tv

Mesozoic plutonic rocks
- gr^{mz}

Paleozoic mixed rocks
- m

0 10 20

Approximate Scale in Miles

Base Map: Modified from Gutierrez, Bryant, Saucedo and Wills, 2010

PACIFIC GEOTECHNICAL ENGINEERING

DATE
May 2013

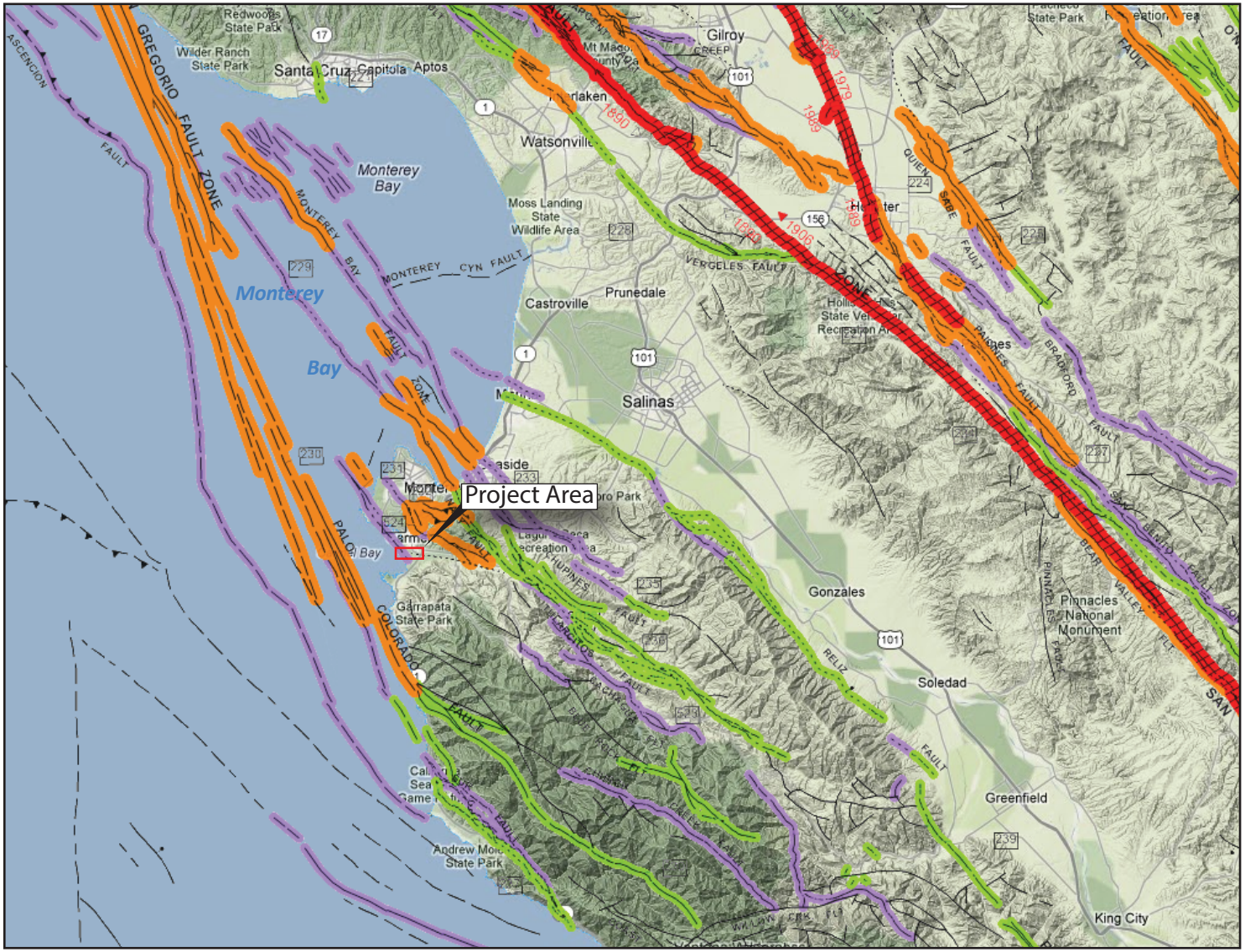
SCALE
As Shown

REGIONAL GEOLOGIC INDEX MAP

Ecosystem Protection Barrier & Scenic Road Protection
Monterey County, California

FIGURE
1

PROJECT
2012.0133
2012.0134



EXPLANATION

- Historic Fault
- Holocene Fault
- Quaternary Fault
- Late Quaternary Fault
- Pre-Quaternary Fault

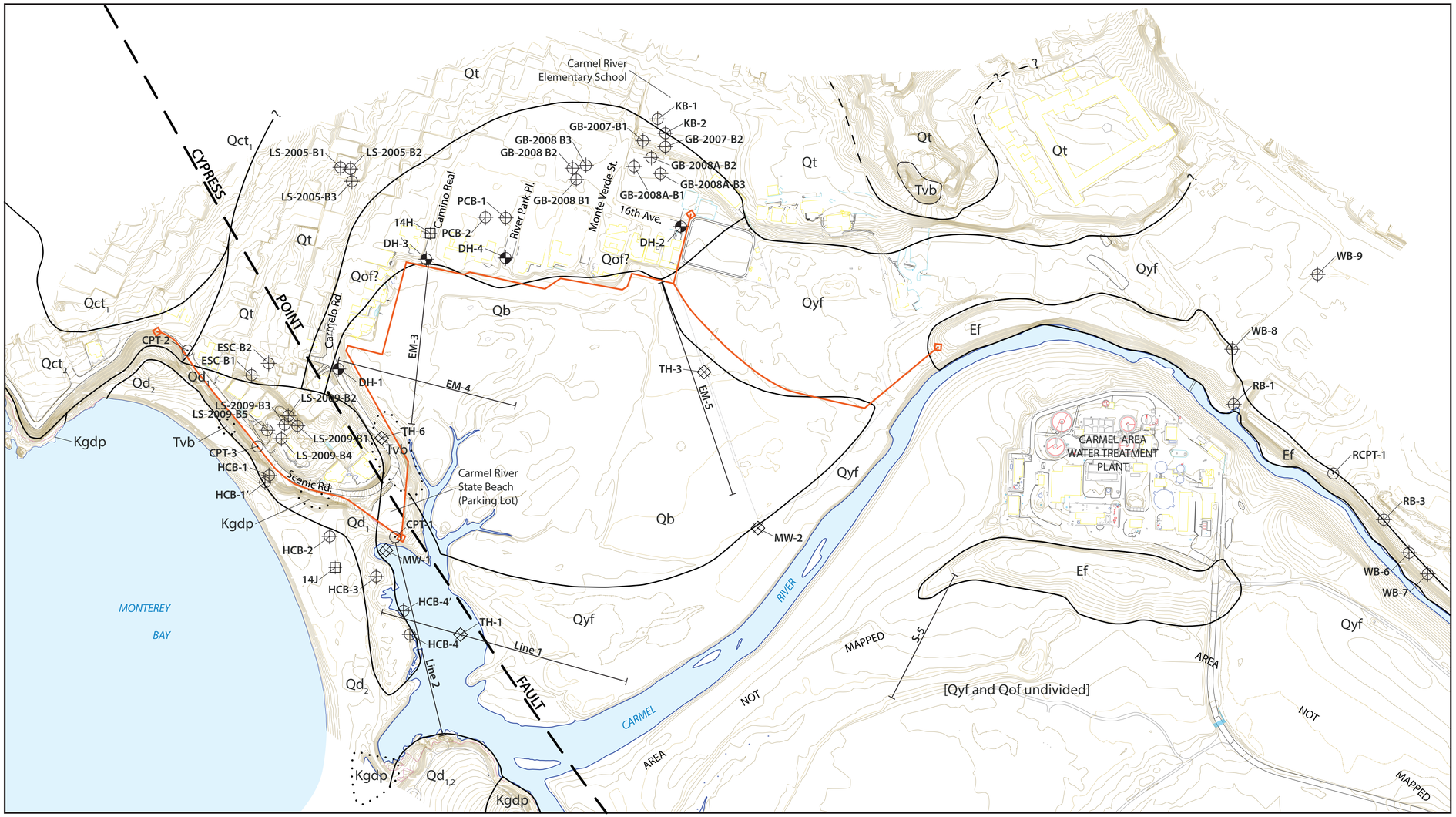
0 10 20

Approximate Scale in Miles

Base Map: Modified from Jennings and Bryant, 2010

PACIFIC GEOTECHNICAL ENGINEERING

DATE	REGIONAL FAULT MAP	FIGURE
May 2013	Ecosystem Protection Barrier & Scenic Road Protection Monterey County, California	2
SCALE As Shown		PROJECT 2012.0133 2012.0134



EXPLANATION

Earth Materials

- Ef — Earth fill - various textures. Fill prisms along roads not mapped for legibility
- Qd — Dune sand - locally subdivided into Qd_1 (older) and Qd_2 (younger)
- Qb — Basin deposits - plastic clay and silty clay
- Qyf — Younger floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qof — Older floodplain deposits - fine sand and silt, minor discontinuous clay layers
- Qt — Alluvial terrace deposits - silt, silty clay, sand and gravel; locally subdivided
- Qct — Coastal terrace deposits - sand with thin, discontinuous gravelly layers
- Tvb — Volcanic rocks - basaltic andesite flows and flow breccia
- Kgdp — Granodiorite (porphyritic granodiorite of Monterey of Ross (1976))

Symbols

- Geologic contact, dashed where approximate, queried where uncertain, dotted where concealed
- Inferred, buried fault
- DH-4 — Exploratory drill hole (this investigation)
- CPT-2 — CPT sounding (this investigation)
- Exploratory drill hole (investigations by others)
  - KB-2 (Kleinfelder, 2011)
  - GB-2008A-B3 (Grice, 2008A)
  - GB-2008 B3 (Grice, 2008B)
  - PCB-2 (Pacific Crest, 2008)
  - LS-2009-B5 (Landset, 2009)
  - LS-2005-B5 (Landset 2005)
  - ESC-B2 (Earth Systems Consultants, 2010)
  - HCB-4 (Hydro-Search, 1981)
  - WB-9 (Wahler, 1989; compiled in Raas [2000])
  - RB-3 (Raas, 2000)
- MW-3 / MW-2 (Staal, Gardner, Dunne, 1989b)
- TH-6 (Staal, Gardner, Dunne, 1989b)
- RCPT-3 — 14H (Previous borings compiled by Staal, Gardner, Dunne, 1989b); CPT sounding (Raas, 2000)
- Geophysical transects (Staal, Gardner, Dunne, 1989)
- Proposed Ecosystem Protection Barrier and Scenic Road Protection

Notes:

Base provided by Whitson Engineers
Geologic interpretation modified from Clark, Dupre and Rosenberg (1997), with additions

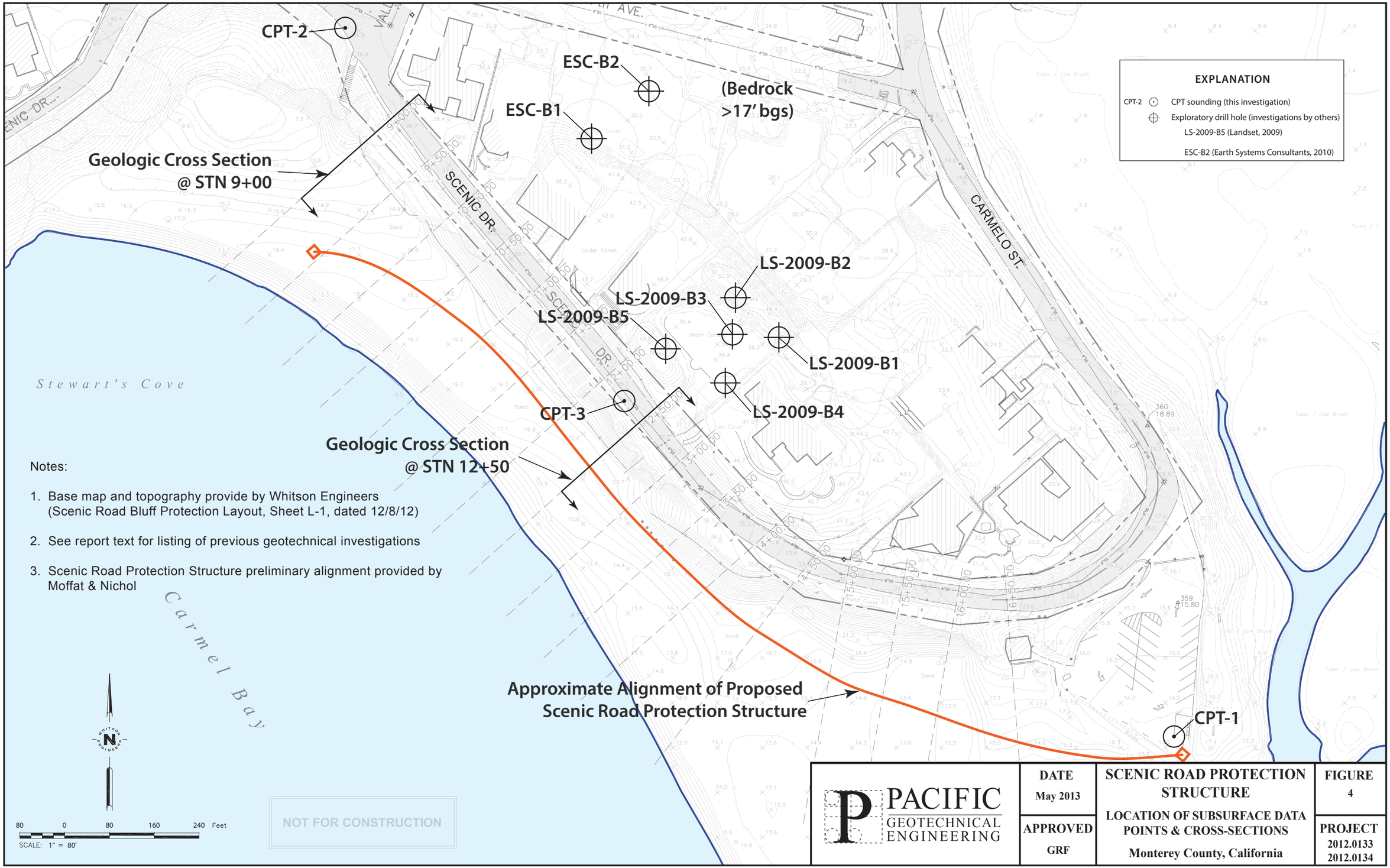
100 0 100 200
Scale in feet

PACIFIC GEOTECHNICAL ENGINEERING

DATE	May 2013
APPROVED	GRF

SITE GEOLOGIC MAP
ECOSYSTEM PROTECTION BARRIER
SCENIC ROAD PROTECTION
MONTEREY COUNTY, CALIFORNIA

FIGURE	3
PROJECT	2012.0133 2012.0134



Notes:

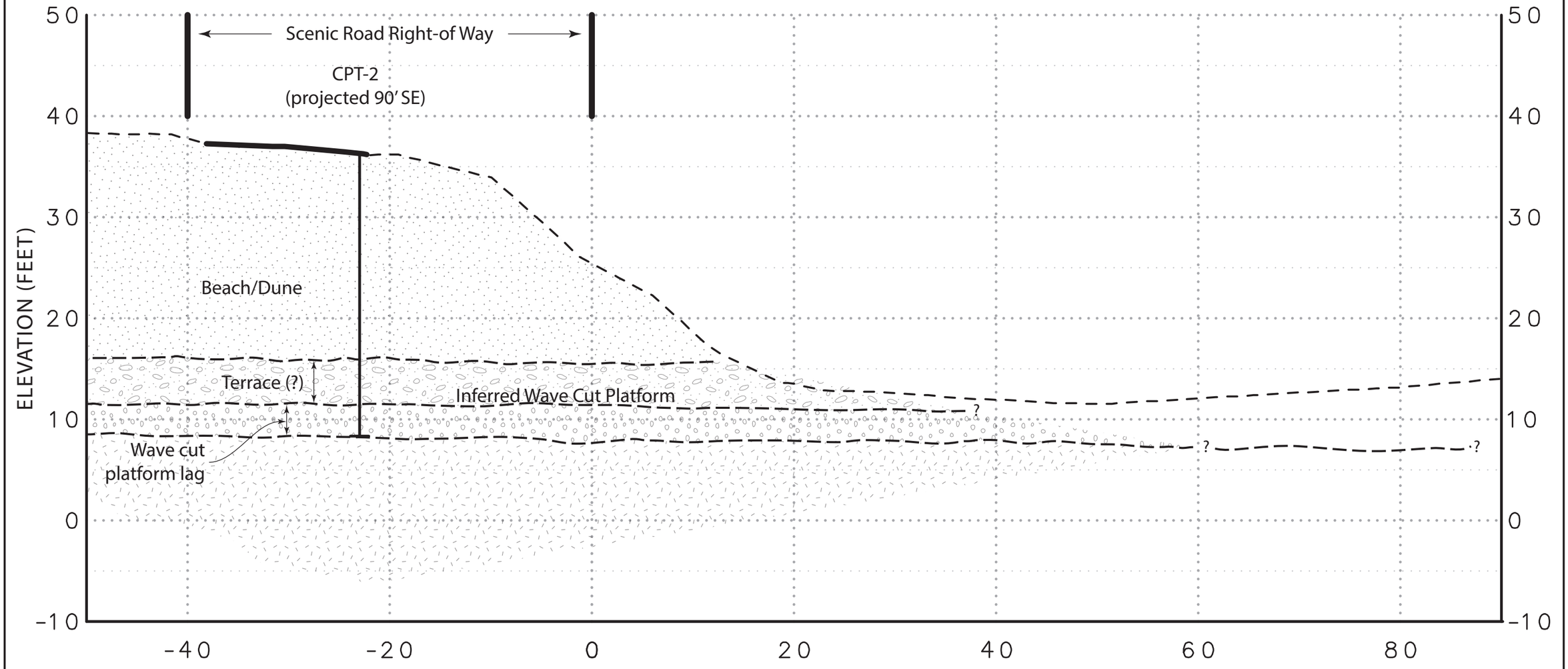
1. Base map and topography provide by Whitson Engineers (Scenic Road Bluff Protection Layout, Sheet L-1, dated 12/8/12)
2. See report text for listing of previous geotechnical investigations
3. Scenic Road Protection Structure preliminary alignment provided by Moffat & Nichol

80 0 80 160 240 Feet
SCALE: 1" = 80'

NOT FOR CONSTRUCTION

PACIFIC GEOTECHNICAL ENGINEERING

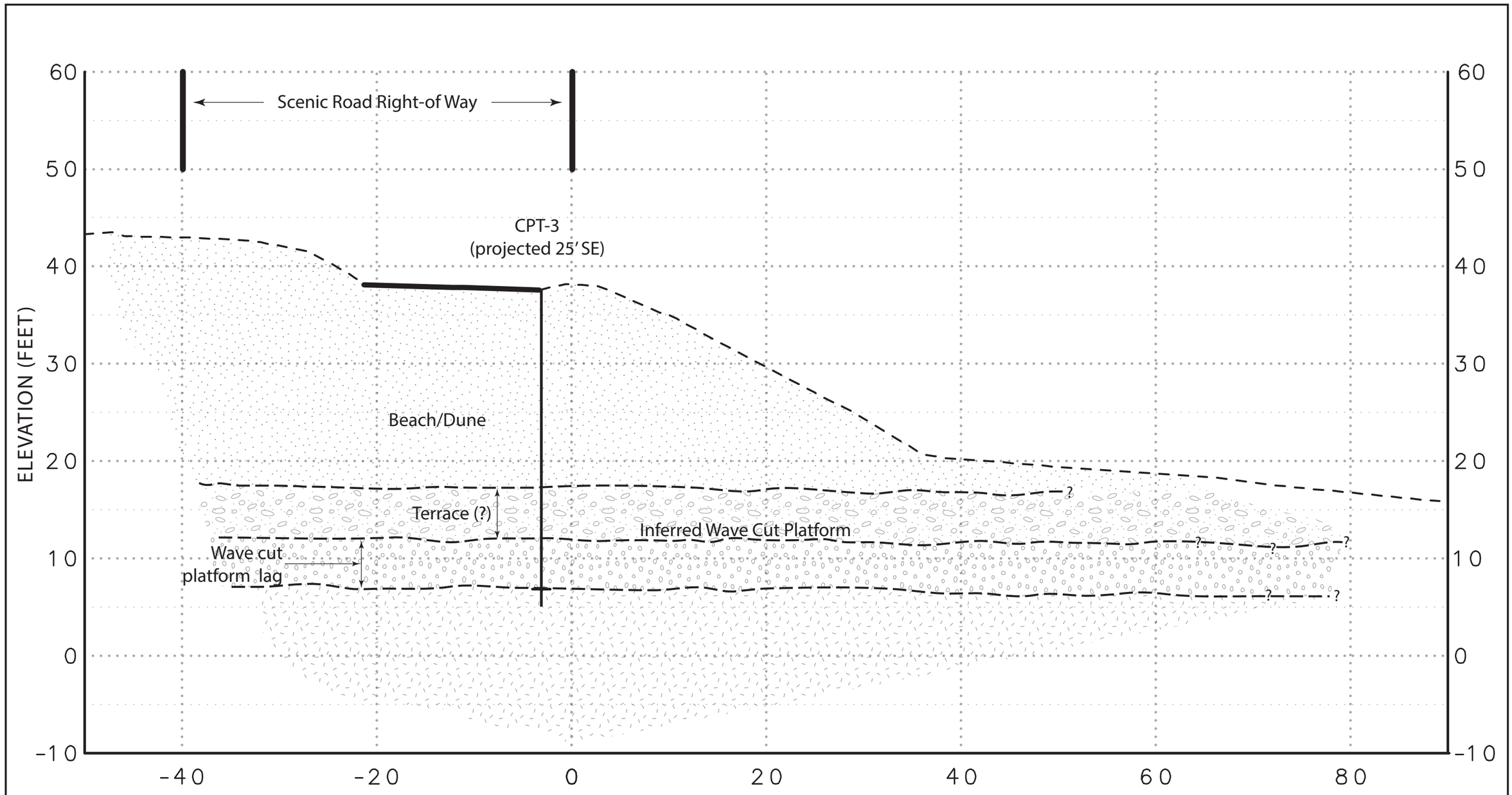
DATE May 2013	SCENIC ROAD PROTECTION STRUCTURE LOCATION OF SUBSURFACE DATA POINTS & CROSS-SECTIONS Monterey County, California	FIGURE 4
APPROVED GRF		PROJECT 2012.0133 2012.0134



Note: Profile derived from Whitson Engineers, "Scenic Road Bluff Protection" dated 12/6/12

PACIFIC GEOTECHNICAL ENGINEERING

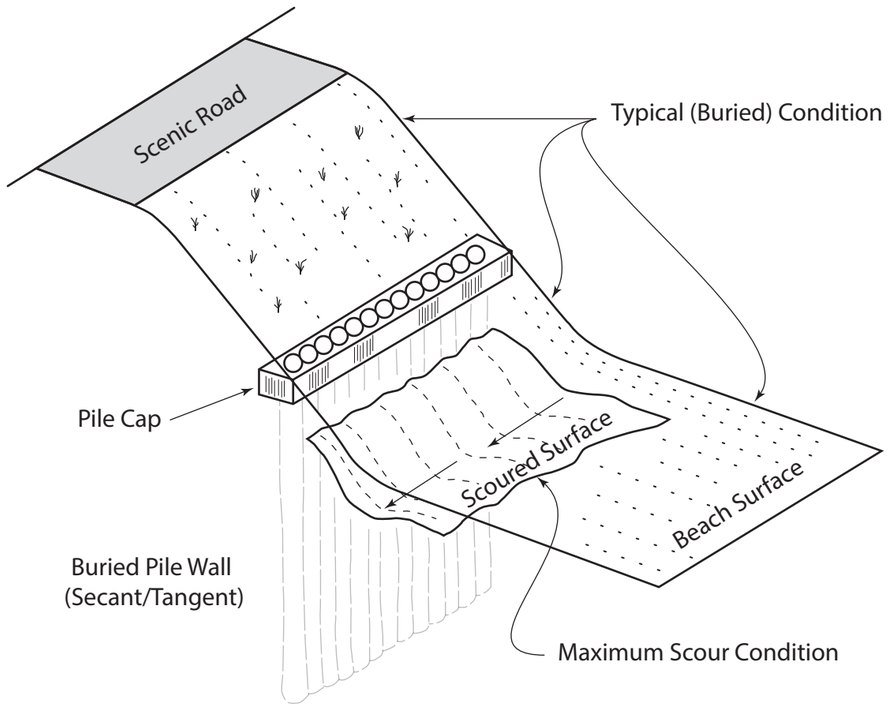
DATE May 2013	SCENIC ROAD PROTECTION STRUCTURE GEOLOGIC CROSS SECTION @ 9+00 Monterey County, California	FIGURE 5
APPROVED GRF		PROJECT 2012.0133 2012.0134



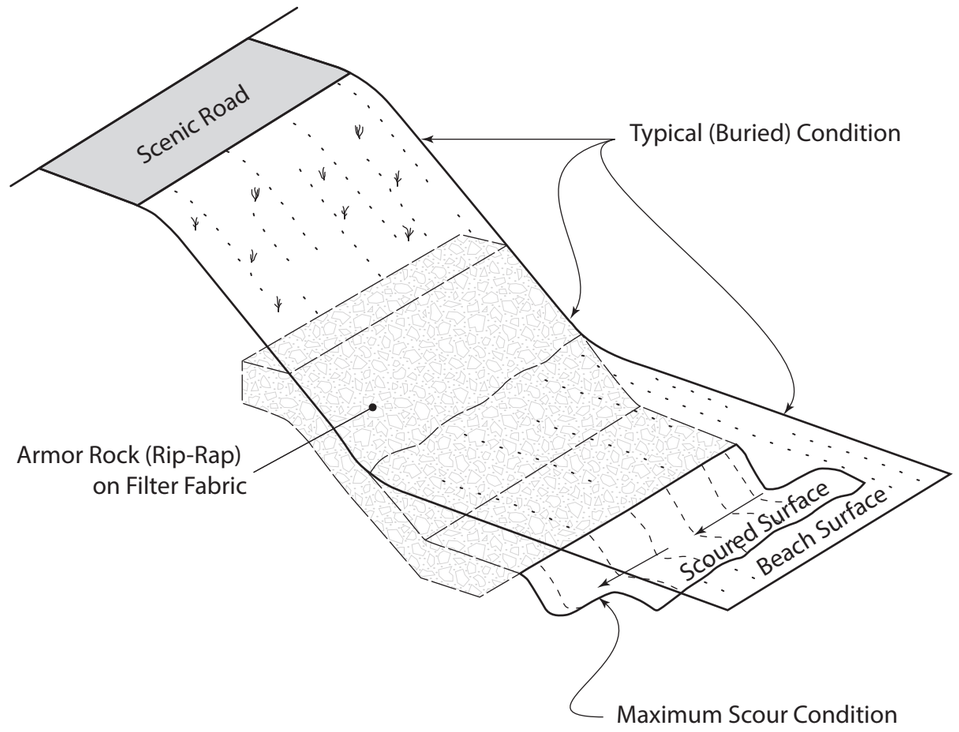
Note: Profile derived from Whitson Engineers, "Scenic Road Bluff Protection" dated 12/6/12

PACIFIC GEOTECHNICAL ENGINEERING

DATE May 2013	SCENIC ROAD PROTECTION STRUCTURE GEOLOGIC CROSS SECTION @ 12+50 Monterey County, California	FIGURE 6
APPROVED GRF		PROJECT 2012.0133 2012.0134



CONCEPTUAL BURIED PILE WALL
(Not to Scale)



CONCEPTUAL BURIED ARMOR ROCK (RIP-RAP)
(Not to Scale)

Notes: Based on concepts supplied by Moffat & Nichol

PACIFIC GEOTECHNICAL ENGINEERING	DATE May 2013	SCENIC ROAD PROTECTION STRUCTURE CONCEPTUAL APPROACHES Monterey County, California	FIGURE 7
	APPROVED GRF		PROJECT 2012.0133 2012.0134

APPENDIX A

Keys to Soil Classification

Logs of Borings

KEY TO SOIL CLASSIFICATION - FINE GRAINED SOILS

(50% OR MORE IS SMALLER THAN NO. 200 SIEVE SIZE)

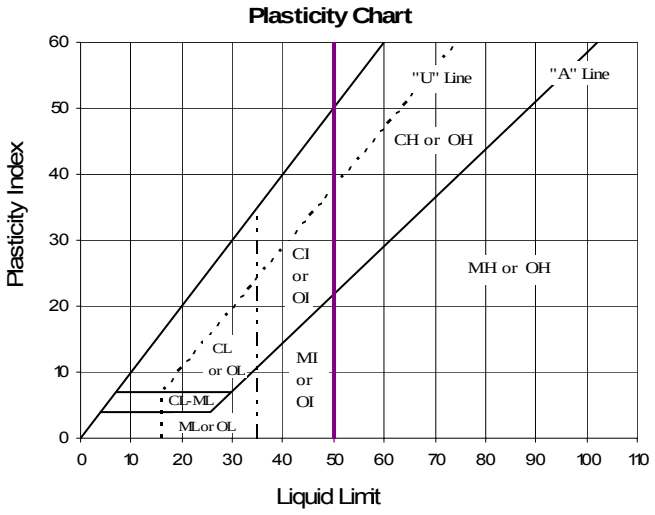
(modified from ASTM D2487 to include fine grained soils with intermediate plasticity)

MAJOR DIVISIONS			GROUP SYMBOLS	GROUP NAMES
SILTS AND CLAYS (Liquid Limit less than 35) Low Plasticity	Inorganic	PI < 4 or plots below "A" line	ML	Silt, Silt with Sand or Gravel, Sandy or Gravelly Silt, Sandy or Gravelly Silt with Sand or Gravel
	Inorganic	PI > 7 or plots on or above "A" line	CL	Lean Clay, Lean Clay with Sand or Gravel, Sandy or Gravelly Lean Clay, Sandy or Gravelly Lean Clay with Sand or Gravel
	Inorganic	PI between 4 and 7	CL-ML	Silty Clay, Silty Clay with Sand or Gravel, Sandy or Gravelly Silty Clay, Sandy or Gravelly Silty Clay with Sand or Gravel
	Organic	See footnote 3	OL	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) (1,2)
SILTS AND CLAYS (35 ≤ Liquid Limit < 50) Intermediate Plasticity	Inorganic	PI < 4 or plots below "A" line	MI	Silt, Silt with Sand or Gravel, Sandy or Gravelly Silt, Sandy or Gravelly Silt with Sand or Gravel
	Inorganic	PI > 7 or plots on or above "A" line	CI	Clay, Clay with Sand or Gravel, Sandy or Gravelly Clay, Sandy or Gravelly Clay with Sand or Gravel
	Organic	See footnote 3	OI	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) (1,2)
SILTS AND CLAYS (Liquid Limit 50 or greater) High Plasticity	Inorganic	PI plots below "A" line	MH	Elastic Silt, Elastic Silt with Sand or Gravel, Sandy or Gravelly Elastic Silt, Sandy or Gravelly Elastic Silt with Sand or Gravel
	Inorganic	PI plots on or above "A" line	CH	Fat Clay, Fat Clay with Sand or Gravel, Sandy or Gravelly Fat Clay, Sandy or Gravelly Fat Clay with Sand or Gravel
	Organic	See note 3 below	OH	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) (1,2)

1. If soil contains 15% to 29% plus No. 200 material, include "with sand" or "with gravel" to group name, whichever is predominant.
2. If soil contains ≥30% plus No. 200 material, include "sandy" or "gravelly" to group name, whichever is predominant. If soil contains ≥15% of sand or gravel sized material, add "with sand" or "with gravel" to group name.
3. Ratio of liquid limit of oven dried sample to liquid limit of not dried sample is less than 0.75.

CONSISTENCY	UNCONFINED SHEAR STRENGTH (KSF)	STANDARD PENETRATION (BLOWS/FOOT)
VERY SOFT	< 0.25	< 2
SOFT	0.25 – 0.5	2 – 4
FIRM	0.5 – 1.0	5 – 8
STIFF	1.0 – 2.0	9 – 15
VERY STIFF	2.0 – 4.0	16 – 30
HARD	> 4.0	> 30

MOISTURE	CRITERIA
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below the water table



PACIFIC GEOTECHNICAL ENGINEERING

KEY TO SOIL CLASSIFICATION – COARSE GRAINED SOILS

(MORE THAN 50% IS LARGER THAN NO. 200 SIEVE SIZE)

(modified from ASTM D2487 to include fines with intermediate plasticity)

MAJOR DIVISIONS			GROUP SYMBOLS	GROUP NAMES[1]
GRAVELS (more than 50% of coarse fraction is larger than No. 4 sieve size)	Gravels with less than 5% fines	Cu ≥ 4 and 1 ≤ Cc ≤ 3	GW	Well Graded Gravel, Well Graded Gravel with Sand
		Cu < 4 and/or 1 > Cc > 3	GP	Poorly Graded Gravel, Poorly Graded Gravel with Sand
	Gravels with 5% to 12% fines	ML, MI or MH fines	GW-GM	Well Graded Gravel with Silt, Well Graded Gravel with Silt and Sand
			GP-GM	Poorly Graded Gravel with Silt, Poorly Graded Gravel with Silt and Sand
		CL, CI or CH fines	GW-GC	Well Graded Gravel with Clay, Well Graded Gravel with Clay and Sand
			GP-GC	Poorly Graded Gravel with Clay, Poorly Graded Gravel with Clay and Sand
	Gravels with more than 12% fines	ML, MI or MH fines	GM	Silty Gravel, Silty Gravel with Sand
		CL, CI or CH fines	GC	Clayey Gravel, Clayey Gravel with Sand
		CL-ML fines	GC-GM	Silty Clayey Gravel; Silty, Clayey Gravel with Sand
SANDS (50% or more of coarse fraction is smaller than No. 4 sieve size)	Sands with less than 5% fines	Cu ≥ 6 and 1 ≤ Cc ≤ 3	SW	Well Graded Sand, Well Graded Sand with Gravel
		Cu < 6 and/or 1 > Cc > 3	SP	Poorly Graded Sand, Poorly Graded Sand with Gravel
	Sands with 5% to 12% fines	ML, MI or MH fines	SW-SM	Well Graded Sand with Silt, Well Graded Sand with Silt and Gravel
			SP-SM	Poorly Graded Sand with Silt, Poorly Graded Sand with Silt and Gravel
		CL, CI or CH fines	SW-SC	Well Graded Sand with Clay, Well Graded Sand with Clay and Gravel
			SP-SC	Poorly Graded Sand with Clay, Poorly Graded Sand with Clay and Gravel
	Sands with more than 12% fines	ML, MI or MH fines	SM	Silty Sand, Silty Sand with Gravel
		CL, CI or CH fines	SC	Clayey Sand, Clayey Sand with Gravel
		CL-ML fines	SC-SM	Silty, Clayey Sand; Silty, Clayey Sand with Gravel

US STANDARD SIEVES	3 Inch	¾ Inch	No. 4	No. 10	No. 40	No. 200	
	COARSE	FINE	COARSE	MEDIUM	FINE		
COBBLES & BOULDERS	GRAVELS		SANDS				SILTS AND CLAYS

RELATIVE DENSITY (SANDS AND GRAVELS)	STANDARD PENETRATION (BLOWS/FOOT)
Very Loose	0 - 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 - 50
Very Dense	50+

1. Add “with sand” to group name if material contains 15% or greater of sand-sized particle. Add “with gravel” to group name if material contains 15% or greater of gravel-sized particle.

MOISTURE	CRITERIA
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soi is below the water table

PACIFIC GEOTECHNICAL ENGINEERING

DATE: 11/4/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 1
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----
SAMPLER: D = 3" OD, 2½" ID Split-spoon X = 2½" OD, 2" ID Split-spoon I = Standard Penetrometer (2" OD SPT) S = Slough in sample		GROUND WATER DEPTH: Initial: approx. 8 ft Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
ALLUVIUM: SILTY SAND: Dark brown, moist, loose to medium dense; (terrace deposit)	SM	1										
		2	S	10				12		96		
		3	D									
		4	D									
loose		5										
		6	S	7		15		12				
		7	I									
SILTY SAND: Yellow brown, wet, loose; (beach/dune sand)	SM	8										
		9	S	9								
		10	I									
		11										
		12										
		13										
slightly clayey		14	S	6								
		15	I									
		16										
		17										
CLAYEY SAND: Gray brown to yellow brown, wet, loose; mostly fine to medium sand; with weathered granitic clasts (probably fluvial deposit)	SC	18										
		19	S	7		26		19				
		20	I									

DATE: 11/4/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 1
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: approx. 8 ft; Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
CLAYEY SAND (continued)	SC	21										
		22										
		23										
light olive brown, medium dense, wet samples, but no free water in hole		24	S I I	17								
		25										
		26										
		27										
WELL GRADED SAND with SILT: Light olive brown, wet, medium dense; mostly fine to medium sand	SM	28										
free water in hole		29	S I I	26		12		19				
		30										
		31										
		32										
		33										
		34	S I I	28								
CLAYEY SAND: Yellow brown, wet, medium dense	SC	35										
		36										
		37										
		38										
		39	S I I	21								
SILTY SAND: Yellow brown, wet, medium dense; fine micaceous sand	SM	40										

DATE: 11/4/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 1
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----
SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample	GROUND WATER DEPTH:	Initial: approx. 8 ft; Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
SILTY SAND (continued)	SM	41										
		42										
CLAYEY SAND: Grayish brown, wet, very dense; mostly fine to medium sand; with granitic clast in shoe; harder drilling below approximately 42.5 feet	SC	43										
		44	I	50/3"		19		14				
		45										
		46										
		47										
		48										
POORLY GRADED GRAVEL with SAND and CLAY: Yellow brown, wet, very dense; fine to coarse sand and gravel; with granitic rounded gravel and cobbles	GP-GC	49	S I I	61								
		50										
		51										
		52										
		53										
grinding on gravel		54	I	50/5"		12		11				
		55										
		56										
		57										
		58										
		59	S I I									
granitic clast in shoe; severely weathered		60		50/6"								

DATE: 11/4/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 1

PROJECT NAME: Ecosystem Protection Barrier **PROJECT NUMBER:** 2012.0133

DRILL RIG: Mobile B-61 **LOGGED BY:** JF

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: **Initial:** approx. 8 ft **Final:** ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
POORLY GRADED GRAVEL with SAND and CLAY (continued)	GP-GC	61										
		62										
hard granitic fragments in shoe			I	50/1"								
BOTTOM OF HOLE @ 62.5 Feet		63										
		64										
		65										
		66										
		67										
		68										
		69										
		70										
		71										
		72										
		73										
		74										
		75										
		76										
		77										
		78										
		79										
		80										

DATE: 11/4/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 2

PROJECT NAME: Ecosystem Protection Barrier **PROJECT NUMBER:** 2012.0133

DRILL RIG: Mobile B-61 **LOGGED BY:** JF

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: **Initial:** 16 feet **Final:** approx. 3.7 ft

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
ALLUVIUM: SANDY SILT: Black, moist, loose to medium dense; micaceous, organic rich (terrace deposit?)	ML	1	S									
		2	D	10				24		93		
		3	D									
CLAYEY SAND: Greenish gray, moist, medium dense; fine to coarse sand; with a black silt layer in upper part of sample	SC	4										
		5	S									
		6	I	16		19		17				
		7	I									
CLAYEY SAND: Dark yellowish brown, moist, medium dense; fine to coarse sand; with decomposed granitic clasts	SC	8										
		9	S									
		10	I	11								
		11	I									
		12										
		13										
with fine to coarse gravel sized granitic fragments; dense		14	S									
		15	I	35		15		13				
		16	I									
		17										
		18										
very dense		19	S									
		20	I	51								

PACIFIC GEOTECHNICAL ENGINEERING **PAGE:** 1 of 1

DATE: 11/4/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 2
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: 16 feet; Final: approx. 3.7 ft

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
CLAYEY SAND (continued)	SC	21										
		22										
WELL GRADED SAND: Yellow brown, wet, medium dense; fine to coarse granitic sand	SW	23										
		24	S									
		25	I	23		5		25				
		26										
		27										
		28										
dense		29	S									
		30	I	49								
		31										
		32										
CLAYEY SAND: Yellow brown, moist, dense to very dense; fine to coarse granitic sand	SC	33										
		34	S									
		35	I	51		21		14				
		36										
		37										
		38										
light gray		39	I	50/6"								
		40										

DATE: 11/4/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 2
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: 16 feet; Final: approx. 3.7 ft

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
CLAYEY SAND (continued)	SC	41										
grinding on gravels/possibly cobbles		42										
CLAYEY SAND: Yellowish brown, wet, very dense; fine to coarse sand; sampling refusal on cobbles; many rounded pebbles and cobbles	SC	43										
		44	S I	50/5"		21		16				
		45										
		46										
		47										
		48										
		49	I	50/6" (no recovery)								
		50										
		51										
		52										
		53										
sampling refusal on cobbles; abundant rounded pebbles and cobbles		54	I I	50/5" 50/5"								
		55										
		56										
		57										
sampling refusal on cobbles		58	I	50/4.5"								
BOTTOM OF HOLE @ 58.5 Feet		59										
		60										

DATE: 11/5/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 3
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: approx. 6.9 ft; Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
ALLUVIUM: CLAYEY SAND: Dark brown, moist, loose to medium dense	SC	1	S I									
CLAYEY SAND: Yellow brown, moist, loose to medium dense; mostly fine to medium sand; granitic clasts	SC	2	S I	10		20		8				
		3										
		4										
loose		5	S I									
		6	I	6		15		13				
		7										
		8										
brown, medium dense to desne; mostly fine to medium granitic sand (weathered granitic cobbles?)		9	S I									
		10	I	31		13		11				
		11										
		12										
CLAYEY SAND: Gray, wet, dense; mostly fine to medium sand; with pebbles and cobbles	SC	13										
		14	S I									
		15	I	40								
		16										
		17										
LEAN CLAY with SAND: Light olive brown, wet, stiff; with mostly fine to medium sand	CL	18										
		19	S I									
		20	I	10		79		41				

DATE: 11/5/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 3
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----
SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample	GROUND WATER DEPTH:	Initial: approx. 6.9 ft; Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
LEAN CLAY with SAND (continued)	CL	21										
SILT and SANDY SILT: Olive to reddish brown, wet, medium dense; with silty sand lenses	ML	22										
		23										
		24	S I I	25		60		33				
		25										
		26										
		27										
		28										
WELL GRADED SAND with SILT: Gray, moist, medium dense to dense; fine to coarse sand	SW-SM	29	S I I	31								
		30										
		31										
		32										
		33										
PEAT, ELASTIC SILT to ORGANIC SILT: Black (10YR 2/1) to very dark gray (2.5Y 3/3), moist, stiff; redwood tree lower half of sample	OH/MH	34	S I I	47				53				
		35										
		36										
		37										
		38										
SANDY CLAY: Light yellowish brown, moist, hard	CL	39	S D D	37				21		104		
		40										

DATE: 11/5/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 3
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: approx. 6.9 ft; Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
SANDY CLAY (continued)	CL	41										
		42										
CLAYEY SAND with GRAVEL: Light olive brown, wet, very dense; fine to coarse sand; with mostly fine gravel	SC	43										
		44	S									
		45	I	50/6"		12		18				
grinding on gravels/cobbles poor sample recovery		46	I	50/1.5"								
BOTTOM OF HOLE @ 46 Feet		47										
		48										
		49										
		50										
		51										
		52										
		53										
		54										
		55										
		56										
		57										
		58										
		59										
		60										

DATE: 11/5/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 4
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: approx. 17 ft; Final: approx. 17½ ft

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
PAVEMENT: AC, baserock & sand fill												
ALLUVIUM: SANDY LEAN CLAY to SANDY SILTY: Dark gray brown, moist, soft; with organic layers (peat?)	CL/ ML	1	S									
		2	I	4		53		40				
		3	I									
		4										
		5										
CLAYEY SAND: Gray, moist, loose; mostly fine to medium sand	SC	6	S	5	(no recovery)							
		7	I									
		8	D	9		32		20				
			D					18		114		
with granitic clasts		9	S									
		10	I	8		22		19				
		11										
		12										
sampling refusal (bouncing) @13.5 feet grinding on gravels		13										
		14										
brown, moist, dense		15	S	35		14		19				
		16	I									
LEAN CLAY to SILT with SAND: Light olive brown, wet, very stiff to hard; with mostly fine to medium sand	CL	17										
		18										
		19	S	75								
		20	I									

PACIFIC GEOTECHNICAL ENGINEERING PAGE: 1 of 1

DATE: 11/5/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 4
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: approx. 17 ft; Final: approx. 17½

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
LEAN CLAY to SILT with SAND (continued)	CL/ML	21										
POORLY GRADED SAND with SILT: Light brownish gray, wet, medium dense; mostly fine to medium sand	SP-SM	22										
		23										
		24	S I I	17		31		31				
CLAYEY SAND: Olive gray to orange brown, wet, medium dense; many fine laminations in clay beds	SC	25										
		26										
		27										
		28										
ELASTIC SILT, ORGANIC SILT to FAT CLAY: Very dark gray, moist, stiff	MH/OH/CH	29	S I I	13		73	62	46	30			
		30										
		31										
		32										
CLAYEY SAND: Light gray, moist, very dense; mostly fine to medium sand; with trace of iron-oxide mottling	SC	33										
		34	S I I	80								
		35										
		36										
		37										
		38										
light yellowish brown; dense		39	S I I	44		33		15				
		40										

DATE: 11/5/2012	LOG OF EXPLORATORY DRILL HOLE	DH- 4
PROJECT NAME: Ecosystem Protection Barrier		PROJECT NUMBER: 2012.0133
DRILL RIG: Mobile B-61		LOGGED BY: JF
HOLE DIAMETER: 8" hollow stem auger		HOLE ELEVATION: -----

SAMPLER: D = 3" OD, 2½" ID Split-spoon; X = 2½" OD, 2" ID Split-spoon; I = Standard Penetrometer (2" OD SPT); S = Slough in sample

GROUND WATER DEPTH: Initial: approx. 17 ft; Final: approx. 17½

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
CLAYEY SAND (continued)	SC	41										
		42										
CLAYEY SAND: Grayish brown, wet, dense	SC	43										
		44	S									
moist, with rounded gravel in shoe		45	D	46				20		109		
		46	D									
		47										
		48										
light olive brown, mottled with iron oxide, grinding on gravels		49	I	50/5"								
		50										
BOTTOM OF HOLE @ 50 Feet (Refusal to Drilling on Hard Cobbles or Boulders)		51										
		52										
		53										
		54										
		55										
		56										
		57										
		58										
		59										
		60										

APPENDIX B

Cone Penetrometer Results

(CPT-1 through CPT-3)

PROJECT: SCENIC ROAD SEAWALL
LOCATION: Carmel CA
PROJ. NO.: 2012.0134(PGE-21)
Terminated at 70.0 feet

CPT NO.: CPT-1
DATE: 10-24-2012
TIME: 10:43:00
Groundwater measured at 8.3 feet

PACIFIC GEOTECHNICAL

cpts by John Sarmiento & Associates

DEPTH (feet)	Qc (tsf)	Qc' (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT' (N')	EffVtStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
0.53	129.9	207.79	0.70	0.5	26	42	0.06	42	----	SAND	100-110
1.06	176.9	283.0	0.84	0.5	35	57	0.12	44	----	"	"
1.55	207.8	332.54	0.83	0.4	42	66	0.17	45	----	"	"
2.07	159.5	255.15	0.70	0.4	32	51	0.22	43	----	"	"
2.54	164.4	262.96	0.77	0.5	33	53	0.27	44	----	"	"
3.01	141.6	226.59	0.72	0.5	28	45	0.32	43	----	"	"
3.55	105.0	168.00	0.54	0.5	21	34	0.38	41	----	"	"
4.03	92.5	147.98	0.52	0.6	23	37	0.43	40	----	SAND to Silty SAND	"
4.52	146.2	233.89	0.62	0.4	29	47	0.48	43	----	SAND	"
5.01	113.2	181.18	0.46	0.4	23	36	0.50	41	----	"	"
5.57	114.0	182.38	0.36	0.3	23	36	0.52	41	----	"	90-100
6.08	117.6	188.22	0.41	0.3	24	38	0.54	42	----	"	"
6.53	125.4	200.67	0.45	0.4	25	40	0.55	42	----	"	"
7.01	104.4	166.99	0.39	0.4	21	33	0.57	41	----	"	"
7.52	94.2	150.64	0.35	0.4	19	30	0.58	40	----	"	"
8.03	83.8	134.03	0.31	0.4	21	34	0.60	40	----	SAND to Silty SAND	"
8.54	38.0	60.80	0.21	0.5	13	20	0.62	35	----	Silty SAND to Sandy SILT	"
9.05	35.6	56.90	0.13	0.4	12	19	0.63	35	----	"	"
9.55	28.4	45.42	0.08	0.3	9	15	0.64	33	----	"	85-90
10.07	49.1	78.61	0.19	0.4	12	20	0.66	37	----	SAND to Silty SAND	90-100
10.53	54.8	87.65	0.09	0.2	14	22	0.67	37	----	"	85-90
11.06	42.6	68.11	0.07	0.2	11	17	0.68	36	----	"	80-85
11.50	55.2	88.37	0.10	0.2	14	22	0.70	37	----	"	85-90
12.02	49.1	78.61	0.09	0.2	12	20	0.71	37	----	"	"
12.55	31.8	50.80	0.04	0.1	11	17	0.72	34	----	Silty SAND to Sandy SILT	80-85
13.08	25.2	40.30	0.03	0.1	8	13	0.73	33	----	"	"
13.51	40.3	64.48	0.07	0.2	10	16	0.74	35	----	SAND to Silty SAND	"
14.06	56.8	90.85	0.11	0.2	14	23	0.75	37	----	"	85-90
14.50	65.8	105.25	0.14	0.2	16	26	0.76	38	----	"	"
15.03	79.2	126.74	0.14	0.2	16	25	0.78	39	----	SAND	"
15.55	93.3	149.20	0.15	0.2	19	30	0.79	40	----	"	"
16.06	110.6	176.79	0.17	0.2	22	35	0.80	41	----	"	"
16.56	109.9	174.45	0.15	0.1	22	35	0.81	41	----	"	80-85
17.01	78.3	123.46	0.12	0.1	16	25	0.82	39	----	"	85-90
17.52	47.2	73.78	0.11	0.2	12	18	0.84	36	----	SAND to Silty SAND	"
18.04	41.7	64.65	0.12	0.3	10	16	0.85	35	----	"	"
18.54	50.1	77.03	0.14	0.3	13	19	0.86	36	----	"	"
19.06	70.4	107.33	0.11	0.2	18	27	0.88	38	----	"	"
19.58	79.4	120.02	0.13	0.2	16	24	0.89	39	----	SAND	"
20.02	69.8	104.72	0.13	0.2	17	26	0.90	38	----	SAND to Silty SAND	"
20.51	72.4	107.74	0.17	0.2	18	27	0.91	38	----	"	"
21.02	72.4	106.82	0.12	0.2	18	27	0.92	38	----	"	"
21.54	40.2	58.79	0.08	0.2	10	15	0.94	35	----	"	"
22.06	31.5	45.66	0.06	0.2	10	15	0.95	33	----	Silty SAND to Sandy SILT	"
22.51	28.8	41.37	0.06	0.2	10	14	0.96	33	----	"	"
23.04	30.4	43.46	0.06	0.2	10	14	0.97	33	----	"	80-85
23.56	31.7	44.80	0.07	0.2	11	15	0.99	33	----	"	85-90
24.09	38.4	53.90	0.06	0.2	10	13	1.00	34	----	SAND to Silty SAND	80-85
24.58	41.9	58.53	0.06	0.2	10	15	1.01	35	----	"	"
25.01	40.7	56.61	0.08	0.2	10	14	1.02	35	----	"	85-90
25.52	32.6	45.09	0.11	0.3	11	15	1.03	33	----	Silty SAND to Sandy SILT	90-100
26.04	45.4	62.04	0.63	1.4	15	21	1.07	35	----	"	120-130
26.57	29.4	39.58	0.76	2.6	12	16	1.10	----	3.76	Sandy SILT to Clayey SILT	130-140
27.01	14.3	19.11	0.24	1.7	7	9	1.13	----	1.74	Clayey SILT to Silty CLAY	110-120

PROJECT: SCENIC ROAD SEAWALL
LOCATION: Carmel CA
PROJ. NO.: 2012.0134(PGE-21)
Terminated at 70.0 feet

CPT NO.: CPT-1
DATE: 10-24-2012
TIME: 10:43:00
Groundwater measured at 8.3 feet

PACIFIC GEOTECHNICAL
cpts by John Sarmiento & Associates

DEPTH (feet)	Qc (tsf)	Qc' (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT' (N')	EffVtStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
27.52	35.5	47.13	0.08	0.2	9	12	1.14	34	----	SAND to Silty SAND	85-90
28.06	49.7	65.7	0.07	0.1	12	16	1.15	36	----	"	80-85
28.52	43.8	57.53	0.14	0.3	11	14	1.17	35	----	"	90-100
29.04	55.1	71.98	0.12	0.2	14	18	1.18	36	----	"	85-90
29.57	81.2	105.52	0.14	0.2	16	21	1.19	38	----	SAND	"
30.00	89.4	115.37	0.38	0.4	18	23	1.21	39	----	"	100-110
30.51	133.0	170.78	0.24	0.2	27	34	1.22	41	----	"	85-90
31.03	142.8	182.07	0.40	0.3	29	36	1.24	41	----	"	90-100
31.54	156.9	198.96	0.29	0.2	31	40	1.25	42	----	"	85-90
32.07	148.9	187.94	0.24	0.2	30	38	1.27	42	----	"	"
32.50	147.4	185.25	0.29	0.2	29	37	1.28	42	----	"	"
33.00	146.6	183.40	0.26	0.2	29	37	1.29	41	----	"	"
33.51	106.8	132.94	0.18	0.2	21	27	1.30	40	----	"	"
34.01	110.9	137.38	0.19	0.2	22	27	1.32	40	----	"	"
34.54	142.5	175.61	0.26	0.2	28	35	1.33	41	----	"	"
35.04	118.4	145.18	0.17	0.1	24	29	1.34	40	----	"	"
35.56	26.4	31.98	0.64	2.4	11	13	1.37	----	3.30	Sandy SILT to Clayey SILT	120-130
36.05	47.8	57.22	0.41	0.8	16	19	1.40	35	----	Silty SAND to Sandy SILT	110-120
36.57	62.7	74.26	0.43	0.7	16	19	1.43	36	----	SAND to Silty SAND	"
37.03	64.4	75.69	0.32	0.5	16	19	1.45	36	----	"	100-110
37.55	93.9	109.70	0.31	0.3	19	22	1.46	39	----	SAND	90-100
38.06	129.4	150.01	0.42	0.3	26	30	1.48	40	----	"	"
38.57	133.2	153.39	0.37	0.3	27	31	1.50	40	----	"	"
39.01	129.7	148.63	0.38	0.3	26	30	1.51	40	----	"	"
39.52	140.2	159.87	0.42	0.3	28	32	1.53	41	----	"	"
40.01	130.5	147.98	0.39	0.3	26	30	1.54	40	----	"	"
40.52	103.9	117.05	0.43	0.4	21	23	1.57	39	----	"	100-110
41.02	135.2	151.52	0.47	0.4	27	30	1.58	40	----	"	90-100
41.52	184.3	205.73	0.35	0.2	37	41	1.59	42	----	"	85-90
42.02	135.7	150.80	0.26	0.2	27	30	1.61	40	----	"	"
42.52	94.9	104.97	0.35	0.4	19	21	1.62	38	----	"	90-100
43.02	77.7	85.15	0.58	0.8	19	21	1.65	37	----	SAND to Silty SAND	110-120
43.53	52.3	56.78	0.46	0.9	17	19	1.68	35	----	Silty SAND to Sandy SILT	"
44.01	31.4	33.75	0.82	2.6	13	13	1.71	----	3.91	Sandy SILT to Clayey SILT	130-140
44.53	112.6	120.22	0.43	0.4	22	24	1.73	39	----	SAND	90-100
45.07	94.0	99.58	0.49	0.5	23	25	1.75	38	----	SAND to Silty SAND	100-110
45.51	55.6	58.46	1.39	2.5	22	23	1.78	----	7.12	Sandy SILT to Clayey SILT	130-140
46.01	141.6	148.43	0.34	0.2	28	30	1.80	40	----	SAND	90-100
46.51	163.2	170.30	0.73	0.4	33	34	1.82	41	----	"	100-110
47.01	110.3	114.58	0.42	0.4	22	23	1.84	39	----	"	90-100
47.53	130.7	135.27	0.32	0.2	26	27	1.85	40	----	"	"
48.03	171.8	177.36	0.37	0.2	34	35	1.87	41	----	"	85-90
48.52	190.4	195.82	0.54	0.3	38	39	1.88	42	----	"	90-100
49.01	175.3	179.79	0.38	0.2	35	36	1.89	41	----	"	85-90
49.51	182.5	186.45	0.54	0.3	36	37	1.91	42	----	"	90-100
50.03	180.9	184.05	0.44	0.2	36	37	1.93	42	----	"	"
50.58	239.9	243.09	0.75	0.3	40	40	1.95	43	----	Gravelly SAND to SAND	"
51.07	237.3	239.55	0.74	0.3	40	40	1.96	43	----	"	"
51.55	238.7	240.25	0.45	0.2	40	40	1.97	43	----	"	85-90
52.03	236.3	236.91	0.53	0.2	39	39	1.99	43	----	"	90-100
52.50	228.7	228.66	0.37	0.2	38	38	2.00	43	----	"	85-90
53.06	233.2	233.17	0.47	0.2	39	39	2.01	43	----	"	"
53.56	234.5	234.34	0.40	0.2	39	39	2.03	43	----	"	"
54.03	259.8	259.57	0.50	0.2	43	43	2.04	44	----	"	"

PROJECT: SCENIC ROAD SEAWALL
LOCATION: Carmel CA
PROJ. NO.: 2012.0134(PGE-21)
Terminated at 70.0 feet

CPT NO.: CPT-1
DATE: 10-24-2012
TIME: 10:43:00
Groundwater measured at 8.3 feet

PACIFIC GEOTECHNICAL
cpts by John Sarmiento & Associates

DEPTH (feet)	Qc (tsf)	Qc' (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT' (N')	EffVtStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
54.51	278.4	278.10	0.53	0.2	46	46	2.05	44	----	Gravelly SAND to SAND	85-90
55.05	251.8	251.49	0.58	0.2	42	42	2.07	43	----	"	90-100
55.54	205.8	205.44	0.38	0.2	34	34	2.08	42	----	"	85-90
56.01	163.7	163.33	0.47	0.3	33	33	2.10	41	----	SAND	90-100
56.58	144.6	144.25	0.40	0.3	29	29	2.11	40	----	"	"
57.03	125.7	125.36	0.21	0.2	25	25	2.13	39	----	"	85-90
57.57	31.9	31.76	0.42	1.3	11	10	2.16	31	----	Silty SAND to Sandy SILT	120-130
58.05	14.7	14.62	0.46	3.1	9	9	2.19	----	1.59	Silty CLAY to CLAY	"
58.57	60.9	60.64	0.39	0.6	15	15	2.21	35	----	SAND to Silty SAND	100-110
59.01	61.6	61.29	0.38	0.6	15	15	2.23	35	----	"	"
59.54	52.7	52.43	0.47	0.9	18	17	2.26	34	----	Silty SAND to Sandy SILT	110-120
60.06	52.2	51.87	0.53	1.0	17	17	2.29	34	----	"	120-130
60.51	56.5	56.18	0.55	1.0	19	19	2.32	35	----	"	"
61.04	56.7	56.28	0.53	0.9	14	14	2.35	35	----	SAND to Silty SAND	"
61.57	55.2	54.72	0.62	1.1	18	18	2.39	35	----	Silty SAND to Sandy SILT	"
62.08	105.9	105.02	0.31	0.3	21	21	2.40	38	----	SAND	90-100
62.52	63.5	63.00	0.42	0.7	16	16	2.43	35	----	SAND to Silty SAND	110-120
63.03	151.3	149.93	0.52	0.3	30	30	2.44	40	----	SAND	90-100
63.52	183.2	181.56	0.48	0.3	37	36	2.46	41	----	"	"
64.06	159.0	157.45	0.68	0.4	32	31	2.48	41	----	"	100-110
64.55	177.8	175.84	0.65	0.4	35	35	2.50	41	----	"	"
65.06	191.6	188.54	0.43	0.2	38	38	2.52	42	----	"	90-100
65.50	197.9	193.75	0.54	0.3	40	39	2.53	42	----	"	"
66.02	177.2	172.45	0.53	0.3	35	34	2.55	41	----	"	"
66.54	236.5	228.88	0.64	0.3	39	38	2.57	43	----	Gravelly SAND to SAND	"
67.05	208.1	200.28	0.57	0.3	42	40	2.58	42	----	SAND	"
67.55	208.8	199.86	0.65	0.3	42	40	2.60	42	----	"	"
68.05	203.7	193.14	1.10	0.5	41	39	2.63	42	----	"	110-120
68.57	198.5	187.14	0.62	0.3	40	37	2.64	42	----	"	90-100
69.00	239.6	224.77	0.56	0.2	40	37	2.66	43	----	Gravelly SAND to SAND	"
69.53	215.7	201.14	0.48	0.2	36	33	2.67	42	----	"	"
70.00	147.3	136.31	0.69	0.5	29	27	2.69	40	----	SAND	100-110

DEPTH = Sampling interval (~0.1 feet)
Qc = Tip bearing uncorrected Qt = Tip bearing corrected Fs = Sleeve friction resistance Rf = Qt / Fs
SPT = Equivalent Standard Penetration Test Qt' and SPT' = Qt and SPT corrected for overburden
EffVtStr = Effective Vertical Stress using est. density** Phi = Soil friction angle*
Su = Undrained Soil Strength* (see classification chart)
References: * Robertson and Campanella, 1988 **Olsen, 1989 *** Durgunoglu & Mitchell, 1975

PROJECT: SCENIC ROAD SEAWALL
LOCATION: Carmel CA
PROJ. NO.: 2012.0134(PGE-21)
Terminated at 27.5 feet

CPT NO.: CPT-2
DATE: 10-24-2012
TIME: 15:03:00
Groundwater estimated at 11.0 feet

PACIFIC GEOTECHNICAL

cpts by John Sarmiento & Associates

DEPTH (feet)	Qc (tsf)	Qc' (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT' (N')	EffVtStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
0.51	161.1	257.81	1.47	0.9	32	52	0.06	43	----	SAND	120-130
1.01	147.6	236.1	1.19	0.8	30	47	0.12	43	----	"	110-120
1.52	137.1	219.41	0.52	0.4	27	44	0.17	43	----	"	100-110
2.06	102.1	163.36	0.55	0.5	20	33	0.23	41	----	"	"
2.54	75.7	121.06	0.44	0.6	19	30	0.28	39	----	SAND to Silty SAND	"
3.03	62.0	99.18	0.39	0.6	15	25	0.33	38	----	"	"
3.53	58.8	94.02	0.39	0.7	15	23	0.38	38	----	"	"
4.03	56.9	91.06	0.38	0.7	14	23	0.43	37	----	"	"
4.53	67.5	108.03	0.37	0.5	17	27	0.49	38	----	"	"
5.04	70.3	112.45	0.33	0.5	18	28	0.51	39	----	"	"
5.55	75.4	120.56	0.37	0.5	19	30	0.53	39	----	"	"
6.02	71.0	113.66	0.34	0.5	18	28	0.55	39	----	"	"
6.52	73.8	118.10	0.34	0.5	18	30	0.57	39	----	"	"
7.05	78.6	125.71	0.33	0.4	20	31	0.59	39	----	"	90-100
7.54	75.5	120.80	0.36	0.5	19	30	0.61	39	----	"	100-110
8.06	85.0	136.03	0.36	0.4	21	34	0.63	40	----	"	90-100
8.52	92.2	147.58	0.39	0.4	18	30	0.64	40	----	SAND	100-110
9.05	94.7	151.52	0.42	0.4	19	30	0.67	40	----	"	"
9.57	89.6	143.41	0.42	0.5	22	36	0.69	40	----	SAND to Silty SAND	"
10.07	106.7	170.70	0.52	0.5	21	34	0.71	41	----	SAND	"
10.52	105.8	169.22	0.52	0.5	21	34	0.73	41	----	"	"
11.01	107.9	172.66	0.53	0.5	22	35	0.75	41	----	"	"
11.54	109.8	175.60	0.54	0.5	22	35	0.77	41	----	"	"
12.04	100.5	160.85	0.53	0.5	20	32	0.80	41	----	"	"
12.52	126.5	200.43	0.63	0.5	25	40	0.82	42	----	"	"
13.00	106.4	166.36	0.57	0.5	21	33	0.84	41	----	"	"
13.56	93.8	144.41	0.50	0.5	23	36	0.86	40	----	SAND to Silty SAND	"
14.05	94.4	143.37	0.49	0.5	19	29	0.88	40	----	SAND	"
14.55	91.6	137.24	0.48	0.5	23	34	0.90	40	----	SAND to Silty SAND	"
15.02	96.2	142.21	0.50	0.5	19	28	0.92	40	----	SAND	"
15.52	109.7	159.87	0.58	0.5	22	32	0.94	41	----	"	"
16.02	141.5	203.19	0.73	0.5	28	41	0.96	42	----	"	"
16.52	124.9	176.09	0.74	0.6	25	35	0.99	41	----	"	110-120
17.00	185.0	257.93	0.81	0.4	37	52	1.01	43	----	"	100-110
17.50	120.6	166.54	0.86	0.7	24	33	1.04	41	----	"	110-120
18.01	132.9	181.66	0.83	0.6	27	36	1.06	41	----	"	"
18.50	125.2	169.45	0.80	0.6	25	34	1.09	41	----	"	"
19.04	112.2	150.14	0.69	0.6	22	30	1.12	40	----	"	"
19.53	80.1	106.29	0.49	0.6	20	27	1.14	38	----	SAND to Silty SAND	100-110
20.02	70.5	92.87	0.46	0.6	18	23	1.16	38	----	"	"
20.52	84.4	109.93	0.55	0.7	21	27	1.19	39	----	"	110-120
21.02	93.4	120.71	0.51	0.5	23	30	1.21	39	----	"	100-110
21.52	80.8	103.53	0.46	0.6	20	26	1.23	38	----	"	"
22.00	71.2	90.37	0.38	0.5	18	23	1.25	37	----	"	"
22.51	54.1	68.14	0.32	0.6	14	17	1.27	36	----	"	"
23.02	48.9	61.05	0.28	0.6	12	15	1.29	35	----	"	"
23.53	58.7	72.86	0.27	0.5	15	18	1.31	36	----	"	90-100
24.04	48.7	60.09	0.22	0.5	12	15	1.33	35	----	"	"
24.55	50.7	62.02	0.30	0.6	13	16	1.35	35	----	"	100-110
25.05	94.7	114.79	0.54	0.6	24	29	1.37	39	----	"	"
25.55	202.5	243.09	1.23	0.6	41	49	1.40	43	----	SAND	110-120
26.02	296.3	351.37	3.09	1.0	59	70	1.42	45	----	"	120-130
26.50	275.1	321.61	3.55	1.3	55	64	1.46	45	----	"	130-140
27.01	240.0	276.34	4.52	1.9	48	55	1.50	44	----	"	"
27.51	317.5	361.29	8.71	2.7	159	181	1.53	45	----	SAND to Clayey SAND *	"

PROJECT: SCENIC ROAD SEAWALL
LOCATION: Carmel CA
PROJ. NO.: 2012.0134(PGE-21)
Terminated at 30.5 feet

CPT NO.: CPT-3
DATE: 10-24-2012
TIME: 14:07:00
Groundwater estimated at 8.2 feet

PACIFIC GEOTECHNICAL

cpts by John Sarmiento & Associates

DEPTH (feet)	Qc (tsf)	Qc' (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT' (N')	EffVtStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
0.51	0.7	1.06	0.10	14.4	1	1	0.06	----	0.13	Organic Material	85-90
1.00	71.0	113.6	1.31	1.8	24	38	0.12	39	----	Silty SAND to Sandy SILT	130-140
1.52	32.3	51.66	1.20	3.7	16	26	0.20	----	4.29	Clayey SILT to Silty CLAY	"
2.02	30.9	49.44	1.12	3.6	15	25	0.26	----	4.10	"	"
2.53	33.5	53.60	0.81	2.4	13	21	0.33	----	4.44	Sandy SILT to Clayey SILT	"
3.04	30.7	49.18	0.79	2.6	12	20	0.40	----	4.07	"	"
3.53	23.6	37.68	0.59	2.5	12	19	0.46	----	3.11	Clayey SILT to Silty CLAY	120-130
4.04	37.5	59.97	0.96	2.6	15	24	0.53	----	4.96	Sandy SILT to Clayey SILT	130-140
4.54	35.3	56.53	0.71	2.0	14	23	0.59	----	4.67	"	120-130
5.00	39.6	63.39	0.28	0.7	13	21	0.61	35	----	Silty SAND to Sandy SILT	100-110
5.56	74.8	119.73	0.56	0.7	19	30	0.64	39	----	SAND to Silty SAND	110-120
6.02	71.5	114.34	0.46	0.6	18	29	0.66	39	----	"	100-110
6.53	85.5	136.86	0.52	0.6	21	34	0.68	40	----	"	"
7.03	94.3	150.83	0.61	0.7	24	38	0.71	40	----	"	110-120
7.53	62.4	99.87	0.44	0.7	16	25	0.74	38	----	"	"
8.04	34.7	55.55	0.25	0.7	12	19	0.76	35	----	Silty SAND to Sandy SILT	100-110
8.56	25.8	41.31	0.18	0.7	9	14	0.77	33	----	"	90-100
9.05	28.1	44.98	0.14	0.5	9	15	0.79	33	----	"	"
9.55	29.2	46.49	0.13	0.4	10	16	0.81	34	----	"	"
10.06	39.4	62.19	0.19	0.5	13	21	0.82	35	----	"	"
10.50	62.6	97.46	0.36	0.6	16	24	0.84	38	----	SAND to Silty SAND	100-110
11.01	76.5	117.14	0.50	0.7	19	29	0.87	39	----	"	110-120
11.51	73.3	110.26	0.49	0.7	18	28	0.90	39	----	"	"
12.05	82.1	121.74	0.49	0.6	21	30	0.92	39	----	"	100-110
12.55	88.9	129.84	0.53	0.6	22	32	0.94	40	----	"	"
13.02	97.5	140.38	0.56	0.6	19	28	0.96	40	----	SAND	"
13.57	107.4	151.65	0.65	0.6	21	30	0.99	40	----	"	110-120
14.04	119.0	165.85	0.69	0.6	24	33	1.01	41	----	"	"
14.51	151.8	209.55	0.85	0.6	30	42	1.04	42	----	"	"
15.07	166.2	226.84	1.02	0.6	33	45	1.07	43	----	"	"
15.55	162.1	219.09	1.01	0.6	32	44	1.09	43	----	"	"
16.00	116.0	155.34	0.84	0.7	23	31	1.12	41	----	"	"
16.54	124.1	164.38	0.75	0.6	25	33	1.14	41	----	"	"
17.02	126.1	165.39	0.76	0.6	25	33	1.17	41	----	"	"
17.51	162.4	210.80	0.89	0.5	32	42	1.20	42	----	"	"
18.08	122.5	157.19	0.75	0.6	25	31	1.23	41	----	"	"
18.52	102.8	130.60	0.66	0.6	21	26	1.25	40	----	"	"
19.04	126.1	158.82	0.70	0.6	25	32	1.27	41	----	"	100-110
19.55	171.2	213.53	1.09	0.6	34	43	1.30	42	----	"	110-120
20.06	218.4	268.45	2.70	1.2	44	54	1.33	44	----	"	130-140
20.52	304.4	369.35	5.51	1.8	61	74	1.37	46	----	"	"
21.01	198.3	238.05	1.55	0.8	40	48	1.39	43	----	"	110-120
21.53	184.9	219.42	1.16	0.6	37	44	1.42	43	----	"	"
22.05	214.0	251.16	1.60	0.7	43	50	1.45	43	----	"	"
22.51	191.3	221.27	6.27	3.3	96	111	1.49	43	----	SAND to Clayey SAND *	>140
23.03	182.2	207.98	5.20	2.9	61	69	1.52	42	----	Silty SAND to Sandy SILT	130-140
23.52	140.3	158.60	1.29	0.9	28	32	1.55	41	----	SAND	120-130
24.04	151.0	169.49	0.76	0.5	30	34	1.58	41	----	"	100-110
24.53	146.3	163.07	0.80	0.5	29	33	1.60	41	----	"	"
25.04	156.5	173.29	0.71	0.5	31	35	1.62	41	----	"	"
25.53	233.1	255.43	1.96	0.8	47	51	1.65	43	----	"	120-130
26.00	211.7	229.71	1.97	0.9	42	46	1.68	43	----	"	"
26.53	369.5	397.24	2.39	0.6	62	66	1.71	46	----	Gravelly SAND to SAND	110-120
27.00	401.4	428.56	2.01	0.5	67	71	1.73	46	----	"	100-110

PROJECT: SCENIC ROAD SEAWALL
LOCATION: Carmel CA
PROJ. NO.: 2012.0134(PGE-21)
Terminated at 30.5 feet

CPT NO.: CPT-3
DATE: 10-24-2012
TIME: 14:07:00
Groundwater estimated at 8.2 feet

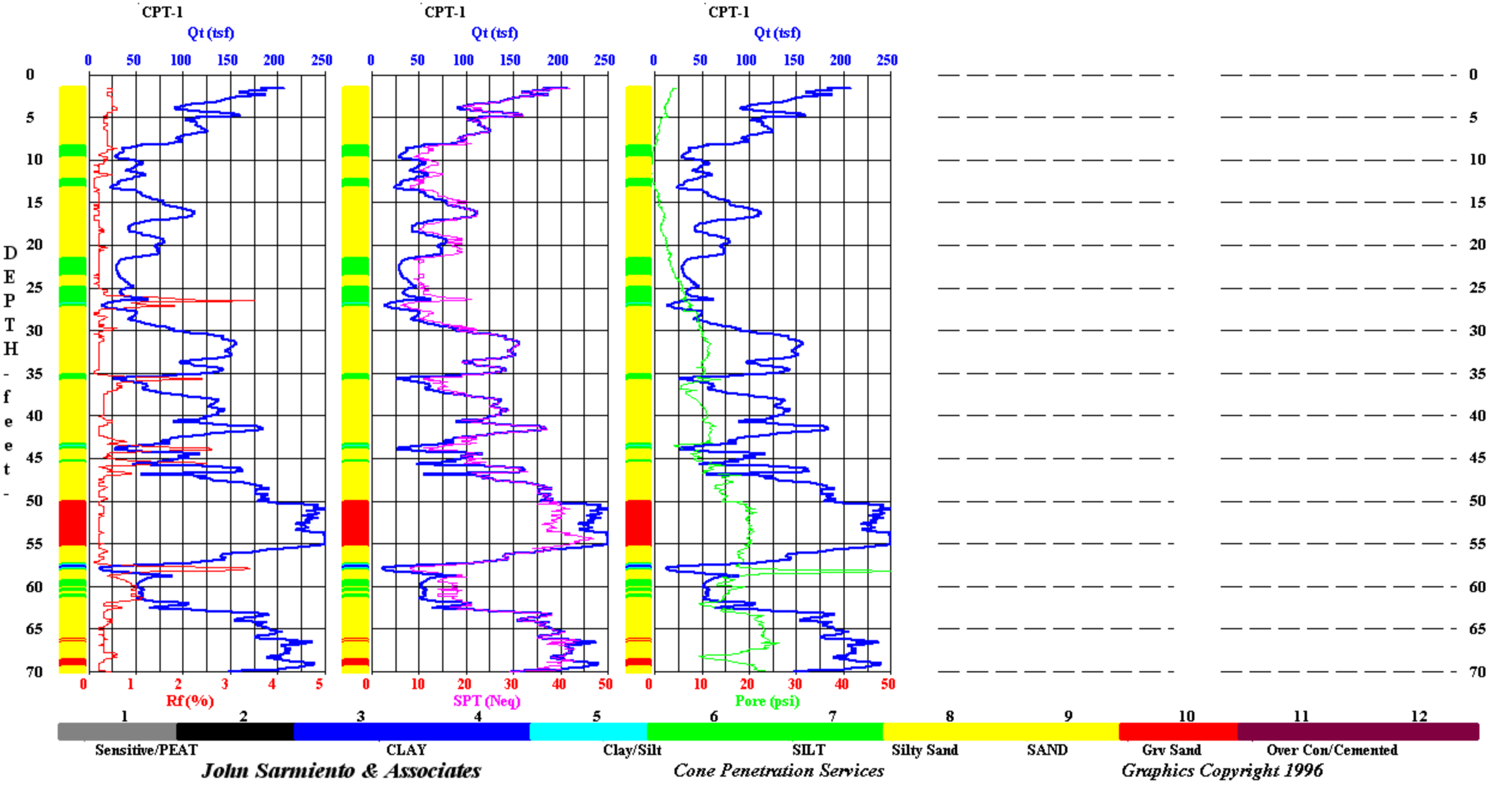
PACIFIC GEOTECHNICAL
cpts by John Sarmiento & Associates

DEPTH (feet)	Qc (tsf)	Qc' (tsf)	Fs (tsf)	Rf (%)	SPT (N)	SPT' (N')	EffVtStr (ksf)	PHI (deg.)	SU (ksf)	SOIL BEHAVIOR TYPE	DENSITY RANGE (pcf)
27.51	438.7	464.49	3.14	0.7	73	77	1.76	47	----	Gravelly SAND to SAND	110-120
28.03	255.5	268.47	2.52	1.0	51	54	1.79	44	----	SAND	120-130
28.54	269.7	281.02	4.47	1.7	54	56	1.82	44	----	"	130-140
29.02	192.4	198.79	7.46	3.9	96	99	1.86	42	----	SAND to Clayey SAND *	>140
29.50	557.2	571.01	7.92	1.4	111	114	1.90	>48	----	SAND	130-140
30.03	240.9	244.64	3.19	1.3	48	49	1.94	43	----	"	"
30.52	603.0	607.24	6.80	1.1	121	121	1.97	>48	----	"	"

DEPTH = Sampling interval (~0.1 feet)
Qc = Tip bearing uncorrected Qt = Tip bearing corrected Fs = Sleeve friction resistance Rf = Qt / Fs
SPT = Equivalent Standard Penetration Test Qt' and SPT' = Qt and SPT corrected for overburden
EffVtStr = Effective Vertical Stress using est. density** Phi = Soil friction angle*
Su = Undrained Soil Strength* (see classification chart)
References: * Robertson and Campanella, 1988 **Olsen, 1989 *** Durgunoglu & Mitchell, 1975

PROJECT: SCENIC ROAD SEAWALL

LOCATION: Carmel CA



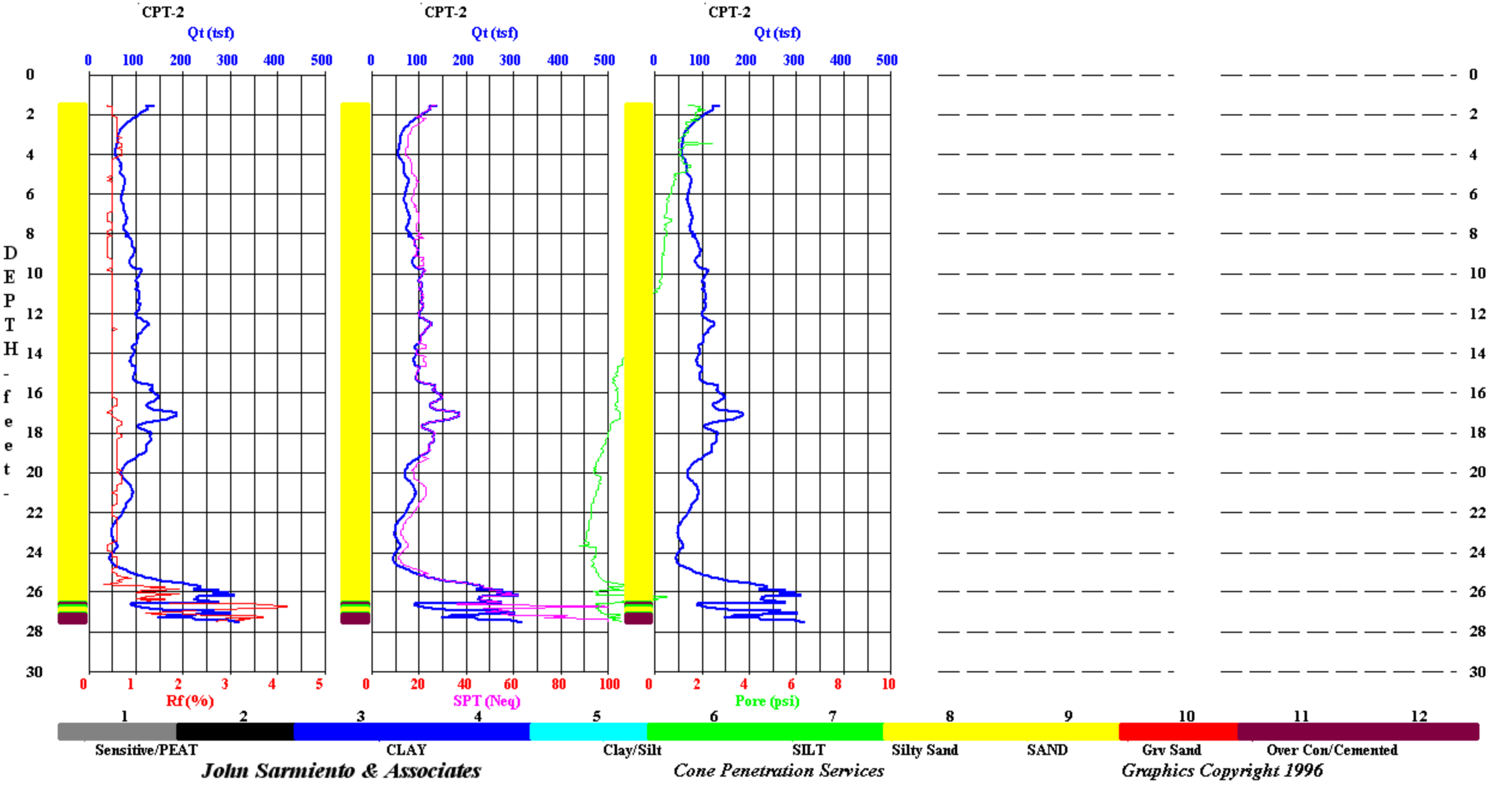
John Sarmiento & Associates

Cone Penetration Services

Graphics Copyright 1996

PROJECT: SCENIC ROAD SEAWALL

LOCATION: Carmel CA



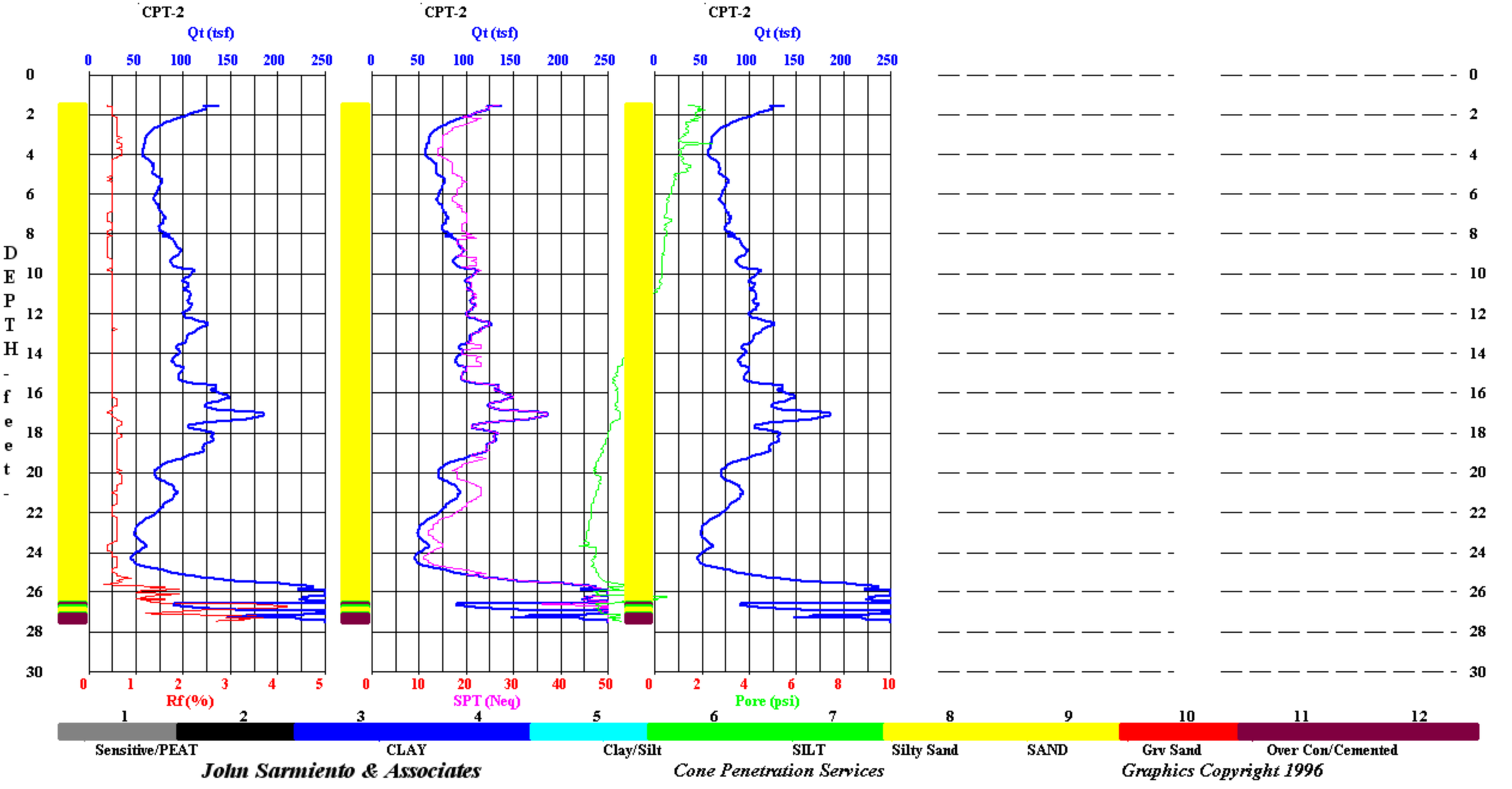
John Sarmiento & Associates

Cone Penetration Services

Graphics Copyright 1996

PROJECT: SCENIC ROAD SEAWALL

LOCATION: Carmel CA



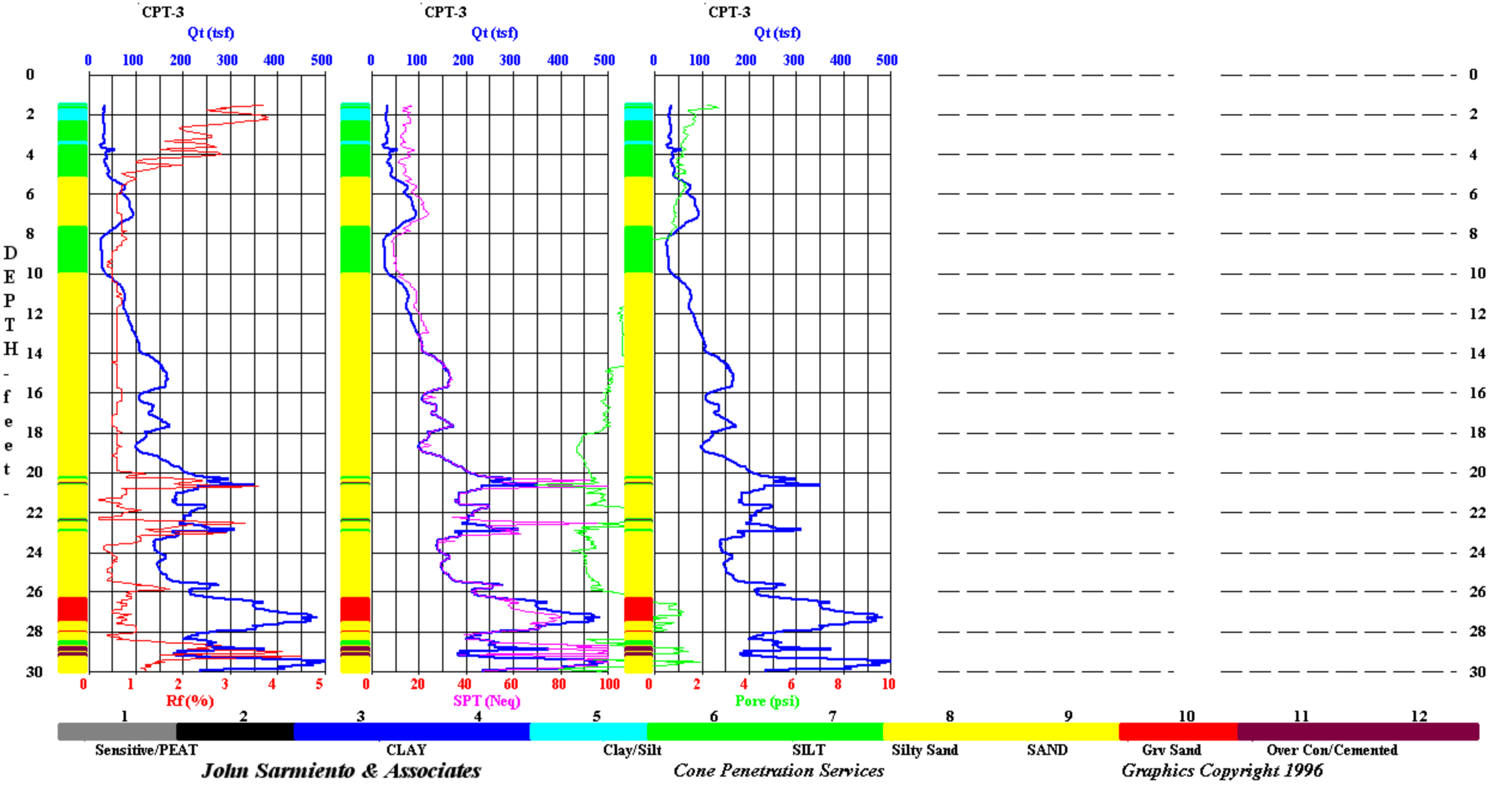
John Sarmiento & Associates

Cone Penetration Services

Graphics Copyright 1996

PROJECT: SCENIC ROAD SEAWALL

LOCATION: Carmel CA



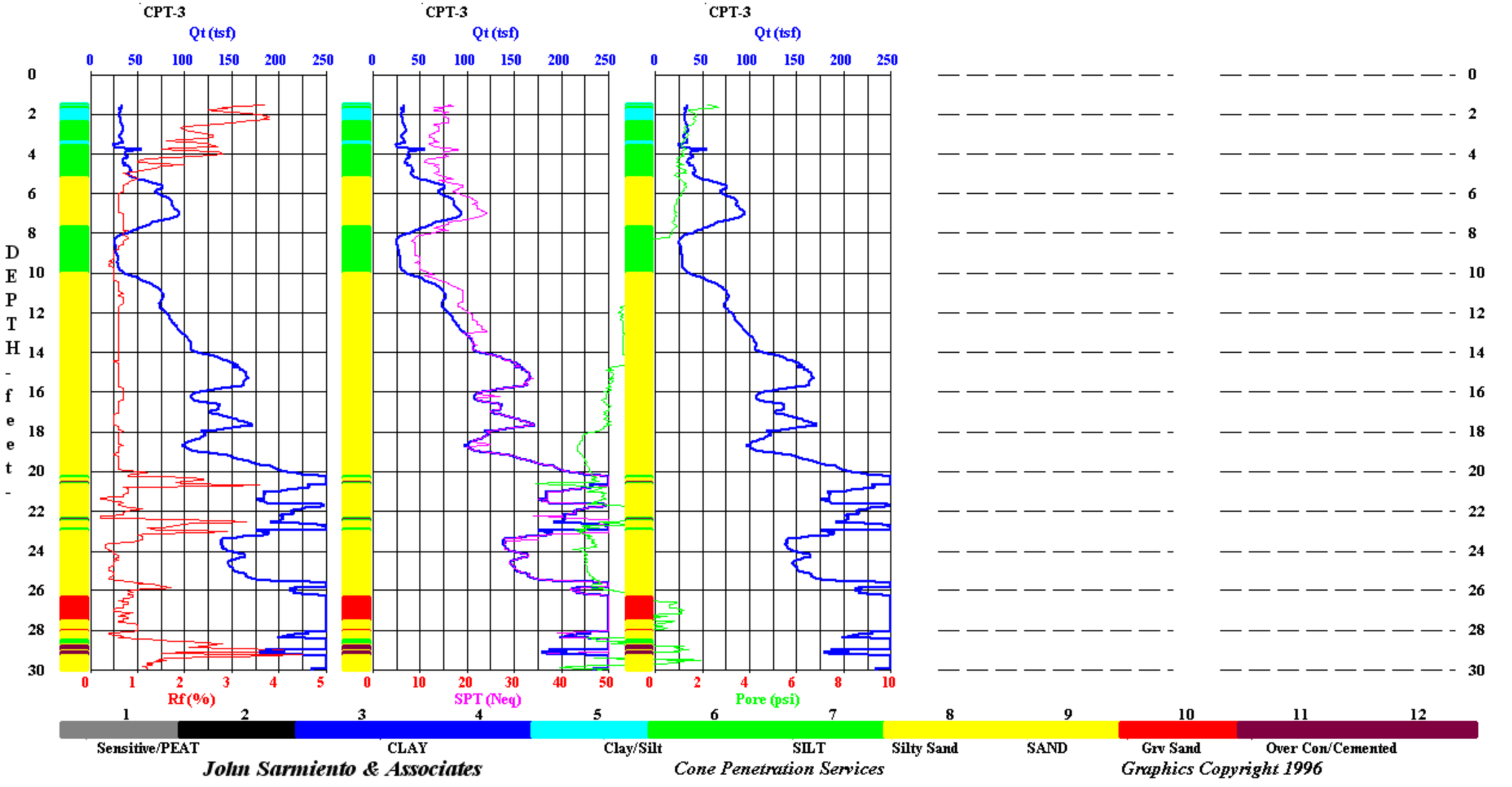
John Sarmiento & Associates

Cone Penetration Services

Graphics Copyright 1996

PROJECT: SCENIC ROAD SEAWALL

LOCATION: Carmel CA



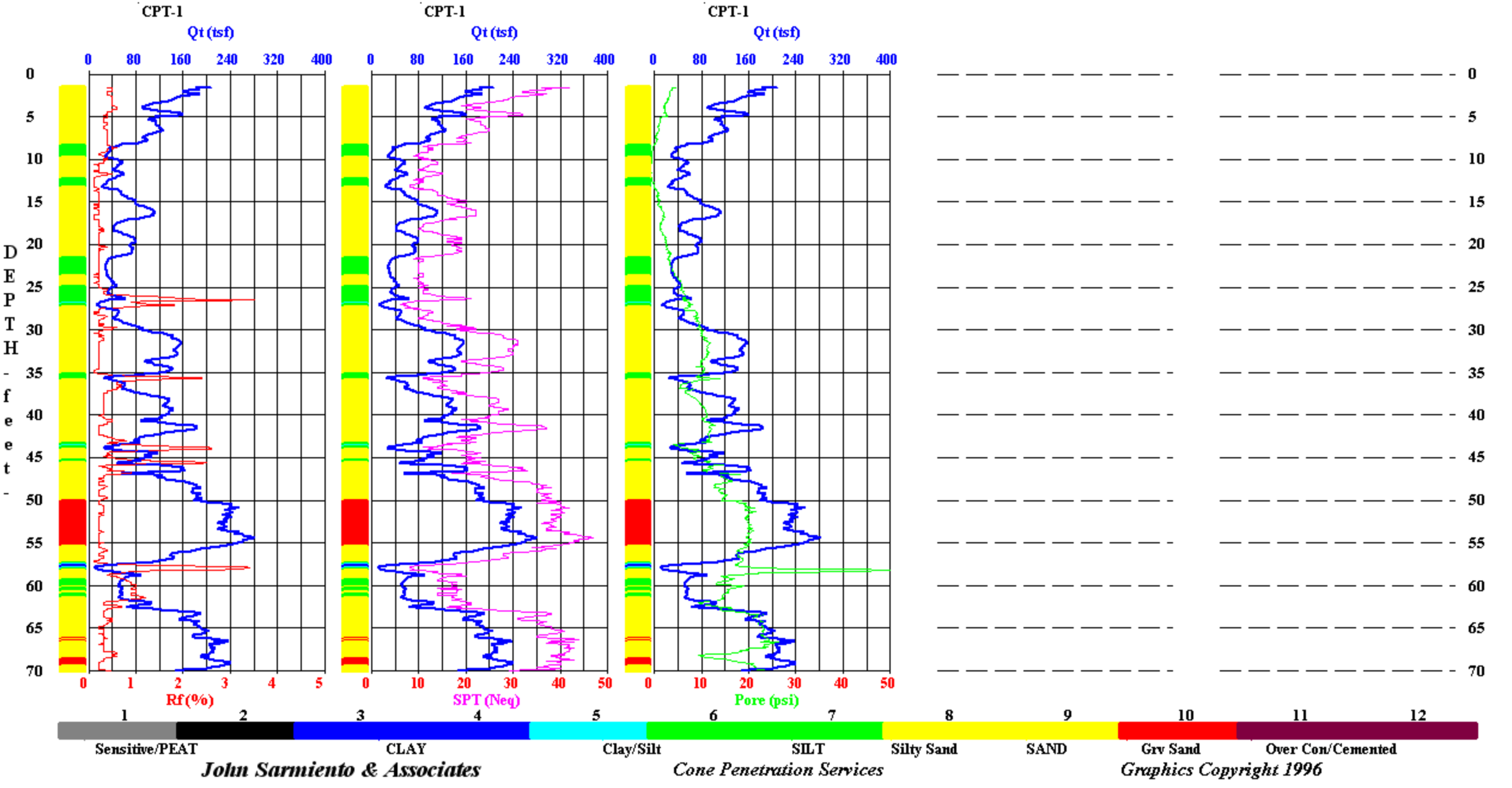
John Sarmiento & Associates

Cone Penetration Services

Graphics Copyright 1996

PROJECT: SCENIC ROAD SEAWALL

LOCATION: Carmel CA



John Sarmiento & Associates

Cone Penetration Services

Graphics Copyright 1996

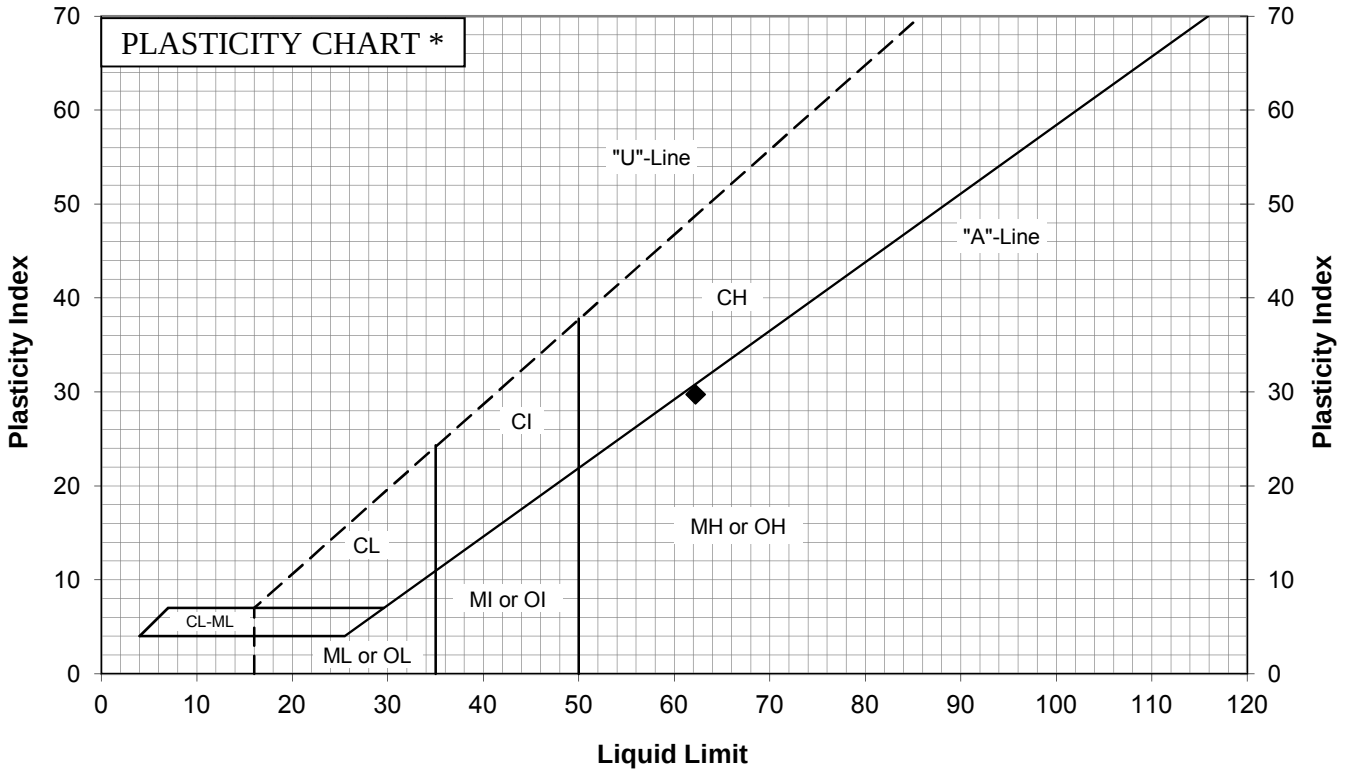
APPENDIX C

Laboratory Test Results

(Figures C-1 through C-17)

ATTERBERG LIMITS TEST RESULTS

PROJECT NAME	**Ecosystem Protection Barrier**			PROJECT No.	2012.0133
DATE OF TEST	11/17/2012				
KEY SYMBOL	♦				
DRILL HOLE No.	4				
DEPTH (ft)	28.5-30				
NATURAL WATER CONTENT (%)	46				
% Retained No. 40 SIEVE (Est.)	4				
% PASSING No. 200 SIEVE	73				
LIQUID LIMIT	62				
PLASTIC LIMIT	32				
PLASTICITY INDEX	30				
CLASSIFICATION SYMBOL	MH				



* Based on the Unified Soil Classification System modified to incorporate the "intermediate" classifications CI, MI, and OI for soils with liquid limits between 35 and 50. In the unmodified Unified Soil Classification System, such soils would be classified as CL, ML and OL, respectively.

PACIFIC GEOTECHNICAL ENGINEERING | **Figure C-1**

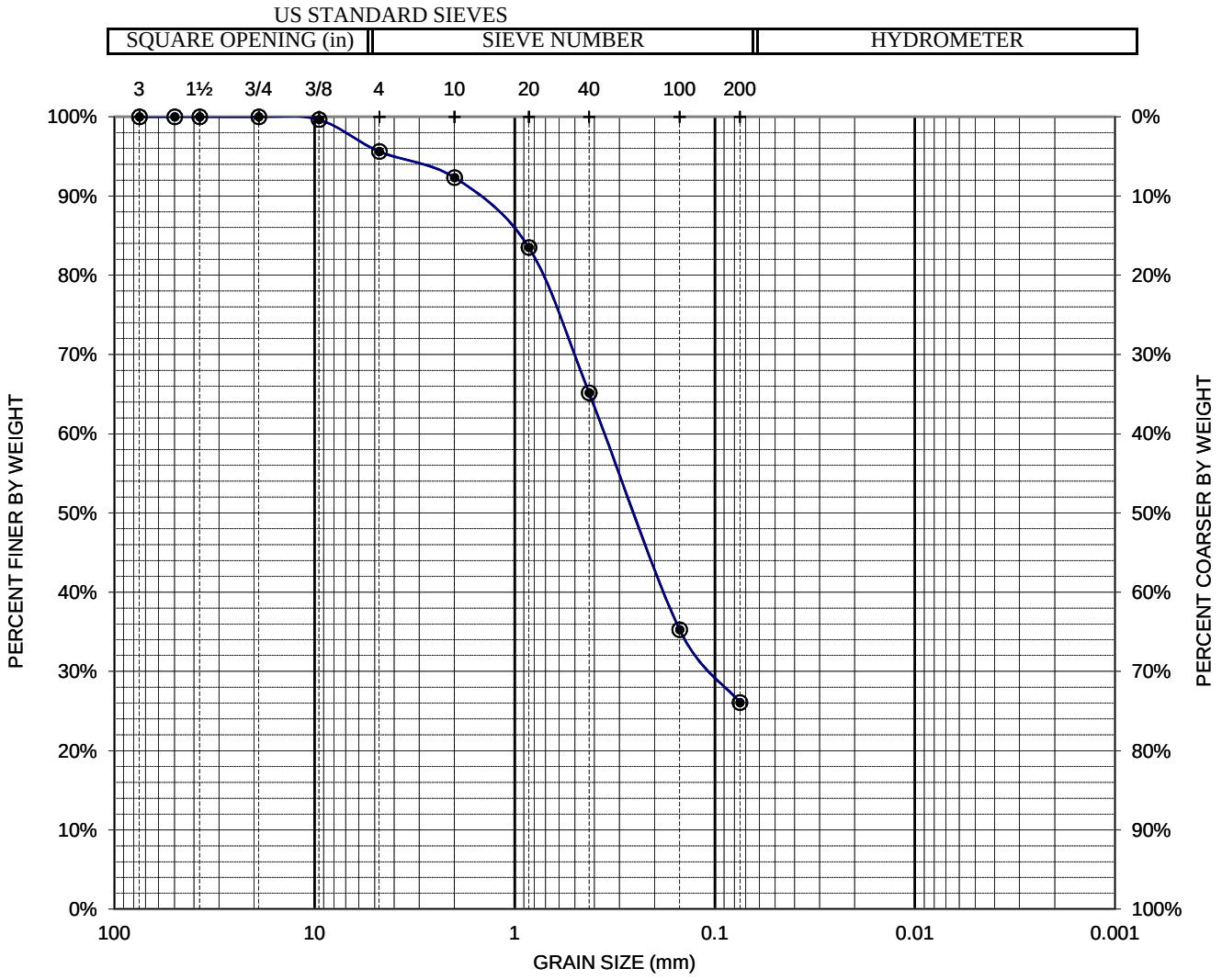
Rev030106

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	1	**DEPTH (ft)** 18.5-20	**SAMPLE** 0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Gray brown to yellow brown, wet



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	4.4%		69.5%			26.1%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-2

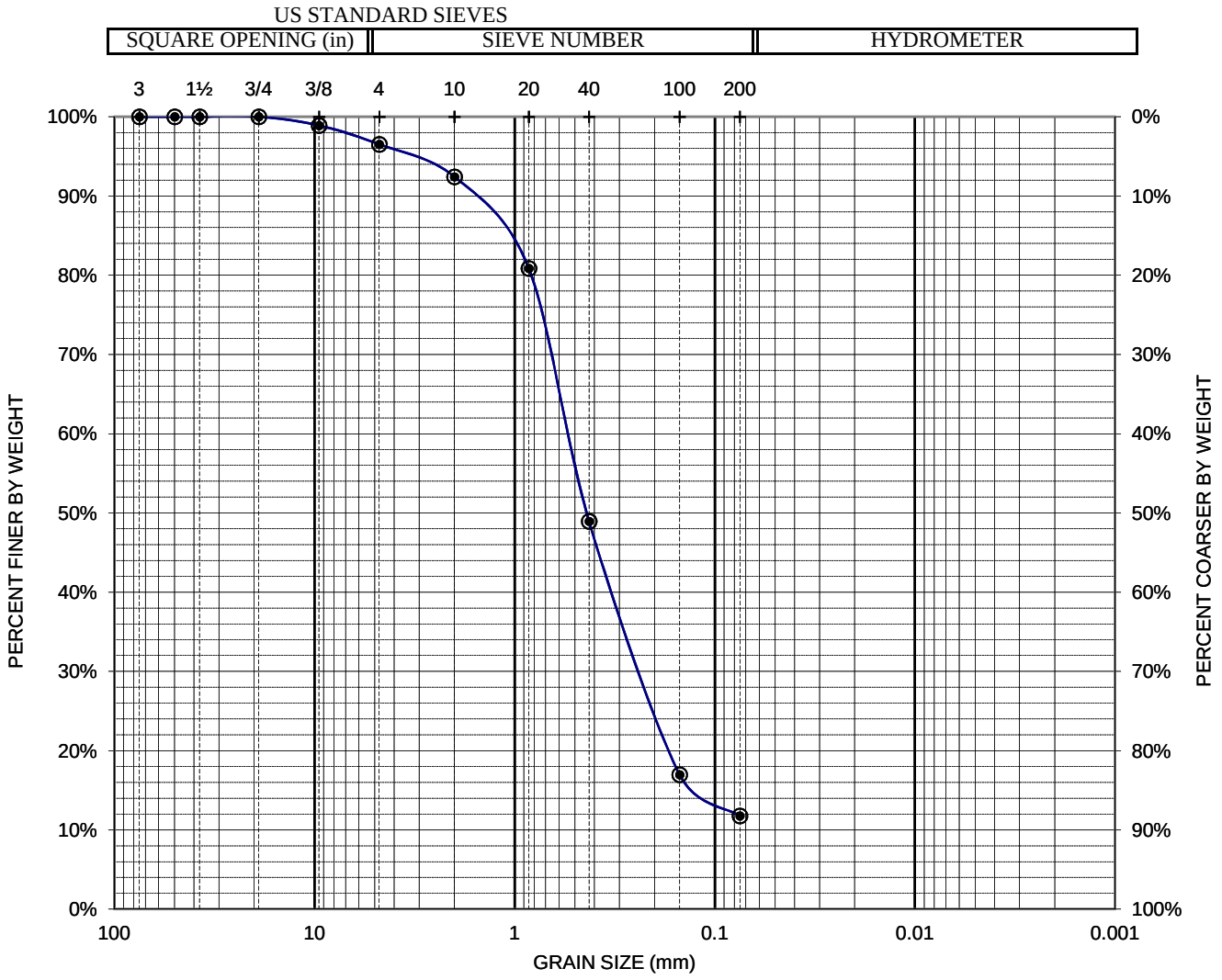
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	1	**DEPTH (ft)** 28.5-30	**SAMPLE** 0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: SILTY SAND: Light olive brown, wet



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	3.5%		84.7%			11.8%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING | **Figure C-3**

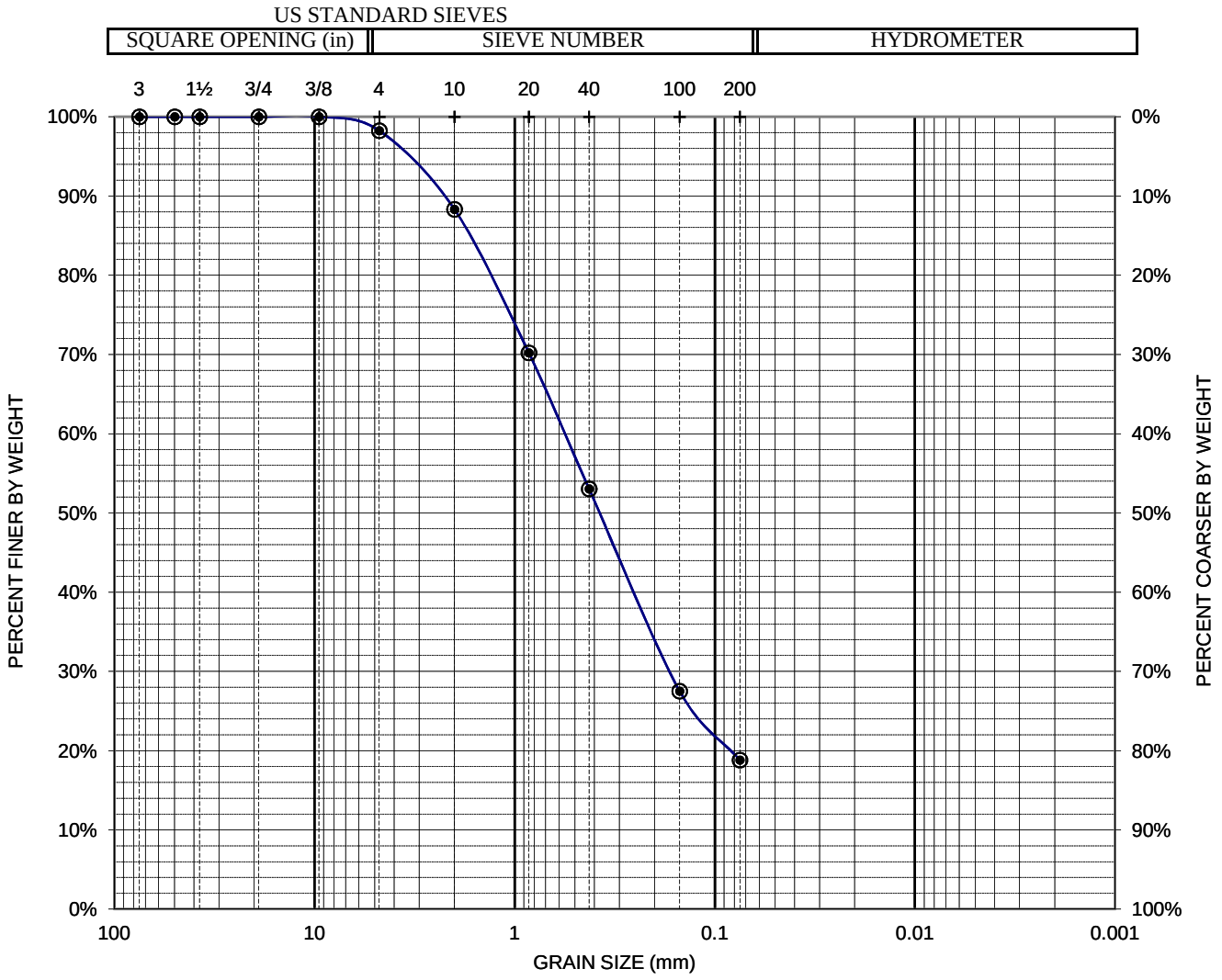
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier					**PROJECT No.**	2012.0133
DRILL HOLE No.	1	**DEPTH (ft)**	43.5-44	**SAMPLE**	0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Grayish brown, wet



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	1.8%		79.4%			18.8%

REMARKS:

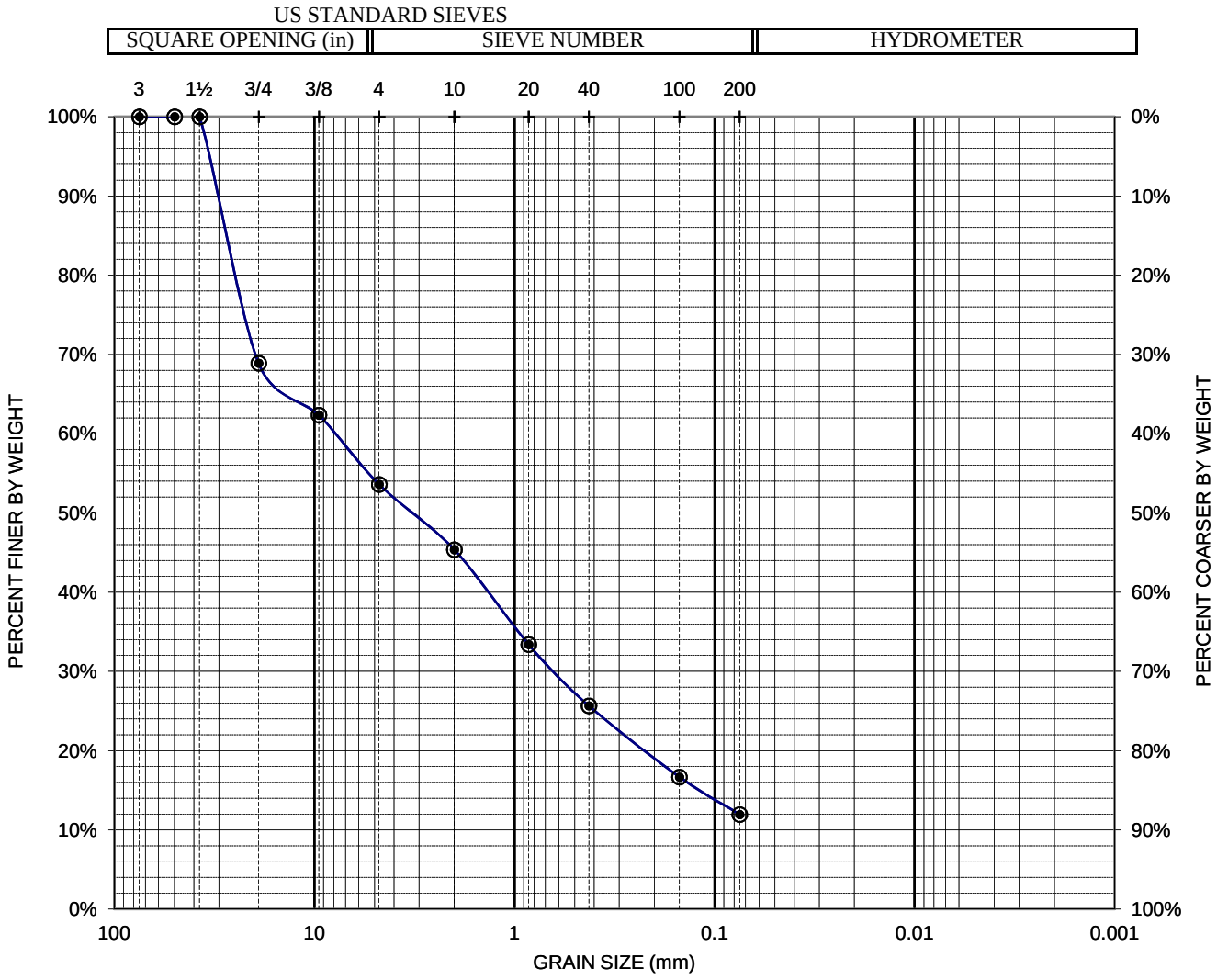
PACIFIC GEOTECHNICAL ENGINEERING

Figure C-4

RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	1	**DEPTH (ft)** 53.5-54	**SAMPLE** 0	**DATE OF TEST**	11/17/2012
SOURCE/QUARRY: ---					
DESCRIPTION OF SOIL: POORLY GRADED GRAVEL with SAND: Yellow brown, moist to wet					



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	46.4%		41.7%			11.9%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-5

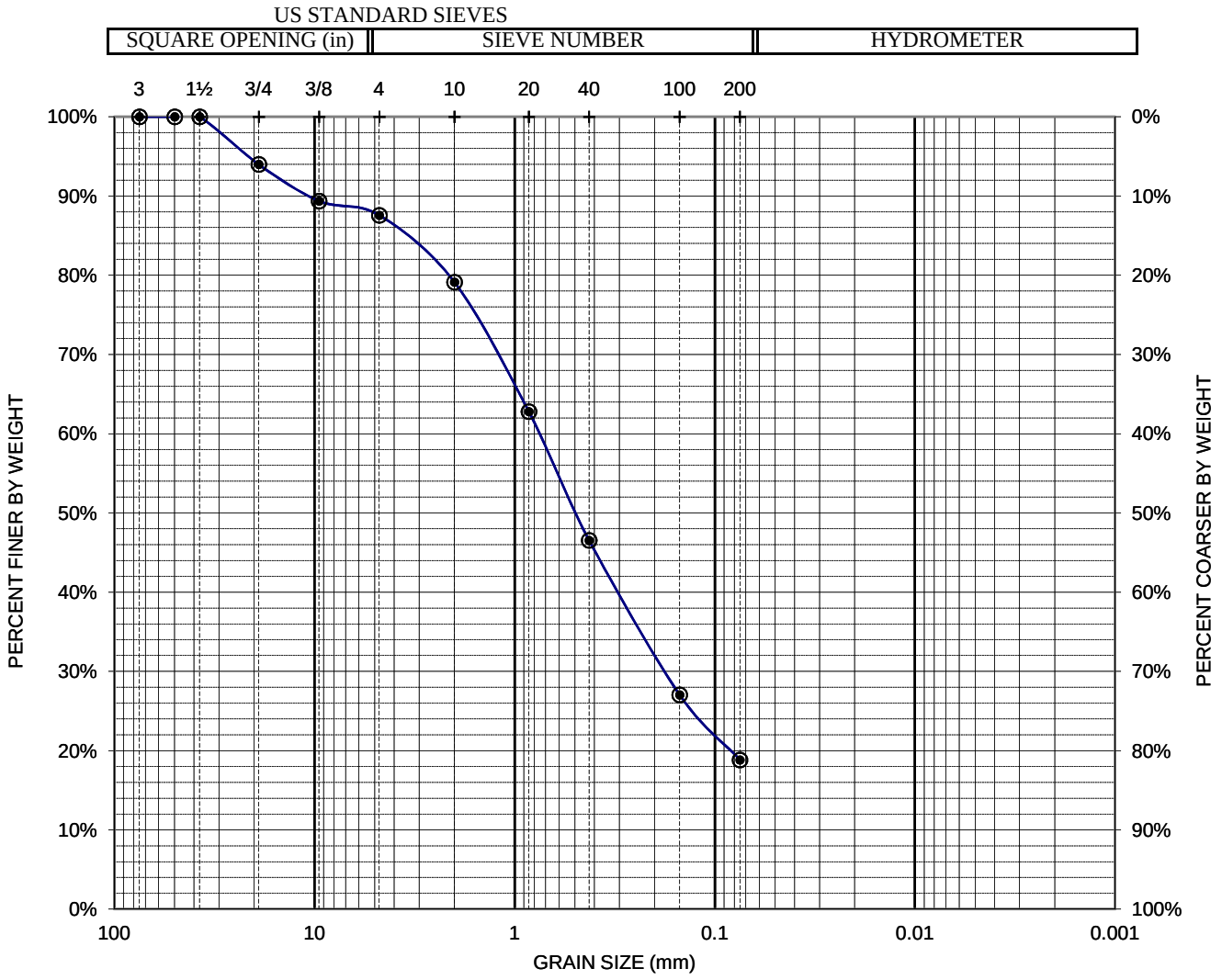
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier					**PROJECT No.**	2012.0133
DRILL HOLE No.	2	**DEPTH (ft)**	5-6.5	**SAMPLE**	0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Greenish gray, moist



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	12.4%		68.7%			18.8%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-6

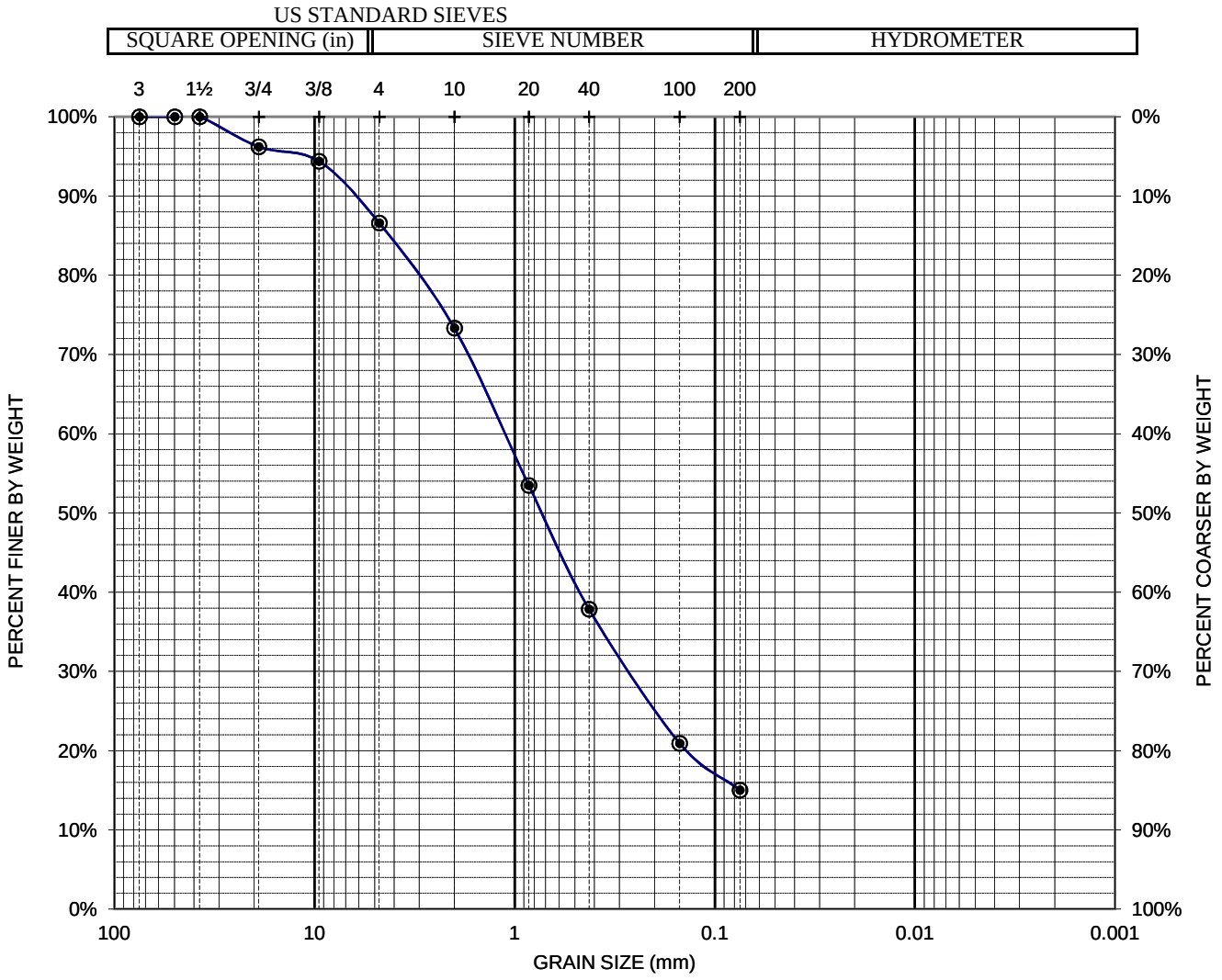
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	2	**DEPTH (ft)** 13.5-15	**SAMPLE** 0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Dark yellowish brown, moist



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	13.4%		71.6%			15.0%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-7

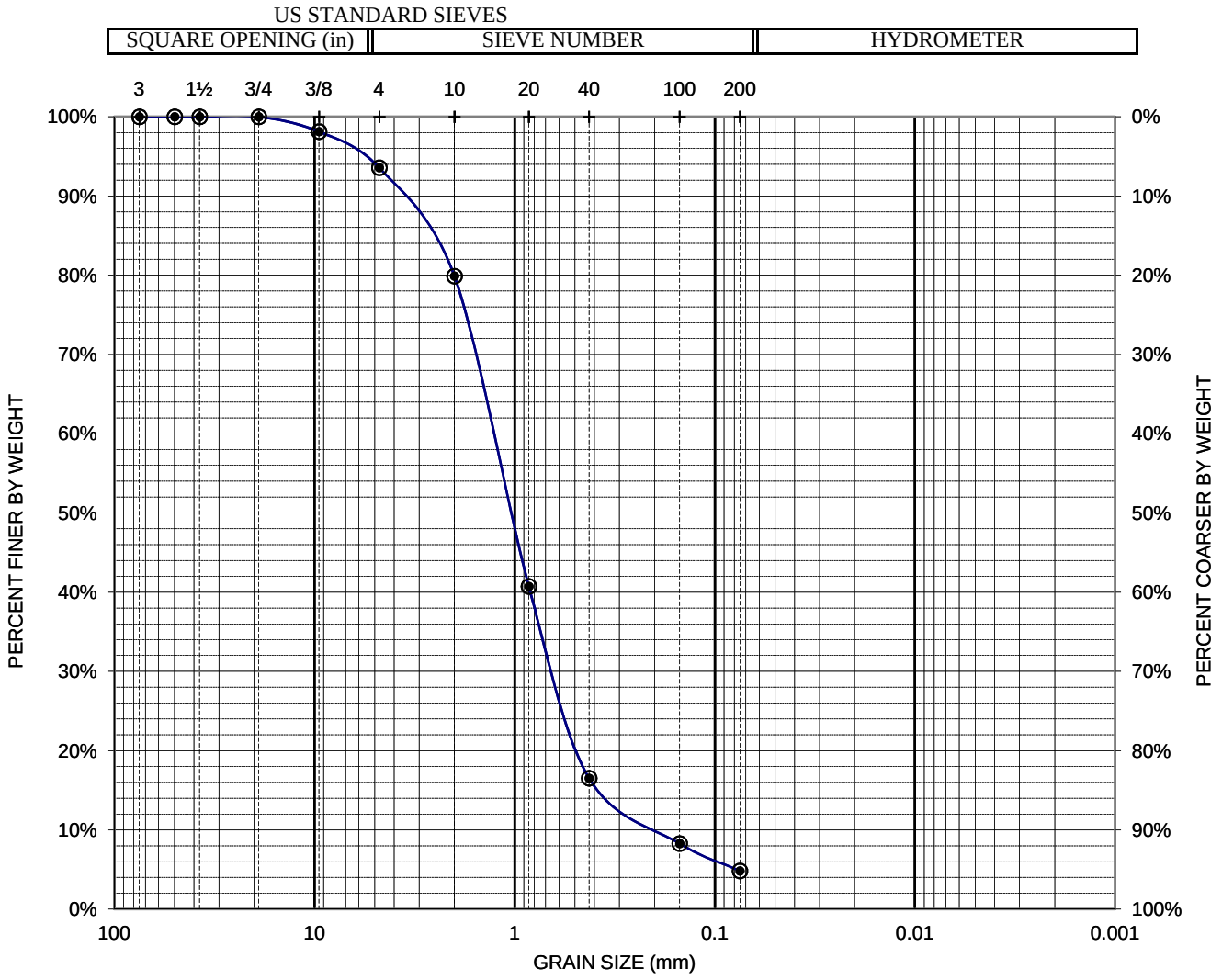
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	2	**DEPTH (ft)** 23.5-25	**SAMPLE** 0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: WELL GRADED SAND: Yellow brown, wet



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	6.4%		88.7%			4.8%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-8

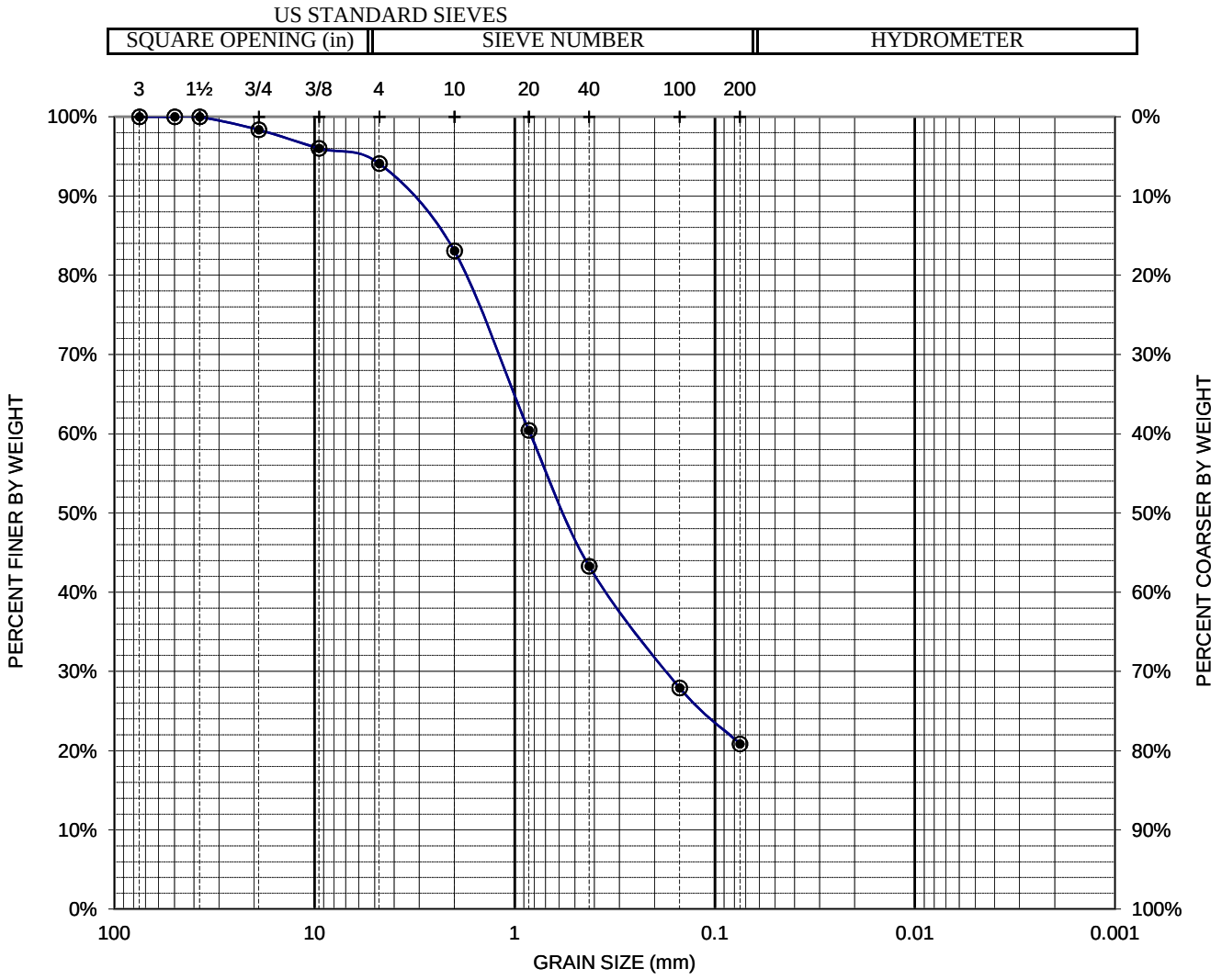
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	2	**DEPTH (ft)** 33.5-35	**SAMPLE** 0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Yellow brown, moist



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	5.9%		73.2%			20.9%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-9

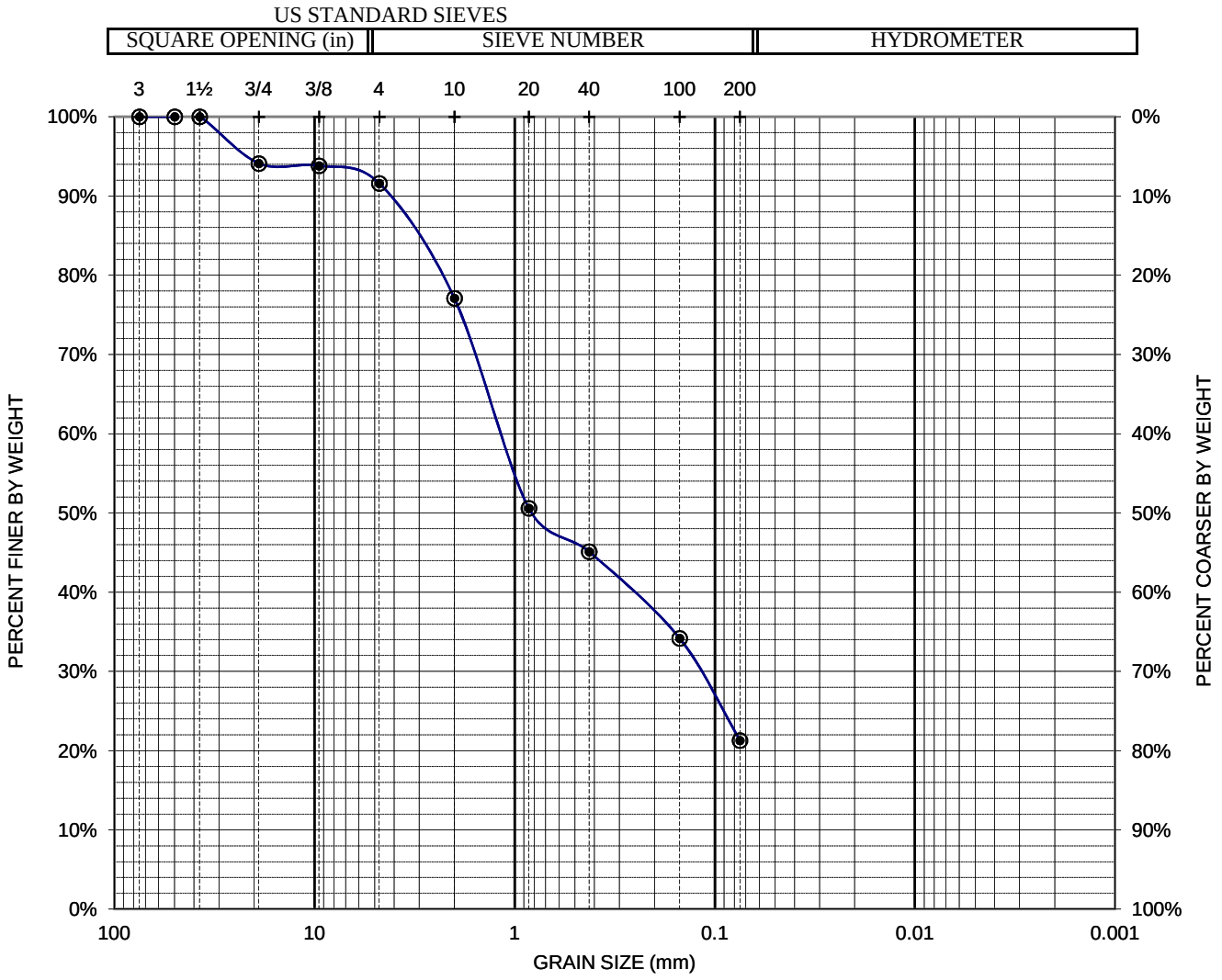
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	2	**DEPTH (ft)** 43.5-44.5	**SAMPLE** 0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Yellowish brown, wet



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	8.4%		70.3%			21.3%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-10

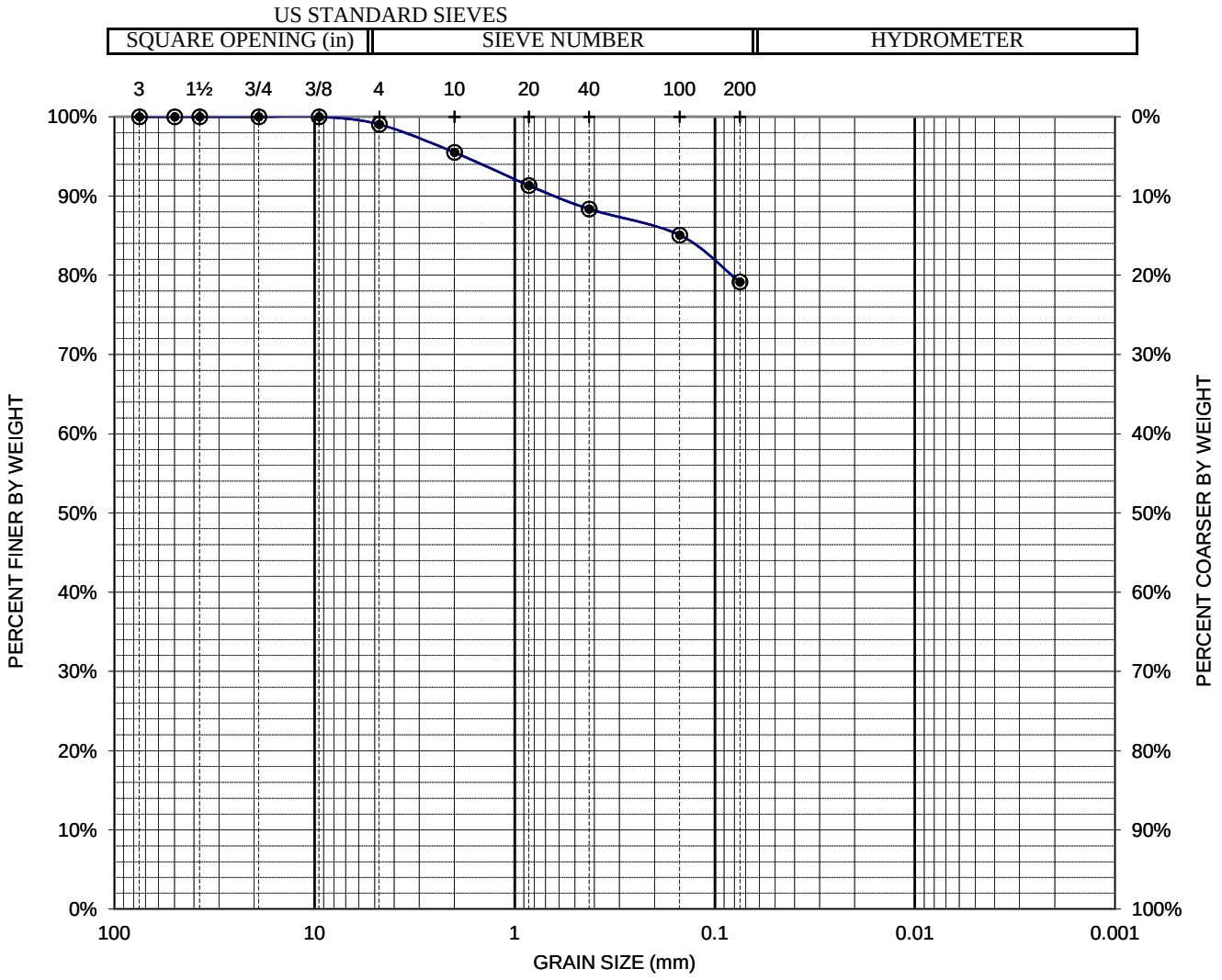
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier					**PROJECT No.**	2012.0133
DRILL HOLE No.	3	**DEPTH (ft)**	20	**SAMPLE**	0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: LEAN CLAY with SAND: Light olive brown, wet



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	1.0%		19.9%			79.2%

REMARKS:

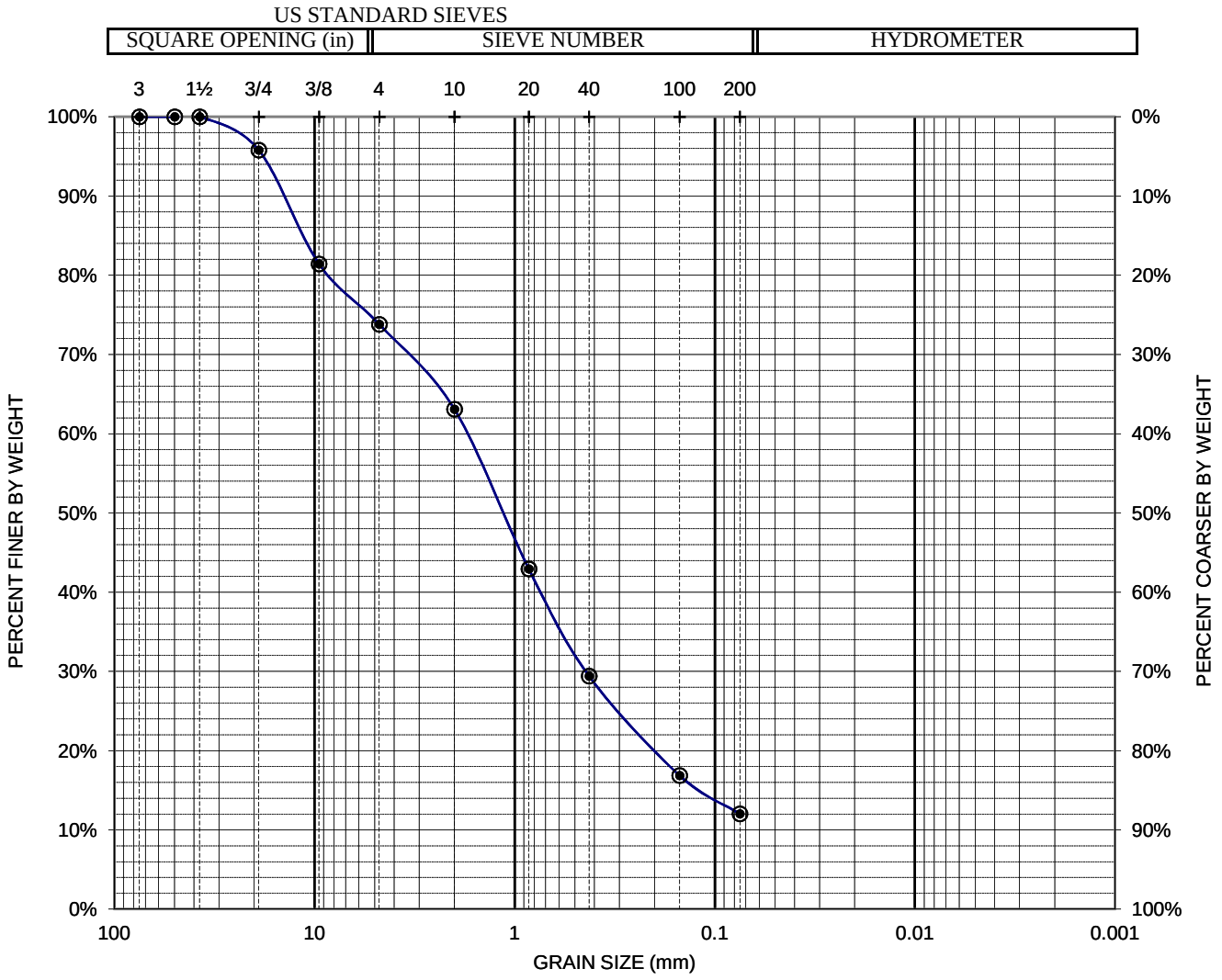
PACIFIC GEOTECHNICAL ENGINEERING

Figure C-11

RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	3	**DEPTH (ft)** 43.5-45	**SAMPLE** 0	**DATE OF TEST**	11/17/2012
SOURCE/QUARRY: ---					
DESCRIPTION OF SOIL: CLAYEY SAND with GRAVEL: Light olive brown, wet					



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	26.2%		61.8%			12.0%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING | **Figure C-12**

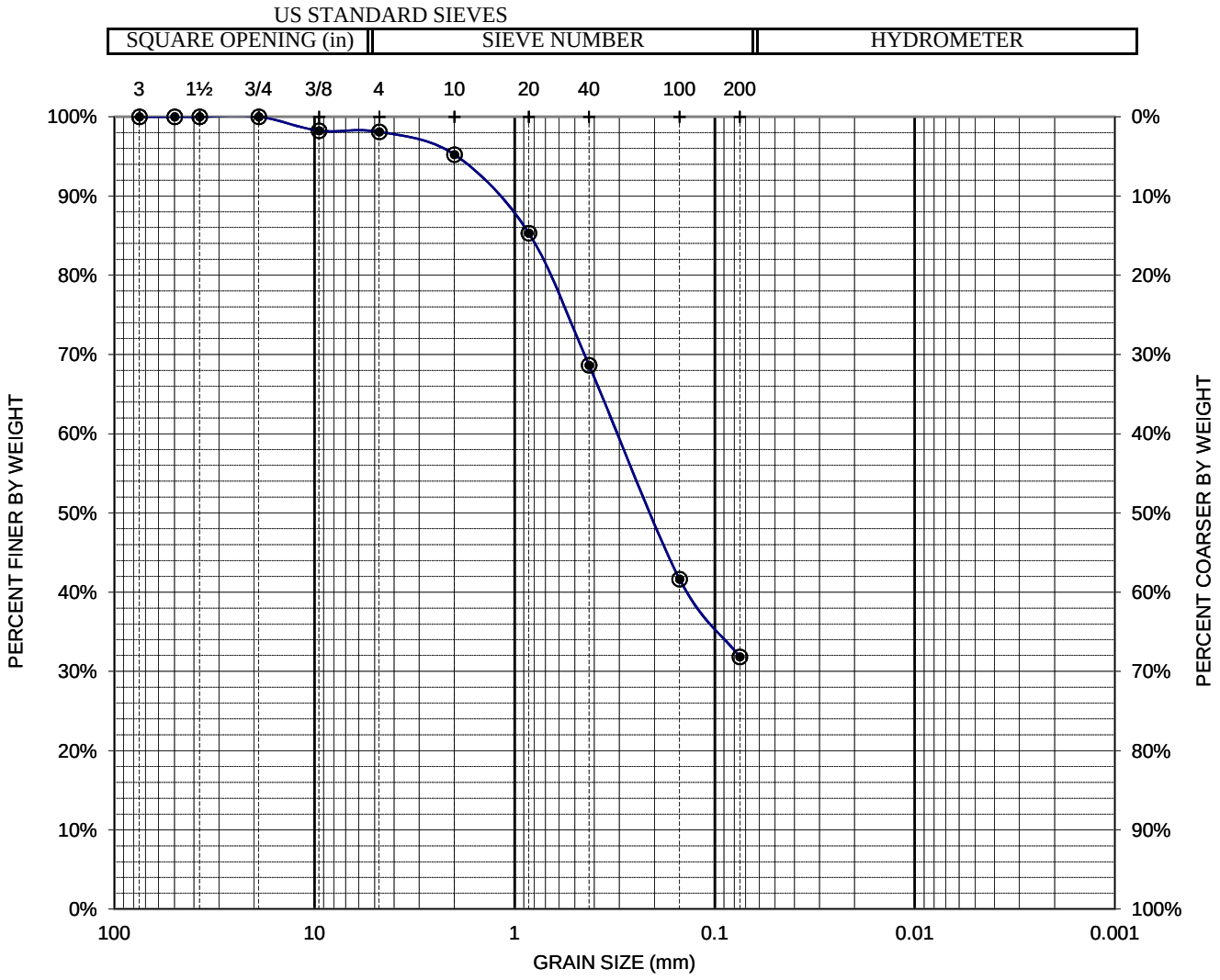
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier					**PROJECT No.**	2012.0133
DRILL HOLE No.	4	**DEPTH (ft)**	7	**SAMPLE**	0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Gray, moist



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	1.9%		66.2%			31.8%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-13

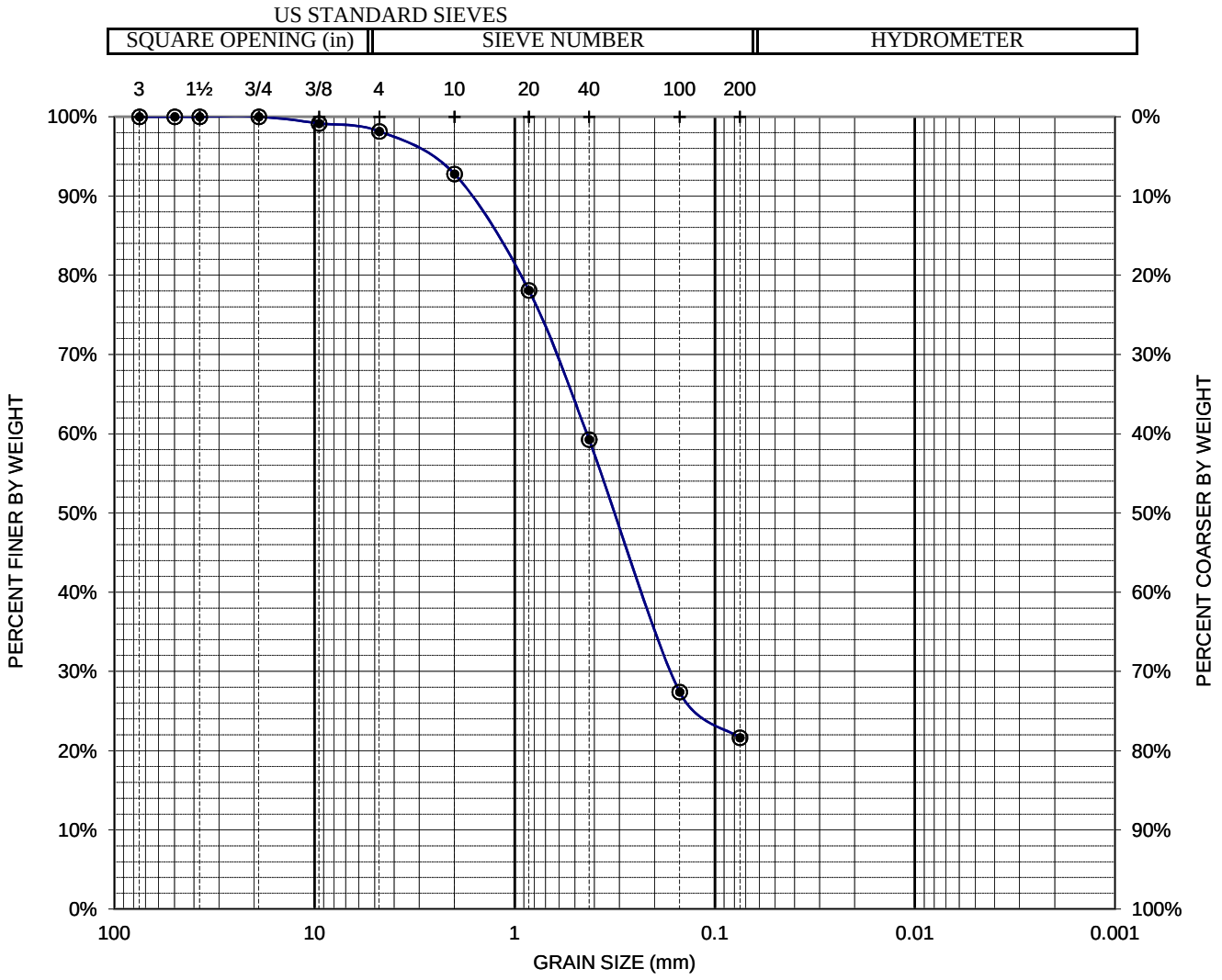
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier					**PROJECT No.**	2012.0133
DRILL HOLE No.	4	**DEPTH (ft)**	8.5-10	**SAMPLE**	0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Gray, moist



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	1.8%		76.5%			21.6%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-14

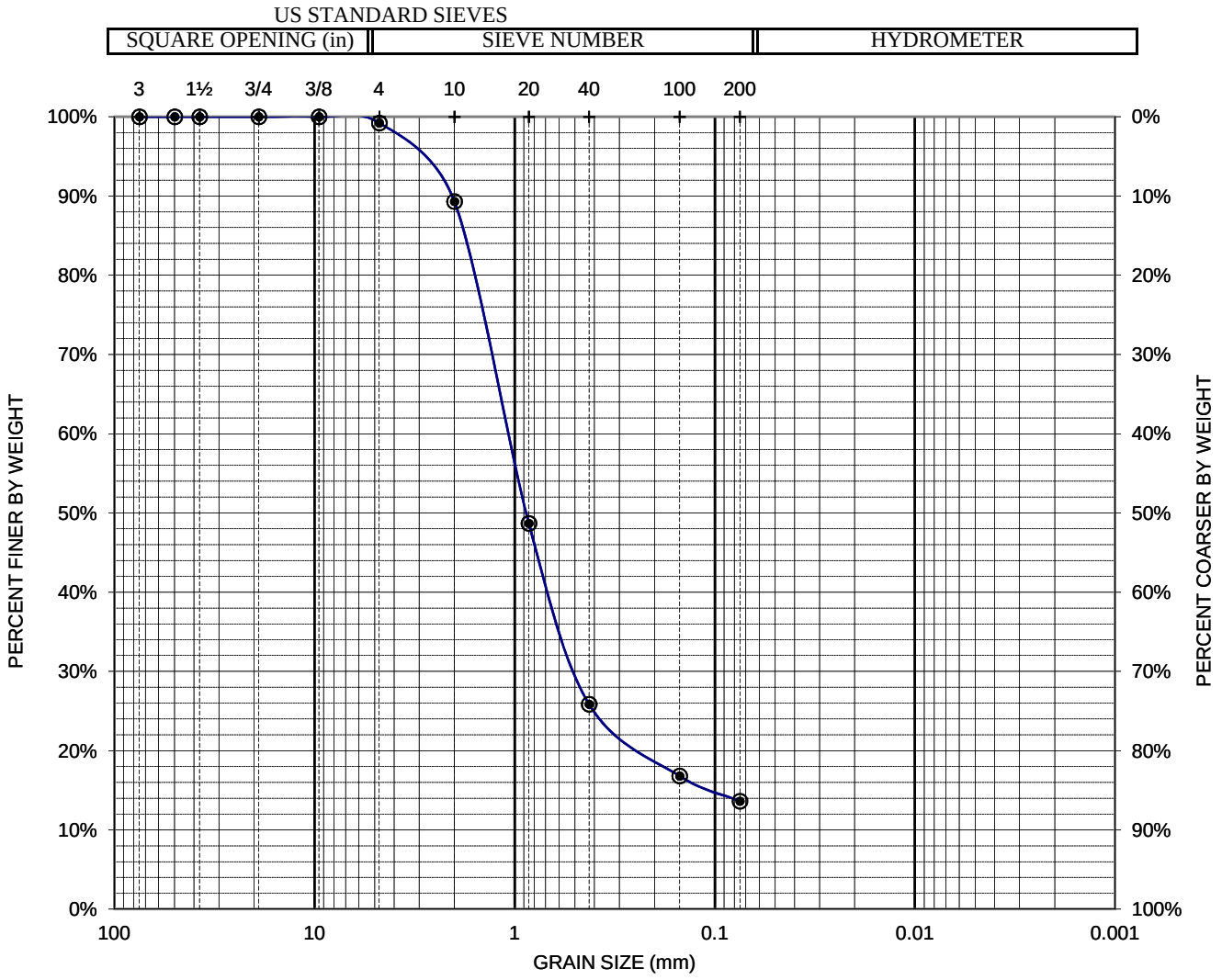
RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	4	**DEPTH (ft)** 14-15.5	**SAMPLE** 0	**DATE OF TEST**	11/17/2012

SOURCE/QUARRY: ---

DESCRIPTION OF SOIL: CLAYEY SAND: Brown, moist



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	0.8%		85.6%			13.6%

REMARKS:

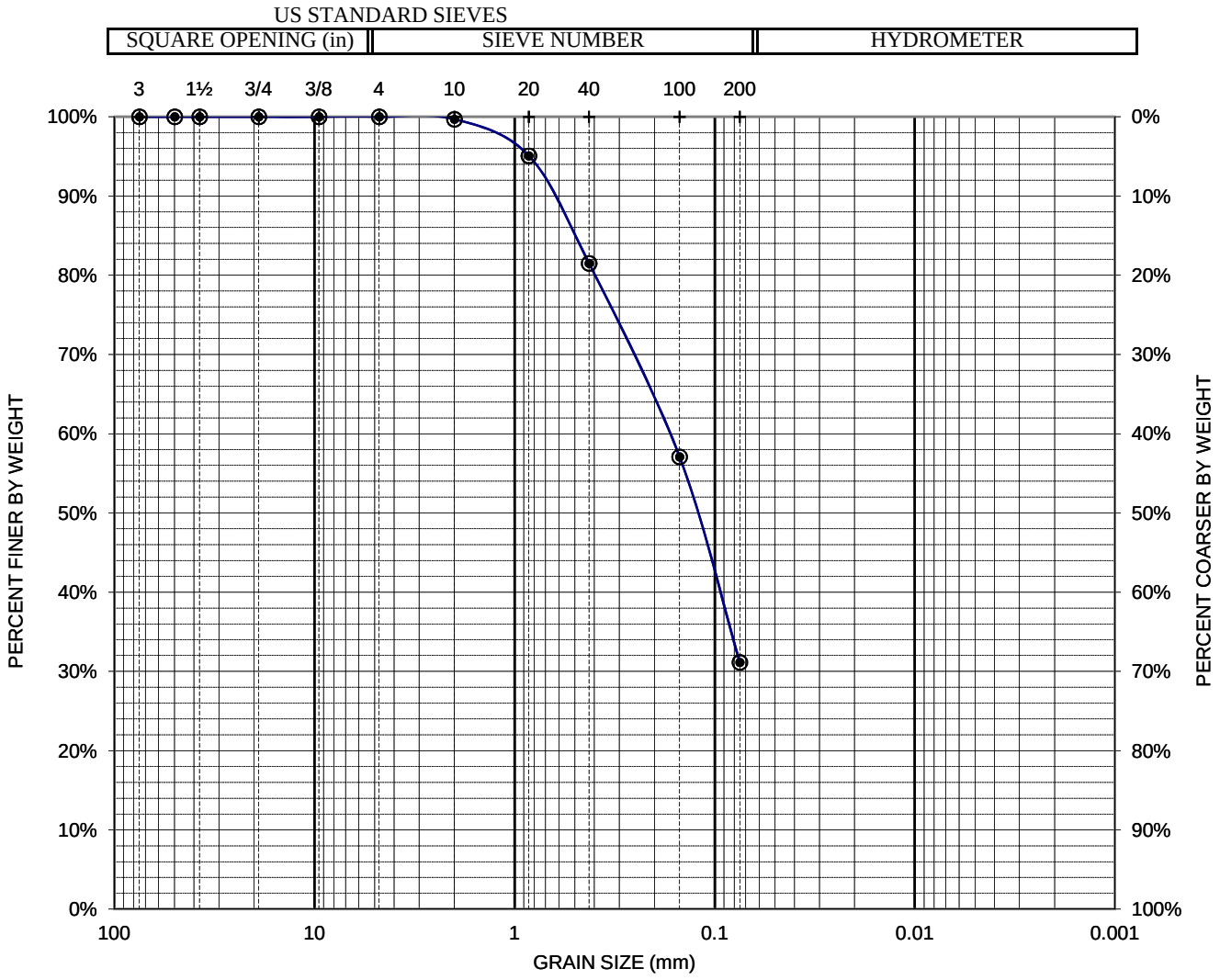
PACIFIC GEOTECHNICAL ENGINEERING

Figure C-15

RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	4	**DEPTH (ft)** 23.5-25	**SAMPLE** 0	**DATE OF TEST**	11/17/2012
SOURCE/QUARRY: ---					
DESCRIPTION OF SOIL: CLAYEY SAND: Oliver gray to orange brown, wet					



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	0.0%		68.9%			31.1%

REMARKS:

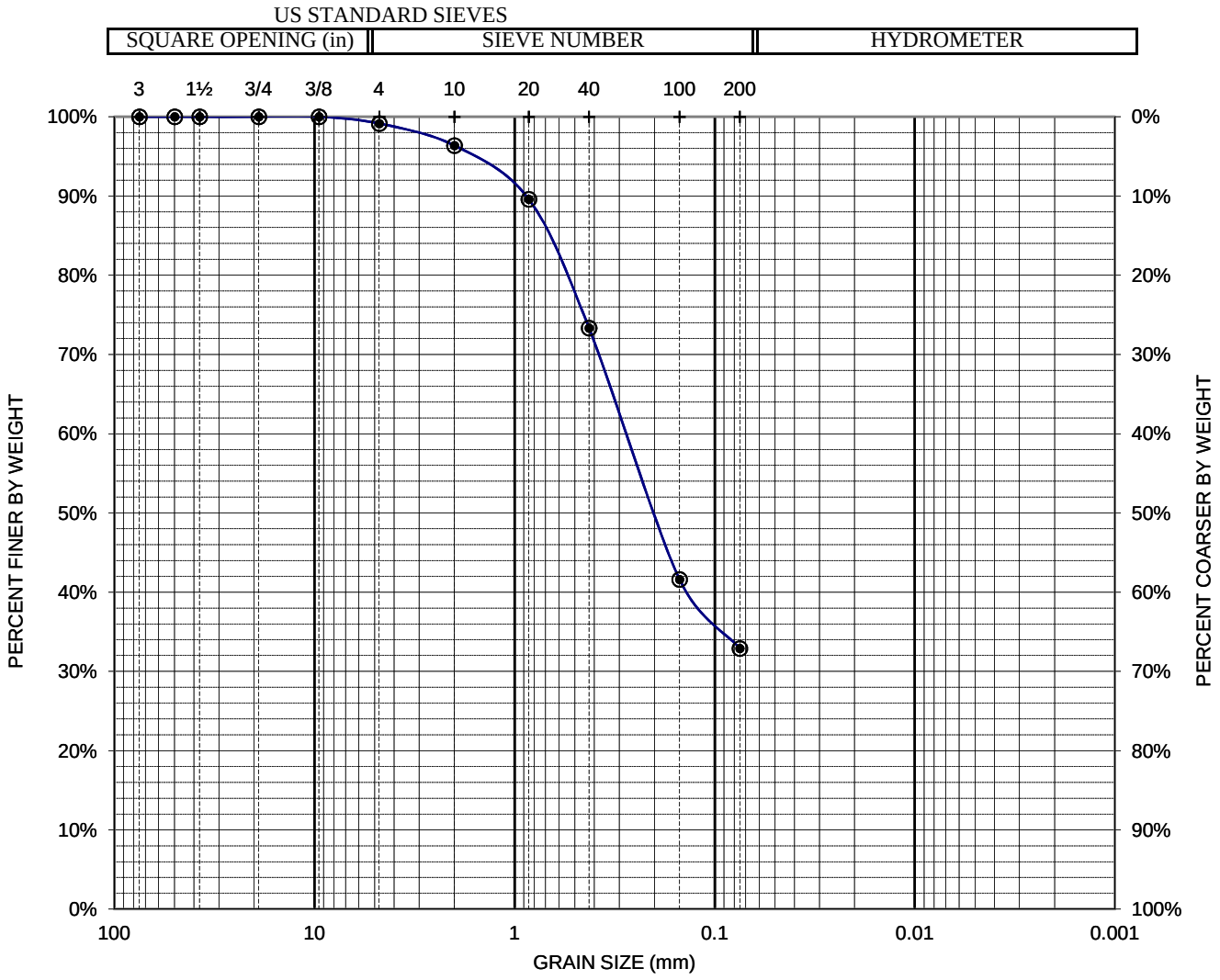
PACIFIC GEOTECHNICAL ENGINEERING

Figure C-16

RevOct20070

GRAIN SIZE TEST RESULTS

PROJECT NAME	Ecosystem Protection Barrier			**PROJECT No.**	2012.0133
DRILL HOLE No.	4	**DEPTH (ft)** 38.5-40	**SAMPLE** 0	**DATE OF TEST**	11/17/2012
SOURCE/QUARRY: ---					
DESCRIPTION OF SOIL: CLAYEY SAND: Light gray, moist					



	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES	GRAVEL		SAND			SILT & CLAY
	0.9%		66.2%			32.9%

REMARKS:

PACIFIC GEOTECHNICAL ENGINEERING

Figure C-17

RevOct20070

APPENDIX D

Subsurface Data From Previous Investigations

PREVIOUS BORINGS BY

Earth Systems Consultants (2000)

SOIL CLASSIFICATION SYSTEM

(Modified from U.S.C.S)

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50% of material is larger than No. 200 sieve size	GRAVEL AND GRAVELLY SOILS More than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	SAND AND SANDY SOILS More than 50% of coarse fraction passing No. 4 sieve	CLEAN SAND (little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
		LIQUID LIMIT GREATER THAN 50		MH	Inorganic silts, micaceous, or diatomaceous fine sand or silty soils
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soils with high organic contents

File Name: 2478 17th Avenue, Carmel, California File No.:HO-07512-01

DATE : _____
EQUIPMENT: _____
Boring Diameter: _____
LOGGED BY: _____

DRIVE WEIGHT: _____
DROP: _____
DEPTH TO GROUNDWATER: _____

Depth (ft)	Sample Type: Drive	Sample Type: Bulk	Blows Per 6 inch	Graphic Log	Explanation of Exploratory Borings and Test Pits	U.S.C.S Soil Group	In-Place: Moisture (% dry weight)	In-Place: Dry Density (pcf)
0								
1								
2					Modified Cal sample			
3					No Sample Recovered		NSR	
4								
5					Bulk sample		Perched Groundwater	
6								
7							Groundwater	
8					Standard Penetration test			
9							Seepage	
10								
11					Solid line denotes lithologic change			
12								
13								
14					Dashed line denotes gradational lithologic change			
15								
16								
17								
18					Termination of boring			
19								
20					Termination of Test Pit			

File Name: 2478 17th Avenue, Carmel, California

File No.:HO-07512-01

DATE DRILLED: 5/12/00

TYPE OF RIG: Minuteman Rig

DRIVE WEIGHT: 140 lbs

BORING DIAMETER: 3" O.D. solid stem

DROP: 30 inches

LOGGED BY: C. Harwood

DEPTH TO GROUNDWATER: N/A

Log of Exploratory Boring No. 1

Depth (ft)	Sample No.	Sample Type: Drive	Sample Type: Bulk	Graphic Log	Blows Per 6 Inch		U.S.C.S. Soil Group	In-Place: Moisture (% dry weight)	In-Place: Dry Density (pcf)
0						surface layer of paver brick (2" thick)			
2						Residual soil: Very dark grayish brown to black silty SAND, moist, loose to medium dense; medium grained	SM		
4					7 8 13				
6						Terrace Deposits: Black silty SAND, moist, medium dense	SM		
8			A		7 12 14			8.6	110.8
10						Terrace Deposits: Light yellowish brown well graded SAND with silt, moist, medium dense	SW-SM		
12					11 17 21			7.3	99.7
14			B						
16						The stratification lines represent the approximate boundry between soil types and the transitions may be gradual. Terminated at a depth of 15.0' below existing grade.			
18						Groundwater was not encountered.			
20									
22									
24									
26									
28									
30									
32									
34									
36									
38									
40									
42									

File Name: 2478 17th Avenue, Carmel, California File No.: HO-07512-01

DATE DRILLED: 5/12/00

TYPE OF RIG: Minuteman Rig DRIVE WEIGHT: 140 lbs

BORING DIAMETER: 3" O.D. solid stem DROP: 30 inches

LOGGED BY: C. Harwood DEPTH TO GROUNDWATER: N/A

Log of Exploratory Boring No. 2

Depth (ft)	Sample No.	Sample Type: Drive	Sample Type: Bulk	Graphic Log	Blows Per 6 Inch	Description	U.S.C.S Soil Group	In-Place: Moisture (% dry weight)	In-Place: Dry Density (pcf)
0–4					3, 4, 6	Residual soil: Very dark grayish brown to black silty SAND, moist, loose to medium dense	SM	6.8	95.1
4–8			C		6, 9, 13	Terrace Deposits: Black silty SAND, moist, medium dense	SM	7.7	105.2
8–16					3, 5, 6; 9, 12, 9	Terrace Deposits: Medium brown well graded SAND with silt, moist, medium dense	SW-SM		

The stratification lines represent the approximate boundry between soil types and the transitions may be gradual. Terminated at a depth of 16.5' below existing grade.

Groundwater was not encountered.

PREVIOUS BORINGS BY

Grice (2008a)

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 1 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Densily	Moisture	Unconfined	Cohesion	Shear
1.00				concrete, 3 inches over sand 4 inches						
	ML			(CUTTINGS) Light olive brown | SILT; non-plastic; friable | little: sand; very fine-fine | damp; soft-medium stiff.						
2.00	CL			(CUTTINGS-SAMPLE) mottled-varigated; dark yellowish brown to very dark brown | CLAY; medium plasticity; slight-modertely pliable | trace: fine sand | damp; medium stiff.						
		2.25	11.00							
3.00			13.00	recover 15 inches						
	SWm		11.00	(CUTTINGS-SAMPLE) Dark brown | SAND; fine to medium; round to suangular | few: silt | moist; medium dense..		102.9	10.1	8.5		
4.00										
5.00	SWMC	4.50	2.50	(CUTTINGS-SAMPLE) Yellowish brown | SAND; fine to medium; trace to fine gravel; round to suangular; granitic | few-little (varies): silty clay; few thin veins of sandy clay | slt wet, saturated at shoe; loose.	free water 53 inches after sample					
			2.75					sat-drand-qk		
			3.75	recover 8 inches		105.2	14.6	3.5	300	27
6.00				same						
7.00		7.00	2.25							
			2.75							
8.00				looks to be same						
			3.75	no recovery						
9.00										
10.00				? takes up, still auger pen is nil						
				drilling is very firm						
11.00	SWmc			(CUTTINGS) Olive grey | SAND; medium to coarse; few to fine; round to subangular; granitic | few to little: silt/clay | wet, dense. ?						
12.00										
		43.00								
	SW,	12.50	22.00	(SAMPLE) Yellowish brown | SAND; medium to coarse; few to fine and to 1 inch gravel; round to subangular; granitic | trace-few: silt; few veins clay | wet, dense.						
13.00			39.00							
			50.00			130.1	11.3	9+		
14.00			0.60							
			end							
15.00				same sane with lenses of increased clay and occasional large gravels/cobbles to eob						
16.00										
17.00										
18.00										
19.00										
20.00										

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 1 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
21.00										
22.00										
23.00										
24.00				End of bore at 24.0 feet. Free water observed below 4.5 feet. Bore backfilled with cuttings and gravel, patched with concrete at grade.						
25.00										
26.00										
27.00										
28.00										
29.00										
30.00										
31.00										
32.00										
33.00										
34.00										
35.00										
36.00										
37.00										
38.00										
39.00										
40.00										

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 2 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
0.50				dirt						
0.50	SWm			(CUTTINGS) Dark brown-brown; verigated | SAND; fine; round to suangular | few: silt | moist; loose						
1.00										
1.50	SPm	1.25	dcpt 8.00 9.00 10.00	(CUTTINGS) Pale yellow | SAND; fine; round to subangular | trace: silt | moist; loose-medium dense.						
2.00										
2.50	ML	2.30	dcpt 9.00 9.00 12.00 14.00	(CUTTINGS) Light olive brown | SILT; non-plastic; friable | little: sand; very fine-fine | damp; soft-medium stiff.						
3.00				(CUTTINGS) mottled-varigated; dark yellowish brown to very dark brown | CLAY; medium plasticity; slight to modertely pliable | trace: fine sand (and silt lenses, lensatic) | damp; medium stiff.						
3.50			dcpt							
4.00	SWmc	42.00	6.25 5.25 4.00 4.00	(CUTTINGS) Dark yellowish brown | SAND; fine to medium; trace to fine gravel; round to suangular; granitic | few-little (varies): silty clay; few thin veins of sandy clay | slt wet, saturated at shoe; loose.						
4.50				free water 49 inches						
5.00				same but light yellowish brown, few silty clay; wet; loose-medium dense						
5.50		5.00	dcpt 12.00 13.00 18.00							
6.00				real tight to hand auger						
6.50	SWC			(CUTTINGS) Yellowish brown; mottled; indication of corrosion | SAND; fine to medium few to coarse; trace to fine gravel; round to subangular; granitic | few to (mostly) little-some: clay, | wet, medium dense.						
7.00										
7.50		7.25	dcpt 15.00 15.00 16.00							
8.00	SWmc			(CUTTINGS) Olive grey | SAND; medium to coarse; few to fine; round to subangular; granitic | few to little: silt/clay | wet, dense.						
8.50				cuttings pale into a yellowish brown similar to b1						
9.00										
9.50										
10.00										

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 2 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
				same, somewhat lensatic						
10.50			dcpt							
		10.50	9.00							
			15.00							
			16.00							
11.00										
				gravels						
11.50										
12.00										
12.50										
13.00										
				End of bore at 13.0 feet. Free water encountered below 4 feet.						
				Bore backfilled with cuttings						
13.50										
14.00										
14.50										
15.00										
15.50										
16.00										
16.50										
17.00										
17.50										
18.00										
18.50										
19.00										
19.50										
20.00										

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 3 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
0.50				grass						
	ML			(CUTTINGS) Light olive brown | SILT; non-plastic; friable | little: sand; very fine-fine | damp; soft-medium stiff.						
0.50										
1.00										
1.50										
				picking up clay						
2.00										
	CL			(CUTTINGS) mottled-varigated; dark yellowish brown to very dark brown | CLAY; medium plasticity; slight to modertely pliable | trace: fine sand (and silt lenses, lensatic) | damp; medium stiff.						
2.50										
				silt lenses are fairly thick						
3.00										
				bottom of hole falls out						
	SWmc			(CUTTINGS) Dark yellowish brown | SAND; fine to medium; trace to fine gravel; round to suangular; granitic | few-little (varies): silty clay; few thin veins of sandy clay | slt wet, saturated at shoe; loose.						
3.50										
4.00				stuff black at topside, yellow-drk brown after 1 foot, very mottled looks like a buried soil profile						
4.50										
	SWC			(CUTTINGS) Yellowish brown; mottled; indication of corrosion | SAND; fine to medium few to coarse; trace to fine gravel; round to subangular; granitic | few to (mostly) little-some: clay, | wet, medium dense.						
5.00					free water 5 ft after drilling					
5.50										
6.00										
6.50										
7.00										
7.50										
				gravelly stop at 8, just to rough to hand auger proabaly						
8.00				(CUTTINGS) Olive grey | SAND; medium to coarse; few to fine; round to subangular; granitic | few to little: silt/clay | wet, dense.						
8.50										
9.00										
9.50										
10.00										

PREVIOUS BORINGS BY

Grice (2008b)

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 1 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Densily	Moisture	Unconfined	Cohesion	Shear
1.00				concrete, 3 inches over sand 4 inches						
	ML			(CUTTINGS) Light olive brown | SILT; non-plastic; friable | little: sand; very fine-fine | damp; soft-medium stiff.						
2.00	CL			(CUTTINGS-SAMPLE) mottled-varigated; dark yellowish brown to very dark brown | CLAY; medium plasticity; slight-modertely pliable | trace: fine sand | damp; medium stiff.						
		2.25	11.00							
3.00			13.00	recover 15 inches						
	SWm		11.00	(CUTTINGS-SAMPLE) Dark brown | SAND; fine to medium; round to suangular | few: silt | moist; medium dense..		102.9	10.1	8.5		
4.00										
5.00	SWMC	4.50	2.50	(CUTTINGS-SAMPLE) Yellowish brown | SAND; fine to medium; trace to fine gravel; round to suangular; granitic | few-little (varies): silty clay; few thin veins of sandy clay | slt wet, saturated at shoe; loose.	free water 53 inches after sample					
			2.75					sat-drand-qk		
			3.75	recover 8 inches		105.2	14.6	3.5	300	27
6.00				same						
7.00		7.00	2.25							
			2.75							
8.00				looks to be same						
			3.75	no recovery						
9.00										
10.00				? takes up, still auger pen is nil						
				drilling is very firm						
11.00	SWmc			(CUTTINGS) Olive grey | SAND; medium to coarse; few to fine; round to subangular; granitic | few to little: silt/clay | wet, dense. ?						
12.00										
		43.00								
	SW,	12.50	22.00	(SAMPLE) Yellowish brown | SAND; medium to coarse; few to fine and to 1 inch gravel; round to subangular; granitic | trace-few: silt; few veins clay | wet, dense.						
13.00			39.00							
			50.00			130.1	11.3	9+		
14.00			0.60							
			end							
15.00				same sane with lenses of increased clay and occasional large gravels/cobbles to eob						
16.00										
17.00										
18.00										
19.00										
20.00										

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 1 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
21.00										
22.00										
23.00										
24.00				End of bore at 24.0 feet. Free water observed below 4.5 feet. Bore backfilled with cuttings and gravel, patched with concrete at grade.						
25.00										
26.00										
27.00										
28.00										
29.00										
30.00										
31.00										
32.00										
33.00										
34.00										
35.00										
36.00										
37.00										
38.00										
39.00										
40.00										

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 2 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
0.50				dirt						
0.50	SWm			(CUTTINGS) Dark brown-brown; verigated | SAND; fine; round to suangular | few: silt | moist; loose						
1.00										
1.50	SPm	1.25	dcpt 8.00 9.00 10.00	(CUTTINGS) Pale yellow | SAND; fine; round to subangular | trace: silt | moist; loose-medium dense.						
2.00										
2.50	ML	2.30	dcpt 9.00 9.00 12.00 14.00	(CUTTINGS) Light olive brown | SILT; non-plastic; friable | little: sand; very fine-fine | damp; soft-medium stiff.						
3.00				(CUTTINGS) mottled-varigated; dark yellowish brown to very dark brown | CLAY; medium plasticity; slight to modertely pliable | trace: fine sand (and silt lenses, lensatic) | damp; medium stiff.						
3.50			dcpt							
4.00	SWmc	42.00	6.25 5.25 4.00 4.00	(CUTTINGS) Dark yellowish brown | SAND; fine to medium; trace to fine gravel; round to suangular; granitic | few-little (varies): silty clay; few thin veins of sandy clay | slt wet, saturated at shoe; loose.						
4.50				free water 49 inches						
5.00				same but light yellowish brown, few silty clay; wet; loose-medium dense						
5.50		5.00	dcpt 12.00 13.00 18.00							
6.00				real tight to hand auger						
6.50	SWC			(CUTTINGS) Yellowish brown; mottled; indication of corrosion | SAND; fine to medium few to coarse; trace to fine gravel; round to subangular; granitic | few to (mostly) little-some: clay, | wet, medium dense.						
7.00										
7.50		7.25	dcpt 15.00 15.00 16.00							
8.00	SWmc			(CUTTINGS) Olive grey | SAND; medium to coarse; few to fine; round to subangular; granitic | few to little: silt/clay | wet, dense.						
8.50				cuttings pale into a yellowish brown similar to b1						
9.00										
9.50										
10.00										

Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 2 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
				same, somewhat lensatic						
10.50			dcpt							
		10.50	9.00							
			15.00							
			16.00							
11.00										
				gravels						
11.50										
12.00										
12.50										
13.00										
				End of bore at 13.0 feet. Free water encountered below 4 feet.						
				Bore backfilled with cuttings						
13.50										
14.00										
14.50										
15.00										
15.50										
16.00										
16.50										
17.00										
17.50										
18.00										
18.50										
19.00										
19.50										
20.00										

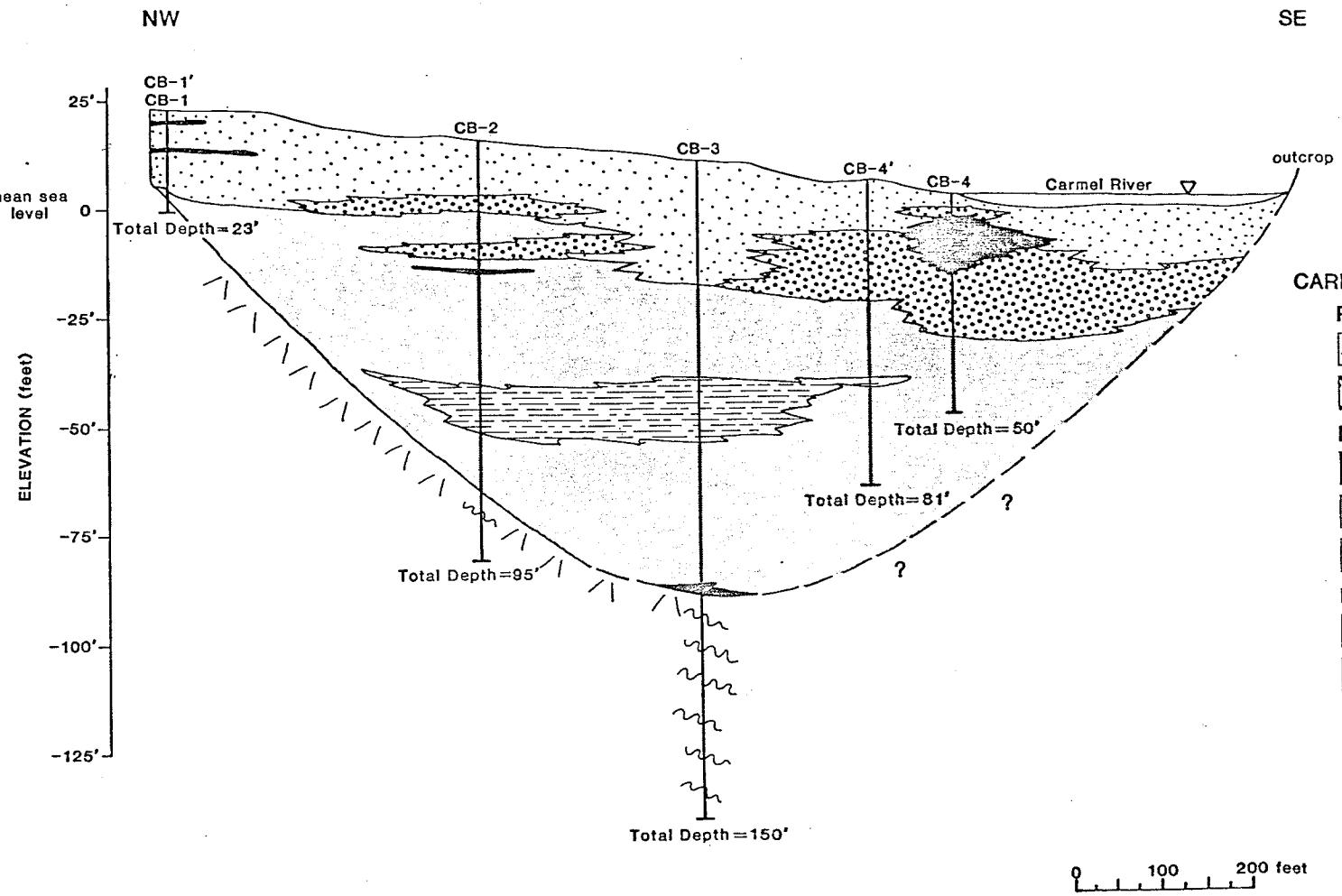
Freeman Residence; 2691 16th Avenue, Carmel

Boring No. 3 February 04, 2008

Depth	Symbol	Sample	Blow Count per 6 inch	Description	Auger Pen.	Density	Moisture	Unconfined	Cohesion	Shear
0.50				grass						
	ML			(CUTTINGS) Light olive brown | SILT; non-plastic; friable | little: sand; very fine-fine | damp; soft-medium stiff.						
0.50										
1.00										
1.50										
				picking up clay						
2.00										
	CL			(CUTTINGS) mottled-varigated; dark yellowish brown to very dark brown | CLAY; medium plasticity; slight to modertely pliable | trace: fine sand (and silt lenses, lensatic) | damp; medium stiff.						
2.50										
				silt lenses are fairly thick						
3.00										
				bottom of hole falls out						
	SWmc			(CUTTINGS) Dark yellowish brown | SAND; fine to medium; trace to fine gravel; round to suangular; granitic | few-little (varies): silty clay; few thin veins of sandy clay | slt wet, saturated at shoe; loose.						
3.50										
4.00				stuff black at topside, yellow-drk brown after 1 foot, very mottled looks like a buried soil profile						
4.50										
	SWC			(CUTTINGS) Yellowish brown; mottled; indication of corrosion | SAND; fine to medium few to coarse; trace to fine gravel; round to subangular; granitic | few to (mostly) little-some: clay, | wet, medium dense.						
5.00					free water 5 ft after drilling					
5.50										
6.00										
6.50										
7.00										
7.50										
				gravelly stop at 8, just to rough to hand auger proabaly						
8.00				(CUTTINGS) Olive grey | SAND; medium to coarse; few to fine; round to subangular; granitic | few to little: silt/clay | wet, dense.						
8.50										
9.00										
9.50										
10.00										

PREVIOUS BORINGS BY

Hydro-Search (1981)



KEY

CARMEL VALLEY ALLUVIUM

Pervious Materials

- fine to coarse sand
- coarse sand

Non Pervious Materials

- organics
- silty sand
- clayey silty sand

BEDROCK (granodiorite)

- hard
- soft (fractured or sheared)

PRELIMINARY

Figure 2.

GEOLOGIC CROSS SECTION
CARMEL RIVER STATE BEACH

PROJECT 1205-81
DATE August 1981
REVISIONS

Hydro-Search, Inc.
CONSULTING HYDROLOGISTS-GEOLOGISTS
Austin • Denver • Reno

LOG OF BOREHOLE

BOREHOLE

LOC. or COORDS. T16S R1W Sec. 12 SE1/4 NW1/4

GROUND ELEV. 22.97

TOTAL DEPTH 23'

BOREHOLE DIAM. 6"

DRILLER Weyer Drilling

RIG modified Mobile B-50

BIT(S) 6" tricone

FLUID bentonite mud

	START	FINISH
DATE	7/24/81	7/24/81
TIME	0900	1000

GEOPHYS. LOG ___ YES XX NO

HOW LEFT backfilled

LOCATION Carmel River State Park

LOGGED BY SLR

PROJECT 12ub-81

DEPTH	PENE. RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
0	300' /hr.				fine to coarse sand		0-5' Drilled dry. Set 5' surface casing. Poorly sorted, medium to fine, subangular fine silty sand.
							2' Dark blue organics in sand.
	300				organics		5' Mud, bentonite, light brown.
10							8' wood fibers return with sand.
	225						9' continued poorly sorted sand.
							17' Drilling mud, dark brown. Increase fines. Silty sands.
					silty sand		19' Bit chattering. Slow drilling. Rig agitated.
20					granodiorite		20' Extreme chatter. Minor white feldspar flakes found in sand.
							22' Mud thickening. Consistent clatter. Tripped out. Changed to 4" bit. Tripped in. Filled in 10'. Drilled to 23'. Material too hard to penetrate. Little evidence of bedrock in returns.
30							Total depth 23'.

LOG OF BOREHOLE

BOREHOLE CB-1

LOC. or COORDS. T16S, R1W Sec. 12 SE1/4 NW1/4
GROUND ELEV. 21.00'
TOTAL DEPTH 20'
BOREHOLE DIAM. 6"

DRILLER Weyer Drilling
RIG modified Mobile B-50
BIT(S) 6" auger
FLUID none

	START	FINISH
DATE	7/24/81	7/24/81
TIME	1050	1100

GEOPHYS. LOG ___ YES X NO
HOW LEFT back filled

LOCATION Carmel River State Beach
LOGGED BY SLR
PROJECT 1203-01

DEPTH	PENE. RATE	CIRC. RET	CIRC. LOSS	AIRLIFT Q (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
0					fine to coarse sand		0-20' Drilled dry, auger. 0-19' Poorly sorted, medium to fine, subangular, Fine silty sand. Granitic composition.
10							
19'							Bit chattering violently.
20					granodiorite		Large cobble size fragments of weathered ganodiorite return. Confirmed bedrock contact. Total depth 20'.

LOG OF BOREHOLE

LOC. or COORDS. T16S R1W
Section 12 SE1/4 NE1/4
GROUND ELEV. 15.88'
TOTAL DEPTH 95'
BOREHOLE DIAM. 4"

DRILLER Weyer Drilling
RIG modified Mobile B-50
BIT(S) 4" tricone
FLUID bentonite mud

	START	FINISH
DATE	7/23/81	7/23/81
TIME	1145	1800

GEOPHYS. LOG ___ YES X NO
HOW LEFT backfilled

LOCATION ___ LOGGED BY SLR

DEPTH	PENE. RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0	300' /hr				fine to coarse sand		0-5' Drilled dry. Set 5' surface casing. Mixed mud.
							0-12' Poorly sorted, loose, medium to fine, subangular fine, silty sand. Tan and white quartz and feldspar, with minor biotite present.
	150						
10					coarse sand		12' Grading coarser. Coarse to medium grained sand with ~ 25% fines.
	150						16' Mud darker brown. Hole caving. Minor rusty brown clay balls return with coarse sand.
	300				silty sand		
20							20' Minor clay lens.
	150						24' Hard drilling. Rig chattering. Sand denser and coarser with rounded pebbles.
					coarse sand		
	300				silty sand		26-30' Minor rusty brown clay balls and gray green clay.
30					organics		
	150				silty sand		30' Dark organic layer. Continued coarse sands and fines.
							34' Harder drilling. Gray green clay chips return. Brief loss of circulation.
	150						35' Caving. Cleared hole.
40							40' Poorly sorted fine to coarse silty sands.
	150						
	150						
50							50' Split spoon sample: poorly sorted, poorly compacted, coarse, subangular sand with ~30% fine sand and silt. Granitic composition.
	150						
	300				clayey, silty sand		55'-60' Easier drilling. Brown to green, silty clayey sand. Split spoon sample: poorly sorted sand with 50% gray green silty clay. Small clay lens present.
60							
	300						
							65-70' Thick, gray-green drilling mud.
	300				silty sand		67' Grading less clay. Poorly sorted silty sand.
70							
	150						
	300						79' Hard drilling.
80					bedrock		

LOG OF BOREHOLE

BOREHOLE

LOC. or COORDS. T16S R1W Sec. 12 SE NE

GROUND ELEV. 15.88'

TOTAL DEPTH 95'

BOREHOLE DIAM. 4"

DRILLER Weyer Drilling

RIG modified Mobile B-50

BIT(S) 4" tricone

FLUID bentonite, organic polymer

	START	FINISH
DATE	7/23/81	7/23/81
TIME	1145	1800

GEOPHYS. LOG ___ YES X NO

HOW LEFT backfilled

LOCATION Camel River State Park

LOGGED BY SLR

PROJECT 1205-81

DEPTH	PENE. RATE	CIRC. RET	CIRC. LOSS	AIRLIFT Q (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
80	90'/hr				fractured bedrock		80-85' slight bit chatter. Poor cuttings returned. Thick dark brown drilling mud.
	60'						79-95' Decreased drill rate and decreased cuttings returned indicate bedrock. Drill stem chatter indicates fractured bedrock.
90	60"						Total depth 95'.
100							

LOG OF BOREHOLE

LOC. or COORDS. T16S R1W Sec. 12 SE1/4 NE1/4
GROUND ELEV. 11.06'
TOTAL DEPTH 150'
BOREHOLE DIAM. 4" (river water mixed with mud)

DRILLER Weyer Drilling
RIG modified Mobile B-50
BIT(S) 4" tricone
FLUID bentonite, organic polymer

	START	FINISH
DATE	7/25/81	7/25/81
TIME	1400	1630

GEOPHYS. LOG ___ YES X NO
HOW LEFT backfilled

LOCATION Camel River State Park
LOGGED BY SLR
PROJECT 1205-81

DEPTH	PENE. RATE	CIRC. RET	CIRC. LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0					fine to coarse sand		0-5' Drilled dry. Set 5' surface casing. Mixed mud. Poorly sorted coarse to fine, subangular silty fine sand. Granitic composition.
10	300' /hr						5-15' Increased silt. Drilling mud, light brown.
	285						15-20' Continued coarse to fine, silty sand.
20	300						25' Caving 1'.
	300						29' Increased silt. Dark brown drilling mud.
30					silty sand		30' Caving 1'.
	300						29-35' Medium, subangular sand in brown, rusty silt. Fines 40%. Set 25' surface casing to prevent caving. Tripping back in. Caved 15'.
	250						35' Thick brown drilling mud.
40	280						40' Caving 1'.
							40-45' Cloudy brown drilling mud. Continued medium subangular silty sand. Granitic composition.
	300						45' Caving 1'.
50	225				clayey, silty sand		50-55' Increased silt. Mud thick with silt and fines. Gray green-brown mud. Gray green clay balls.
	300						
60	300						60-65' Continued silty clayey sands. Drilling mud thick gray green brown.
							65' Caving 1'.
	150				silty sand		69' Slight bit chatter. Silty sands returned.
70	150						70' Caving 3'
							70-75' Mild chatter. Continued poorly sorted, coarse to fine, silty sand. Granitic composition
	150						
80							

LOG OF BOREHOLE

LOC. or COORDS. T16S R1W Sec. 12 SE1/4 NE1/4
GROUND ELEV. 11.06'
TOTAL DEPTH 150'
BOREHOLE DIAM. 4" (river water mixed with mud)

DRILLER Weyer Drilling
RIG modified Mobile B-50
BIT(S) 4" tricone
FLUID bentonite, organic polymer

	START	FINISH
DATE	7/25/81	7/25/81
TIME	1400	1630

GEOPHYS. LOG ___ YES XX NO
HOW LEFT backfilled

LOGGED BY SLR

DEPTH	PENE. RATE	CIRC RET	CIRC LOSS	AIRLIFT Q (gpm)	MATERIAL	SYM-BOL	DESCRIPTION and COMMENTS
80	225' /hr.				silty sand		83' Drill stem has slight chatter. 85-90' Chatter diminished.
	150						
90	150						94' Dark brown silty sand.
	150						
100	250				organics bedrock ?		100' Lost circulation briefly. Black and gray wood fibers in returns. 100-105' Little cuttings returned after organics penetrated. Slight chatter.
	225						105-110' Thick gray brown drilling mud.
110	150						110-115' Silty sand.
	150						
120	120						120' Caving 5'. Slight drill stem chatter.
	150						125' Minor white feldspar flakes return with dark silty sand.
130	150						136' Slight drill stem chatter.
	90						
140							140-145' Drill stem chattering erratically.
	50						145-150' Circulation decreasing. Driller cannot clear hole of cuttings. Little evidence of bedrock in returns.
150							Total depth 150'. Caved to 27'.

LOG OF BOREHOLE

BOREHOLE _____

PAGE 1 OF 1

LOC. or COORDS. T16S R1W Sec. 12 SE1/4 NE1/4
GROUND ELEV. 7.14'
TOTAL DEPTH 81'
BOREHOLE DIAM. 4"

DRILLER Weyer Drilling
RIG modified Mobile B-50
BIT(S) 4" tricone
FLUID bentonite, organic polymer

	START	FINISH
DATE	7/25/81	7/25/81
TIME	0800	1240

GEOPHYS. LOG ___ YES XX NO
HOW LEFT backfilled

LOCATION Carmel River State Park
LOGGED BY SLR
PROJECT 1205-81

DEPTH	PENE. RATE	CIRC. RET	CIRC. LOSS	AIRLIFT Q (gpm)	MATERIAL	SYMBOL	DESCRIPTION and COMMENTS
0					fine to med. sand		0-5' Drilled dry. Set surface casing, Mixed mud. Poorly sorted, medium to fine, subangular, fine, silty, sand.
10	225' /hr.				coarse sand		12' Coarse to very coarse, subangular sand Drilling mud gray blue (due to mud compound).
	300						15-20' Continued coarse sands. Drilling mud thin.
20	225						20-25' Orange rusty silt returns with coarse sand.
	300						27' Drilling mud darker gray brown. Grading to silt.
30	300				silty sand		30' Caving 2'. Hole tight when pulling rods.
	600						36'. Dark gray silty sand.
40	225						40' Caving 2'. 40-45' Dark gray micaceous silt with fine to coarse, poorly sorted sand.
	225				clayey, silty sand		45' Caving 4'. 45-50' Continued poorly sorted fine to coarse sand with minor clay balls
50	300				silty sand		50' Caving 4'. Drilling mud circulating outside of surface casing. Poorly sorted silty sand.
	300						
60	300						
	225						70' Tripped out. Set 15' surface casing. Caved 30'. Drilling mud circulating outside of casing
70	225						70-75' Poorly sorted silty sand.
	250						81' Temporarily lost circulation. Built up pressure on mud pump. Blew hose off mud pump. Re-gained circulation. Caving prevents further drilling.
80							Total depth 81'.

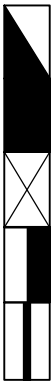
PREVIOUS BORINGS BY

Kleinfelder (2011)

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY	GW		Well-graded gravels or gravel with sand, little or no fines.
		GP		Poorly-graded gravels or gravel with sand, little or no fines.
		GM		Silty gravels, silty gravel with sand mixture.
		GC		Clayey gravels, clayey gravel with sand mixture.
	SAND AND SANDY	SW		Well-graded sands or gravelly sands, little or no fines.
		SP		Poorly-graded sands or gravelly sands, little or no fines.
		SM		Silty sand.
		SC		Clayey sand.

MAJOR DIVISIONS		LTR	ID	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS	ML		Inorganic silts and very fine sands, rock flour or clayey silts with slight plasticity.
		CL		Inorganic lean clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
		OL		Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS	MH		Inorganic elastic silts, micaceous or diatomaceous or silty soils.
		CH		Inorganic fat clays (high plasticity).
		OH		Organic clays of medium high to high plasticity.
HIGHLY ORGANIC SOILS		Pt		Peat and other highly organic soils.



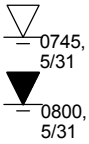
Standard Penetration Split Spoon Sampler 2.0 inch O.D., 1.4 inch I.D.

Modified California Sampler 2.5 inch O.D., 2.0 inch I.D.

Bulk Sample

California Sampler, 3.0 inch O.D., 2.5 inch I.D.

Shelby Tube 3.0 inch O.D.



Approximate water level first observed in boring. Time recorded in reference to a 24 hour clock.

Approximate water level observed in boring following drilling

PEN	Pocket Penetrometer reading, in tsf
TV:Su	Torvane shear strength, in ksf

LL	Liquid Limit
PI	Plasticity Index
%-#200	Sieve Analysis (#200 Screen)
DS	Direct Shear
C	Cohesion (psf)
PHI	Friction Angle
UC	Unconfined Compression
TxUU	Triaxial Shear
CONSOL	Consolidation
R-Value	Resistance Value
SE	Sand Equivalent
EI	Expansion Index
FS	Free Swell (U.S.B.R.)

Notes: Blow counts represent the number of blows a 140-pound hammer falling 30 inches required to drive a sampler through the last 12 inches of an 18 inch penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 120198

BORING LOG LEGEND

CARMEL RIVER SCHOOL CLASSROOMS
15th AVENUE AND MONTE VERDE STREET
CARMEL, CALIFORNIA

PLATE

A-1

7/18/2011 9:37:52 AM

Date Completed: 7/1/11

Logged By: R. Hasseler

Total Depth: Approximately 50.0 ft

Drilling method: 8" Hollow Stem Auger

Hammer Wt: 140 lbs., 30" drop

Notes: Surface Conditions: Asphalt Concrete Parking Lot

Depth,ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Compress. Strength tsf	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Surface Elevation: **Estimated 31.0 feet (MSL)**
						Passing -#200=19%		**ASPHALT CONCRETE** - approximately 4-inches thick
								AGGREGATE BASEROCK - approximately 2.5-inches thick
								SILTY SAND with GRAVEL (SM) - dark brown, moist, loose, fine grained sand
		10	106	6.9				**WELL GRADED SAND with SILT and GRAVEL (SW-SM)** - orange-brown, moist, loose, fine to coarse grained sand, fine gravel
5		19						- medium dense
								WELL GRADED GRAVEL with CLAY (GW-GC) - light brown, moist, medium dense, coarse gravels, monterey formation gravels, low plasticity
								CLAYEY SAND with GRAVEL (SC) - red-brown, moist, very dense, fine to coarse grained sand, fine to coarse gravel, low plasticity clay, decomposed granite gravels
10		63				Passing -#200=13%		- grading
			9:20					
						Passing -#200=95%		**LEAN CLAY (CL)** - olive-brown, moist, very stiff, trace fine grained sand, low plasticity clay
15		27						
			9:05					
20		50/6"						**WELL GRADED SAND with SILT (SW-SM)** - olive-brown, wet, very dense, fine to coarse grained sand
								POORLY GRADED SAND with SILT (SP-SM) - olive-brown, wet, very dense, medium grained sand
25		50/5"						- hard drilling cobble

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 120198

LOG OF BORING NO. B-1

CARMEL RIVER SCHOOL CLASSROOMS
15th AVENUE AND MONTE VERDE STREET
CARMEL, CALIFORNIA

PLATE

A-2

L:\2011\11PROJECTS\120198-CARMEL RIVER SCHOOL CLASSROOMS\120198.GPJ

8/11/2011 9:22:56 AM

Depth, ft	Sample	Blows/ft	Dry Density pcf	Moisture Content %	Compress. Strength tsf	Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								POORLY GRADED SAND with SILT (SP-SM) - continued
				18.7		LL=0; PI=0 Passing #200=24%		**SILTY SAND (SM)** - olive-brown, wet, medium dense, fine to coarse grained sand
30		29						
								- dark brown, very dense
35		51						
		50/6"						**WELL GRADED SAND with CLAY and GRAVEL (SW-SC)** - olive-brown, wet, very dense, fine to coarse grained sand, fine to coarse gravel, low plasticity clay
40								
		50/5"						
45								
		50/5"						
50								Boring terminated at approx. 50 feet below ground surface. Backfilled with drilling spoils and grout, capped with PPC plug.
55								

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. **120198**

LOG OF BORING NO. B-1

CARMEL RIVER SCHOOL CLASSROOMS
15th AVENUE AND MONTE VERDE STREET
CARMEL, CALIFORNIA

PLATE

A-2
(cont'd)

L:\2011\11PROJECTS\120198-CARMEL RIVER SCHOOL CLASSROOMS\120198.GPJ

8/11/2011 9:22:56 AM

Date Completed: **7/1/11**

Logged By: **R. Hasseler**

Total Depth: **Approximately 7.0 ft**

Drilling method: **4" Solid Flight Auger**

Hammer Wt: **70 lbs., 30" drop**

Notes: **Surface Conditions: Landscape/ Earth Cover**

Depth,ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength tsf	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								Surface Elevation: **Estimated 30.0 feet (MSL)**
						Passing -#200=25%		**SILTY SAND with GRAVEL (SM)** - brown, moist, loose, fine grained sand, fine to coarse gravel
								SILTY SAND (SM) - light brown, moist, loose, fine grained sand
5				6.7		Passing -#200=19%		
		12						
		50/2"						**WELL GRADED GRAVELS WITH CLAY (GW-GC)** - light brown, moist, very dense, fine to coarse gravel, low plasticity clay
								- drilling refusal at 7 feet
10								Boring terminated at approx. 7 feet below ground surface.
								No free water encountered.
								Backfilled with drilling spoils.
15								
20								
25								

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 120198

LOG OF BORING NO. B-2

CARMEL RIVER SCHOOL CLASSROOMS
15th AVENUE AND MONTE VERDE STREET
CARMEL, CALIFORNIA

PLATE

A-3

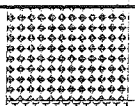
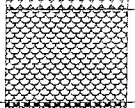
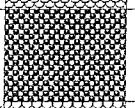
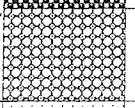
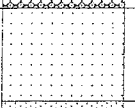
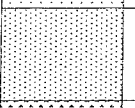
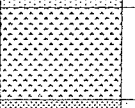
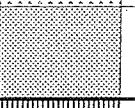
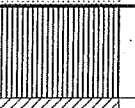
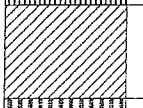
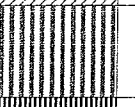
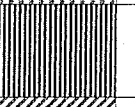
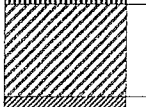
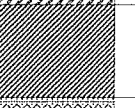
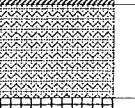
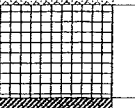
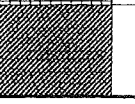
L:\2011\11PROJECTS\120198-CARMEL RIVER SCHOOL CLASSROOMS\120198.GPJ

8/11/2011 9:22:58 AM

PREVIOUS BORINGS BY

Landset Engineers (2005)

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50 % of material is larger than No. 200 sieve size.	GRAVEL AND GRAVELLY SOILS More than 50 % of coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS		GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES		GM	Silty gravel, gravel-sand-silt mistures.
				GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS More than 50 % of coarse fraction passing No. 4 sieve.	CLEAN SAND (Little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly-graded sands, gravelly sands, little or no fines.
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS More than 50 % of material is smaller than No. 200 sieve size.	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
				OL	Organic silts and organic silty clay of low plasticity.
		LIQUID LIMIT GREATER THAN 50		MH	Inorganic silty, micaceous or diatomaceous fine sand or silty soils.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soils with high organic contents.
VARIOUS SOILS AND MAN MADE MATERIALS					Fill materials.
MAN MADE MATERIALS					Asphalt and concrete.

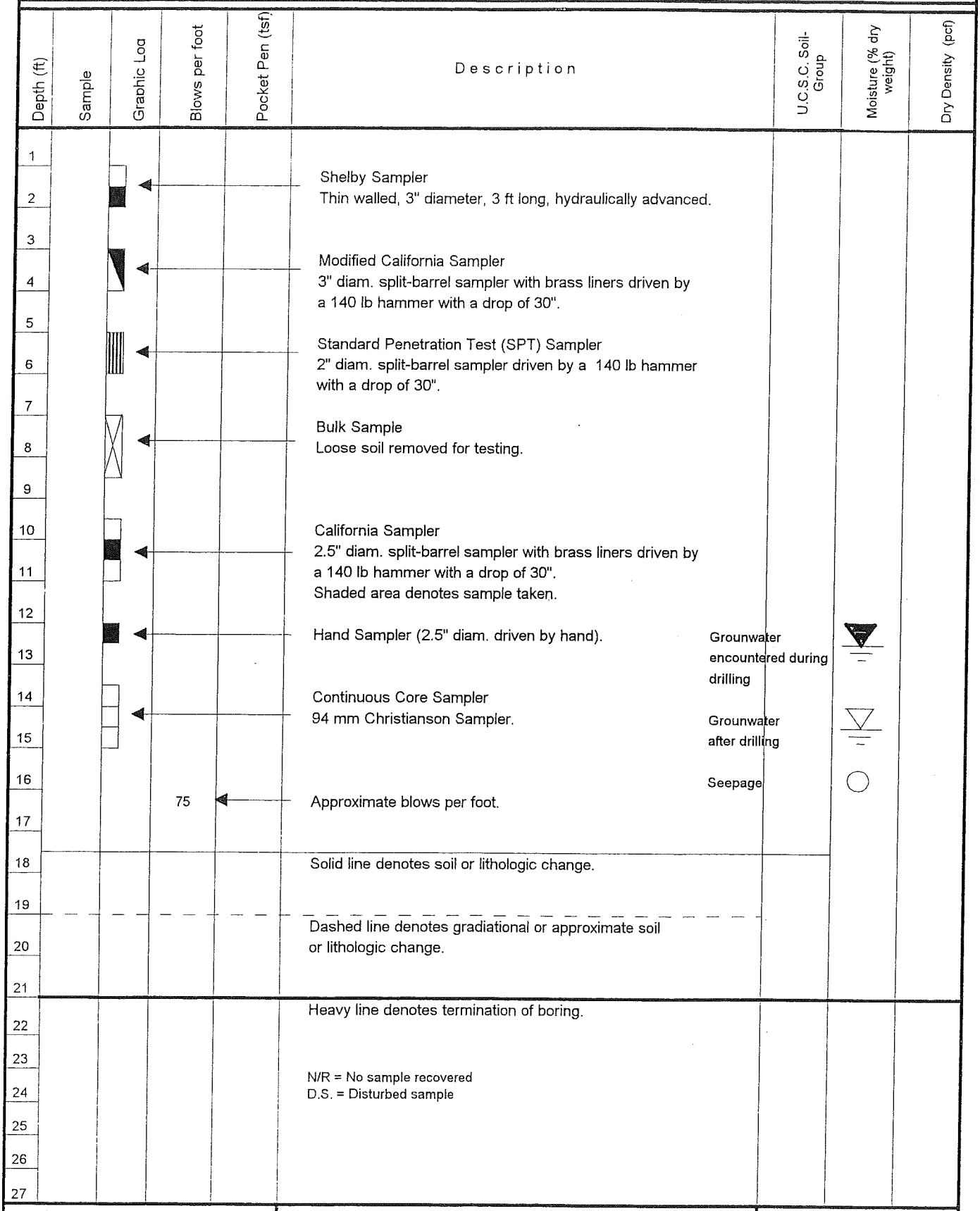
Landset Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907

(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A1

KEY TO LOG OF BORINGS



LandSet Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A2

SOIL TERMINOLOGY

SOIL TYPES (Ref. 1)

Boulders:	Particles of rock that will not pass a 12 inch screen.
Cobbles:	Particles of rock that will pass a 12 inch screen, but not a 3 inch sieve.
Gravel:	Particles of rock that will pass a 3 inch sieve, but not a No.4 sieve.
Sand:	Particles that will pass a No. 4 sieve, but not a No. 200 sieve.
Silt:	Soil that will pass a No. 200 sieve, that is non-plastic or very slightly plastic, and that exhibits little or no strength when dry.
Clay:	Soil that will pass a No. 200 sieve, that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when dry.

MOISTURE AND DENSITY

Moisture Condition:	An observational term; dry, slightly moist, moist, very moist, saturated.
Moisture Content:	The weight of water in a sample divided by the weight of dry soil in the soil sample, expressed as a percentage.
Dry Density:	The pounds of dry soil in a cubic foot of soil.

DESCRIPTORS OF CONSISTENCY (Ref. 3)

Liquid Limit:	The water content at which a No. 40 soil is on the boundary between exhibiting liquid and plastic characteristics. The consistency feels like soft butter.
Plastic Limit:	The water content at which a No. 40 soil is on the boundary between exhibiting plastic and semi-solid characteristics. The consistency feels like stiff putty.
Plasticity Index:	The difference between the liquid limit and the plastic limit, i.e. the range in water contents over which the soil is in a plastic state.

MEASURES OF CONSISTENCY OF COHESIVE SOILS (CLAYS) (Ref's. 2 & 3)

Very soft	N=0-1 *	C=0-250 psf	Squeezes between fingers
Soft	N=2-4	C=250-500 psf	Easily molded by finger pressure
Medium Stiff	N=5-8	C=500-1000 psf	Molded by strong finger pressure
Stiff	N=9-15	C=1000-2000 psf	Dented by strong finger pressure
Very Stiff	N=16-30	C=2000-4000 psf	Dented slightly by finger pressure
Hard	N>30	C>4000 psf	Dented slightly by a pencil point

* N = Blows per foot in the Standard Penetration Test. In cohesive soils, with the 3" diameter sampler, 140 pound weight, divide the blow count by 1.2 to get N (Ref. 4).

MEASURES OF RELATIVE DENSITY OF GRANULAR SOILS (GRAVELS, SANDS AND SILTS) (Ref's. 2 & 3)

Very Loose	N=0-4 **	RD=0-30	Easily push a 1/2" reinforcing rod by hand
Loose	N=5-10	RD=30-50	Push a 1/2" reinforcing rod by hand
Medium Dense	N=11-30	RD=50-70	Easily drive a 1/2" reinforcing rod
Dense	N=31-50	RD=70-90	Drive a 1/2" reinforcing rod 1 foot
Very Dense	N>50	RD=90-100	Drive a 1/2" reinforcing rod a few inches

** N = Blows per foot in the Standard Penetration Test. In granular soils, with the 3" diameter sampler, 140 pound weight, divide the blow count by 2 to get N (Ref. 4). RD = Relative Density

Ref. 1: ASTM Designation: D 2487-93, Standard Classification of Soils for Engineering Purposes (Unified Soils Classification System).

Ref. 2: Terzaghi, Karl, and Peck, Ralph B., Soil Mechanics in Engineering Practice, John Wiley & Sons, New York, 2nd Ed., 1967, pp. 30, 341, 347.

Ref. 3: Sowers, George F., Introductory Soil Mechanics and Foundations: Geotechnical Engineering, Macmillan Publishing Company, New York, 4th Ed., 1979, pp. 80,81 and 312.

Ref. 4: Lowe, John III, and Zaccheo, Phillip F., Subsurface Explorations and Sampling Chapter 1 in "Foundation Engineering Handbook," Hsai-Yang Fang, Editor, Van Nostrand Reinhold Company, New York, 2nd Ed., 1991, p. 39.

Landset ENGINEERS, INC.

520-B Crazy Horse Canyon Rd, Salinas, CA 93907

(831) 443-6970, Fax (831) 443-3801, Landset@aol.com

Figure A3

EXPLORATORY BORING LOG

No. B-1

PROJECT: Campos Residence | **DATE DRILLED:** 8-24-05 | **FILE No.:** LSw-0425-01

DRILLER: California Geotech | **DRILLING METHOD:** Man Portable | **LOGGED BY:** IMS

BORING DIAMETER: 4" SS | **BORING DEPTH:** 16.5' | **GROUNDWATER DEPTH:** N/A

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.S.C.S Soil Group	Moisture (% dry weight)	Dry Density (pcf)
0								
1					Qt: Terrace Deposits (Pleistocene): Dark brown SAND: medium dense, dry, fine sand, trace coarse gravel	SW		
2	1-1			1.0			7.5	93.2
3	1-2		16	0.5			7.3	92.3
4								
5	1-3		21	1.5	Color change to dark yellowish brown		6.9	94.5
6								
7	1-4			>0.28			6.7	100.6
8			34					
9								
10	1-5			>0.28	dense		4.2	92.3
11			52					
12								
13								
14								
15								
16					interbeded grey silt and yellowish brown coarse sand			
17	1-6		42				15.7	
18					**TD @ 16.5'**			
19					**NO GROUND WATER ENCOUNTERED**			
20								
21								
22								
23								
24								
25								
26								

Landset Engineers, Inc.

520 B Crazy Horse Canyon Rd., Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801

Figure A4

EXPLORATORY BORING LOG — No. B-2

PROJECT: Campos Residence | **DATE DRILLED:** 8-24-05 | **FILE No.:** LSw-0425-01
DRILLER: California Geotech | **DRILLING METHOD:** Man Portable | **LOGGED BY:** IMS
BORING DIAMETER: 4" SS | **BORING DEPTH:** 16.5' | **GROUNDWATER DEPTH:** N/A

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.S.C.S Soil Group	Moisture (% dry weight)	Dry Density (pcf)
0								
1–9	2-1 2-2		20	0.5 0.75	Qt: Terrace Deposits (Pleistocene): Dark brown SAND W/SILT: medium dense, dry, fine sand	SW	8.1 7.8	95.5 97.7
6–9	2-3		18	2.0			7.7	104.1
10–16	2-4		28	>0.28	Dark yellowish brown SAND: medium dense, slightly moist, fine to coarse sand	SW	5.2	97.8
16	2-5		46		dense		8.3	
17					**TD @ 16.5'** **NO GROUND WATER ENCOUNTERED**			

Landset Engineers, Inc.
520 B Crazy Horse Canyon Rd., Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801

Figure A5

EXPLORATORY BORING LOG

No. B-3

PROJECT: Campos Residence | **DATE DRILLED:** 8-24-05 | **FILE No.:** LSw-0425-01

DRILLER: California Geotech | **DRILLING METHOD:** Man Portable | **LOGGED BY:** IMS

BORING DIAMETER: 4" SS | **BORING DEPTH:** 16.5' | **GROUNDWATER DEPTH:** N/A

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.S.C.S Soil Group	Moisture (% dry weight)	Dry Density (pcf)
0								
1					Fill: Dark brown SAND: loose, dry, fine sand, brick in cuttings	SW		
2					Qt: Terrace Deposits (Pleistocene):Brown SAND: medium dense, dry, fine sand	SW		
3	3-1		15	2.25			5.3	95.5
4								
5								
6								
7	3-2			2.75			5.4	98.3
8	3-3		21	2.0			5.7	99.6
9					Dark yellowish brown SAND W/CLAY: medium dense, 5-15% fines, fine sand, boring caved to 8', blows for sample 2-4 not representative	SW		
10								
11	3-4		16	1.5			6.9	100.2
12					**TD @ 11.5'**			
13					**NO GROUND WATER ENCOUNTERED**			
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

Landset Engineers, Inc.

520 B Crazy Horse Canyon Rd., Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801

Figure A6

PREVIOUS BORINGS BY

Landset Engineers (2009)

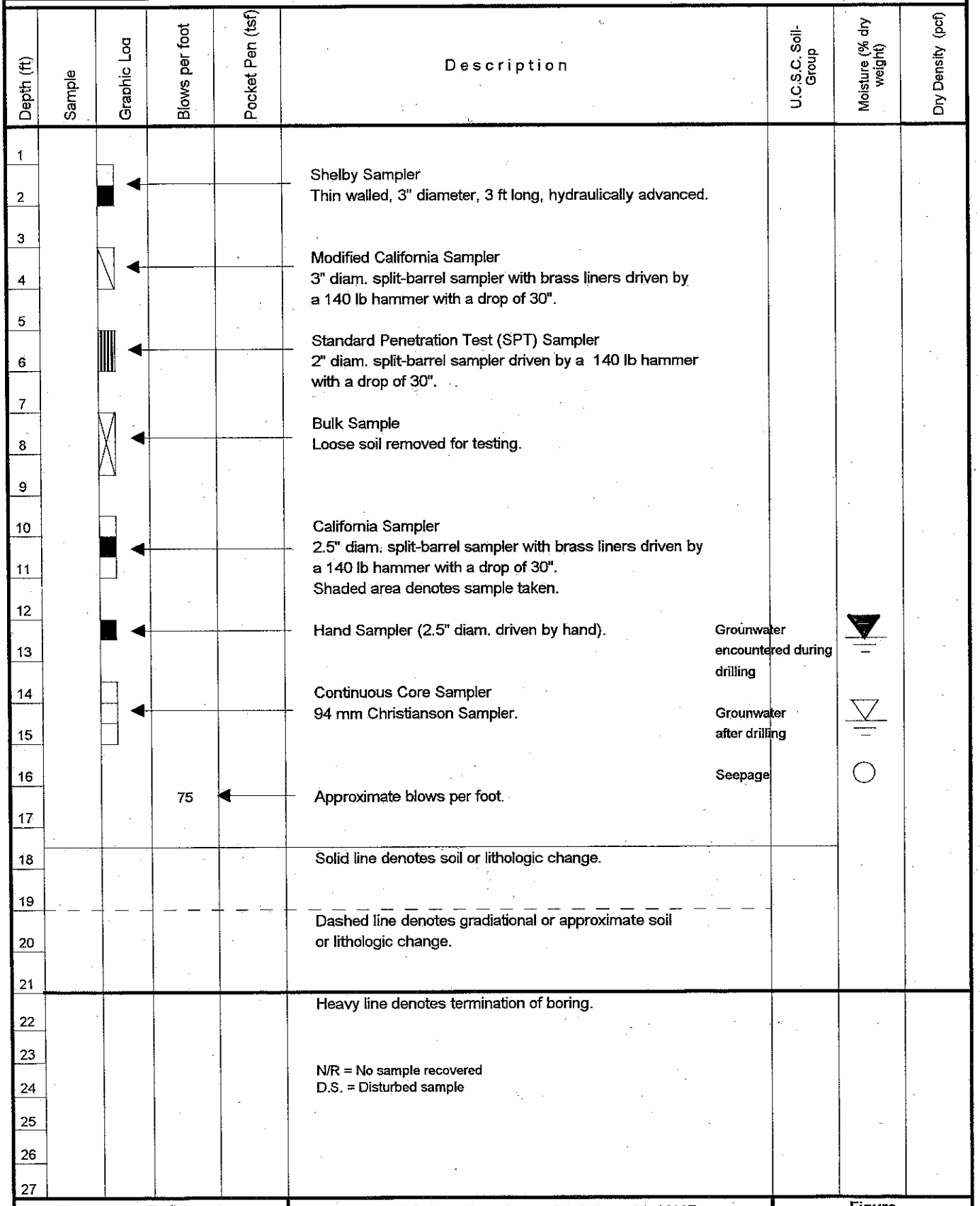
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50 % of material is larger than No. 200 sieve size.	GRAVEL AND GRAVELLY SOILS More than 50 % of coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS		GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES		GM	Silty gravel, gravel-sand-silt mistures.
				GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS More than 50 % of coarse fraction passing No. 4 sieve.	CLEAN SAND (Little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly-graded sands, gravelly sands, little or no fines.
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS More than 50 % of material is smaller than No. 200 sieve size.	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
				OL	Organic silts and organic silty clay of low plasticity.
		LIQUID LIMIT GREATER THAN 50		MH	Inorganic silty, micaceous or diatomaceous fine sand or silty soils.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soils with high organic contents.
VARIOUS SOILS AND MAN MADE MATERIALS					Fill materials.
MAN MADE MATERIALS					Asphalt and concrete.

LandSet Engineers, Inc.
520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A1

KEY TO LOG OF BORINGS



LandSet Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A2

SOIL TERMINOLOGY

SOIL TYPES (Ref. 1)

Boulders:	Particles of rock that will not pass a 12 inch screen.
Cobbles:	Particles of rock that will pass a 12 inch screen, but not a 3 inch sieve.
Gravel:	Particles of rock that will pass a 3 inch sieve, but not a No.4 sieve.
Sand:	Particles that will pass a No. 4 sieve, but not a No. 200 sieve.
Silt:	Soil that will pass a No. 200 sieve, that is non-plastic or very slightly plastic, and that exhibits little or no strength when dry.
Clay:	Soil that will pass a No. 200 sieve, that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when dry.

MOISTURE AND DENSITY

Moisture Condition:	An observational term; dry, slightly moist, moist, very moist, saturated.
Moisture Content:	The weight of water in a sample divided by the weight of dry soil in the soil sample, expressed as a percentage.
Dry Density:	The pounds of dry soil in a cubic foot of soil.

DESCRIPTORS OF CONSISTENCY (Ref. 3)

Liquid Limit:	The water content at which a No. 40 soil is on the boundary between exhibiting liquid and plastic characteristics. The consistency feels like soft butter.
Plastic Limit:	The water content at which a No. 40 soil is on the boundary between exhibiting plastic and semi-solid characteristics. The consistency feels like stiff putty.
Plasticity Index:	The difference between the liquid limit and the plastic limit, i.e. the range in water contents over which the soil is in a plastic state.

MEASURES OF CONSISTENCY OF COHESIVE SOILS (CLAYS) (Ref's. 2 & 3)

Very soft	N=0-1 *	C=0-250 psf	Squeezes between fingers
Soft	N=2-4	C=250-500 psf	Easily molded by finger pressure
Medium Stiff	N=5-8	C=500-1000 psf	Molded by strong finger pressure
Stiff	N=9-15	C=1000-2000 psf	Dented by strong finger pressure
Very Stiff	N=16-30	C=2000-4000 psf	Dented slightly by finger pressure
Hard	N>30	C>4000 psf	Dented slightly by a pencil point

* N = Blows per foot in the Standard Penetration Test. In cohesive soils, with the 3" diameter sampler, 140 pound weight, divide the blow count by 1.2 to get N (Ref. 4).

MEASURES OF RELATIVE DENSITY OF GRANULAR SOILS (GRAVELS, SANDS AND SILTS) (Ref's. 2 & 3)

Very Loose	N=0-4 **	RD=0-30	Easily push a 1/2" reinforcing rod by hand
Loose	N=5-10	RD=30-50	Push a 1/2" reinforcing rod by hand
Medium Dense	N=11-30	RD=50-70	Easily drive a 1/2" reinforcing rod
Dense	N=31-50	RD=70-90	Drive a 1/2" reinforcing rod 1 foot
Very Dense	N>50	RD=90-100	Drive a 1/2" reinforcing rod a few inches

** N = Blows per foot in the Standard Penetration Test. In granular soils, with the 3" diameter sampler, 140 pound weight, divide the blow count by 2 to get N (Ref. 4). RD = Relative Density

Ref. 1: ASTM Designation: D 2487-93, Standard Classification of Soils for Engineering Purposes (Unified Soils Classification System).

Ref. 2: Terzaghi, Karl, and Peck, Ralph B., Soil Mechanics in Engineering Practice, John Wiley & Sons, New York, 2nd Ed., 1967, pp. 30, 341, 347.

Ref. 3: Sowers, George F., Introductory Soil Mechanics and Foundations: Geotechnical Engineering, Macmillan Publishing Company, New York, 4th Ed., 1979, pp. 80,81 and 312.

Ref. 4: Lowe, John III, and Zaccheo, Phillip F., Subsurface Explorations and Sampling Chapter 1 in "Foundation Engineering Handbook," Hsai-Yang Fang, Editor, Van Nostrand Reinhold Company, New York, 2nd Ed., 1991, p. 39.

Landset ENGINEERS, INC.

520-B Crazy Horse Canyon Rd, Salinas, CA 93907

(831) 443-6970, Fax (831) 443-3801, Landset@aol.com

EXPLORATORY BORING LOG

No. B-1

PROJECT:	Peery Residence	**DATE DRILLED:**	27-Feb-09	**FILE No.**	LSW-0685-01
DRILLER:	California Geotech	**DRILLING METHOD:**	B-24	**LOGGED BY:**	TL
BORING DIAMETER:	4" SS	**BORING DEPTH:**	29.6'	**GROUNDWATER DEPTH:**	N/A

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.C.S.C. Soil-Group	Moisture (% dry weight)	Dry Density (pcf)
0								
					6" Concrete			
1					**Dune deposits (Qd) Holocene:**	SP		
2					Moderate yellowish brown (10YR5/4) poorly graded SAND,			
3					loose, dry, very fine to medium grained, 5-10% fines			
4	1-1		9				1.8	
5								
6								
7	1-2		7				1.8	
8								
9								
10								
11								
12	1-3		20		Medium dense			
13								
14								
15								
16					**Older beach sand (Qobs) Holocene:**	SP		
17	1-4		18		Brownish black (5YR2/1) poorly graded SAND medium dense, moist, <5% fines		8.4	
18								
19								
20								
21					**Terrace deposits (Qt) Pleistocene:**			
22	1-5		30		Moderate yellowish brown (10YR 5/4) poorly graded SAND, with (10YR6/6) mottles, medium dense to dense, trace coarse gravel, < 5% fines		6.1	
23								
24								
25								
26								
27	1-6		21				7.0	

LANDSET
Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A-4

EXPLORATORY BORING LOG

No. B-1 Cont.

PROJECT:	Peery Residence	**DATE DRILLED:** 27-Feb-09	**FILE No.** LSW-0685-01
DRILLER:	California Geotech	**DRILLING METHOD:** B-24	**LOGGED BY:** TL
BORING DIAMETER:	4" SS	**BORING DEPTH:** 29.6'	**GROUNDWATER DEPTH:** N/A

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.C.S.C. Soil-Group	Moisture (% dry weight)	Dry Density (pcf)
28					**Terrace deposits (Qt) Pleistocene:** Moderate yellowish brown (10YR 5/4) poorly graded SAND, with (10YR6/6) mottles, medium dense to dense, trace coarse gravel, < 5% fines	SP		
29								
	1-7		50/1		**Volcanic Rock (Tvb) Oligocene:**			
30					Very dense basaltic andesite			
31					**TD @ 29.6'** **NO GROUNDWATER ENCOUNTERED** **Drill Rig Refusal**			

LANDSET Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907

(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A-4

EXPLORATORY BORING LOG

No. B-2

PROJECT:	Peery Residence	**DATE DRILLED:**	27-Feb-09	**FILE No.**	LSW-0685-01
DRILLER:	California Geotech	**DRILLING METHOD:**	B-24	**LOGGED BY:**	TL
BORING DIAMETER:	4" SS	**BORING DEPTH:**	11.5'	**GROUNDWATER DEPTH:**	N/A

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.C.S.C. Soil-Group	Moisture (% dry weight)	Dry Density (pcf)
0								
1					6" Concrete			
2					**Dune deposits (Qd) Holocene:** Pale yellowish brown (10YR6/2) poorly graded SAND, very loose to loose, dry to slightly moist	SP		
3								
4	2-1		6				3.5	
5								
6								
7	2-2		4				4.0	
8								
9								
10								
11								
12	2-3		7				2.5	
13					**TD @ 11.5'**			
14					**NO GROUNDWATER ENCOUNTERED**			
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								

LANDSET
Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure
A-5

EXPLORATORY BORING LOG

No. B-3

PROJECT: Peery Residence		**DATE DRILLED:** 27-Feb-09	**FILE No.** LSW-0685-01
DRILLER: California Geotech		**DRILLING METHOD:** B-24	**LOGGED BY:** TL
BORING DIAMETER: 4" SS	**BORING DEPTH:** 21.5'	**GROUNDWATER DEPTH:** N/A	

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.C.S.C. Soil-Group	Moisture (% dry weight)	Dry Density (pcf)
0								
1					6" Concrete			
2					**Dune deposits (Qd) Holocene:** Moderate yellowish brown (10YR5/4) poorly graded SAND, loose, slightly moist, very fine to fine grained, 10-15% fines	SP		
3	3-1		8		Color change to pale yellowish brown (10YR6/2) loose, dry, slightly moist, <5% fines		3.7	
4								
5								
6	3-2		15		Medium dense, slightly moist		4.0	
7								
8								
9								
10								
11	3-3		20		**Older beach sand (Qobs) Holocene:** Brownish black (10YR2/1) poorly graded SAND, medium dense, slightly moist		5.0	
12								
13								
14								
15								
16	3-4		19				6.2	
17								
18								
19								
20								
21	3-5		25		**Terrace deposits (Qt) Pleistocene** Medium yellowish brown (10YR5/4) poorly graded SAND with gravel, medium dense, slightly moist, mottled		4.5	
22					**TD @ 21.5'** **NO GROUNDWATER ENCOUNTERED**			
23								
24								
25								
26								
27								

LANDSET
Engineers, Inc.
520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A-6

EXPLORATORY BORING LOG

No. B-4

PROJECT: Peery Residence	**DATE DRILLED:** 27-Feb-09	**FILE No.** LSW-0685-01	
DRILLER: California Geotech	**DRILLING METHOD:** B-24	**LOGGED BY:** TL	
BORING DIAMETER: 4" SS	**BORING DEPTH:** 16.5'	**GROUNDWATER DEPTH:** N/A	

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.C.S.C. Soil-Group	Moisture (% dry weight)	Dry Density (pcf)
0								
					6" Concrete			
1					**Dune deposits (Qd) Holocene:**	SP		
2					Pale yellowish brown (10YR6/2) poorly graded SAND, medium dense slightly moist, <5% fines, very fine to medium grained			
3								
4	4-1		11				5.9	
5								
6					Color change to brownish black (5YR2/1) loose, moist			
7	4-2		6				11.0	
8								
9								
10					Color change to pale yellowish brown (10YR6/2) medium dense, moist to very moist			
11								
12	4-3		27				6.8	86.4
13								
14								
15								
16					**Older beach sand (Qobs) Holocene:**	SP		
	4-4		49	4.50	Brownish black (5YR2/1) poorly graded SAND, dense, slightly moist, trace fine gravel		4.7	119.1
17					**TD @ 16.5'**			
					NO GROUNDWATER ENCOUNTERED			
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								

LANDSET
Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A-7

EXPLORATORY BORING LOG

No. B-5

PROJECT:	Peery Residence	**DATE DRILLED:** 04-Mar-09	**FILE No.** LSW-0685-01
DRILLER:	Landset Engineers, Inc	**DRILLING METHOD:** Hand Auger	**LOGGED BY:** TL
BORING DIAMETER:	4" SS	**BORING DEPTH:** 10.5'	**GROUNDWATER DEPTH:** N/A

Depth (ft)	Sample	Graphic Log	Blows per foot	Pocket Pen (tsf)	Description	U.C.S.C. Soil-Group	Moisture (% dry weight)	Dry Density (pcf)
0								
1					**Dune deposits (Qd) Holocene:** Dusky yellowish brown (10YR2/2) silty SAND, loose, 15-20% fines, very fine to fine grained	SM		
2								
3	5-1				Pale yellowish brown (10YR6/2) poorly graded SAND, loose, slightly moist, <5% fines, very fine to fine grained	SP	4.2	
4								
5								
6	5-2				Color change to brownish black (5YR2/1) medium dense, moist very fine to medium grained		7.0	
7								
8								
9								
10								
11	5-3				Color change to pale yellowish brown (10YR6/2) medium dense to dense		9.0	
12					**TD @ 10.5'** **NO GROUNDWATER ENCOUNTERED**			
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								

LANDSET
Engineers, Inc.

520 B Crazy Horse Canyon Rd, Salinas, CA 93907
(831) 443-6970, Fax (831) 443-3801, landset@aol.com

Figure A-8

PREVIOUS BORINGS BY

Pacific Crest Engineers (2008)

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D2488 (Modified)

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN #4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels or gravels-sand mixtures, little or no fines
		GRAVELS (MORE THAN 12% FINES)	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN #4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		SANDS (MORE THAN 12% FINES)	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 35%		ML	Inorganic silts and very fine clayey sand silty sands, with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly, sand, silty or lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS LIQUID LIMIT IS BETWEEN 35% AND 50%		MI	Inorganic silts, clayey silts and silty fine sands of intermediate plasticity
			CI	Inorganic clays, gravelly/sandy clays and silty clays of intermediate plasticity
			OI	Organic clays and silty clays of intermediate plasticity
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Organic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils

BORING LOG EXPLANATION

LOGGED BY_____ DATE DRILLED_____ BORING DIAMETER_____ BORING NO.____

Depth, ft.	Sample No. and Type	Symbol	SOIL DESCRIPTION	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density, p.c.f.	Moisture % of Dry Wt.	MISC. LAB RESULTS
1			← Ground water elevation						
2	1-1 L		←Soil Sample Number ←Soil Sampler Size/Type L = 3" Outside Diameter M = 2.5" Outside Diameter T = 2" Outside Diameter ST = Shelby Tube BAG = Bag Sample						NOTE: All blows/foot are normalized to 2" outside diameter sampler size
3									
4									
5									

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	BLOWS/FOOT
VERY SOFT	0-2
SOFT	2-4
FIRM	4-8
STIFF	8-16
VERY STIFF	16-32
HARD	OVER 32

Pacific Crest Engineering Inc. 444 Airport Blvd., Suite 106 Watsonville, CA 95076	**Boring Log Explanation** McCasland Residence Carmel, California	Figure No. 3 Project No. 0894 Date: 12/23/08

LOGGED BY CLR DATE DRILLED 11/20/08 BORING DIAMETER 3 1/2" BORING NO. 1

Depth (feet)	Sample No. and Type	Symbol	Soil Description	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density (pcf)	Moisture % of Dry Wt.	Misc. Lab Results
1	1-1 L		Brown SILT, very fine grained, micaceous, roots scattered throughout the sample, trace oxidation patches scattered throughout the sample, damp, firm	ML					
2			Dark brown Clayey SAND, very fine to medium grained, trace coarse grains, sub-angular to sub-rounded shaped, mica flakes and roots scattered throughout the sample, damp to slightly moist, very loose	SC	4		99.6	11.7	
5	1-2 L		Color change to reddish tan than to tan by 6 1/2 feet, sample coarsens with depth, increase in coarseness of sand, medium to very coarse grained, angular to sub-rounded shaped, wet, loose		7		117.1	14.6	
10	1-3 L		Variegated gray, white, and reddish tan Clayey Sandy GRAVEL resulting from weathered granitic bedrock, very fine to very coarse grained, clay exhibits low plastic characteristics, and and gravel is angular to sub-rounded shaped, poorly graded, wet, medium dense, (granite floater)	GP	30		125.2	10.5	11.2% Passing #200 Sieve
15	1-4 T		Mottled gray, reddish brown, and dark gray CLAY, very fine grained, very smooth texture, intermediate plasticity, micaceous, clayey gravel slough in shoe of sampler, wet, stiff	CI	11	24		36.6	
20	1-5 T		Gray Clayey SAND, very fine to coarse grained, angular to sub-rounded shaped, poorly graded, mica flakes scattered throughout the sample, oxidation patches scattered throughout the sample, trace rounded sandstone pebbles scattered throughout the sample, wet, medium dense	SC	24			17.2	30.9% Passing #200 Sieve

Pacific Crest Engineering Inc.
444 Airport Blvd., Suite 106
Watsonville, CA 95076

Log of Test Borings
McCasland Residence
Carmel, California

Figure No. 4
Project No.094
Date: 12/23/08

LOGGED BY CLR DATE DRILLED 11/20/08 BORING DIAMETER 3 1/2" BORING NO. 1

Depth (feet)	Sample No. and Type	Symbol	Soil Description	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density (pcf)	Moisture % of Dry Wt.	Misc. Lab Results
25	1-6 T		Gray Clayey SAND, very fine to coarse grained, trace very coarse grains, angular to sub-rounded shaped, poorly graded, sticky texture, very small mica flakes scattered throughout the sample, oxidation patches scattered throughout the sample, wet, very dense	SC	50/4.5"			13.6	23.0% Passing #200 Sieve
30	1-7 T		Weathered, decomposed granite near 31 feet, wet, very dense		50/5"			13.0	28.9% Passing #200 Sieve
32			Boring Terminated at 31 1/2 feet. Groundwater encountered at 6 feet.						

Pacific Crest Engineering Inc. 444 Airport Blvd., Suite 106 Watsonville, CA 95076	**Log of Test Borings** McCasland Residence Carmel, California	Figure No. 5 Project No.0894 Date: 12/23/08

LOGGED BY CLR DATE DRILLED 12/2/08 BORING DIAMETER 4 1/2" BORING NO. 2

Depth (feet)	Sample No. and Type	Symbol	Soil Description	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density (pcf)	Moisture % of Dry Wt.	Misc. Lab Results
			3" Brick Driveway						
1	2-1 L		Dark yellowish brown Silty SAND, very fine to medium grained, trace coarse grains, sub-angular to sub-rounded shaped, mica flakes scattered throughout the sample, poorly graded, rootlets near 2 feet, sample coarsens with depth, moist, loose	SM	5			8.6	31.4% Passing #200 Sieve
5	2-2 L		Variegated gray, yellowish tan, and reddish tan Silty Gravelly SAND that grades to Silty GRAVEL, very fine to very coarse grained, angular to sub-rounded shaped, poorly graded, mica flakes scattered throughout the sample, rounded quartz and chert pebbles scattered throughout the sample, weathered decomposed granite near 6 feet, wet, loose	SM-GM	10		121.8	14.0	12.2% Passing #200 Sieve
10	2-3 L		Variegated gray and reddish brown Clayey Gravelly SAND, very fine to very coarse grained, sub-angular to sub-rounded shaped, poorly graded, mica flakes scattered throughout the sample, very weathered granite scattered throughout the sample, gravels are quartz, moist to wet, dense	SC-SG	44		127.0	10.7	11.9% Passing #200 Sieve
15	2-4 L		Mottled gray, reddish brown, and yellowish brown SILT, inorganic and organic, intermediate plasticity, very fine to fine grained, smooth texture, micaceous, moist, very stiff	MI & OI	20	16	85.8	38.1	94.0% Passing #200 Sieve
20	2-5 L		Grayish tan Silty SAND, fine to medium grained, sub-rounded shaped, poorly graded, micaceous, trace amounts of silt, wet, medium dense	SM	25		93.5	32.1	21.5% Passing #200 Sieve

Pacific Crest Engineering Inc. 444 Airport Blvd., Suite 106 Watsonville, CA 95076	**Log of Test Borings** McCasland Residence Carmel, California	Figure No. 6 Project No.0894 Date: 12/23/08

LOGGED BY CLR DATE DRILLED 12/2/08 BORING DIAMETER 4 1/2" BORING NO. 2

Depth (feet)	Sample No. and Type	Symbol	Soil Description	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density (pcf)	Moisture % of Dry Wt.	Misc. Lab Results
25-29	2-6 T		Mottled reddish brown and gray Silty SAND, very fine to medium grained, trace coarse grains, sub-angular to sub-rounded shaped, poorly graded, mica flakes scattered throughout the sample, patches of coarse grained mica flakes scattered throughout the sample, wet, very dense	SM	58			26.2	13.0% Passing #200 Sieve
30-34	2-7 L		Grayish tan Sandy CLAY, very fine to medium grained, sand is sub-angular to sub-rounded shaped, oxidized veins scattered throughout the sample, mica flakes scattered throughout the sample, moist, hard	CL	31	18		15.5	
35-39	2-8 T		Trace coarse to very coarse sub-angular shaped quartz gravels (sand) scattered throughout the sample, lack of oxidized veins, oxidized patches scattered throughout the sample, moist to wet, very hard		50/5.5"			12.8	
40-46	2-9 T		Grayish tan Sandy SILT, very fine to fine grained, smooth texture, micaceous, oxidation patches scattered throughout the sample, significant amount of slough in sampler, damp to moist, very stiff	ML	30			32.2	59.9% Passing #200 Sieve
			Looser drilling						
			Stiffer drilling						
47-48	2-10 T		Gray Silty GRAVEL, very fine to very coarse grained, angular to sub-rounded shaped, poorly graded, gravels are mostly quartz with trace siltstone rounded rocks and gravels, micaceous, saturated, very dense	GM	50/5"			25.6	11.9% Passing #200 Sieve

Pacific Crest Engineering Inc.
444 Airport Blvd., Suite 106
Watsonville, CA 95076

Log of Test Borings
McCasland Residence
Carmel, California

Figure No. 7
Project No.0894
Date: 12/23/08

LOGGED BY CLR DATE DRILLED 12/2/08 BORING DIAMETER 4 1/2" BORING NO. 2

Depth (feet)	Sample No. and Type	Symbol	Soil Description	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density (pcf)	Moisture % of Dry Wt.	Misc. Lab Results
49	2-10 T		Gray Silty GRAVEL, very fine to very coarse grained, angular to sub-rounded shaped, poorly graded, gravels are mostly quartz with trace siltstone rounded rocks and gravels, micaceous, saturated, very dense	GM	50/5"				
50			Boring Terminated at 48 1/2 feet. Groundwater initally encountered at 10 feet and stabilized at 5'9".						
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									
63									
64									
65									
66									
67									
68									
69									
70									
71									
72									

Pacific Crest Engineering Inc.
444 Airport Blvd., Suite 106
Watsonville, CA 95076

Log of Test Borings
McCasland Residence
Carmel, California

Figure No. 8
Project No.0894
Date: 12/23/08

PREVIOUS BORINGS DRILLED AND COMPILED BY

Raas and Associates (2009)

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D2488-84

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN #4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel sand mixture, little or no fines.
			GP	Poorly graded gravels or gravels-sand mixtures, little or no fines.
		GRAVELS (MORE THAN 12% FINES)	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN #4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS (MORE THAN 12% FINES)	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine clayey sand silty sands, with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly, sandy, silty or lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Organic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils

BORING LOG EXPLANATION

LOGGED BY_____ DATE DRILLED_____ BORING DIAMETER_____ BORING NO. _____

Depth, ft.	Sample No. and Type	Symbol	SOIL DESCRIPTION	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density, p.c.f.	Moisture % of Dry Wt.	MISC. LAB RESULTS
1			← Ground water elevation						Note: All blows/foot are normalized to 2" outside diameter sampler size
2	1-1 L		← Soil Sample Number ← Soil Sampler Size/Type L = 3" Outside Diameter M = 2.5" Outside Diameter T = 2" Outside Diameter ST = Shelby Tube BAG = Bag Sample						
3									
4									
5									
6									

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	BLOWS/FOOT
VERY SOFT	0-2
SOFT	2-4
FIRM	4-8
STIFF	8-16
VERY STIFF	16-32
HARD	OVER 32

STEVEN RAAS & ASSOCIATES, INC. | FIGURE NO. 5 Boring Log Explanation

LOGGED BY BDB DATE DRILLED 12/15/98 BORING DIAMETER 3 1/2" SS BORING NO. 1

Depth, ft.	Sample No. and Type	Symbol	SOIL DESCRIPTION	Unified Soil Classification	Blows/foot 175 ft-lbs.	Plasticity Index	Dry Density, p.c.f.	Moisture % of Dry Wt.	MISC. LAB RESULTS
1			LEVEE FILL Dark brown very Silty SAND with organics, lense of yellow brown low plasticity silt at 1'	SM-ML					
2			Brown Silty SAND with subrounded gravel						
3	1-1 M		Orangish brown Silty SAND, fine grained	SM					21% Passing #200 Sieve
4									
5	1-2 T		Light brown Sandy GRAVEL with silt, subrounded gravel to 2 1/2", very loose, damp	GW-GM	15*		83.4	7.2	6% Passing #200 Sieve 57% Passing #4 Sieve
6					6*			2.4	
7			NATIVE SOIL Interbedded gray and reddish brown Sandy GRAVEL and Gravelly SAND, well graded from fine sand to 2 1/2" gravels, subangular to subrounded gravel, loose, caving	GW-SW					
8									
9									
10	1-3 BAG		gray and reddish brown Gravelly SAND, 1/4" to 1" subangular to subrounded gravel, loose, caving						1% Passing #200 Sieve 38% Passing #4 Sieve
11								2.5	
12									
13									
14				SW-GW					
15	1-4 BAG		Brown SAND with gravel, fine to coarse grained, well graded, subrounded gravel to 1/2", very moist becoming wet at 16'						
16								10.0	4% Passing #200 Sieve
17			▼						
18			Caving SAND						
19									
20									
21									
22			Interbedded lenses of Sandy GRAVEL, subrounded gravel to 1/2"						
23									
24									

STEVEN RAAS & ASSOCIATES, INC.

FIGURE NO. 6 Log of Test Borings

LOGGED BY BDB DATE DRILLED 12/15/98 BORING DIAMETER 3 1/2" SS BORING NO. 1

Depth, ft.	Sample No. and Type	Symbol	SOIL DESCRIPTION	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density, p.c.f.	Moisture % of Dry Wt.	MISC. LAB RESULTS
25				SW-GW					
26	1-5 BAG		Interbedded lenses of well graded, fine to coarse SAND and Sandy GRAVEL, subrounded gravel to 1/2", grading to well graded, fine to coarse grained, silty sand with gravel at 26', wet					18.3	
27									
28									
29									
30			Boring Terminated at 30'						
31									
32									
33									
34									
35			*Non-Standard Sampling 70lb Hammer, 30 Inch Drop						
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									

STEVEN RAAS & ASSOCIATES, INC.

FIGURE NO. 7 Log of Test Borings

LOGGED BY BDB DATE DRILLED 12/16/98 BORING DIAMETER 3 1/2" SS BORING NO. 3

Depth, ft.	Sample No. and Type	Symbol	SOIL DESCRIPTION	Unified Soil Classification	SPT "N" Value	Plasticity Index	Dry Density, p.c.f.	Moisture % of Dry Wt.	MISC. LAB RESULTS
1	3-1 M		LEVEE FILL Brown Silty SAND, fine to medium grained, micaceous, occasional pockets of gravelly sand and clay blebs, grading to fine to coarse grained Gravelly SAND at 2 1/2', well graded, subangular to subrounded gravel, moist, medium dense	SM-SW					
2	3-2 T				13		99.2	15.1	41% Passing #200 Sieve
3					23			3.5	28% Passing #200 Sieve
4			Sandy GRAVEL, well graded, gravel to 2 1/2", moist	GW					
5			NATIVE SOIL Dark brown very Silty fine SAND, micaceous, moist	SM					
6	3-3 M								
7	3-4 T		Yellowish brown SAND with silt, fine to coarse grained with occasional gravel to 1 1/2", moist, loose	SW	11			3.0	
8					17			6.1	5% Passing #200 Sieve
9	3-5 M		Yellowish brown SAND with silt, medium to coarse grained, medium dense, moist						
10	3-6 M				17			6.6	
11			Siltstone cobbles in driving shoe at 11 1/2', wet		14		110.9	15.4	5% Passing #200 Sieve
12			▼						
13			Brown SAND with silt and occasional gravel, fine to coarse grained, wet						
14									
15									
16									
17									
18				SW-SM					
19									
20			Interbedded lenses of fine to coarse grained SAND with gravel and Silty SAND with gravel, wet						
21									
22									
23									
24			Boring Terminated at 24'						

STEVEN RAAS & ASSOCIATES, INC.

FIGURE NO. 10 Log of Test Borings

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS — MORE THAN HALF OF MATERIALS IS LARGER THAN #200 SIEVE SIZE	GRAVELS — MORE THAN HALF OF COARSE FRACTION IS LARGER THAN #4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.
			GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.
		GRAVEL WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURE. NON PLASTIC FINES.
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES. PLASTIC FINES.
	SANDS — MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN #4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES.
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES. NON-PLASTIC FINES.
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES. PLASTIC FINES.
FINE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE	SILTS & CLAYS — LIQUID LIMIT IS LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
	SILTS & CLAYS — LIQUID LIMIT IS GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS.
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS.

DEFINITION OF TERMS

GRAIN SIZES

U.S. STANDARD SERIES SIEVE

200 — 50 — 16 — 4 — 3/4" — 3" — 6"

SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE ⟶)

DRY — SLIGHTLY DAMP — DAMP (PL) — MOIST — VERY MOIST — WET (SATURATED) (LL)

KEY

SAMPLE NUMBER	MODE	RECOVERY
SAMPLE CONTAINER: BAG..... B JAR..... J SHELBY TUBE... S DRIVE SAMPLER RINGS..... R	METHOD OF ADVANCING HOLE: DRILL FLIGHT AUGER..... AO BUCKET AUGER..... BA SPIN AUGER..... SD HOLLOW STEM AUGER... HA ROTARY DRILL..... RO CABLE TOOL..... CT SAMPLER DRIVE..... DR PITCHER BARREL..... PB CORE..... C PUSH..... P	RECOVERY RATIO INDICATED BY A FRACTION: 1.2 / 1.5 = FOOTAGE RECOVERED / FOOTAGE SAMPLED REMARKS INCLUDES DRILLING INFORMATION, E.G. WATER LEVEL, DATES. REFUSAL: STOPPED BY MATERIAL TOO HARD FOR EQUIPMENT. TERMINATED: SUFFICIENT INFORMATION OBTAINED. ABANDONED: STOPPED BECAUSE OF DIFFICULTIES EXPLAINED ON LOG.

PENETRATION RESISTANCE (PR)
(RECORDED AS BLOWS/0.5 FOOT)

SANDS & GRAVELS

RELATIVE DENSITY	BLOWS/FOOT*
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CLAYS & SILTS

CONSISTENCY	BLOWS/FOOT*	STRENGTH †
VERY SOFT	0-2	0-¼
SOFT	2-4	¼-½
FIRM	4-8	½-1
STIFF	8-15	1-2
VERY STIFF	15-30	2-4
HARD	OVER 30	OVER 4

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) Split-Barrel sampler (ASTM-1586 standard penetration test).

† Unconfined compressive strength in tons/sq ft. Read from a pocket penetrometer.

Wahler Associates

LOWER CARMEL RIVER
NORTH LEVEE

KEY FOR SOIL EXPLORATION LOGS

PROJECT NO.	FIGURE NO.
GSN-126A	A-1

BORING LOCATION : See Site Plan		APPROVED BY:	GROUND EL:
DEPTH TO GROUND WATER LEVEL: 17.5 '	DRILL CONTRACTOR : West Tek Drilling		TOTAL DEPTH : 26.5'
DRILL RIG	BORING DIA. : 8"	DATE DRILLED:: 10-25-88	LOGGED BY : ME

SOIL CLASS	DESCRIPTION	DEPTH	SAMPLE NO.	PR / REQ	REC.	MODE	REMARKS
		0					
SC	0.0'-3.0' CLAYEY SAND: (LEVEE) dark brown, damp, medium dense, with coarse gravel, rounded to subangular, coarse grained sand.		R-1 R-2	15 22 28	1.5 1.5	DR	
		2				AD	
SW-SM	3.0'-6.0' GRAVELLY SAND: light greyish to dark brown, damp, medium dense, coarse gravel.		R-3 R-4	14 26 31	1.5 1.5	DR	
		4					
			R-5 R-6	12 11 11	1.5 1.5	DR	
SM	6.0'-7.0' SILTY SAND: drown, moist, loose to medium dense.	6					
		8				AD	
SP	7.0'-18.5' SAND: lught greyish, moist, loose, coarse grained.						
		10	SP-1	3 4 6	1.5 1.5	DR	
		12				AD	
	14.0' - 18.0' Increase in moisture content.	14					
		16	SP-2	5 6 5	1.5 1.5	DR	
		18					17.5' GROUNDWATER ENCOUNTERED.
SM	18.5'-20.0' SILTY SAND: dark brown, wet, loose, coarse sand with lenses of dark brown silt.	20					

Wahler Associates	CARMEL RIVER LEVEE MONTEREY COUNTY	EXPLORATION BORING LOG	BORING NO.
		Project No. GSN-126A	Sheet: 1 OF 2
			B- 6

BORING LOCATION SEE SITE PLAN		APPROVED BY:	GROUND EL:
DEPTH TO GROUND WATER : 17.5'	DRILL CONTRACTOR : West Tek Drilling		TOTAL DEPTH: 26.5'
DRILL RIG : CME-850	BORING DIA. : 8"	DATE DRILLED: 10-25-88:	LOGGED BY : ME

SOIL CLASS	DESCRIPTION	DEPTH	SAMPLE NO.	PR / REQ	REC.	MODE	REMARKS
		20					
CL	20.0'-21.0' SILTY CLAY: black, wet, soft		SP-3	2 3 2	1.5 1.5	DR	
ML	20.0'-26.5' SANDY SILT: dark brown, wet, soft, fine to coarse grained sand.	22				AD	
		24					
		26	SP-4	3 2 1	1.5 1.5	DR	
	Boring terminated at 26.5'. Boring backfilled with soil .	28					
		30					
		32					
		34					
		36					
		38					
		40					

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CARMEL RIVER LEVEE MONTERY COUNTY	EXPLORATION BORING LOG		BORING NO.
		Project No. GSN-126A	Sheet: 2 Of 2	B- 6

BORING LOCATION : See Site Plan		APPROVED BY:	GROUND EL:
DEPTH TO GROUND WATER LEVEL: None	DRILL CONTRACTOR : West Tek Drilling		TOTAL DEPTH : 11.5'
DRILL RIG : CME-850	BORING DIA. : 8"	DATE DRILLED:: 10-26-88	LOGGED BY : ME

SOIL CLASS	DESCRIPTION	DEPTH	SAMPLE NO.	PR / REQ	REC.	MODE	REMARKS
CL	0.0'-3.0' SILTY CLAY: (LEVEE) light greyish, damp, medium dense.	0	R-1	8	1.5	DR	
			R-2	13 13	1.5		
		2				AD	
SM	3.0'-5.0' SILTY SAND: light greyish brown, loose to medium dense, coarse grained sand.		R-3	6	1.5	DR	
		4	R-4	9 11	1.5		
SP	5.0'-11.5' SAND: greyish, damp, loose, coarse grained sand, with fine gravel.		B-1	5 4 5	0.0 1.5	DR	
		6					
		8				AD	
		10	SP-1	2 3 2	1.3 1.5	DR	
	Boring terminated at 11.5'. Boring backfilled with soil.	12					
		14					
		16					
		18					
		20					

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CARMEL RIVER LEVEE MONTEREY COUNTY	EXPLORATION BORING LOG	BORING NO.
		Project No. GSN-126A	Sheet: 1 OF 1	B- 7

BORING LOCATION : See Site Plan		APPROVED BY:	GROUND EL:
DEPTH TO GROUND WATER LEVEL: 15.0'	DRILL CONTRACTOR : West Tek Drilling		TOTAL DEPTH : 26.5'
DRILL RIG : CME-850	BORING DIA. : 8"	DATE DRILLED:: 10-26-88	LOGGED BY : ME

SOIL CLASS	DESCRIPTION	DEPTH	SAMPLE NO.	PR / REQ	REC.	MODE	REMARKS
SM	0.0'- 4.5' SILTY CLAY: (LEVEE) brown, damp, loose to medium dense.	0	R-1	9	1.5	DR	
			R-2	12 13	1.5		
		2				AD	
	Increase in moisture content with depth		R-3	5	1.5	DR	
		4	R-4	6 8	1.5		
CL	4.5'-7.5' SILTY CLAY: dark brown, very moist, soft to firm, trace of fine sand.	6	R-5	7	1.3	DR	
			R-6	3 3	1.5		
SP	7.5'-26.5' SAND: light brown, very moist, loose to medium dense, fine to coarse grained sand.	8				AD	
		10	R-7	5	1.5	DR	
			R-8	7 10	1.5		
		12				AD	
		14					
			R-9	7	1.5	DR	
		16	R-10	8 9	1.5		
		18				AD	
		20					

Wahler Associates	CARMEL RIVER LEVEE MONTEREY COUNTY	EXPLORATION BORING LOG		BORING NO.
		Project No. GSN-126A	Sheet: 1 OF 2	B-8

BORING LOCATION SEE SITE PLAN		APPROVED BY:	GROUND EL:
DEPTH TO GROUND WATER :	DRILL CONTRACTOR : West Tek Drilling		TOTAL DEPTH
DRILL RIG : CME-850	BORING DIA. : 8"	DATE DRILLED: 10-26-88:	LOGGED BY : ME

SOIL CLASS	DESCRIPTION	DEPTH	SAMPLE NO.	PR / REQ	REC.	MODE	REMARKS
SP	20.0'-26.5' SAND:(CONT.)	20	SP-1	8 6 8	1.5 1.5	DR	
		22				AD	
		24	SP-2	3 3 3	1.5 1.5	DR	
	Boring terminated at 26.5'. Boring backfilled with soil.	26					
		28					
		30					
		32					
		34					
		36					
		38					
		40					

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN OR LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CARMEL RIVER LEVEE MONTEREY COUNTY	EXPLORATION BORING LOG	BORING NO.
		Project No. GSN-126A	Sheet: 2 Of 2	B-8

BORING LOCATION : See Site Plan		APPROVED BY:	GROUND EL:
DEPTH TO GROUND WATER LEVEL: 13.6'	DRILL CONTRACTOR : West Tek Drilling		TOTAL DEPTH : 26.5'
DRILL RIG : CME-850	BORING DIA. : 8"	DATE DRILLED:: 10-26-88	LOGGED BY : ME

SOIL CLASS	DESCRIPTION	DEPTH	SAMPLE NO.	PR / REQ	REC.	MODE	REMARKS
SC	0.0'-8.0' CLAYEY SAND: brown, damp, loose to medium dense	0	R-1	4	1.5	DR	
			R-2	6 9	1.5		
		2				AD	
			R-3	6	1.5	DR	
		4	R-4	7 9	1.5		
			R-5	4	1.5	DR	
		6	R-6	8 12	1.5		
		8				AD	
CH	8.0'-10.5' SILTY CLAY: brown, very moist, stiff.	10	R-7	4 6 7	1.5 1.5	DR	
SP	10.5'-26.5' SAND: light greyish brown, very moist, very loose to loose	12				AD	13.6'-GROUNDWATER ENCOUNTERED.
		14					
		16	SP-1	4 2 2	1.3 1.5	DR	
		18					
		20					

Wahler Associates	CARMEL RIVER LEVEE MONTEREY COUNTY	EXPLORATION BORING LOG	BORING NO.
		Project No. GSN-126A	Sheet: 1 OF 2	B-9

BORING LOCATION SEE SITE PLAN		APPROVED BY:	GROUND EL:
DEPTH TO GROUND WATER : 13.6'	DRILL CONTRACTOR : West Tek Drilling		TOTAL DEPTH: 26.5'
DRILL RIG : CME-850	BORING DIA. : 8"	DATE DRILLED: 10-26-88:	LOGGED BY : ME

SOIL CLASS	DESCRIPTION	DEPTH	SAMPLE NO.	PR / REQ	REC.	MODE	REMARKS
		20					
SP	20.0'-26.5' SAND(CONT.)		SP-2	4 2 2	1.3 1.5	DR	
		22				AD	
		24					
			SP-3	2 3 4	1.2 1.5	DR	
		26					
	Boring terminated at 26.5'. Boring backfilled with soil.	28					
		30					
		32					
		34					
		36					
		38					
		40					

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

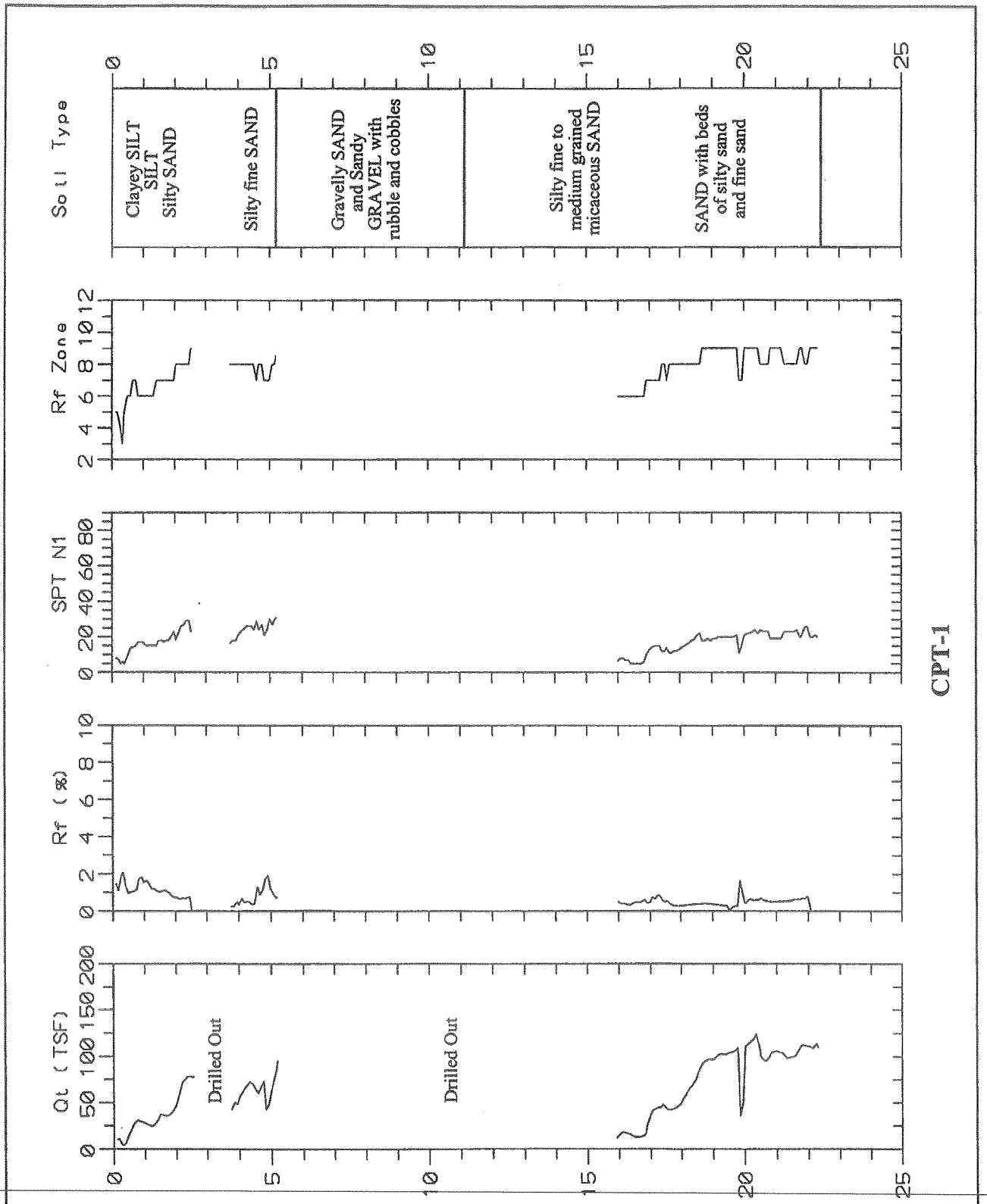
THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

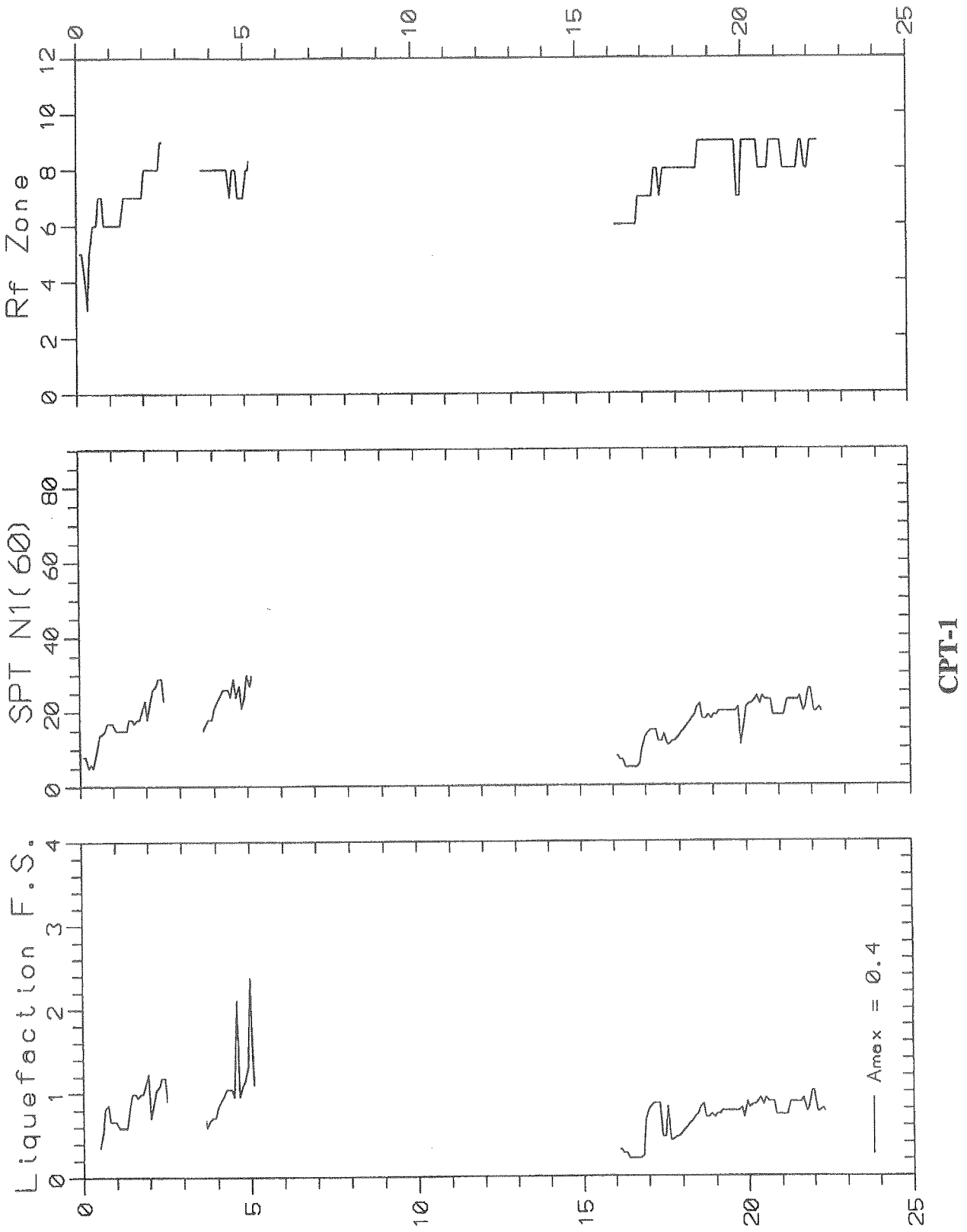
THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CARMEL RIVER LEVEE MONTEREY COUNTY	EXPLORATION BORING LOG	BORING NO.
		Project No. GSN-126A	Sheet: 2 Of 2
			B- 9



STEVEN RAAS & ASSOCIATES, INC. | FIGURE NO. 12 Log of CPT Sounding



STEVEN RAAS & ASSOCIATES, INC.	FIGURE NO. 19 CPT/U Liquefaction Correlations

```
"
"Output file from CPTINT - Version 4.2
"=====================================
"INPUT FILE: G:\CPTINT\data\003C12~1.COR
"-------------------------------------
"
"Licensed to:  Steven Raas & Associates
"    Address:  Suite 106, 444 Airport Blvd
"       City:  Watsonville, CA 95076
"
"Interpreter Name: Brian D. Bauldry
"
"File Number:                Date: 01:07:99 08:15
"Operator: GREGG              On Site Location: 12+50
"Cone Type: BRIAN BAULDRY     Comment: CARMEL LEVEE
"
"SUMMARY SHEET
"-------------
"'a' for calculating Qt:                0.850
"Value for Water Table (in m):          3.800
"Valid Zone Classification based on:    Rf
"Missing unit weight to surface:        19.500
"Define Zone 6 as Silty Sand?           YES
"Method for Friction Angle:             Robertson & Campanella
"Silty sand correction for CSR (Qc)?    YES
"EQ magnitudes for CSR (Qc):            7.900
"'a max/g' value for calc CSR (Eq):     0.400
"Graph used for calculating rd:         Fraser Delta
"
"Soil Behavior Type Zone Numbers
"For Rf Zone & Bq Zone Classification
"-----------------------------------
"Zone #1=Sensitive fine grained     Zone #7 =Sand with some Silt
"Zone #2=Organic material           Zone #8 =Fine sand
"Zone #3=Clay                      Zone #9 =Sand
"Zone #4=Silty clay                Zone #10=Gravelly sand
"Zone #5=Clayey silt               Zone #11=Very stiff fine grained *
"Zone #6=Silty sand                Zone #12=Sand to clayey sand *
"   * Overconsolidated and/or cemented
"
"NOTE:
"-----
"For soil classification, Rf values > 8 are assumed to be 8.
"
"( Note: 9E9 means Out Of Range )
"
```

INPUT FILE: G:\CPTINT\data\003C12~1.COR

Depth (feet)	Qt(avg) (TSF)	Rf (%)	U2 (psi)	DPPR (ratio)	Rf Zone (zone #)	Bq Zone (zone #)	Spt N (blow/ft)	Spt N1 (blow/ft)	CSR(Qc) (ratio)	CSR(Eq) (ratio)	FL (ratio)	Phi (degree)
0.098	10.326	1.453	0.590	0.004	5	6	5	8	9E9	9E9	9E9	9E9
0.164	11.091	1.082	0.080	0.001	5	6	5	8	9E9	9E9	9E9	9E9
0.262	4.670	1.927	0.020	0.000	4	4	3	5	9E9	9E9	9E9	9E9
0.328	4.379	2.055	-0.100	-0.002	3	4	4	6	9E9	9E9	9E9	9E9
0.394	6.967	1.435	-0.260	-0.003	5	5	3	5	9E9	9E9	9E9	9E9
0.492	15.801	0.949	0.120	0.001	6	6	6	9	0.091	0.260	0.350	47
0.591	23.149	1.037	-0.080	-0.000	6	7	9	14	0.142	0.260	0.547	9E9
0.656	27.951	1.038	0.100	0.000	7	7	9	14	0.213	0.259	0.822	9E9
0.755	31.100	1.158	0.020	0.000	7	7	10	15	0.224	0.259	0.862	9E9
0.820	29.951	1.703	0.060	0.000	6	7	11	17	0.172	0.259	0.665	9E9
0.919	29.101	1.821	0.100	0.000	6	7	11	17	0.172	0.259	0.665	47
0.984	28.211	1.524	0.060	0.000	6	7	11	17	0.172	0.259	0.665	47
1.083	26.261	1.637	0.100	0.000	6	7	10	15	0.152	0.259	0.587	47
1.148	25.111	1.434	0.060	0.000	6	7	10	15	0.152	0.259	0.587	47
1.247	24.900	1.165	0.020	0.000	6	7	10	15	0.152	0.259	0.587	47
1.312	27.320	1.171	-0.040	-0.000	6	7	10	15	0.152	0.259	0.587	47
1.411	31.309	1.054	-0.080	-0.000	7	7	10	15	0.224	0.259	0.864	47
1.476	37.299	1.019	-0.120	-0.000	7	8	12	18	0.257	0.259	0.994	47
1.575	36.579	1.066	-0.060	-0.000	7	8	12	18	0.257	0.259	0.995	47
1.640	35.689	1.121	-0.100	-0.000	7	8	11	17	0.246	0.259	0.949	47
1.739	36.488	1.014	-0.140	-0.000	7	8	12	18	0.257	0.259	0.995	47
1.804	37.809	0.952	-0.120	-0.000	7	8	12	18	0.257	0.259	0.995	47
1.870	40.568	0.789	-0.220	-0.000	7	8	13	20	0.281	0.259	1.087	47
1.968	45.628	0.723	-0.220	-0.000	7	8	15	23	0.319	0.258	1.236	47
2.034	51.528	0.718	-0.180	-0.000	8	8	12	18	0.183	0.258	0.707	47
2.133	64.018	0.640	-0.160	-0.000	8	8	15	23	0.234	0.258	0.905	47
2.198	72.648	0.688	-0.220	-0.000	8	8	17	26	0.269	0.258	1.042	9E9
2.297	75.369	0.677	-0.120	-0.000	8	9	18	27	0.281	0.258	1.088	9E9
2.362	78.208	0.690	-0.160	-0.000	8	9	19	29	0.306	0.258	1.186	9E9
2.461	78.168	0.742	-0.160	-0.000	8	9	19	29	0.306	0.258	1.186	47
2.526	77.068	0.026	-0.220	-0.000	9	9	15	23	0.234	0.258	0.906	47
2.625	78.977	0.025	-0.240	-0.000	9	9	15	23	0.234	0.258	0.906	47
2.690	92.278	0.022	-0.220	-0.000	9	9	18	27	0.281	0.258	1.089	9E9
2.789	137.008	0.015	-0.220	-0.000	9	9	26	39	0.745	0.258	2.890	9E9
3.674	40.360	0.198	0.040	0.000	8	8	10	15	0.152	0.257	0.591	43
3.773	44.610	0.247	0.040	0.000	8	8	11	17	0.172	0.257	0.671	43
3.839	49.921	0.260	0.060	0.000	8	8	12	18	0.183	0.257	0.711	45
3.937	48.690	0.472	0.040	0.000	8	8	12	18	0.183	0.257	0.711	45
4.003	56.380	0.337	0.040	0.000	8	8	14	21	0.213	0.257	0.831	45
4.101	61.760	0.664	0.020	0.000	8	8	15	23	0.234	0.257	0.911	45
4.167	65.774	0.456	0.350	0.000	8	8	16	24	0.246	0.257	0.957	45
4.265	70.143	0.513	0.280	0.000	8	8	17	26	0.269	0.257	1.049	45
4.331	72.356	0.484	0.510	0.001	8	8	17	26	0.269	0.257	1.049	45
4.429	69.424	0.346	0.350	0.000	8	8	17	26	0.269	0.256	1.049	45
4.495	64.927	0.400	0.670	0.001	8	8	16	24	0.246	0.256	0.958	45
4.593	60.121	1.331	0.060	0.000	7	8	19	29	0.543	0.256	2.117	45
4.659	65.680	0.883	0.000	0.000	8	8	16	24	0.246	0.256	0.958	45
4.757	73.160	1.148	0.020	0.000	8	8	18	27	0.281	0.256	1.096	45

"---| INPUT FILE: G:\CPTINT\data\003C12~1.COR |----------

Depth (feet)	Qt(avg) (TSF)	Rf (%)	U2 (psi)	DPPR (ratio)	Rf Zone (zone #)	Bq Zone (zone #)	Spt N (blow/ft)	Spt N1 (blow/ft)	CSR(Qc) (ratio)	CSR(Eq) (ratio)	FL (ratio)	Phi (degree)
4.823	42.402	1.722	0.160	0.000	7	8	14	21	0.293	0.256	1.143	43
4.921	48.861	1.903	0.120	0.000	7	8	16	24	0.338	0.256	1.321	43
4.987	61.523	1.203	0.240	0.000	7	8	20	30	0.610	0.256	2.383	45
5.085	75.070	0.906	0.040	0.000	8	9	18	27	0.281	0.256	1.098	45
5.151	84.593	0.745	0.280	0.000	8	9	20	30	0.319	0.256	1.248	45
5.249	110.542	0.624	0.160	0.000	9	9	21	32	0.357	0.256	1.397	47
5.315	138.972	0.014	0.200	0.000	9	9	27	41	0.880	0.256	3.441	47
5.413	164.880	0.012	0.040	0.000	9	9	32	48	1.352	0.256	5.289	47
5.479	187.781	0.011	0.060	0.000	10	9	30	45	1.150	0.256	4.498	9E9
5.577	200.100	0.010	0.040	0.000	10	9	32	48	1.352	0.256	5.291	9E9
15.912	11.485	0.697	1.360	-0.001	6	6	4	4	0.047	0.252	0.184	9E9
16.010	15.393	0.455	1.200	-0.002	6	6	6	7	0.070	0.253	0.278	31
16.076	17.813	0.393	1.160	-0.002	6	6	7	8	0.081	0.253	0.318	31
16.174	17.432	0.402	1.100	-0.002	6	6	7	8	0.081	0.253	0.318	31
16.240	16.584	0.362	1.300	-0.001	6	6	6	7	0.070	0.254	0.277	31
16.338	15.643	0.320	1.220	-0.002	6	6	6	7	0.070	0.254	0.277	31
16.404	13.905	0.360	1.360	-0.002	6	6	5	5	0.054	0.254	0.213	31
16.502	12.637	0.475	1.530	-0.001	6	6	5	5	0.054	0.254	0.213	9E9
16.568	12.808	0.468	1.690	-0.000	6	6	5	5	0.054	0.255	0.213	9E9
16.666	12.978	0.462	1.710	-0.001	6	6	5	5	0.054	0.255	0.212	31
16.732	13.568	0.516	1.650	-0.001	6	6	5	5	0.054	0.255	0.212	31
16.831	15.310	0.588	1.810	-0.000	6	6	6	6	0.062	0.255	0.244	31
16.896	27.589	0.435	1.790	-0.000	7	7	9	10	0.172	0.256	0.675	35
16.995	36.679	0.463	1.770	-0.000	7	8	12	13	0.203	0.256	0.794	37
17.060	41.309	0.750	1.730	-0.000	7	8	13	14	0.213	0.256	0.833	37
17.159	43.269	0.647	1.730	-0.001	7	8	14	15	0.224	0.256	0.872	37
17.224	44.288	0.835	1.710	-0.001	7	8	14	15	0.224	0.257	0.871	37
17.323	44.668	0.806	1.690	-0.001	7	8	14	15	0.224	0.257	0.870	37
17.388	47.899	0.564	1.790	-0.001	8	8	11	12	0.121	0.257	0.472	37
17.487	44.586	0.493	1.510	-0.001	8	8	11	12	0.121	0.257	0.472	37
17.552	42.117	0.546	1.590	-0.001	7	8	13	14	0.213	0.257	0.829	37
17.651	42.328	0.402	1.690	-0.001	8	8	10	11	0.111	0.258	0.431	37
17.716	42.801	0.327	1.970	-0.001	8	8	10	11	0.111	0.258	0.431	37
17.815	44.031	0.295	1.990	-0.001	8	8	11	12	0.121	0.258	0.470	37
17.880	45.442	0.286	2.080	-0.000	8	8	11	12	0.121	0.258	0.470	37
17.979	48.664	0.288	2.180	-0.000	8	8	12	13	0.132	0.258	0.509	37
18.044	53.254	0.282	2.200	-0.000	8	8	13	14	0.142	0.259	0.548	39
18.143	58.994	0.322	2.240	-0.000	8	8	14	15	0.152	0.259	0.587	39
18.208	63.194	0.332	2.200	-0.000	8	8	15	16	0.162	0.259	0.627	39
18.307	67.065	0.328	2.300	-0.000	8	8	16	17	0.172	0.259	0.666	39
18.372	69.785	0.358	2.300	-0.000	8	8	17	18	0.183	0.259	0.705	39
18.471	74.755	0.375	2.280	-0.000	8	9	18	19	0.193	0.260	0.743	39
18.537	82.184	0.377	2.240	-0.000	8	9	20	21	0.213	0.260	0.822	41
18.635	89.021	0.382	1.970	-0.001	8	9	21	22	0.224	0.260	0.860	41
18.701	93.440	0.385	1.850	-0.001	9	9	18	18	0.183	0.260	0.703	41
18.799	95.611	0.408	1.930	-0.001	9	9	18	18	0.183	0.260	0.702	41
18.865	96.969	0.382	1.790	-0.001	9	9	19	19	0.193	0.260	0.741	41
18.963	96.541	0.383	1.970	-0.001	9	9	18	18	0.183	0.260	0.701	41

"---| INPUT FILE: G:\CPTINT\data\003C12~1.COR |----------

Depth (feet)	Qt(avg) (TSF)	Rf (%)	U2 (psi)	DPPR (ratio)	Rf Zone (zone #)	Bq Zone (zone #)	Spt N (blow/ft)	Spt N1 (blow/ft)	CSR(Qc) (ratio)	CSR(Eq) (ratio)	FL (ratio)	Phi (degree)
19.029	97.051	0.361	1.970	-0.001	9	9	19	19	0.193	0.261	0.740	41
19.127	100.622	0.338	2.050	-0.001	9	9	19	19	0.193	0.261	0.740	41
19.193	102.192	0.333	2.010	-0.001	9	9	20	20	0.203	0.261	0.779	41
19.291	102.703	0.302	2.120	-0.001	9	9	20	20	0.203	0.261	0.778	41
19.357	102.153	0.294	2.140	-0.001	9	9	20	20	0.203	0.261	0.778	41
19.455	102.872	0.282	2.080	-0.001	9	9	20	20	0.203	0.261	0.777	41
19.521	104.154	0.058	2.260	-0.001	9	9	20	20	0.203	0.261	0.777	41
19.619	104.745	0.181	2.340	-0.001	9	9	20	20	0.203	0.262	0.777	41
19.685	105.724	0.265	2.180	-0.001	9	9	20	20	0.203	0.262	0.776	41
19.783	109.124	0.266	2.260	-0.001	9	9	21	21	0.213	0.262	0.815	41
19.849	35.759	1.622	2.670	-0.001	7	8	11	11	0.183	0.262	0.698	35
19.947	50.199	0.936	2.670	-0.001	7	8	16	16	0.234	0.262	0.892	37
20.013	110.825	0.424	2.360	-0.001	9	9	21	21	0.213	0.262	0.814	41
20.111	113.285	0.565	2.360	-0.001	9	9	22	22	0.224	0.262	0.852	41
20.177	115.795	0.648	2.340	-0.001	9	9	22	22	0.224	0.262	0.852	41
20.275	118.344	0.575	2.260	-0.001	9	9	23	23	0.234	0.263	0.891	41
20.341	123.692	0.590	2.010	-0.001	9	9	24	24	0.246	0.263	0.935	41
20.439	112.690	0.612	1.870	-0.001	9	9	22	22	0.224	0.263	0.851	41
20.505	99.015	0.687	2.360	-0.001	8	9	24	24	0.246	0.263	0.934	41
20.603	95.660	0.585	2.810	-0.001	8	9	23	23	0.234	0.263	0.889	41
20.669	95.200	0.546	2.750	-0.001	8	9	23	23	0.234	0.263	0.889	41
20.767	99.489	0.533	2.640	-0.001	8	9	24	23	0.234	0.263	0.889	41
20.833	103.818	0.501	2.580	-0.001	9	9	20	19	0.193	0.263	0.733	41
20.932	105.386	0.503	2.400	-0.001	9	9	20	19	0.193	0.263	0.733	41
20.997	105.685	0.501	2.280	-0.001	9	9	20	19	0.193	0.263	0.733	41
21.096	103.894	0.529	2.260	-0.001	9	9	20	19	0.193	0.263	0.732	41
21.161	104.064	0.519	2.200	-0.001	9	9	20	19	0.193	0.264	0.732	41
21.260	100.752	0.536	2.050	-0.001	8	9	24	23	0.234	0.264	0.887	41
21.325	98.372	0.549	2.030	-0.001	8	9	24	23	0.234	0.264	0.887	41
21.424	99.052	0.545	2.030	-0.001	8	9	24	23	0.234	0.264	0.886	41
21.489	99.603	0.582	2.120	-0.001	8	9	24	23	0.234	0.264	0.886	41
21.588	100.924	0.634	2.200	-0.001	8	9	24	23	0.234	0.264	0.886	41
21.653	105.005	0.638	2.280	-0.001	8	9	25	24	0.246	0.264	0.930	41
21.752	110.695	0.641	2.340	-0.001	9	9	21	20	0.203	0.264	0.769	41
21.817	112.605	0.675	2.360	-0.001	9	9	22	21	0.213	0.264	0.808	41
21.916	111.675	0.707	2.360	-0.001	8	9	27	26	0.269	0.264	1.019	41
21.981	111.075	0.792	2.320	-0.001	8	9	27	26	0.269	0.264	1.019	41
22.080	110.185	0.018	2.300	-0.001	9	9	21	20	0.203	0.264	0.769	41
22.145	108.865	0.018	2.320	-0.001	9	9	21	20	0.203	0.264	0.769	41
22.244	113.887	0.018	2.540	-0.001	9	9	22	21	0.213	0.264	0.807	41
22.309	110.067	0.018	3.460	-0.001	9	9	21	20	0.203	0.264	0.768	41

PREVIOUS BORINGS DRILLED AND COMPILED BY

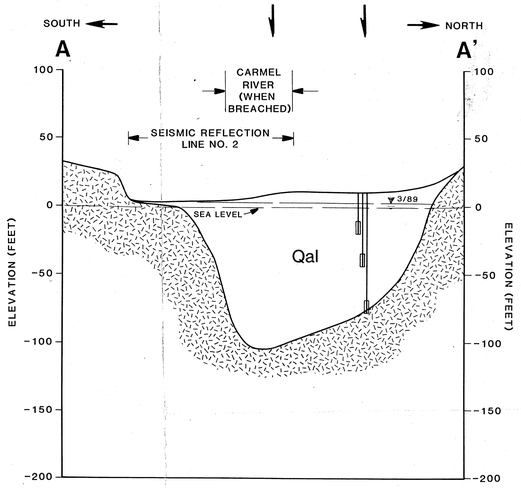
Staal, Gardner, Dunne (1989b)

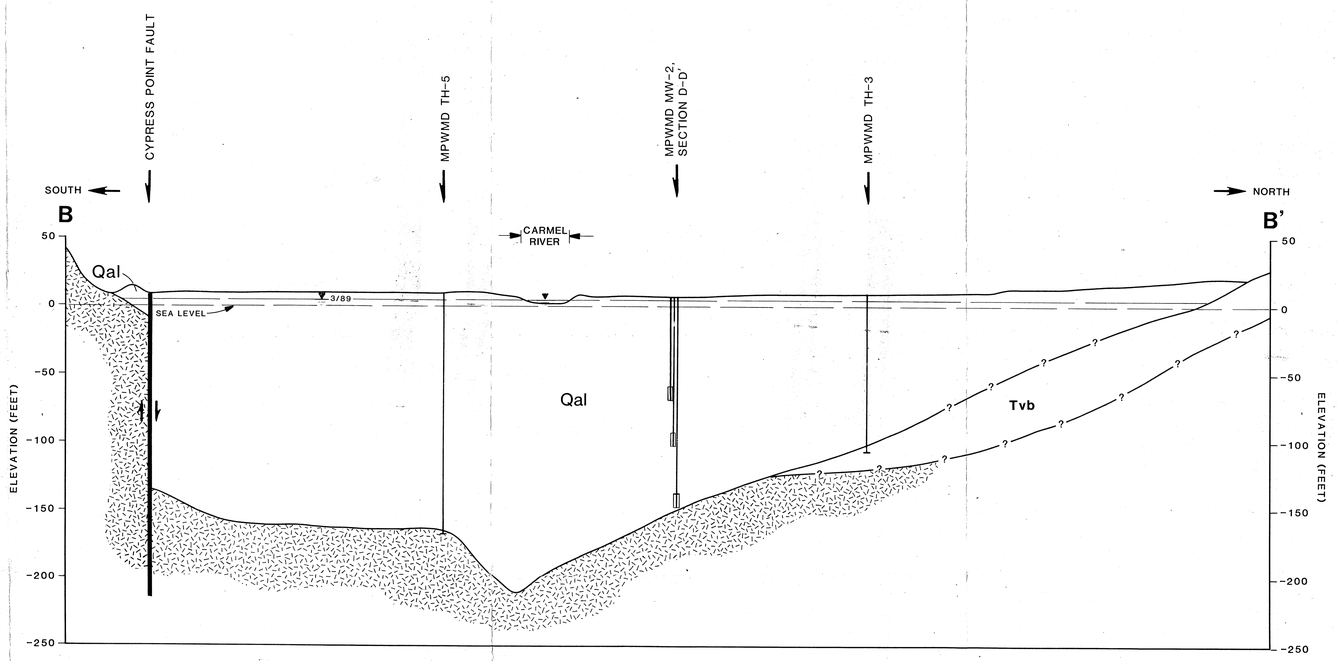
HYDROGEOLOGIC SECTIONS

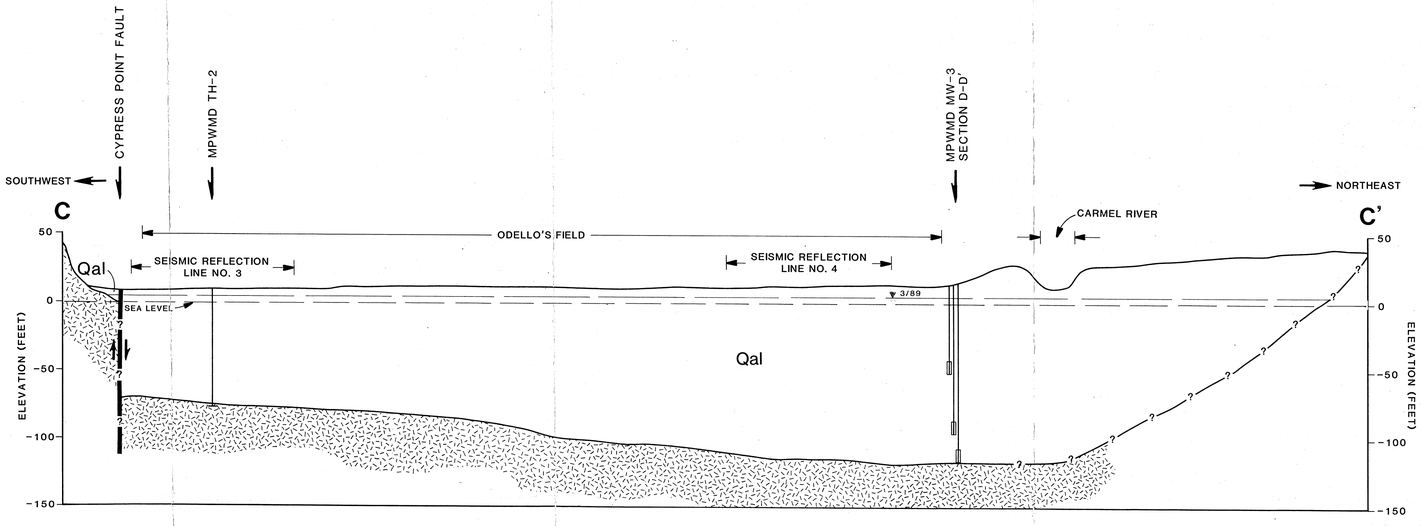
For: MONTEREY PENINSULA WATER MANAGEMENT DIST.

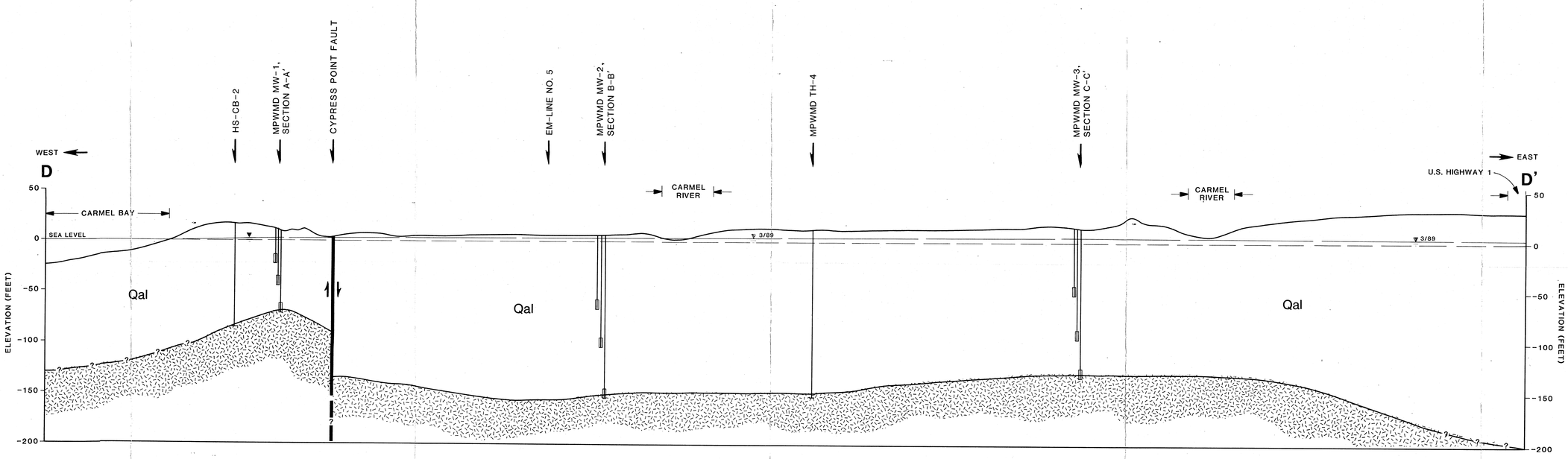
88152 May 1989 Plate 3

Staal, Gardner & Dunne, Inc.
Consulting Engineers and Geologists









LEGEND

- Qal — ALLUVIUM
- Tvb — OLIGOCENE BASALT OF LAWSON (1893)
- SANTA LUCIA GRANITE
- LOCATION OF TEST HOLE OR MONITORING WELL, PERFORATIONS INDICATED IF KNOWN
- ▼ 3/89 — WATER LEVEL ELEVATION

100
50
0
0 200 400
Scale in Feet
Vertical Exaggeration = 4x

LEGEND TO LOGS

TERMS AND SYMBOLS

SAMPLE

SAMPLE TYPES ARE INDICATED AS FOLLOWS:

- UNDISTURBED
- STANDARD PENETRATION
- UNSUCCESSFUL ATTEMPT
- DISTURBED

BLOW COUNT

THE NUMBER OF HAMMER BLOWS REQUIRED TO DRIVE THE SAMPLER THE LAST 12 INCHES.

SYMBOL	HAMMER WEIGHT (POUNDS)	DROP HEIGHT (INCHES)	HAMMER TYPE
7	_____	_____	_____
(3)	_____	_____	_____
[6]	_____	_____	_____
(4)	_____	_____	_____
□	_____	_____	_____
⟨5⟩	_____	_____	_____

WATER LEVEL | WATER INFLOW | HEAVY CAVING | LIGHT CAVING

ADDITIONAL TESTS

UC–	UNCONFINED COMPRESSION	EX–	EXPANSION INDEX
TD–	TRIAXIAL COMPRESSION, DRAINED	R–	R VALUE
TU–	TRIAXIAL COMPRESSION, UNDRAINED	CBR–	CALIFORNIA BEARING RATIO
TDy–	TRIAXIAL COMPRESSION, DYNAMIC	pH–	HYDROGEN ION CONCENTRATION
GS–	GRAIN SIZE DISTRIBUTION	RS–	RESISTIVITY
SE–	SAND EQUIVALENT	CL–	CHLORIDE
SG–	SPECIFIC GRAVITY	SU–	SULPHATE
CP–	COMPACTION	PA–	PALEONTOLOGIC ANALYSIS
C–	CONSOLIDATION	WP–	WATER PRESSURE
DS–	DIRECT SHEAR	PMt–	PRESSUREMETER
PM–	PERMEABILITY	AS–	AGRICULTURAL SUITABILITY

(UNIFIED SOIL CLASSIFICATION AND PLASTICITY CHART ON REVERSE)

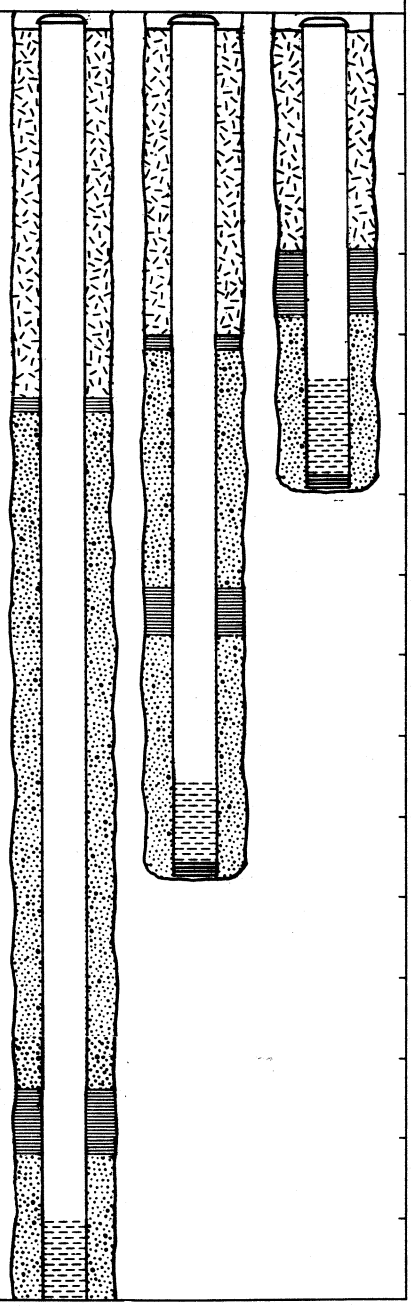
LOG OF MONITORING WELL

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Carmel River State Beach
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1140 3/1/89
TIME STOP : 1300 3/2/89

MONITORING WELL NO.: MW-1
DRILLING DATE : 3/1/89
DATUM : MSL
REFERENCE EL. : 10.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	PHOTOIONIZATION DETECTOR (PPM)	MONITORING WELL SCHEMATIC
10 / 0					**BEACH SAND (Qs)** SAND (SW), grayish brown, loose, moderately well graded, fine- to coarse- predominately medium-grained, subrounded to subangular, damp		
0 / 10					**ALLUVIUM (Qal)** SAND (SW), brownish gray, well graded, fine- to coarse-grained, subangular, granitic, abundant mica, minor fine granitic gravel		
-10 / 20							
-20 / 30					predominantly coarse-grained, common fine subrounded to subangular granitic gravel		
-30 / 40							
-40 / 50							
-50 / 60					dark gray, moderately well graded, fine- to coarse- with abundant fine-grained material, abundant mica		
-60 / 70							
75					minor gray, silty clay lenses		
-70							



LEGEND TO LOGS ON PLATE A-2

LOG OF MONITORING WELL

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Carmel River State Beach
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1140 3/1/89
TIME STOP : 1300 3/2/89

MONITORING WELL NO.: MW-1
DRILLING DATE : 3/1/89
DATUM : MSL
REFERENCE EL. : 10.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	PHOTOIONIZATION DETECTOR (PPM)	MONITORING WELL SCHEMATIC
-70							
85					coarser grained sand		
					refusal on granite		

Bottom of drill hole at a depth of 89 feet.
Refusal on top of granite at a depth of 89 feet.
Drill hole completed as a monitoring well to a depth of 85 feet.
Adjacent drill holes to depths of 54 and 30 feet completed as monitoring wells as part of well cluster.

LEGEND TO LOGS ON PLATE A-2

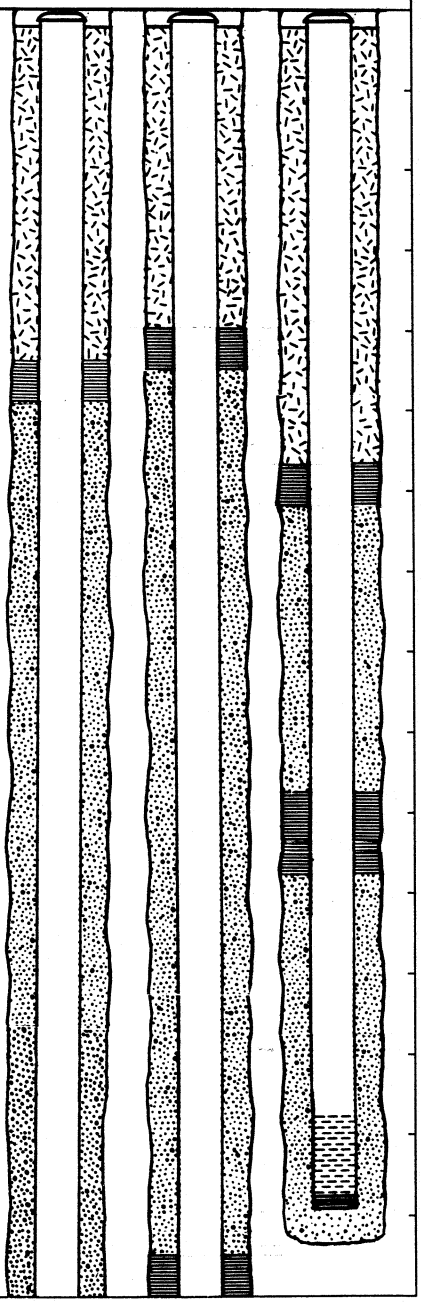
LOG OF MONITORING WELL

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Mission Ranch, Carmel
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1100 3/6/89
TIME STOP : 1700 3/7/89

MONITORING WELL NO.: MW-2
DRILLING DATE : 3/6/89
DATUM : MSL
REFERENCE EL. : 7.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	PHOTOIONIZATION DETECTOR (PPM)	MONITORING WELL SCHEMATIC
5 / 0 / 10 / 15 / -10 / 20 / 25 / -20 / 30 / 35 / -30 / 40 / 45 / -40 / 50 / 55 / -50 / 60 / 65 / -60 / 70 / 75 / -70					**ALLUVIUM (Qal)** SILT (ML), very dark grayish brown to black, organic rich, abundant mica, abundant organic debris SAND (SW), gray (washed), fine- to coarse-grained, subangular, granitic, micaceous, very silty (organic rich) CLAYEY SILT (ML), very dark gray to black, sticky, organic rich, abundant mica with several thin lenses of fine grained granitic sand (10 to 20 percent sand) lenses of fine to coarse granitic sand		



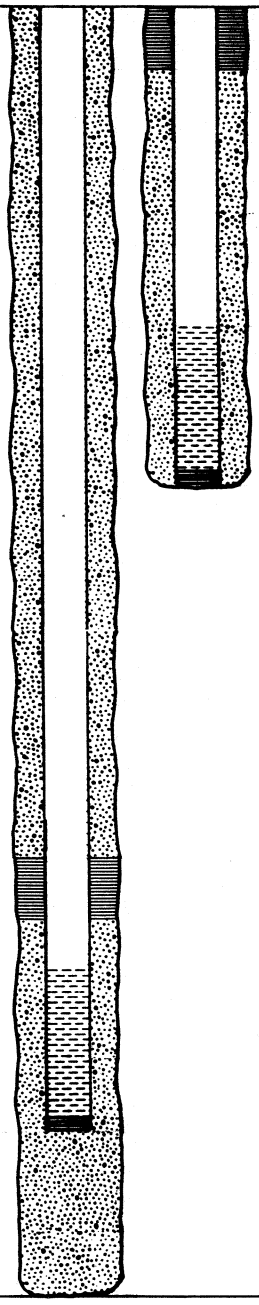
LEGEND TO LOGS ON PLATE A-2

LOG OF MONITORING WELL

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Mission Ranch, Carmel
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1100 3/6/89
TIME STOP : 1700 3/7/89

MONITORING WELL NO.: MW-2
DRILLING DATE : 3/6/89
DATUM : MSL
REFERENCE EL. : 7.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	PHOTOIONIZATION DETECTOR (PPM)	MONITORING WELL SCHEMATIC
85 -80 90 95 -90 100 105 -100 110 115 -110 120 125 -120 130 135 -130 140 145 -140 150 155 -150					SAND (SW), gray (washed), fine- to coarse-grained, subangular, granitic, abundant mica, common fine granitic gravel and gravel fragments, minor volcanics in sedimentary gravel, common thin lenses of organic rich silt (20 to 25 percent) **SANTA LUCIA QUARTZ DIORITE (gr)**, extremely weathered SILTY CLAY (CL), olive gray, common quartz fragments and mafic minerals, spongy GRANITE (Rx), slightly weatered to fresh, extremely hard Bottom of drill hole at a depth of 160 feet. Refusal at 160 feet interpretted as top of fresh granite surface. Drill hole completed as a monitoring well to a depth of 150 feet. Adjacent drill holes to depths of 77 and 110 feet completed as monitoring wells as part of cluster.		

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Carmel River State Beach
DRILLING METHOD: Rotary Wash/Revert 5

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1340 3/2/89
TIME STOP : 1550 3/2/89

DRILL HOLE NO.: TH-1
DRILLING DATE : 3/2/89
DATUM: MSL
REFERENCE EL. : 6.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
0 5					**BEACH SAND (Qs)** SAND (SW), brown, fine- to coarse-grained but predominantly medium, subangular to subrounded							
10					**ALLUVIUM (Qal)** SAND (SW), grayish brown, fine- to coarse-grained, subangular to subrounded, granitic, abundant mafic minerals including bialite, minor fine granitic gravel							
-10 15 20												
-20 25					gray to dark gray							
30												
-30 35												
40												
-40 45												
50												
-50 55												
60					finer grained							
-60 65												
70					CLAYEY SILT (ML), black, organic rich, abundant mica, very sticky							
-70 75					SAND (SW), brownish gray, fine- to coarse-grained, subangular, granitic, with minor subangular, fine granitic gravel, few subrounded volcanic gravel with lenses of silt							

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Carmel River State Beach
DRILLING METHOD: Rotary Wash/Revert 5

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1340 3/2/89
TIME STOP : 1550 3/2/89

DRILL HOLE NO.: TH-1
DRILLING DATE : 3/2/89
DATUM: MSL
REFERENCE EL. : 6.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
-80 85												
90												
-90 95												
100												
-100 105												
110												
-110 115												
120												
-120 125												
130					silty							
-130 135												
140					abundant lenses of organic rich silt							
-140 145												
150					Bottom of drill hole at a depth of 150 feet. Refusal at 150 feet interpretted as top of granite. Drill hole backfilled.							

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Mission Ranch, Carmel
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 0930 3/6/89
TIME STOP : 1220 3/6/89

DRILL HOLE NO.: TH-3
DRILLING DATE : 3/6/89
DATUM: MSL
REFERENCE EL. : 7.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
5 / 0 / 10 / 15 / -10 / 20 / 25 / -20 / 30 / 35 / -30 / 40 / 45 / -40 / 50 / 55 / -50 / 60 / 65 / -60 / 70 / 75 / -70					**ALLUVIUM (Qal)** SILT (ML), black, sticky, organic rich, micaceous, wet to saturated SAND (SW), gray (washed), fine- to coarse-grained, subangular, granitic, silty SILT (ML), black, organic rich, micaceous, with few thin lenses of fine-grained sand SAND (SW), gray (washed), fine- to coarse-grained, subangular, granitic, with minor fine gravel and gravel fragments, common lenses of silt (25 percent) SILT (ML), black, organic rich, micaceous, with common lenses of sand (15 to 20 percent)							

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Mission Ranch, Carmel
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 0930 3/6/89
TIME STOP : 1220 3/6/89

DRILL HOLE NO.: TH-3
DRILLING DATE : 3/6/89
DATUM: MSL
REFERENCE EL. : 7.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
85 -80 90 95 -90 100 105 -100 110 115 -110					CLAY (CL), olive gray, abundant mica **UNNAMED VOLCANICS (Tvb)** BASALT (Rx), dark red, very hard, with common olive minerals, aphanitic texture Bottom of test hole at a depth of 118 feet. Drill hole backfilled.							

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Odello Artichoke Field near CTP
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 0900 3/8/89
TIME STOP : 1300 3/8/89

DRILL HOLE NO.: TH-4
DRILLING DATE : 3/8/89
DATUM: MSL
REFERENCE EL. : 10.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
10					**ALLUVIUM (QaL)** CLAYEY SILT (ML), very dark brown to black, sticky, common organic material							
5												
0 10					SAND (SW), grayish brown, well graded, subangular with lenses of brownish gray to dark gray clay							
15					CLAY (CL), very dark gray to black, organic rich, abundant mica, very silty							
-10 20					SAND (SW), brownish gray, fine- to coarse-grained, subangular, granitic, abundant mica, with common lenses of black, organic rich, micaceous silt (20- to 30-feet at 15 percent)							
25												
-20 30												
35												
-30 40					more silt (35- to 45-feet at 50 percent)							
45												
-40 50					less silt (45- to 60-feet at 10 percent)							
55												
-50 60					black silt							
65												
-60 70					finer grained sand, predominately fine- to medium-grained, with common lenses of silt (65- to 103-feet at 15 to 20 percent)							
75												
-70												

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Odello Artichoke Field near CTP
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 0900 3/8/89
TIME STOP : 1300 3/8/89

DRILL HOLE NO.: TH-4
DRILLING DATE : 3/8/89
DATUM: MSL
REFERENCE EL. : 10.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
70												
85												
-80 90												
95												
-90 100					more silt							
105												
-100 110					coarser sand							
115												
-110 120												
125					coarser grained							
-120 130												
135					lense of coarse-grained granitic sand and fine- to medium-granitic gravel							
-130 140					138- to 148-feet at 40 percent							
145												
-140 150					coarse grained							
155												
150					wood fagments (tree?)							

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: Odello Artichoke Field near CTP
DRILLING METHOD: Rotary Wash/Revert 6

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 0900 3/8/89
TIME STOP : 1300 3/8/89

DRILL HOLE NO.: TH-4
DRILLING DATE : 3/8/89
DATUM: MSL
REFERENCE EL. : 10.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
150												
165					**SANTA LUCIA QUARTZ DIORITE (GR)**, extremely weathered CLAY (CL), olive brown, micaceous, remnant grantic structure GRANITE (Rx), fresh, very hard, angular cuttings Bottom of drill hole at a depth of 166 feet. Refusal on top of granite at a depth of 160 feet. Drill hole backfilled.							

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: West Odello Artichoke Field
DRILLING METHOD: Rotary Wash/Revert 5

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1400 3/10/89
TIME STOP : 1600 3/10/89

DRILL HOLE NO.: TH-5
DRILLING DATE : 3/10/89
DATUM: MSL
REFERENCE EL. : 9.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
0 DEPTH 0					**ALLUVIUM (Qal)** SILTY CLAY (CL), dark grayish brown, sticky, abundant organic material							
5					SAND (SW), dark gray, fine- to coarse-grained, subangular, granitic, with lenses of silty clay and clyey sitl (15- to 20-percent)							
10					lenses of clayey silt							
15												
-10 / 20												
25					CLAYEY SILT (ML), black, organic rich, micaceous, with few, then lenses of sand (25- to 40-feet at <10 percent)							
-20 / 30												
35												
-30 / 40												
45					more sand (40- to 46-feet at 20 percent)							
-40 / 50					less sand (46- to 55-feet <10 percent)							
55					thin sand lenses (55- to 70-feet at 10 percent)							
-50 / 60												
65												
-60 / 70					70- to 85-feet at 10 to 15 percent							
75												
-70												

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: West Odello Artichoke Field
DRILLING METHOD: Rotary Wash/Revert 5

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1400 3/10/89
TIME STOP : 1600 3/10/89

DRILL HOLE NO.: TH-5
DRILLING DATE : 3/10/89
DATUM: MSL
REFERENCE EL. : 9.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
85					SAND (SW), dark gray, fine- to coarse-grained, subangular, granitic, with fine subangular granitic gravel, few thine lenses of clayey silt (88- to 89-feet at 20 percent)							
-80 90												
95					98 to 105 feet at 40 percent silt							
-90 100												
105					CLAYEY SILT (ML), black, organic rich, micaeous, with few thin layers of sand							
-100 110												
115												
-110 120												
125												
-120 130					SAND (SW), dark gray, fine- to coarse-grained, subangular, granitic, with mica fine granitica gravel, lenses of clayey silt (130 to 150 feet at 25 percent)							
135												
-130 140												
145					more silt							
-140 150					less silt (150 to 160 feet at 15 to 20 percent)							
155												
-150												

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152
PROJECT : MPWMD, Lower Carmel River
LOCATION: West Odello Artichoke Field
DRILLING METHOD: Rotary Wash/Revert 5

LOGGED BY : M. S. Burke
DRILLED BY: Pitcher Drilling Co.
TIME START: 1400 3/10/89
TIME STOP : 1600 3/10/89

DRILL HOLE NO.: TH-5
DRILLING DATE : 3/10/89
DATUM: MSL
REFERENCE EL. : 9.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
165					lenses of brown silt							
-160 170												
175					**SANTA LUCIA QUARTZ DIORITE (gr)** GRANITE (Rx), fresh, extremely hard, angular, fresh cutting							
					Bottom of drill hole at a depth of 176 feet. Drill hole backfilled.							

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO. : 88152A
PROJECT : MPWMD, Lower Carmel River
LOCATION: Carmelo Road
DRILLING METHOD: Rotary Air - 6"

LOGGED BY : M. S. Burke
DRILLED BY: Salinas Pump
TIME START: 1000 4/24/89
TIME STOP : 1130 4/24/89

DRILL HOLE NO.: TP-6
DRILLING DATE : 4/24/89
DATUM: MSL
REFERENCE EL. : 17.0 feet (approx.)

ELEVATION (FEET) DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	Atterberg Limits: LIQUID LIMIT (%)	Atterberg Limits: PLASTIC LIMIT (%)	TORVANE (TSF)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
5					**BEACH SAND (Qs)** SAND (SW), brown, loose, dry, fine- to coarse-grained, subangular to subrounded, predominantly quartz, with minor fine to coarse subangular gravel and common organic material fragments (twigs, leaves, etc.)							
10					moist							
10					**UNNAMED VOLCANICS (Tvb)** BASALT (Rx), moderately weathered, gray to olive gray, moderately hard, common reddish brown, phenocrysts, biotite, dry							
15					very hard, moist							
0					Bottom of drill hole at a depth of 19 feet. No ground water encountered. Drill hole backfilled.							

LEGEND TO LOGS ON PLATE A-2

APPENDIX E

Additional Reference Material

FEMA



Levee Certification vs. Accreditation

What is Levee Certification?

Levee certification is the process that deals specifically with the design and physical condition of the levee, and is the responsibility of the levee owner or community in charge of the levee's operations and maintenance. Certification must be completed for the levee to be eligible for accreditation by the Federal Emergency Management Agency (FEMA). Certification consists of documentation, signed and sealed by a registered Professional Engineer, as defined in Chapter 44 of the Code of Federal Regulations (44 CFR), Section 65.2. This documentation must state the following:

- The levee meets the requirements of 44 CFR, Section 65.10
- The data is accurate to the best of the certifier's knowledge
- The analyses are performed correctly and in accordance with sound engineering practices

This documentation is provided to FEMA to demonstrate that a registered Professional Engineer certified the levee, and meets the specific criteria and standards to provide risk reduction from at least the one-percent-annual-chance flood. Once the levee meets the other requirements of 44 CFR 65.10, FEMA can accredit the levee and show the area behind it as being a moderate-risk area on a Flood Insurance Rate Map (FIRM). If a community or levee owner wants the area behind a levee to be shown as reducing risk from the one-percent-annual-chance flood, they must first complete the process for having the levee certified.

How is a Levee Certified?

To certify a levee, the community or levee owner must work with a licensed engineer or a Federal agency responsible for levee design to develop and certify documentation that the levee meets design construction standards for at least the one-percent-annual-chance flood. *Levee certification does not warrant or guarantee performance*, and it is the responsibility of the levee owner to ensure the levee is being maintained and operated properly.





Levees

FEMA defines a levee as a "man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide a level of protection from temporary flooding."

Levees reduce the risk of flooding, but do not eliminate all flood risk. As levees age, their ability to reduce this risk can change and regular maintenance is required to retain this critical ability. In serious flood events, levees can fail or be overtopped and, when this happens, the flooding that follows can be catastrophic.

RiskMAP
Increasing Resilience Together

What is Accreditation?

A levee cannot be accredited until the certification process is completed. FEMA accredits a levee as providing adequate risk reduction on the FIRM if the certification and adopted operation and maintenance plan provided by the levee owner are confirmed to be adequate. An operations and maintenance plan specifies key operating parameters and limits, maintenance procedures and schedules, and documentation methods. FEMA's accreditation is not a health and safety standard – it only affects insurance and building requirements.

An area impacted by an accredited levee is shown as a moderate-risk area, and is labeled Zone X (shaded) on a FIRM. In this case, the National Flood Insurance Program (NFIP) floodplain management regulations do not have a mandatory flood insurance purchase requirement. However, FEMA recommends the purchase of flood insurance due to the risk of flooding from potential levee failure or overtopping.

If the levee is not accredited, the area will be mapped as a high-risk area, known as a Special Flood Hazard Area, or SFHA. In this case, the NFIP floodplain management regulations must be enforced and the federal mandatory purchase of flood insurance applies.

FEMA's Role

FEMA does not own, operate, maintain, inspect, or certify levees. FEMA's role is limited to identifying and mapping the level of flood risk associated with levees and only accredits them where data showing compliance with 44 CFR 65.10 is provided by the community, levee owner, or other interested parties. FEMA has a responsibility to the public to identify the risks associated with levees that are either not certified or no longer compliant with 44 CFR 65.10. Areas behind non-accredited levees will be shown on FIRMs as a high-risk floodplain.

What is a Provisionally Accredited Levee or PAL?

FEMA created the PAL designation to facilitate the certification and accreditation process for communities unable to readily provided certification documents, but who reasonably expect levees in the community to provide one-percent-annual-chance flood risk reduction. A PAL is a designation for a levee that FEMA previously accredited on an effective FIRM, and is now awaiting certified data and/or documentation to show the levee remains compliant with NFIP regulations. Levees with structural deficiencies are not eligible for the PAL designation. However, a PAL may include a 12-month period for the correction of maintenance deficiencies.

A community or levee owner's failure to provide full documentation of the status of a levee does not mean the levee doesn't provide the designated level of risk reduction. However, it does impact how the levee will be mapped on a FIRM because it will be de-accredited, and the impacted area will be mapped as an SFHA.

Before FEMA will apply the PAL designation to a levee, the community or levee owner must sign and return an agreement that indicates the data and documentation required for accreditation will be provided within 24 months or less. The procedures for PALs are clarified and documented in FEMA Procedure Memorandum No. 43, *Guidelines for Identifying Provisionally Accredited Levees*.



For More Information

Living with levees is a shared responsibility. It is important for both levee owners and those who live and work near levees to understand the risk associated with levees. FEMA has a number of resources available for further information about levees, including the certification and accreditation process. Below are links to additional information:

- A levee-specific webpage has been set up on the FEMA.gov. Please visit http://www.fema.gov/living-levees-its-shared-responsibility.
- For additional information on NFIP criteria for accrediting levees, visit: www.fema.gov/library/viewRecord.do?id=2517.
- For more background on Provisionally Accredited Levees, download the fact sheet at: www.fema.gov/library/viewRecord.do?id=1987.
- For more specific information regarding levee construction and restoration, visit:http://www.fema.gov/living-levees-its-shared-responsibility/levee-system-construction-restoration-projects
- For additional information on Procedure Memorandums visit: http://www.fema.gov/ctp-main/guidelines-specifications-flood-hazard-mapping-partners.

RiskMAP
Increasing Resilience Together

CARMEL RIVER LAGOON RESTORATION

Scenic Road Protection Options



Prepared Under Contract to Whitson Engineers for:

Monterey County Water Resources Agency
893 Blanco Circle, Salinas, CA 93901-4455

Prepared by:

moffatt & nichol
2185 No California Blvd., Ste. 500
Walnut Creek, CA 94596

February 25, 2013
M&N Job No: 7871

CONTENTS

1. INTRODUCTION 1
2. Data Summary 4
   2.1 Topography 4
   2.2 Bathymetry 4
   2.3 Geotechnical Conditions 4
   2.4 Additional Information 5
3. Coastal Processes 6
   3.1 Water Levels 6
   3.2 Wave Climate 6
   3.3 Sea Level Rise 7
   3.4 Littoral Transport 8
   3.5 Beach Morphology 8
   3.6 River Breaching 9
4. Conceptual Protection Options 11
   4.1 Alternative 1 - Revetment (Rip Rap) Located at the Toe of Slope 12
   4.2 Alternative 2 - Seawall Located at Toe of Slope 12
   4.3 Alternative 3 - Reinforced Earth Wall Located at Mid-Slope 13
   4.4 Alternative 4 - Pile Wall Located at Top of Slope 14
5. REFERENCES 16

APPENDICES

A. County Aerial Photographs

FIGURES

1. Project Site Overview
2. Depths (in fathoms, MLLW) near project site (NOAA Chart)
3. Nearshore Bathymetry (in ft, MLLW)
4. Wave Conditions (Annual Average) for Monterey Bay (~30 Miles Northwest of Project Site)
5. Wave Conditions (Annual Average) for Point Sur (~50 Miles South of Project Site)
6. Winter (left) and Summer (right) Wave Height for Monterey Bay
7. Winter (left) and Summer (right) Wave Peak Period for Monterey Bay
8. Observed Seasonality in Wave Conditions for Monterey Bay (Winter (left) and Summer (right))
9. Wave Refraction Diagram for WNW, 11-second Swell (Howell, 1972)
10. Example of Nearshore Wave Model Domain (PMS Model)
11. Example of Nearshore PMS Wave Model Results
12. Alternative 1 – Riprap
13. 10+00 Cross Section Alternative 1 – Riprap
14. 14+00 Cross Section Alternative 1 – Riprap
15. 16+00 Cross Section Alternative 1 – Riprap, Alternative 2 – Seawall & Riprap
16. Alternative 2 – Seawall & Riprap
17. 10+00 Cross Section Alternative 2 – Seawall & Riprap
18. 14+00 Cross Section Alternative 2 – Seawall & Riprap
19. Alternative 3 – Reinforced Earth & Riprap
20. 10+00 Cross Section Alternative 3 – Soil Nail Wall & Riprap Grade Control
21. 14+00 Cross Section Alternative 3 – Soil Nail Wall
22. Alternative 4 – Pile Wall at Edge of Road
23. 14+00 Cross Section Alternative 4 – Pile Wall at Edge of Road

1. INTRODUCTION

This report presents an overview of the Scenic Road Protection Project, and provides a description of potential bluff protection options for times when Scenic Road is threatened by a northerly meandering Carmel River. The project description below describes the Carmel River history and management drivers. Subsequent sections include a summary of available topography and bathymetry, a description of the coastal processes influencing the beach dynamics along Scenic Road, and potential bluff protection options.

The Carmel River drains an approximate 250 square mile watershed. Like many California streams entering the Pacific, there is a very productive estuary at the mouth, called the Carmel River Lagoon, which serves as rearing habitat for juvenile steelhead. The Carmel River Lagoon supports threatened species such as the South-Central California Coast (S-CCC) steelhead, California red-legged frog, Western snowy plover, and Smith's blue butterfly. The Carmel River was also designated as critical habitat for S-CCC steelhead in September 2005 (County of Monterey et. al, 2012).

The lagoon is not connected to the ocean during times of low or no river flow, when waves build a barrier beach across the mouth of the river. When the mouth of the river is closed, lagoon water levels rise between late fall and spring seasons and threaten private properties along the northern edges of the lagoon, as well as a parking lot and restroom facility operated by the State Parks. Therefore, since 1973 the County has mechanically breached the sandbar. Evidence shows that the barrier beach has been breached since at least the early 20th century (Final Study Plan, 2007). Historically, the breaches were created such that the river would flow directly west out to the Pacific Ocean; however, the river meanders north or south along the beach in response to beach build-up from wave action. Often numerous breaches are mechanically and naturally formed over the winter and early spring, depending on variable ocean and river conditions (James, 2005). Beginning in 2005, the sandbar has also been mechanically closed in the spring when the river flows have subsided in order to maintain adequate water levels for steelhead throughout the summer. A larger, deeper lagoon during the summer and fall increases the quality and quantity of fish and wildlife habitat until river flows resume during the winter (County of Monterey et. al, 2012).

The rate of the lagoon drawdown after a breach and the post-breach lagoon water surface elevation are dependent on several factors, including breach location, channel length and width, tidal conditions, and the presence or absence of a rock sill along the outflow channel. Breaches which result in the lagoon reaching relatively low elevations reduce the available aquatic habitat area for fish and wildlife. Breaches directly west out to the ocean also have swift stream flows that push juvenile steelheads out to sea prematurely. When the river channel migrates along the northern or southern beach, a longer, meandering path is taken which extends the hydraulic gradient slowing the water exit. Local fisheries groups and agencies have preferred a northern meandering outlet channel alignment because, in the past, when the river channel migrated northwards, it reduced the rate and amount of *drawdown* (drop in lagoon water levels before and after a breach to the ocean) and subsequent loss of threatened juvenile steelhead that get flushed out to sea, as compared to when the channel flows along the southerly and westerly outlet channel (James, 2005).

Scenic Road is located immediately north of the Carmel River mouth in Monterey County. It is a publicly maintained road that is threatened by erosion when the river takes a northerly route along the beach before discharging into the Pacific Ocean. The road runs around the northern headlands of Stewart's Cove, southwest to intersect with Carmelo Street near the Carmel River State Beach parking lot and restrooms. Scenic Road provides recreational access to the State Beach, sole access to six private homes, and has a sanitary sewer pipe under the

roadway. Monterey County (County) is investigating bluff stabilization methods to protect the road, sewer infrastructure, and homes.

If a northerly river alignment on the beach were to persist over an extended period of time (several months), it is likely that the bluff fronting Scenic Road may also require protection from wave erosion. As a result, although river-induced scour is believed to be the primary mechanism that undermines the sand dune fronting the bluff (Thornton, 2005), the protection options developed for this study take both factors into consideration.

Bedrock underlies the northern beach that prevents a deep exit channel from forming. A bedrock sill is also found on the south beach, and often mechanical breaches are directed towards this sill to prevent damage.

In 1992, regulatory agencies informed the County that sandbar management did not qualify as an emergency due to the predictability of flooding at Carmel River Lagoon. In response, the County prepared an Interim Management Plan and Breaching Criteria and submitted it to the agencies. The County updated the agencies in the years following; however, a lack of supporting data and analysis was expressed by the agencies. In 2007 a Final Study Plan for Long Term Adaptive Management was released, identifying baseline studies needed to find a long-term solution to managing Carmel River (Final Study Plan, 2007).

In November 2011, the County applied for permits from the US Army Corps of Engineers (Corps), Regional Water Quality Control Board (RWQCB), California Coastal Commission (CCC), and the California Department of Fish and Wildlife (CDFW) to manage lagoon water levels and install a sand ramp for public beach access. The Corps consulted with the NMFS and the US Fish and Wildlife Service (USFWS) as part of permit review. In September 2012, the County and the Corps, in consultation with NMFS, drafted a Memorandum of Understanding (MOU) regarding the management of the Carmel River Lagoon. The MOU lays out a long-term plan to balance protection of private property with protection of federally listed species. The MOU parties also recognize that mechanically managing the Carmel River Lagoon over the long run is not in the best interest of the County, Corps, and NMFS (County of Monterey et. al, 2012). So the MOU identified two long-term solutions as alternatives to performing sandbar management: the Ecosystem Protective Barrier (EPB) and the Scenic Road Protection and Preservation Project (this project). The Scenic Road Protection Project is proposed for the purpose of protecting Scenic Road and the State Parks parking lot and restrooms from erosion when the river is allowed to naturally breach along a northern alignment. The purpose of the EPB is to protect nearby residential property by constructing a flood wall around portions of the lagoon, which would allow a higher lagoon water level, significantly reducing, if not eliminating, the need for sandbar management.

The EPB and Scenic Road Protection Projects are anticipated to be completed by 2018 or earlier. Meanwhile, the Interim Sandbar Management Plan (County of Monterey et. al, 2012) provides well-established protocols on sandbar management. These include:

- The use of sandbags, public outreach, sandbar breaching and closure, and sand relocation for access purposes;
- Mobilizing equipment and personnel when the water level in the lagoon reaches +12.77 feet NAVD88[1], or when the projected water level is expected to reach this elevation within hours, or when the flow in the river reaches 200 cfs;

[1] All elevations in this report reference the North American Vertical Datum (NAVD) of 1988, unless specifically stated otherwise. The conversion factor between NAVD and the National Geodetic Vertical

- Mechanical sandbar breaching when the Lagoon water level reaches +13.27 feet NAVD88, or high river inflows and/or wave overtopping is expected to raise the water level to +12.77 feet in less than 6 hours, or if the predicted tides are unusually high;
- Managing the breach in the winter to maintain a minimum lagoon elevation of +6 feet NAVD88, or closing the breach if excessive scouring is observed;
- Managing the breach, and conducting beach grooming as required, in the summer with the intent of achieving a +12.77 feet pool elevation in the lagoon.

This is a change to the County's historic practice, which in general, was to mobilize at +10.27 feet and breach at +11.55 feet (James 2005). In reality, the average lagoon elevation at breaching was +11.83 feet for the 1992-1998 period, and +13.57 feet for the 1999-2005 period. This change over time was likely due to the Federal listing of the Carmel River Steelhead as a threatened species in 1997, which increased the involvement of resource agencies such as the National Marine Fisheries Service (NMFS).

Datum (NGVD) of 1929 is 2.77 feet, with the NGVD datum being higher (add 2.77 feet to NGVD elevations to obtain NAVD elevations)

2. DATA SUMMARY

2.1 Topography

The project reach is within a crenulate-shaped bay, anchored by the rocky Carmel Point headland (south of Stewart's Cove) to the north and a bedrock outcrop to the south. Consistent with typical headland-bay beaches, the shoreline shape is oriented parallel to the wave crests as they refract and diffract around the headland. There is also a wave energy gradient along the beach such that during the winter, when waves are predominantly from the northwest direction, the energy decreases from south to north.

The slope of the beach also progressively becomes flatter from the south to the north. Field observations by Prof. Ed Thornton of the Naval Postgraduate School show that the beach slope varies from about 8H:1V (12%) at the north end of the beach, to about 3.6H:1V (28%) at the south end of the beach (Thornton, 2005). Sand grain size, and therefore wave energy, also increases from the north to the south end of the beach. Sand is deposited on the beach berm by wave action, and at high tides, waves overtop the berm depositing sand and debris on the back beach (nearest the lagoon). Prof. Thornton also determined that the beach is relatively stable and has not migrated over the past 130 years (Thornton, 2006).

The beach topography is seasonally variable and dependent on numerous factors including river flow, wave height, period and direction, tide, mechanical or natural breaching, wind direction and strength, and river sediment deposition. After reviewing the available surveys of the Carmel River mouth and beach along Scenic Drive, it is evident that the beach is heavily managed and mechanical breaching significantly alters the beach topography. By mechanically breaching in different locations each year, the beach to the north, south and middle of the river mouth are unnaturally modified, eliminating the ability to decipher the "natural" beach topography and breaching process. If natural breaching predictability is desired, cross sections for multiple years would have to be surveyed along the beach at specific locations to maintain congruency in the data. Surveys would have to be completed prior to, and after, sand management on the beach (after final closure and before first breaching) over several years to remove inter-annual variability to decipher a natural signal.

2.2 Bathymetry

The sea floor offshore of the Carmel River Beach is relatively steep, quickly dropping off to depths greater than 100 ft in the Carmel Canyon; however, very little detailed information exists on the nearshore bathymetry within the surf zone. Figure 2 below gives a detail from the NOAA navigation chart of the area, but survey dates are unknown and there is still a lack of detail in the direct project vicinity.

A bathymetric survey performed in the early 1970's, with the locations of 20 to 100 feet depth contours, is provided in Figure 3 (Howell, 1972). Rock outcroppings at the northern and southern headlands are evident in the figure, with the sea floor between the two headlands reported to be mantled by over 5 feet of fine to coarse sand.

In 2007 RMC performed a stage-volume analysis for Carmel River Lagoon. They performed bathymetric surveys in 2006 and 2007 of the lagoon and utilized a 2003 LIDAR survey to build the stage-volume curve (RMC, 2007).

2.3 Geotechnical Conditions

As part of this SRPS Project, a feasibility-level geotechnical investigation was performed by Pacific Geotechnical Engineering. The draft report presents recommendations for the various

conceptual design options based on a subsurface geotechnical investigation of the project area and review of past investigations. In addition to geologic cross-sections in the project area, the report includes information on topography, bathymetry, and anecdotal records of recent changes in beach character.

2.4 Additional Information

Additional information on the basic hydrologic and oceanographic processes at Carmel River including lagoon levels, streamflows, wave heights, and rainfall, along with an analysis on open and closed lagoon dynamics including natural and mechanical breaching practices is also available (Monterey Peninsula Water Management District, MPWMD, 2005).

3. COASTAL PROCESSES

3.1 Water Levels

Typical tidal water levels at the site can be characterized using measurements from the Monterey, CA tide gage, located approximately 7 miles north of the project site on the opposite side of the Monterey Peninsula. The lag time between water levels over this distance is less than 5 minutes, and differences in water levels are negligible (Laudier, 2009). Table 1 below gives the tidal datums at the project site referenced to Mean Lower Low Water (MLLW), NGVD29, and NAVD88 datums.

Table 1: Tidal Datums at Monterey, CA (NOAA CO-OPS #9413450)

Tidal Plane	Elevation (ft)		
	MLLW Datum	NGVD29 Datum	NAVD88 Datum
Mean Higher High Water (MHHW)	5.34	2.74	5.48
Mean High Water (MHW)	4.64	2.04	4.78
Mean Tide Level (MTL)	2.87	0.27	3.01
National Geodetic Vertical Datum 1929 (NGVD29)	2.6	0	2.74
Mean Low Water (MLW)	1.1	-1.5	1.24
Mean Lower Low Water (MLLW)	0	-2.6	0.14
National Geodetic Vertical Datum 1988 (NAVD88)	-0.14	-2.74	0

Note that the difference between NAVD88 and NGVD29 datums of 2.74 ft is provided at the Monterey tide gage and is used in this report. At the project site, the County uses a conversion of 2.77 ft (County of Monterey et. al, 2012).

3.2 Wave Climate

The wave climate offshore of the project site is characterized by long-period, energetic swell that typically approaches from the west through northwest (clockwise) directions. Figure 4 and Figure 5 show wave height roses for the two closest wave measurement buoys located approximately 30 miles NW and 50 miles south of the project site, which show the predominance of the west through northwesterly swells.

The wave climate varies seasonally to a high degree. During the fall and winter seasons, North Pacific storms generate long period swells that propagate from the west though northwest directions, though infrequent southerly swells can occur as well (James, 2005). During the summer months, shorter period (local seas) waves predominate from the northwest; infrequent southern hemisphere swells are also present. Figure 6 and Figure 7 give summer and winter wave height and peak period roses for the Monterey Bay gage, where the seasonal shift is evident. Figure 8 plots a measured time series of sea and swell conditions at a Coastal Data Information Buoy during a recent winter storm season and the subsequent summer.

Carmel River Beach is largely protected from the predominant wave directions by both the southern end of the Monterey Peninsula and the rocky headland directly north of the beach. As long period NW waves propagate towards shore, they undergo refraction due to changes in bathymetry and diffract to a large degree by the protecting headlands, filtering out higher-frequency wave energy so that mostly low-frequency swell impacts the beach. The beach is exposed to the rare, westerly storms, where wave focusing can amplify approaching waves

(Thornton, 2005). At the northern portion of the beach, diffraction of wave energy from the sheltering headland results in further diminished waves that approach the curved portion of the beach at a northerly direction. Figure 9 below gives a computed wave refraction diagram for WNW swell of 11 seconds, where the refraction and diffraction of waves along the northern section is evident (Howell, 1972). Overlaid on the figure are schematic wave rays (direction of wave travel) and sediment transport directions that are typical of a headland-bay system in California.

While the reduction in wave heights towards the northern section of the beach can only be calculated using site-specific, quantitative methods, calculated wave refraction/diffraction patterns at similarly-shaped crenulate beaches can offer a good indication of the expected patterns at the Carmel River State Beach. Figure 10 and Figure 11 from a similar crenulate shaped headland-bay system (Shelter Cove in Mendocino County) show the results of a detailed numerical modeling effort to determine refracted and diffracted waves. Waves approaching Shelter Cove from the southwest (240^o) to south (180^o) direction are similar to north to northwest waves approaching Carmel River State Beach because Shelter Cove is a south-facing beach, while Carmel is a west-facing beach. The Shelter Cove model results show the gradient in wave heights moving from south to north that results from the headland-induced wave transformation processes.

3.3 Sea Level Rise

Sea level rise (SLR) projections for the project vicinity were taken from the October 2010 State of California Sea-Level Rise Interim Guidance Document and are given below in Table 2. While some estimates of historical rates of global sea level rise indicate an accelerating trend, the current rate of increase along the San Francisco coast is less certain, and analysis of the most recent 19 year tidal record from the San Francisco gauge does not support the global trend. The October 2010 State of California Sea-Level Rise Interim Guidance Document recommends the use of global mean sea level rise predictions based on present and future greenhouse gas emission scenarios which give future SLR values from the year 2000 baseline (CO-CAT, 2010). The absence of sea level rise over the last 10 years in SF Bay indicates that the 0 ft. sea level rise baseline can be shifted ahead to 2010. With the 2010 baseline, M&N recommends that the high estimate of 1.4 feet (16 inches) in the Interim Guidance Document be shifted to 2060 instead of 2050.

Table 2: Sea Level Rise Projections (CO-CAT, 2010)

Baseline Year	Modified* Baseline Year	Range	Range of Models (feet)		
			Low	Average	High
2000	2010	N/A	0 (baseline)		
2030	2040	All	0.4	0.6	0.7
2050	2060	All	0.9	1.2	1.4
2070	2080	Low	1.4	1.9	2.3
		Medium	1.5	2.0	2.4
		High	1.7	2.3	2.7
2100	2110	Low	2.6	3.3	4.2
		Medium	3.1	4.0	5.0
		High	3.6	4.6	5.8

* 2000 baseline year shifted to 2010 due to lack of observed sea level rise at the San Francisco Presidio gage over the last 10 years.

Sea level rise could be expected to increase wave heights in locations where wave height is limited by water depths and the beach response to higher water levels is limited by sand

supply. The shore along Scenic Road is depth-limited; therefore, sea level rise should influence a shore protection design.

3.4 Littoral Transport

Cross-Shore Transport

The periodic, orbital motion of water under waves is important in transporting sediment up and down the beach profile (cross-shore direction). Seasonal changes in wave climate, especially in locations that have a distinct winter storm season, induce corresponding changes in the state of a beach, where sediment is transported offshore during storm events and the beach slowly recovers during less-energetic events (Bosboom & Stive, 2010).

Because the Carmel River Beach is sheltered from the predominant wave direction, very little wave energy in the form of large, storm waves reaches the northern portions of the beach; instead, swell impacts the beach for most of the year, transporting sediment shoreward and building up the beach berm (Thornton, 2005). The high seasonal variability in shoreline position common for other area beaches is not observed here, with an estimated position variation of only +/- 10 m (Thornton, 2006).

Long-Shore Transport

Waves approaching a beach at some angle away from perpendicular induce a small mean current parallel to the shoreline as they break across the surf zone. This current drives the corresponding transport of suspended sediment parallel to the beach, and gradients in this transport rate due to differences in nearshore wave height or wave incidence angle promote erosion or accretion of the beach face in different areas (Bosboom & Stive, 2010). The incident-angle driven transport gradients often alter the shoreline so that it tends to align with the predominant incident wave angle, diminishing transport rates so that an equilibrium condition exists.

Due to the shape of the Carmel River Beach system, long-shore transport is most likely northward in the north portion of the beach and southward in the south portion of the beach, serving to distribute sediment brought to the coast by the river along the length of the beach. This hypothesis was also verified in studies performed for Carmel Beach (Howell 1972). The concave shape of the beach is largely aligned with the crests of the refracted and diffracted breaking waves, suggesting the beach is close to an equilibrium shape and transport magnitudes are relatively low (Thornton, 2005).

An additional mechanism other than oblique wave incidence may drive long-shore transport northwards toward the anchoring headland. Waves breaking across the surf zone induce a heightening of the mean water level known as wave setup, and larger waves produce setup of greater magnitude. Because of the sheltering effect of the northern headland, wave heights decrease northward along the beach resulting in a water level gradient that drives a northward flowing current (Thornton, 2005). While the magnitude of the transport due to this gradient is unknown, research at the more-exposed Ocean Beach in San Francisco shows that a setup-gradient induced longshore current can greatly exceed that produced by oblique incidence or tide (Barnard, Hansen, & Erikson, 2012).

3.5 Beach Morphology

The Carmel River Beach is steep, reflective, and composed of fairly coarse sand delivered to the beach by the river (Rich & Keller, 2013). Beach face slopes typically vary along the length of the beach, ranging from as low as 8% at the north to 28% to the south (Laudier, 2009;

Thornton, 2005). The mean grain sizes also increase to the south, corresponding to the increased wave energy along the less-sheltered portion (Thornton, 2005).

The shape of the beach shoreline is typical of crenulate or headland-bay beaches where the equilibrium condition can be described by one of several mathematical shape functions, usually log-spiral in form. These equilibrium beach shapes are typically present where a headland fixes the shape at one beach end and waves approach from a predominant direction (Moreno & Kraus, 1999). Waves approaching the beach both refract and diffract into the sheltered zone behind the upcoast headland, and differential long-shore transport shapes the beach so that it is perpendicular to the resulting wave rays at equilibrium (Silvester & Ho, 1972). While littoral transport is limited at the beach, the differences in wave energy reaching the different beach sections has resulted in alongshore variation in beach berm heights with lower berm elevations to the north (Rich & Keller, 2013).

3.6 River Breaching

The Carmel River Beach forms a barrier between the Pacific Ocean and the adjacent Carmel River Lagoon that is seasonally breached (either naturally or artificially) when high rainfall events increase the water level in the lagoon (Kraus, Patsch, & Munger, 2008). Because the Carmel river is ephemeral and the beach is subjected to swell for most of the year, wave run-up rebuilds the berm and closes off the barrier beach when river outflows are low or absent (Laudier, 2009).

During the early fall, the lagoon mouth usually remains closed to the sea, but occasional overtopping of the beach berm by long period ocean swell can raise the lagoon water level over the typical low, summer levels. Major fall overtopping-induced water level increases have usually been associated with high waves in conjunction with higher tide levels (James, 2005). During late fall/early winter, rainfall in the Carmel river watershed is usually sufficient to advance the flowing river to the lagoon and fill up the available storage. At this point, the beach berm has historically been mechanically breached to prevent flooding of roads and homes along the northern edge of the lagoon. Lagoon outflow through the breach quickly scours a channel sufficient to release most of the stored lagoon water into the ocean. Based on 13 years of observations, the berm breach remains open approximately 85% of the time, with river inflows of 100 cubic feet per second, usually ensuring that the breach will not be closed by predominant wave-transported sand. Because lower flows or large waves encourage breach closure (and then an increase in water level as the lagoon fills), the water level in the lagoon is not directly correlated to river inflow (James, 2005).

Historically, the initial artificial breach channel has been excavated straight offshore near the southern end of the beach, though the breach management strategy has varied considerably over the past decade, and has included northerly and southerly managed breaches. Bedrock sills underlie the beach along both the north and south edges, so scour by migrating channels or channels intentionally opened in these sections is less than that when channels are excavated through the central beach portion. With the relatively long channel alignments, further limited by the sills north and south of the river mouth, river outflow is extending over a longer period (drawdown), which is beneficial for threatened species (County of Monterey et. al, 2012; Thornton, 2005). In 2005, the berm was breached toward the north with the unintended consequence of severe erosion along the backing bluff which supports road and wastewater infrastructure (Thornton, 2005).

An elongated channel forms to the north along the beach in half of the years of observation (James, 2005) and either natural breaching or channel migration is expected to tend towards the northern alignment since the antecedent, lowered beach alignment has not recovered to typical berm heights and widths (Thornton, 2005). The lower berm elevations, due to milder

beach slope and finer sediment, also favor natural breaching or channel migration towards the northern portion of the beach; however, this varies greatly on a year to year basis and depends on wave energy arriving over the winter/spring seasons.

A preliminary analysis of beach berm elevations from the County provided surveys for the 2003 to 2012 period indicates the following:

- The *low point* of the beach berm is generally about +14 feet and is to the south of the river mouth in most of the surveys (5 out of 7 surveys reviewed). The highest elevation of this low point was about 15.5 feet in Dec 2004.
- The *high point* is generally in the middle of the beach, and ranges from +16 to +17 feet (5 of the 7 surveys reviewed).
- The beach immediately north of the entrance is generally between the above two range of elevations and was as low as the southern portion in 2 of the 7 surveys reviewed, and actually was the high point in 2 of the 7 surveys.

The above observations indicate that the low point in the beach berm is about 1 to 2 feet higher than the +13.3 feet elevation which is the current trigger for breaching the sandbar by the County under the Interim Management Plan.

4. CONCEPTUAL PROTECTION OPTIONS

Bluff erosion along the project site has been attributed to northward-flowing, river-induced scour along the bluff toe. To prevent this from occurring while the river seeks a northern breach, some form of slope protection along the bluff toe is necessary. The primary objective of the slope protection is to limit the landward migration of the bluff toe, so it must be a non-erodible feature capable of resisting anticipated waves and currents. Typically, bluff slope protection will fall into one of the following categories:

Engineered Revetment – a thick layer of armor rock sized to withstand wave and current forces, often underlain by a thinner layer of smaller rock and/or a geotextile fabric to prevent fine aggregate from being eroded through the revetment. The revetment does not support the bluff slope above the revetment, but prevents landward migration of the bluff toe.

Seawall Structure – a retaining wall constructed vertically (or near vertically). The wall height depends on the retained height and the embedded depth, which in turn is dependent on whether the wall is cantilevered or tied back with earth anchors.

Reinforced Earth Structure – this type of structure will have soil nails or tiebacks inserted into the slope and a facing to prevent the retained soil from erosion. The facing can be solid (shotcrete, precast concrete panels) or partially open (gabions).

Pile Wall - this type of structure would be a tangent or secant type of pile wall. The piles are driven in at the top of slope, likely along the County right-of-way and would be exposed after the dune and portions of bluff fronting the pile wall are eroded. At that time, the exposed pile wall could be given a shotcrete facing for a natural bluff appearance.

The alignment of the slope protection will be roughly parallel to Scenic Drive and will be either along the existing toe of the bluff slope (Alternatives 1 and 2); or at some location landward of the toe of slope (Alternatives 3 and 4). The alignments which follow the existing toe of slope allow for a natural dune above the structure and would provide the minimum visual impact, as the structure would be naturally reburied by wave action. The alignments which are located at some point mid slope (Alternative 3), or at the top of the slope (Alternative 4), would provide a wider beach over which the river could meander. (Note that an evaluation of the likelihood for the river to go in a northerly or southerly direction is beyond the scope of this Study). Also, Alternative 4 would be significantly more expensive but is included because it is within (or very near to) existing County right of way, which could be important for project feasibility as the other three alignments presented would need to be constructed on State Parks property or the property would need to be acquired by the County.

The existing toe of the bluff slope is typically at an elevation of approximately +20 feet. The alignment will extend from the southern tip of the public parking lot toward the northwest for a total length of about 900-ft. The northern terminus was selected to match the general topography of the beach during non-breach periods; this currently shows a wave-built sand berm running west-east and connecting with the bluff at around station 10+00. The slope protection will thus be aligned to direct the riverine flow to turn west and breach at approximately station 10+00, which would be the northern limit of river migration.

The reasoning for having a northern limit of migration is to ensure that the river does not swing all the way into the cove where Scenic Road turns to the west, where beach erosion could cause significant damage to the unprotected bluff and habitat that has established there. It

would also reduce the extent of the bluff toe protection proposed herein, reducing impacts to the environment and minimizing costs.

4.1 Alternative 1 - Revetment (Rip Rap) Located at the Toe of Slope

For an engineered revetment, the armor rock would be placed to a stable slope and with a thickness designed to resist both wave forces and riverine current forces. Placement of the rock would require extensive excavation of the beach, followed by installation of a geotextile fabric laid on the excavated subgrade. Two layers of armor rock (1/2 to 1 ton size) would be placed over the fabric and the excavated sand would be re-placed over the rock. Plan and section view graphics of the revetment structure are provided in Figures 12 through 15. The rock would remain hidden from view during most of the year and would be exposed only during significant events. The elevations shown on Figures 12 through 15 reflect this desire to keep the rock revetment buried for most of the year unless exposed when the river migrates to the north.

Constructing a rock revetment has several significant benefits:

Minimized Cost – Installation of the armor rock involves excavation, placement of rock, and backfill. The methods of performing these operations are standard in the marine construction industry, and can be performed by a number of marine contractors, leading to a relatively predictable cost of construction.

Flexibility - Rock can be constructed to conform to a varying subgrade. This is especially beneficial when encountering a non-uniform marine terrace formation. The completed revetment can also adjust to localized scour by self-launching rock from the revetment toe into the scoured area.

Energy Dissipation - Rock has the ability to dissipate energy due to wave or currents.

Reparability – Additional rock can be added to the revetment to rebuild portions that are damaged by large storm events or to restore areas that self-launched rock into scour holes.

Visual Appearance – Although large rock is not naturally present at the site, it is a more natural appearing material than standard concrete or steel. Rock also allows local sand to fill the void spaces and have a lesser impact on aesthetics.

4.2 Alternative 2 - Seawall Located at Toe of Slope

This engineered structure would act as a retaining wall, supporting the loads on the landside of the wall. Plan and section view graphics of the seawall option are provided in Figures 16 through 18. This wall can be cantilevered or include tiebacks for additional capacity if necessary. The wall would extend to a depth sufficient to support the loads and ensure stability under various load conditions. The wall would be designed and constructed such that it would be completely buried for most of the year, and would only be exposed during large riverine flow events or large wave events. Once the event has passed, normal wave action or mechanical sand movement would re-cover the structure with sand.

A structural seawall alternative has many benefits. It provides a permanent solution with the small footprint, leaving the upper bluff untouched and providing a substantial beach width for riverine flow and beach users. However, it will also have one of the highest costs of any alternative, and will create barriers to access and safety when the beach is eroded from the toe; a potentially 10-ft high vertical drop will exist if river flows to the north scour away the bluff toe. Additionally, the visual appearance of a vertical wall may be undesirable to the public and to stakeholders.

There are numerous types of walls that can be used based on the site-specific conditions, performance criteria, and other constraints such as cost and permitting. At a minimum, the following issues will be addressed during the type-selection process:

Geotechnical Conditions: The depth and location of the dense marine terrace material, water table depth, and the properties of the beach sand will have a profound impact on the type of wall that can be constructed.

Construction Method – driven piles or drilled piles. This will be largely determined by the geotechnical conditions.

- Driven Wall Type: This type of wall consists of steel piles driven by an impact hammer into the subgrade material. Sheet pile walls use interlocking Z- or U-shaped sheets to create a uniform, continuous wall. Soldier pile walls use heavier structural shapes such as H-piles or wide-flange beams/columns driven at specified intervals; the gaps between the soldier piles are subsequently filled with lagging panels or a structural facing such as shotcrete.
- Drilled Wall Type: There are many types of drilled wall that can be constructed. Some are standard in the construction industry, while others are proprietary and require specialized equipment and materials. Although not an exhaustive list, below are some examples of the options available for a drilled wall:
  - Secant/Tangent Pile Wall (cantilever)
  - Soldier Pile Wall reinforced with steel H-pile (cantilever or tied back);
  - Jet Grout Piles reinforced with H-piles (cantilever);
  - Cast-in-Drilled-Hole (CIDH) pile wall with full-length casing (cantilever or tied back);
  - Continuous Flight Auger Pile Wall, reinforced with steel H-pile (cantilever);
  - Other options.

In each of the drilled wall types above, the wall would be constructed while the beach has a relatively flat surface suitable for staging of drilling equipment. To determine the preferred wall type, an evaluation of each type would include the ability of the wall to be built through an upper layer of loose beach sand, a lower layer of marine terrace material, and a high water table.

Material Type: Steel or Concrete – Due to the marine environment, steel H-piles or sheet piles must be coated to prevent corrosion or oversized to allow corrosion to occur without compromising structural integrity. However, coating can be damaged during driving operations; coatings for drilled piles are less likely to be damaged during installation. A concrete wall may be used for drilled-pile walls (too large for driving through hard material). Because the wall will be in bending, steel reinforcement is needed; typically this is done with a wide-flange structural steel member such as an H-pile, but a reinforced steel (rebar) cage can also be used.

Cost Considerations – The various types of seawall have significant cost implications and a cost-benefit analysis may be necessary to reach a preferred solution if the seawall alternative is selected.

4.3 Alternative 3 - Reinforced Earth Wall Located at Mid-Slope

Rather than supporting the bluff, this type of slope protection improves the ability of the bluff to support itself by inserting hundreds of tiebacks and creating a mass of reinforced in-situ

material extending beyond the slip-failure plane. The tiebacks work together with a sloped structural facing (typically shotcrete) to provide a stable bluff with a minimum impact on the visual appearance of the improvements. Plan and section view graphics of the reinforced earth option are provided in Figures 19 through 21.

A top-down, tiered construction method is utilized. The uppermost portion of the slope is excavated to the desired slope angle and the facing is constructed. Tiebacks – typically soil nails or grouted anchors – are installed, and the excavation continues to the next tier down. Unlike the toe wall alternatives, after river scouring the normal wave action would only partially re-cover the wall with sand leaving the top portion of the wall exposed. As such, an architectural facing would be applied to the wall, to give it a more pleasing and natural appearance.

A reinforced earth alternative has several benefits:

Low Cost – The facing will extend only a few feet below the anticipated limit of scour, which minimized the overall area of bluff to be stabilized to a vertical height of 15- to 20-ft at minimum (or a maximum of 40-ft if the entire bluff is to be stabilized).

Flexibility – The facing can be conformed to a varying surface, and can be easily adjusted in the field.

Visual Appearance – The facing can be sculpted to appear similar to naturally-occurring rock formations and greatly improve aesthetics.

There are significant issues to resolve for a reinforced earth alternative, including the following:

- Bluff material properties – If the bluff consists of running/caving sands and cannot support itself prior to application of the facing, this alternative may be infeasible. Loose bluff material will also make the facing construction and tieback installation challenging.
- Changing bluff toe conditions – The duration of construction may also change the toe conditions after the upper slope is complete, creating a change of site conditions (this may be mitigated by a temporary sheet pile wall along the toe).
- Utilities – The installation of tiebacks beneath a city street may impact existing underground utilities, and will hinder future underground or utility work.

4.4 Alternative 4 - Pile Wall Located at Top of Slope

Similar to the seawall alternative, a high retaining wall could be constructed along the edge of Scenic Road and within (or very near to) the right-of-way. The height of such a wall would be approximately double that of the seawall constructed at the toe of slope and would range from 30 to 40-ft in retained height. This type of wall would be constructed of a secant or tangent pile wall system embedded into the marine terrace layer and tied back with earth anchors attached at the top of the wall; tieback anchors will extend under Scenic Road. Plan and section view graphics of the pile wall are provided in Figures 22 and 23.

The wall would be completely buried until large riverine flow events or large wave events scour away the bluff toe. As the bluff toe scours, more of the pile wall becomes visible; eventually the entire retained height could conceivably be exposed. Unlike the seawall toe wall alternatives, after the storm event has passed, normal wave action or mechanical sand movement would only partially re-cover the pile wall with sand, leaving the top portion visible.

Because the pile wall may not be re-covered by the sand, it may be desirable to apply an architectural facing on the pile wall after it has been exposed. The facing would require doweling of short anchors into the concrete piles, placement of rebar mats, and shotcrete

application. Additionally, the shotcrete can be troweled and stained to provide a natural appearance.

This alternative provides a permanent solution with the smallest footprint, providing the maximum beach width for riverine flow and beach users. It will also have the highest cost of any alternative, and will create significant barriers to beach access and safety once the beach is eroded from the toe; a potentially 30- to 40-ft high vertical drop will exist if river flows to the north scour away the bluff toe. As with the seawall alternative, the visual appearance of a vertical wall may be undesirable to the public and to stakeholders.

5. REFERENCES

1. Barnard, P. L., Hansen, J. E., & Erikson, L. H. (2012). Synthesis Study of an Erosion Hot Spot, Ocean Beach, California. Journal of Coastal Research, 283, 903–922. doi:10.2112/JCOASTRES-D-11-00212.1
2. Bosboom, J., & Stive, M. J. F. (2010). Coastal Dynamics 1: Lecture notes CT4305. Delft, the Netherlands: Delft University of Technology, Faculty of Civil Engineering and Geosciences, Section of Hydraulic Engineering.
3. Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT). 2010. State of California Sea-Level Rise Interim Guidance Document. <http://http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20100911/14.%20SLR/1011_COPC_SLR_Interim_Guidance.pdf>.
4. County of Monterey, U.S. Army Corps of Engineers, & National Marine Fisheries Service. (2012). Memorandum of Understanding regarding Flood Prevention and Habitat Protection at the Carmel Lagoon.
5. Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon. (2007). (Author unknown)
6. Howell, Buford F., Naval Postgraduate School. (1972) Sand Movement Along Carmel River State Beach, Carmel, California. Naval Postgraduate School. September.
7. James, G. W. (2005). Monterey Peninsula Water Management District, Technical Memorandum 05-01: Surface Water Dynamics at the Carmel River Lagoon, Water Years 1991 through 2005.
8. Kraus, N. C., Patsch, K., & Munger, S. (2008). Barrier beach breaching from the lagoon side, with reference to Northern California. Shore and Beach, 76(2), 33–43.
9. Laudier, N. A. (2009). Wave Overtopping of a Barrier Beach. thesis submitted to Naval Postgraduate School, Monterey, CA.
10. Monterey County Public Works (MCPW). (2005). Sand Bar Survey. May 25.
11. MCPW. (2005). Sand Bar Survey. October 4.
12. MCPW. (2006). Sand Bar Survey. April 18.
13. MCPW. (2007). Sand Bar Survey. October 2.
14. MCPW. (2008). Sand Bar Survey. October 30.
15. MCPW. (2010). Sand Bar Survey. January 15.
16. Moreno, L. J., & Kraus, N. C. (1999). Equilibrium Shape of Headland-Bay Beaches for Engineering Design. Coastal Sediments ’99 (pp. 860–875). ASCE.
17. NOAA Navigation Chart #18686, Pfeiffer Point to Cypress Point, 13th edition, July 17, 1999.
18. Pacific Geotechnical Engineering. (2013). Feasibility Geotechnical Investigation Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California. DRAFT. January 11.
19. Rich, A., & Keller, E. A. (2013). A Hydrologic and Geomorphic Model of Estuary Breaching and Closure. in review.

20. RMC Water and Environment. (2007). Hydrographic Survey and Stage-Volume Relationship. November 29.

21. Silvester, R., & Ho, S. K. (1972). Use of crenulate shaped bays to stabilize coasts. 13th Coastal Eng. Conf. (pp. 1347–1365). ASCE.

22. Thornton, E. B. (2005). Littoral Processes and River Breachings at Carmel River Beach. Naval Postgraduate School, Monterey, CA.

23. Thornton, E. B. (2006). Carmel River Beach Shoreline History. Naval Postgraduate School, Monterey, CA. April 9.

24. Whitson Engineers. (2012). Project Aerial Topographic Map for Scenic Road Bluff Stabilization Project. November 27.

FIGURES

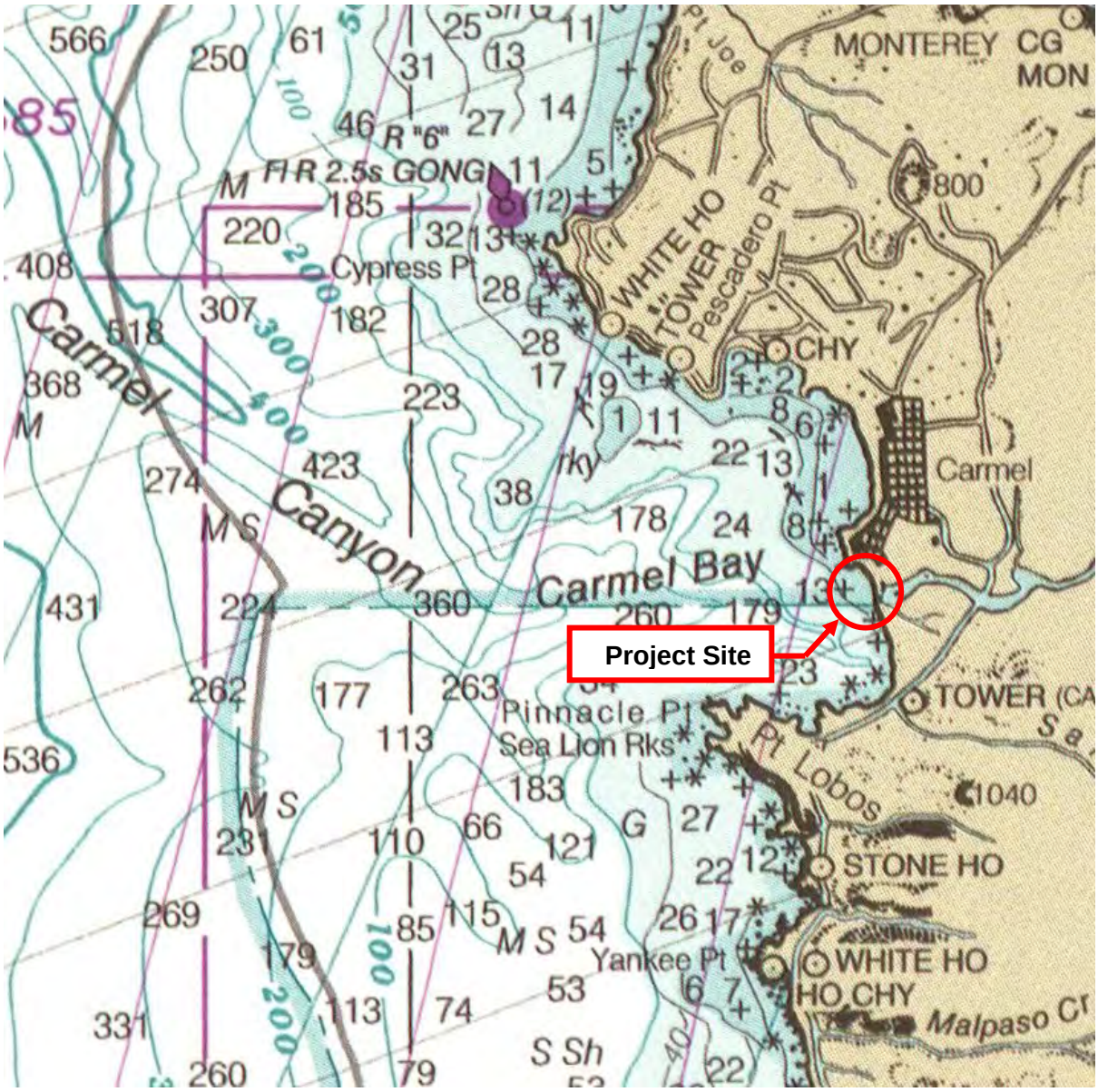


Figure 1: Project Site Overview

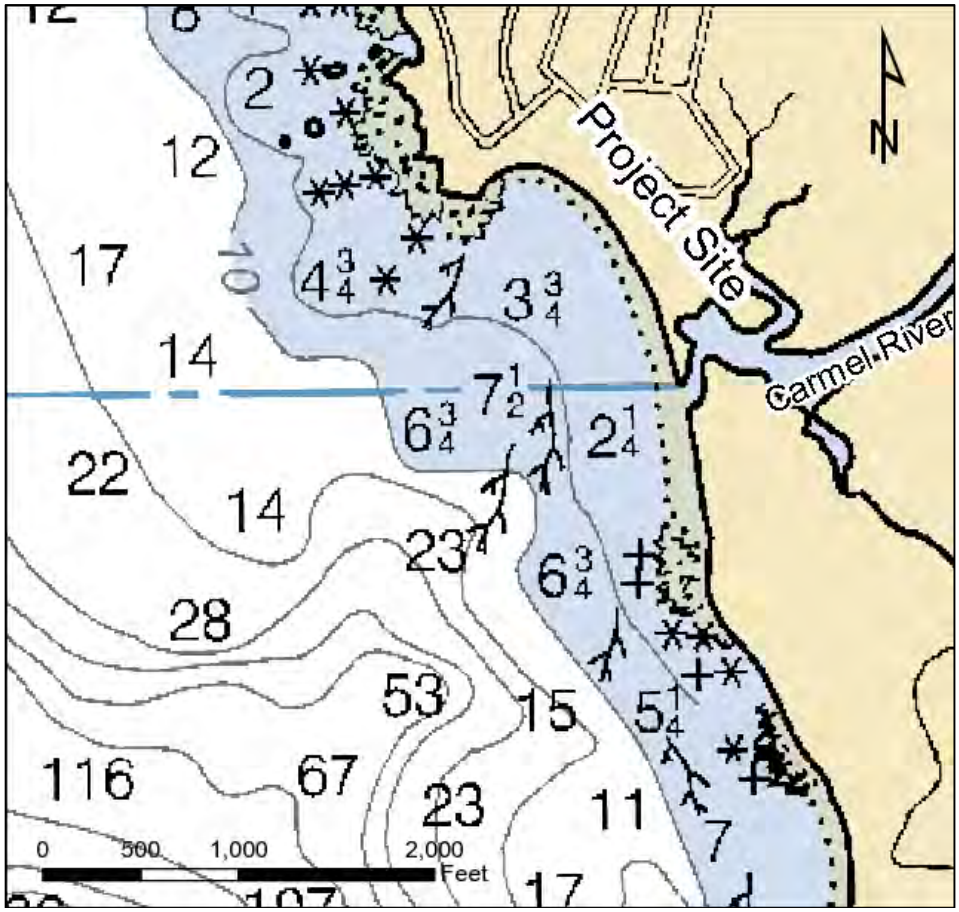


Figure 2: Depths (in fathoms, MLLW) near project site (NOAA Chart)

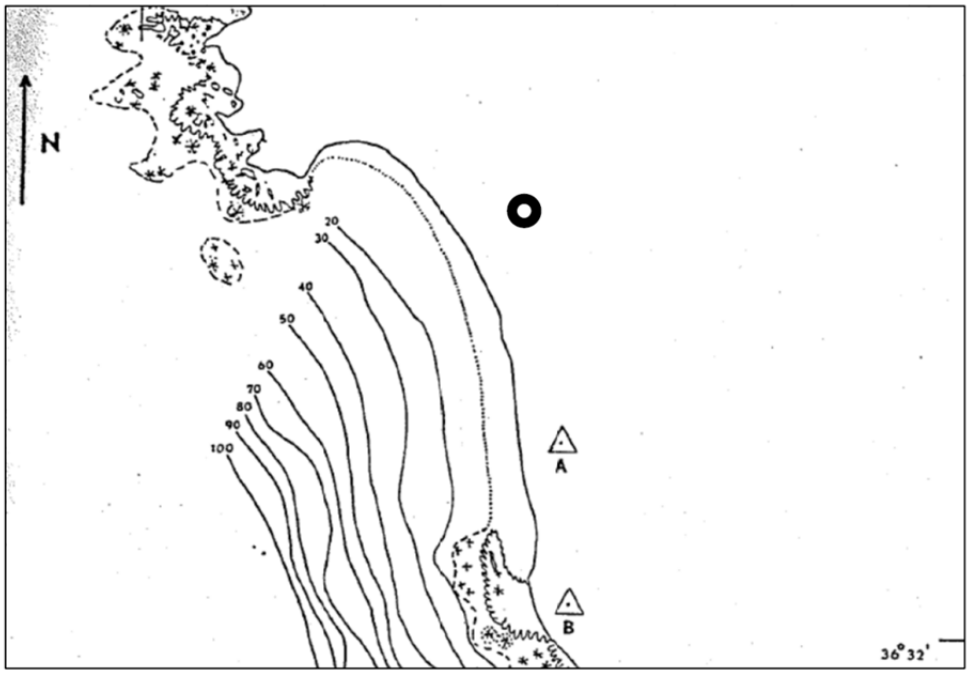
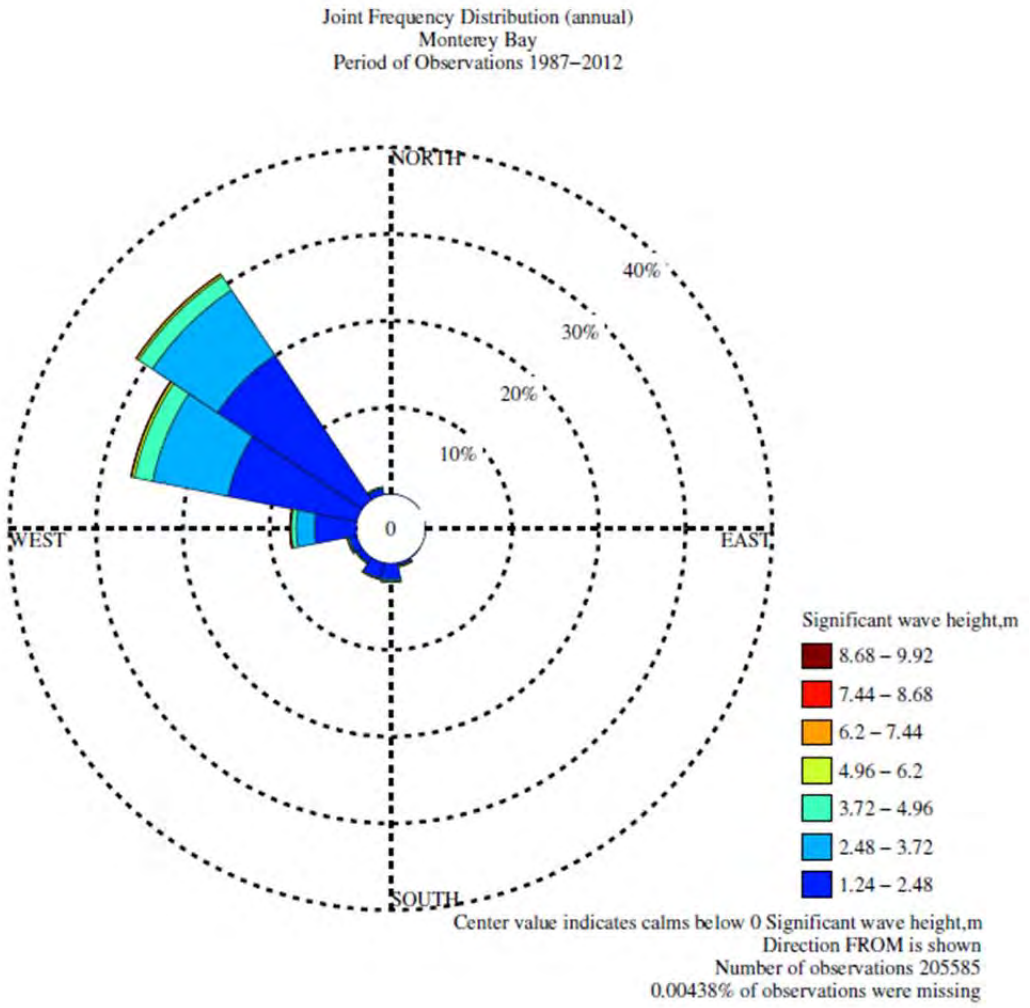


Figure 3: Nearshore Bathymetry (in ft, MLLW)
(Source: Howell, 1972)

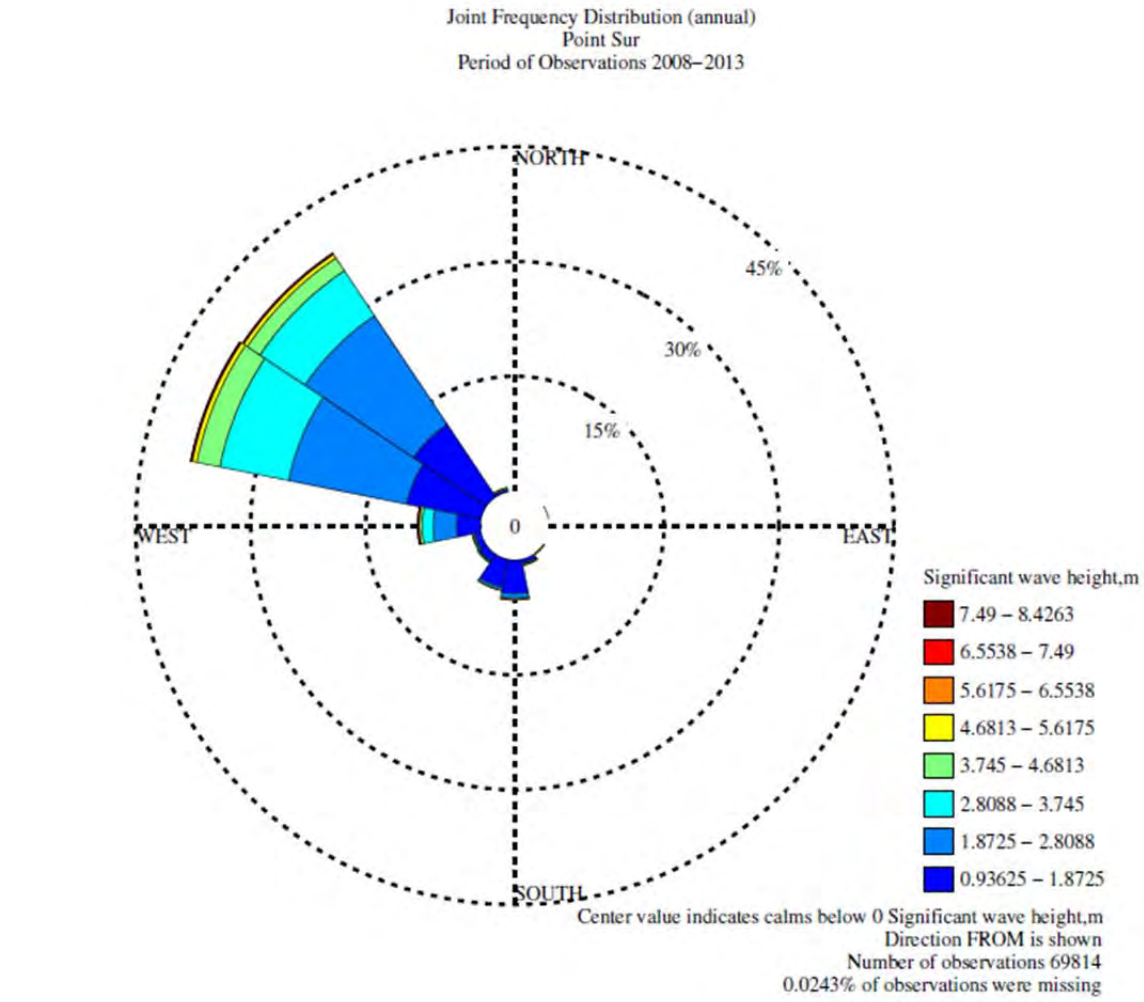


Percentage of Occurrence

Significant wave height,m	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	0.01						0.02	0.73	4.2	4.38	1.87	1.88	10.5	34.7	40.4		100
9.92																	
8.68																	
7.44													0.02	0.01			0.03
6.2													0.07	0.07	0.05		0.2
4.96								0.02	0.03			0.01	0.12	0.42	0.36		0.98
3.72								0.07	0.12	0.04	0.03	0.07	0.67	2.61	2.33		5.93
2.48								0.17	0.33	0.12	0.12	0.28	2.57	10.8	11		25.4
1.24							0.02	0.33	2.17	2.22	0.91	1.03	5.87	18.4	24.4		55.4
0								0.14	1.55	1.99	0.82	0.47	1.18	2.4	2.28		10.9
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total

Figure 4: Wave Conditions (Annual Average) for Monterey Bay (~30 Miles Northwest of Project Site)

Source: Coastal Data Information Program (http://cdip.ucsd.edu) Station 156



Percentage of Occurrence

Significant wave height,m	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total							0.06	0.78	3.31	4.82	1.45	1.24	8.3	38.9	38.4		100
8.426																	0.01
7.49													0.04	0.05			0.09
6.554									0.01				0.07	0.17	0.18		0.43
5.618									0.04				0.14	0.61	0.57		1.38
4.681								0.02	0.05	0.02		0.02	0.38	3.06	1.99		5.55
3.745							0.03	0.09	0.09	0.03	0.05	0.12	1.4	9.16	7.08		18
2.809							0.02	0.19	0.64	0.4	0.21	0.25	3.06	15.7	17.1		37.6
1.873								0.47	4.39	3.7	1.09	0.8	3.12	9.89	11.4		34.9
0.9363									0.29	0.67	0.09	0.05	0.1	0.18	0.09		1.49
0																	

Figure 5: Wave Conditions (Annual Average) for Point Sur (~50 Miles South of Project Site)

Source: Coastal Data Information Program (http://cdip.ucsd.edu) Station 156

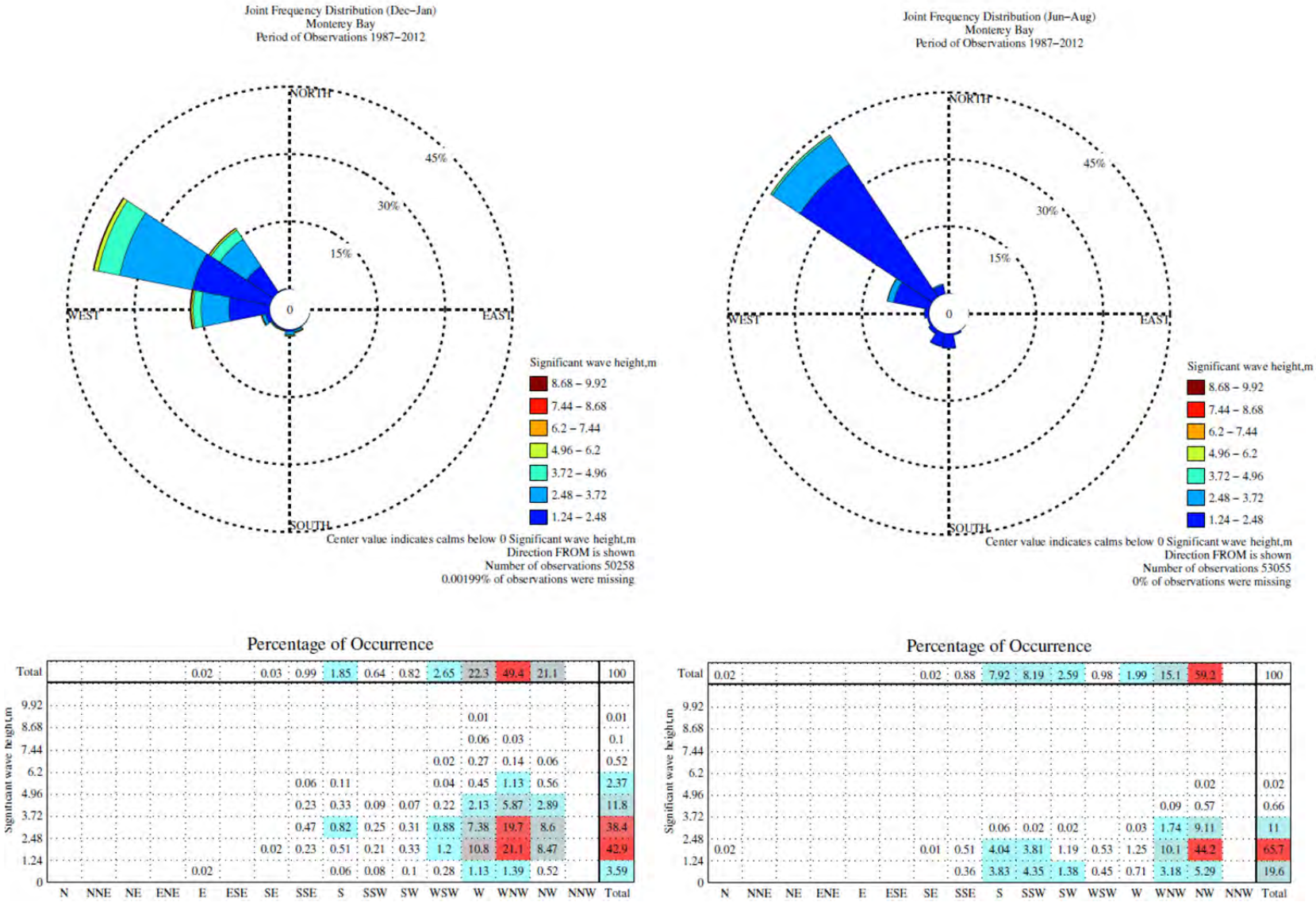


Figure 6: Winter (left) and Summer (right) Wave Height for Monterey Bay

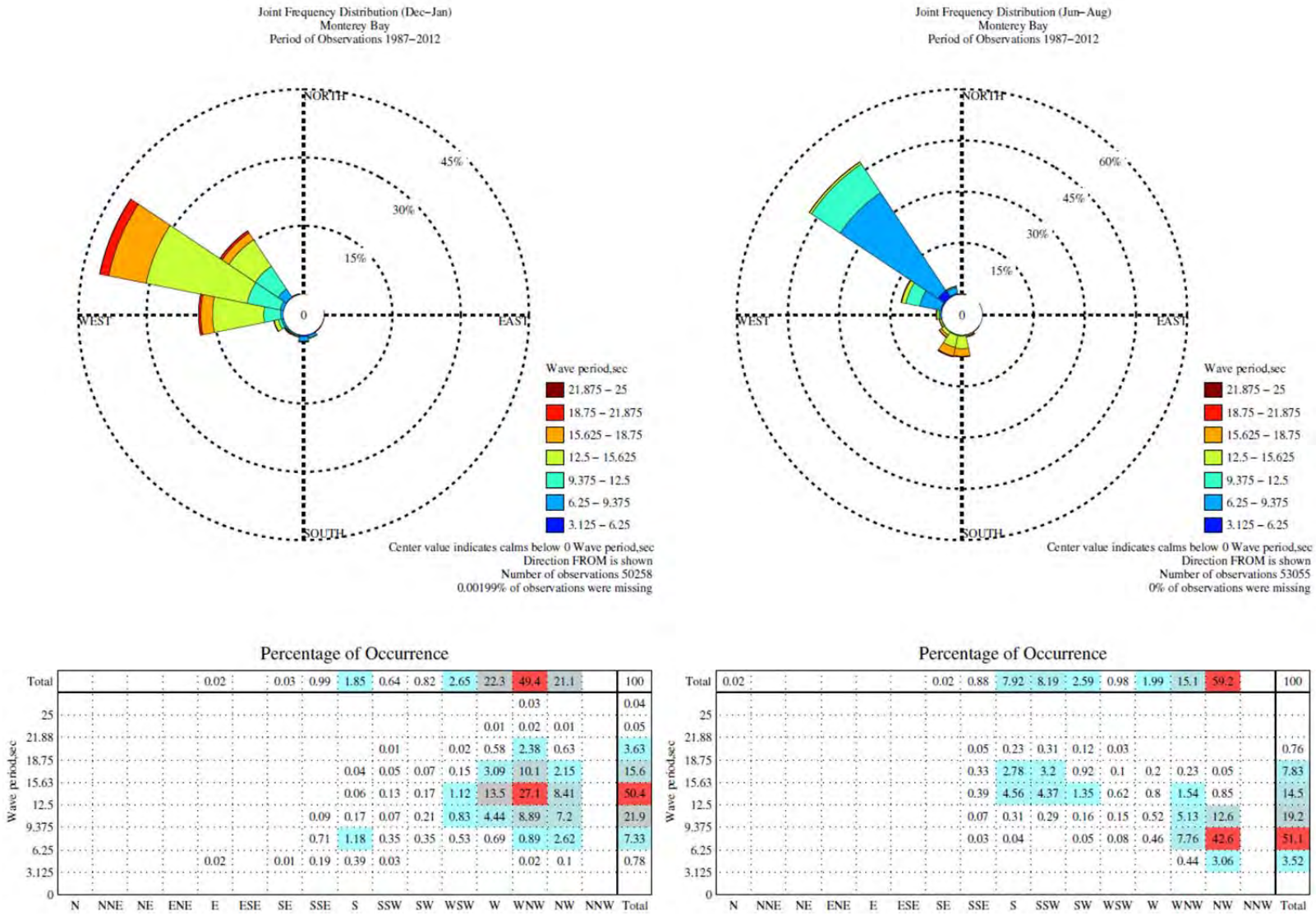


Figure 7: Winter (left) and Summer (right) Wave Peak Period for Monterey Bay

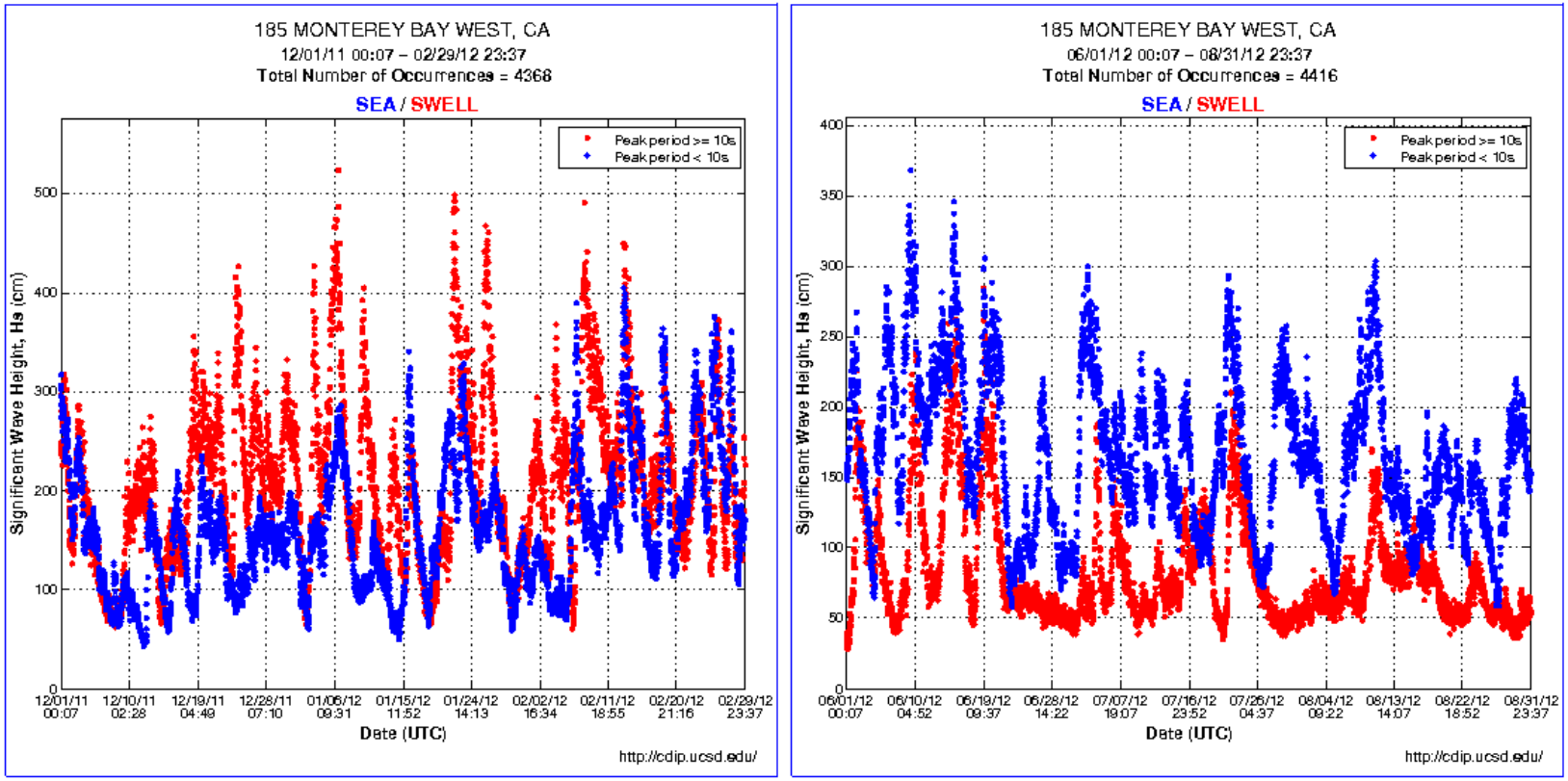


Figure 8: Observed Seasonality in Wave Conditions for Monterey Bay (Winter (left) and Summer (right))

Source: Coastal Data Information Program (http:cdip.ucsd.edu) Station 156

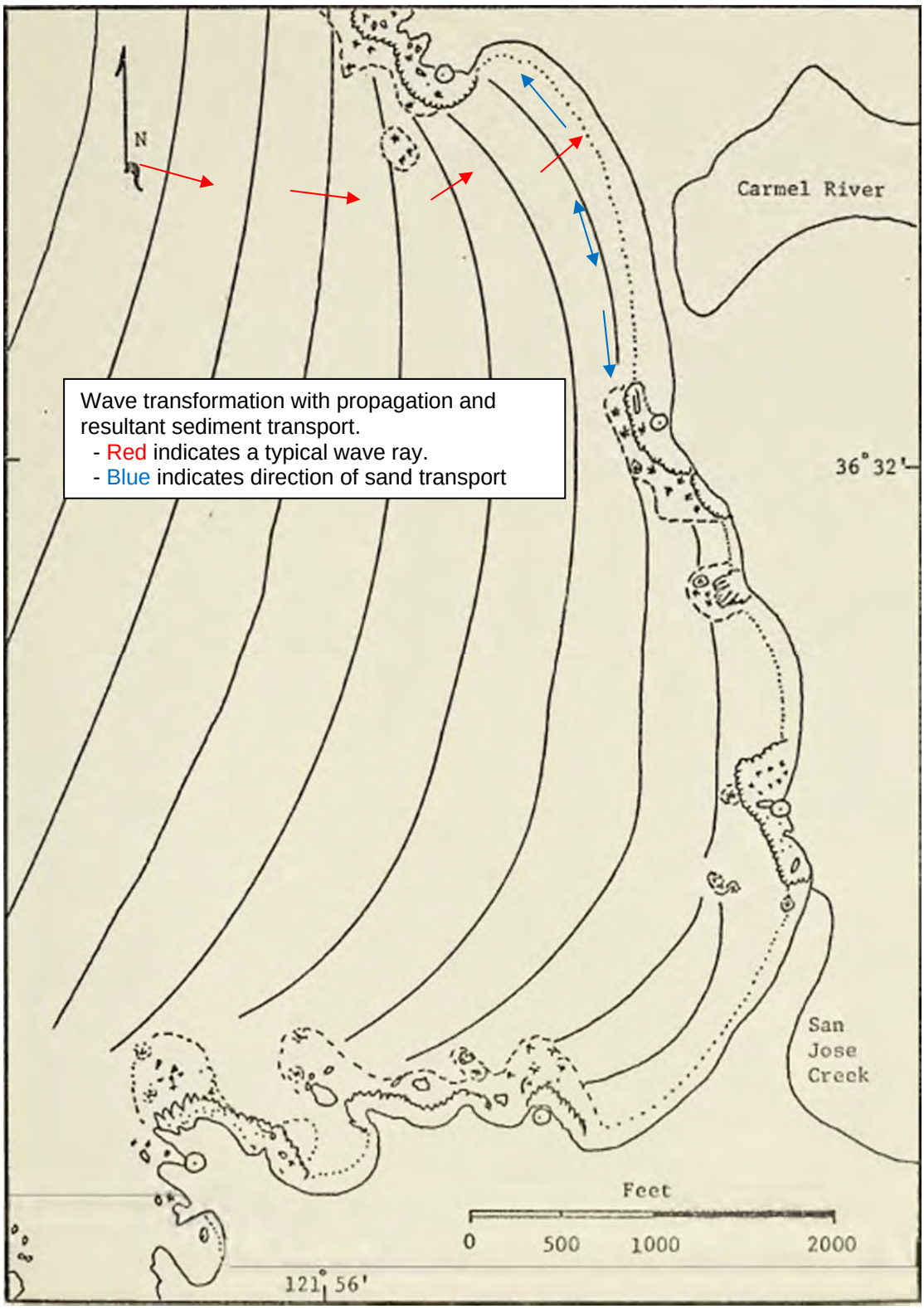


Figure 9: Wave Refraction Diagram for WNW, 11-second Swell (Howell, 1972)

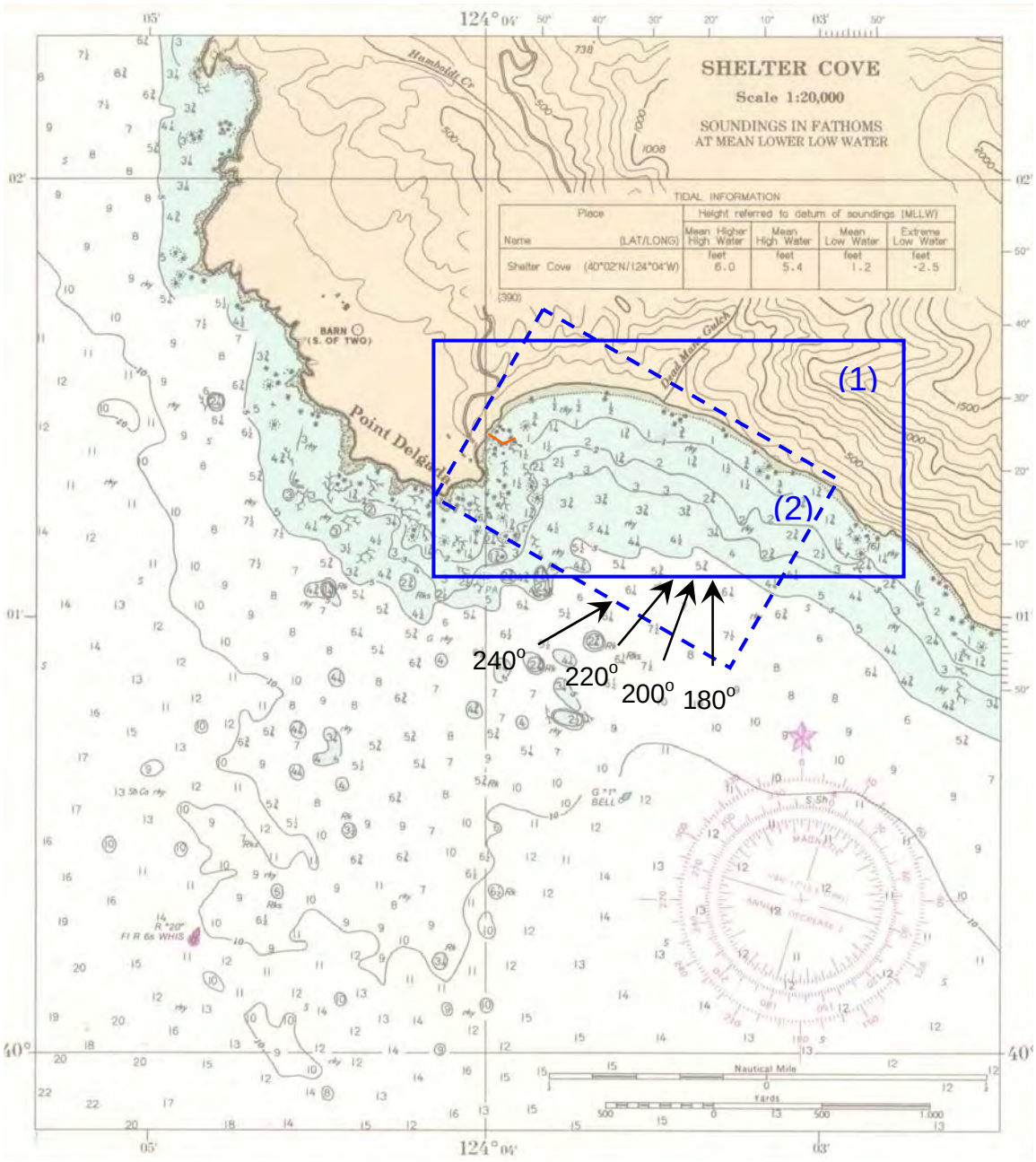


Figure 10: Example of Nearshore Wave Model Domain (PMS Model) for Shelter Cove, Mendocino County

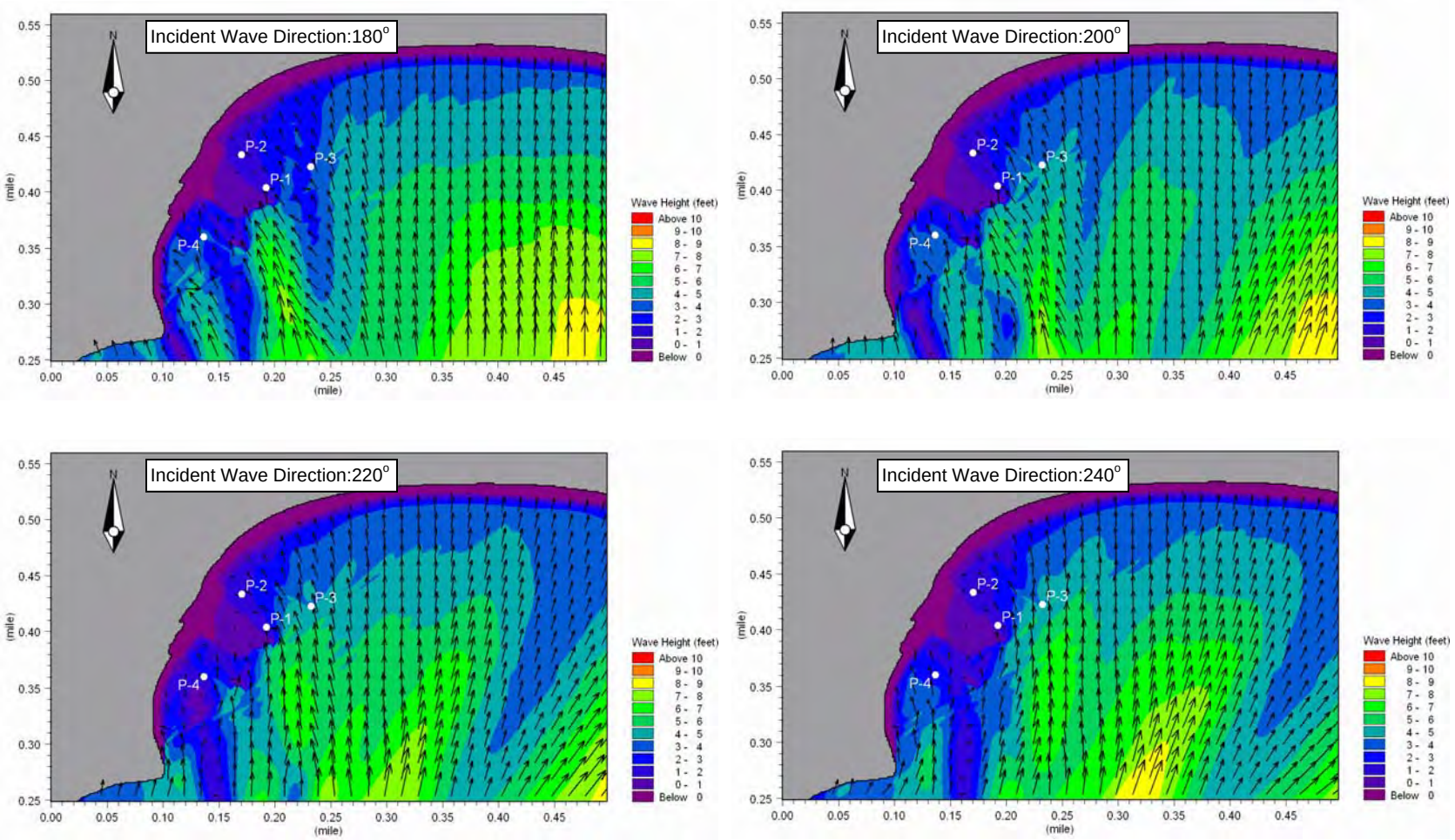
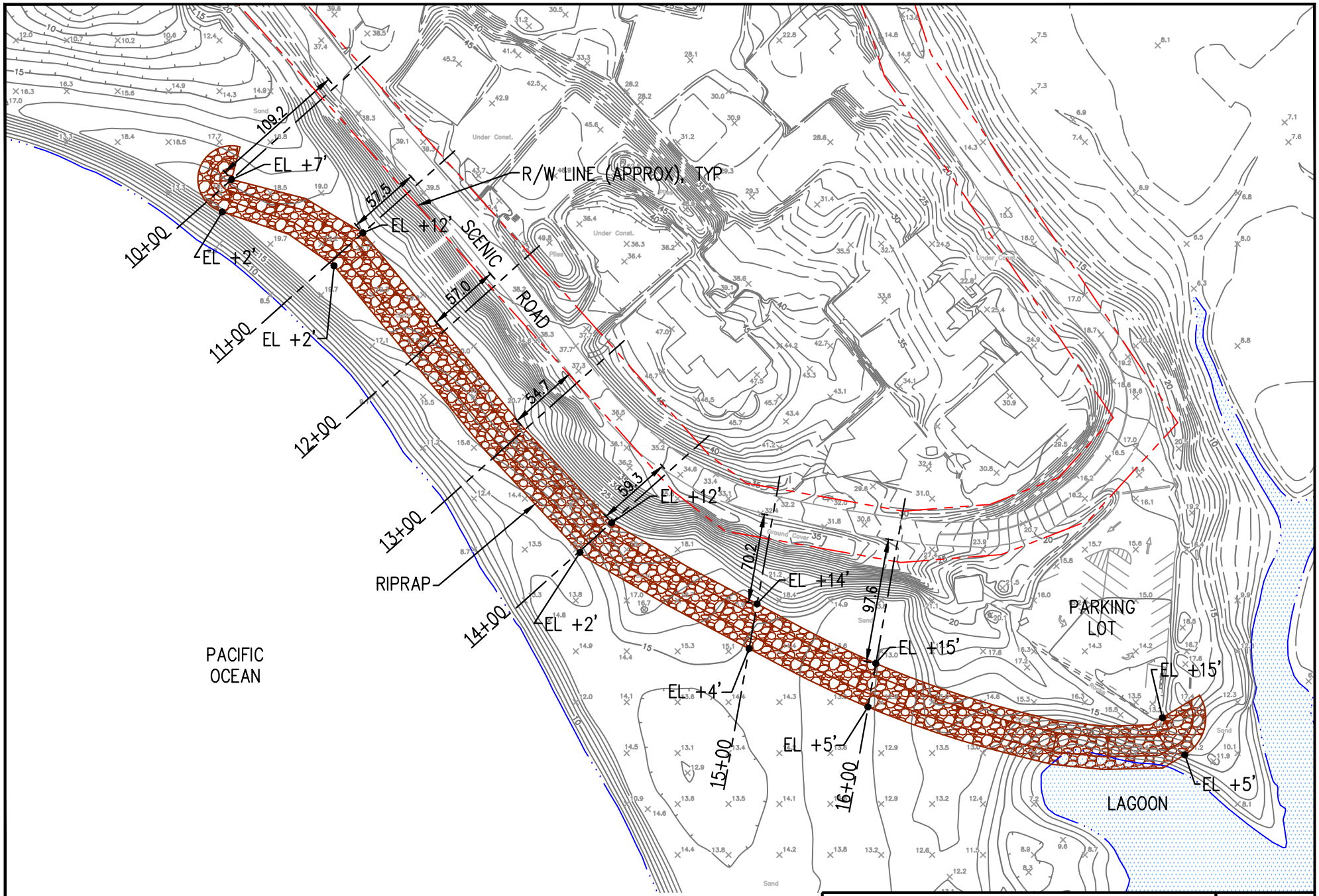


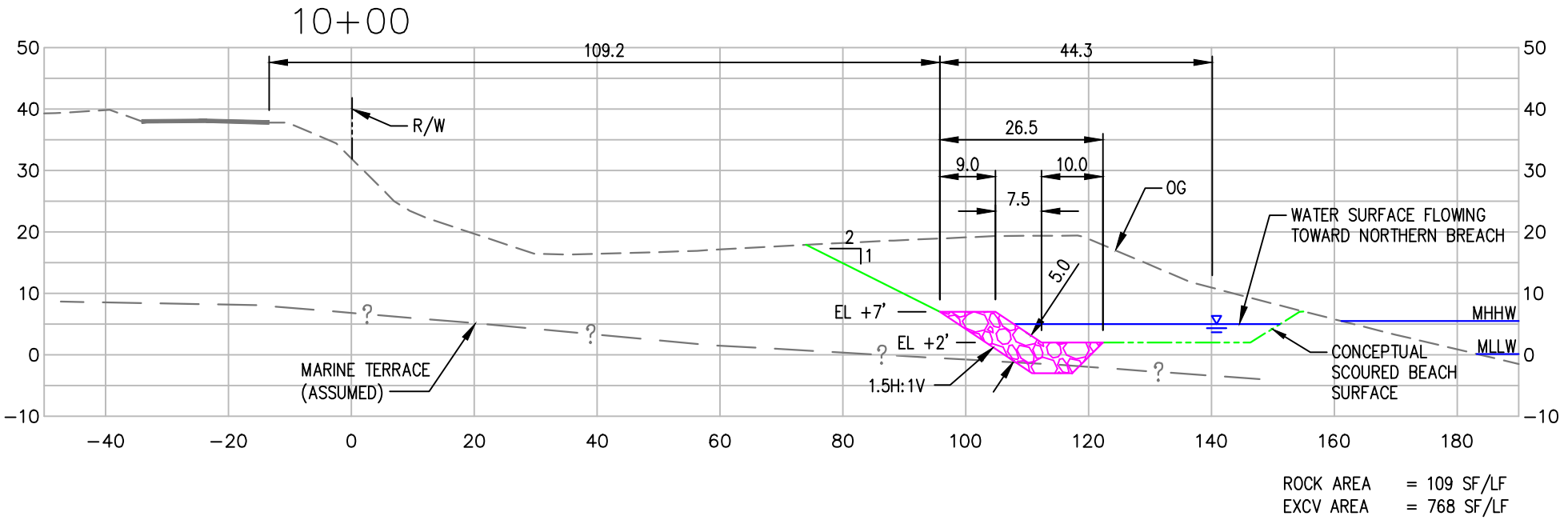
Figure 11: Example of Nearshore PMS Wave Model Results for Shelter Cove, Mendocino County

Note: The 240° wave direction at Shelter Cove (south-facing beach) is analogous with a northwesterly swell at Carmel River State Beach, while an 180° wave direction correlates with a west swell at Carmel River State Beach.



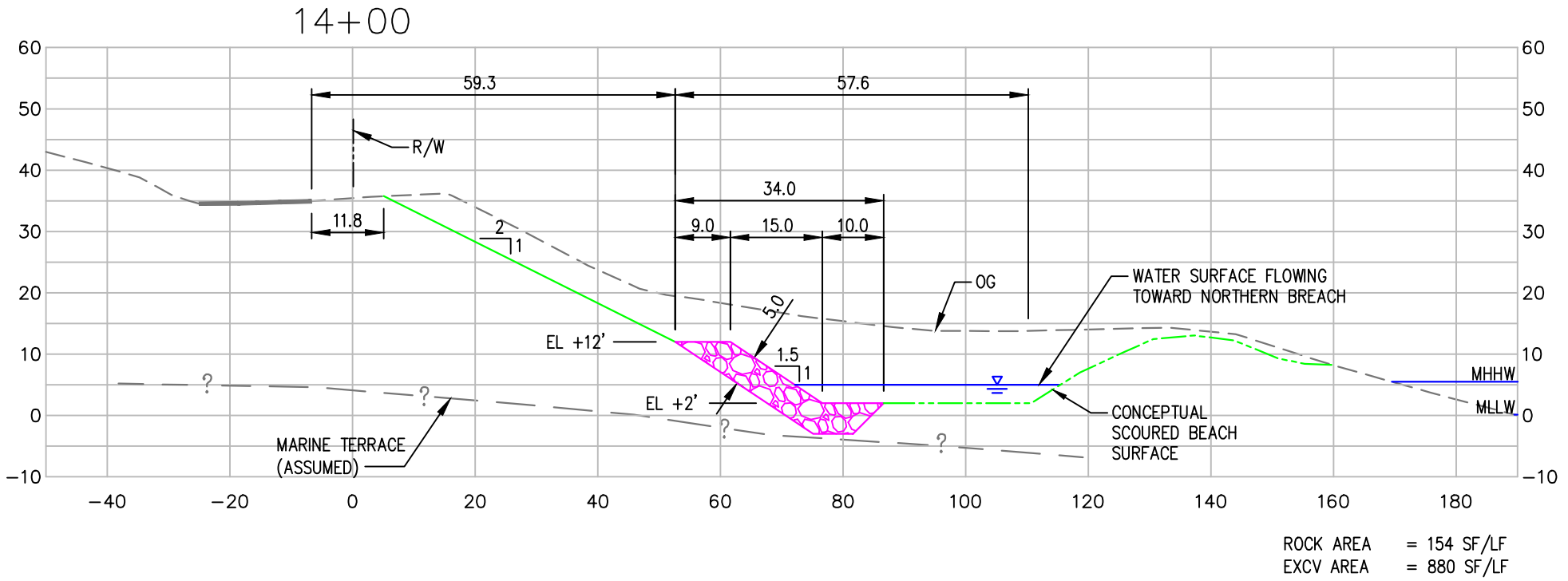
ALTERNATIVE 1 - RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 12
moffatt & nichol	FEB 2013	



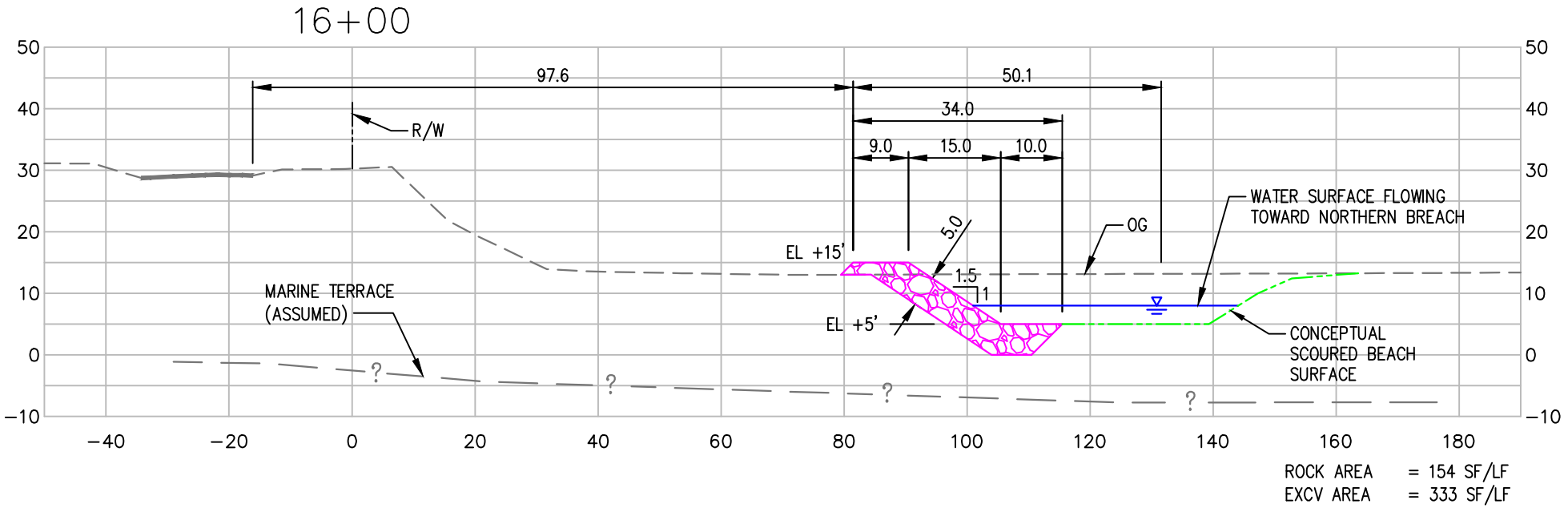
CROSS-SECTION
ALTERNATIVE 1 - RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 13
moffatt & nichol	FEB 2013	



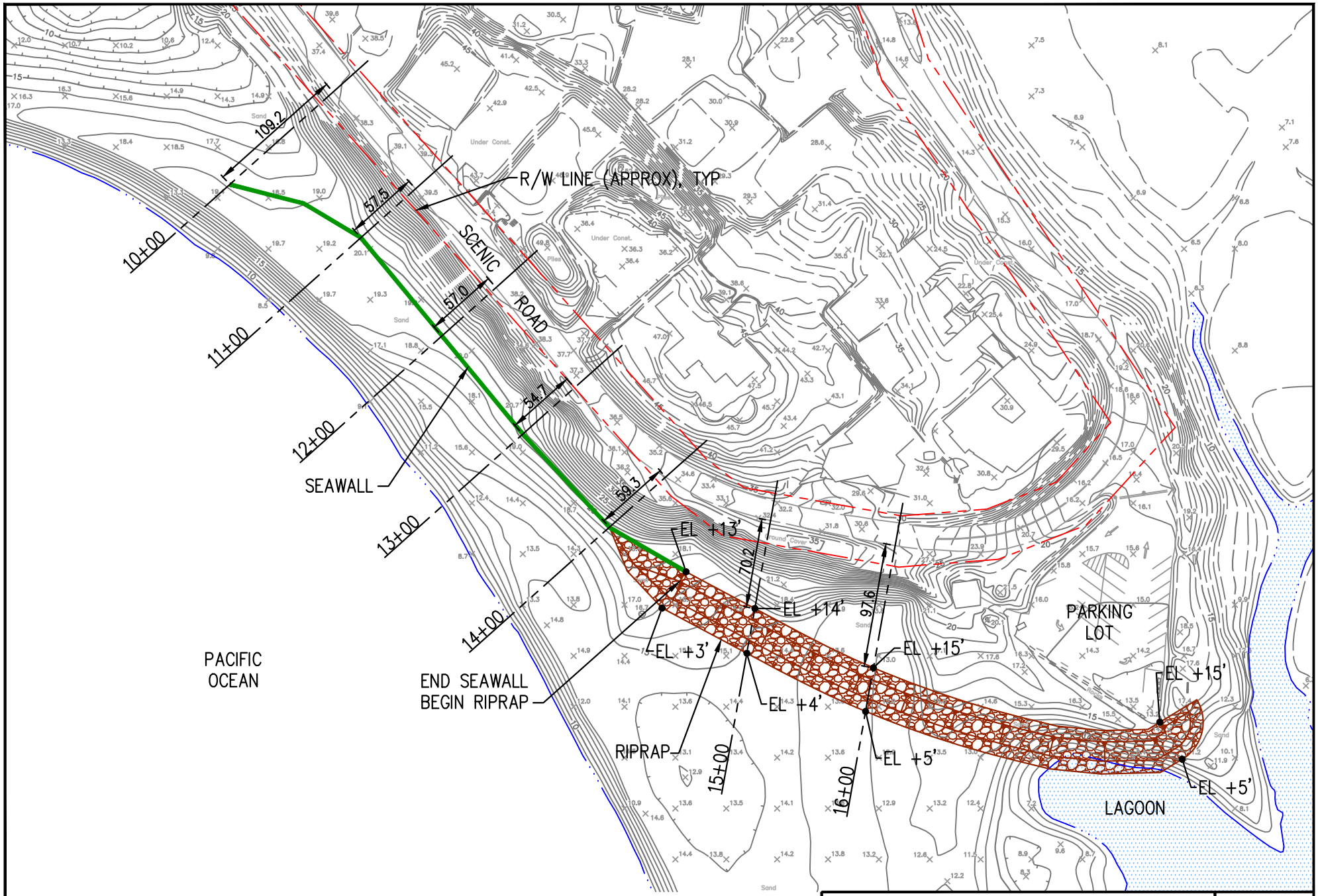
CROSS-SECTION
ALTERNATIVE 1 - RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 14
moffatt & nichol	FEB 2013	



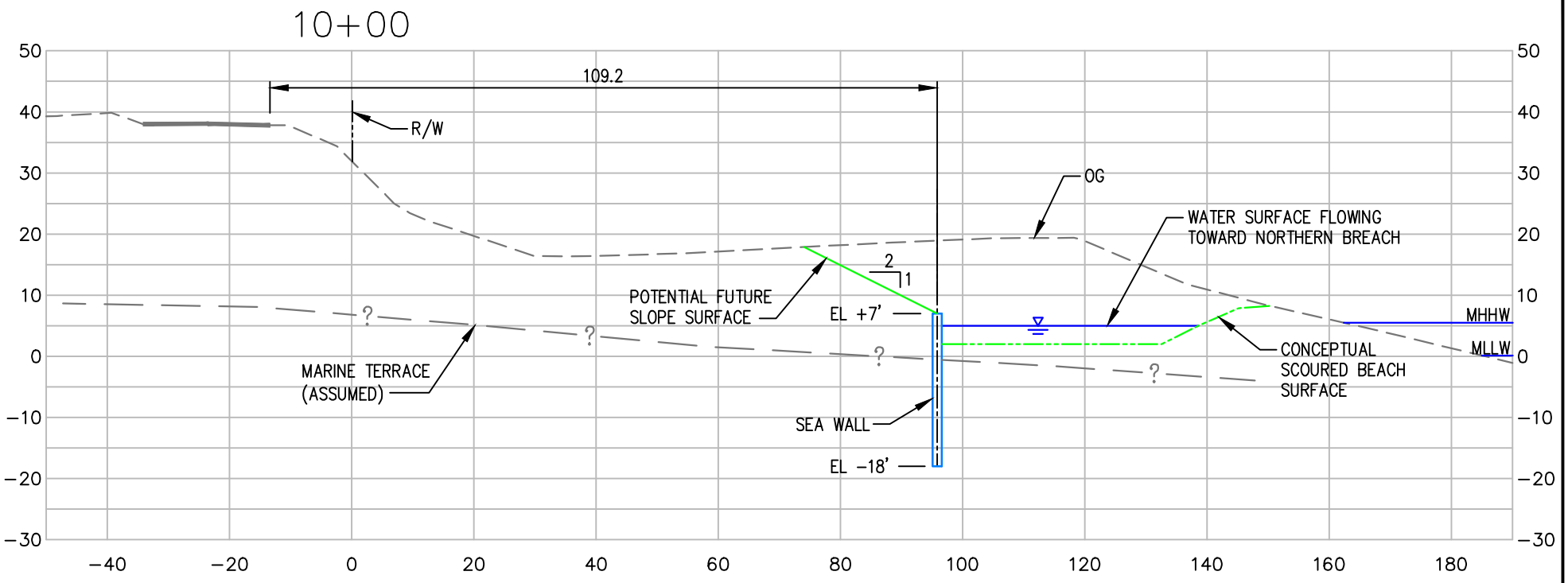
CROSS-SECTION
ALTERNATIVE 1 - RIPRAP
ALTERNATIVE 2 - SEAWALL & RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 15
moffatt & nichol	FEB 2013	



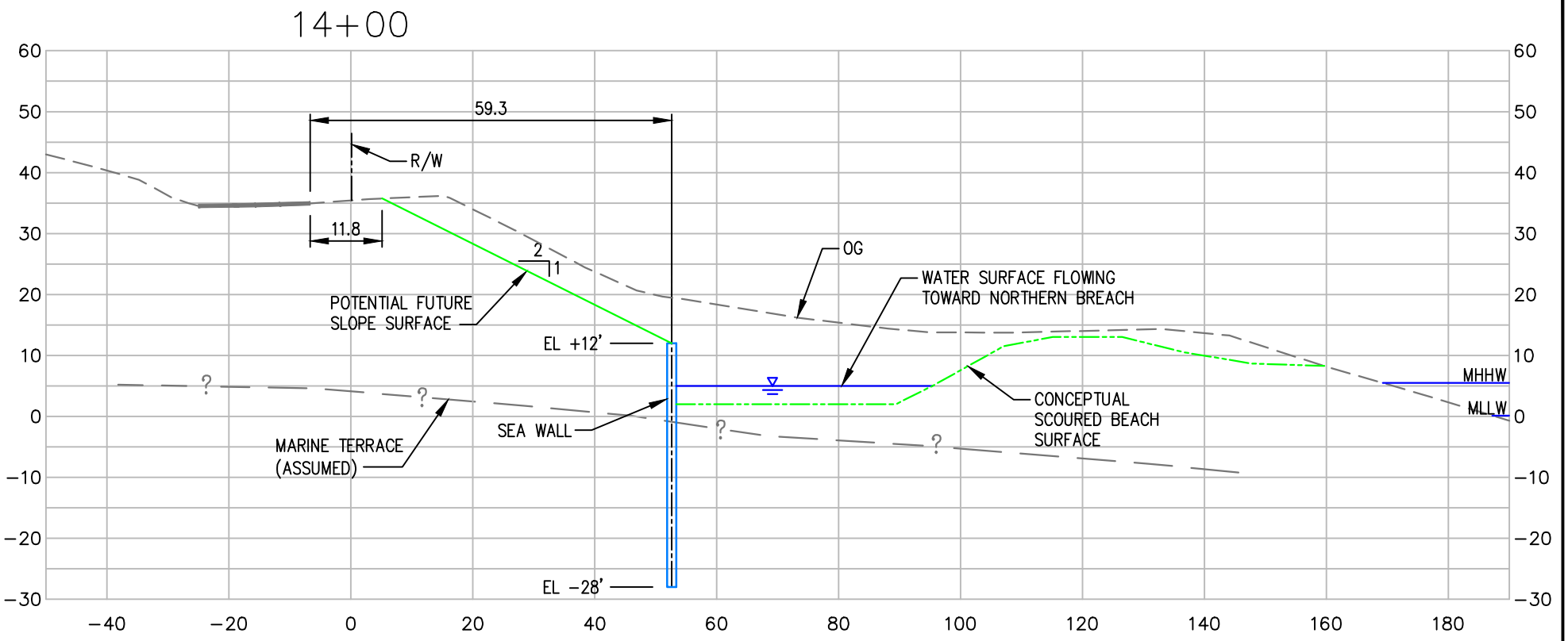
ALTERNATIVE 2 - SEAWALL AND RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 16
moffatt & nichol	FEB 2013	



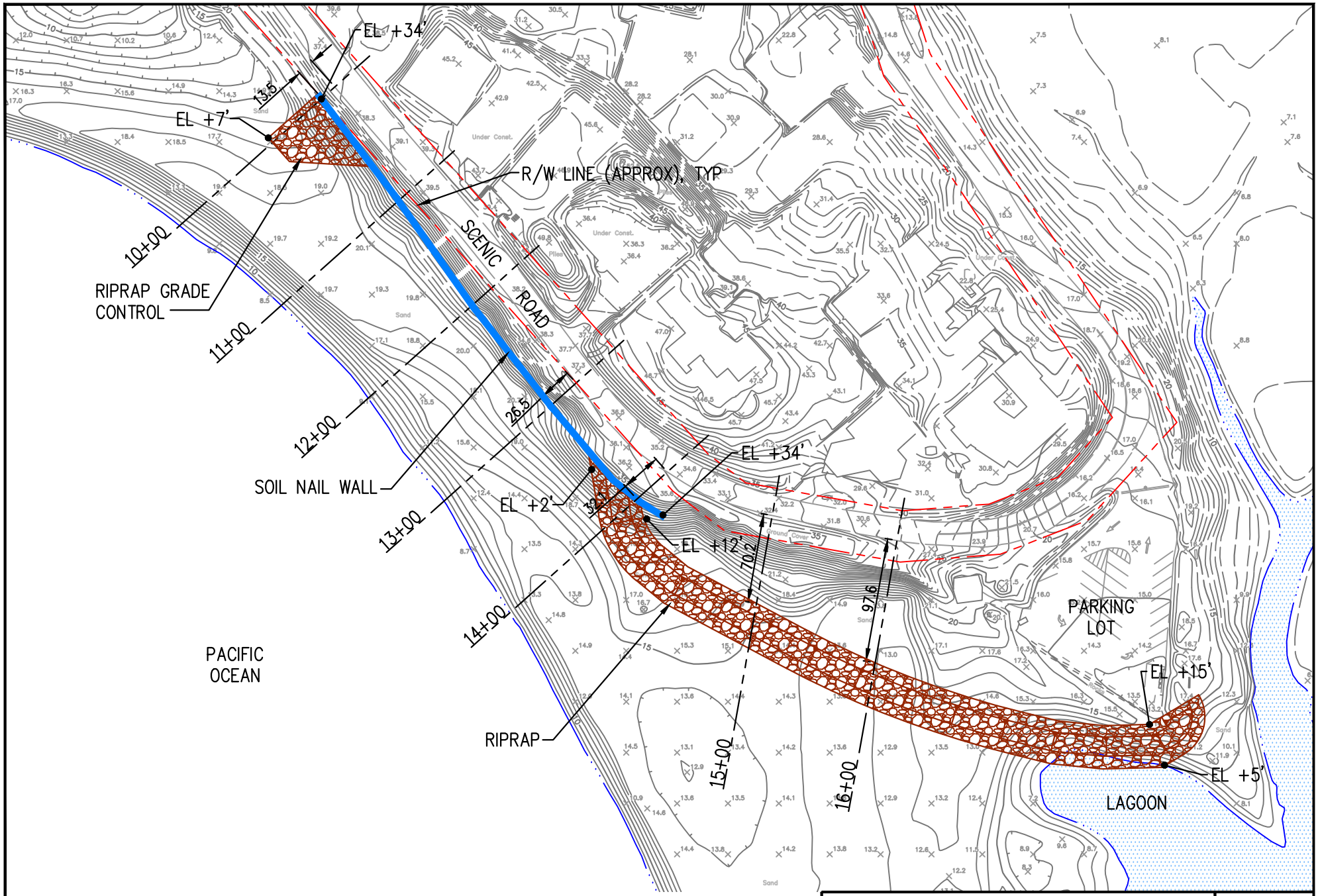
CROSS-SECTION
ALTERNATIVE 2 - SEAWALL AND RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 17
moffatt & nichol	FEB 2013	



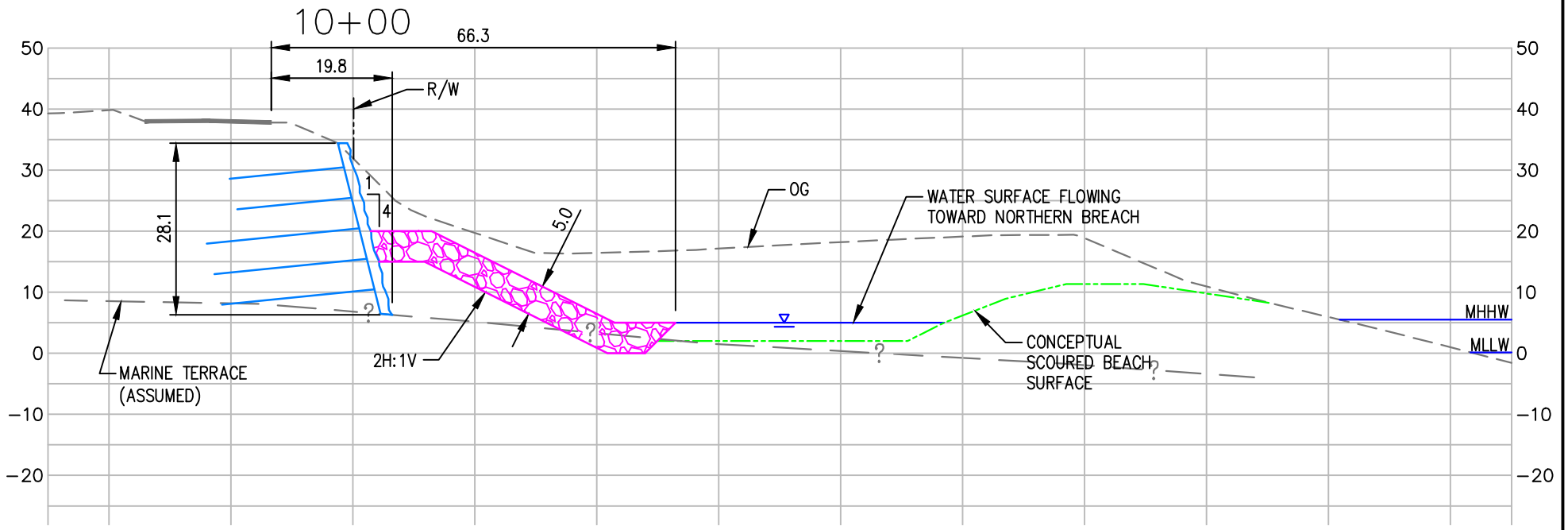
CROSS-SECTION
ALTERNATIVE 2 - SEAWALL AND RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 18
moffatt & nichol	FEB 2013	



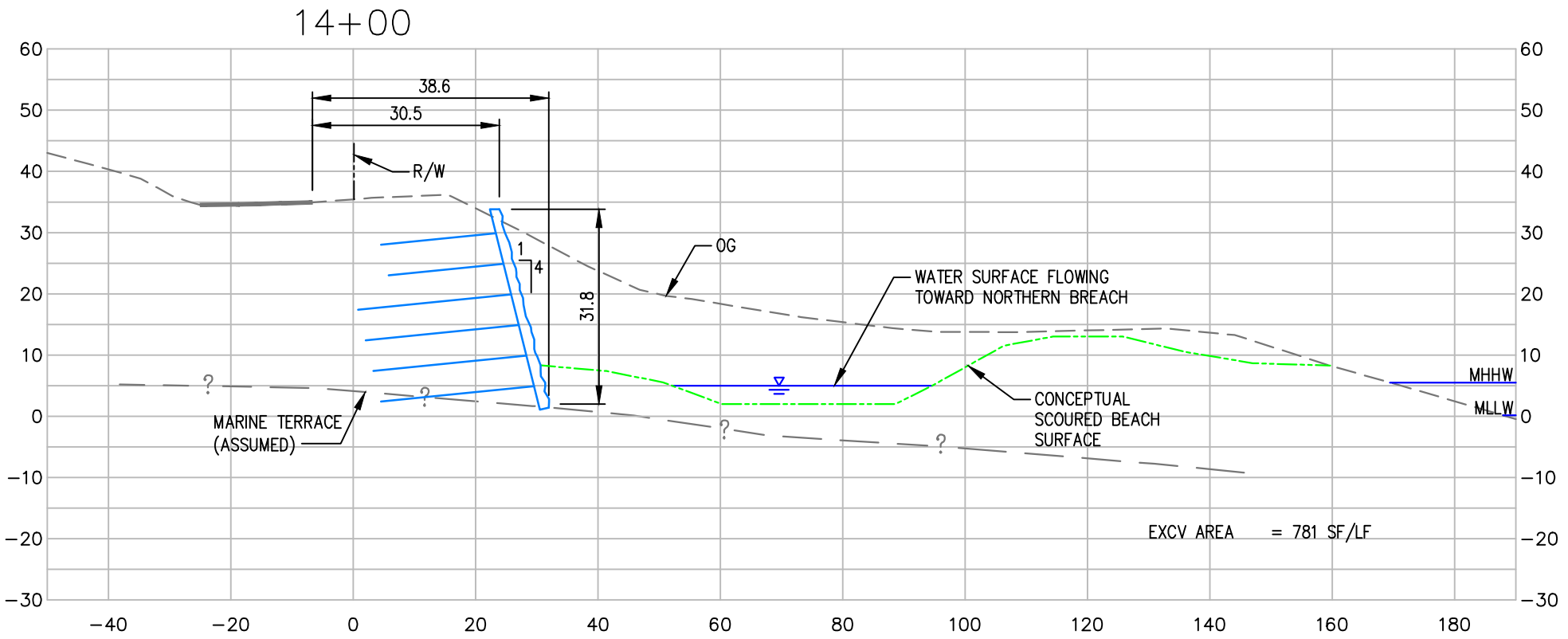
ALTERNATIVE 3 - REINFORCED EARTH & RIPRAP

SCENIC ROAD BLUFF PROTECTION		FIG 19
moffatt & nichol	FEB 2013	



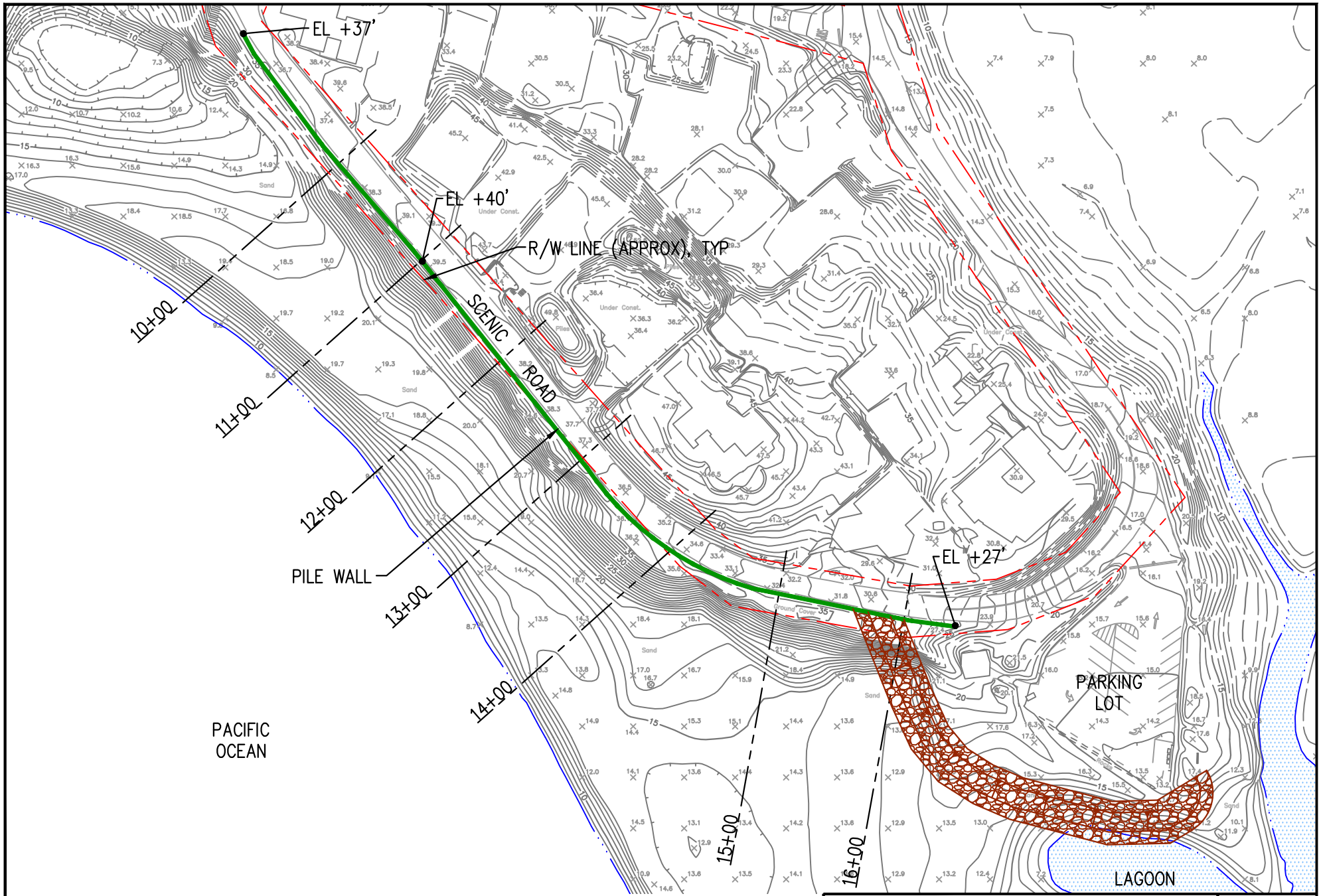
CROSS-SECTION
ALTERNATIVE 3 - SOIL NAIL WALL & RIPRAP GRADE CONTROL

SCENIC ROAD BLUFF PROTECTION		FIG 20
moffatt & nichol	FEB 2013	



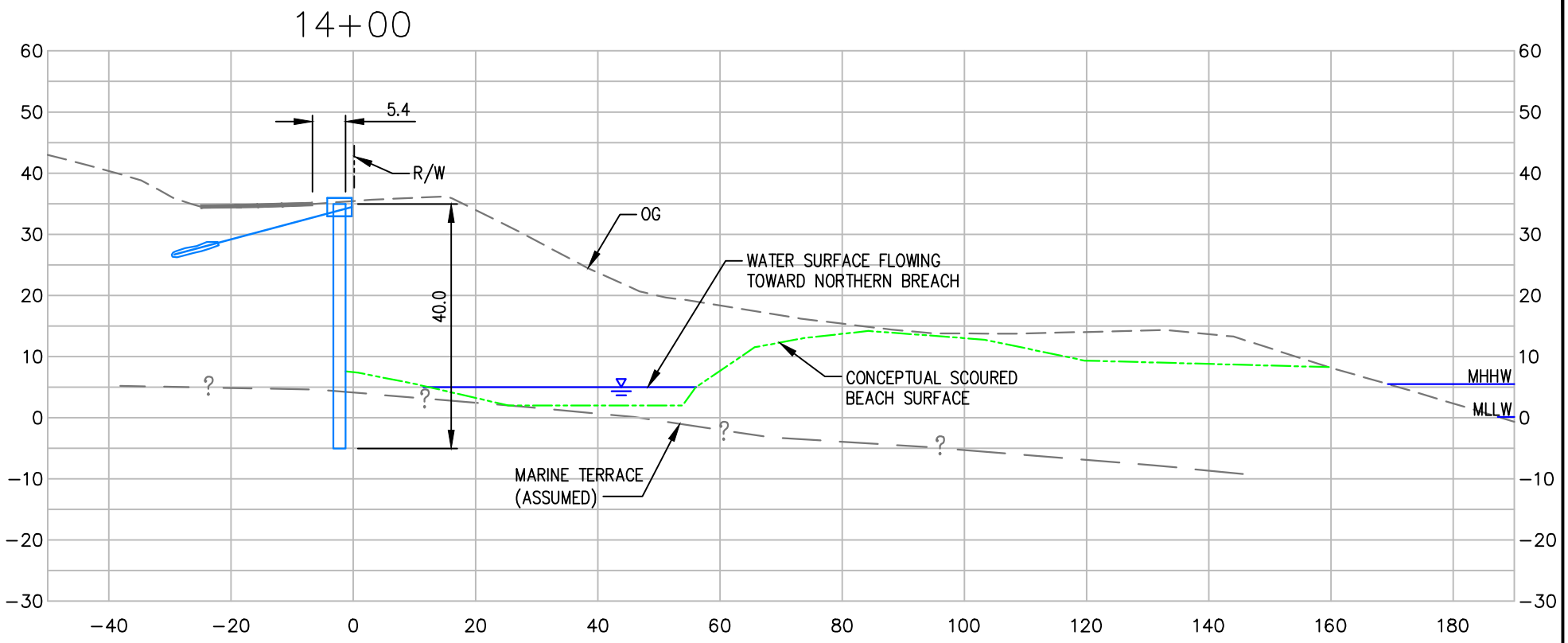
CROSS-SECTION
ALTERNATIVE 3 - SOIL NAIL WALL

SCENIC ROAD BLUFF PROTECTION		FIG 21
moffatt & nichol	FEB 2013	



ALTERNATIVE 4 - PILE WALL AT EDGE OF ROAD

SCENIC ROAD BLUFF PROTECTION		FIG 22
moffatt & nichol	FEB 2013	



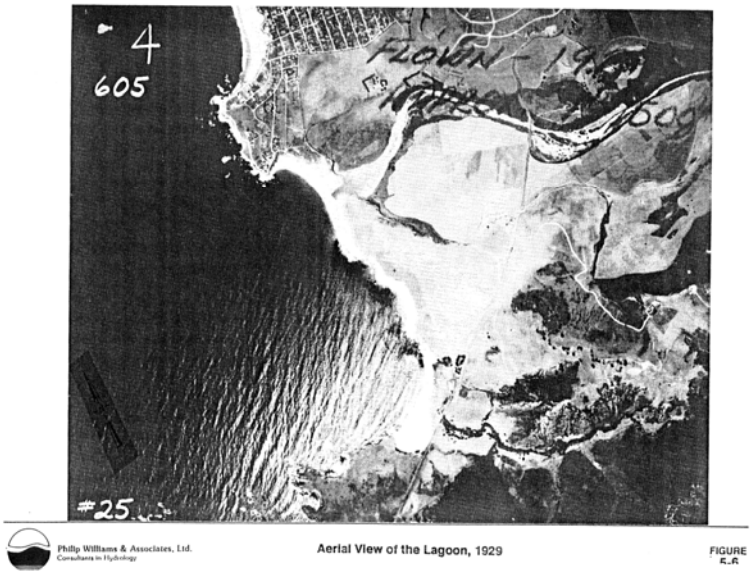
CROSS-SECTION
ALTERNATIVE 4 - PILE WALL AT EDGE OF ROAD

SCENIC ROAD BLUFF PROTECTION		FIG 23
moffatt & nichol	FEB 2013	

APPENDIX A

County Aerial Photographs

1929



Source: Williams, J. and Philip Williams & Associates. (1992). Carmel River Lagoon Enhancement Plan.

1972



Source: Unknown. Provided by Whitson Engineers.

April 30, 1979



Source: Unknown. Provided by Whitson Engineers.

June 1982



Source: Unknown. Provided by Whitson Engineers.

March 1993





Source: Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon (2007)

September 6, 1998



October 1, 2002



August 12, 2003



Source: CaliforniaCoastaline.org

July 30, 2004



August 25, 2005



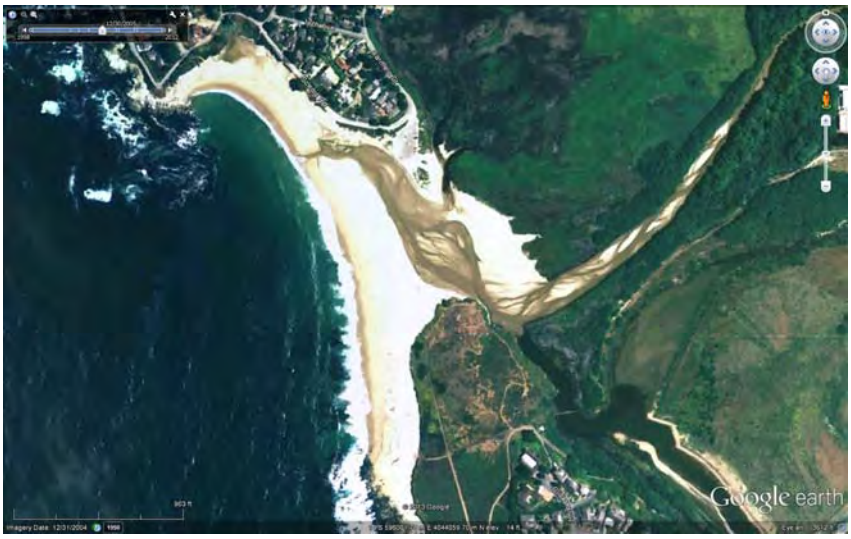
Source: James, G. (2005). Surface Water Dynamics at the Carmel River Lagoon Water Years 1991 through 2005; Technical Memorandum 05-01

October 28, 2005



Source: CaliforniaCoastline.org

December 30, 2005



July 3, 2006



Source: Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon (2007)

June 29, 2007



October 6, 2007



May 2008



Source: CaliforniaCoastline.org

June 5, 2009



September 29, 2009



2011



Photo courtesy of Monterey County

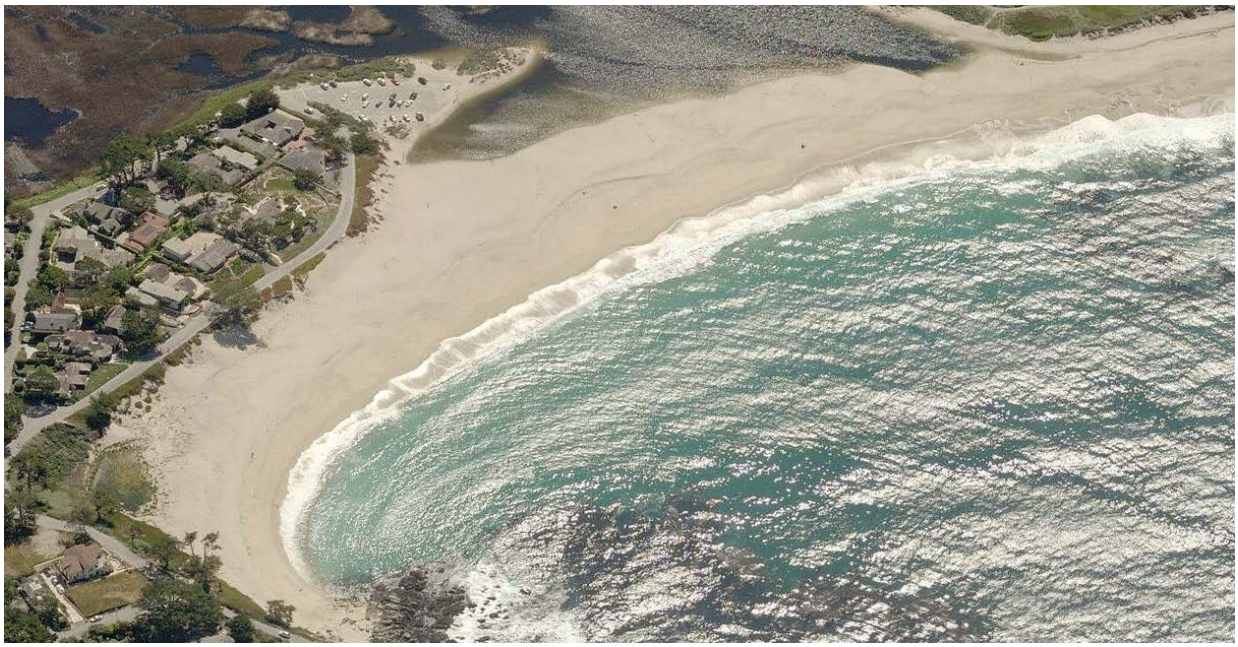
May 5, 2012



PROGRESS DRAFT

CARMEL RIVER LAGOON BIOLOGICAL ASSESSMENT

COASTAL ENGINEERING ANALYSIS



Prepared Under Contract to Denise Duffy & Associates, Inc. for:

Monterey County Water Resources Agency
893 Blanco Circle, Salinas, CA 93901-4455

Prepared by:

moffatt & nichol
2185 No California Blvd., Ste. 500
Walnut Creek, CA 94596

August 2, 2013
M&N Job No: 8116

CONTENTS

1. INTRODUCTION 1
1.1 Background 1
2. Data Summary 4
2.1 Beach Morphology 4
2.2 Bathymetry 5
2.3 Astronomical Tides 5
2.4 Waves 5
2.5 River Discharge and Lagoon Water Levels 6
3. Wave Analysis 7
3.1 Model Development 7
3.2 Model Results 7
4. Coastal Processes 9
4.1 Littoral Transport 9
4.2 Beach Morphology 9
4.3 River Breaching 10
5. Inlet Morphology 12
5.1 Fall Wave Overtopping 12
5.2 Fall and Winter Intermittent Breaches 12
5.3 Winter and Spring Intermittent Closings 13
5.4 Summer Closures 13
6. REFERENCES 14

APPENDICES

A. Carmel River Breaching and Relevant Processes, Monthly Figures, Water Years 2013, 2010, 2009
B. Monterey County Aerial Photographs
C. Monterey County Carmel River Mouth Surveys 2001 - 2012

FIGURES

Figure 1-1. Project Site Overview
Figure 2-1. Depths (in fathoms, MLLW) near project site (NOAA Chart)
Figure 2-2. Nearshore Bathymetry (in ft., MLLW)
Figure 2-3. Location of NDBC Wave Measurement Buoys
Figure 2-4. Significant Wave Height Rose at Monterey Bay NDBC Wave Buoy
Figure 2-5. Significant Wave Height Rose at Point Sur NDBC Wave Buoy
Figure 3-1. Mike21-SW Swell Transformation Model Domain
Figure 3-2. Mike21-SW Model Mesh and Bathymetry in Project Vicinity
Figure 3-3. Mike21-SW Model Output Points
Figure 3-4. Example Model Output – Transformation of Unit Wave Height, 16 sec, 270° Swell
Figure 3-5. Example Model Output – Transformation of Unit Wave Height, 16 sec, 315° Swell
Figure 3-6. Swell Transformation from Offshore – H_s Roses at Selected Output Points
Figure 3-7. Wave Roses at Points along Carmel River State Beach
Figure 5-1. Water Year 2013, Annual – Carmel River Breaching and Relevant Processes
Figure 5-2. Water Year 2012, Annual – Carmel River Breaching and Relevant Processes
Figure 5-3. Water Year 2011, Annual – Carmel River Breaching and Relevant Processes
Figure 5-4. Water Year 2010, Annual – Carmel River Breaching and Relevant Processes
Figure 5-5. Water Year 2009, Annual – Carmel River Breaching and Relevant Processes
Figure 5-6. Water Year 2012, Oct. – Nov. – Carmel River Breaching and Relevant Processes
Figure 5-7. Water Year 2012, Dec. – Jan. – Carmel River Breaching and Relevant Processes
Figure 5-8. Water Year 2012, Feb. – Mar. – Carmel River Breaching and Relevant Processes
Figure 5-9. Water Year 2012, Apr. – Jun. – Carmel River Breaching and Relevant Processes
Figure 5-10. Water Year 2011, Oct. – Nov. – Carmel River Breaching and Relevant Processes
Figure 5-11. Water Year 2011, Dec. – Jan. – Carmel River Breaching and Relevant Processes
Figure 5-12. Water Year 2011, Feb. – Mar. – Carmel River Breaching and Relevant Processes
Figure 5-13. Water Year 2011, Apr. – May. – Carmel River Breaching and Relevant Processes
Figure 5-14. Water Year 2011, Jun. – Jul. – Carmel River Breaching and Relevant Processes

1. INTRODUCTION

1.1 Background

The Carmel River drains an approximate 250 square mile watershed. Like many California streams entering the Pacific, there is a very productive estuary at the mouth, called the Carmel River Lagoon, which serves as rearing habitat for juvenile steelhead. The Carmel River Lagoon supports threatened species such as the South-Central California Coast (S-CCC) steelhead, California red-legged frog, Western snowy plover, and Smith's blue butterfly. The Carmel River was also designated as critical habitat for S-CCC steelhead in September 2005 (County of Monterey et. al, 2012). Figure 1-1 gives an overview of the project site location.

The lagoon is not connected to the ocean during times of low or no river flow, when waves build a barrier beach across the mouth of the river. When the mouth of the river is closed, lagoon water levels rise between late fall and spring seasons and threaten private properties along the northern edges of the lagoon, the County wastewater treatment plant, as well as a parking lot and restroom facility operated by the State Parks. Since 1973, the County mechanically breaches the sandbar to prevent flooding. Evidence shows that the barrier beach has been breached since at least the early 20th century (Final Study Plan, 2007). Historically, the breaches were created such that the river would flow directly west out to the Pacific Ocean; however, the river meanders north or south along the beach in response to beach build-up from wave action. Often numerous breaches are mechanically and naturally formed over the winter and early spring, depending on variable ocean and river conditions (James, 2005). Beginning in 2005, the sandbar has also been mechanically closed in the spring when the river flows have subsided in order to maintain adequate water levels for steelhead throughout the summer. A larger, deeper lagoon during the summer and fall increases the quality and quantity of fish and wildlife habitat until river flows resume during the winter (County of Monterey et. al, 2012).

The rate of the lagoon drawdown after a breach and the post-breach lagoon water surface elevation are dependent on several factors, including breach location, channel length and width, tidal conditions, and the presence or absence of a rock sill along the outflow channel. Breaches which result in the lagoon reaching relatively low elevations reduce the available aquatic habitat area for fish and wildlife. Breaches directly west out to the ocean also have swift stream flows that push juvenile steelheads out to sea prematurely. When the river channel migrates along the northern or southern beach, a longer, meandering path is taken which extends the hydraulic gradient slowing the water exit. Local fisheries groups and agencies have preferred a northern meandering outlet channel alignment because, in the past, when the river channel migrated northwards, it reduced the rate and amount of *drawdown* (drop in lagoon water levels before and after a breach to the ocean) and subsequent loss of threatened juvenile steelhead that get flushed out to sea, as compared to when the channel flows along the southerly and westerly outlet channel (James, 2005).

Scenic Road is located immediately north of the Carmel River mouth in Monterey County. It is a publicly maintained road that is threatened by erosion when the river takes a northerly route along the beach before discharging into the Pacific Ocean. The road runs around the northern headlands of Stewart's Cove, southwest to intersect with Carmelo Street near the Carmel River State Beach parking lot and restrooms. Scenic Road provides recreational access to the State Beach, sole access to six private homes, and has a sanitary sewer pipe under the roadway. Bluff stabilization methods to protect the road, sewer infrastructure, and homes are also being investigated as part of this work effort.

In November 2011, the County applied for permits from the US Army Corps of Engineers (Corps), Regional Water Quality Control Board (RWQCB), California Coastal Commission (CCC), and the California Department of Fish and Wildlife (CDFW) to manage lagoon water levels and install a sand ramp for public beach access. The Corps consulted with the NMFS and the US Fish and Wildlife Service (USFWS) as part of permit review. In September 2012, the County and the Corps, in consultation with NMFS, drafted a Memorandum of Understanding (MOU) regarding the management of the Carmel River Lagoon. The MOU lays out a long-term plan to balance protection of private property with protection of federally listed species. The MOU parties also recognize that mechanically managing the Carmel River Lagoon over the long run is not in the best interest of the County, Corps, and NMFS (County of Monterey et. al, 2012). So the MOU identified two long-term solutions as alternatives to performing sandbar management: the Ecosystem Protective Barrier (EPB) and the Scenic Road Protection and Preservation Project (this project).

The Scenic Road Protection Project is proposed for the purpose of protecting Scenic Road and the State Parks parking lot and restrooms from erosion when the river is allowed to naturally breach along a northern alignment. The purpose of the EPB is to protect nearby residential property by constructing a flood wall around portions of the lagoon, which would allow a higher lagoon water level, significantly reducing, if not eliminating, the need for sandbar management. Once installed, the expectation is that the EPB will positively impact the management of the Carmel River Lagoon by reducing the number of mechanical breaches per year.

The potential reduction in number of mechanical breaches per year and the potential for erosion of the bluffs along Scenic Road can only be determined after a better understanding of the coastal processes in the area is achieved, which is described in this report.

The EPB and Scenic Road Protection Projects are anticipated to be completed by 2018 or earlier. Meanwhile, the Interim Sandbar Management Plan (County of Monterey et. al, 2012) provides well-established protocols on sandbar management. These include:

- The use of sandbags, public outreach, sandbar breaching and closure, and sand relocation for access purposes;
- Mobilizing equipment and personnel when the water level in the lagoon reaches +12.77 feet NAVD88[1], or when the projected water level is expected to reach this elevation within hours, or when the flow in the river reaches 200 cfs;
- Mechanical sandbar breaching when the Lagoon water level reaches +13.27 feet NAVD88, or high river inflows and/or wave overtopping is expected to raise the water level to +12.77 feet in less than 6 hours, or if the predicted tides are unusually high;
- Managing the breach in the winter to maintain a minimum lagoon elevation of +6 feet NAVD88, or closing the breach if excessive scouring is observed;
- Managing the breach, and conducting beach grooming as required, in the summer with the intent of achieving a +12.77 feet pool elevation in the lagoon.

[1] All elevations in this report reference the North American Vertical Datum (NAVD) of 1988, unless specifically stated otherwise. The conversion factor between NAVD and the National Geodetic Vertical Datum (NGVD) of 1929 is 2.77 feet, with the NGVD datum being higher (add 2.77 feet to NGVD elevations to obtain NAVD elevations)

This is a change to the County's historic practice, which in general, was to mobilize at +10.27 feet and breach at +11.55 feet (James 2005). In reality, the average lagoon elevation at breaching was +11.83 feet for the 1992-1998 period, and +13.57 feet for the 1999-2005 period. This change over time was likely due to the Federal listing of the Carmel River Steelhead as a threatened species in 1997, which increased the involvement of resource agencies such as the National Marine Fisheries Service (NMFS).

2. DATA SUMMARY

The project reach is within a crenulate-shaped bay, anchored by the rocky Carmel Point headland (south of Stewart's Cove) to the north and a bedrock outcrop to the south. Consistent with typical headland-bay beaches, the shoreline shape is oriented parallel to the wave crests as they refract and diffract around the headland. There is also a wave energy gradient along the beach such that during the winter, when waves are predominantly from the northwest direction, the energy decreases from south to north.

The estuarine morphology (beach, lagoon and nearshore bathymetry), coupled with oceanographic conditions (tides and wave conditions) and the hydrologic components (river discharge and lagoon water level) of the Carmel River Estuary result in the annual and seasonal variation in the response of the system. Each of these components is described below.

2.1 Beach Morphology

The slope of the beach progressively becomes flatter from the south to the north. Field observations by Prof. Ed Thornton of the Naval Postgraduate School show that the beach slope varies from about 8H:1V (12%) at the north end of the beach, to about 3.6H:1V (28%) at the south end of the beach (Thornton, 2005). Sand grain size, and therefore wave energy, also increases from the north to the south end of the beach. Sand is deposited on the beach berm by wave action, and at high tides, waves overtop the berm depositing sand and debris on the back beach (nearest the lagoon). Prof. Thornton also determined that the beach is relatively stable and has not migrated over the past 130 years (Thornton, 2006).

The beach topography is seasonally variable and dependent on numerous factors including river flow, wave height, period and direction, tide, mechanical or natural breaching, wind direction and strength, and river sediment deposition. After reviewing the available surveys of the Carmel River mouth and beach along Scenic Drive, it is evident that the beach is heavily managed and mechanical breaching significantly alters the beach topography. By mechanically breaching in different locations each year, the beach to the north, south and middle of the river mouth are unnaturally modified, eliminating the ability to decipher the "natural" beach topography and breaching process. If natural breaching predictability is desired, cross sections for multiple years would have to be surveyed along the beach at specific locations to maintain congruency in the data. Surveys would have to be completed prior to, and after, sand management on the beach (after final closure and before first breaching) over several years to remove inter-annual variability to decipher a natural signal.

A preliminary analysis of beach berm elevations from the County provided surveys for the 2003 to 2012 period indicates the following:

- The *low point* of the beach berm is generally about +14 feet and is to the south of the river mouth in most of the surveys (5 out of 7 surveys reviewed). The highest elevation of this low point was about 15.5 feet in Dec 2004.
- The *high point* is generally in the middle of the beach, and ranges from +16 to +17 feet (5 of the 7 surveys reviewed).
- The beach immediately north of the entrance is generally between the above two range of elevations and was as low as the southern portion in 2 of the 7 surveys reviewed, and actually was the high point in 2 of the 7 surveys.

The above observations indicate that the low point in the beach berm is about 1 to 2 feet higher than the +13.3 feet elevation which is the current trigger for breaching the sandbar by the County under the Interim Management Plan.

2.2 Bathymetry

The sea floor offshore of the Carmel River Beach is relatively steep, quickly dropping off to depths greater than 100 ft. in the Carmel Canyon; however, very little detailed information exists on the nearshore bathymetry within the surf zone. Figure 2-1 below gives a detail from the NOAA navigation chart of the area, but survey dates are unknown and there is still a lack of detail in the direct project vicinity.

A bathymetric survey performed in the early 1970's, with the locations of 20 to 100 feet depth contours, is provided in Figure 2-2 (Howell, 1972). Rock outcroppings at the northern and southern headlands are evident in the figure, with the sea floor between the two headlands reported to be mantled by over 5 feet of fine to coarse sand.

In January 2013, Whitson Engineers obtained new aerial topographic mapping and performed a lagoon stage-volume-area analysis (Whitson Engineers, 2013). Lagoon bathymetry data from a previous 2007 RMC study was used for the ground below the water surface at the time of the aerial mapping (RMC, 2007).

2.3 Astronomical Tides

Typical tidal water levels at the site can be characterized using measurements from the Monterey, CA tide gage, located approximately 7 miles north of the project site on the opposite side of the Monterey Peninsula. The lag time between water levels over this distance is less than 5 minutes, and differences in water levels are negligible (Laudier, 2009). Table below gives the tidal datums at the project site referenced to Mean Lower Low Water (MLLW), NGVD29, and NAVD88 datums.

Table 2-1: Tidal Datums at Monterey, CA (NOAA CO-OPS #9413450)*

Tidal Plane	Elevation (ft.)		
	MLLW Datum	NGVD29 Datum	NAVD88 Datum
Mean Higher High Water (MHHW)	5.34	2.74	5.48
Mean High Water (MHW)	4.64	2.04	4.78
Mean Tide Level (MTL)	2.87	0.27	3.01
National Geodetic Vertical Datum 1929 (NGVD29)	2.6	0	2.74
Mean Low Water (MLW)	1.1	-1.5	1.24
Mean Lower Low Water (MLLW)	0	-2.6	0.14
National Geodetic Vertical Datum 1988 (NAVD88)	-0.14	-2.74	0

* Note that the difference between NAVD88 and NGVD29 datums of 2.74 ft. is provided at the Monterey tide gage and is used in this report. At the project site, the County uses a conversion of 2.77 ft. (County of Monterey et. al, 2012).

2.4 Waves

The wave climate offshore of the project site is characterized by long-period, energetic swell that typically approaches from the west through northwest (clockwise) directions. The location of the two

closest wave measurement buoys, one approximately 50 miles NW and one approximately 30 miles south of the project site, are shown in Figure 2-3. Figure 2-4 and Figure 2-5 show wave height roses for, which show the predominance of the west through northwesterly swells. The data measured at the Point Sur buoy will be used in this analysis to represent the offshore wave conditions affecting the site. Directional wave height and period information at this buoy were only available from 2008 to present.

The wave climate varies seasonally to a high degree. During the fall and winter seasons, North Pacific storms generate long period swells that propagate from the west though northwest directions, though infrequent southerly swells can occur as well (James, 2005). During the summer months, shorter period (local seas) waves predominate from the northwest; infrequent southern hemisphere swells are also present. Carmel River Beach is largely protected from the predominant wave directions by both the southern end of the Monterey Peninsula and the rocky headland directly north of the beach. As long period NW waves propagate towards shore, they undergo refraction due to changes in bathymetry and diffract to a large degree by the protecting headlands, filtering out higher-frequency wave energy so that mostly low-frequency swell impacts the beach. The beach is exposed to the rare, westerly storms, where wave focusing can amplify approaching waves (Thornton, 2005). At the northern portion of the beach, diffraction of wave energy from the sheltering headland results in further diminished waves that approach the curved portion of the beach at a northerly direction.
Lagoon Stage

2.5 River Discharge and Lagoon Water Levels

Carmel River Lagoon water surface elevations from the south arm gage, and Carmel River flow data measured at the Highway 1 gage, are not described in detail in this report; a Lagoon Hydrology report is being prepared separately by Balance Hydrologics. A summary of the data, relevant to coastal processes, is discussed in section 5 of this report.

3. WAVE ANALYSIS

The MIKE-21 Spectral Wave (SW) model was used to investigate wave propagation and wave transformation from deep water to shallow water, offshore of the Carmel River Lagoon. The model includes important wave phenomena, such as shoaling and refraction due to depth variations, diffraction and reflection near artificial structures, wave breaking in the surf zone, wave dissipation, and non-linear wave-current interactions (DHI 2011). The SW model uses unstructured meshes to conduct numerical calculations with the advantage of flexible resolutions (or densities) based on the area of interest. Typically, the offshore area of the model domain has less mesh elements, whereas in the vicinity of the site the mesh elements are dense and in higher resolution.

3.1 Model Development

The model domain was chosen to encompass the project site and surrounding shorelines, nearshore, and offshore areas that affect the propagation of swell waves to the beach (Figure 3-1). The offshore boundary was placed near to the NDBC Point Sur buoy so that swell wave data measured at the buoy could be used for model boundary conditions. Figure 3-2 shows the model computational mesh and bathymetry in the vicinity of the project site. The variable shoreline in the area that influences wave conditions at the beach through diffraction and refraction is represented with sufficient detail. The flexible-mesh (FM) capabilities of the Mike21-SW model allow the high-resolution representation of wave transformation and diffraction processes in the shallow areas directly offshore of the Carmel River Beach without imposing the same resolutions in offshore areas where it is not needed.

Time series of wave parameters were output at specific points in the model domain so that both the variation along the beach and across the domain from offshore to nearshore could be assessed. The locations and ID's of the output points, referred to in discussions of the model results, are given in Figure 3-3.

3.2 Model Results

The wave model was run for 180 cases representing offshore unit amplitude swell boundary conditions with varying peak periods and directions. The results for the unit amplitude cases were used to develop transformation matrices at each output point, describing the reduction/amplification of the significant wave height for each peak period and direction case. The matrices were used along with the swell measurement time series at the NDBC Point Sur buoy to develop time series of swell wave parameters at the model output points, assuming that the wave transformation factors are constant for varying boundary condition wave amplitude.

The parameters of interest included the significant wave height (H_s), peak wave period (T_p), and wave power, a parameter that represents that transport of wave energy and can be an analogue for potential sediment transport. Figures 3-4 and 3-5 give example model outputs of significant wave height and wave velocity vectors for unit amplitude swell of 16 seconds and directions of 270° and 315°, respectively. The pattern of refraction and diffraction that alters the swell direction is evident as it propagates towards the shoreline. Table 3-1 below presents the transformation coefficients computed at the beach shoreline (output point carmel_03) for several peak period classes and each offshore incident direction. For each direction and period class, the value represents the ratio of the wave height near the shore to the offshore boundary swell wave height.

Table 3-1: Swell Transformation Coefficients at Carmel River State Beach (model output point carmel_03)

Offshore Swell Tp (s)	Offshore Swell Direction												
	180	**195**	**210**	**225**	**240**	**255**	**270**	**285**	**300**	**315**	**330**	**345**	**360**
<10	0.04	0.10	0.22	0.32	0.40	0.39	0.40	0.37	0.31	0.26	0.19	0.11	0.05
10-16	0.14	0.22	0.33	0.46	0.59	0.69	0.74	0.71	0.62	0.50	0.37	0.25	0.17
16-20	0.19	0.26	0.34	0.45	0.57	0.67	0.71	0.70	0.62	0.50	0.38	0.27	0.19
>20	0.19	0.26	0.34	0.45	0.57	0.66	0.71	0.69	0.61	0.49	0.37	0.27	0.19

Wave roses were create from the significant wave height time series at each output point to demonstrate how the wave climate is altered as swell moves inshore and along the shoreline. Figure 3-6 shows wave roses for output points offshore_03, offshore_02, and carmel_03 to show how the Northwesterly and less-frequent Southwesterly swell are transformed to approach the beach primarily from due West. Figure 3-7 zooms in on the Carmel River State Beach (with roses at output points carmel_01, carmel_03, carmel_05, and carmel_07 to show how diffraction shifts the primary wave approach direction to West-Southwest from due West going from South to North along the shoreline.

The time series of wave power at the representative point carmel_03 was used in subsequent work to show the correlation of variations in the wave conditions with Carmel River Lagoon water levels and beach berm breaching events.

4. COASTAL PROCESSES

4.1 Littoral Transport

Cross-Shore Transport

The periodic, orbital motion of water under waves is important in transporting sediment up and down the beach profile (cross-shore direction). Seasonal changes in wave climate, especially in locations that have a distinct winter storm season, induce corresponding changes in the state of a beach, where sediment is transported offshore during storm events and the beach slowly recovers during less-energetic events (Bosboom & Stive, 2010).

Because the Carmel River Beach is sheltered from the predominant wave direction, very little wave energy in the form of large, storm waves reaches the northern portions of the beach; instead, swell impacts the beach for most of the year, transporting sediment shoreward and building up the beach berm (Thornton, 2005). The high seasonal variability in shoreline position common for other area beaches is not observed here, with an estimated position variation of only +/- 10 m (Thornton, 2006).

Long-Shore Transport

Waves approaching a beach at some angle away from perpendicular induce a small mean current parallel to the shoreline as they break across the surf zone. This current drives the corresponding transport of suspended sediment parallel to the beach, and gradients in this transport rate due to differences in nearshore wave height or wave incidence angle promote erosion or accretion of the beach face in different areas (Bosboom & Stive, 2010). The incident-angle driven transport gradients often alter the shoreline so that it tends to align with the predominant incident wave angle, diminishing transport rates so that an equilibrium condition exists.

Due to the shape of the Carmel River Beach system, long-shore transport is most likely northward in the north portion of the beach and southward in the south portion of the beach, serving to distribute sediment brought to the coast by the river along the length of the beach. This hypothesis was also verified in studies performed for Carmel Beach (Howell 1972). The concave shape of the beach is largely aligned with the crests of the refracted and diffracted breaking waves, suggesting the beach is close to an equilibrium shape and transport magnitudes are relatively low (Thornton, 2005). The shift in predominate wave angle is evident in the wave roses produced with spectral wave model results in Figure 3-7.

An additional mechanism other than oblique wave incidence may drive long-shore transport northwards toward the anchoring headland. Waves breaking across the surf zone induce a heightening of the mean water level known as wave setup, and larger waves produce setup of greater magnitude. Because of the sheltering effect of the northern headland, wave heights decrease northward along the beach resulting in a water level gradient that drives a northward flowing current (Thornton, 2005). While the magnitude of the transport due to this gradient is unknown, research at the more-exposed Ocean Beach in San Francisco shows that a setup-gradient induced longshore current can greatly exceed that produced by oblique incidence or tide (Barnard, Hansen, & Erikson, 2012).

4.2 Beach Morphology

The Carmel River Beach is steep, reflective, and composed of fairly coarse sand delivered to the beach by the river (Rich & Keller, 2013). Beach face slopes typically vary along the length of the beach, ranging from as low as 8% at the north to 28% to the south (Laudier, 2009; Thornton, 2005). The mean

grain sizes also increase to the south, corresponding to the increased wave energy along the less-sheltered portion (Thornton, 2005).

The shape of the beach shoreline is typical of crenulate or headland-bay beaches where the equilibrium condition can be described by one of several mathematical shape functions, usually log-spiral in form. These equilibrium beach shapes are typically present where a headland fixes the shape at one beach end and waves approach from a predominant direction (Moreno & Kraus, 1999). Waves approaching the beach both refract and diffract into the sheltered zone behind the upcoast headland, and differential long-shore transport shapes the beach so that it is perpendicular to the resulting wave rays at equilibrium (Silvester & Ho, 1972). While littoral transport is limited at the beach, the differences in wave energy reaching the different beach sections has resulted in alongshore variation in beach berm heights with lower berm elevations to the north (Rich & Keller, 2013).

4.3 River Breaching

The Carmel River Beach forms a barrier between the Pacific Ocean and the adjacent Carmel River Lagoon that is seasonally breached (either naturally or artificially) when high rainfall events increase the water level in the lagoon (Kraus, Patsch, & Munger, 2008). Because the Carmel river is ephemeral and the beach is subjected to swell for most of the year, wave run-up rebuilds the berm and closes off the barrier beach when river outflows are low or absent (Laudier, 2009).

During the early fall, the lagoon mouth usually remains closed to the sea, but occasional overtopping of the beach berm by long period ocean swell can raise the lagoon water level over the typical low, summer levels. Major fall overtopping-induced water level increases have usually been associated with high waves in conjunction with higher tide levels (James, 2005). During late fall/early winter, rainfall in the Carmel river watershed is usually sufficient to advance the flowing river to the lagoon and fill up the available storage. At this point, the beach berm has historically been mechanically breached to prevent flooding of roads and homes along the northern edge of the lagoon. Lagoon outflow through the breach quickly scours a channel sufficient to release most of the stored lagoon water into the ocean. Based on 13 years of observations, the berm breach remains open approximately 85% of the time, with river inflows of 100 cubic feet per second, usually ensuring that the breach will not be closed by predominant wave-transported sand. Because lower flows or large waves encourage breach closure (and then an increase in water level as the lagoon fills), the water level in the lagoon is not directly correlated to river inflow (James, 2005).

Historically, the initial artificial breach channel has been excavated straight offshore near the southern end of the beach, though the breach management strategy has varied considerably over the past decade, and has included northerly and southerly managed breaches. Bedrock sills underlie the beach along both the north and south edges, so scour by migrating channels or channels intentionally opened in these sections is less than that when channels are excavated through the central beach portion. With the relatively long channel alignments, further limited by the sills north and south of the river mouth, river outflow is extending over a longer period (drawdown), which is beneficial for threatened species (County of Monterey et. al, 2012; Thornton, 2005). In 2005, the berm was breached toward the north with the unintended consequence of severe erosion along the backing bluff which supports road and wastewater infrastructure (Thornton, 2005).

An elongated channel forms to the north along the beach in half of the years of observation (James, 2005) and either natural breaching or channel migration is expected to tend towards the northern alignment since the antecedent, lowered beach alignment has not recovered to typical berm heights and widths (Thornton, 2005). The lower berm elevations, due to milder beach slope and finer sediment, also favor natural breaching or channel migration towards the northern portion of the

beach; however, this varies greatly on a year to year basis and depends on wave energy arriving over the winter/spring seasons.

5. INLET MORPHOLOGY

The lagoon water surface elevation, Carmel River discharge, tide, and wave power are plotted in Figures 5-1 through 5-5 for water years 2009 through 2013. These four components of the beach berm system demonstrate the complex interactions that cause berm breaches and closures. Water years 2009 and 2010 are considered above normal flow in Carmel River, as determined by MPWMD. Water years 2011 through 2013 are considered dry. Significant seasonal events are described below.

5.1 Fall Wave Overtopping

Typically in September of any given water year, James (2005) noted a large increase of water surface elevation in the lagoon due to seawater overwash. In Figures 5-2 to 5-5 (WY2009 – 2012), this annual event is apparent, and is correlated with the first large wave event of the winter season during a spring tide. Table 5-1 below summarizes the overtopping events. In general, the higher the wave power, the more seawater overtops the berm and enters the lagoon.

Table 5-1: Fall Wave Overtopping Events WYs 2009 - 2013

Date	Water Surface Elevation Increase (start-end) (ft. NAVD88)	Volume Increase* (acre-feet)	Peak Daily Mean Wave Power (kW/m)	Tide (ft., NAVD88)
Sept. 20 - 25, 2012	+2.5 (5.8 – 8.3)	68	16.3	5.5 – 5.8 HHW
Sept. 20 - 22, 2011	+1.2 (8.3 – 9.5)	63	15.9	5.1 – 5.2 HHW
Sept. 20 - 28, 2010	+2.5 (6.4 – 8.9)	85	26.5	4.8 – 5.4 HHW
Sept. 11 - 14, 2009	+1.7 (6.5 – 8.2)	51	14.2	5.7 – 5.9 HHW

* Volume increase calculated using Whitson Engineer's Stage-Volume-Area table (Whitson 2013).

After the initial overtopping, continued wave overwash occurs on the berm slowly increasing the lagoon water surface elevation. In water year 2009, this period of periodic overwash occurred until the first river discharge in February 2010 (Figure 5-5).

5.2 Fall and Winter Intermittent Breaches

Prior to significant river discharge, the dominant force on the lagoon water surface elevation is believed to be wave events. Figure 5-6 shows small increases in water surface elevation that correlate with wave events in early October, mid-October, and mid- and late November. Also evident is the larger influence on water surface elevation when wave events and spring tides are combined. The wave event on November 5, 2011 was over 20 kW/m, however it's occurrence at a neap tide did not increase the water surface elevation in the lagoon noticeably. The length of the wave event (over a span of days), not only its peak wave power, is relevant when determining the seawater overwash over a wide and high berm. Similar trends are visible in Figure 5-10 and Appendix A figures.

As the water rises in the lagoon, eventually a mechanical or natural breach releases the water into the ocean. During these periods of low river discharge and high wave activity, the lagoon enters a phase of rising waters and intermittent breachings. Peak water surface elevations occur during this period, when river discharge is insufficient to keep the outflow channel open. Figure 5-8 shows this scenario from February through mid-March 2012, and Figure 5-12 in early February.

5.3 Winter and Spring Intermittent Closings

As the river discharge increases during the winter months, the high river flow maintains a deep and wide outflow channel open to the ocean. The water surface elevation appears to fluctuate significantly, and is maintained at a lower elevation because of the constant, deep and wide outflow channel. The fluctuating, lower water surface elevation during high river discharge is evident in Figures 5-9, 5-11, 5-13, as well as others.

Also apparent during this period is a stronger tidal influence on the opened lagoon. The water surface elevation fluctuates with the daily and monthly tidal ranges. The month of June in Figure 5-14 is a good example of this phenomenon.

James (2005) noted that discharges over 200, 100, and 20 cfs keep the river mouth open 100%, 90%, and 20% of the time, respectively. Flows ranging from 10-20 cfs indicate a closed outflow channel. These are consistent with observations from water years 2009 – 2013.

When river inputs decrease into the lagoon and intermittent closings begin to occur, the lagoon water surface elevation fluctuates with the opening and closing of the beach berm similar to patterns seen at the beginning of the rainy season.

5.4 Summer Closures

In the summer months, Carmel River has little to minimal flow and ocean wave conditions are such to promote beach building, rather than berm breaching. Initially after the season closure of the lagoon (mechanical or natural), the water surface elevation quickly increases up to 9 – 11.5 ft. NAVD88 due to the last of the seasonal river discharge (Figures 5-2 to 5-5). After the water surface elevation peaks, the lagoon slowly decreases over the summer months due to evaporation and seepage losses. Closure dates since water year 2009, and as interpolated from water surface elevations, includes:

- May 17, 2012
- July 25, 2011
- July 9, 2010
- May 18, 2009

The wave power, as seen in Figures 5-2 through 5-5, rarely exceeds 10 kW/m during the summer closure period. Once wave power events increase up to 15-20 kW/m, there is wave overtopping of the berm and seawater washes in, beginning the annual cycle again.

6. REFERENCES

1. Barnard, P. L., Hansen, J. E., & Erikson, L. H. (2012). Synthesis Study of an Erosion Hot Spot, Ocean Beach, California. Journal of Coastal Research, 283, 903–922. doi:10.2112/JCOASTRES-D-11-00212.1
2. Bosboom, J., & Stive, M. J. F. (2010). Coastal Dynamics 1: Lecture notes CT4305. Delft, the Netherlands: Delft University of Technology, Faculty of Civil Engineering and Geosciences, Section of Hydraulic Engineering.
3. County of Monterey, U.S. Army Corps of Engineers, & National Marine Fisheries Service. (2012). Memorandum of Understanding regarding Flood Prevention and Habitat Protection at the Carmel Lagoon.
4. Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon. (2007). (Author unknown)
5. Howell, Buford F., Naval Postgraduate School. (1972) Sand Movement Along Carmel River State Beach, Carmel, California. Naval Postgraduate School. September.
6. James, G. W. (2005). Monterey Peninsula Water Management District, Technical Memorandum 05-01: Surface Water Dynamics at the Carmel River Lagoon, Water Years 1991 through 2005.
7. Kraus, N. C., Patsch, K., & Munger, S. (2008). Barrier beach breaching from the lagoon side, with reference to Northern California. Shore and Beach, 76(2), 33–43.
8. Laudier, N. A. (2009). Wave Overtopping of a Barrier Beach. thesis submitted to Naval Postgraduate School, Monterey, CA.
9. Monterey County Public Works (MCPW). (2005). Sand Bar Survey. May 25.
10. MCPW. (2005). Sand Bar Survey. October 4.
11. MCPW. (2006). Sand Bar Survey. April 18.
12. MCPW. (2007). Sand Bar Survey. October 2.
13. MCPW. (2008). Sand Bar Survey. October 30.
14. MCPW. (2010). Sand Bar Survey. January 15.
15. Moreno, L. J., & Kraus, N. C. (1999). Equilibrium Shape of Headland-Bay Beaches for Engineering Design. Coastal Sediments ’99 (pp. 860–875). ASCE.
16. NOAA Navigation Chart #18686, Pfeiffer Point to Cypress Point, 13th edition, July 17, 1999.
17. Rich, A., & Keller, E. A. (2013). A Hydrologic and Geomorphic Model of Estuary Breaching and Closure. in review.
18. RMC Water and Environment. (2007). Hydrographic Survey and Stage-Volume Relationship. November 29.
19. Silvester, R., & Ho, S. K. (1972). Use of crenulate shaped bays to stabilize coasts. 13th Coastal Eng. Conf. (pp. 1347–1365). ASCE.
20. Thornton, E. B. (2005). Littoral Processes and River Breachings at Carmel River Beach. Naval Postgraduate School, Monterey, CA.

21. Thornton, E. B. (2006). Carmel River Beach Shoreline History. Naval Postgraduate School, Monterey, CA. April 9.

22. Whitson Engineers. (2013). Carmel River Lagoon Ecosystem Protective Barrier Lagoon Stage-Volume-Area Analysis. January 29.

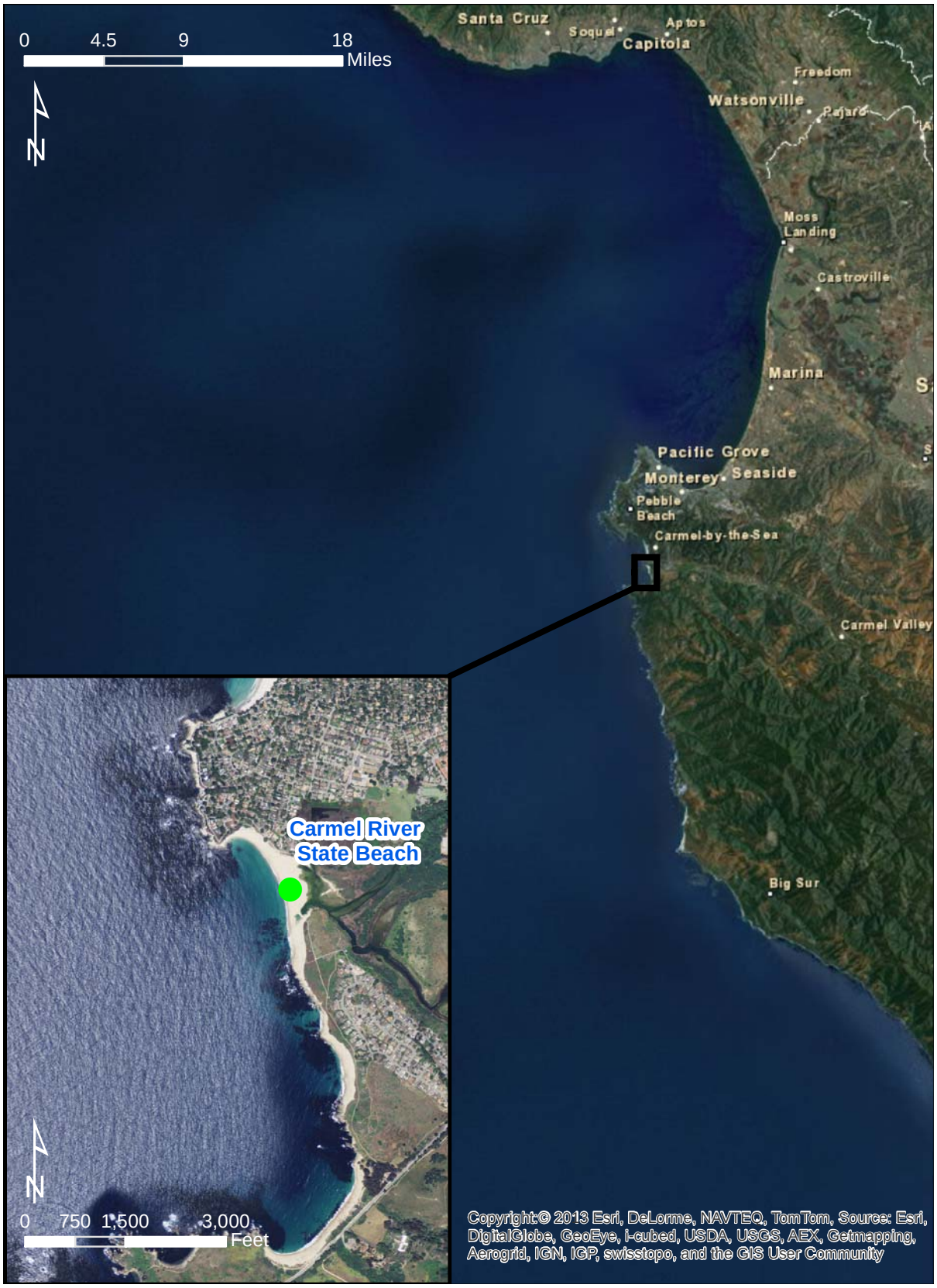


Figure 1-1: Project Site Overview

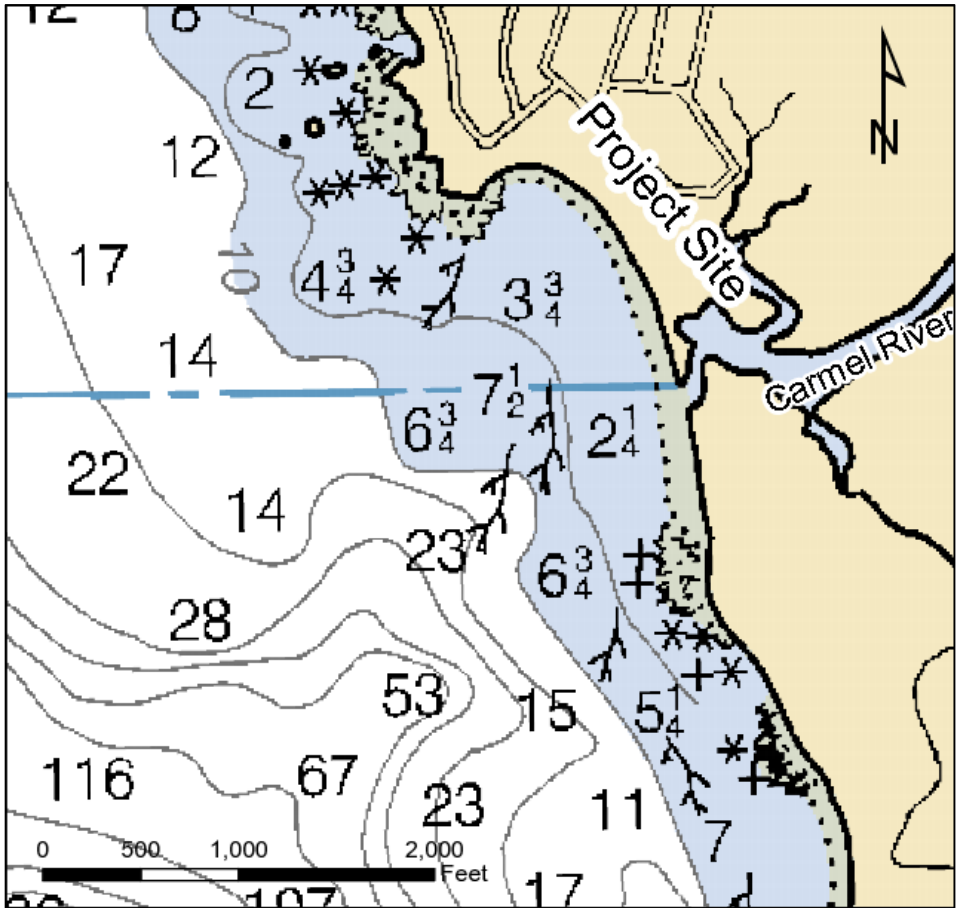


Figure 2-1: Depths (in fathoms, MLLW) near project site (NOAA Chart)

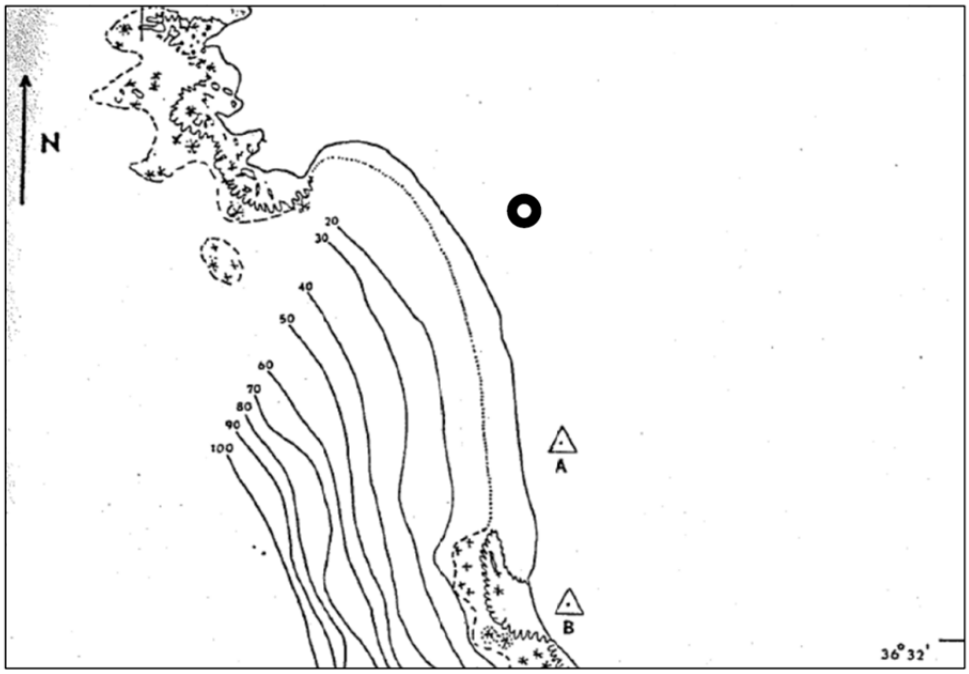


Figure 2-2: Nearshore Bathymetry (in ft, MLLW)
(Source: Howell, 1972)

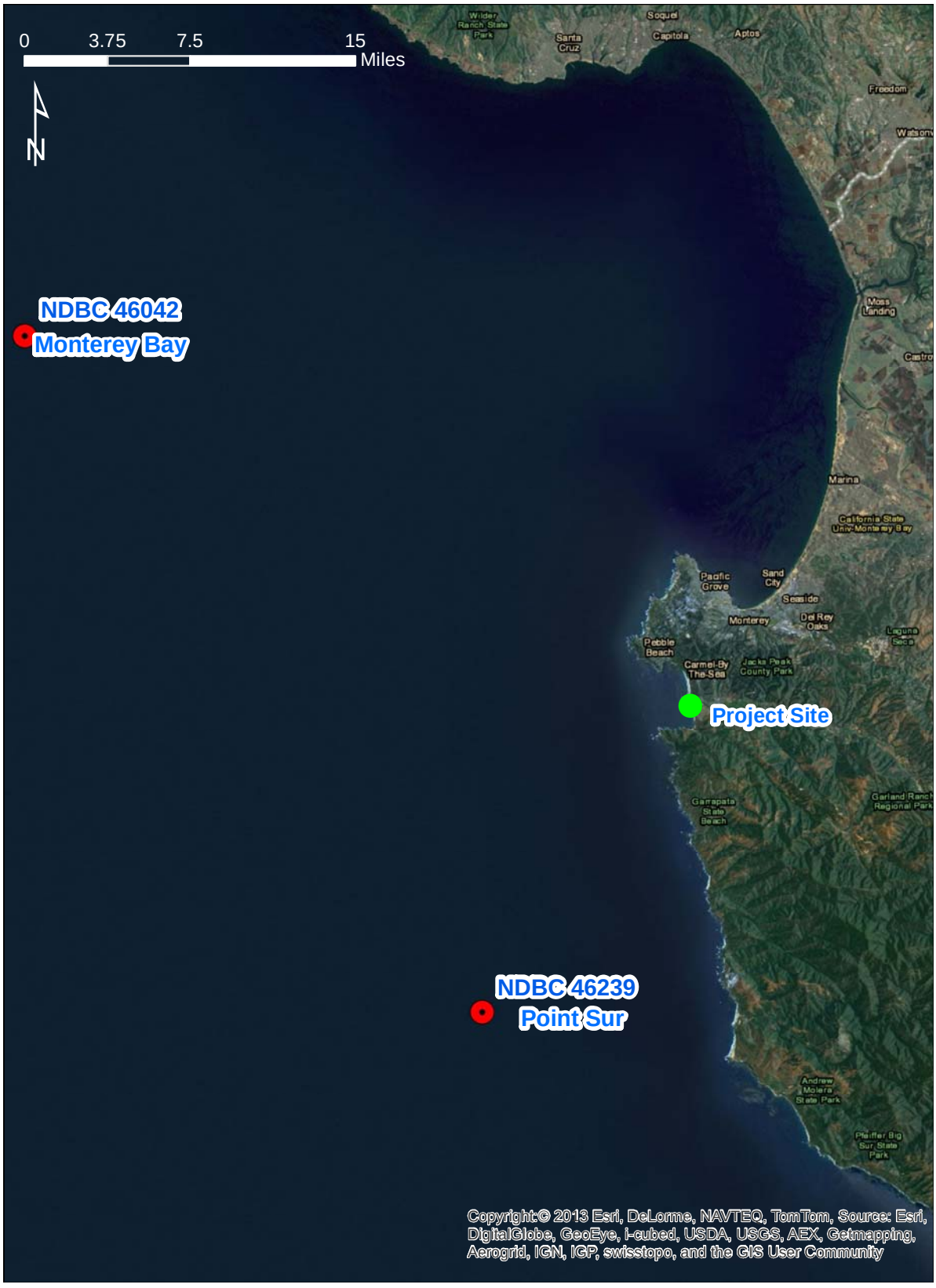
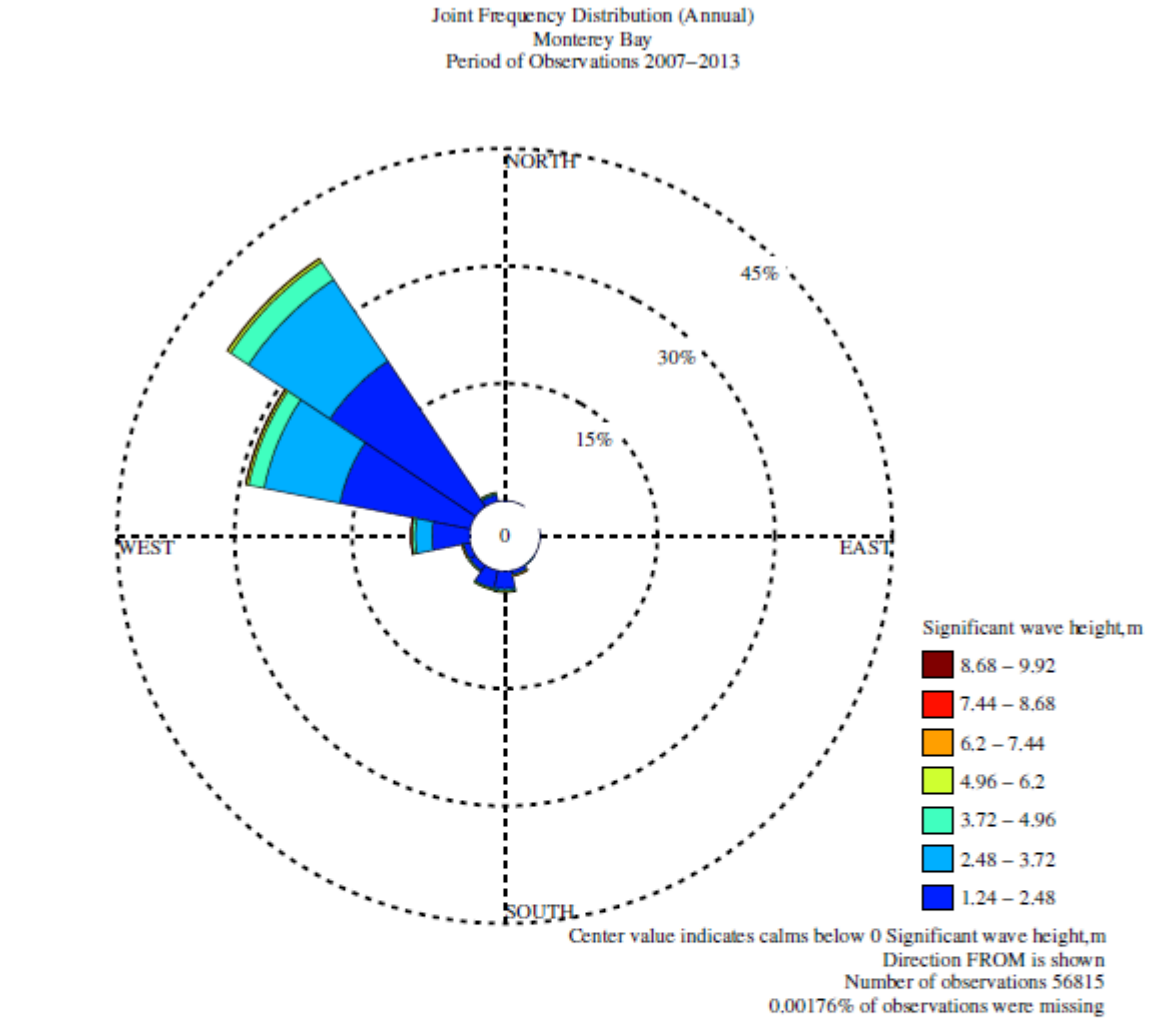


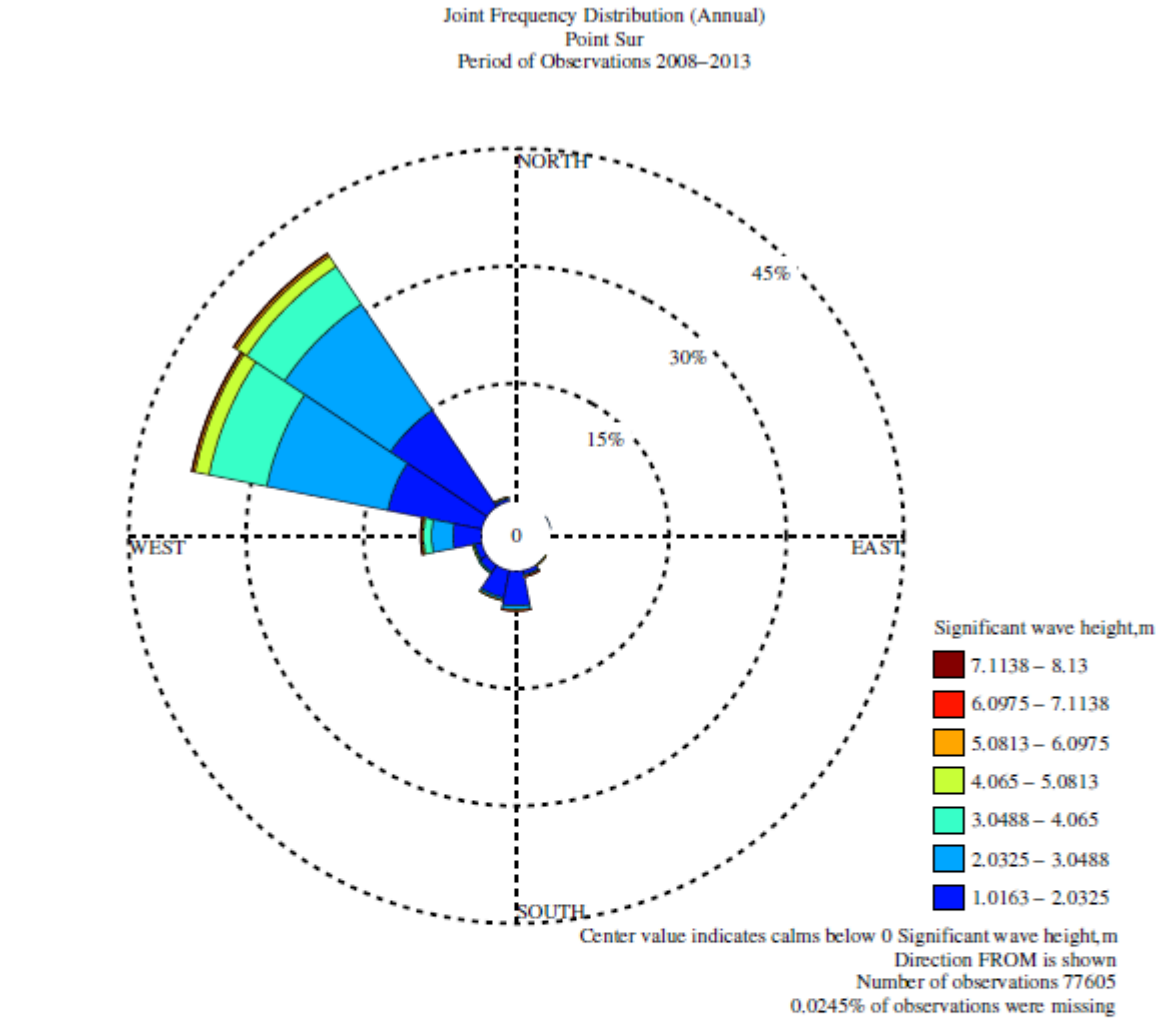
Figure 2-3: Location of NDBC Wave Measurement Buoys



Percentage of Occurrence

Significant wave height,m	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
9.92																	
8.68																	
7.44													0.01				0.01
6.2													0.05	0.05	0.06		0.16
4.96								0.03	0.05				0.09	0.37	0.47		1.03
3.72								0.04	0.09	0.05	0.02	0.02	0.43	2.12	2.92	0.05	5.75
2.48								0.12	0.31	0.14	0.12	0.16	2.23	10.4	13.2	0.27	27
1.24	0.02						0.05	0.57	2.39	2.49	0.9	0.91	5.09	17.9	23.6	0.89	54.9
0	0.01						0.02	0.29	1.93	2.25	0.78	0.35	0.88	2.46	2.1	0.11	11.2
Total	0.04						0.08	1.06	4.78	4.94	1.82	1.45	8.79	33.3	42.4	1.33	100

Figure 2-4: Significant Wave Height Rose at Monterey Bay NDBC Wave Buoy



Percentage of Occurrence

Significant wave height,m	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total							0.08	0.85	5.63	4.78	1.45	1.24	7.95	38.2	39.2	0.6	100
8.13													0.02	0.01			0.03
7.114													0.05	0.1	0.08		0.23
6.098								0.01	0.03				0.09	0.32	0.37		0.83
5.081									0.04				0.23	1.82	1.55		3.67
4.065							0.02	0.07	0.08	0.02	0.04	0.09	1.04	7.53	5.81	0.05	14.7
3.049							0.02	0.18	0.48	0.34	0.16	0.2	2.74	15.8	16.3	0.17	36.4
2.033							0.04	0.55	4.43	3.55	1.09	0.87	3.57	12.2	14.8	0.38	41.5
1.016								0.03	0.57	0.86	0.16	0.08	0.21	0.42	0.26		2.6
0																	

Figure 2-5: Significant Wave Height Rose at Point Sur NDBC Wave Buoy

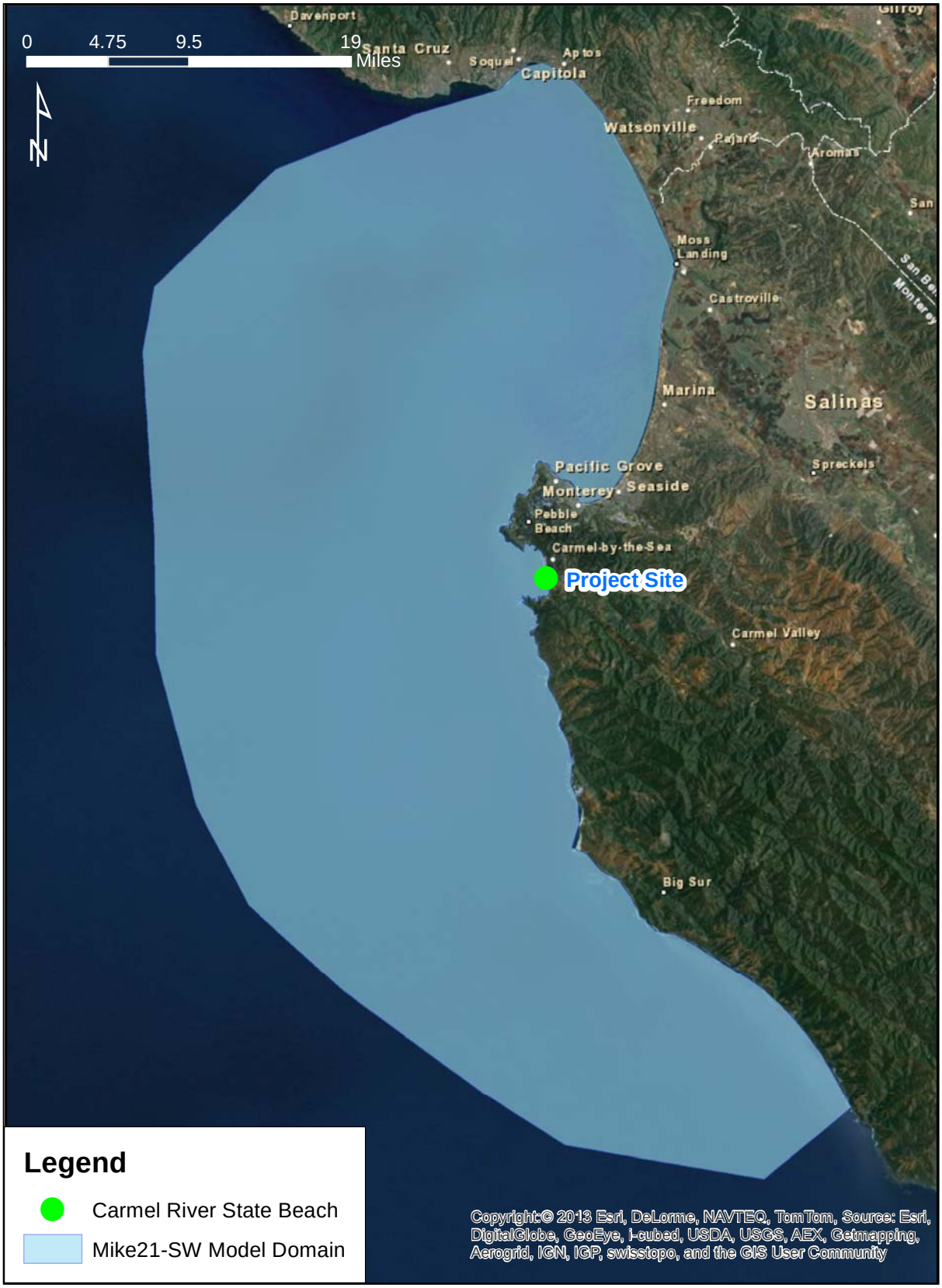


Figure 3-1: Mike21-SW Swell Transformation Model Domain

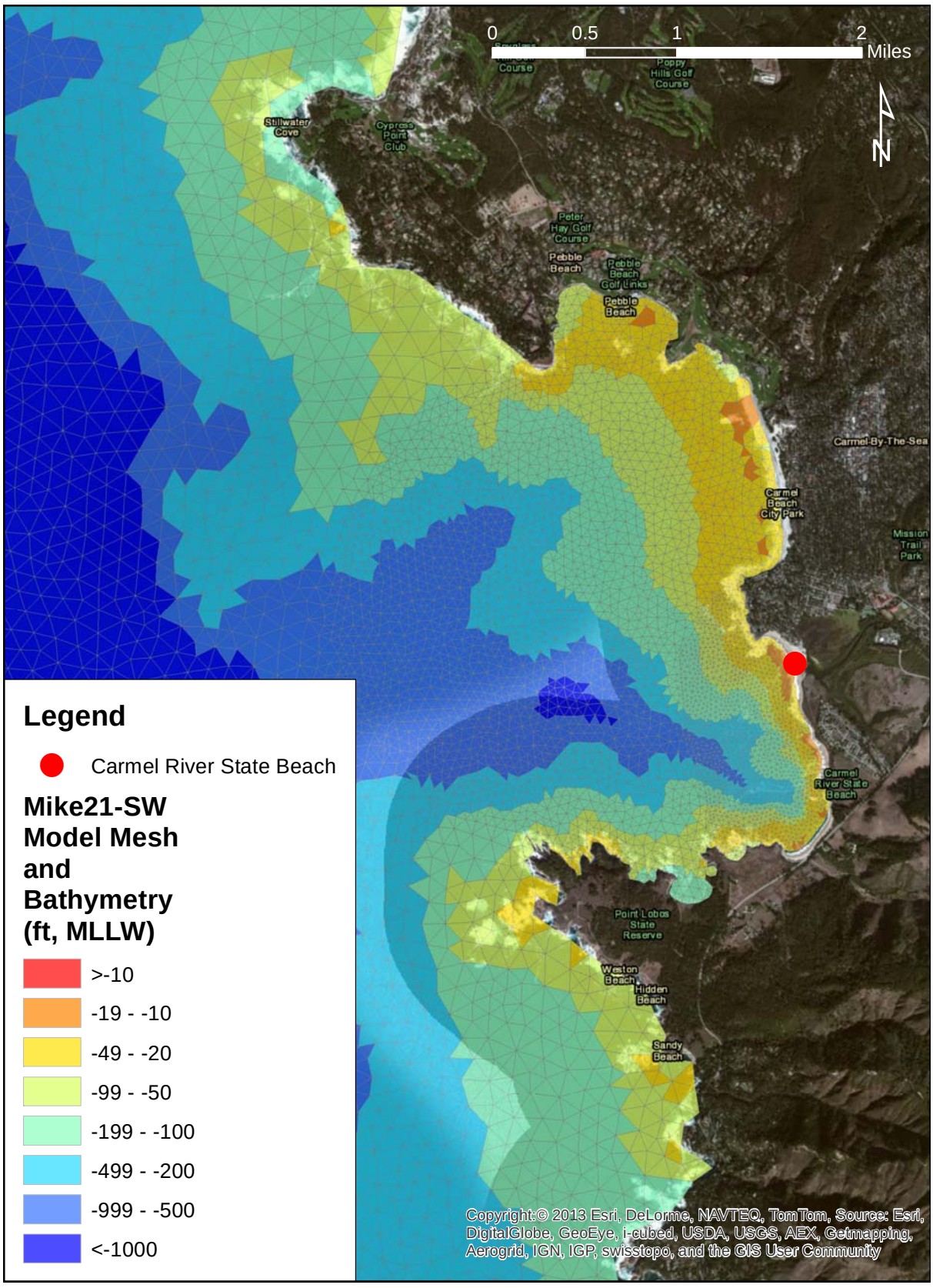


Figure 3-2: Mike21-SW Model Mesh and Bathymetry in Project Vicinity

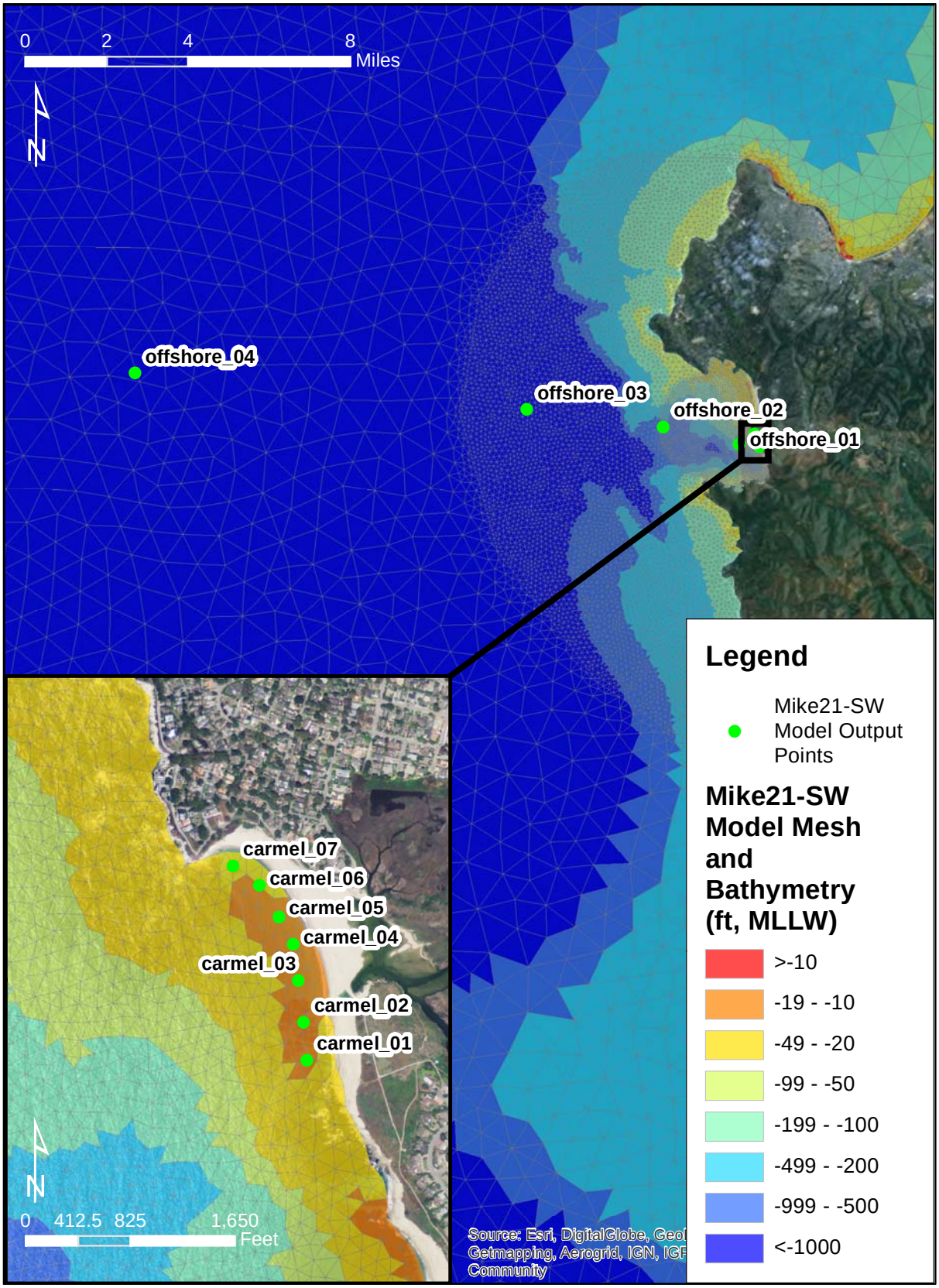


Figure 3-3: Mike21-SW Model Output Points

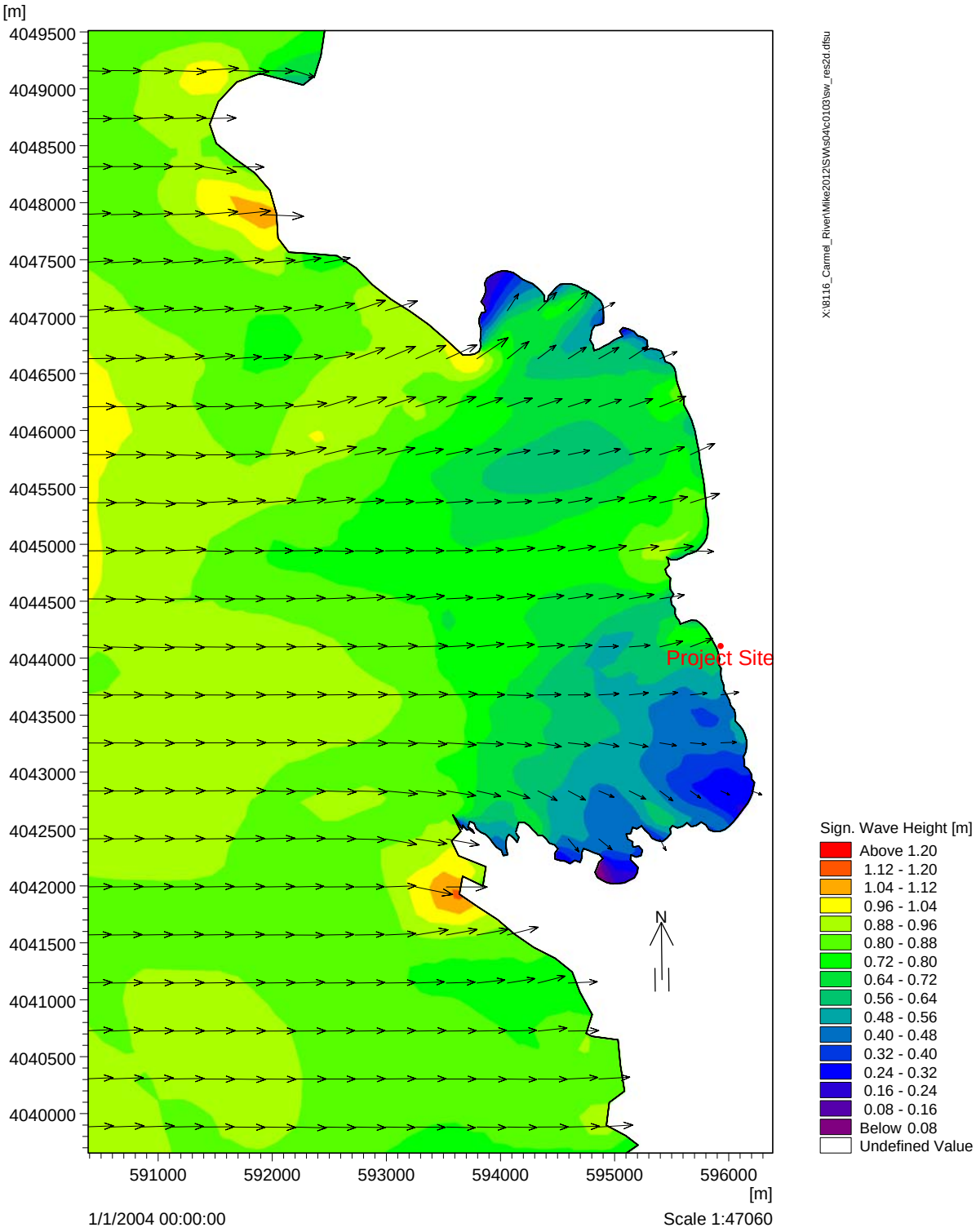


Figure 3-4: Example Model Output – Transformation of Unit Wave Height, 16 sec, 270° Swell

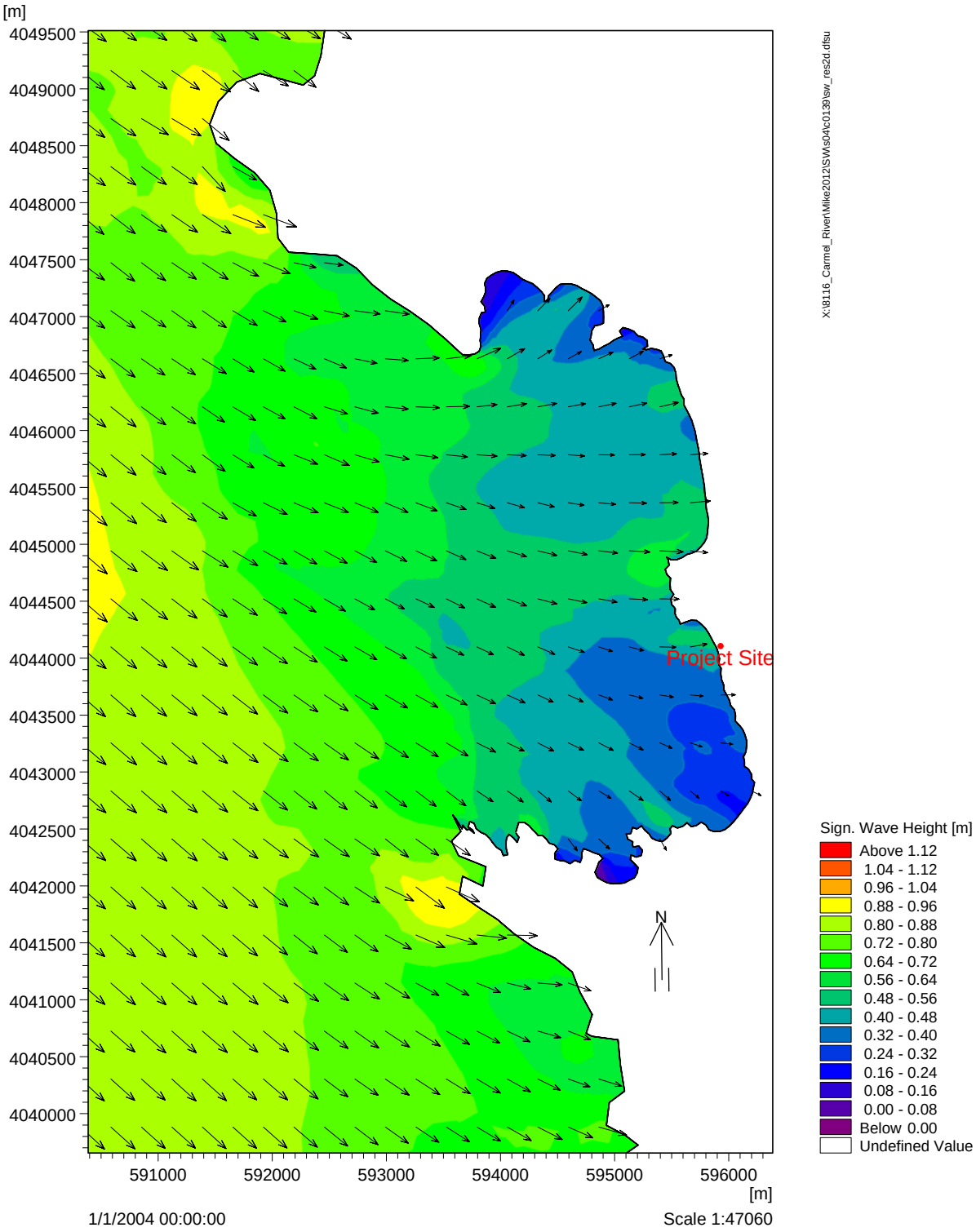


Figure 3-5: Example Model Output – Transformation of Unit Wave Height, 16 sec, 315° Swell

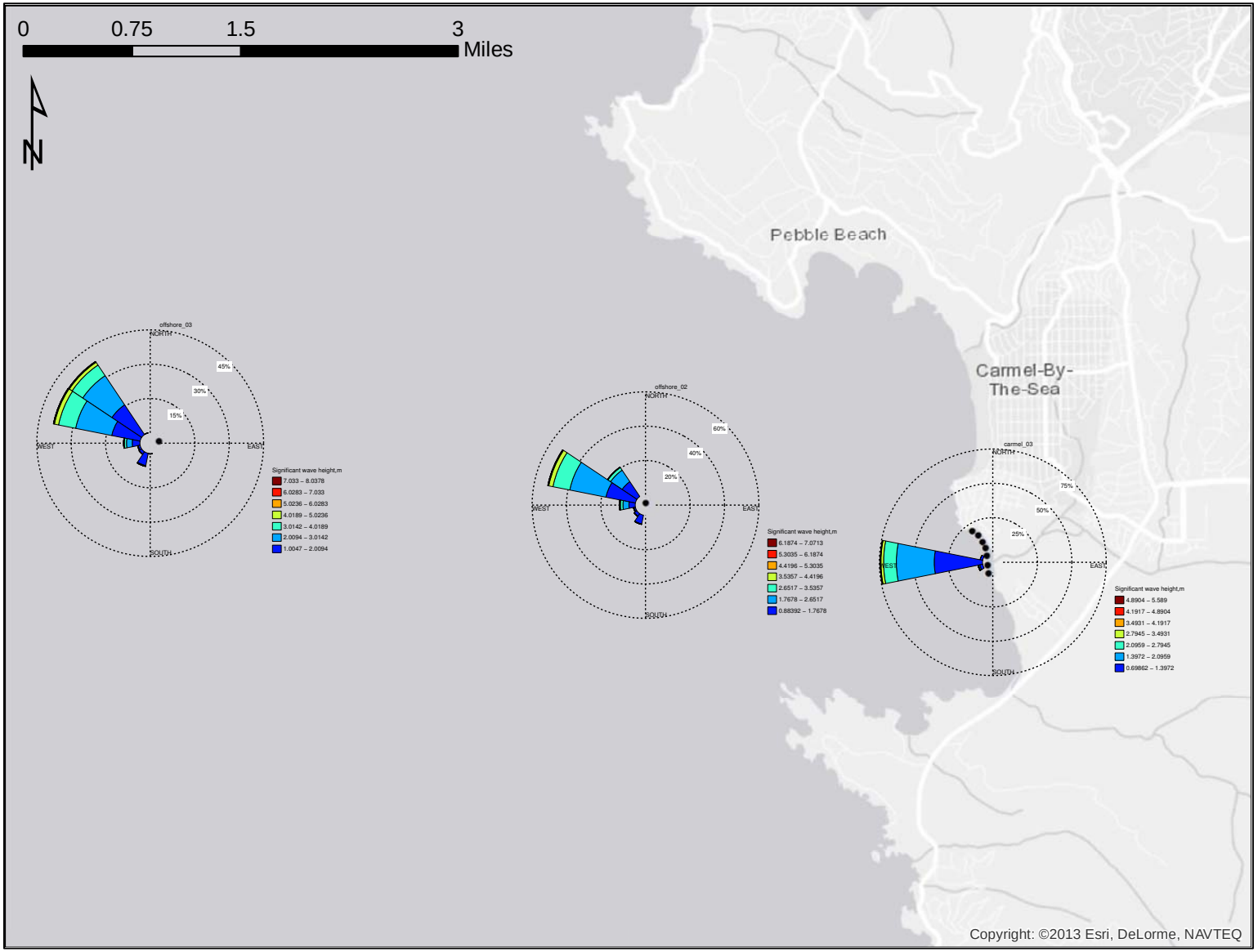


Figure 3-6: Swell Transformation from Offshore – H_s Roses at Selected Output Points

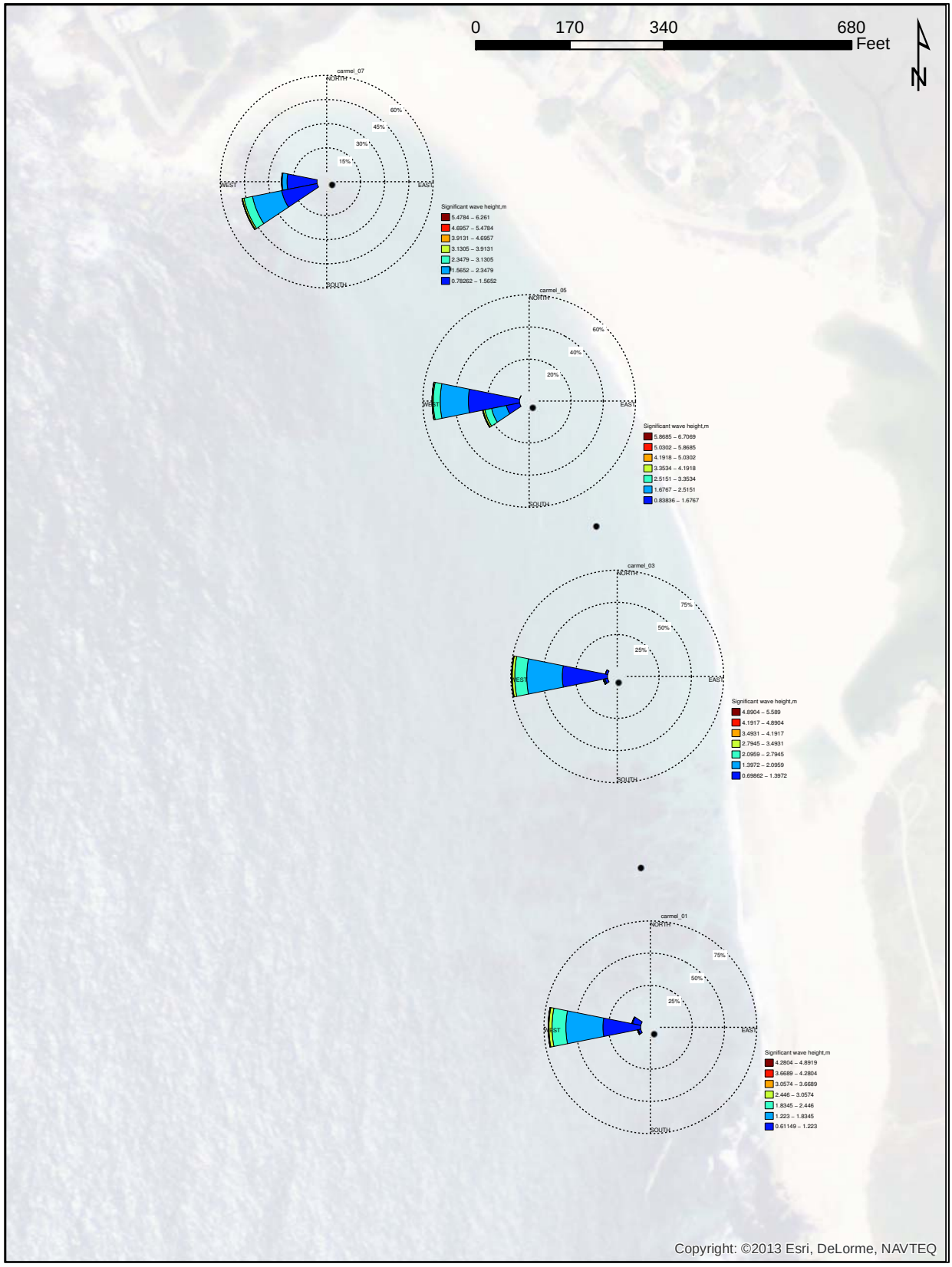


Figure 3-7: Wave Roses at Points along Carmel River State Beach

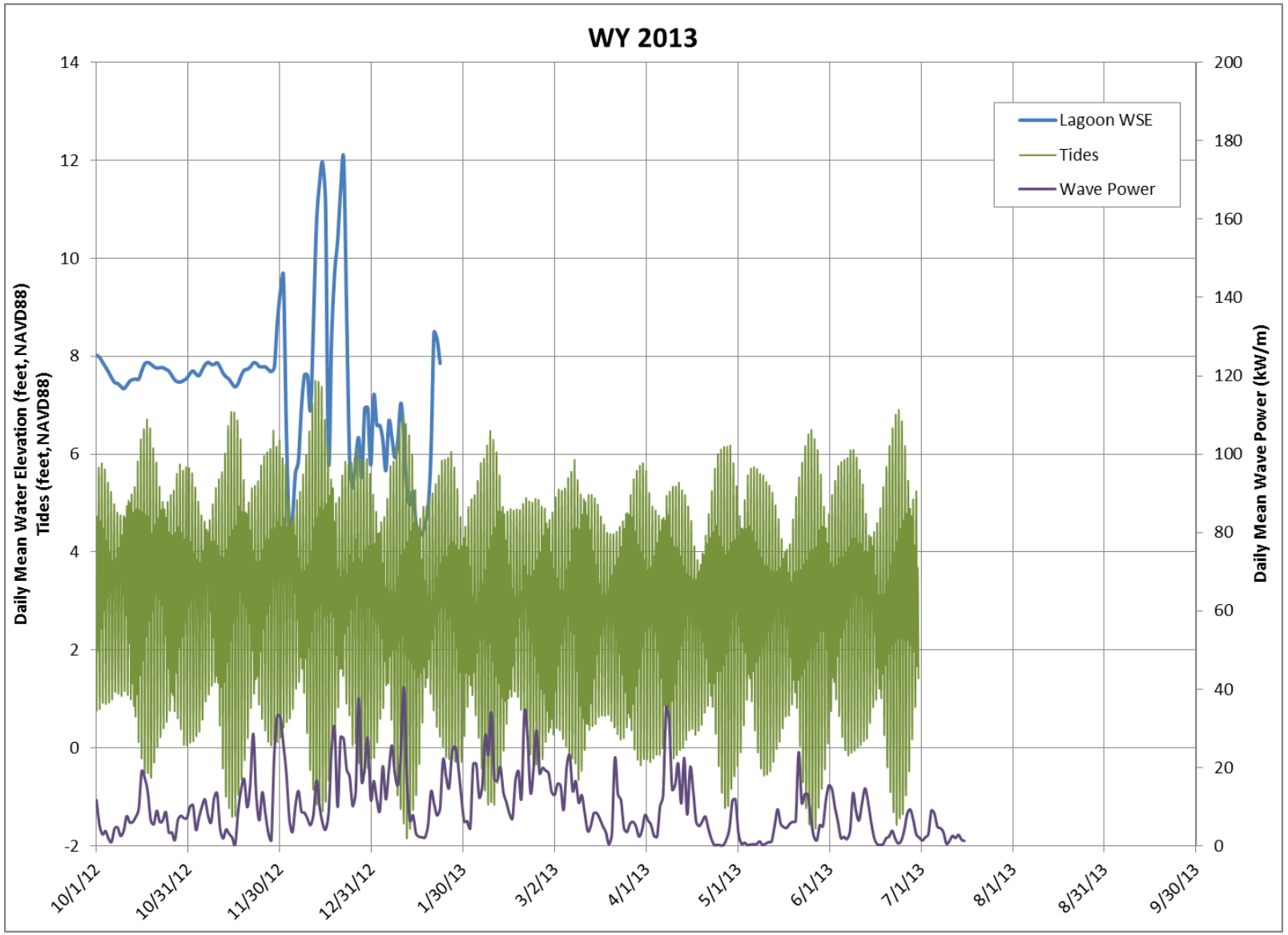


Figure 5-1: Water Year 2013, Annual – Carmel River Breaching and Relevant Processes

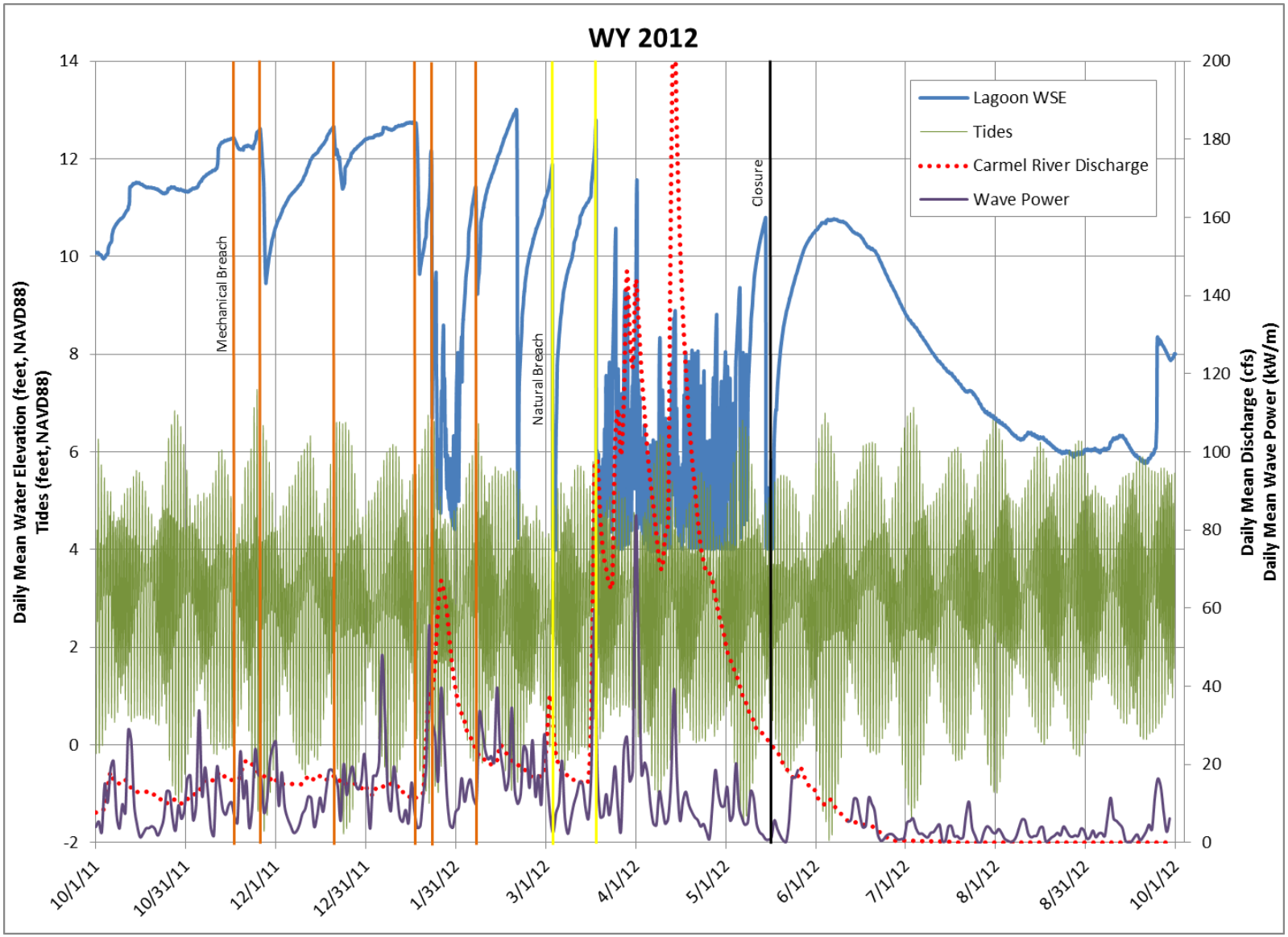


Figure 5-2: Water Year 2012, Annual – Carmel River Breaching and Relevant Processes

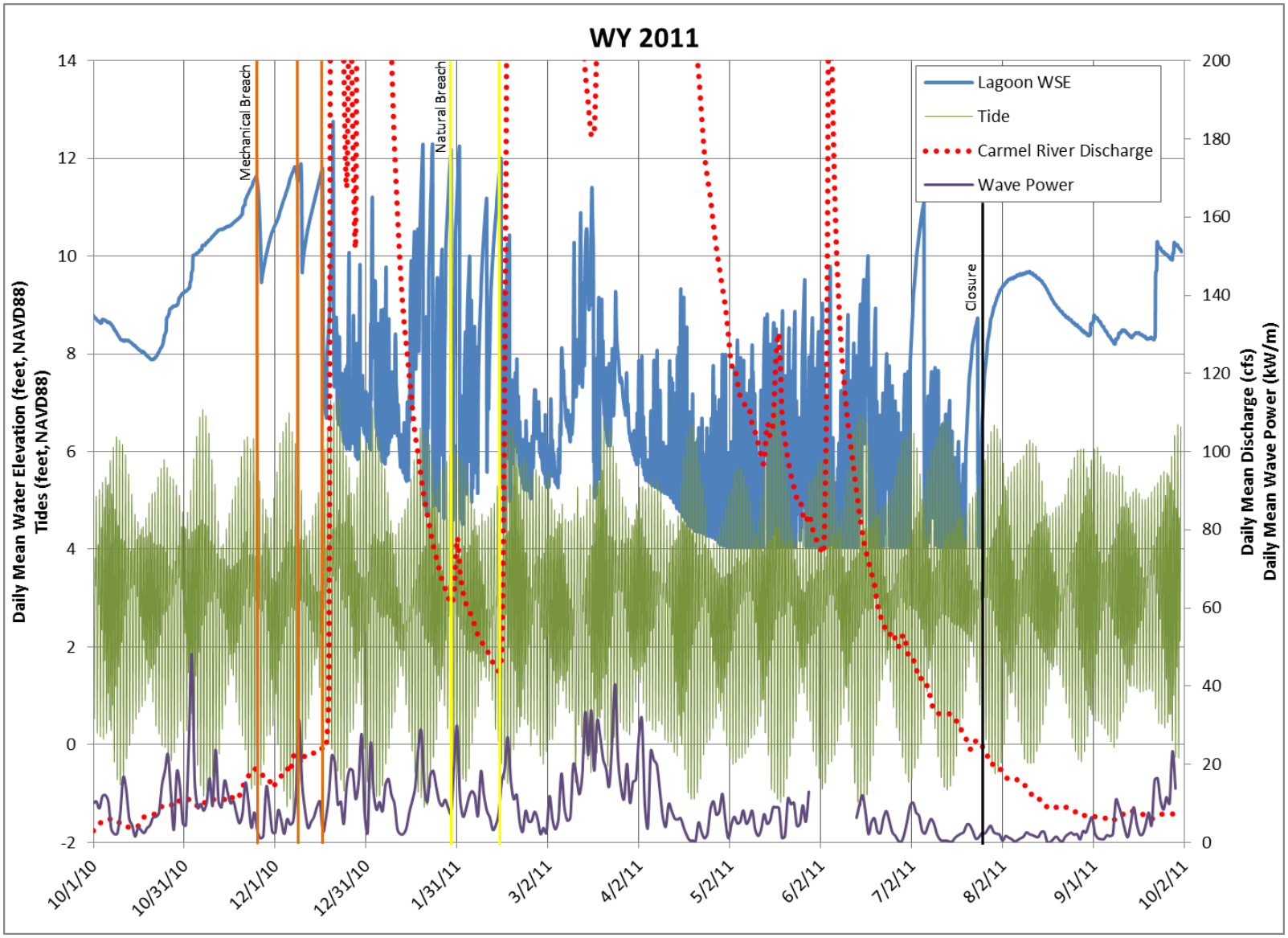


Figure 5-3: Water Year 2011, Annual – Carmel River Breaching and Relevant Processes

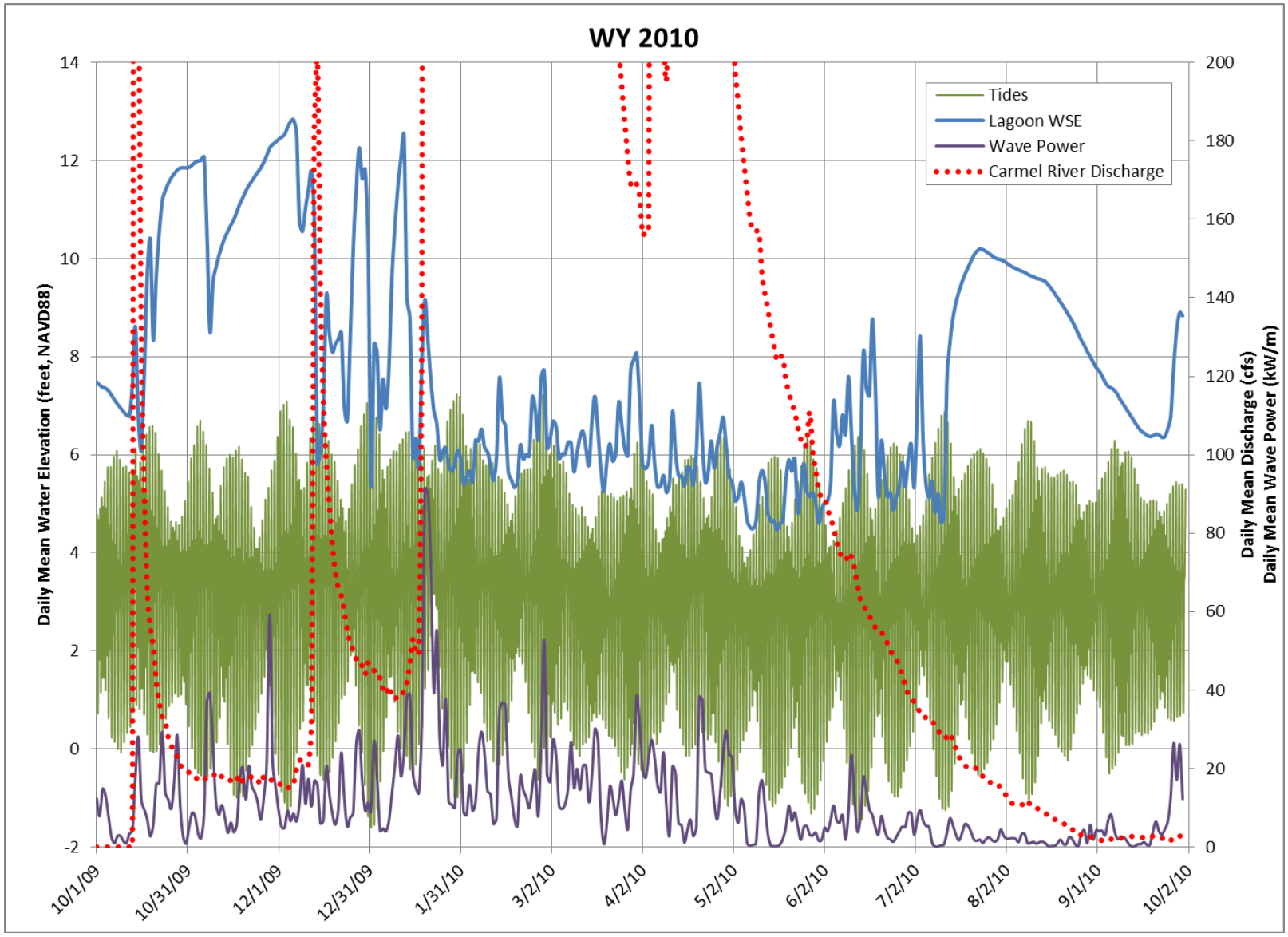


Figure 5-4: Water Year 2010, Annual – Carmel River Breaching and Relevant Processes

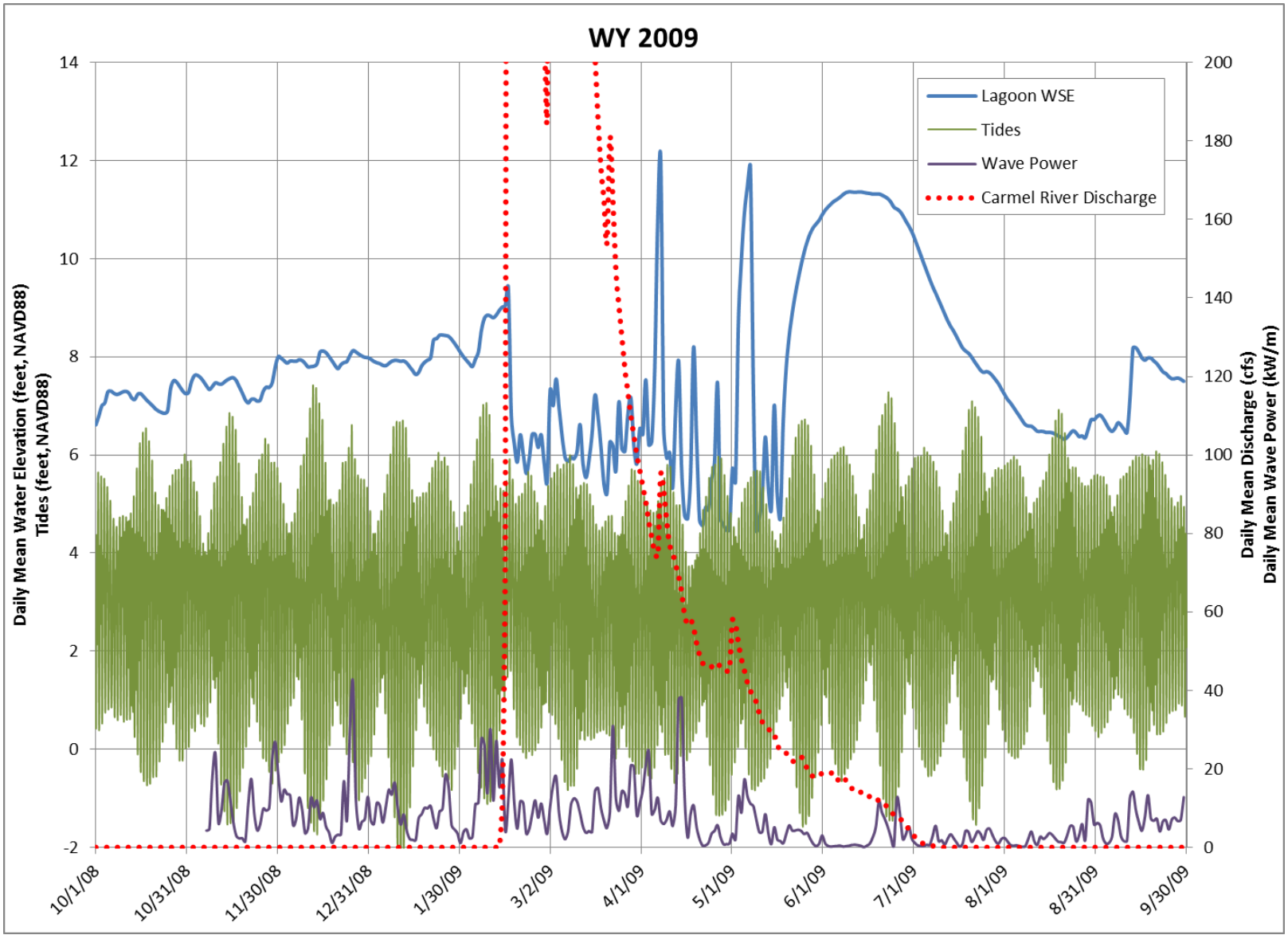


Figure 5-5: Water Year 2009, Annual – Carmel River Breaching and Relevant Processes

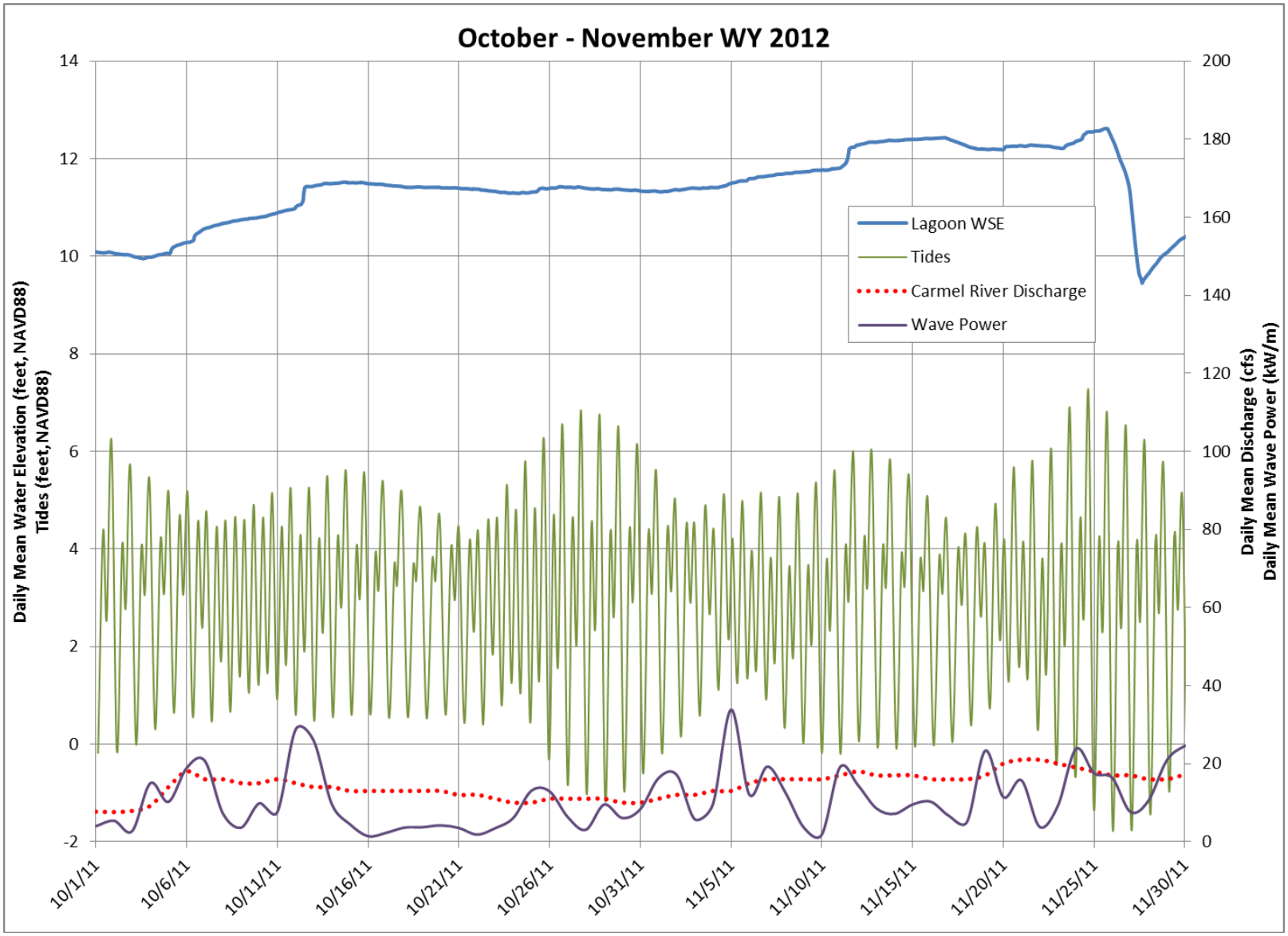


Figure 5-6: Water Year 2012, Oct-Nov – Carmel River Breaching and Relevant Processes

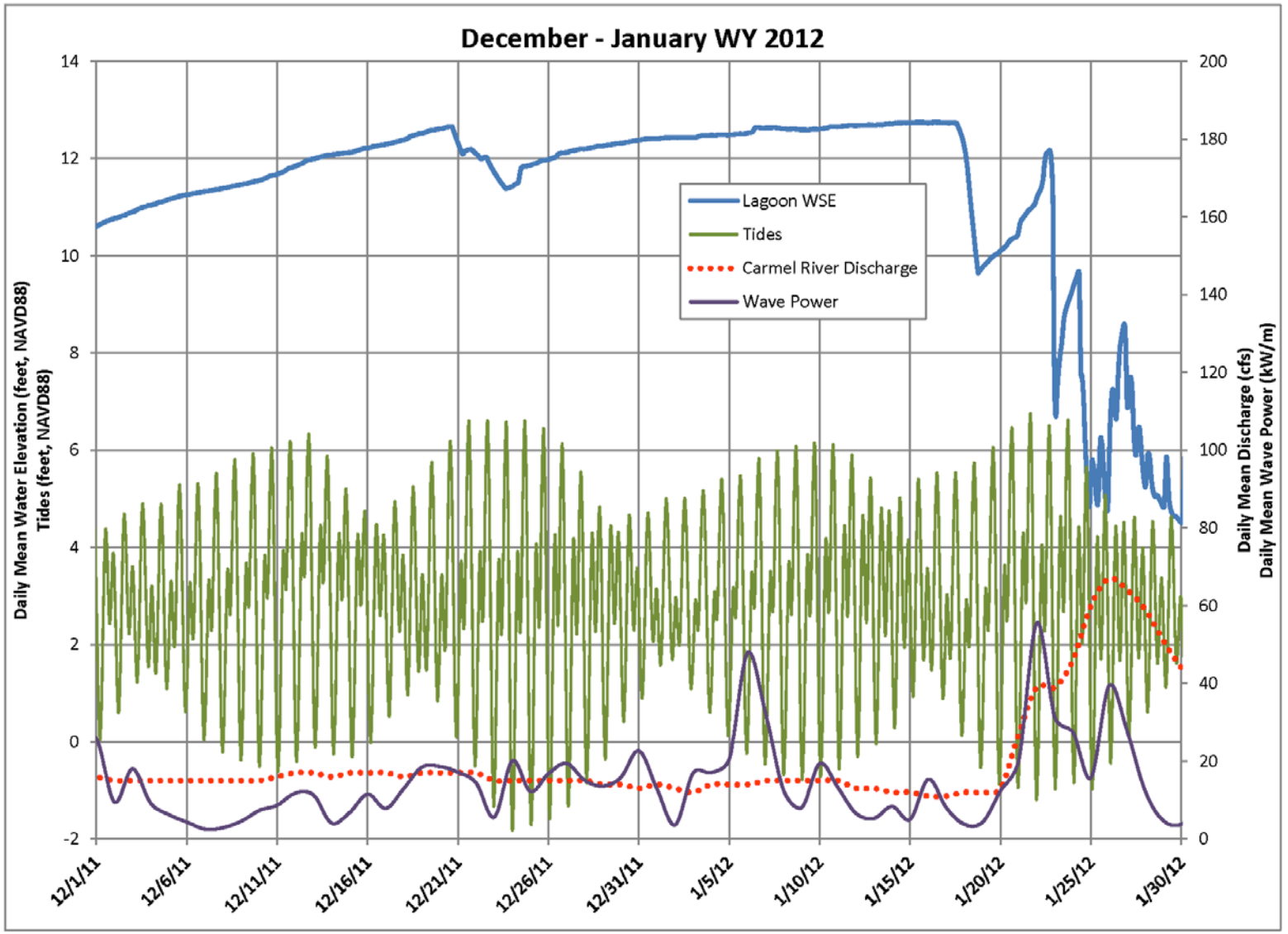


Figure 5-7: Water Year 2012, Dec-Jan – Carmel River Breaching and Relevant Processes

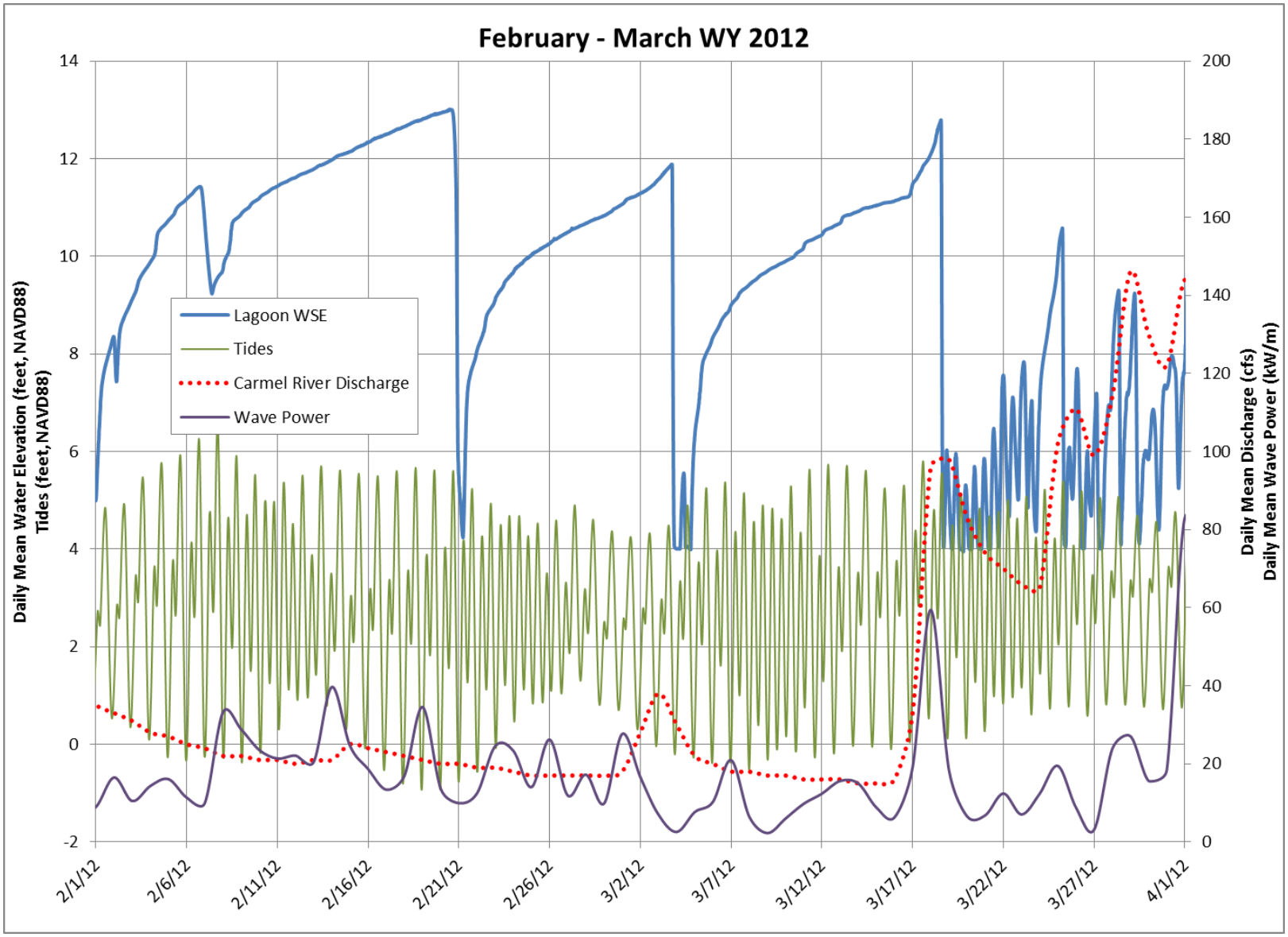


Figure 5-8: Water Year 2012, Feb-Mar – Carmel River Breaching and Relevant Processes

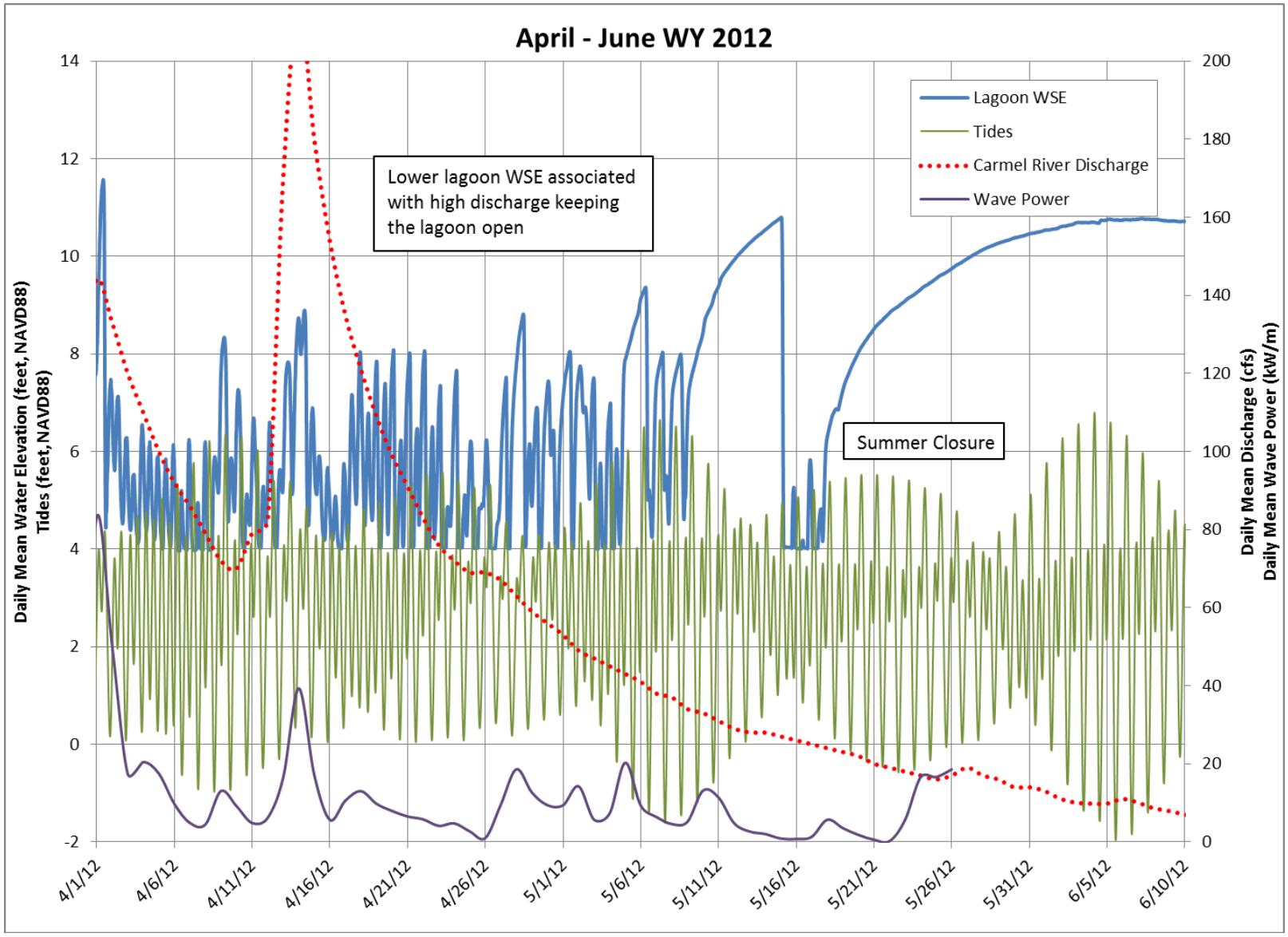


Figure 5-9: Water Year 2012, Apr-Jun – Carmel River Breaching and Relevant Processes

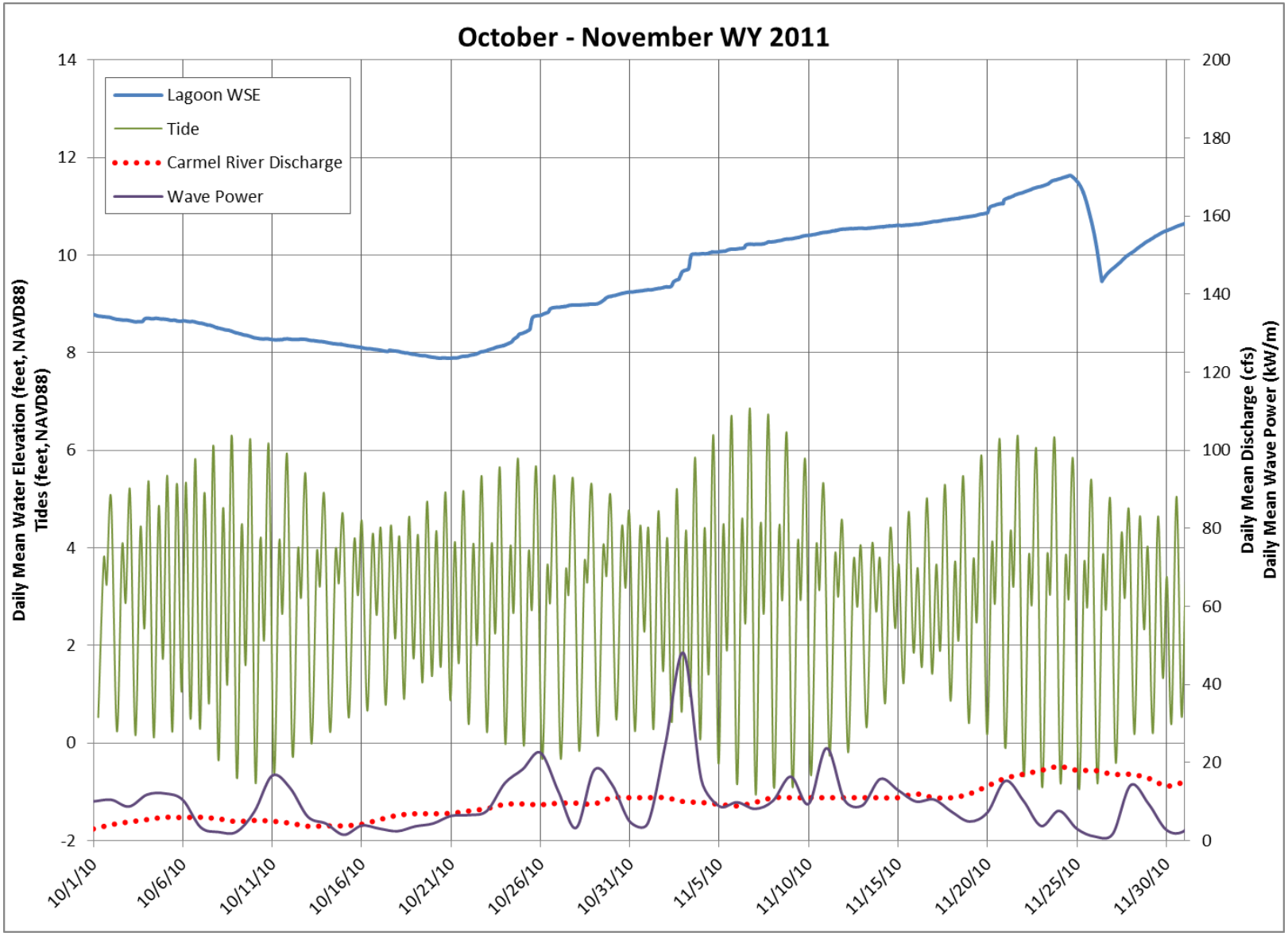


Figure 5-10: Water Year 2011, Oct-Nov – Carmel River Breaching and Relevant Processes

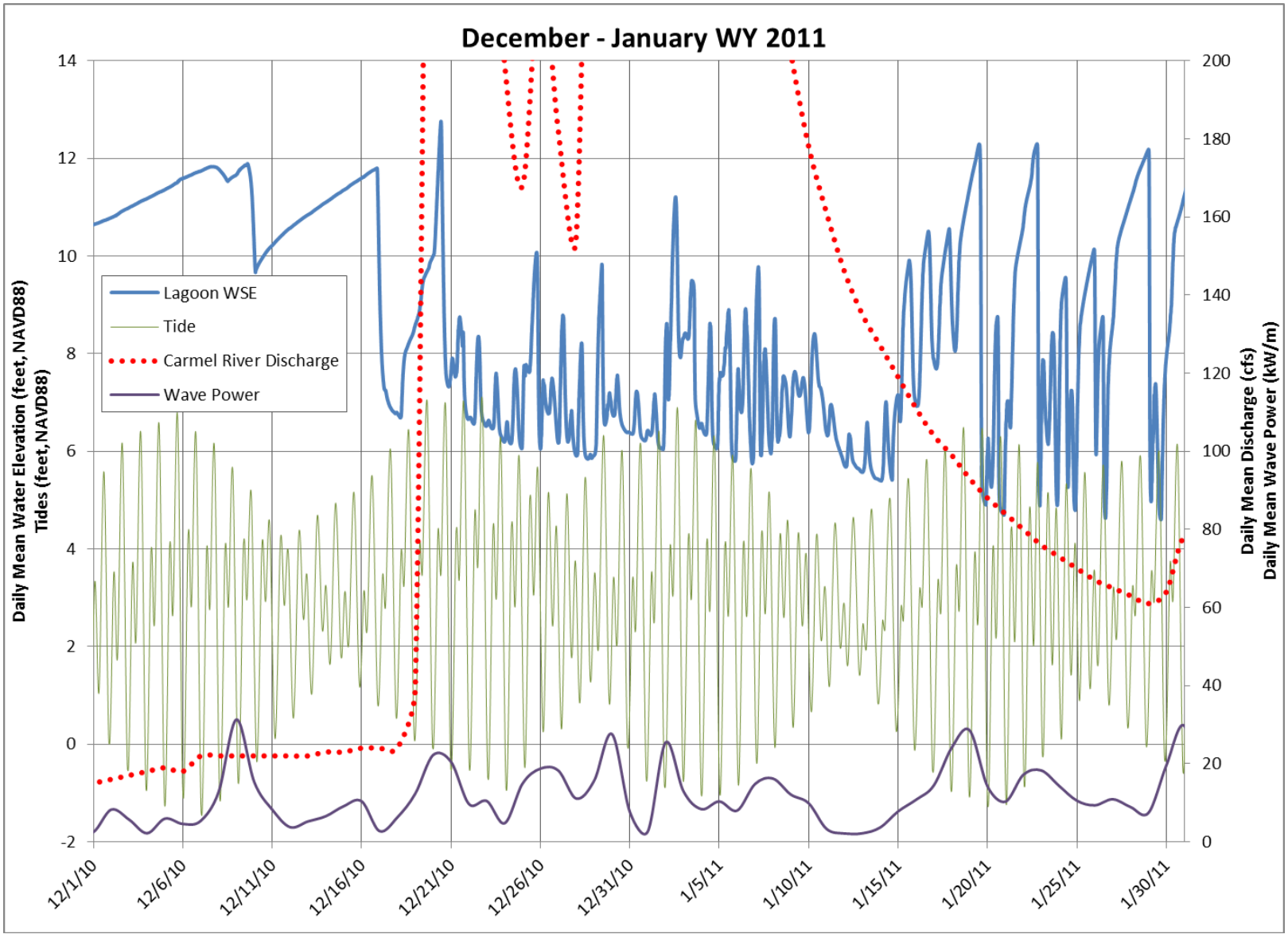


Figure 5-11: Water Year 2011, Dec-Jan – Carmel River Breaching and Relevant Processes

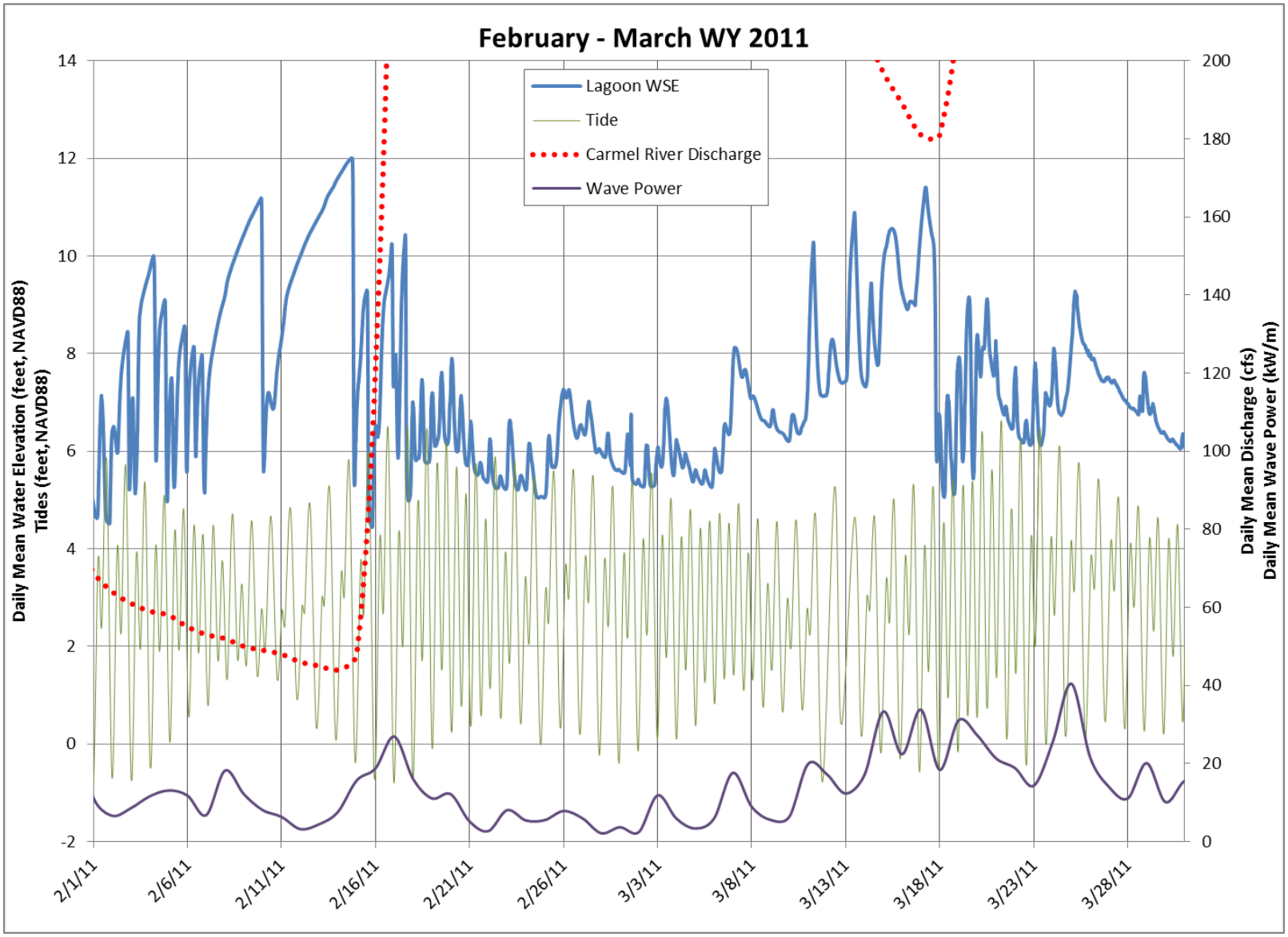


Figure 5-12: Water Year 2011, Feb-Mar – Carmel River Breaching and Relevant Processes

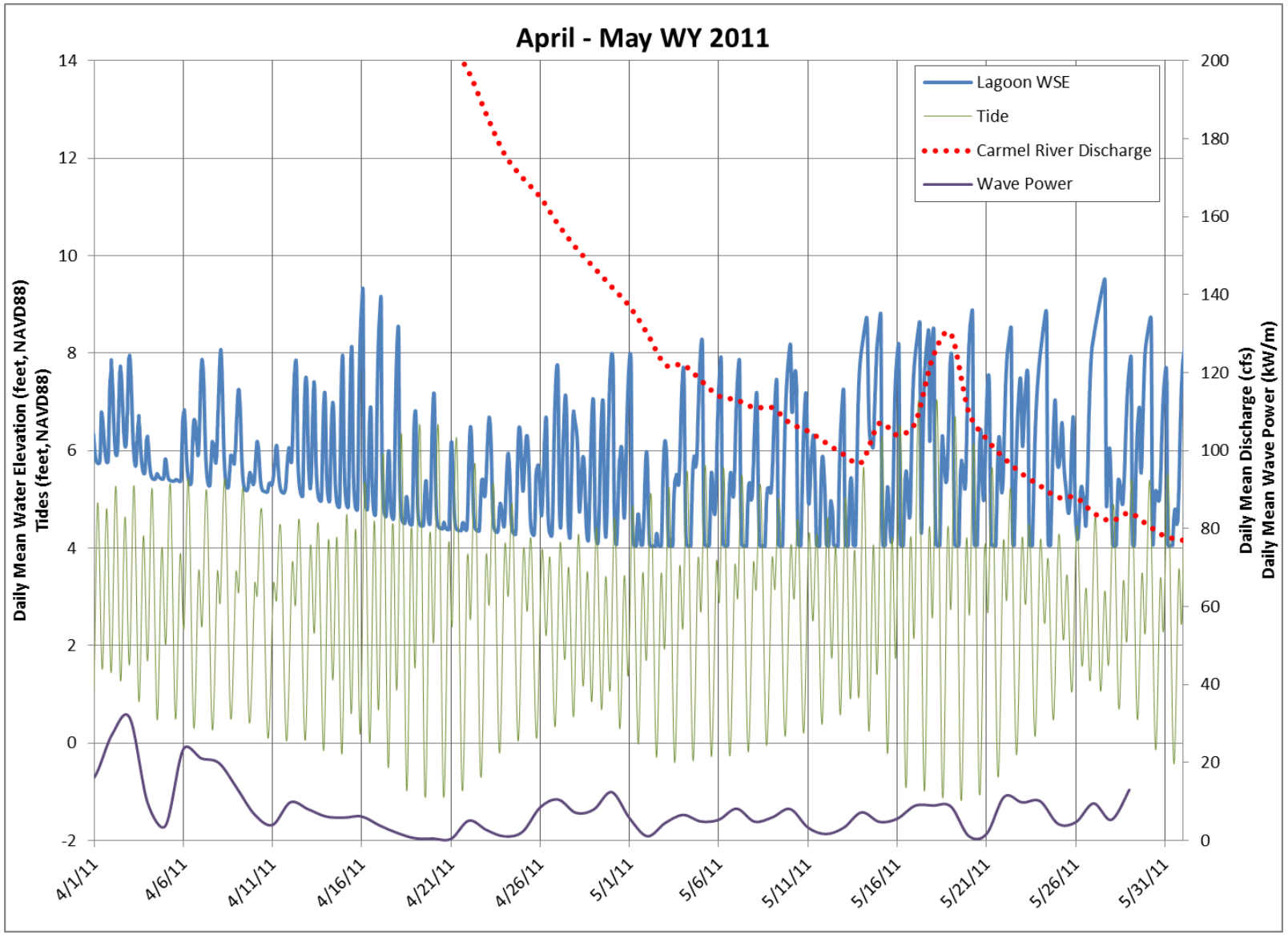


Figure 5-13: Water Year 2011, Apr-May – Carmel River Breaching and Relevant Processes

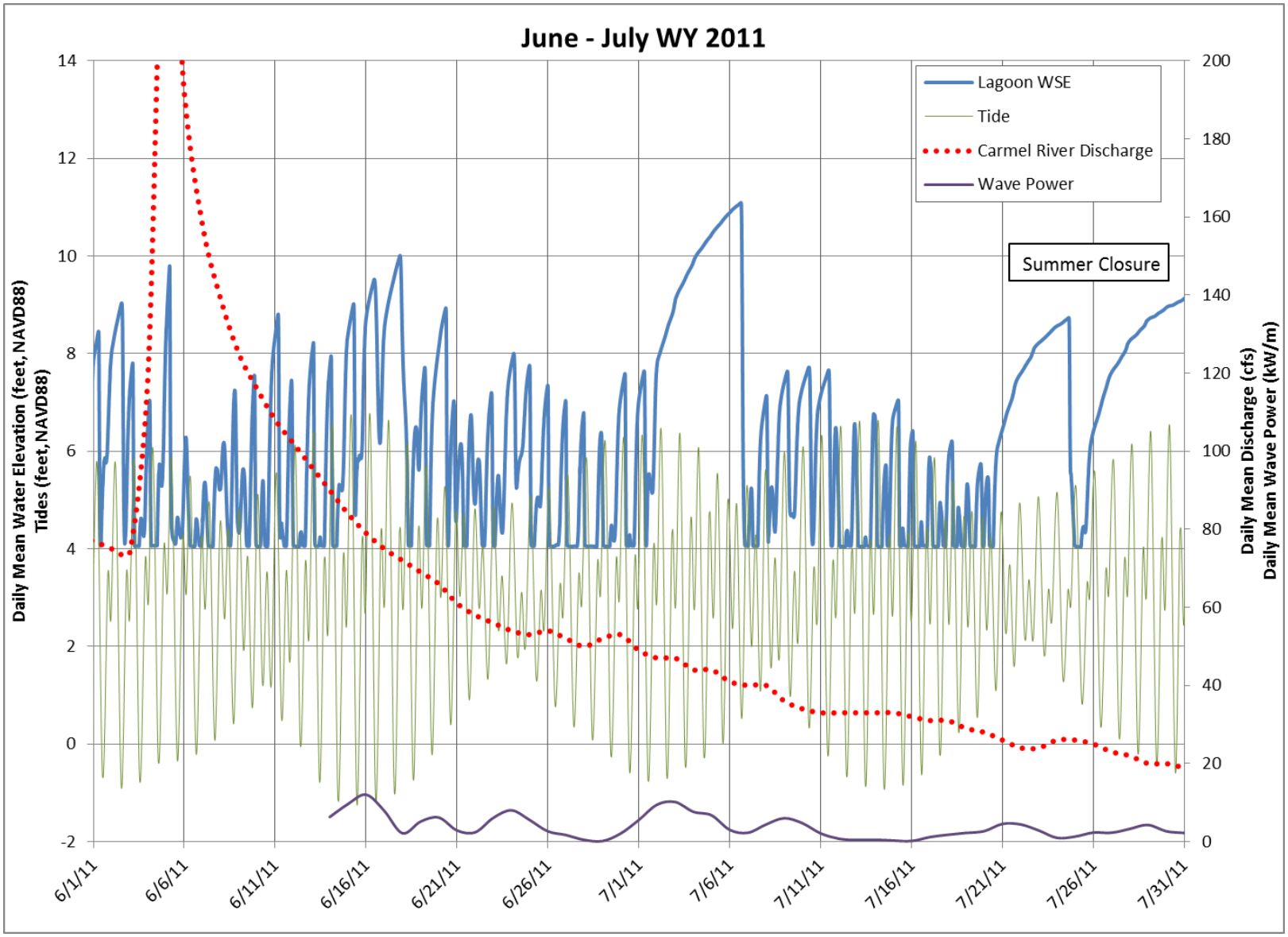
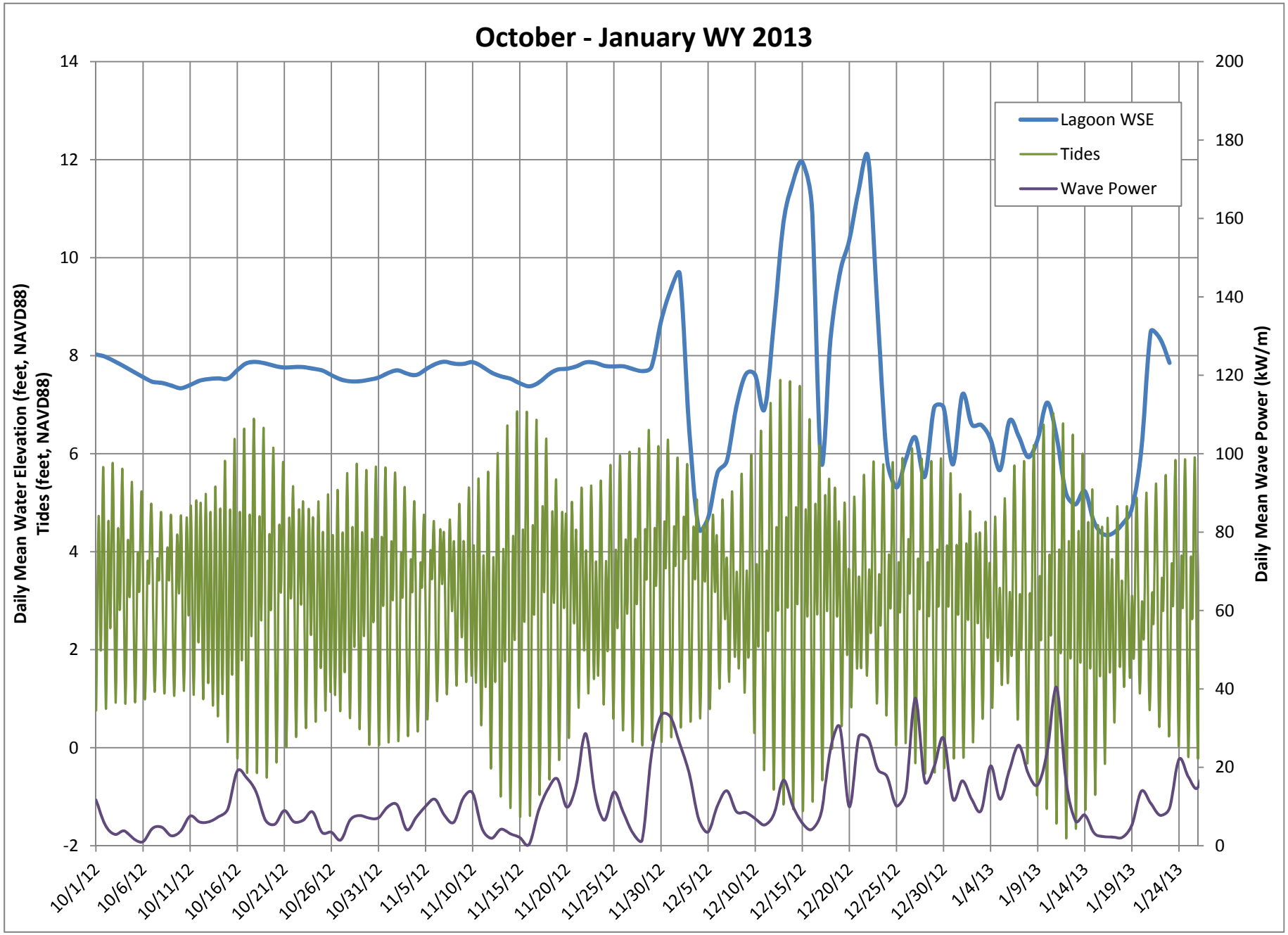


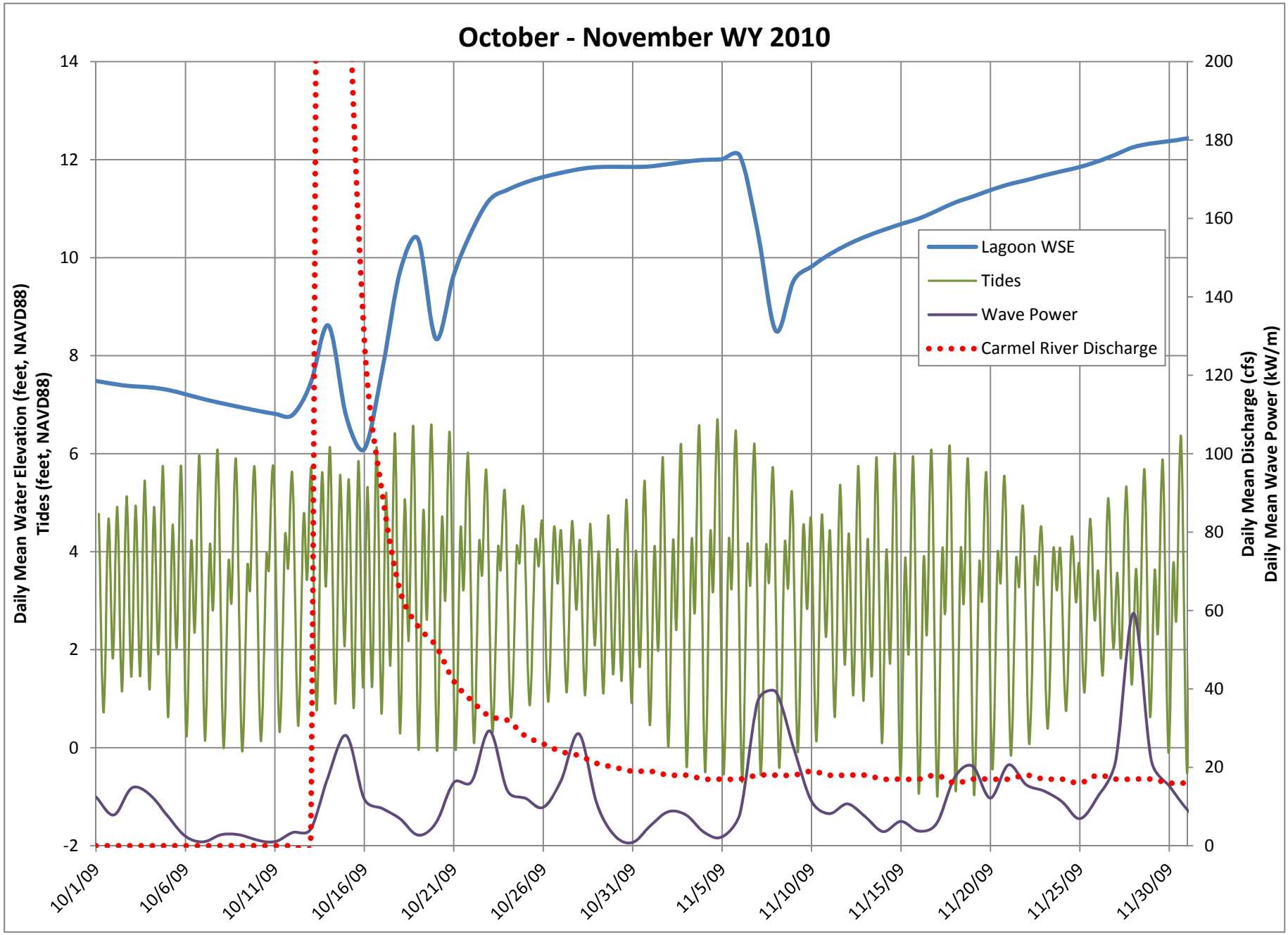
Figure 5-14: Water Year 2011, June-July – Carmel River Breaching and Relevant Processes

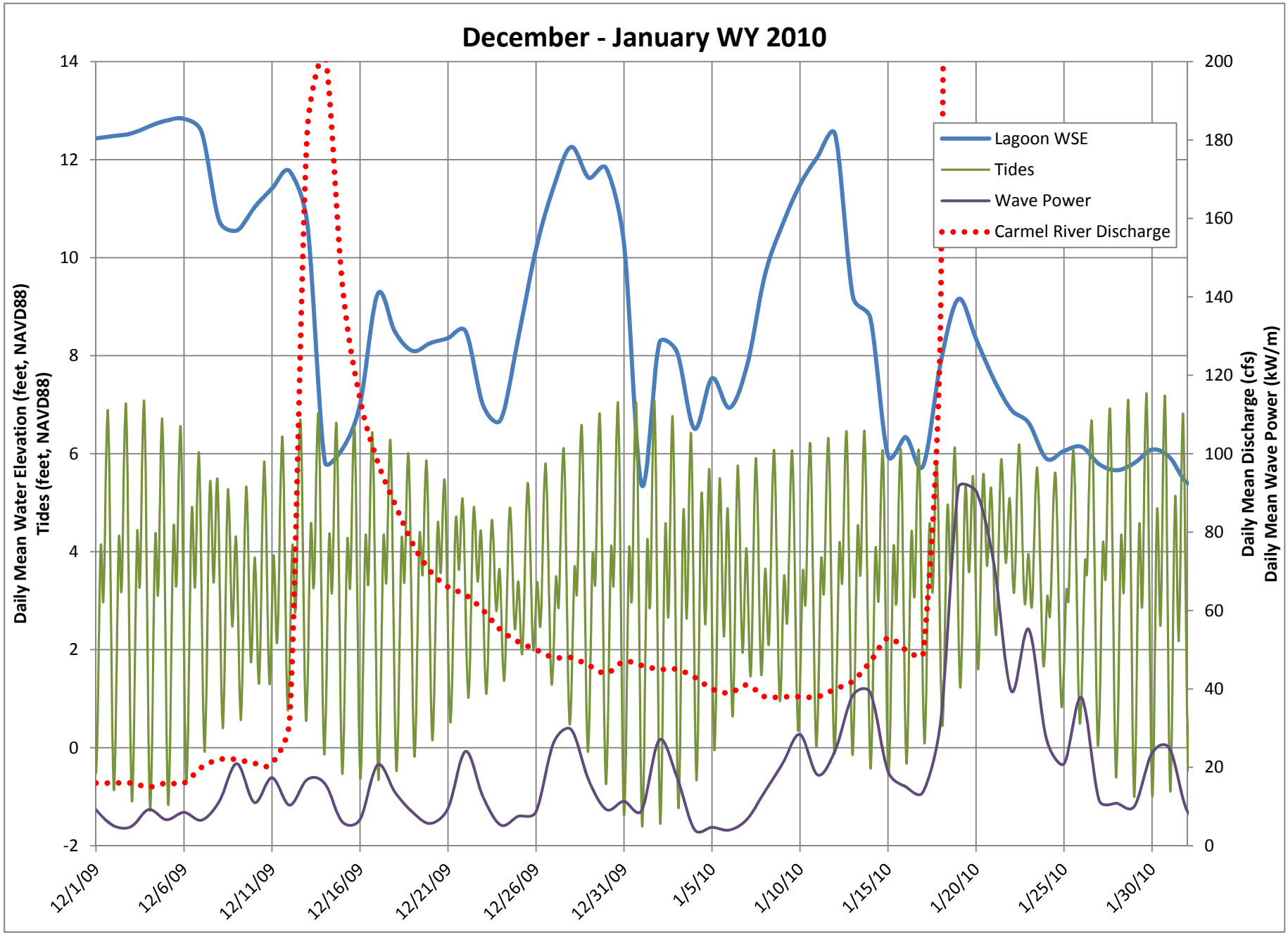
APPENDIX A

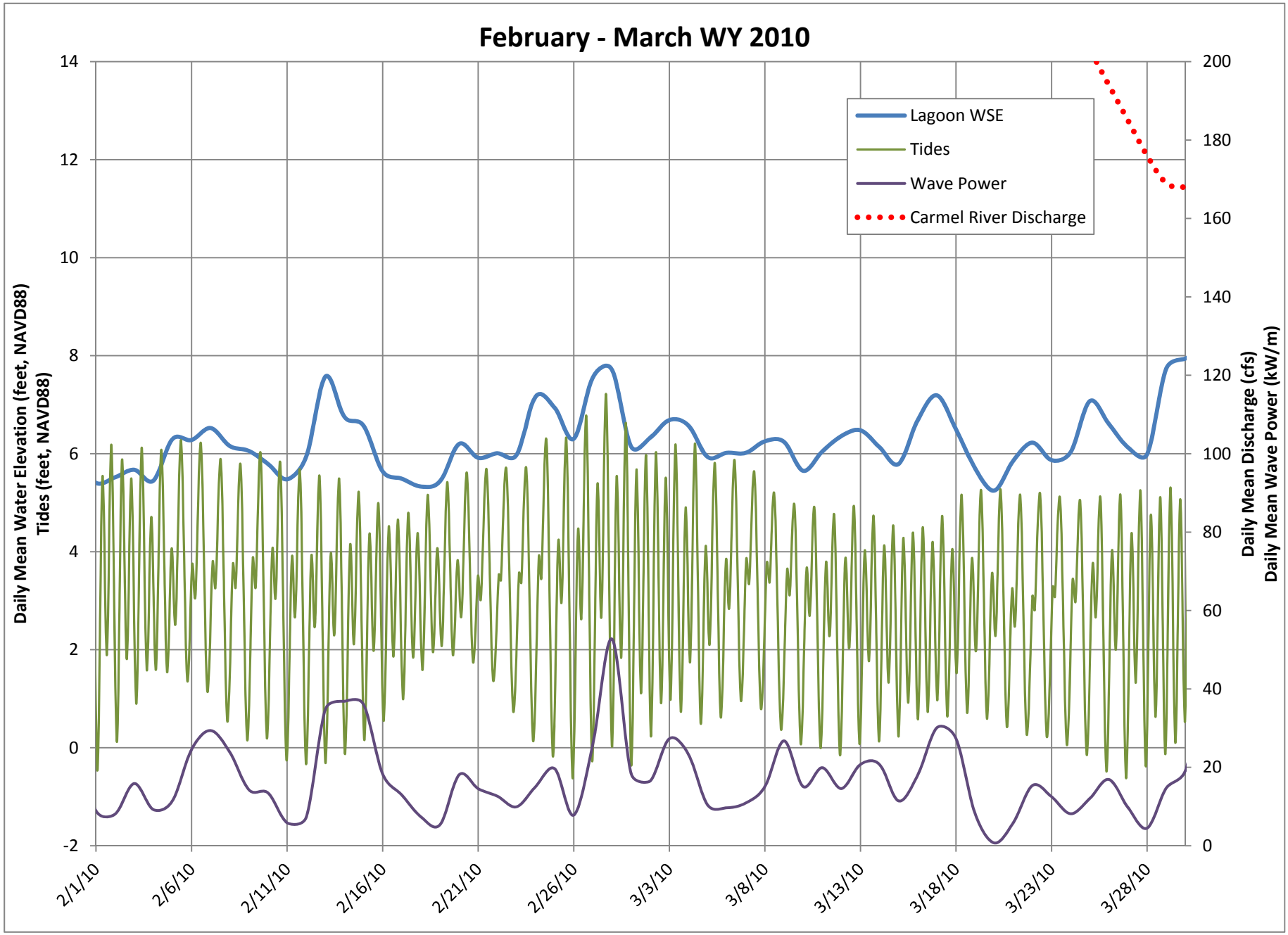
Carmel River Breaching and Relevant Processes

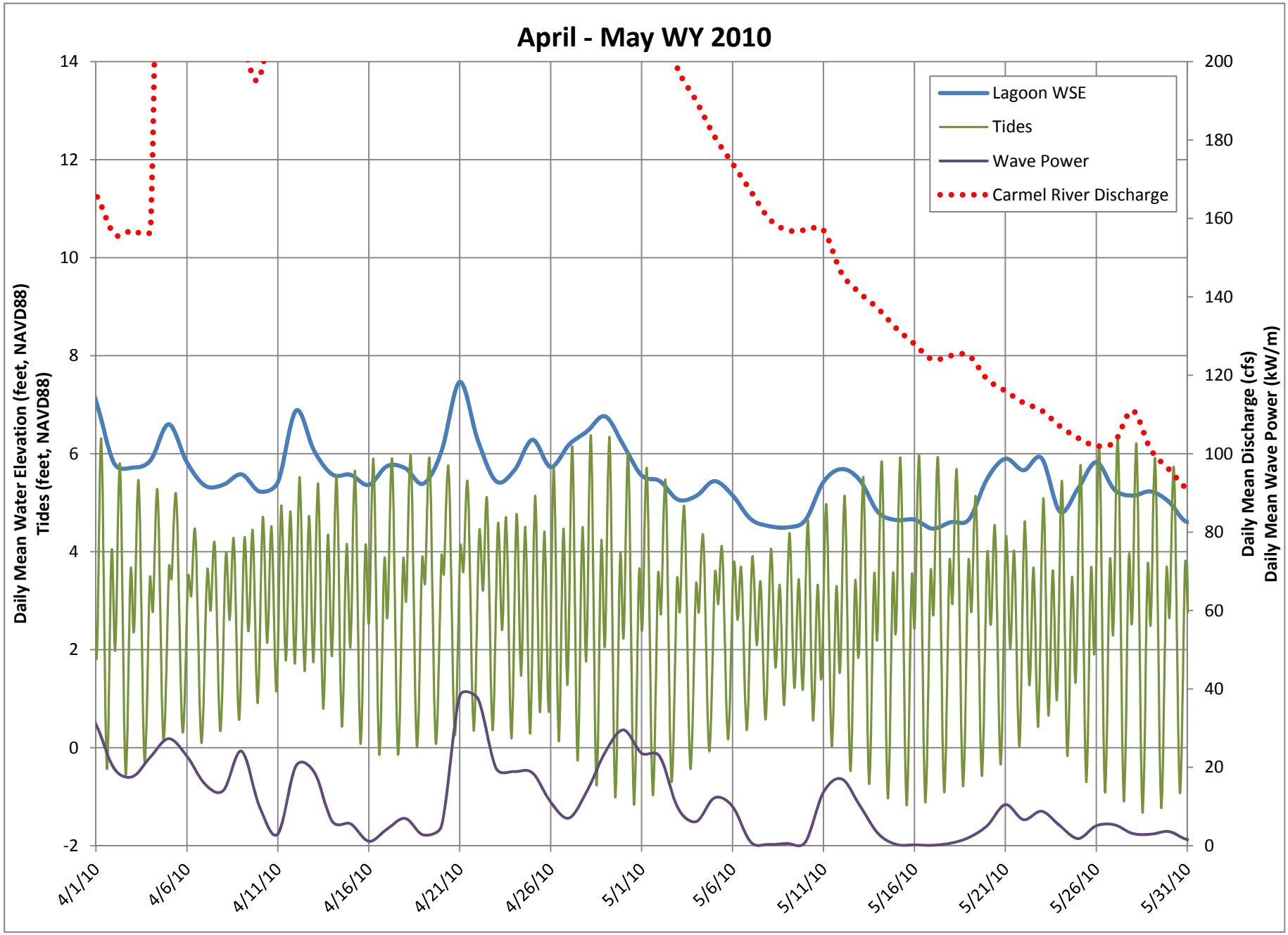
Monthly Figures Water Years 2013, 2010, 2009

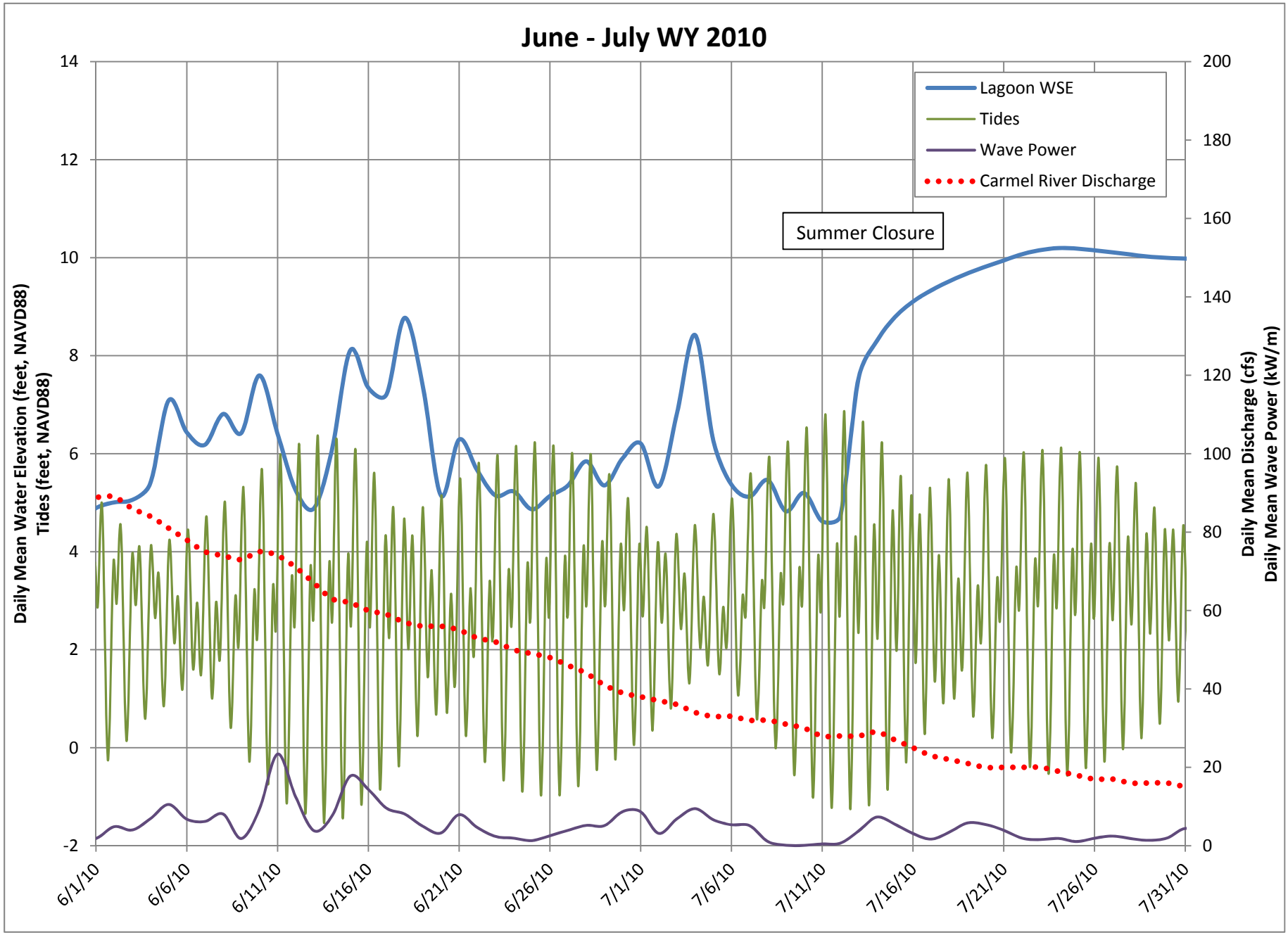

October - January WY 2013
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
10/1/12
10/6/12
10/11/12
10/16/12
10/21/12
10/26/12
10/31/12
11/5/12
11/10/12
11/15/12
11/20/12
11/25/12
11/30/12
12/5/12
12/10/12
12/15/12
12/20/12
12/25/12
12/30/12
1/4/13
1/9/13
1/14/13
1/19/13
1/24/13

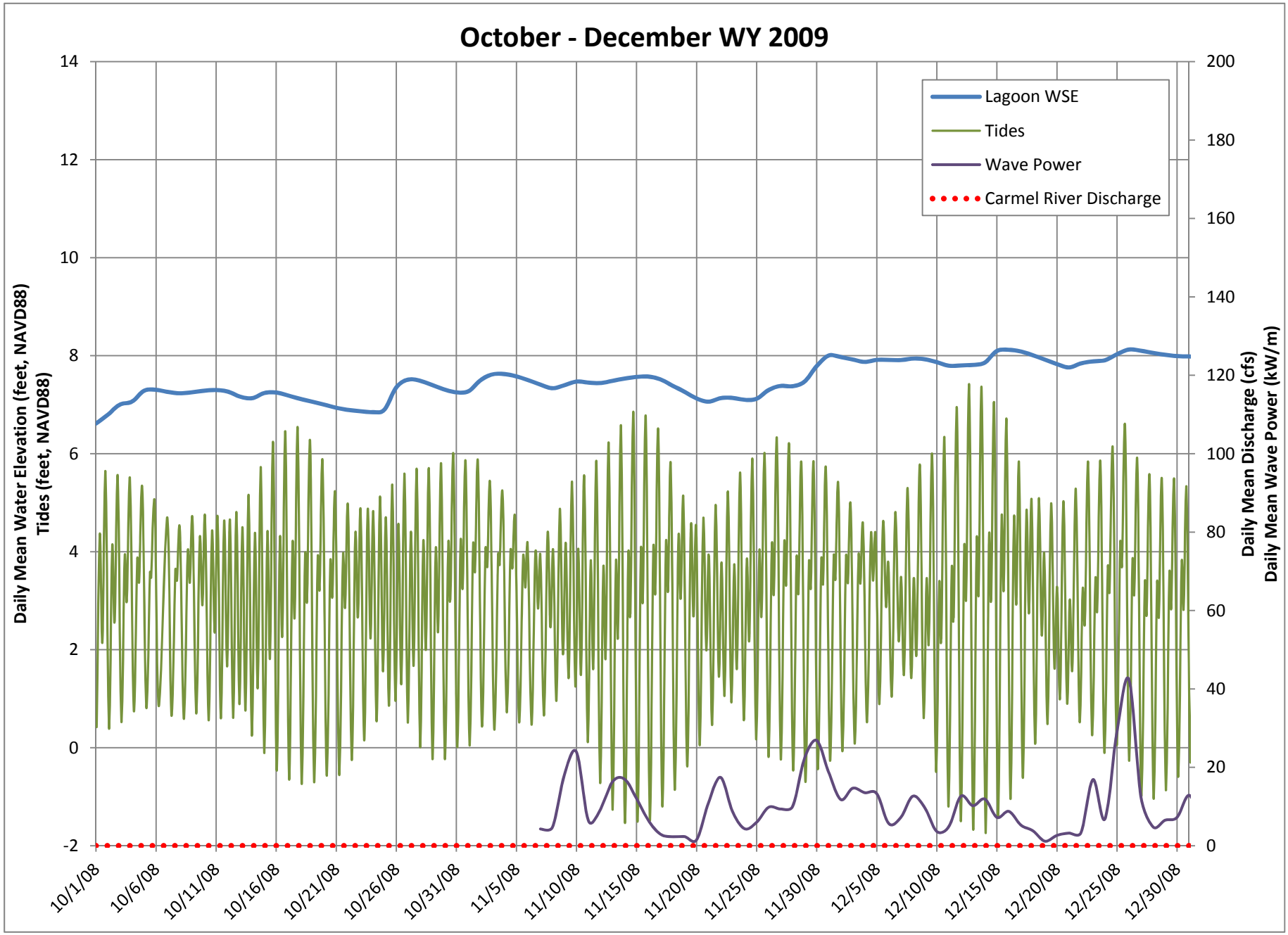

October - November WY 2010
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
10/1/09
10/6/09
10/11/09
10/16/09
10/21/09
10/26/09
10/31/09
11/5/09
11/10/09
11/15/09
11/20/09
11/25/09
11/30/09

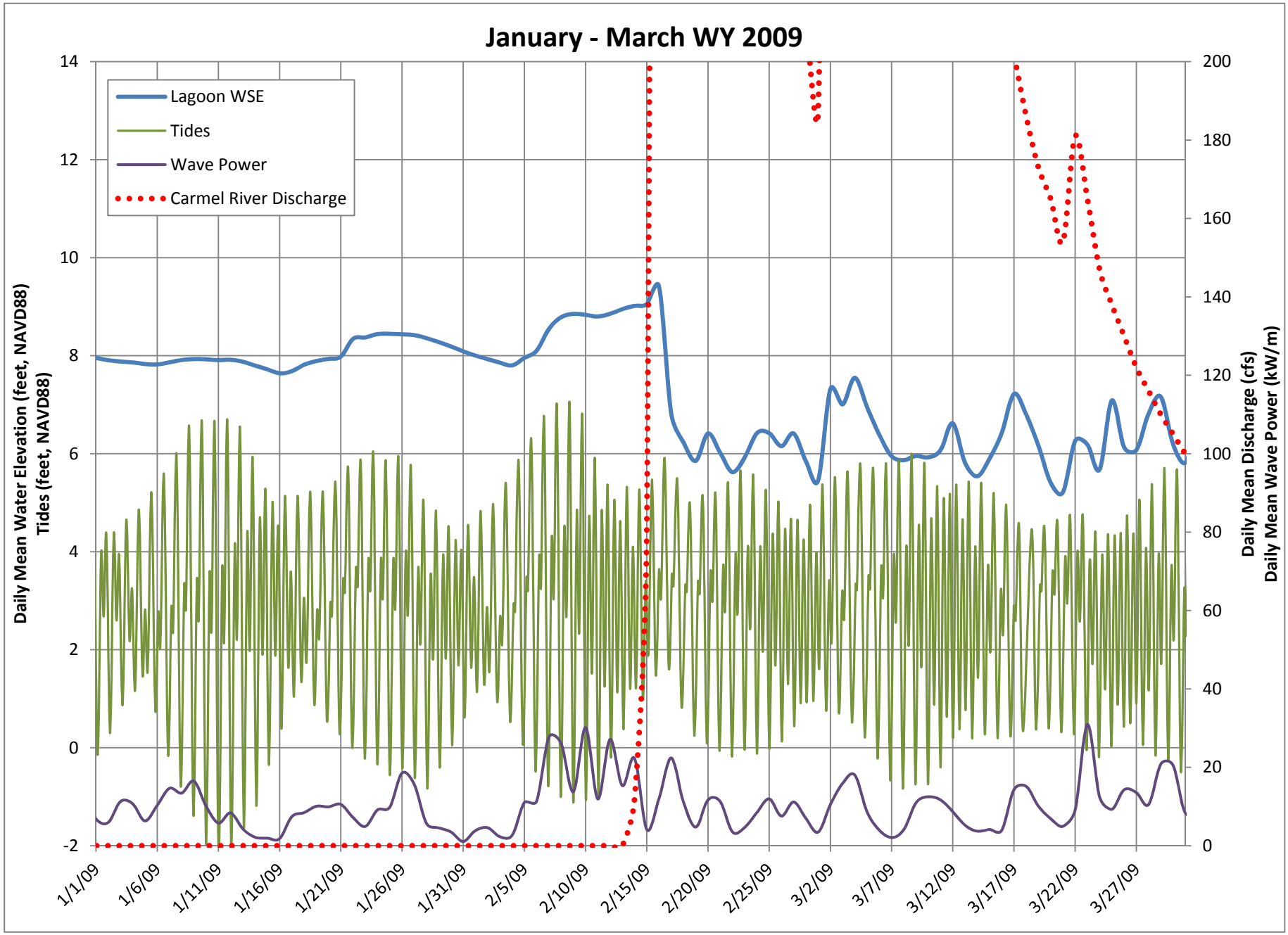

December - January WY 2010
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
12/1/09
12/6/09
12/11/09
12/16/09
12/21/09
12/26/09
12/31/09
1/5/10
1/10/10
1/15/10
1/20/10
1/25/10
1/30/10

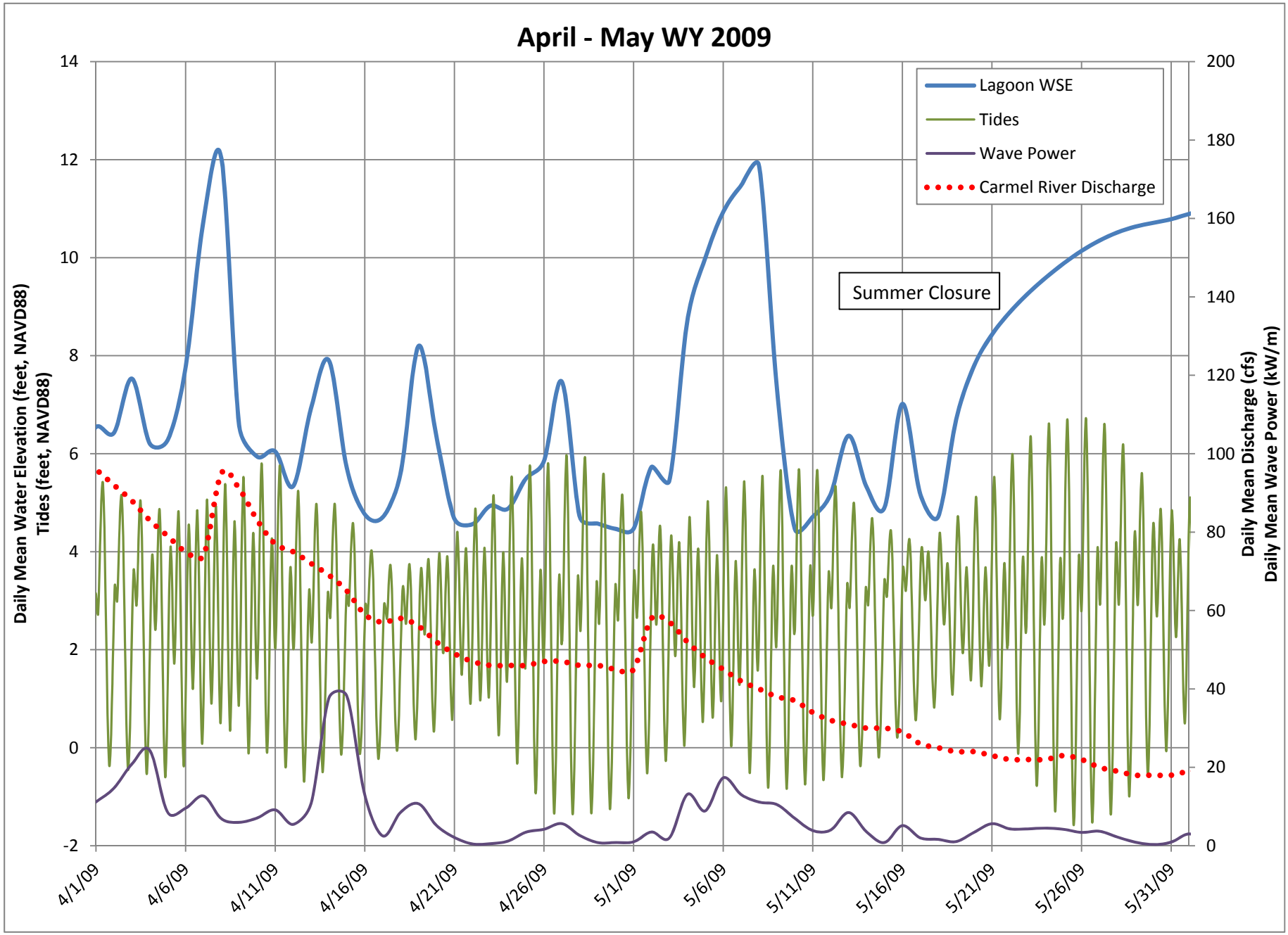

February - March WY 2010
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
2/1/10
2/6/10
2/11/10
2/16/10
2/21/10
2/26/10
3/3/10
3/8/10
3/13/10
3/18/10
3/23/10
3/28/10


April - May WY 2010
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
4/1/10
4/6/10
4/11/10
4/16/10
4/21/10
4/26/10
5/1/10
5/6/10
5/11/10
5/16/10
5/21/10
5/26/10
5/31/10


June - July WY 2010
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Summer Closure
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
6/1/10
6/6/10
6/11/10
6/16/10
6/21/10
6/26/10
7/1/10
7/6/10
7/11/10
7/16/10
7/21/10
7/26/10
7/31/10


October - December WY 2009
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
10/1/08
10/6/08
10/11/08
10/16/08
10/21/08
10/26/08
10/31/08
11/5/08
11/10/08
11/15/08
11/20/08
11/25/08
11/30/08
12/5/08
12/10/08
12/15/08
12/20/08
12/25/08
12/30/08

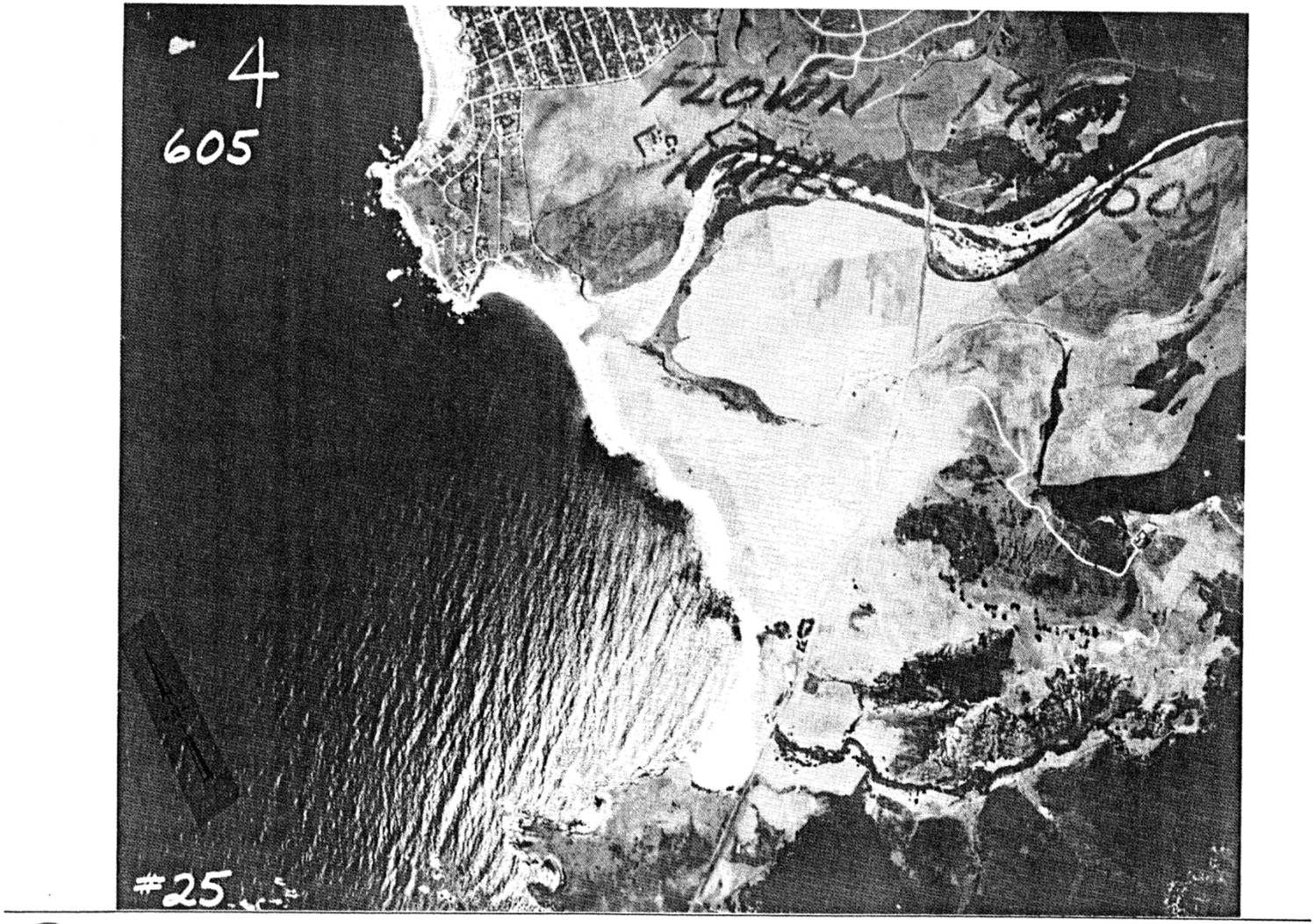

January - March WY 2009
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
1/1/09
1/6/09
1/11/09
1/16/09
1/21/09
1/26/09
1/31/09
2/5/09
2/10/09
2/15/09
2/20/09
2/25/09
3/2/09
3/7/09
3/12/09
3/17/09
3/22/09
3/27/09


April - May WY 2009
Daily Mean Water Elevation (feet, NAVD88)
Tides (feet, NAVD88)
Daily Mean Discharge (cfs)
Daily Mean Wave Power (kW/m)
Lagoon WSE
Tides
Wave Power
Carmel River Discharge
Summer Closure
14
12
10
8
6
4
2
0
-2
200
180
160
140
120
100
80
60
40
20
0
4/1/09
4/6/09
4/11/09
4/16/09
4/21/09
4/26/09
5/1/09
5/6/09
5/11/09
5/16/09
5/21/09
5/26/09
5/31/09

APPENDIX B

Monterey County Aerial Photographs

1929



Philip Williams & Associates, Ltd.
Consultants in Hydrology

Aerial View of the Lagoon, 1929

FIGURE
5-6

Source: Williams, J. and Philip Williams & Associates. (1992). Carmel River Lagoon Enhancement Plan.

1972



Source: Unknown. Provided by Whitson Engineers.

April 30, 1979



Source: Unknown. Provided by Whitson Engineers.

June 1982



Source: Unknown. Provided by Whitson Engineers.

March 1993





Source: Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon (2007)

September 6, 1998



October 1, 2002



August 12, 2003



Source: CaliforniaCoastaline.org

July 30, 2004


7/30/2004
17th Ave
Camelo St
Scenic Rd
Image USDA Farm Service Agency
© 2013 Google
903 ft
Google earth
Imagery Date: 6/30/2004
1998
10 S 596001.78 m E 4044059.70 m N elev 14 ft
Eye alt 3612 ft

August 25, 2005



Source: James, G. (2005). Surface Water Dynamics at the Carmel River Lagoon Water Years 1991 through 2005; Technical Memorandum 05-01

October 28, 2005



Source: CaliforniaCoastline.org

December 30, 2005



July 3, 2006



Source: Final Study Plan for Long Term Adaptive Management of the Carmel River State Beach and Lagoon (2007)

June 29, 2007


6/29/2007
1998
2012
17th Ave
Carmelo St
Scenic Rd
Villa Cruz
903 ft
1998
©2013 Google
10 S 596001.78 m E 4044059.70 m N elev 14 ft
Google earth
Eye alt 3612 ft

October 6, 2007



May 2008



Source: CaliforniaCoastline.org

June 5, 2009


6/5/2009
1998
2012
17th Ave
Camelo St
Scenic Rd
903 ft
Image USDA Farm Service Agency
© 2013 Google
Google earth
Imagery Date: 5/24/2009
1998
10 S 595625.56 m E 4044412.99 m N elev 52 ft
Eye alt 3612 ft

September 29, 2009



2011



Photo courtesy of Monterey County

May 5, 2012


5/5/2012
17th Ave
Camelo St
Scenic Rd
Santa Cruz
903 ft
© 2013 Google
Imagery Date: 5/5/2012
1998
10 S 595633.03 m E 4044361.62 m N elev 49 ft
Eye alt 3612 ft
Google earth

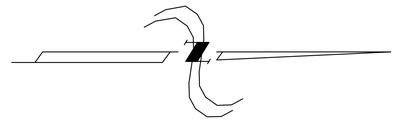
APPENDIX C

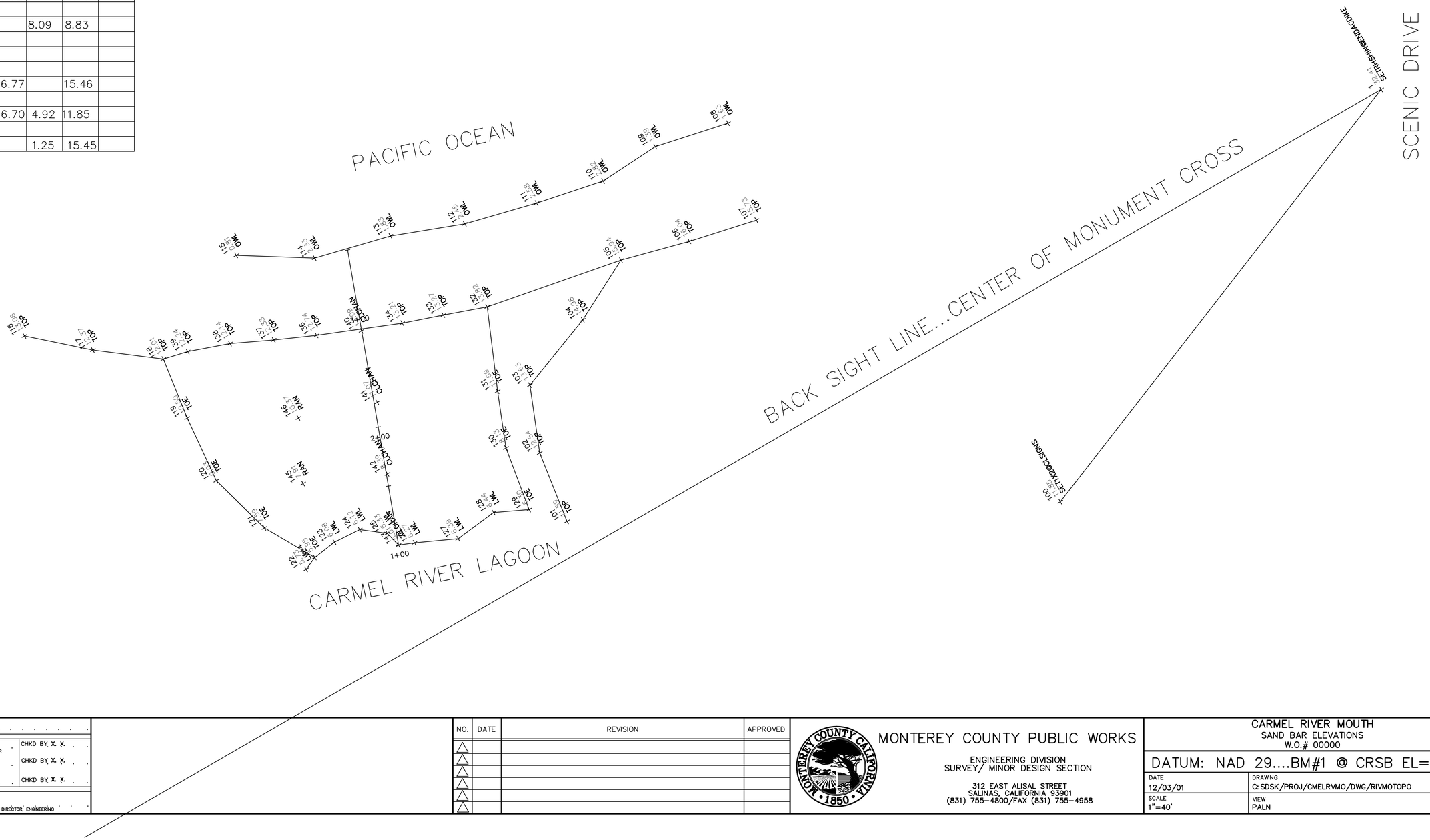
Monterey County Carmel River Mouth Surveys

2001 - 2012

SHEET NUMBER	TOTAL SHEETS
1	1

STA.	+	HI	–	ELEV.	
BM#1	4.55	20.01		15.46	
0	2.24	18.69	3.56	16.45	
SETRHSH	7.12	18.61	7.20	11.49	
0	3.59	20.04	2.16	16.45	
BM#1			4.58	15.46	
SETRHSH	5.43	16.92		11.49	
BOT RED			8.09	8.83	
BM#1	1.31	16.77		15.46	
SET 100	4.85	16.70	4.92	11.85	
BM#1			1.25	15.45	





SUBMITTED BY X. X. XXXXX		
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.	
DRAWN BY K.A.PEAKE	CHKD BY X. X.	
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.	
APPROVAL RECOMMENDED BY X. X. XXXXX (DEPUTY PUBLIC WORKS DIRECTOR, ENGINEERING)		

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

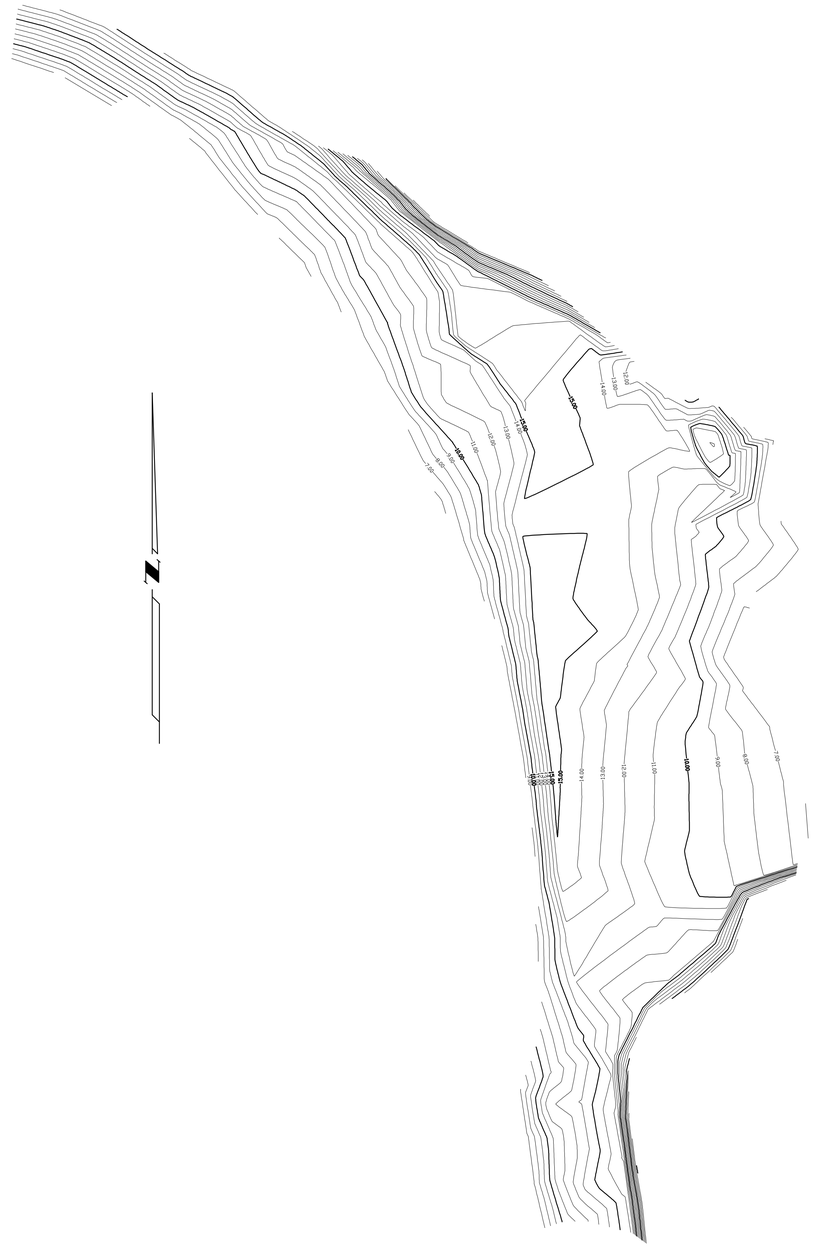
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
W.O.# 00000

DATUM: NAD 29....BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
12/03/01	C:SDSK/PROJ/CMELRVMO/DWG/RIVMOTOPO	1
SCALE 1"=40'	VIEW PALN	OF 1

SHEET NUMBER	TOTAL SHEETS
XX	XX



SUBMITTED BY X. X. XXXXX	
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.
DRAWN BY X. X. XXXXX	CHKD BY X. X.
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.
APPROVAL RECOMMENDED BY X. X. XXXXX (DEPUTY PUBLIC WORKS DIRECTOR, ENGINEERING)	

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

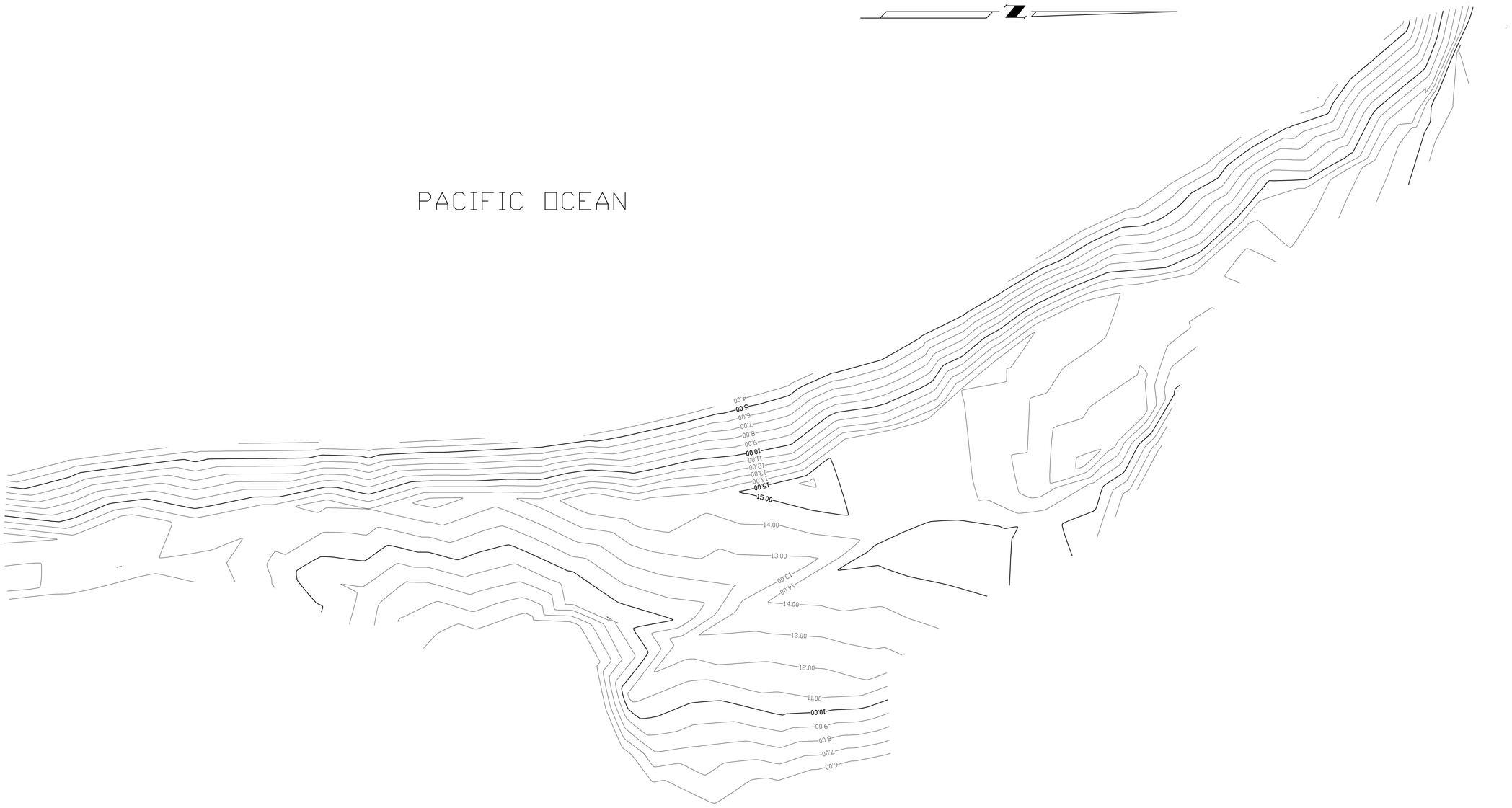
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

PROJECT TITLE
TITLE LINE 2
CONTRACT NO.

SHEET TITLE

DATE	DRAWING	SHEET
xx/xx/xx	DRAWING PATH	SHEET#
SCALE	VIEW	OF
SCALE	VIEW NAME	TOTAL

SHEET NUMBER	TOTAL SHEETS
1	1



SUBMITTED BY X. X. XXXXX	
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.
DRAWN BY K.A.PEAKE	CHKD BY X. X.
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.
APPROVAL RECOMMENDED BY X. X. XXXXX (DEPUTY PUBLIC WORKS DIRECTOR, ENGINEERING)	

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

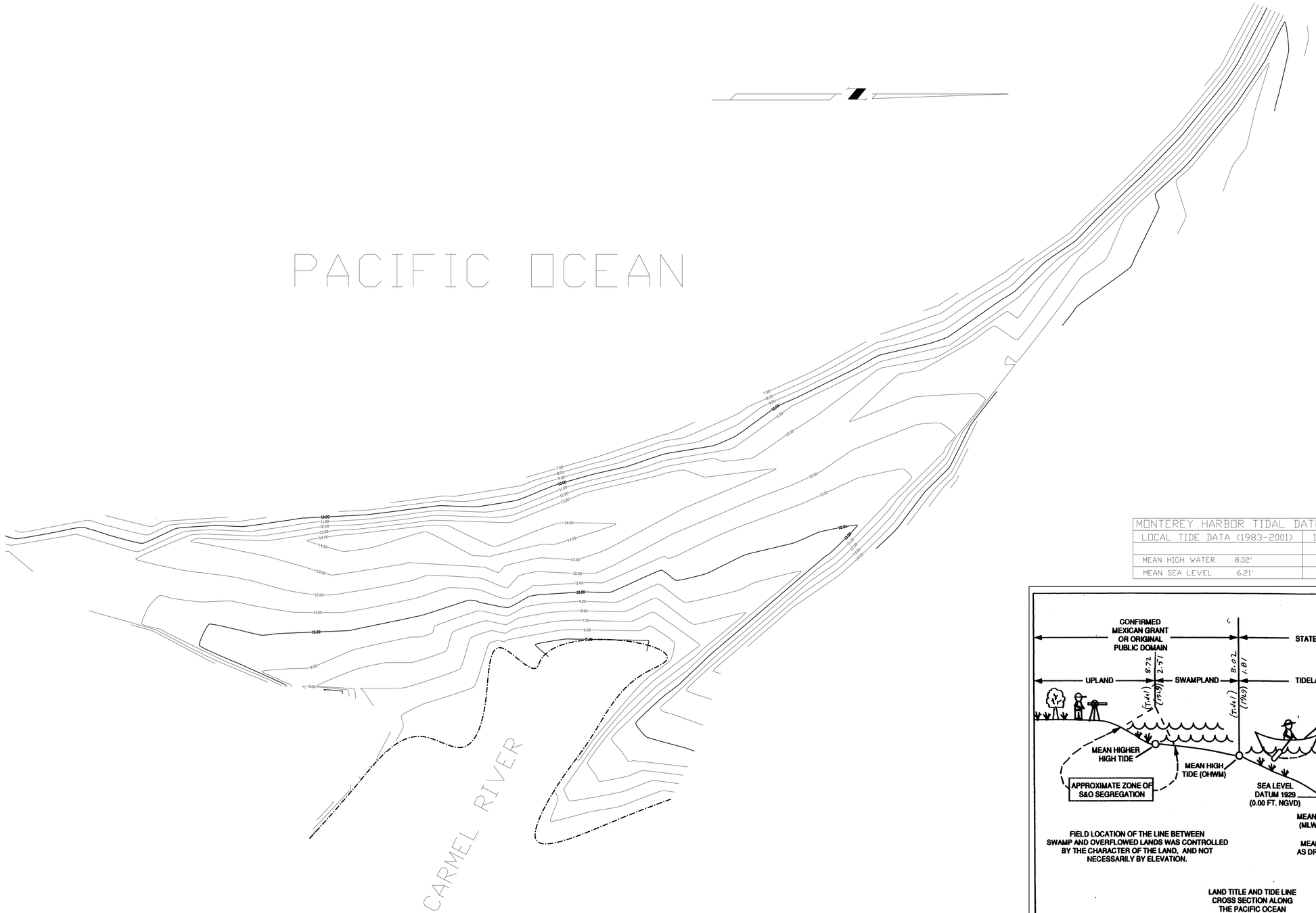
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
W.O.# 000000

DATUM: NAD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
11/18/03	C:\Land Projects 3\CRM03LDD	1
SCALE 1"=60'	VIEW extopo111803	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



MONTEREY HARBOR TIDAL DATUM EPOCH	
LOCAL TIDE DATA (1983-2001)	1929 ELEV.
MEAN HIGH WATER 8.02'	1.81'
MEAN SEA LEVEL 6.21'	0.00'

SUBMITTED BY X. X. XXXXX

DESIGN BY X. X. XXXXX PROJECT ENGINEER — CHKD BY X. X.

DRAWN BY K.A.PEAKE — CHKD BY X. X.

SPECIFICATIONS WRITTEN BY X. X. XXXXX — CHKD BY X. X.

APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR

NOTE: BOTTOM OF RED ON PADDLE / ELEV.= 8.81'
READING ON SCALE NEXT TO PADDLE / ELEV.= 8.91'

ELEV. 1.81', N.G.V.D. 1929 DATUM, IS THE STATE BOUNDARY LINE

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

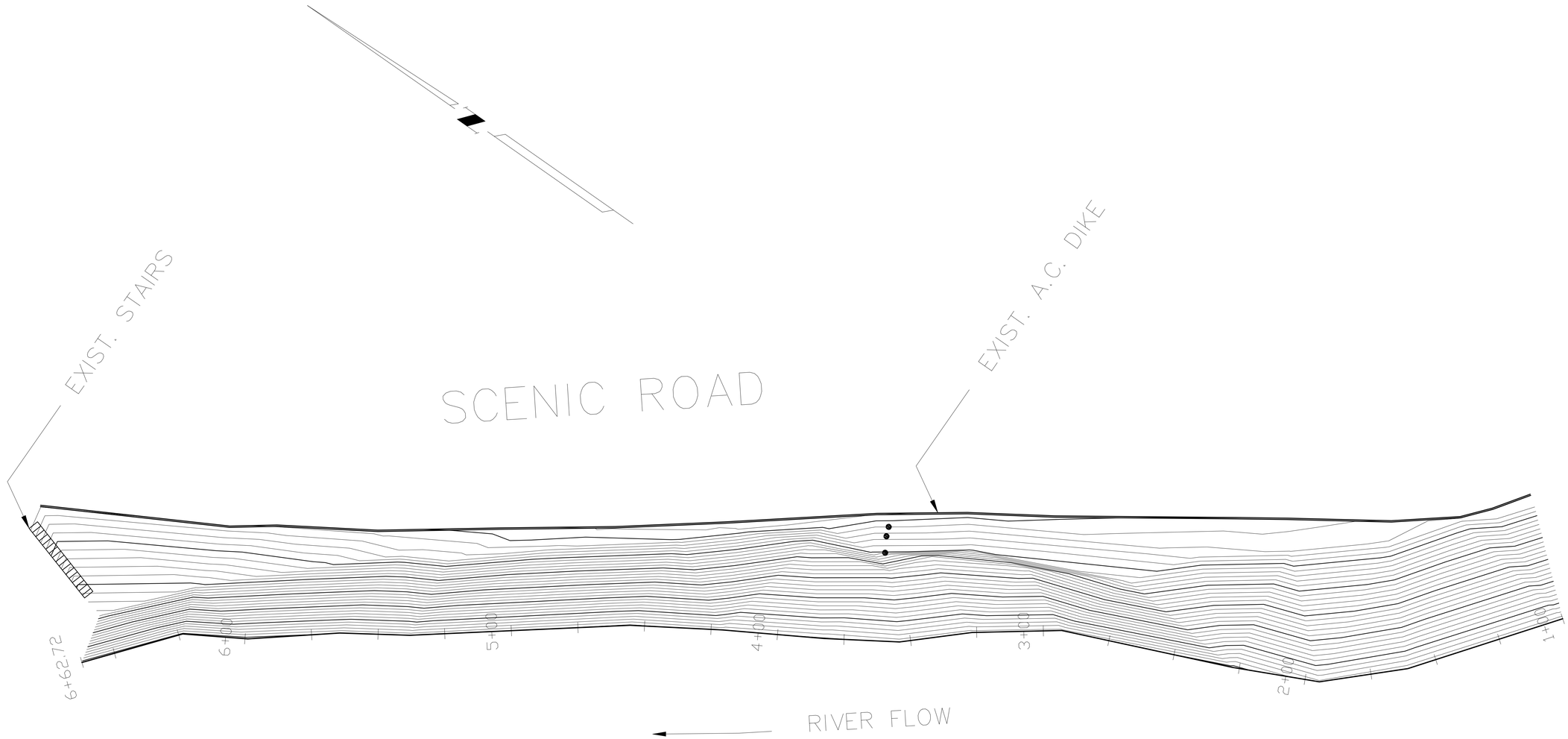
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
W.O.# 873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
12/03/04	C\Land Projects 2004\CRMO2004	1
SCALE 1"=60'	VIEW extopo120204.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	3



SUBMITTED BY X. X. XXXXX

DESIGN BY X. X. XXXXX PROJECT ENGINEER — CHKD BY X. X.

DRAWN BY KAPEAKE — CHKD BY X. X.

SPECIFICATIONS WRITTEN BY X. X. XXXXX — CHKD BY X. X.

APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

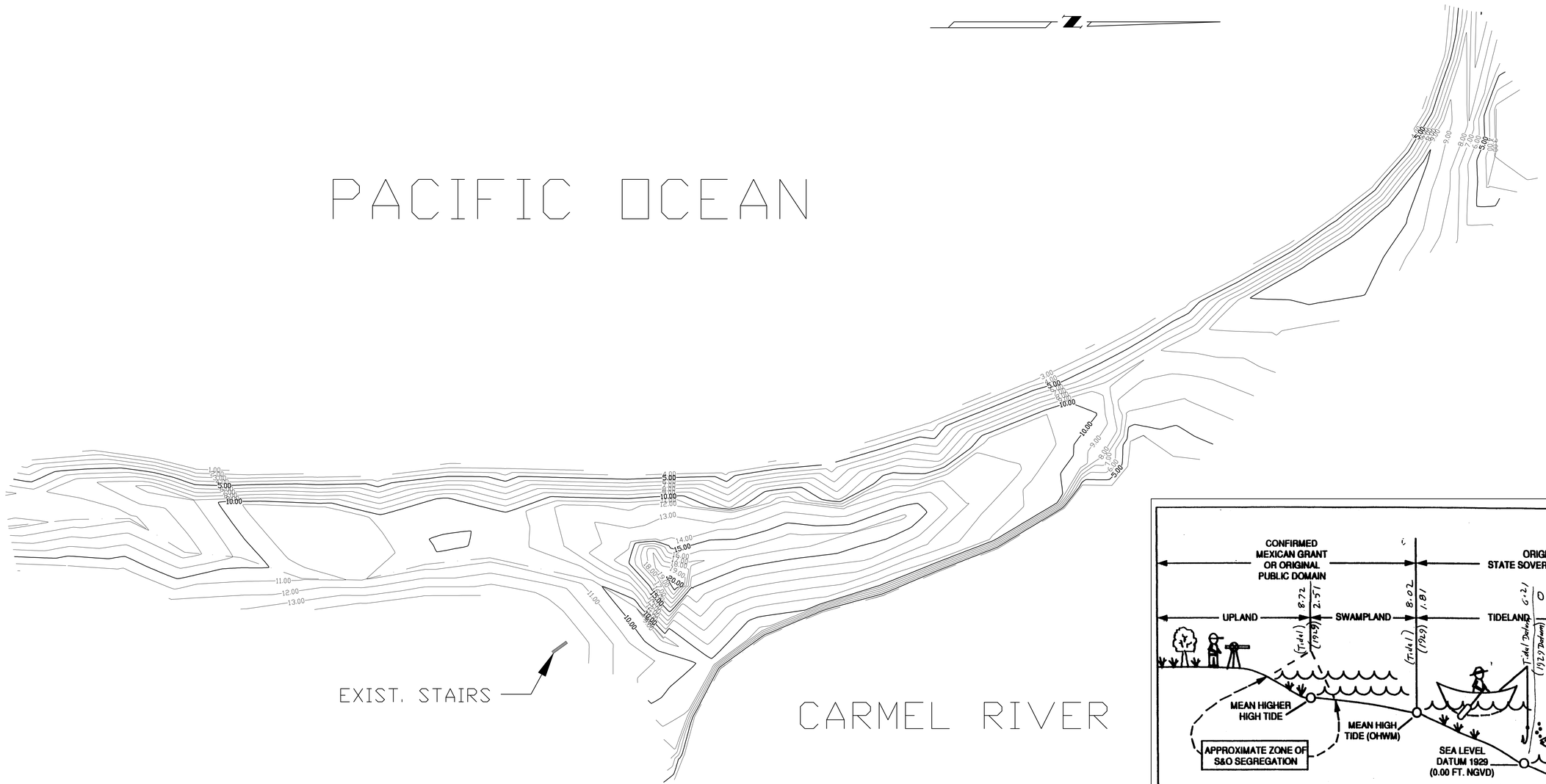
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

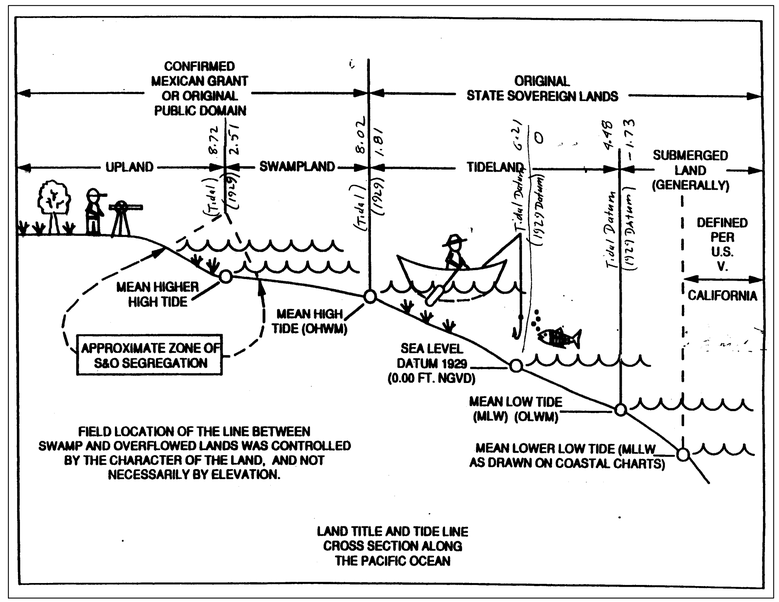
CARMEL RIVER MOUTH
EMERGENCY ROAD DAMAGE
W.O.# 520001

PLAN

DATE	DRAWING	SHEET
05/25/05	C\Land Projects 2005\CRM02005	1
SCALE 1"=20'	VIEW CRM0052405.dwg	OF 3

SHEET NUMBER	TOTAL SHEETS
1	1





LAND TITLE AND TIDE LINE
CROSS SECTION ALONG
THE PACIFIC OCEAN

SUBMITTED BY X. X. XXXXX	
DESIGN BY X. X. XXXXX PROJECT ENGINEER	CHKD BY X. X.
DRAWN BY K.A.PEAKE	CHKD BY X. X.
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.
APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR	

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

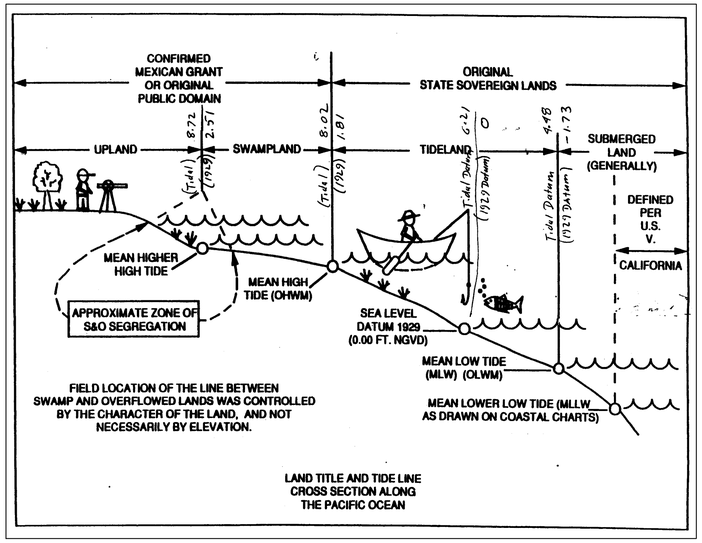
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
10/04/05	C:\Land Projects 2005\CRRM100405	1
SCALE 1"=80'	VIEW CRM0100405.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



LAND TITLE AND TIDE LINE
CROSS SECTION ALONG
THE PACIFIC OCEAN

SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)			

NO.	DATE	REVISION	APPROVED
1			
2			
3			
4			
5			
6			

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

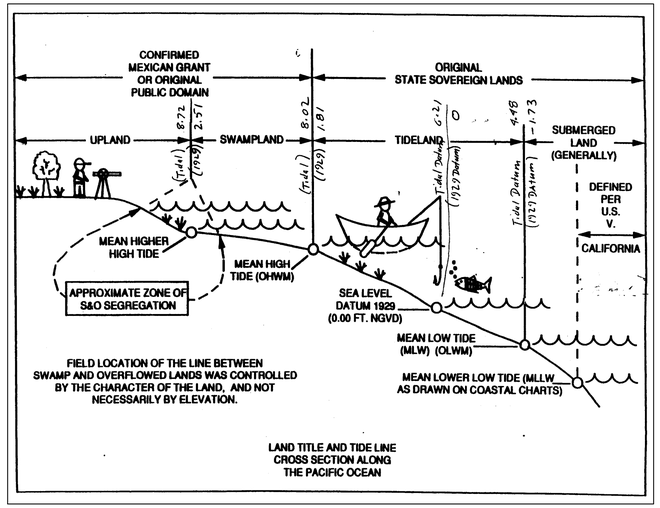
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
04/18/06	C:\Land Projects 2005\CRMO2006	1
SCALE 1"=60'	VIEW CRMO012606add041806.dwg	OF 1

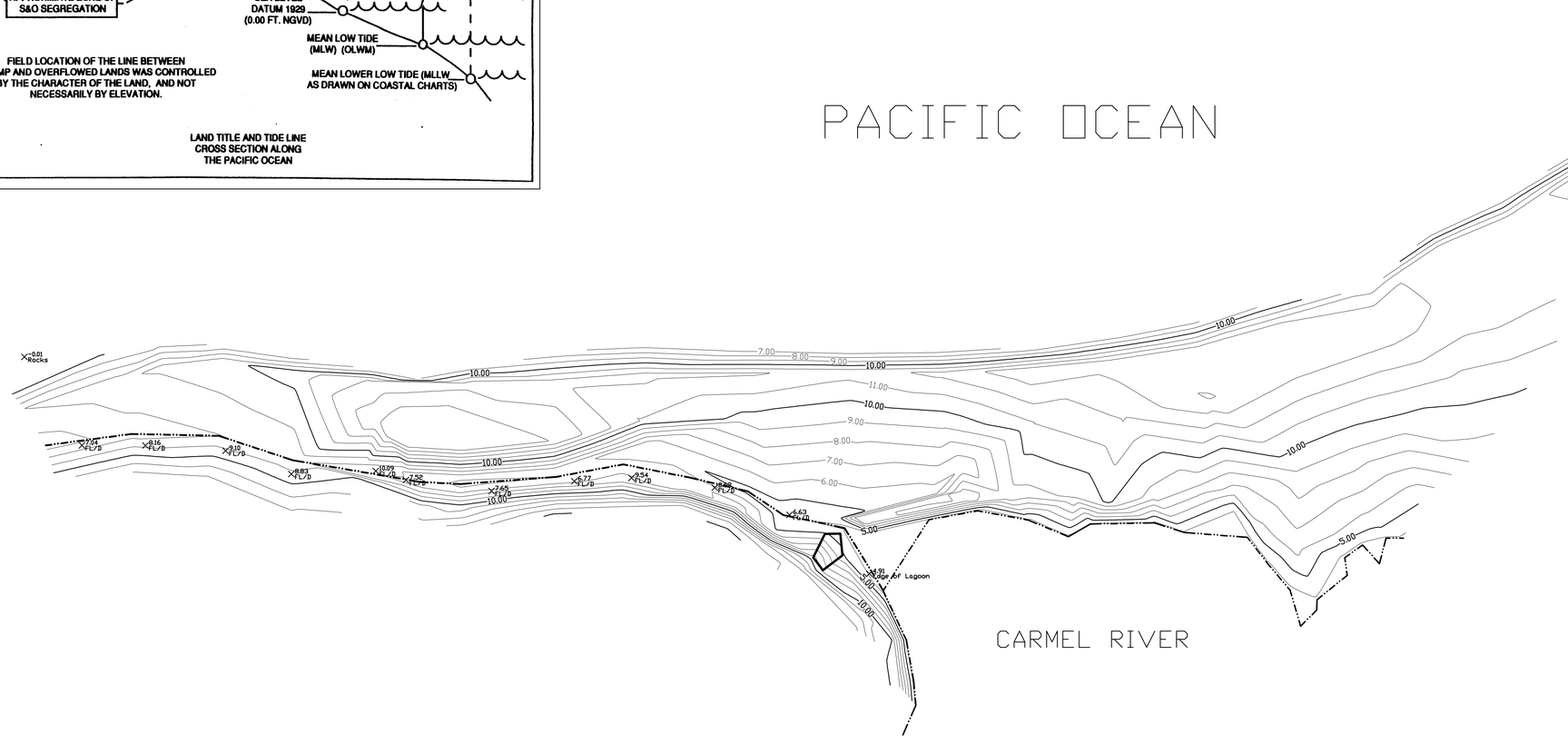
SHEET NUMBER	TOTAL SHEETS
1	1



LAND TITLE AND TIDE LINE
CROSS SECTION ALONG
THE PACIFIC OCEAN

PACIFIC OCEAN

SCENIC ROAD



CARMEL RIVER

SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

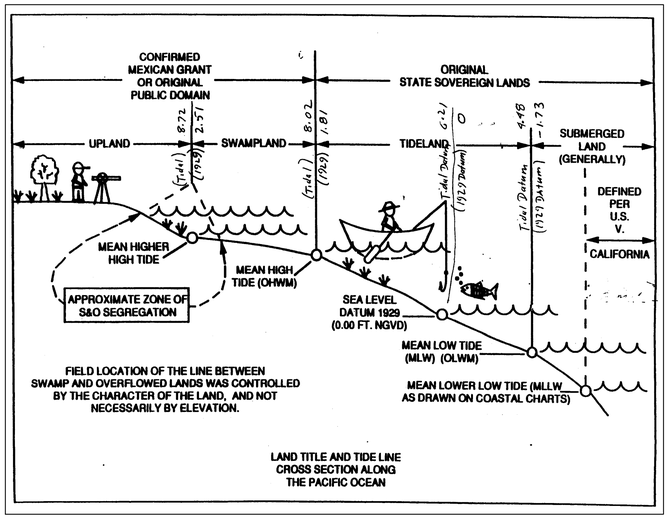
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

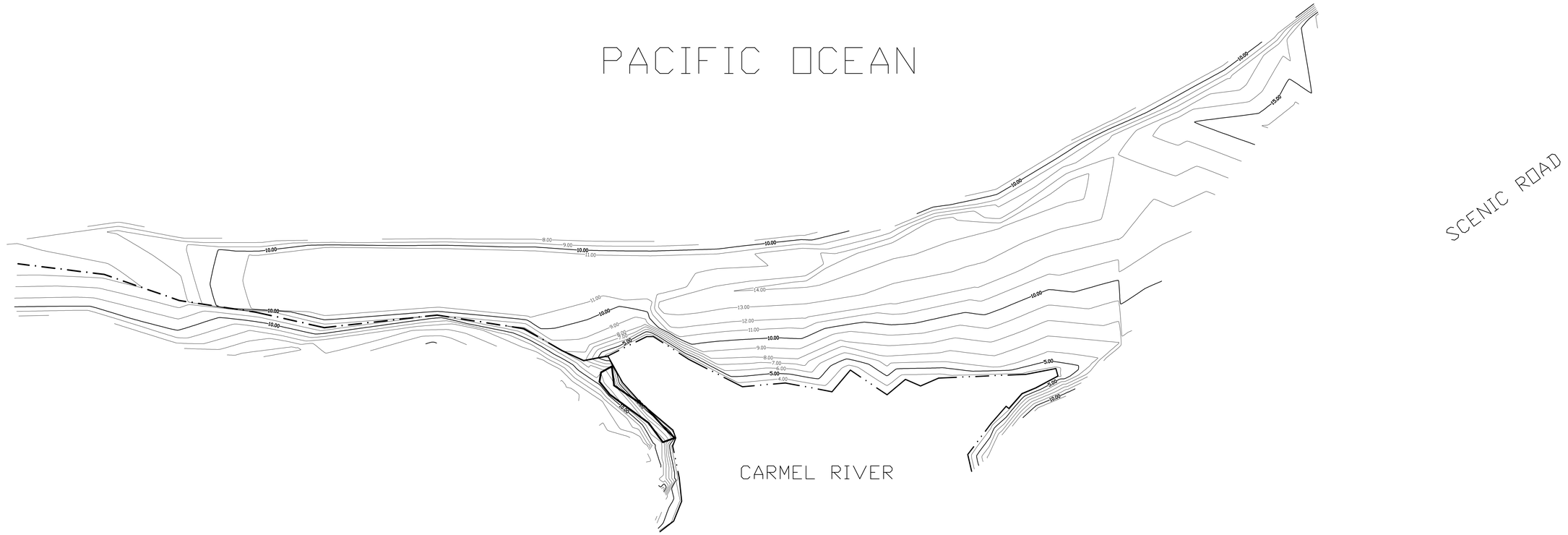
CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
11/20/06	C:\Land Projects 2005\CRM02007	1
SCALE 1"=80'	VIEW CRMO101206ADD112006.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1





SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX PROJECT ENGINEER	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

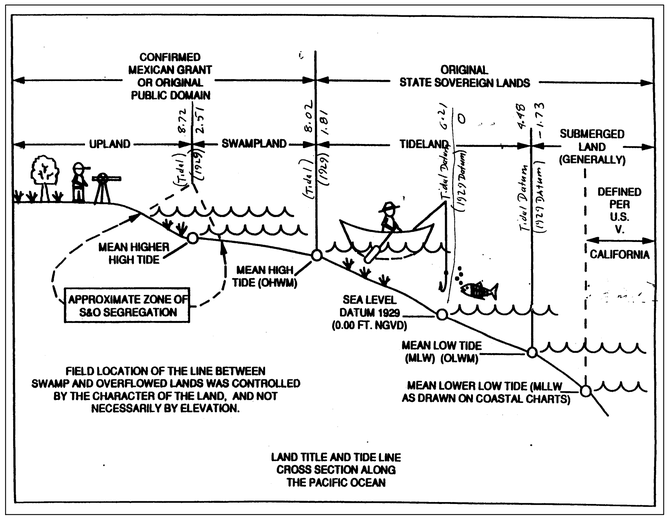
312 EAST ALISAL STREET
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4958

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

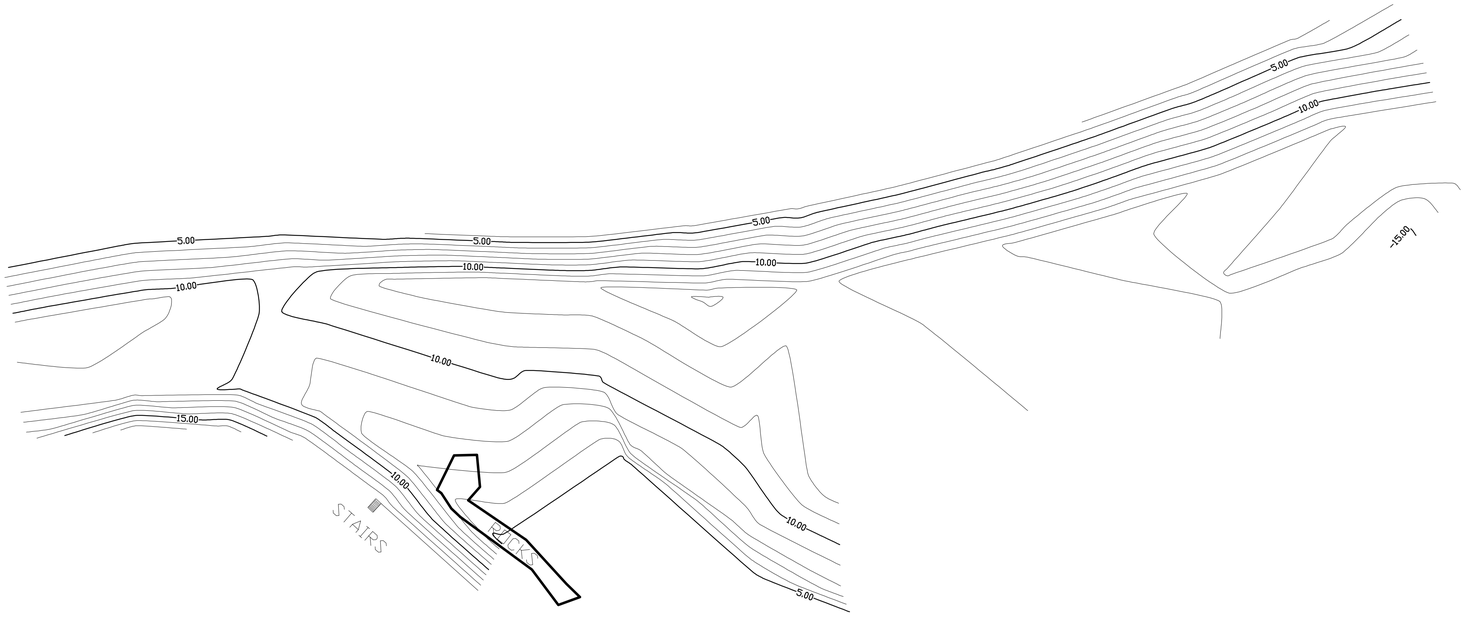
DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
10/02/07	C:\Land Projects 2005\CRM0100207\dwg	1
SCALE 1"=80'	VIEW CRM0100207.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



PACIFIC OCEAN



CARMEL RIVER

SCENIC ROAD

SUBMITTED BY . X. X. XXXXX					
DESIGN BY . X. X. XXXXX PROJECT ENGINEER	CHKD BY. X. X.	NO.	DATE	REVISION	APPROVED
DRAWN BY . K.A.PEAKE	CHKD BY. X. X.				
SPECIFICATIONS WRITTEN BY . X. X. XXXXX	CHKD BY. X. X.				
APPROVAL RECOMMENDED BY . X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR					

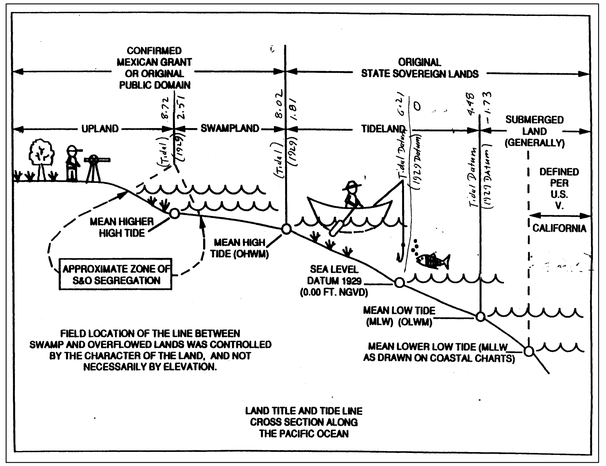
MONTEREY COUNTY PUBLIC WORKS
ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

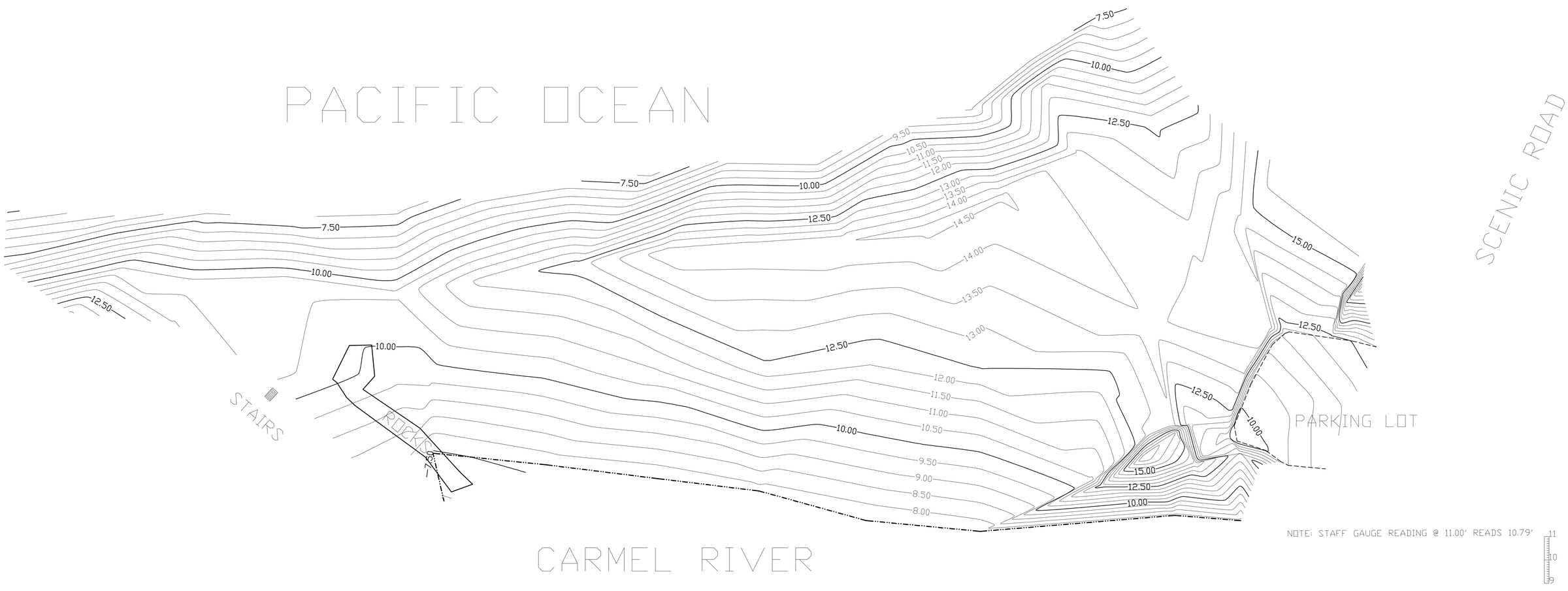
DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
10/30/08	C:\Land Projects 2008 \CRM103008	1
SCALE 1"=60'	VIEW CRM103008.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	1



LAND TITLE AND TIDE LINE
CROSS SECTION ALONG
THE PACIFIC OCEAN



SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

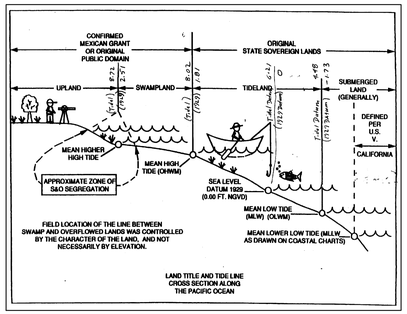
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

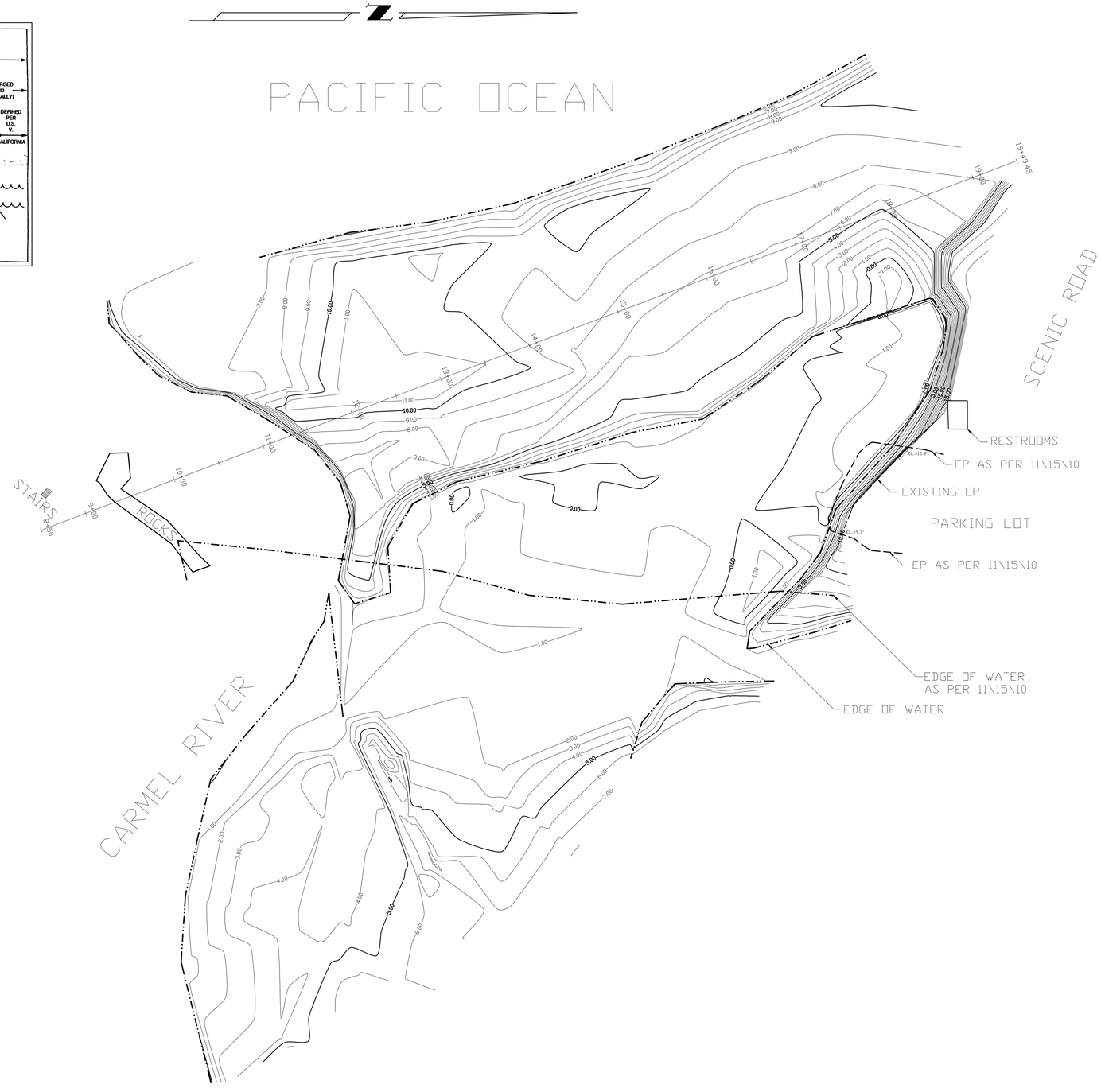
CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
11/15/10	C:\Land Projects 2008\CRM111510	1
SCALE 1"=40'	VIEW CRM111510.dwg	OF 1

SHEET NUMBER	TOTAL SHEETS
1	2





SUBMITTED BY X. X. XXXXX			
DESIGN BY X. X. XXXXX (PROJECT ENGINEER)	CHKD BY X. X.		
DRAWN BY K.A.PEAKE	CHKD BY X. X.		
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.		
APPROVAL RECOMMENDED BY X. X. XXXXX (ASSISTANT PUBLIC WORKS DIRECTOR)			

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

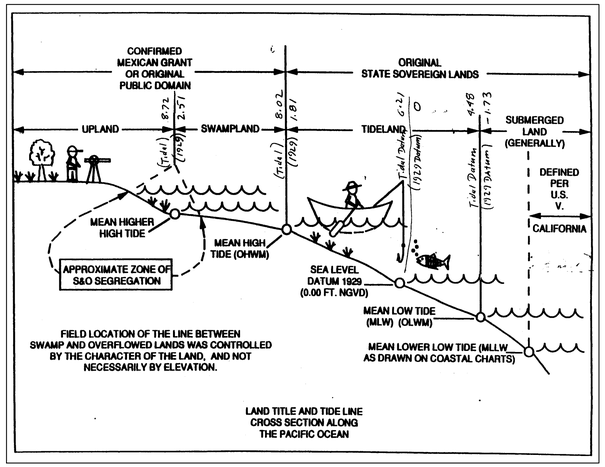
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
05\18\11	C:\Land Projects 2008\CRM0050611	1
SCALE 1"=60'	VIEW PLAN	OF 2

SHEET NUMBER	TOTAL SHEETS
1	2



SUBMITTED BY X. X. XXXXX					
DESIGN BY X. X. XXXXX PROJECT ENGINEER	CHKD BY X. X.	NO.	DATE	REVISION	APPROVED
DRAWN BY K.A.PEAKE	CHKD BY X. X.				
SPECIFICATIONS WRITTEN BY X. X. XXXXX	CHKD BY X. X.				
APPROVAL RECOMMENDED BY X. X. XXXXX ASSISTANT PUBLIC WORKS DIRECTOR					

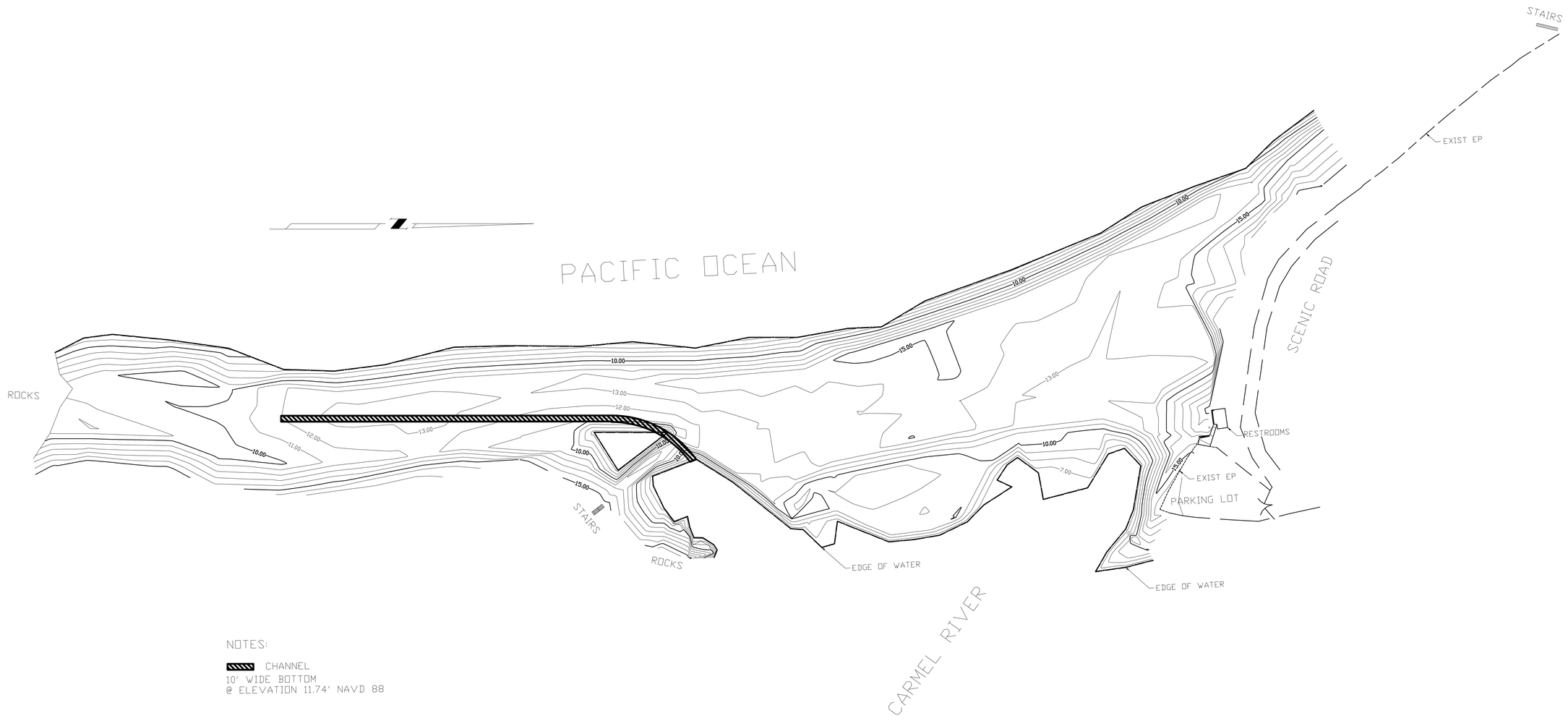
MONTEREY COUNTY PUBLIC WORKS
ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION
168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NGVD 29...BM#1 @ CRSB EL=15.46'

DATE	DRAWING	SHEET
09\26\11	C:\Land Projects 2008\CRM092611	1
SCALE	VIEW	OF
1"=80'	extopo092611add050611survey	2

SHEET NUMBER	TOTAL SHEETS
1	1



NOTES:

CHANNEL
10' WIDE BOTTOM
@ ELEVATION 11.74' NAVD 88

SUBMITTED BY	X. X. XXXXX
DESIGN BY (PROJECT ENGINEER)	X. X. XXXXX
CHKD BY	X. X.
DRAWN BY	K.A.PEAKE
CHKD BY	X. X.
SPECIFICATIONS WRITTEN BY	X. X. XXXXX
CHKD BY	X. X.
APPROVAL RECOMMENDED BY (ASSISTANT PUBLIC WORKS DIRECTOR)	X. X. XXXXX

NO.	DATE	REVISION	APPROVED

MONTEREY COUNTY PUBLIC WORKS

ENGINEERING DIVISION
SURVEY/ MINOR DESIGN SECTION

168 WEST ALISAL STREET, 2nd FLOOR
SALINAS, CALIFORNIA 93901
(831) 755-4800/FAX (831) 755-4900

CARMEL RIVER MOUTH
SAND BAR ELEVATIONS
WO#873400

DATUM: NAVD 88...BM#2 @ CRSB EL=62.14'

DATE	DRAWING	SHEET
09/25/12	C:\Land Projects 2011\CRM0091212LDD11	1
SCALE	VIEW	OF
1"=80'	extopo091212revdatum092812	1

Littoral Processes and River Breachings at Carmel River Beach

Edward B. Thornton
Naval Postgraduate School
Monterey, CA 93943

Introduction

This short report examines beach and littoral processes at Carmel River Beach. The issue here, as I understand it, is maintaining a sufficient water level within the lagoon for fish habitat during the process of breaching, i.e. not flushing too rapidly. The proposals being considered are to breach the river either to the north or to the south where there is bedrock to act as a sill, or weir, to slow the flushing of the lagoon. A question is which breach is more effective in protecting fish habitat. The problem with the north breach last year is that it caused cliff erosion along Scenic Drive. The concern with a south breach is that sand may be diverted into the canyon.

In the following, I have attempted to synthesize published literature, photographs of the beach from 1880 to the present, bathymetry charts dating from 1885, and observations of the beach (including my frequent visits to the beach over the last 36 years), in order to quantify past breaching processes. Below, I present a discussion on waves and beach processes and a quantitative summary of past breachings (locations and migration rates). Based on this analysis, I present estimates of the most probable consequences of various breaching scenarios.

Waves

Directional wave spectra are measured routinely at NOAA 46042 buoy, located 40 km offshore of Monterey Bay, and are refracted shoreward to provide wave heights within the bay every hour (http://cdip.ucsd.edu/models/monterey). The Carmel River Beach is protected from the predominant waves from the northwest owing to the shoreline orientation and the northern headland. Waves must be severely refracted in order to reach the beach (Figure 1). The beach is vulnerable to occasional winter storms from the west, which can focus their wave energy on it (Figure 2). The waves arriving at the beach are mostly reduced to their swell components because of the severe refraction and because the narrower aperture of the headlands filters the higher frequency wave components. Consequently, the waves arriving at the beach for most of the year are swell waves, which act to move sand onto the beach and build the berm (see below).

Longshore currents and littoral transport

Longshore currents and sediment transport are predicted to be southward at the southern end of the beach and northward at the northern end of the beach (Figure 3). Waves arriving at an oblique angle to the beach drive currents and sediment transport alongshore within the surf zone. The longshore currents and littoral transport were reported by Howell (1970) to be to the south based on wave refraction of offshore wave climatology. All subsequent reports and papers are based on this reference. However, it is obvious that

processes other than simply wave refraction are important, as can be seen by standing on the shore and observing waves bend around the northern rocky reef into Stuart's Cove. The process of waves bending behind a point is called diffraction. This results in the breaking waves having a northerly direction, which drives currents and sediment transport to the north. Another, probably more important cause of north-directed currents is that waves behind the reef in Stuart's Cove are smaller than waves in the center of Carmel River Beach. When waves break, there is a change in their momentum that is balanced by a hydrostatic pressure head, which results in an increase in the mean water level above what would be the still-water level. This is referred to as set-up. The set-up is approximately 10-20 percent of the offshore wave height, and thus is larger for larger waves. In the present case, the mean water level set-up is higher in the center of the beach and lower to the north in Stewart's Cove. This creats an alongshore pressure gradient pushing water to the north within the surf zone (water flows downhill). The longshore currents can carry sand to the north from the center of the Carmel River Beach and result in a migration of the river mouth to the north.

Beach Morphology

I have visited this beach for 36 years and have hundreds of photos of documentation. I conducted experiments here in 1978. I took pictures of the beach every week for a year after the 1983 El Ninos winter to understand how the beach behaves. I conduct a field trip to the beach every year with my class. Compared with the Ocean Avenue Beach in Carmel, this is not a dynamic beach, and it does not have strong on-offshore seasonal movement. The biggest impact to this beach is from the river breaching.

Carmel River Beach is steep with the beach slope increasing from 0.12 at the north to 0.28 at the south. The steep beach is the result of the relatively large grain sand if which it is composed. The mean grain size shows a corresponding increase from medium to coarse sands, indicative of increasing wave energy from north to south. The beach is classified as reflective with the waves breaking as collapsing (shore break) or surging (high swash up the beach. The high berm is built by waves rushing up the beach face and carrying sand along with the swash. Much of the water of the swash percolates into the coarse bed and deposits the sand at the top of the berm. The back beach is built by the larger waves overtopping the berm at high tides and by prevailing onshore winds blowing sand shoreward.

The approximately 2500 foot shoreline is concave and anchored at the north end by a rocky headland and at the south end by a rock reef. Rocky reefs extend offshore as determined by divers and evidenced by the Macrocystis kelp beds visible from shore. Macrocystis kelp requires a holdfast on a rock bottom to survive the high energy wave environment along this coast. The north rocky reef is extensive and is devoid of sand, indicating that no sand is transported around the point. The south rocky reef is interspersed with sand, indicating that sand is moved over the rocks. Significant sand deposits (depths greater than 5 feet) reside offshore of the river (Howell, 1972).

Nature continually strives to reach equilibrium. The concave shape of this beach came about because a shoreline tends to align itself with the breaking wave crests to obtain an equilibrium shape in the alongshore. This would suggest that the longshore currents and littoral transport are most probably weak on this beach.

The beach appears to be in quasi-equilibrium. The river delivers its sediments to the beach and discharged some of them offshore. Some of the offshore sand is then brought back onshore by the waves to rebuild the beach and berm. Some of the sand is lost to the Carmel Submarine Canyon. Sand from at least as deep as 60 feet will be moved back onshore. The building of the beach goes on year-around. The beach width does not appear to be growing or diminishing significantly. The rebuilding of the beach does not appear to be dependent on a north or south breaching of the river. When I visited the beach in November 2004 with my class, I noted that the beach width and berm height were as wide and high as I could remember. However, the beach at present is in a vulnerable state owing to breaching of the river to the north last winter.

Quantitative measures of beach width were made by Storlazzi and Field (2000), who compared aerial photos for 1949, 1970 and 1990. These measurements qualitatively suggest a decrease in width of the north and central portions of the beach and an increase in width of the south portion. However, standard statistical hypothesis tests fail to show any significant change in beach width (i.e., 3 data points are not statistically meaningful). Dave Reid, a contractor with the USGS, has been summarized beach widths for much of the State of California, and I am trying to obtain information from him. In comparing aerial photos (starting in 1929) and old charts (starting in 1885), the beach qualitatively does not appear to change much from year to year. Qualitative comparison of the bathymetry chart of 1885 with the 1987 aerial photo indicates that there has not been significant change to the beach configuration during that period.

River Breachings

The river is mechanically breached each year to avoid flooding. The breachings historically have been straight offshore, nearer the southern end of the beach. After initial breaching, the river sometimes has migrated either north or south. The river openings will tend to migrate in the direction of littoral sediment transport, and the migration direction depends on where the initial opening occurred. The breach will only stay open if the outflow is greater than approximately 200 cfs (James, 2005). Hence, the river may open and close a number of times during a year, dependent on river flow, tide elevation and wave energetics. Breaching locations are summarized in Table 1 based on the past 13 years of observations by James (2005) and including examination of photos dating back to 1880 and bathymetry charts dating back to 1885. For many of the photos, the river mouth was closed, and the direction of outflow can only be inferred from the antecedent lagoon channel. The observations by James (2005) show that the river mouth can open and close a number of times and its location can migrate. For example during highest flood year 1997-98 winter, the river was opened in the center and then migrated to the north and then to the south. Only observations and photos of locations of the river

flowing are included in the analysis. To account for the different opening locations in a single year, a percent of openings was assigned for each location. In summary, the river migrated to the north, stayed in the center or migrated to the south 11, 56 and 34 percent of the time. Only actual observed openings are used for the summary statistics and 2005 is not included.

Migration rates were determined by measuring the displacement of the openings between subsequent dates with positive displacement to the south and negative to the north. Since the migration rates are based on end state locations, it is possible the migration rates could have been much greater as some (or much) of the time between observations the river opening may have been stationary. It is assumed the river was always initially opened in the center or slightly south of center. The river did not migrate much of the time. The migration rates to north were higher with a weighted (based on amount of time) average of 19 ft/day, as compared with an average weighted migration rate of 10 ft/day to the south. The maximum migration rates to the north were 140 ft/day and to the south 150 ft/day. The river mouth migrated to the north about a third of the years, stayed in the center about a third of the years, and migrated to the south a third of the years. Once the river migrated to either the north or the south, it tended to stay there.

When the river migrated to the south it tended to flow along the back beach over a rock sill. An example is in 1995.

The river has migrated to the north four times since 1992 (not including 2005) from an initial opening in the center. During three of the years (1996, 1997 and 2000), the river cut a channel between the beach and the berm as the opening migrated north so that the back beach was not disturbed. However, in 1993, the river cut to the back beach and started to erode the cliff along Scenic Drive; the river was then mechanically diverted to the center to stop the erosion. This past winter, the breaching to the north resulted in the river being diverted and migrating further north so that the river channel was in the back beach with subsequent erosion of the cliff. It was my personal observation that the primary agent for erosion of the cliff was the river, with the ocean waves being only a very secondary cause. The peak flows during the times of erosion in 2005 were not unusual.

Breaching the river to the north in 2005

The beach was mechanically breached at the north end for the first time in 2005. The breaching of the river toward the north end of the beach resulted in a diversion of the river further north. This caused severe erosion of the back beach and cliff on Scenic Drive, threatening a Cypress tree, the road and the sewer line. The bank along Scenic Drive appears to be unstable at present. The beach has not recovered, particularly in the back beach to the north. River flow has been measured on the Carmel River since 1962. Extreme flood years coincided with El Nino events in 1983 and 1998. Peak flow however occurred in 1995 when the Carmel River Bridge failed. The total flow in 2005 was above normal, but peak flows were below the average. If the river is diverted to the north this coming year, it is my opinion that if a comparable moderate rain year occurs as in 2005,

the bank most probably will fail. This could mean the loss of portions of the road along with the cypress tree and sewer line.

Scenarios

What happens this winter is highly dependent on total and peak river discharges, as well as wave energy. These are not predictable. In the following scenarios I assume similar conditions to those of last year, in which the peak flow was below normal, the volume of flow was above normal, and the wave climate was average.

1 October 2005 until it rains- The beach and berm will continue to grow. The berm is presently being overtopped at each high tide even for moderate waves. This is good as this is how the berm is built up. However, I do not anticipate that the northern end of the beach and the back beach will recover from the damage of last year. The berm at this year's northern breach is very narrow (Figure 6) and is vulnerable to opening again with the first rains. It is noted that the Scenic Drive cliffs are not vulnerable to wave erosion unless the breach is to the north.

Breach to the north this winter scenario- Most probably the river would take up the same course as last year as the back beach is in depression and has not recovered. This would result in erosion of the cliff along Scenic Drive, which was left unstable from last year (it slope is greater than angle of repose in places). Most probably this cliff would fail with possible loss of road, tree and sewer line.

Breach to the south this winter scenario- Most probably, the river would migrate further south owing to the prevailing sediment transport, as it has in the past when the river mouth was in the south.

Migration measures

1. If is desired to breach the river other than in the north, the north beach should be repaired mechanically by filling in the lagoon to the north. Otherwise, the rive most probably will naturally breach to the north.
2. If the plan is to breach to the north, considerable protection of the cliff along Scenic Drive will be required to protect the road and sewer line.

Recommendations

1. Analyze the lagoon elevation time series during times in the past when the river breached to the north (last winter) and to south (e.g. 1995) when the discharges were comparable to determine how fast the lagoon flushes and estimate the water levels within the lagoon. These data exist.
2. Develop an engineering model of the lagoon flushing and test the model using available data.
3. Better understand the sediment processes. Dave Reid, a contractor for the USGS, may have longterm quantitative beach width measurements. I will contact him.

Brian Clure has stated that the sedimentation in the river is deficit. The bulge of sand moving down the river from the Tularcitos Creek water shed (generated after the 1977 Cone Peak fire?) will reach the ocean in 20??. What does this mean to the beach in the future? To aid in this understanding, the Naval Postgraduate School is planning a beach and offshore bathymetry survey within the next two weeks.

4. Better documentation of the river openings and closings and migration of the river mouth is desirable. To this end, I am working to get a video system installed to monitor lagoon, river and beach processes. We have four systems installed in Monterey Bay (e.g., http://www.oc.nps.navy.mil/~stanton/miso/cameras.html). The images are rectified to a plan view so that quantitative information can be obtained.

References:

Howell, B.F., 1972, Sand movement along Carmel River State Beach, Carmel, California, M.S. Thesis, Naval Postgraduate School, 71pp.

James, G., 2005, Locations of river openings.

Storlazzi, C.D. and M.E. Field, 2000, Sediment distribution and transport along a rocky, embayed coast: Monterey Peninsula and Carmel Bay, California, Marine Geology, 170, 289-316.

Table 1. River mouth openings partitioned into locations of north, central or south by water year (see Figure 1 below). X's indicate observations of openings to ocean. i's indicate inferred from antecedent beach conditions in photos. The total percentages are only based on actual observation of opening indicated by x's and do not include 2005.

date	north	central	south
1880		x	
29			i
39			i
49			i
54			i
56			i
60			i
66			i
68			i
71			i
72		i	
79			x
87		i	
92			x
93	0.6x	0.2x	0.2x
95		0.3x	0.7x
96	0.1x	0.4x	0.5x
97	0.3x	0.3x	0.3x
98		0.3x	0.7x
99		0.8x	0.2x
0	0.5x	0.5x	
1		X	
2		X	
3		X	
4		X	
5	x		
Total %	11	56	34

Table 2. Migration rates are calculated as the distance between sequential river mouth opening locations from James (2005) divided by interval between dates.

dates		days	south ft/day	north ft/day	zero days
1992	3/30/-				
1993	1/18-2/11	24		90	
	2/1-3/25	55			55
1994	not data				
1995	3/7-4/3	26	2		
	4/3-4/19	16	4		
	4/19-5/3	15	7		
	5/3-5/22	19	5		
	5/22-5/31	9		47	
	5/31-6/5	6		20	
	7/5-7/10	5	28		
	7/10-7/17	7	10		
	7/17-7/18	1	150		
1996	12/7-2/12	67	1		
	2/12-3/18	36	1		
	3/18-4/9	22		64	
	4/16-4/25	39	14		
	4/25-6/6	42			42
	6/6-6/12	7	14		
1997	12/9-2/5	58		25	
	2/12-3/7	23	33		
1998	1/20-4/2	72			72
	4/2-4/20	18	37		
	4/20-5/11	31			31
	5/11-6/10	29	4		
	6/10-7-14	34			34
	7/14-8/12	29	4		
1999	4/20-5/19	30			
	3/12-4/20	39			39
2000	2/1-3/15	15			15
	3/15-4/6	22		9	
	4/6-5/12	37		49	
	5/12-6/20	39			39
2001	1/19-3-23	62		10	
	3/27-5/17	51			51
2002	1/17-4/12	87			87
	4/12-4/22	10	5		
2003	1/17-6/23	159			159
2004	12/30-2/23	75		5	
2005	1/14-1/19	5		140	
	1/19-2/1	13	12		
	2/1-2/16	5		23	
	2/16-5/23	102			102
	Weighted velocity average		10 ft/day	19 ft/day	

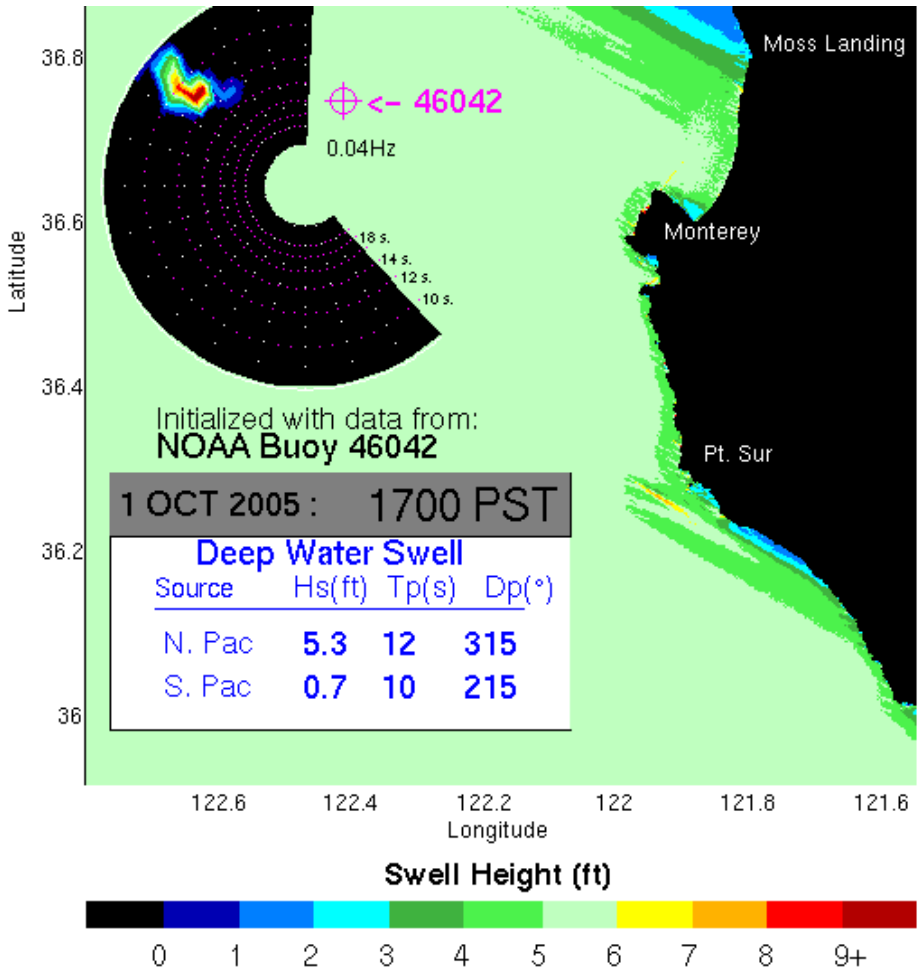


Figure 1. Predominant waves from the northwest showing Carmel River Beach is protected by the northern headlands.

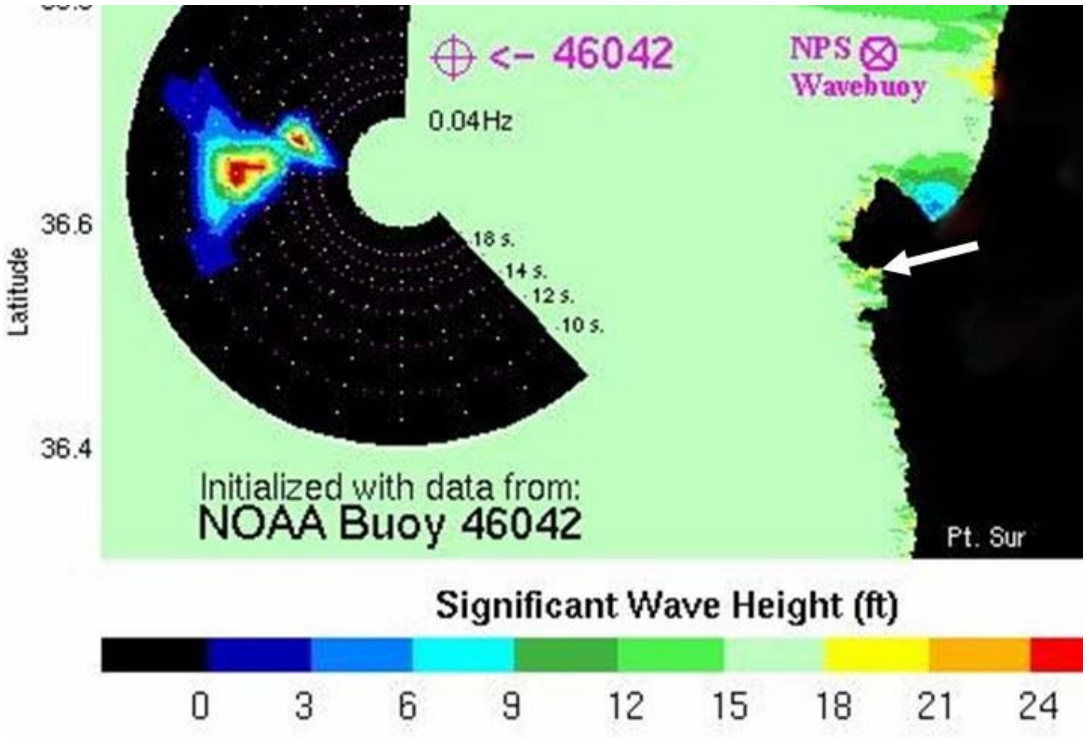


Figure 2. Large winter storm waves from the west focusing energy at Carmel River Beach (arrow).

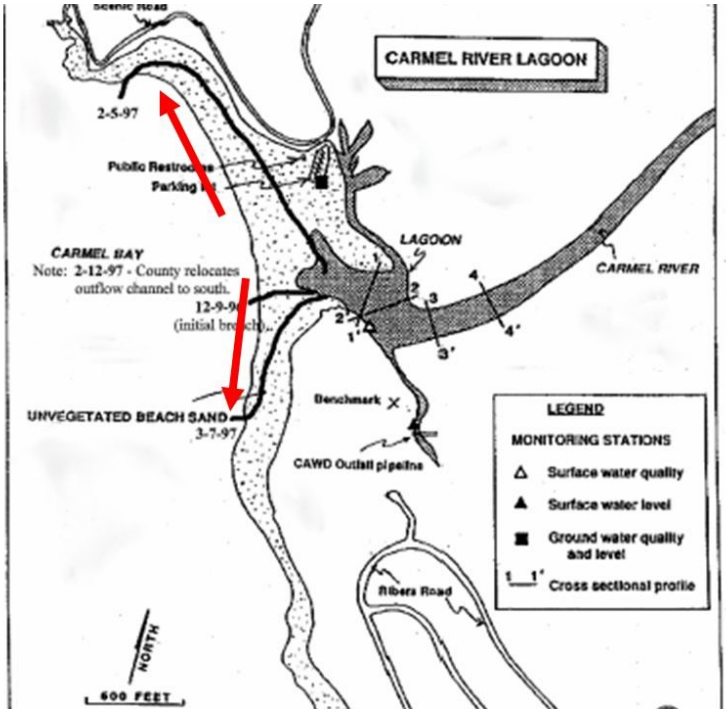


Figure 3. Direction of sediment transport (arrows) at the Carmel River Beach is to north in northern portion of the beach and to the south in the southern portion of the beach.

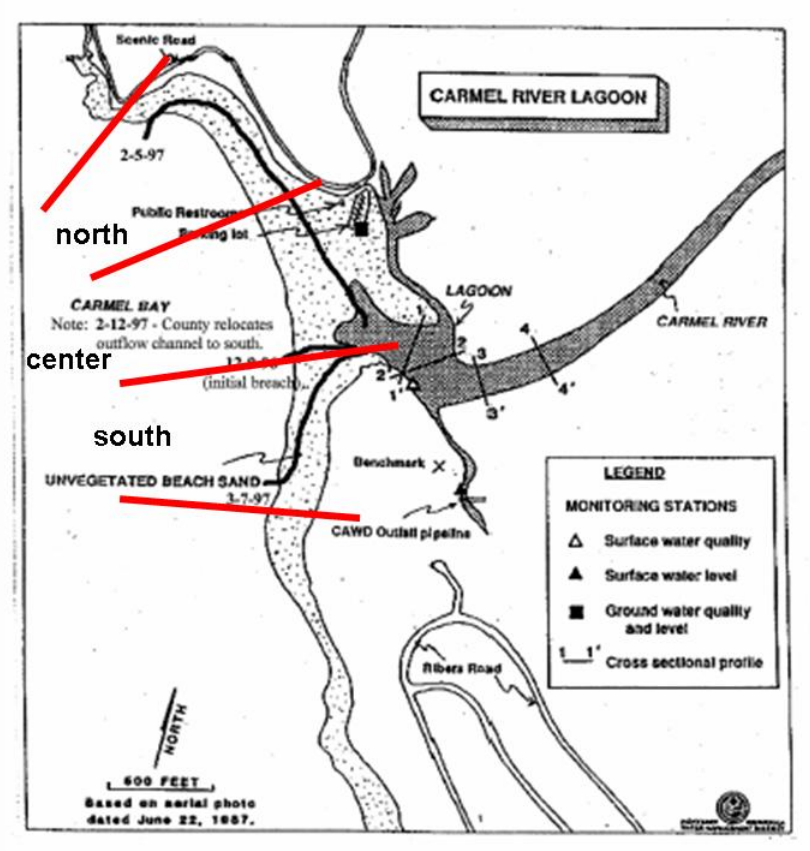


Figure 4. Lagoon opening designation areas to north, center and south for water year 1998. Adapted from G. James, MPWMD



Figure 5. 2003 aerial photo showing the rock basement of south channel.



Figure 6. Photo taken 30 September 2005 showing evidence of overtopping of berm (rack line back of berm and water in the back beach) and the narrow distance between lagoon and ocean.

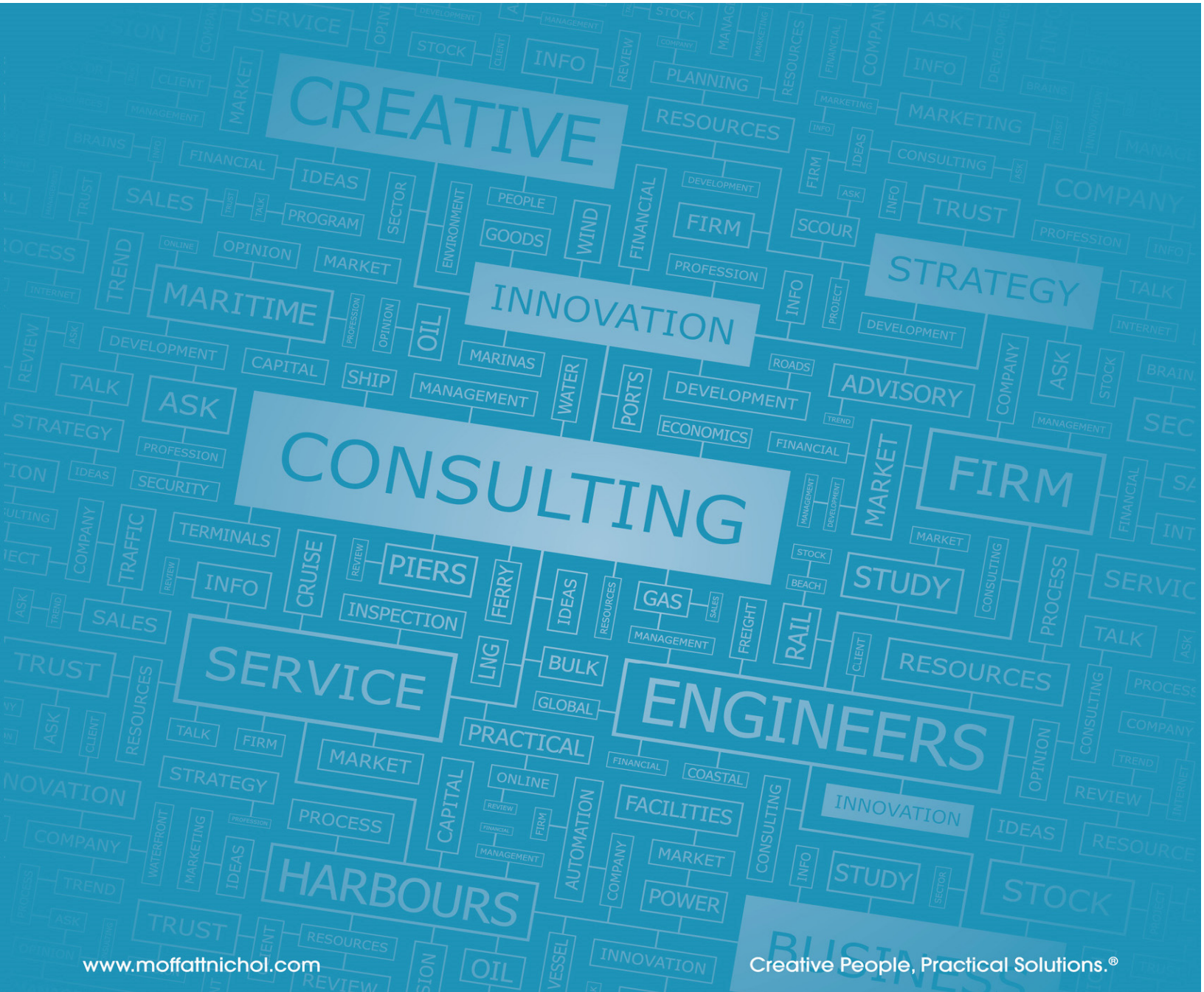
moffatt & nichol

Carmel River Lagoon

Natural Breach Alignment and Location

PRODUCED FOR DENISE DUFFY & ASSOCIATES

DECEMBER 2021



Document Verification

Client	Denise Duffy & Associates
Project name	Carmel River Lagoon
Document title	Natural Breach Alignment and Location
Document subtitle	
Status	Final Report
Date	December 6, 2021
Project number	11132
File reference	

Revision	Description	Issued by	Date	Checked
1	Final Report	M. Jorgensen	December 6, 2021	R. Dornhelm

Produced by:
Moffatt & Nichol
2185 N. California Blvd., Suite 500
Walnut Creek, CA 94596-3500
T 925.944.5411
www.moffattnichol.com

Table of Contents

Document Verification i

Glossary iv

Executive Summary 1

1. Introduction 2
1.1. Project Objectives 3
1.2. Scope of Work 3
1.2.1. TAC Review Panel 3

2. Site Information 5
2.1. Carmel River Lagoon 5

3. Wave Climate 8
3.1. Wave Statistics 9
3.1.1. Swell Waves 9
3.1.2. Wind-Waves 10

4. Beach Morphology 11
4.1. Littoral Transport Driven by Swell Waves 12
4.2. Littoral Transport Driven by Wind-Waves 14

5. Lagoon and Beach Morphology 16
5.1. Lagoon Morphology Prior to Breaching 18
5.2. Lagoon Morphology after Breaching 18

6. Conclusions 20

References 21

Appendix A: Wave Statistics ..... A

List of Figures

Figure 1-1: Overview of lagoon closures and breaches (1991-2021). 2
Figure 2-1: Carmel River State Beach site location. 5
Figure 2-2: Carmel River State Beach and Carmel River Lagoon. 6
Figure 3-1: Angles of wave incidence at Carmel, adopted from USGS (2006). 8
Figure 4-1: Overview of lagoon closures and breaches (1991-2021). 11
Figure 4-2: Sediment transport patterns associated with swell waves. 13
Figure 4-3: Sediment transport patterns for northwest wind-waves. 14
Figure 5-1: Overview of CRSB seasonal variation and lagoon morphology 17
Figure 5-2: Wave-driven processes affecting lagoon breach migration. 19

List of Tables

Table 3-1: Distribution of swell waves by month and offshore direction of incidence.....9
Table 3-2: Distribution of wind-waves by month and offshore direction of incidence. 10

Glossary

cfs	Cubic feet per second
CRL	Carmel River Lagoon
CRSB	Carmel River State Beach
CSUMB	California State University, Monterey Bay.
DD&A	Denise Duffy & Associates
lat	Latitude
lon	Longitude
MN	Moffatt & Nichol
MPWMD	Monterey Peninsula Water Management District
NDBC	National Data Buoy Center
nm	Nautical miles
NPS	Naval Postgraduate School

Executive Summary

This report provides an assessment of the natural stream alignment and breach location of the Carmel River Lagoon.

The analysis finds that lagoon morphology is primarily driven by discharge from the Carmel River, i.e. the planar extent of the lagoon grows as the water level within the lagoon increases. The analysis demonstrates that the morphological evolution of the lagoon is affected by water-level driven breaching and wave-driven breach migration north or south of its initial location. The ability of wave action to affect migration of the lagoon breach increases the closer the lagoon shoreline is to the ocean beach shoreline and dominates once a breach has formed. In this case, the direction of littoral sand transport, either north or south along the beach, strongly affects migration of the breach channel, which follows the littoral transport direction.

The analysis finds that there is no preordained seasonal pattern with respect to whether the breach migrates north, south or remains close to its initial location in a given year. Depending on the incident wave direction and their period, wave-driven littoral transport processes can induce northward or southward migration. The analysis finds that there are certain swell wave conditions that have a tendency to temporarily stabilize the breach channel at the north or at the central portion of the beach, while wind-wave events tend to cause a southward migration. This is likely the explanation behind why many of the breach channels are observed in approximately the same areas of the beach, whether at the northern, central, or southern portions.

However, it should be noted that these observations are after a breach has occurred and a channel formed. The analysis has not found any indication that there is a preferred location where a breach would naturally tend to occur.

While wave-driven processes are found to significantly influence the migration of the breach, it is primarily the inflow to the lagoon from the Carmel River that controls breaching and closure of the lagoon. Field observations have established that following the seasonal initial breach event, the lagoon will close temporarily and breach intermittently until its seasonal closure. Closure has been found to occur when discharge from the Carmel River decreases to around 10 cfs or lower. Closure can and does occur at inflows greater than 10 cfs, but the duration of the closure declines with higher inflows. At flows of 20-200 cfs the lagoon may close and breach intermittently, but even 50-100 cfs is sufficient to keep the lagoon open. During inflows higher than 200 cfs, a breach will remain open for as long as the discharge persists.

Because of the random nature of the wind and wave climate and significant variation in precipitation from year to year, lagoon breaching is highly dynamic and episodic. Irrespective of the ability of waves to close off a breach channel, it is still the discharge from the river that governs when a breach will occur, and when an open breach channel might close and subsequently re-form.

1. Introduction

The Carmel River Lagoon (CRL) undergoes an annual cycle of lagoon progression approximately as follows (per Figure 1-1):

1. Initial breaching, often in November through January. Initial breaching may be done mechanically (typically November to January) or occurs naturally (typically December to January).
2. Intermittent breaching and closure, typically over the months from February through May.
3. Seasonal closure, in most years from around June through November.

Each year as the rainy season commences, Monterey County will monitor the rise of the water level in the lagoon and initiate sandbar management to facilitate breaching if expected inflows to the lagoon are projected to cause a flood hazard to properties along the edge of the lagoon. Sandbar management involves excavation of a pilot channel across the sandbar, which enables the lagoon to breach if the water level reaches a flood stage of concern. Inflows to the lagoon primarily consist of discharge from the Carmel River, but can also include local and regional precipitation events, and wave overtopping events.

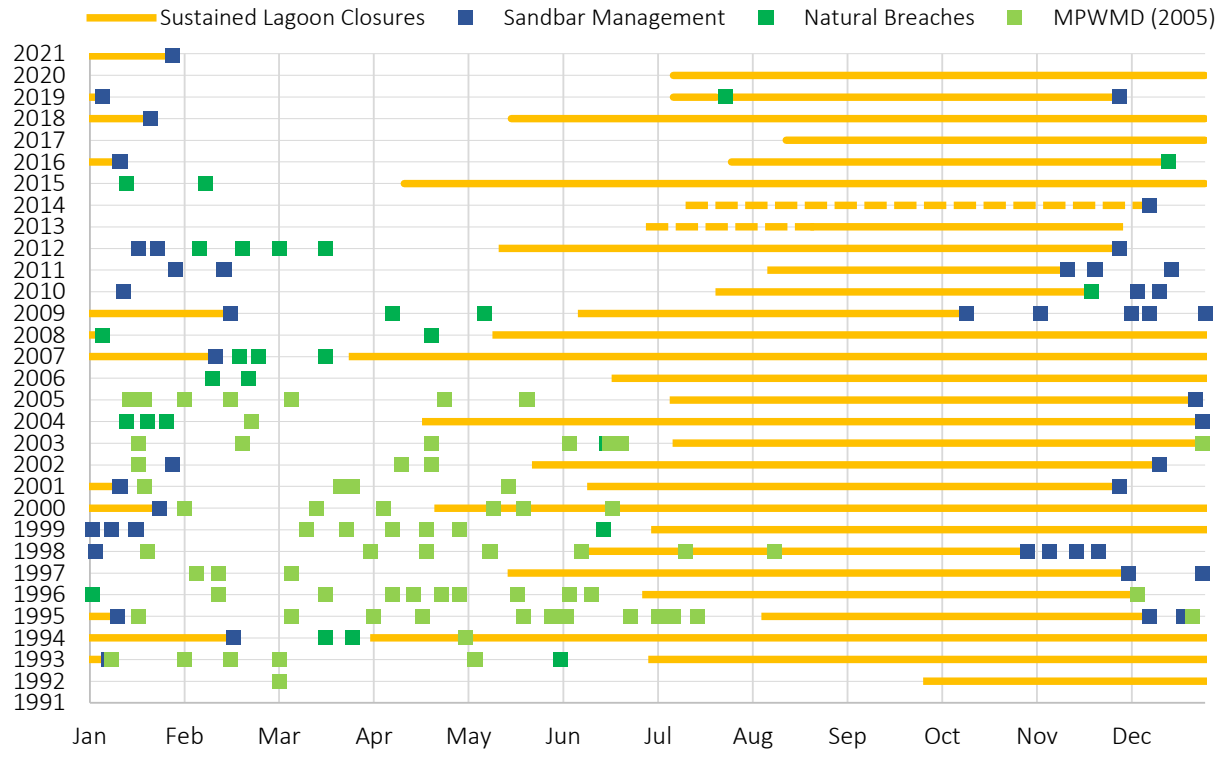


Figure 1-1: Overview of lagoon closures and breaches (1991-2021).

Discharge from the Carmel River typically diminishes or ceases over the summer months, which can cause the water quality to decline and the water level in the lagoon to decrease due to seepage and evaporation. For this reason, there is a concerted effort to initiate early sustained closure of the lagoon in order to retain as much water as possible for the summer months.

1.1. Project Objectives

The objective of this analysis is to evaluate what would be the natural behavior of the lagoon, breach alignment and location without intervention via mechanical breaching.

Because the lagoon has been managed for several decades, it is not straightforward to identify the natural lagoon behavior in terms of breach alignment and location. The present analysis arrives at conclusions about the lagoon morphology by examining known cases of the lagoon breaching naturally, and the observed lagoon behavior outside of mechanical breaching events.

1.2. Scope of Work

Moffatt & Nichol was retained by Denise Duffy & Associates to assess the natural breach alignment and location of the CRL.

The assessment was conducted based on review of aerial photo history, flow records, ocean wave conditions, and prior studies on the Carmel River State Beach (CRSB) and CRL. The work was performed with input from Balance Hydrologics, Inc. and Whitson Engineers on the subconsultant team lead by Denise Duffy & Associates as the prime consultant to Monterey County.

1.2.1. TAC Review Panel

The work was conducted with input and peer reviewed by a Technical Advisory Committee (TAC) consisting of the following panel members:

1. Dr. Mara Orescanin, Professor of Coastal Oceanography at the Naval Postgraduate School (NPS). Dr. Orescanin has experience with the morphology of coastal lagoons, sandbar build-up, erosion, and sediment transport, and familiarity with CRLM gained from field work on the beach and lagoon.

2. Dr. Doug Smith, Professor of Hydrology and watershed restoration at California State University, Monterey Bay (CSUMB). Dr. Smith has experience in lagoon and river flooding cycles, river sediment transport and flow, and familiarity with the Carmel River and CRL.

3. Larry Hampson, (retired) engineer and consultant for the Monterey Peninsula Water Management District (MPWMD). Mr. Hampson has expertise with flood management, and sandbar management and longstanding experience with the historical setting of the CRL and on the ground knowledge gained from observations and field visits.

4. Jeff Hagar, consultant for Hagar Environmental Science. Mr. Hagar specializes in water resource management and aquatic species conservation, and has experience with monitoring

of salmonoid habitat in lagoon ecosystems on the central coast, and specific expertise with steelhead trout on the San Lorenzo River at Santa Cruz, CA.

2. Site Information

2.1. Carmel River Lagoon

Figure 2-1 shows the location of Carmel River State Beach (CRSB) where the Carmel River Lagoon (CRL) is located at the mouth of the Carmel River.

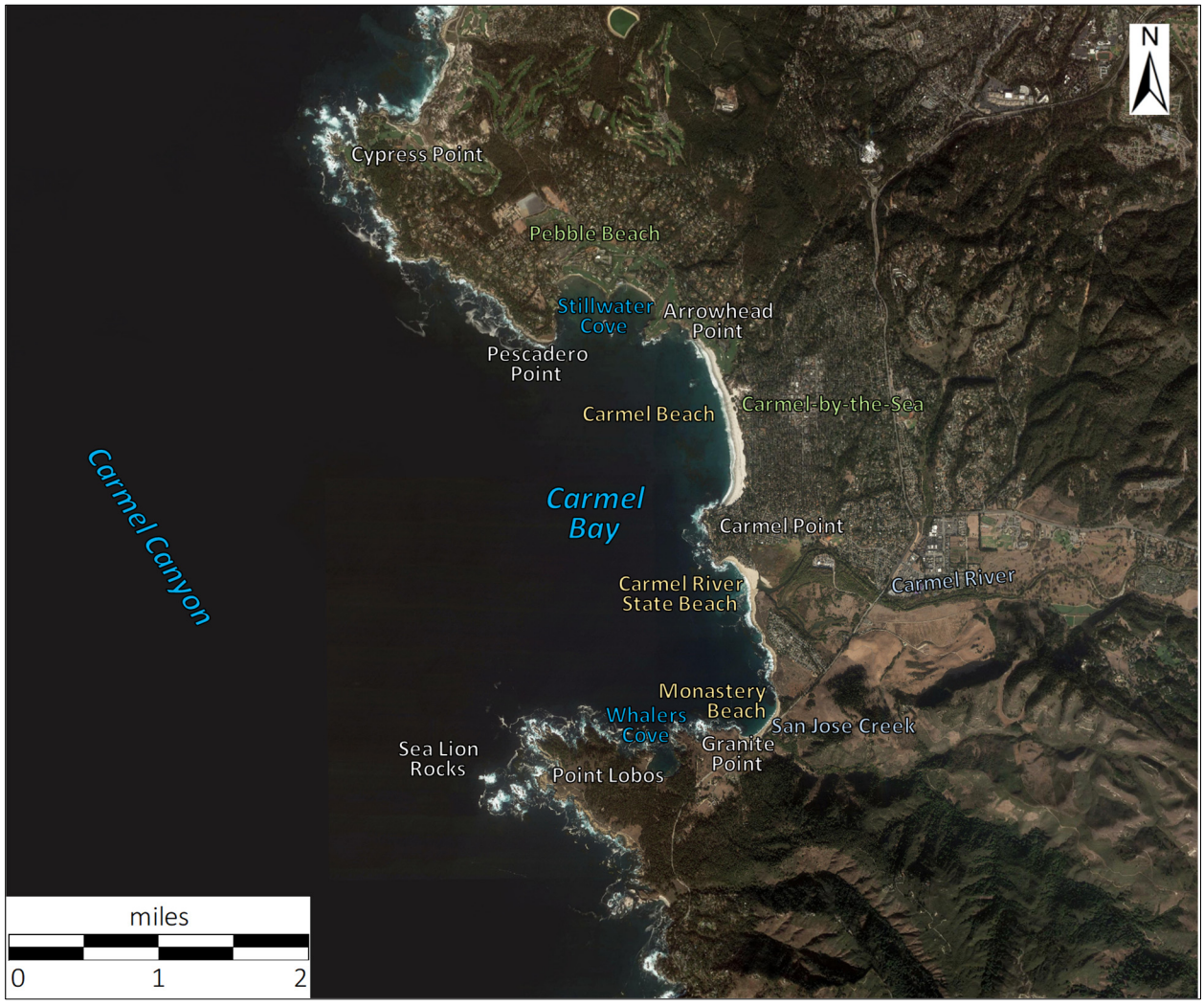


Figure 2-1: Carmel River State Beach site location.

The Carmel River drains approximately 250 square miles of the Santa Lucia and Sierra de Salinas Mountains into Carmel Bay. The Carmel River watershed has historically experienced large variations in seasonal and yearly discharge rates. A complex dynamic exists between the CRL and the Pacific Ocean. Figure 2-2 provides a closeup of the CRL and CRSB.

During times of low or no river discharge, waves build up the beach profile to form a sandbar along the CRSB shoreline. The sandbar closes off the mouth of the lagoon, which causes the lagoon to dam up. Some amount of outflow from the lagoon to the Pacific occurs via groundwater seepage through the beach sand. The lagoon water body also loses water due to evaporation, primarily over the summer months. When river discharge is minimal, the lagoon water level recedes to a base elevation that persists over the dry summer months.

When river discharge increases, the lagoon water level can rise rapidly and potentially reach or exceed the defined flood stage. This can occur at any time from late fall to early spring.



Figure 2-2: Carmel River State Beach and Carmel River Lagoon.

Management of the lagoon water level has therefore been implemented to mitigate flood hazards to properties along the north side of the lagoon. The management practices include monitoring of the lagoon water level and projected river inflows to the lagoon, and mechanical breaching of the lagoon. If inflows to the lagoon do not pose a flood hazard, no management action is carried out and the lagoon can breach naturally. Following a breach event (mechanical or natural), the incident waves can build up the beach and reform the sandbar, which closes the lagoon outlet. This can occur progressively or

quite rapidly depending on the wave characteristics. When the annual rainy season ends, and depending on whether or not the outlet has been closed off naturally, the decision is made to mechanically close the outlet before the river flow subsides in order to maximize the volume of water stored in the lagoon leading into the dry season.

3. Wave Climate

The Carmel shoreline is exposed to wind-waves generated by local storm systems as well as swell waves originating from distant storms over the Pacific. Figure 3-1 shows the general angles of wave incidence from USGS (2006).

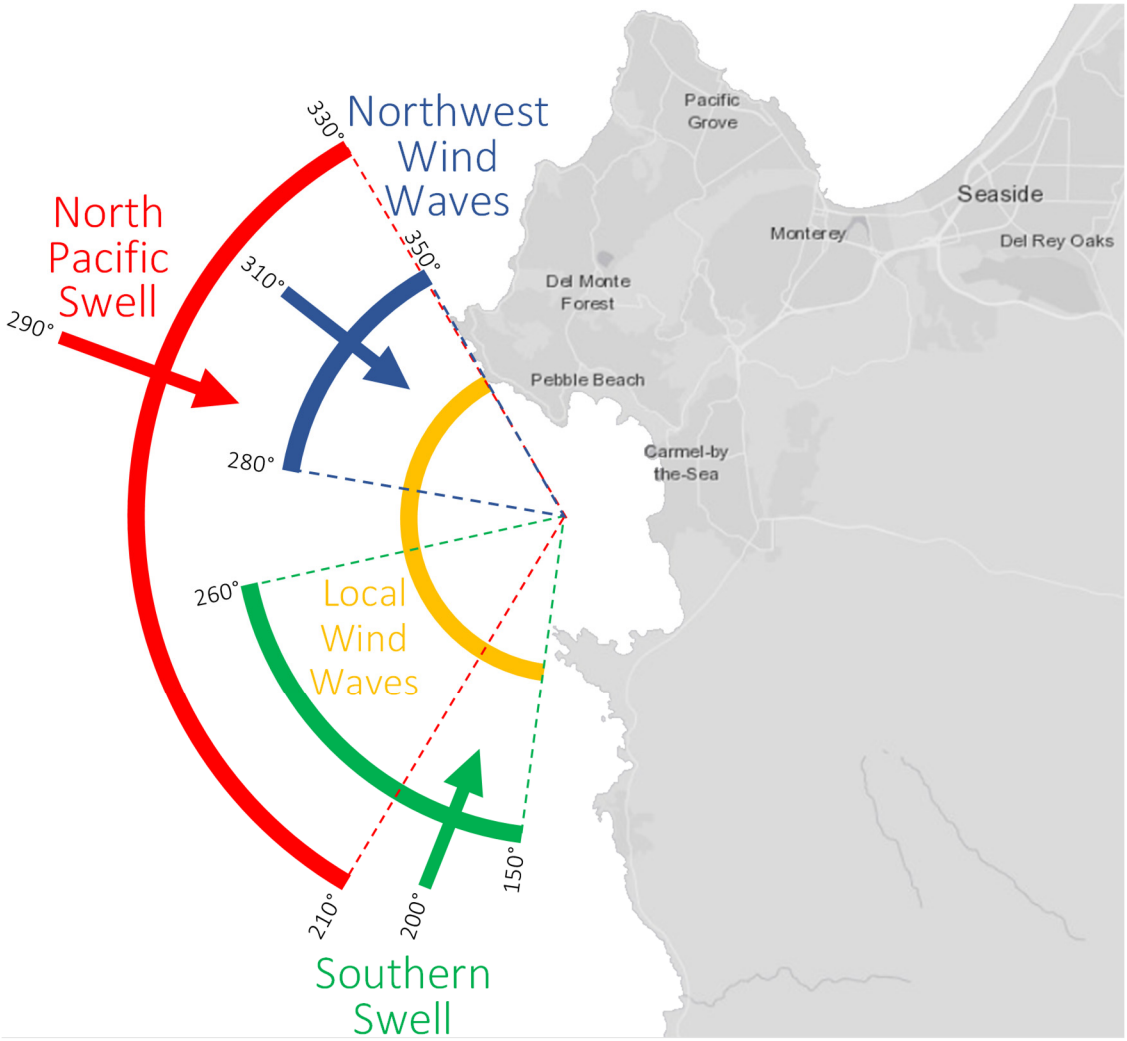


Figure 3-1: Angles of wave incidence at Carmel, adopted from USGS (2006).

There are four different wave systems that affect Carmel Bay: 1) North Pacific swell waves originating from distant storms over the North Pacific, 2) Southern swell originating from distant storms in the South Pacific, 3) Northwest wind waves generated by regional wind systems, and 4) Local wind waves which can occur from any direction with open water. North Pacific swell waves are generated by extra-tropical storm systems, mid-latitude low-pressure systems, and cold fronts over the North Pacific, USGS (2006). Southern swell is generated by storms in the Southern Hemisphere and occurs in the summertime. Swell waves are characterized by long wave periods, typically from 8 to 18 seconds.

Northwest wind waves are generated by daily sea-breeze conditions and are more pronounced in the spring and early summer months, USGS (2006). Wind waves are generated by regional and local wind conditions and produce waves with shorter periods, typically from 3 to 8 seconds. Local storms can occur from October through April.

3.1. Wave Statistics

Wave statistics are summarized in the following. These distinguish between swell waves originating from distant storm systems over the Pacific, and wind-waves generated by the passage of regional storm systems. The wave statistics presented in the following are based on data from NDBC Station 46042 located 27 nm west of Monterey Bay at lat/lon 36.785°N 122.398°W in a water depth of 5,400 feet (1,645.9 m).

3.1.1. Swell Waves

Table 3-1 provides the offshore distribution of swell waves by month. Swell waves from the west (W) and west-northwest (WNW) exhibit a pronounced decrease over the summer months May through September and become much more prevalent over the months from October through April.

Swell waves from the directions north-west (NW), south (S), and south-southwest (SSW) have a pronounced increase over the summer months from May through September and a decrease over the winter months from October through April.

Swell waves from the directions south-southeast (SSE), south-west (SW), west-southwest (WSW), and north-northwest (NNW) are evenly distributed and occur with a constant low-level presence.

Table 3-1: Distribution of swell waves by month and offshore direction of incidence.

Month	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
JAN	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	1.9%	5.9%	1.2%	0.0%	9.2%
FEB	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	1.7%	4.0%	1.6%	0.0%	7.8%
MAR		0.0%	0.1%	0.2%	0.1%	0.2%	1.2%	4.7%	2.1%	0.0%	8.6%
APR		0.0%	0.3%	0.3%	0.2%	0.2%	0.8%	4.3%	2.6%	0.0%	8.7%
MAY		0.0%	0.8%	0.7%	0.2%	0.1%	0.4%	2.1%	3.6%	0.0%	8.0%
JUN		0.1%	0.7%	0.9%	0.2%	0.1%	0.2%	1.1%	3.9%	0.1%	7.1%
JUL		0.1%	1.3%	1.2%	0.3%	0.1%	0.1%	0.6%	4.0%	0.1%	7.9%
AUG	0.0%	0.2%	1.5%	1.0%	0.2%	0.1%	0.3%	0.7%	2.6%	0.0%	6.6%
SEP		0.1%	0.7%	0.9%	0.2%	0.1%	0.3%	2.3%	3.3%	0.1%	8.0%
OCT		0.0%	0.3%	0.4%	0.3%	0.3%	0.8%	4.0%	2.7%	0.0%	8.9%
NOV		0.0%	0.1%	0.1%	0.1%	0.1%	0.7%	4.8%	3.4%	0.0%	9.4%
DEC	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.9%	5.6%	3.0%	0.0%	9.8%
Total	**0.0%**	**0.5%**	**6.1%**	**5.7%**	**2.0%**	**1.7%**	**9.4%**	**40.1%**	**34.2%**	**0.4%**	**100%**

In general, there is a fairly even presence of swell waves across all months of the year. This indicates that the swell is persistent and occurs at all times of the year.

3.1.2. Wind-Waves

Table 3-2 provides the distribution of wind-waves by month. The percentage indicated in this table totals to 79%. The remainder of the time, winds are either calm or from overland directions (north to east-southeast).

Although the strongest storms occur over the winter months, the data indicates that the months with the most wind are from May through September.

Wind-waves from north-westerly (NW) and west-northwesterly (WNW) directions exhibit a pronounced increase over the summer months from May through September and wane over the months from October through April. 71% percent of wind-waves (out of a total of 79%) occur from these directions.

Wind-waves from the remaining directions are less frequent or calm over the summer months with a tendency to pick up slightly over the winter months.

Table 3-2: Distribution of wind-waves by month and offshore direction of incidence.

Month	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
JAN	0.2%	0.4%	0.4%	0.0%	0.0%	0.2%	0.0%	0.1%	0.7%		2.0%
FEB	0.0%	0.6%	0.3%	0.1%	0.2%	0.2%	0.2%	0.2%	1.0%	0.0%	2.8%
MAR	0.0%	0.3%	0.3%	0.2%	0.1%	0.0%	0.0%	0.3%	2.3%	0.0%	3.6%
APR		0.0%	0.1%	0.0%		0.0%	0.1%	0.6%	3.1%	0.2%	4.1%
MAY	0.1%	0.3%	0.1%		0.0%	0.0%	0.3%	1.9%	10.5%	0.8%	14.1%
JUN							0.0%	1.7%	12.2%	0.4%	14.4%
JUL							0.0%	2.4%	14.9%	0.3%	17.6%
AUG							0.0%	1.9%	17.2%	1.2%	20.2%
SEP								1.1%	9.9%	0.4%	11.5%
OCT	0.0%	0.1%	0.0%	0.0%			0.1%	0.7%	3.1%	0.1%	4.1%
NOV	0.0%	0.6%	0.2%	0.0%		0.0%	0.0%	0.3%	1.5%	0.2%	2.9%
DEC	0.0%	0.7%	0.3%	0.1%	0.1%	0.1%	0.2%	0.3%	0.9%	0.1%	2.8%
Total	**0.4%**	**1.6%**	**1.2%**	**0.3%**	**0.3%**	**0.4%**	**0.8%**	**9.0%**	**61.8%**	**2.9%**	**79%**

Additional wave statistics are provided in Appendix A with tables summarizing the distribution of wind-waves and swell waves by significant wave height and direction; and peak wave periods.

4. Beach Morphology

Figure 4-1 provides an overview of lagoon states (natural and managed) over the period from 1991 to 2021, compiled based on data from the County of Monterey (2021), BH (2014), and MPWMD (2005). Over the period from 1991 to 2005, Greg W. James logged natural breach events based on site visits and visual inspection as reported in MPWMD (2005). In a 2014 analysis, Balance Hydrologics identified lagoon breaches and closures based on analysis of water level variations recorded in the lagoon, BH (2014). Data from these sources is summarized in Figure 4-1. The horizontal yellow bars indicate periods of lagoon closure, i.e. with no outlet to the ocean. This period can start as early as April or May, but typically occurs over the summer months from July through November, at times extending into December and January. Dashed yellow lines indicate years where the start date of sustained lagoon closure is not accurately known. In these cases, the duration of lagoon closure was estimated based on inspection of historical aerial imagery.

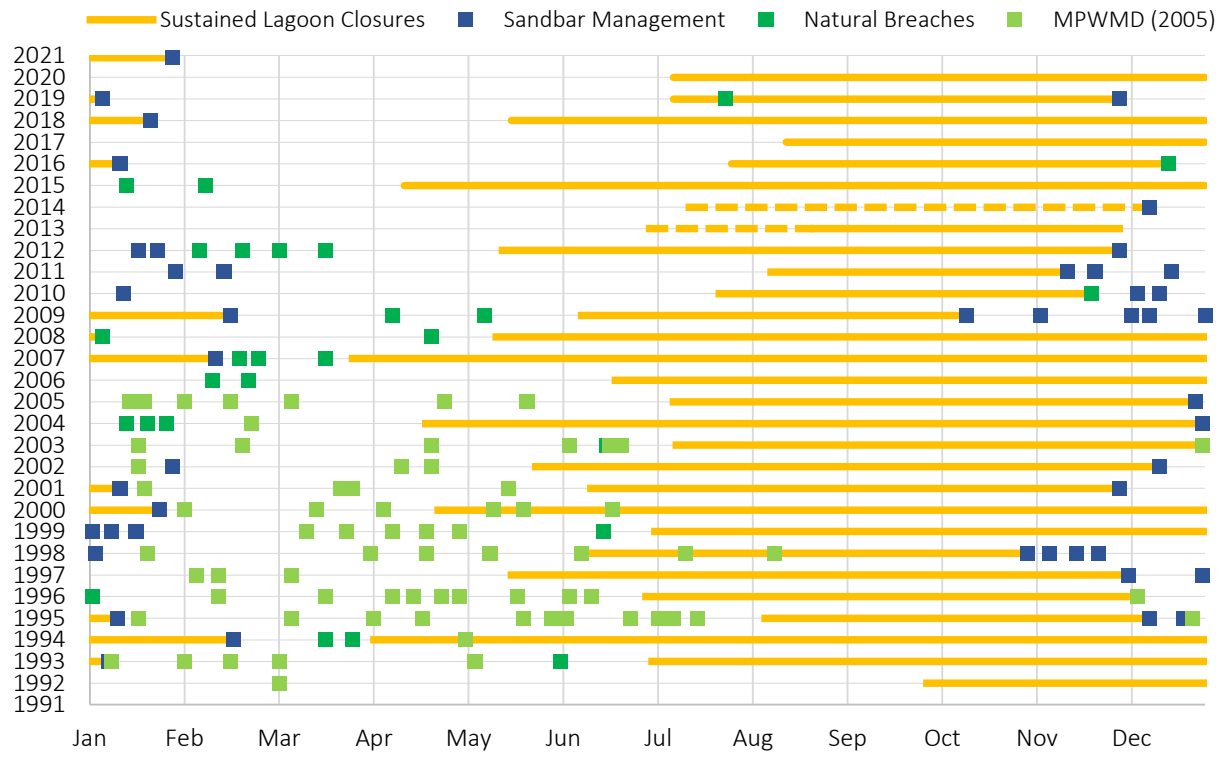


Figure 4-1: Overview of lagoon closures and breaches (1991-2021).

The blue squares indicate dates of sandbar management to reduce flood risk. This management action is initiated when the lagoon water level is high or projected to reach flood stage and typically takes place from November through January. The dark green squares indicate dates when naturally formed lagoon breaches have been observed, from BH (2014). The squares in light green indicate dates of additional observations by Greg W. James reported in MPWMD (2005). It should be noted that natural breaching of the lagoon has not been monitored in detail since 2012. The period and frequency of

natural breach events over the years from 2012 to present should be expected to follow the same pattern as observed by James over the years from 1991 to 2005. During the phase of natural breaching of the lagoon from around January to June/July, the lagoon will remain open for approximately 85% of the time and close intermittently[1]. Per MPWMD (2005) Carmel River inflows to the lagoon greater than 200 cfs will cause breaches to remain open 100% of the time during this phase. When inflows are between 200 and 20 cfs, the lagoon may close and breach intermittently, and when inflows are below 10 cfs wave action will typically close the breach. Refer to Thornton (2005) for additional interpretation of beach morphology.

4.1. Littoral Transport Driven by Swell Waves

Waves and littoral transport patterns associated with waves have been studied in Thornton (2005) and documented in field observations by Greg W. James, MPWMD (2005).

Figure 4-2 shows sediment transport patterns associated with swell waves occurring over the months of November through January where initial lagoon breaching usually takes place. During this time of the year, the swell wave climate is dominated by episodes of North Pacific swell.

Swell episodes can last from hours to several days, depending on the magnitude and duration of the storm system of origin. During an episode of swell, the waves with the longest wave periods will arrive first, followed by waves with progressively shorter periods, for example initial swell waves with 18 second periods, transitioning to swell with 15 second periods, then 13 second periods and so forth until the swell front dies down.

Offshore from Carmel Bay, North Pacific swell can arrive from a wide range of directions (Figure 3-1). These are grouped in Figure 4-2 into waves arriving from northwesterly directions (dark blue arrows), waves from westerly directions (light blue arrows), and waves from southwesterly directions (red arrows). These offshore directions of wave incidence are indicated by the three arrows on the left side of the figure. The percentage indicates the amount of time incident swell waves arrive from the respective direction. It can be seen that the majority of swell waves arrive from westerly and northwesterly directions and a limited amount of waves from southwesterly directions. The size of the arrows used in the figure (large, medium, and small) indicates the magnitude of the littoral transport. The littoral transport is the result of wave-driven processes. Wave breaking in the surf zones causes sediment to be mobilized and brought into suspension. The longshore current, also generated by wave breaking transports the sediment along the shoreline.

The results show that irrespective of the offshore angle of wave incidence, the resultant direction of longshore transport along is generally southward in the deeper water along the shoreline. Closer to the shoreline, waves from northwesterly and westerly directions can set up a circulation pattern where the direction of sediment transport is northward along the southern part of CRSB.

The variation of the seabed and crenulate shape of the bay causes incident waves to undergo a significant amount of refraction. At the north end of CRSB, where the beach is sheltered behind Carmel

[1] In wet years the lagoon was observed to remain open almost 100% of the time. In drought years, approximately 50% of the time.

Point, the transport direction is to the east-southeast along the beach, which explains why the headland is rocky (and not saturated with sand).

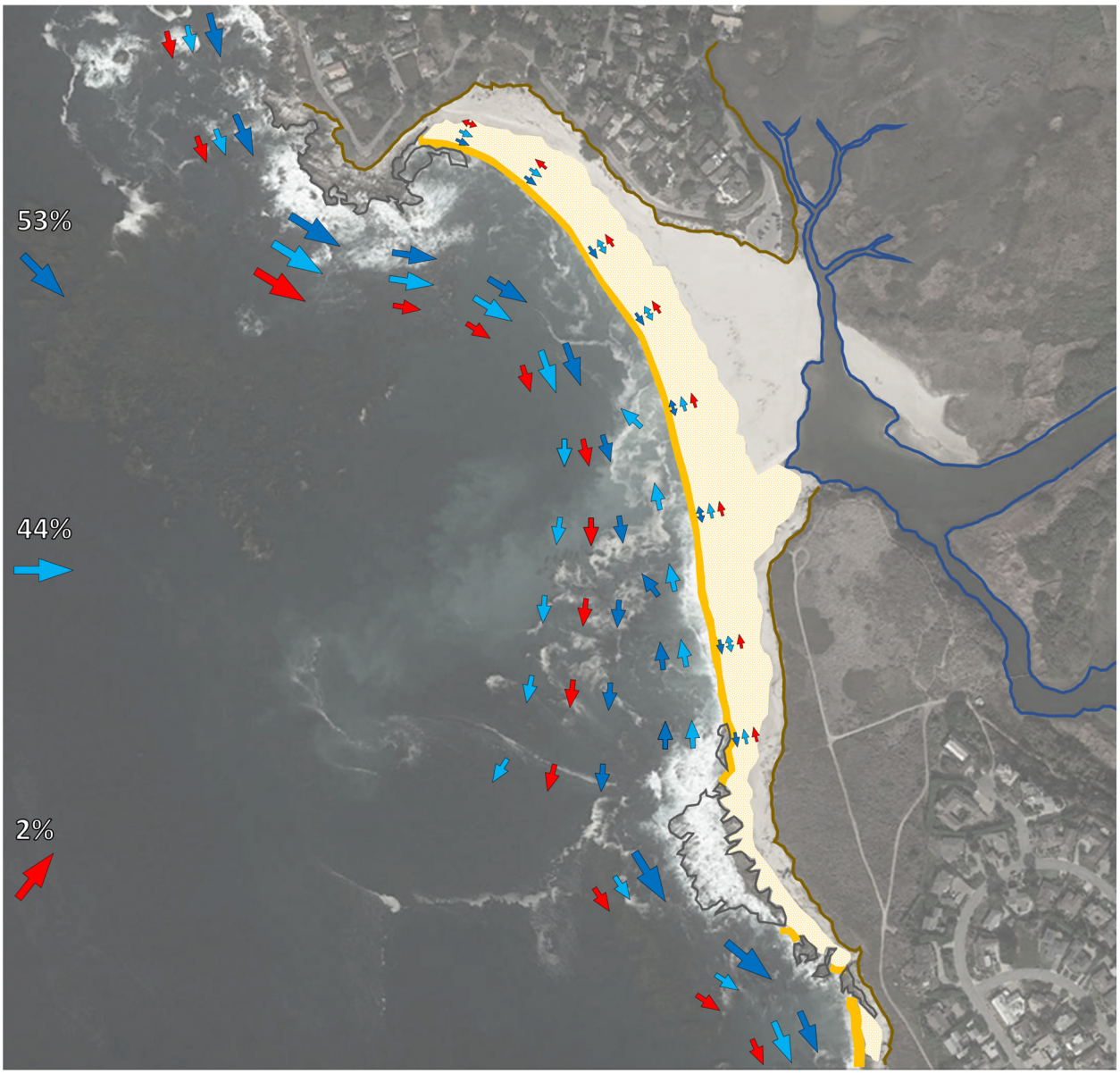


Figure 4-2: Sediment transport patterns associated with swell waves.

Wave runup over the beach is also able to transport sediment along the shoreline. This occurs when the wave runup is angled slightly with respect to the shoreline. This mode of transport is indicated by the small arrows shown on the beach in Figure 4-2 (swash zone). For northwesterly waves, the results show that the direction of sediment transport is generally southward along the beach, but there is an area at the center of the beach where the transport can be either northward or southward. For westerly waves there is a similar finding – the direction of transport is generally southward along the beach, but there is an area of the south end of CRSB where the transport can be either northward or southward.

For southwesterly waves, the direction of transport is northward nearly all the way to the north end of CRSB. The areas of mixed transport directions are locations where open breach channels might tend to congregate. These areas correlate well with where breach channels have been observed in the field, i.e. at the north and south end, and central part of the beach.

4.2. Littoral Transport Driven by Wind-Waves

Figure 4-3 shows sediment transport patterns associated with wind-waves occurring over the months of November through January for wind-waves from northwesterly, westerly, and southwesterly directions.

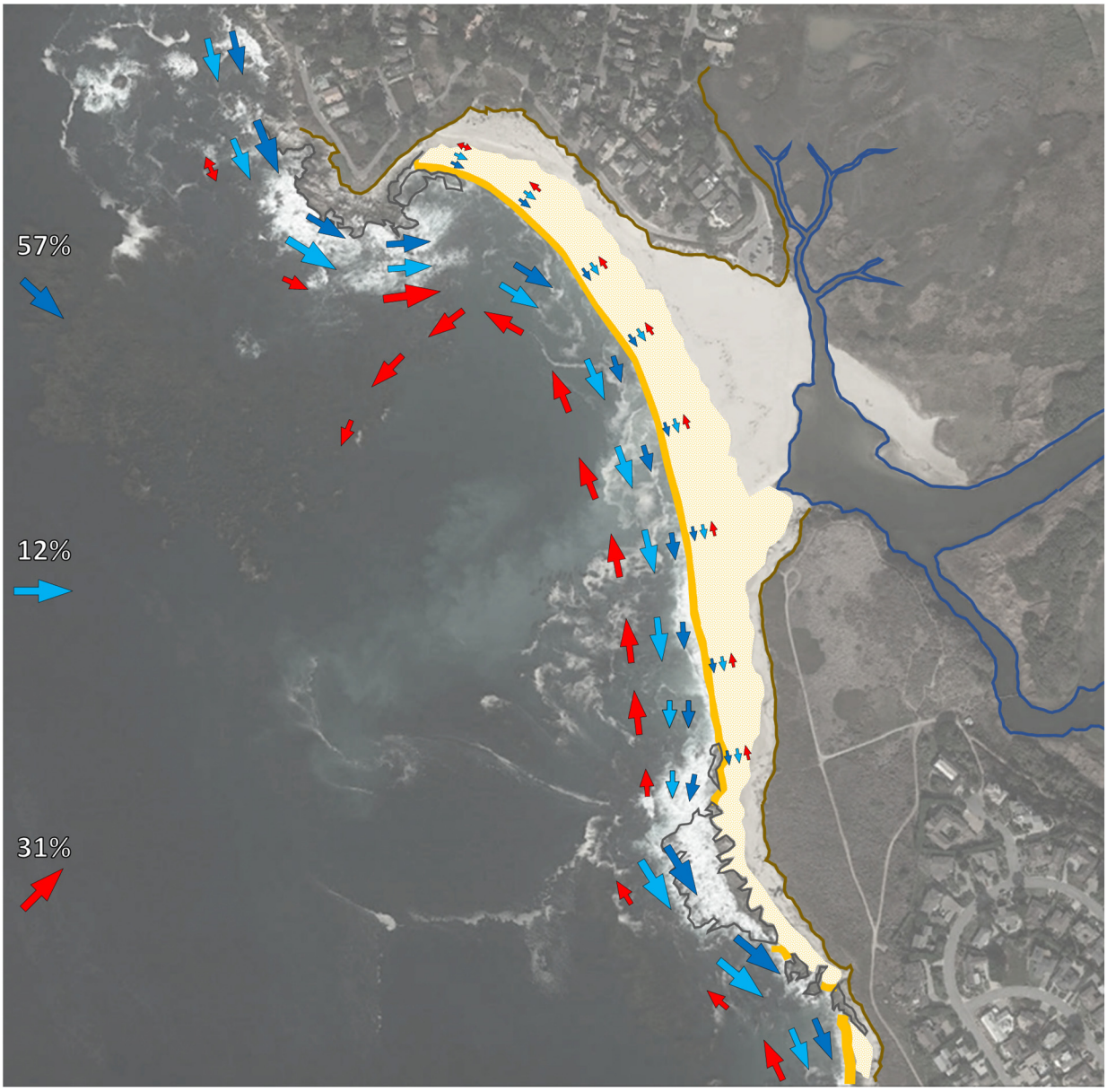


Figure 4-3: Sediment transport patterns for northwest wind-waves.

Because wind-waves have shorter wave periods than swell waves they are not subject to the same degree of wave refraction as swell waves as they propagate into Carmel Bay. The relationship between sediment transport direction and wind-wave direction is therefore much more obvious. Wind-waves from west-northwesterly and westerly directions produce southward transport both in deeper water and within the swash zone on the beach. Wind-waves from southwesterly directions generally produce northward transport both in deeper water and within the swash zone.

The percentages noted along the left edge of the figures indicate that the majority of wind-wave event occur from northwesterly directions and from southerly directions. Wind-waves during these events develop during the passage of regional storm systems and are therefore relatively short-lived and highly episodic.

Figure 4-3 illustrates that a wave event associated with wind from northwesterly directions can transport significant amounts of sediment away from CRSB south along the coast. The process removes sediment both along the shore and out in deeper water with the net effect being a substantial depletion of sediment from the CRSB shoreline and seabed.

Southwesterly wind-wave events will produce a strong northward directed transport along the shoreline and in deeper water. However, in most cases these events will not bring sand to the area of CRSB, but will rather shift the sand along the shoreline up to the north end of CRSB. The net effect is that the width of the beach decreases along the south end of CRSB, while the beach widens at the north end of CRSB.

5. Lagoon and Beach Morphology

The lagoon and beach morphology has been the subject of extensive studies and field observations. Greg W. James documented valuable site information based on numerous field visits, MPWMD (2005). Refer to Thornton (2005) for insight on waves, littoral transport, beach morphology and lagoon breaching. Natalie Laudier investigated wave overtopping of the CRSB sandbar, Laudier (2009), and established a stage-volume relationship relating volumetric changes in the lagoon to wave overtopping of the sandbar.

Jeffrey Scooler, Scooler (2017), conducted a field exploration program and theoretical study of mechanisms for lagoon breaching and closure to evaluate intermittent opening and closure of the lagoon based on wave action, tide level, lagoon water level, and discharge.

A companion analysis and field study was conducted by Orescanin and Scooler (2018) to study lagoon breach channel opening and closure dependent on tide stage, wave forcing at the mouth of the breach channel, wave penetration into the estuary, lagoon water level, and river discharge. The study led to development of a momentum balance equation to predict the critical discharge required to maintain an open river mouth.

Jillian Coughlin, Coughlin (2019) investigated the seasonal movement of the lagoon breach channel across the beach based on field observations, aerial photography and photogrammetry. The study considered the effects of wave height and direction on the morphological changes observed, and the overall net transport of sediment involved. The study concluded that the lagoon may be subject to alternating migratory and stationary breach seasons. Migratory years were identified to be associated with beach erosion, and stationary years associated with sediment accretion and beach building. The study confirmed that river breach migration at CRSB is influenced by river discharge levels and the local wave climate and concluded that seasonal variations in wave direction produce northward momentum during migratory years.

Orescanin et al (2019) conducted a further study of the lagoon water level, river discharge and wave action to investigate the seasonal adjustment of the CRSB in response to mechanical and natural breaching events. The study found that lagoon breach events supply sand to the foreshore. Another finding of the study was that wave runup and overwash can erode the foreshore and deposit sand on the backshore beyond the sandbar crest, resulting in onshore migration of the CRSB.

Figure 5-1 provides an overview of the processes that shape the CRSB and lagoon planform. Incident wave crests and wave troughs are indicated by the light blue solid/dashed lines. The crenulate shape of the bay and seabed contours cause incident waves to refract and diffract. Refraction causes incident waves to turn so the direction of wave propagation is approximately perpendicular to the seabed contours. Diffraction is spreading of wave energy and occurs in the lee of the headland (Carmel Point) at the north end of the beach.

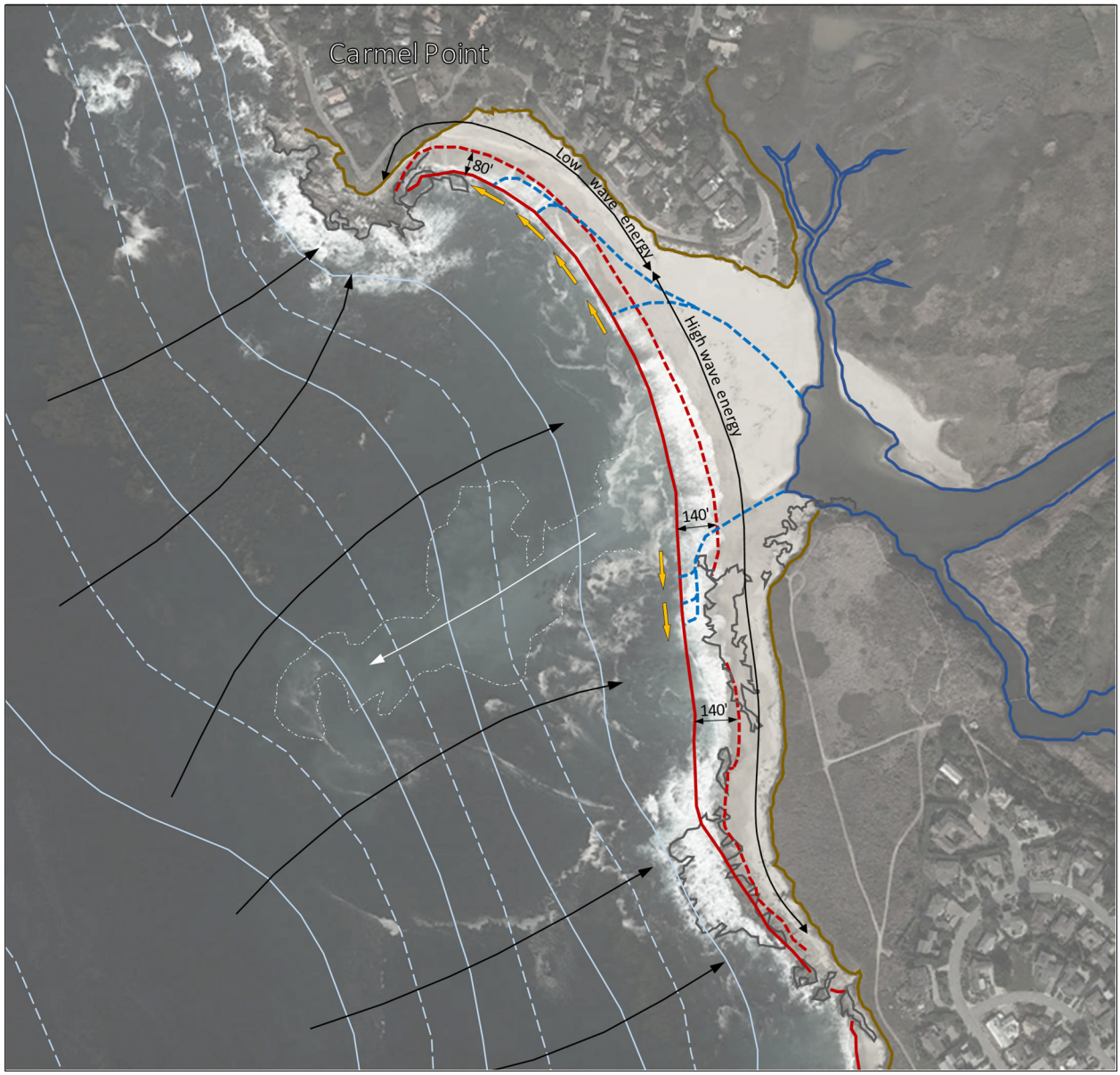


Figure 5-1: Overview of CRSB seasonal variation and lagoon morphology.

Refraction causes the incident waves to converge on the headland at Carmel Point and the rock outcrop located at the south end of CRSB at the transition to Ribera Beach (black arrows in figure). Diffraction occurs primarily in the lee of the headland at Carmel Point. Because of the dispersal of wave energy in this area, the northern portion of CRSB is an area of low wave energy compared to the beach to the south, which is an area of relatively high wave energy.

Summer swell waves tend to build up the beach, while winter storm waves pull sand off the beach into deeper water. The typical summer beach extent is indicated by the solid red line, while the narrower winter beach planform is indicated by the dashed red line. Because of the wave diffraction effects at the north end of the beach and the low wave energy versus high wave energy zones, there is less

variation of the beach width at the northern (on the order of 80 feet) end and more variation at the center and south end of the beach (on the order of 140 feet) between the summer and winter planforms.

The general Carmel River and lagoon planform is indicated by the solid blue line. Example paths showing migration of lagoon breaches are indicated by the dashed blue lines. The breaches can migrate south if the wave-driven littoral transport is southward (yellow arrows); and can migrate north if the direction of littoral transport is to the north. Migration of lagoon breaches occur when there is a significant discharge from the Carmel River (which keeps the breach channel open), while the littoral transport tries to close the beach. If the discharge from the river decreases, the littoral transport can close the breach. Closure of a breach can occur due to littoral transport (along the shoreline in the plan view), and also due to vertical buildup of sand deposited with wave runup.

Northward lagoon migration has historically reached the northern end of the beach where it terminates at the rock outcrop at Carmel Point. Southward migration is limited by the rock outcrops at the south end of the beach. If the beach level is high, these outcrops are typically buried under the sand but appear when the beach level lowers.

5.1. Lagoon Morphology Prior to Breaching

Formation of the lagoon each season is primarily related to enlargement of the lagoon as the water level rises in response to inflow from the river. This causes the planar extent of the lagoon to widen out over the sandbar.

5.2. Lagoon Morphology after Breaching

Figure 5-2 shows how wave action affects lagoon breach migration. As waves propagate towards the shoreline, they are subject to refraction due to their angle of incidence relative to the change in water depth. The process turns the incident wave crests so they are nearly parallel to the shoreline. However, as waves break in the surf zone the direction of wave motion may still have a small angle relative to the shoreline. This produces a net longshore transport of sediment, indicated by the purple arrow in the figure. Wave runup on the beach follows a zig-zag motion as indicated by the orange lines in the figure. The process deposits sand on the sandbar with the wave runup and occasional wave overwash. This wave-driven sediment transport process actively builds up the sandbar.

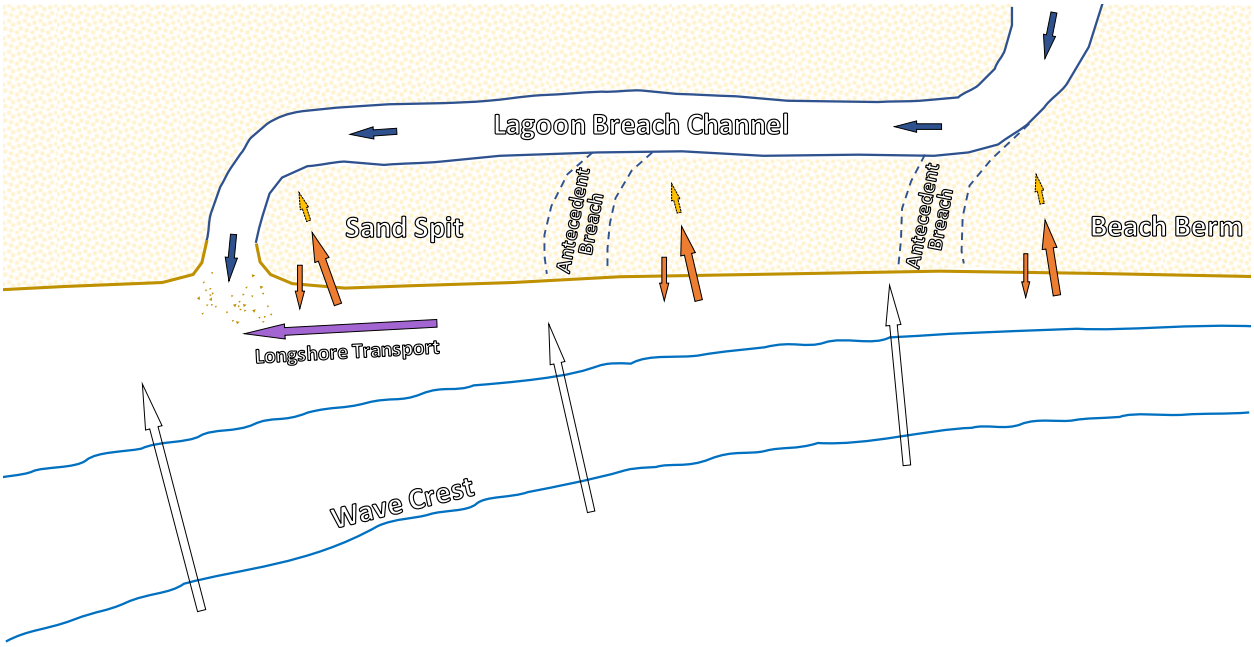


Figure 5-2: Wave-driven processes affecting lagoon breach migration.

When sufficient outflow from the lagoon maintains an open breach channel, sediment will be move within the breach channel. Field data has shown that as long as discharge from the river is higher than 10 cfs (Thornton, 2005), the breach channel will tend to remain open. Where the breach channel outflow encounters the active swash zone on the beach, an equilibrium can develop where the outflow keeps the breach channel open whereas wave action continually seeks to close off the breach channel. The result is migration of the breach channel, shown right to left in the figure. The dashed blue lines indicate antecedent breach channels, going from right to left. Recent field observations of breach channel migration were conducted by Jeffrey Scooler in his 2017 Thesis, Scooler (2017). Thornton (2005) found that the lagoon breach channel can migrate north or south by 5 to 40 feet per day and in extreme cases 150 feet per day.

6. Conclusions

The analysis finds that lagoon formation is primarily driven by discharge from the Carmel River, i.e. the planar extent of the lagoon grows as the volume of water contained within the lagoon increases. The analysis demonstrates that the morphological evolution of the lagoon is affected by wave-driven processes which can influence whether the lagoon migrates north, south or central to the beach in a given year. The ability of wave action to affect migration of the lagoon increases the closer the edge of the lagoon is to the shoreline, and dominates once a breach has taken place and a breach channel formed. In this case, the direction of littoral transport, either north or south along the beach, strongly affects migration of the lagoon breach channel, which follows the littoral transport direction.

The analysis finds that there is no preordained directionality with respect to whether the lagoon migrates north, south or central to the beach in a given year. Depending on the angle of incidence of waves and their duration, wave-driven longshore littoral processes can induce northward or southward migration of the lagoon. The analysis finds that there are certain wave conditions that have a tendency to temporarily stabilize lagoon breach channels at the north end of the beach and at the central portion of the beach, while wind-wave events often cause a southward migration of the lagoon breach channel. This is likely the explanation behind why many of the lagoon breach channels are observed to appear in approximately the same areas of the northern, central, and southern portion of the beach.

However, it should be noted that these observations are after a breach has occurred and a breach channel formed. The analysis has not found any indication that there is a preferred location where breaches would naturally tend to occur.

While wave-driven processes are found to significantly influence the migration of the breach, it is primarily the inflow to the lagoon from the Carmel River that controls breaching and closure of the lagoon. Field observations have established that following the seasonal initial breach event, the lagoon will close temporarily and breach intermittently until its seasonal closure. Closure has been found to occur when discharge from the Carmel River decreases to around 10 cfs or lower. At flows of 20-200 cfs the lagoon may close and breach intermittently. During inflows higher than 200 cfs, a breach will remain open for as long as the discharge persists.

Because of the random nature of the wind and wave climate and significant variation in precipitation from year to year, lagoon breaching is highly dynamic and episodic. Irrespective of the ability of waves to close off a breach channel, it is still the discharge from the river that governs when a breach will occur, and when an open breach channel might close and subsequently re-form.

References

BH (2014). *The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report.* Prepared for: Monerey County Resource Management Agency. Prepared by: Edward D. Ballman, P.E. and Anne E. Senter. Balance Hydrologics, Inc. January 2014.

Coughlin (2019). *Morphology Changes to Carmel River State Beach in Relation to Waves and River Discharge.* Thesis by: Jillian N. Coughlin, June 2019. Naval Postgraduate School, Monterey, California.

County of Monterey (2021). Carmel River Lagoon Water Years 2011-2021 Breach Information. Carmel River Lagoon Water Year 2011-2017 Breach Info & Timeline. County of Monterey, November 2021.

Laudier (2009). *Wave overtopping of a barrier beach.* By: Natalie A. Laudier. Naval Postgraduate School, Monterey, California. September 2009.

MPWMD (2005). *Surface Water Dynamics at the Carmel River Lagoon Water Years 1991 through 2005.* Prepared by: Greg. W. James. Monterey Peninsula Water Management District. October 2005.

NDBC (2020). *National Data Buoy Center.* National Oceanic and Atmospheric Administration's Center of Excellence in Marine Technology. National Data Buoy Center, Bldg. 3205, Stennis Space Center, MS 39529.

Orescanin and Scooler (2018). *Observations of episodic breaching and closure at an ephemeral river.* By: Orescanin, Mara M. and Scooler, Jeff, Department of Oceanography, Naval Postgraduate School, Monterey, CA, USA.

Orescanin et al (2019). *Seasonal Morphological Change at a Bar Built Estuary: Carmel River, CA.* By: Orescanin, Mara & Young, W. & Coughlin, J. & Herrmann, D. & Metcalf, Jeremy. (2019). 674-683. 10.1142/9789811204487_0059.

Scooler (2017). *Episodic Changes in Lagoon Water Levels due to Emphemeral River Breaching and Closure Events.* Thesis by: Jeffrey D. Scooler, December 2017. Naval Postgraduate School, Monterey, California.

Thornton (2005). *Littoral Processes and River Breachings at Carmel River Beach.* By: Edward B. Thornton, Naval Postgraduate School, Monterey, CA 93943.

USGS (2006). *National Assessment of Shoreline Change Part 3: Historical Shoreline Change and Associated Coastal Land Loss Along Sandy Shorelines of the California Coast.* Cheryl J. Hapke, David Reid, Bruce M. Richmond, Peter Ruggiero and Jeff List. Open-File Report 2006-1219. U.S. Department of the Interior. U.S. Geological Survey.

Appendix A:

Wave Statistics

Wind Waves

Wind-waves are waves generated by local storm systems. The most significant storms typically occur over the winter months from directions over the sector from south to northwest. Table A-1 summarizes statistics for wave conditions for these storms, based on data from NDBC Station 46042 located 27 nm west of Monterey Bay at lat/lon 36.785°N 122.398°W in a water depth of 5,400 feet (1,645.9 m).

Table A-1: Distribution of wind-waves by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 2								0.0%	0.0%		0.0%
2 - 4	0.0%	0.0%	0.03%	0.0%	0.01%	0.2%	0.3%	2.4%	6.7%	0.5%	10.1%
4 - 6	0.0%	0.6%	0.7%	0.1%	0.1%	0.3%	0.5%	5.9%	39.1%	2.6%	50.0%
6 - 8	0.0%	0.9%	1.2%	0.3%	0.2%	0.1%	0.2%	2.6%	22.2%	1.6%	29.3%
8 - 10		0.7%	1.4%	0.3%	0.1%	0.1%	0.1%	0.7%	3.8%	0.2%	7.4%
10 - 12		0.5%	0.8%	0.11%	0.02%	0.0%	0.0%	0.1%	0.7%	0.02%	2.2%
12 - 14		0.2%	0.3%	0.0%	0.02%	0.0%	0.0%	0.01%	0.10%	0.0%	0.7%
14 - 16		0.06%	0.06%		0.0%				0.02%		0.1%
16 - 18		0.01%	0.01%	0.0%							0.0%
Total	**0.1%**	**3.0%**	**4.5%**	**0.9%**	**0.4%**	**0.7%**	**1.2%**	**11.7%**	**72.6%**	**4.9%**	**100%**

Table A-2 summarizes peak wave periods for wind-waves by significant wave height and direction.

Table A-2: Average peak period of wind-wave periods (in seconds) by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0 - 2								4.3	6.7	
2 - 4	5.3	4.5	4.3	4.3	7.2	6.9	7.2	6.8	6.5	5.0
4 - 6	5.2	5.2	5.3	5.8	6.7	7.2	7.3	6.9	6.8	6.1
6 - 8	6.1	5.8	6.0	6.5	7.3	7.3	7.3	7.2	7.3	7.1
8 - 10		6.6	6.7	7.1	7.2	7.2	7.5	7.4	7.5	7.4
10 - 12		7.1	7.2	7.2	7.2	7.5	7.0	7.4	7.6	7.5
12 - 14		7.5	7.4	7.3	7.7	7.7	7.7	7.7	7.7	7.7
14 - 16		7.7	7.6		7.7				7.7	
16 - 18		7.7	7.7	7.7						

Swell Waves

Information on swell waves is provided in the following. Swell waves characterize waves with long wave periods, exceeding 8 seconds. At Carmel the primary direction of swell waves incidence is from west-northwest to northwest. There is also a smaller percentage of swell arriving from southerly to south-southwesterly directions.

Table A-3: Distribution of swell waves by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 2			0.0%	0.006%	0.002%	0.001%	0.001%	0.005%	0.0%		0.023%
2 - 4	0.0%	0.2%	1.7%	2.1%	0.9%	0.5%	1.2%	2.3%	1.5%	0.06%	10.5%
4 - 6	0.017%	0.3%	2.1%	2.2%	0.9%	0.8%	3.5%	9.1%	8.6%	0.3%	27.8%
6 - 8	0.002%	0.0%	0.4%	0.4%	0.2%	0.4%	3.0%	10.0%	11.2%	0.4%	26.0%
8 - 10		0.01%	0.1%	0.1%	0.1%	0.2%	1.9%	7.3%	7.6%	0.2%	17.4%
10 - 12	0.0%	0.02%	0.06%	0.03%	0.05%	0.1%	1.0%	4.1%	4.2%	0.06%	9.7%
12 - 14		0.03%	0.06%	0.03%	0.02%	0.06%	0.6%	2.1%	2.1%	0.03%	5.0%
14 - 16		0.03%	0.04%	0.01%	0.009%	0.04%	0.3%	0.9%	0.8%	0.01%	2.1%
16 - 18		0.02%	0.02%	0.004%	0.003%	0.020%	0.1%	0.4%	0.3%	0.01%	0.9%
18 - 20		0.006%	0.01%	0.000%	0.001%	0.007%	0.05%	0.2%	0.1%	0.0%	0.3%
20 - 22		0.003%	0.002%	0.0%		0.005%	0.05%	0.1%	0.0%	0.0%	0.2%
22 - 24			0.0%			0.004%	0.03%	0.02%	0.01%		0.1%
24 - 26						0.0%	0.013%	0.01%	0.000%		0.02%
26 - 28							0.0%	0.00%	0.000%		0.01%
28 - 30							0.0%	0.002%	0.000%		0.009%
30 - 32							0.0%	0.000%			0.001%
32 - 34							0.0%	0.0%			0.001%
34 - 36							0.0%				0.000%
Total	**0.0%**	**0.6%**	**4.4%**	**4.8%**	**2.1%**	**2.1%**	**11.8%**	**36.4%**	**36.6%**	**1.1%**	**100%**

Table A-4 summarizes peak wave periods for swell waves by significant wave height and direction.

Table A-4: Average peak period of swell waves (in seconds) by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0 - 2			13.0	13.3	14.0	12.7	12.5	10.3	9.3	
2 - 4	16.8	14.5	14.4	14.7	14.4	13.1	12.3	11.2	9.7	10.1
4 - 6	15.7	14.6	15.3	15.6	15.0	13.4	12.8	12.0	10.0	10.0
6 - 8	18.9	14.8	15.8	16.1	14.0	12.5	13.2	12.9	10.5	9.7
8 - 10		10.9	12.5	13.2	10.7	11.6	13.5	13.4	11.1	9.9
10 - 12	10.5	9.1	9.4	9.5	9.8	12.2	13.9	14.0	11.8	11.0
12 - 14		9.2	8.8	9.1	10.3	12.8	14.0	14.4	12.5	11.2
14 - 16		9.1	9.1	9.3	10.8	13.4	14.6	14.7	13.1	11.8
16 - 18		9.5	9.5	10.0	10.8	14.4	15.2	15.1	13.2	11.2
18 - 20		10.0	9.7	10.0	12.1	15.3	15.4	15.6	13.1	12.0
20 - 22		10.1	9.5	9.8		16.3	15.8	16.0	13.8	11.9
22 - 24			9.1			17.7	16.1	16.6	14.0	
24 - 26						17.2	16.1	16.4	13.8	
26 - 28							16.6	17.2	14.8	
28 - 30							17.2	16.7	14.8	
30 - 32							19.1	19.1		
32 - 34							17.4	19.1		
34 - 36							19.1			

This Page Intentionally Left Blank

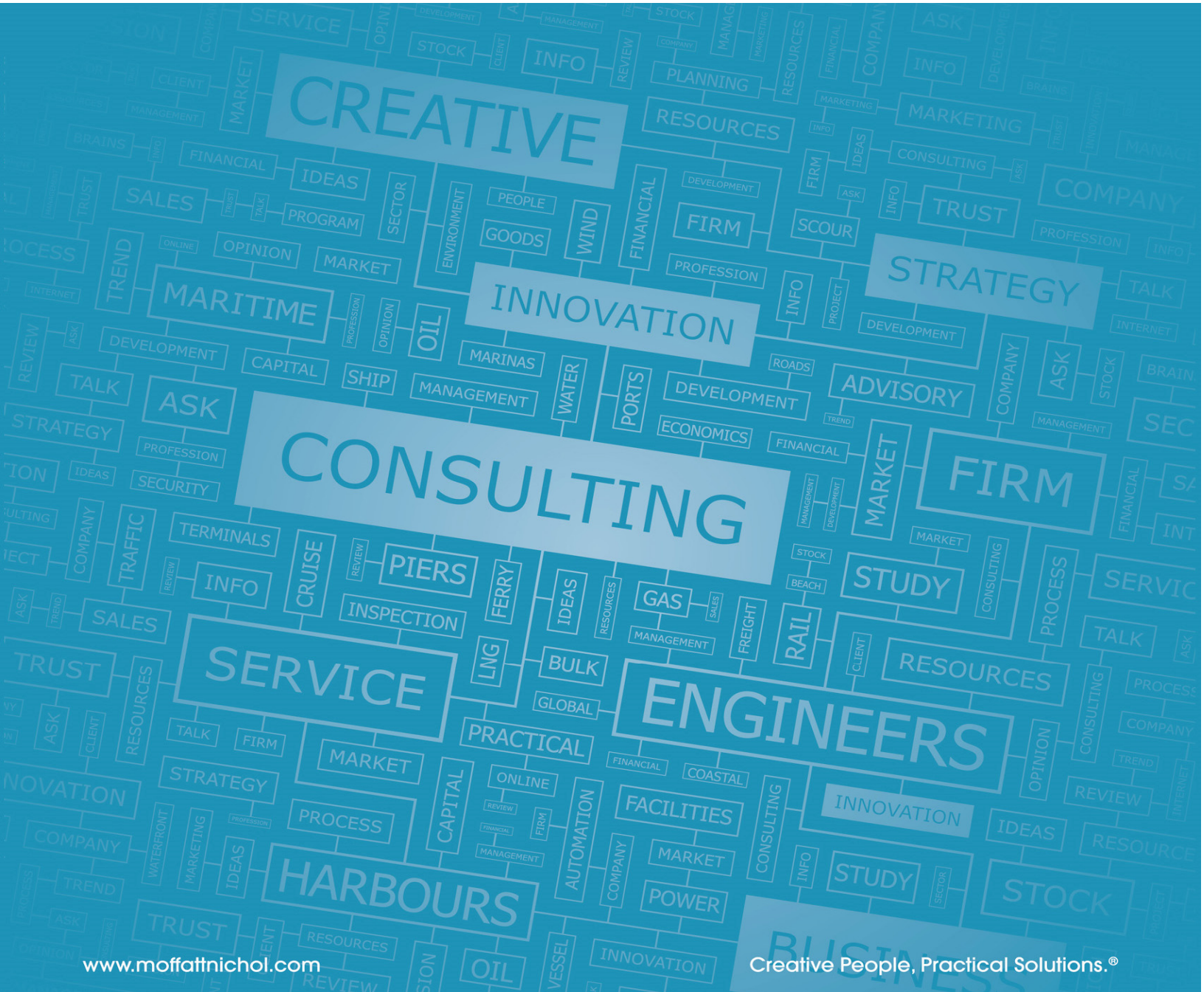
moffatt & nichol

Carmel River Lagoon

Sediment Transport Study

PRODUCED FOR DENISE DUFFY & ASSOCIATES

DECEMBER 2021



Document Verification

Client	Denise Duffy & Associates
Project name	Carmel River Lagoon
Document title	Sediment Transport Study
Document subtitle	
Status	Final Report
Date	December 6, 2021
Project number	11132
File reference	

Revision	Description	Issued by	Date	Checked
1	Final Report	M. Jorgensen	December 6, 2021	R. Dornhelm

Produced by:
Moffatt & Nichol
2185 N. California Blvd., Suite 500
Walnut Creek, CA 94596-3500
T 925.944.5411
www.moffattnichol.com

Table of Contents

Document Verification i

Glossary vi

1. Introduction 4
1.1.1. Summary of Draft Environmental Impact Report 4
1.2. Scope of Work 5
1.2.1. TAC Review Panel 5

2. Site Information 6
2.1. Carmel River Lagoon 6

3. Basis of Analysis 8
3.1. Water Levels 8
3.2. Base Flood Elevations 8
3.3. Tides and Storm Surge 8
3.3.1. Astronomical Tides 9
3.3.2. El Niño Southern Oscillation 10
3.4. Sea Level Rise 13
3.5. Wind Statistics 15

4. Wave Climate 17
4.1. Wave Statistics 18
4.1.1. Wind-Waves 18
4.1.2. Swell Waves 19
4.2. Wave Model Development 20
4.2.1. Model Domain and Bathymetry 21
4.2.2. SW Model Verification 22
4.2.3. Conducted Wave Scenarios 23
4.3. Wave Transformation 26
4.3.1. Focusing and Dispersal of Waves 30
4.3.2. Reflection by the Carmel Submarine Canyon 31

5. Cliff Retreat Rates 32

6. Shoreline Change 33

7. Sediment Grain Sizes 37

8. Carmel Littoral Cell 41
8.1. Sub-Cells 41
8.2. Sediment Transport 41
8.3. Sand Sources and Loss of Sediment 44
8.4. Coastal Cliffs from Cypress Point to Pescadero Point 45
8.5. Stillwater Cove 45
8.6. Carmel Beach 45

8.7. Carmel River State Beach 46
8.7.1. Carmel River Sand Supply 46
8.7.2. Sand Losses 47
8.8. Ribera Beach 47
8.9. Monastery Beach 48
8.10. Carmel Canyon 48
8.11. Sediment Budget 50
8.12. Sediment Input to Littoral Cell 52
8.13. Sediment Fluctuations 52
8.14. Sediment Losses from Littoral Cell 53

9. Beach Morphology 56
9.1. Wave Statistics and Lagoon Morphology 57

10. Lagoon and Beach Morphology 62
10.1. Beach Profile Variation 64
10.2. Lagoon Breaching 66

11. Climate Change 69
11.1. Sea-Level Rise 69

12. Conclusions 72
12.1. Carmel Littoral Cell 72
12.2. Carmel Canyon 72
12.3. Swell Waves 73
12.4. Wind-Waves 73
12.5. Wave Climate Interaction with Lagoon Breaching 73
12.6. Sea-Level Rise 74

References 75

Appendix A: Wind Roses ..... A

Appendix B: Wentworth Classification Scale ..... B

Appendix C: Wave Transformation Coefficients C

List of Figures

Figure 1-1: Overview of Carmel Bay. 1
Figure 2-1: Carmel River State Beach site location. 7
Figure 2-2: Carmel River State Beach and Carmel River 1929 (left) and 2020 (right). 7
Figure 3-1: Terminology used to describe astronomical tides. 9
Figure 3-2: Recurrence interval of El Niño Conditions. 12
Figure 3-3: Recurrence Interval of La Niña Conditions. 12
Figure 3-4: Wind rose for Monterey Regional Airport. 15

Figure 3-5: Offshore wind speeds for NDBC Buoy 46042 Monterey. 16
Figure 4-1: Angles of wave incidence at Carmel, adopted from USGS (2006). 17
Figure 4-2: Metocean gauges and SW model domain. 21
Figure 4-3: Regional model bathymetry (left), and local bathymetry (right). 22
Figure 4-4: Comparison of simulated wave parameters with data from NBDC wave buoy 46114. 23
Figure 4-5: Comparison of simulated wave parameters with data from NDBC wave buoy 46236. 24
Figure 4-6: Comparison of simulated wave parameters with data from NDBC wave buoy 46239. 25
Figure 4-7: Illustration of swell wave transformation (offshore H_S=3.5m, T_P=11s, Northwest). 26
Figure 4-8: Illustration of swell wave transformation (Offshore H_S=3.5m, T_P=13s, West). 26
Figure 4-9: Illustration of swell wave transformation (Offshore H_S=1.5m, T_P=15s, Southwest). 27
Figure 4-10: Transformation of swell waves arriving from northwest by west. 28
Figure 4-11: Transformation of swell waves arriving from south by west. 29
Figure 4-12: Refraction by a submarine canyon. 30
Figure 5-1: Overview of cliff erosion data, USGS (2020). 32
Figure 6-1: Shoreline locations (1929 to 2020). 34
Figure 6-2: Long-term shoreline recession rates at Carmel River State Beach. 35
Figure 6-3: Shoreline change transects from USGS (2020). 36
Figure 7-1: Overview of grain size samples from NPS (1972). 37
Figure 7-2: CRSB beach sand. 38
Figure 7-3: CRSB beach sand. 38
Figure 8-1: Overview of Carmel Littoral Cell. 42
Figure 8-2: Wave-driven sediment transport along the shore. 43
Figure 8-3: Definition of coastal terms and closure depth, adapted from SPM (1984). 43
Figure 8-4: Illustrations of hypopycnal flow (upper) and hyperpycnal flow (lower). 49
Figure 8-5: Littoral cell sediment sources and losses. 51
Figure 9-1: Overview of lagoon closures and breaches (1991-2021). 56
Figure 9-2: Patterns and occurrence of North Pacific swell. 58
Figure 9-3: Patterns and occurrence of Southern swell. 59
Figure 9-4: Patterns and occurrence of northwest wind-waves. 59
Figure 9-5: Patterns and occurrence of southwest wind-waves. 60
Figure 10-1: Overview of CRSB seasonal variation and lagoon morphology. 63
Figure 10-2: Beach erosion. Figure adapted from Weir (2006). 64
Figure 10-3: Sandbar vertical buildup. Figure adapted from Weir (2006). 65
Figure 10-4: Sandbar widening. Figure adapted from Weir (2006). 65
Figure 10-5: Monthly tide cycle of neap and spring tides. 66
Figure 10-6: Sandbar horizontal and vertical growth. Figure adapted from Weir (2006). 66
Figure 10-7: Parameters governing lagoon breaching. Figure adapted from Kraus (2008). 67
Figure 11-1: Schematic of Bruun Rule. 70

List of Tables

Table 3-1: Carmel River Percent Annual Chance Peak Discharge. 8
Table 3-2: Water Level Datums. 8
Table 3-3: Years with Very Strong, Strong, Moderate and Weak El Niño / La Niña Conditions. 11
Table 3-4: Sea-Level Rise Projections for Monterey, *OPC (2018)*. 14
Table 4-1: Distribution of wind-waves by significant wave height and direction. 18
Table 4-2: Average peak period of wind-wave periods (in seconds) by significant wave height and direction. 18
Table 4-3: Distribution of swell waves by significant wave height and direction. 19
Table 4-4: Average peak period of swell waves (in seconds) by significant wave height and direction. 20
Table 4-5: Influence of water depth on wave characteristics. 31
Table 6-1: Aerial imagery dates and color code. 33
Table 7-1: Sediment grain size based on sampling and sieve analysis. 39
Table 8-1: Carmel River sand supply analysis summary, Balance Hydrologics, BH (2021). 46
Table 8-2: Carmel littoral cell sediment budget. 54
Table 11-1: Tidal datums with sea-level rise. Elevations in feet NAVD88. 69
Table 11-2: Annual rate of sea-level rise. 70

Glossary

AP	Arrowhead Point
BFE	Base Flood Elevation
CB	Carmel Beach
CRL	Carmel River Lagoon
CRSB	Carmel River State Beach
CRSB	Carmel River State Beach
DD&A	Denise Duffy & Associates
ENSO	El Niño Southern Oscillation
FEMA	Federal Emergency Management Agency
IPCC	International Panel on Climate Change
lat	Latitude
lon	Longitude
MB	Monastery Beach
MN	Moffatt & Nichol
NDBC	National Data Buoy Center
NGS	National Geodetic Survey
nm	Nautical miles
NOAA	National Oceanic and Atmospheric Administration
ONI	Oceanic Niño Index
OPC	{California} Ocean Protection Council
PP	Pescadero Point
SC	Stillwater Cove
SLR	Sea-Level Rise
SWEL	Stillwater Elevation
TAC	Technical Advisory Committee
USGS	United States Geological Survey
WC	Whaler's Cove

Executive Summary

The Carmel littoral cell extends from Cypress Point to Point Lobos, Figure 1-1. This report provides an overview of sediment transport patterns within the Carmel littoral cell and the beach morphology and sediment dynamics of Carmel River State Beach (CRSB) and the Carmel River Lagoon (CRL).

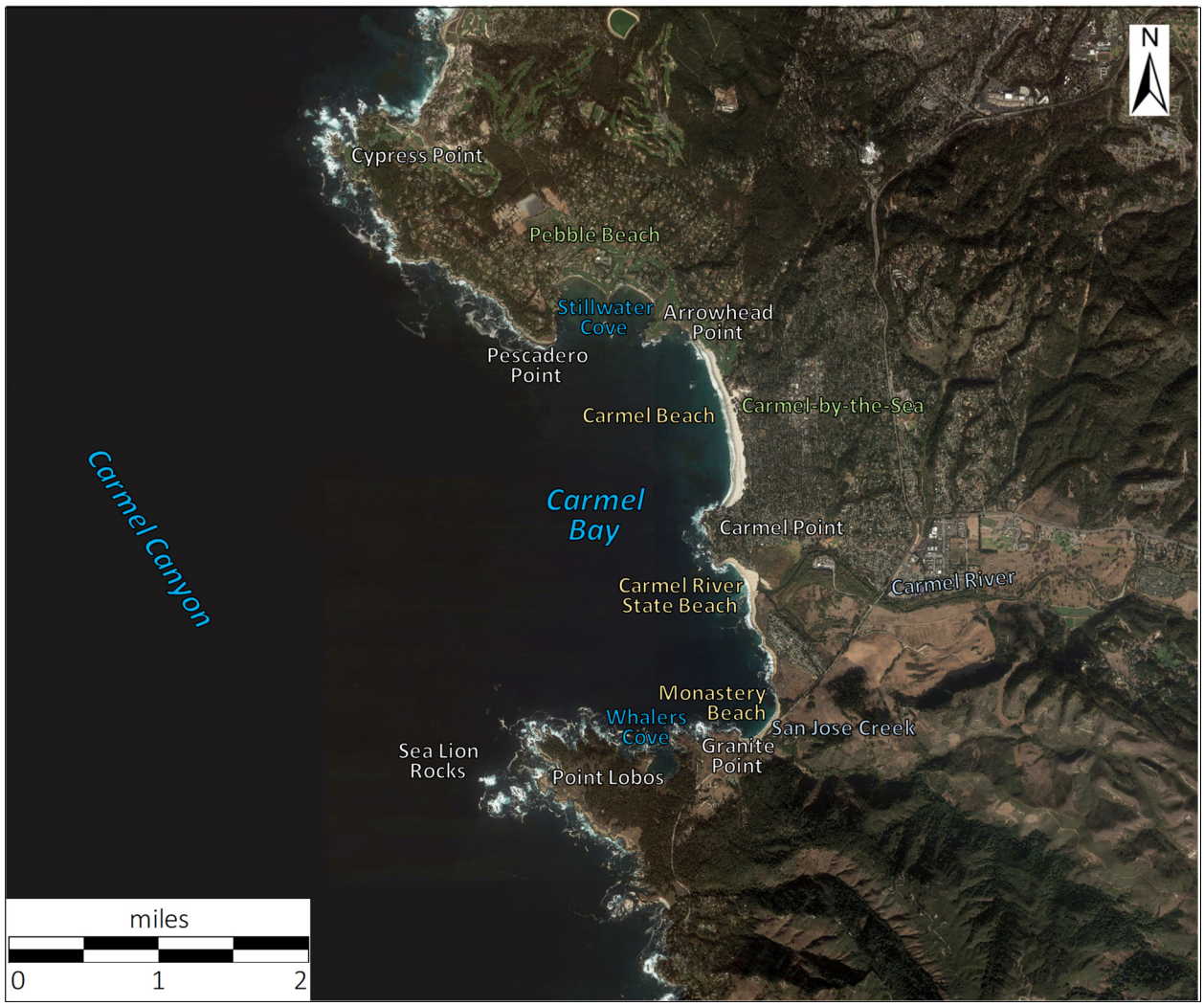


Figure 1-1: Overview of Carmel Bay.

The analysis finds the following:

Carmel Littoral Cell

The Carmel littoral cell is contained between Cypress Point and Point Lobos. The general littoral transport direction is from north to south. The main input of sediment to the system comes from

breakdown and erosion of the granodiorite rock formations along the coast. The Carmel River provides sand to the Carmel River State Beach. San Jose Creek similarly provides sand to Monastery Beach. Remining creeks and streams in the area provide limited input of sand to the shoreline. The pocket beaches and crenulate bay shaped sections of shoreline: Stillwater Cove (SC), Carmel Beach (CB), Carmel River State Beach (CRSB), Monastery Beach (MB), and Whaler's Cove (WC) comprise quasi-stable littoral sub-cells. However, waves during winter storms can be large enough to induce longshore sand transport between these cells in a southward direction. Such storm events are infrequent and highly episodic.

CRSB can therefore be characterized as a quasi-stable littoral sub-cell where the primary input of sand comes from the Carmel River and there is a secondary input of sand from Carmel Beach. Wave patterns at CRSB induce a circular pattern of sediment movement where the longshore transport at the shoreline is often in a northward direction, whereas the sediment transport direction in deeper is in a southward direction. This circular pattern of sediment movement works to maintain the beach, although sand episodically moves southward past Ribera Beach towards Monastery Beach. The majority of sand volumes transported south are lost from the CRSB sub-cell and do not return. The magnitude of sand retained in the system at CRSB is therefore dependent on the wave climate from year to year, the occurrence of intermittent northwesterly high wind-wave events (during which sand is lost from the sub-cell), and sand input from the Carmel River. The latter is the most important, as a decline in sediment output from the Carmel River will lead to depletion of sediment from the system; conversely an increase can aid in restoring the beach.

Carmel Submarine Canyon

The Carmel submarine canyon is a significant element of the Carmel Littoral Cell. Sand transport south along the coast is eventually lost to the submarine canyon in the area of Monastery Beach where the submarine canyon come closest to shore and is within the active portion of the beach profile. Several mechanisms of sand loss to the submarine canyon have been identified, including: wave- and current-induced downslope migration of sand, submarine slope failures along the edge of the canyon, and rip currents. In the broader area from Pescadero Point down to CRSB large wave events during winter storms are capable of mobilizing sand to greater depths, which causes a loss of sand to the submarine canyon. Specific to CRSB, bursts of outflow from the Carmel River can wash sediment into the submarine canyon as well. The canyon acts as a sink to littoral cell system, and sediment that enters the canyon is lost from the system.

Swell Waves

Swell waves approach the coast year-round. Swell waves originating from storm systems in the North Pacific primarily occur during the fall and winter months, while swell waves from storm systems in the Southern Hemisphere tend to occur over the summer months. Swell wave events follow a sequence where the longest waves roll in first followed by progressively shorter waves until the wave trains die out. Each episode of swell can last from hours to several days, depending on the magnitude and duration of the storm system of origin.

The Carmel submarine canyon has a pronounced effect on swell waves as they propagate towards the shoreline. The canyon overall acts as a lens which focuses wave action along the cliffs from Cypress Point to Pescadero Point, at Point Lobos, and to a lesser degree focuses waves propagating towards Carmel Beach. Incident waves traveling along the canyon axis tend to disperse at the canyon heads in Carmel Bay, at CRSB, and at Monastery Beach, which produces a milder wave climate in these areas. The wave transformation caused by the canyon is to such a degree that incident swell waves end up having nearly the same angle of incidence at the shoreline irrespective of whether the swell arrives from northwesterly or southwesterly directions offshore. Wave transformation due to the submarine canyon is more significant the longer the wave periods of the incident waves, and therefore has a greater effect on swell waves.

Wind-Waves

The Carmel submarine canyon does not transform wind-waves to the same degree as swell waves. This is because the wave periods of wind-waves are significantly shorter than for swell waves. Waves associated with high winds from northwesterly directions can therefore cause intermittent bursts of sediment transport southward along the shoreline. These infrequent events can produce an exchange of sediment between the quasi-stable sub-cells of the system (SC, CB, CRSB, MB, and WC). Episodic wind events from southwesterly directions produce northward sediment transport along the shoreline. However, these events do not replenish sand to the littoral sub-cells, but rather tend to shift sand to the north within each sub-cell.

Wave Climate Interaction with Lagoon Breaching

Field observations have established that the primary agent responsible for natural lagoon breaching is inflow to the Lagoon from the Carmel River. Swell waves play a key role in closing off the breaches, but only when the discharge from the river decreases to 10 cfs or less. The primary role of swell waves is in building up the sandbar between the lagoon and the ocean. Both swell waves and wind-waves can promote migration of the breach north or south of its initial location depending on the incident wave direction; wind-waves probably more so than swell waves.

The magnitude of swell wave and wind-wave action increases in November and December around the time when initial lagoon breaching often takes place. Because the wind/wave climate is episodic, it is not possible to predict if the breach will migrate north or south, and when an initial breach may close. Swell waves combined with diminishing outflow from the Carmel River in June to July of average years result in closure of the lagoon for the season.

Sea-Level Rise Hazards

The CRSB and lagoon appear to be resilient to SLR hazards in the near-term as the Carmel River provides sufficient sediment annually to compensate for the sediment deficit caused by sea-level rise. However, it is evident that the beach is dependent on the Carmel River sediment supply. So, to the extent that climate change alters the sediment supply, the effect on the beach could be substantial.

1. Introduction

The present sediment transport study is in support of the Draft Environmental Impact Report (DEIR), DD&A (2016), for the *Carmel Lagoon Ecosystem Protective Barrier, Scenic Road Protection Structure, and Interim Sandbar Management Plan.*

The overall goal of the *Carmel Lagoon Ecosystem Protective Barrier, Scenic Road Protection Structure, and Interim Sandbar Management Plan* is to improve habitat for threatened and endangered species in the lower Carmel River and Lagoon, improve natural floodplain function, and protect public infrastructure, while maintaining flood protection to existing developed areas. There is a need to improve, and if possible, restore the natural breaching regime in the Lagoon while providing flood protection to low-lying areas. The intent is to try to reduce the current level of active management of the lagoon and reduce the necessity for mechanical breaching of the sandbar.

1.1.1. Summary of Draft Environmental Impact Report

The DEIR, DD&A (2016), identified a need to achieve the following objectives in order to meet the overall goal of the project:

- Reduce the necessity for mechanical breaching of the sandbar to the greatest extent practicable;
- Maintain the current level of flood protection for existing public facilities and private structures in the low-lying developed areas located immediately to the north of and within the Lagoon;
- Protect Scenic Road embankment and the California Department of Parks and Recreation's (State Parks') restroom, interpretive, and parking facilities from scour resulting from a northerly aligned Lagoon outflow channel that may result from a reduction in mechanical breaching;
- Protect the Scenic Road embankment from the increasing risk of erosion resulting from ocean storm surge and high tides, which could increase in severity due to climate change; and
- Allow for interim management of the sandbar while the design and construction of the other project components proceed;
- Design and construct project elements within the permitted timeframe; and
- Minimize infrastructure that could detract from the function and value of the natural environment.

To this end, the (DD&A, 2016) DEIR identified a Proposed Project and explored and evaluated a wide range of options and alternatives in the context of the objectives listed above.

1.2. Scope of Work

Moffatt & Nichol was retained by Denise Duffy & Associates to develop a sediment transport study for Carmel River State Beach and the Carmel Lagoon.

The intent of the study is to gain a better understanding of how much sand is in the system, how much moves by fluvial action (Carmel River) and under what flow condition, how much moves by ocean waves and currents, and where it moves to. The overall sand movement within the Carmel littoral cell is presented in the form of a sediment budget. Beach morphology and sediment dynamics of the Carmel River State Beach and Carmel Lagoon are analyzed using a simulation model.

A multi-year simulation of waves and flows was conducted to evaluate beach profile shapes, shoreline location, sandbar elevation, and beach width, including the distance from the edge of the lagoon to the shoreline.

1.2.1. TAC Review Panel

The work was conducted with input and peer reviewed by a Technical Advisory Committee (TAC) consisting of the following panel members:

1. Dr. Mara Orescanin, Professor of Coastal Oceanography at the Naval Postgraduate School (NPS). Dr. Orescanin has experience with the morphology of coastal lagoons, sandbar build-up, erosion, and sediment transport, and familiarity with CRL gained from field work on the beach and lagoon.

2. Dr. Doug Smith, Professor of Hydrology and watershed restoration at California State University, Monterey Bay (CSUMB). Dr. Smith has experience in Lagoon and river flooding cycles, river sediment transport and flow, and familiarity with the Carmel River and CRL.

3. Larry Hampson, (retired) engineer and consultant for the Monterey Peninsula Water Management District (MPWMD). Mr. Hampson has expertise with flood management, and sandbar management and longstanding experience with the historical setting of the CRL and on the ground knowledge gained from observations and field visits.

4. Jeff Hagar, consultant for Hagar Environmental Science. Mr. Hagar specializes in water resource management and aquatic species conservation, and has experience with monitoring of salmonoid habitat in lagoon ecosystems on the central coast, and specific expertise with steelhead trout on the San Lorenzo River at Santa Cruz, CA.

2. Site Information

2.1. Carmel River Lagoon

The Carmel River drains approximately 250 square miles of the Santa Lucia and Sierra de Salinas Mountains into Carmel Bay. The Carmel River watershed has historically experienced large variations in seasonal and yearly discharge rates. A complex dynamic exists between the Carmel River Lagoon (CRL) and the Pacific Ocean. Figure 2-1 shows the location of the CRL and general east-west orientation of the Carmel River. Figure 2-2 provides closeups of the CRL and Carmel River State Beach (CRSB) based on historical aerial imagery from 1929 and present.

During times of low or no river flow, waves build up the sandbar to form a berm along the CRSB shoreline that closes off the mouth of the lagoon. Groundwater exchange helps supply the lagoon, but some amount of outflow from the lagoon to the ocean occurs via groundwater seepage through the sandbar. The lagoon also loses water due to evapotranspiration. Eventually, a condition of dynamic equilibrium sets in and the lagoon water surface elevation reaches a base elevation typically seen over the dry summer months.

When river flows increase, the water level in the lagoon can rise rapidly and potentially reach or exceed the defined flood stage. This can occur at times from late fall to early spring.

Management of the lagoon water level has therefore been implemented to mitigate flood hazards to properties along the north side of the lagoon. The management practices include monitoring of the lagoon water level and projected river inflows to the lagoon, and mechanical breaching of the lagoon. If inflows to the lagoon do not pose a flood hazard, no management action is carried out and the lagoon can breach naturally. Following a breach event (mechanical or natural), depending on the wave climate, the incident waves will close the beach and reform the sandbar. This can occur progressively or quite rapidly depending on the wave characteristics and river outflows. When the annual rainy season ends, and depending on whether or not the breach has closed naturally, the decision is made to close the lagoon outlet before the river inflow subsides in order to maximize the volume of water in the lagoon heading into the dry season.

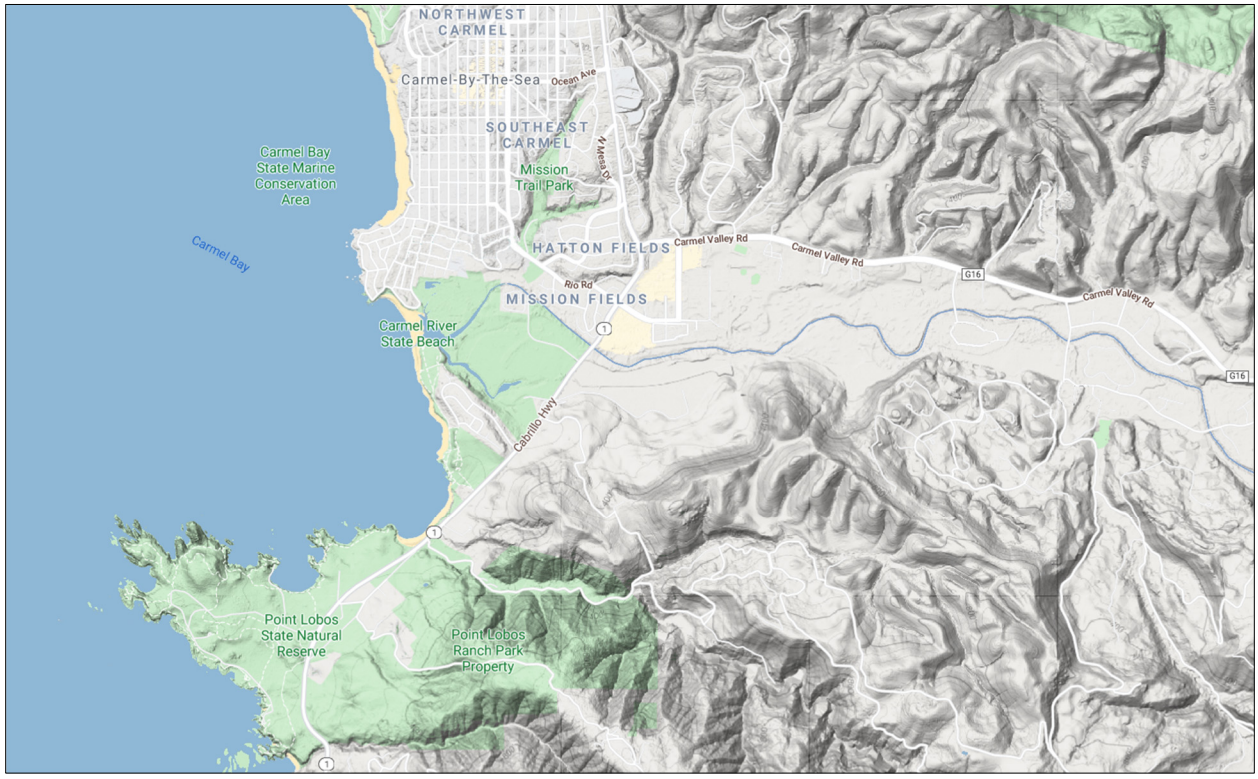


Figure 2-1: Carmel River State Beach site location.



Figure 2-2: Carmel River State Beach and Carmel River 1929 (left) and 2020 (right).

3. Basis of Analysis

3.1. Water Levels

Ocean water levels affecting the site include astronomical tides, storm surge, and wave action as described in the following sections.

3.2. Base Flood Elevations

Flood levels in the area of the Carmel River Lagoon are influenced by coastal flooding as well as fluvial flooding. The coastal Stillwater Elevation (SWEL) is around El. +8.2 feet NAVD88. The Coastal Base Flood Elevation (BFE) including wave runup ranges from El. +27 to +28 feet NAVD88 along Carmel River State Beach, per FEMA (2018). The fluvial BFE in the area of the sandbar is El. +16 feet NAVD88, increasing to El. +18 feet NAVD88 in the area of the Wastewater Treatment Facility (WTF) operated by the Carmel Area Wastewater District.

For reference, Table 3-1 summarizes discharge data for the Carmel River from FEMA (2017).

Table 3-1: Carmel River Percent Annual Chance Peak Discharge.

Percent Annual Chance	10%	2%	1%	0.2%
Recurrence Interval (every)	10 years	50 years	100 years	500 years
Discharge	9,800 cfs	19,000 cfs	23,300 cfs	33,500 cfs

3.3. Tides and Storm Surge

Coastal water level datums at the project site are summarized in Table 3-2 based on data from NOAA Station 9413450 at Monterey, NOAA (2020a). The values in the upper and lower part of the table reflect water level extremes due to a combination of astronomical tide and meteorological effects producing storm surge (positive or negative). The values in the center portion of the table indicate datums for astronomical tides only. Conversion between the older NGVD29 datum and NAVD88 datum was done based on the NGS (2020) datum shift.

Table 3-2: Water Level Datums.

Water Level Datum	Feet MLLW	Feet NAVD88	Description
100-yr	+8.08	+8.22	1% annual chance high water level.
50-yr	+7.92	+8.06	2% annual chance high water level.
10-yr	+7.59	+7.73	10% annual chance high water level.
5-yr	+7.42	+7.56	20% annual chance high water level.
HAT	+7.04	+7.18	Highest Astronomical Tide
KT	+6.90	+7.04	King Tide

Water Level Datum	Feet MLLW	Feet NAVD88	Description
MHHW	+5.34	+5.48	Mean Higher High Water
MHW	+4.64	+4.78	Mean High Water.
MTL	+2.87	+3.01	Mean Tide Level.
MSL	+2.83	+2.97	Mean Sea Level.
NGVD29	+2.59	+2.73	National Geodetic Vertical Datum of 1929.
MLW	+1.09	+1.23	Mean Low Water.
MLLW	0.00	+0.14	Mean Lower Low Water.
NAVD88	-0.14	0.00	North American Vertical Datum of 1988.
LAT	-1.91	-1.77	Lowest Astronomical Tide.
5-yr	-1.99	-1.85	20% annual chance low water level.
10-yr	-2.12	-1.98	10% annual chance low water level.
50-yr	-2.29	-2.15	2% annual chance low water level.
100-yr	-2.35	-2.21	1% annual chance low water level.

3.3.1. Astronomical Tides

Figure 3-1 summarizes the terminology used to describe tides. Tides at Carmel are semi-diurnal, which means that two high tides and two low tides occur each lunar day (in the figure, the higher high tides occurring at 24 hours and 24 hours later, and the lower low tides at 6 hours). The highest tides are referred to as “Higher high water” while the intermediate high tides are referred to as “Lower high water”. A similarly terminology is used for the low tides, where the lowest tides are referred to as “Lower low water” and the intermediate low tides “Higher low water”.

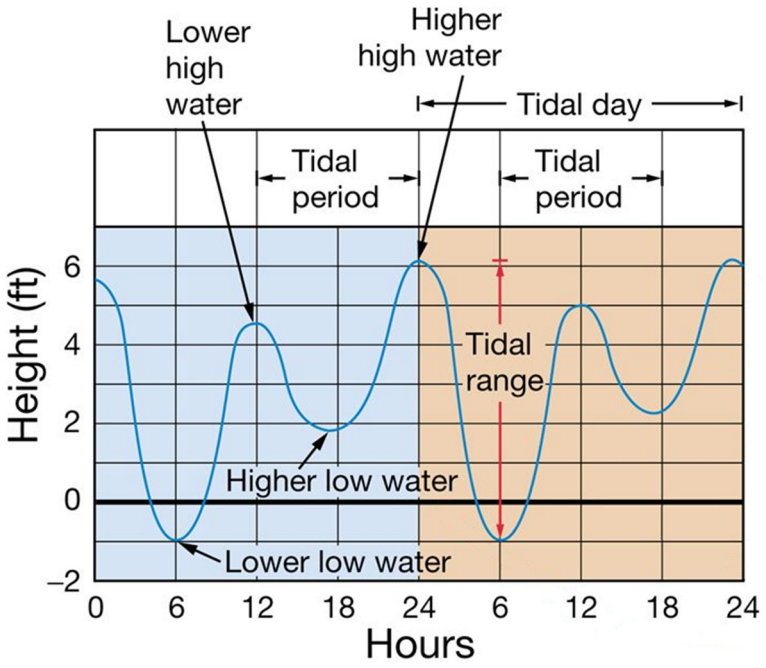


Figure 3-1: Terminology used to describe astronomical tides.

Tides occur due to the gravitational pull of the moon and the sun and vary over the cycle of a lunar day. A lunar day is approximately 24 hours and 50 minutes. The tidal period is the time between consecutive high tides or low tides. The tidal range is the difference in height between the low tide and the high tide.

3.3.2. El Niño Southern Oscillation

The El Niño Southern Oscillation (ENSO) reflects irregular variations of the sea surface temperature in the Eastern Pacific. The warming phase is termed El Niño while the cooling phase is named La Niña.

When warming of the ocean exceeds +0.5˚C El Niño conditions prevail. If the ocean temperature cools below -0.5˚C La Niña conditions are present. Within the range of+/-0.5˚C, conditions are termed ENSO-neutral. The ENSO cycle affects temperatures and rainfall worldwide.

El Niño and La Niña cycles typically last 9 to 12 months. They often commence in June or August and reach their peak during December through April, and subsequently, decay over May through July of the following year. Their periodicity is irregular, occurring every 3 to 5 years on average.

When El Niño conditions are present, ocean wave heights can be larger by 1 to 4 feet. Storms associated with El Niño effects typically approach from the west or southwest and may produce local littoral drift to the north, counter to the predominant southerly transport. The warming of the ocean that occurs during El Niño also produces a rise of the mean sea level which can be on the order of 10 to 12 inches. ENSO can therefore be considered as a form of temporary sea-level rise. Shorelines often experience severe erosion during El Niño storms.

During La Niña periods in the winter months, ocean wave heights are larger by 0.3 to 1.3 feet. When La Niña occurs in the summer months, ocean waves are slightly smaller than average.

Table 3-3 groups years categorized as having very strong, strong, moderate, or weak El Niño or La Niña conditions.

Table 3-3: Years with Very Strong, Strong, Moderate and Weak El Niño / La Niña Conditions.

El Niño				La Niña		
Very Strong	**Strong**	**Moderate**	**Weak**	**Weak**	**Moderate**	**Strong**
1972-73	1957-58	1951-52	1950-51	1950-51	1970-71	1955-56
1982-83	1965-66	1956-57	1952-53	1953-54	1971-72	1973-74
1997-98	1987-88	1963-64	1953-54	1954-55	1974-75	1975-76
2015-16	1991-92	1968-69	1958-59	1956-57	1983-84	1988-89
	2009-10	1986-87	1964-65	1963-64	1984-85	1998-99
		1994-95	1969-70	1964-65	1987-88	1999-00
		1996-97	1971-72	1966-67	1995-96	2007-08
		2002-03	1976-77	1967-68	2011-12	2010-11
		2014-15	1977-78	1972-73	2017-18	
			1979-80	1980-81		
			1981-82	1985-86		
			1990-91	1996-97		
			1992-93	2000-01		
			2001-02	2005-06		
			2004-05	2008-09		
			2006-07	2009-10		
			2018-19	2016-17		
			2019-20			

Extreme-Value Analysis (EVA) was utilized to assess return periods for the recurrence of El Niño and La Niña events. The data is summarized in Figure 3-2 and Figure 3-3. The results show that very strong El Niño conditions occur every 14 years on average (Oceanic Niño Index > 2.0). Return periods for Strong, Moderate, Weak, and Neutral conditions are indicated along the horizontal axis in Figure 3-2.

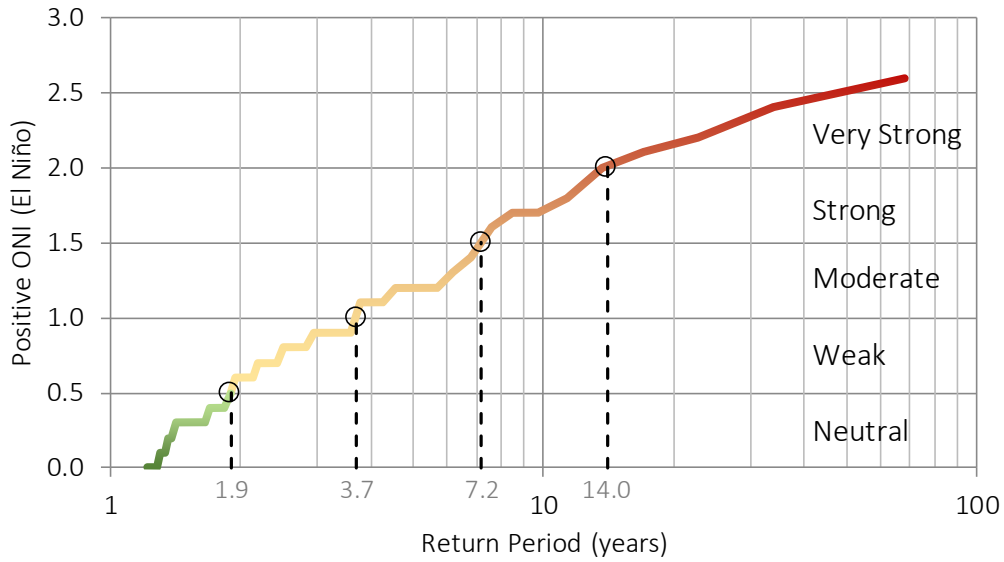


Figure 3-2: Recurrence interval of El Niño Conditions.

Recurrence intervals for La Niña conditions are shown in Figure 3-3, where Strong La Niña conditions are estimated to occur every 8 years on average (Oceanic Niño Index < -1.5). Very Strong La Niña conditions have so far not been observed.

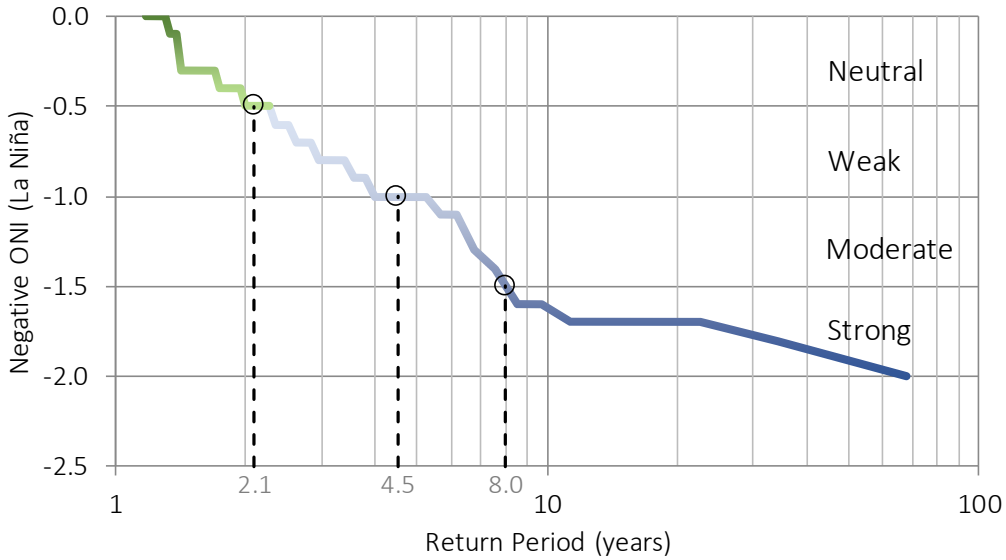


Figure 3-3: Recurrence Interval of La Niña Conditions.

3.4. Sea Level Rise

Current guidance for California recommends evaluation of sea-level rise (SLR) impacts using a scenario-based analysis. This method is founded on the approach by the Intergovernmental Panel on Climate Change (IPCC) to understand how sea-level rise and other drivers interact to threaten health, safety, and resources of coastal communities.

IPCC climate change scenarios are expressed in terms of Representative Concentration Pathways (RCPs). RCP 8.5 projects a future with the highest greenhouse gas emissions, high population and relatively slow income growth with modest rates of technological change and energy intensity improvements, leading in the long term to high energy demand and greenhouse gas (GHG) emissions. Some estimates of current emissions are tracking close to RCP 8.5.

The best available science and most recent guidance is summarized in *OPC (2018)* and has been adopted for this assessment. The guidance relies on the best available science to identify a range of sea-level rise scenarios including median, likely, 1-in-20 chance, and 1-in-200 chance projections, taking into account regional factors such as El Niño and extreme storm events that affect ocean levels, precipitation, and storm surge. This approach allows planners to understand the full range of possible impacts that can be reasonably expected based on the best available science, and build an understanding of the overall risk posed by potential future sea-level rise

Table 3-4 summarizes sea-level rise scenarios from *OPC (2018)* for Monterey which are applicable to Carmel. The columns outlined in dark blue reflects the OPC guidance for risk levels, which include low risk aversion, medium to high risk aversion, and extreme risk aversion.

Table 3-4: Sea-Level Rise Projections for Monterey, *OPC (2018)*.

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.4	0.3 -	0.5	0.6	0.8	1.0
	2040	0.6	0.4 -	0.8	0.9	1.2	1.7
	2050	0.8	0.5 -	1.1	1.3	1.9	2.7
Low emissions	2060	0.9	0.5 -	1.2	1.5	2.3	
High emissions	2060	1.0	0.7 -	1.4	1.8	2.6	3.8
Low emissions	2070	1.0	0.6 -	1.4	1.9	3.0	
High emissions	2070	1.3	0.9 -	1.8	2.3	3.4	5.1
Low emissions	2080	1.2	0.7 -	1.7	2.3	3.8	
High emissions	2080	1.6	1.1 -	2.3	2.9	4.4	6.6
Low emissions	2090	1.3	0.8 -	2.0	2.7	4.6	
High emissions	2090	2.0	1.3 -	2.8	3.5	5.5	8.2
Low emissions	2100	1.5	0.9 -	2.3	3.1	5.5	
High emissions	2100	2.3	1.5 -	3.3	4.3	6.9	10.1
Low emissions	2110*	1.6	1.0 -	2.4	3.3	6.1	
High emissions	2110*	2.5	1.7 -	3.4	4.4	7.2	11.8
Low emissions	2120	1.7	1.0 -	2.7	3.8	7.3	
High emissions	2120	2.8	2.0 -	4.0	5.2	8.5	14.0
Low emissions	2130	1.9	1.1 -	3.0	4.2	8.3	
High emissions	2130	3.1	2.2 -	4.5	5.9	9.9	16.4
Low emissions	2140	2.0	1.1 -	3.2	4.7	9.5	
High emissions	2140	3.5	2.4 -	5.1	6.7	11.3	18.9
Low emissions	2150	2.1	1.1 -	3.6	5.3	10.8	
High emissions	2150	3.8	2.6 -	5.7	7.6	12.9	21.8

Notes:

- MEDIAN. Mean sea-level rise taken as an average of probabilistic scenarios.
- LIKELY RANGE. Median projection with 66% confidence limits. The upper range (outlined by blue box) is applicable to facilities and infrastructure with a low risk aversion to sea-level rise.
- 1-IN-20 CHANCE. 5% probability that sea-level rise meets or exceeds this projection (1 in 20 chance).
- 1-IN-200 CHANCE. 0.5% probability that sea-level rise meets or exceeds this projection (1 in 200 chance). This projection (outlined by a blue box) is representative of medium to high risk aversion and is applicable to facilities and infrastructure that are vulnerable to sea-level rise impacts.
- H++ Scenario. Worst case scenario representative of rapid ice sheet loss and accelerated sea-level rise. This projection is applicable to facilities with extreme risk aversion to sea-level rise hazards. For example critical infrastructure or facilities that are extremely sensitive to sea-level rise hazards and unable to adapt to sea-level rise.

3.5. Wind Statistics

Figure 3-4 summarizes annual wind data for the Monterey Regional Airport for the years from 1996 to 2019. The wind rose shows that high winds can occur over the sector from west-southwest (WSW) to northwest (NW).

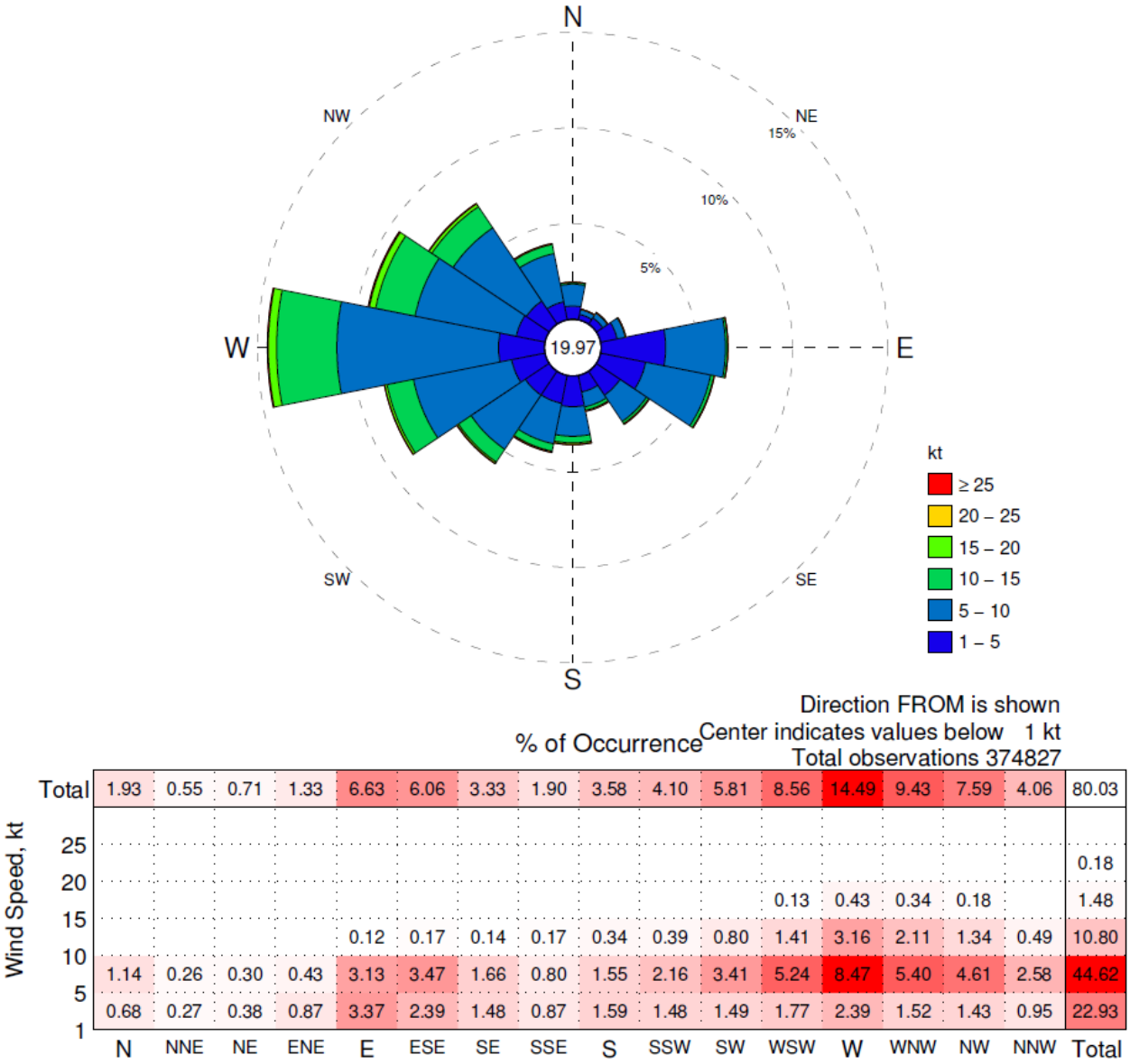
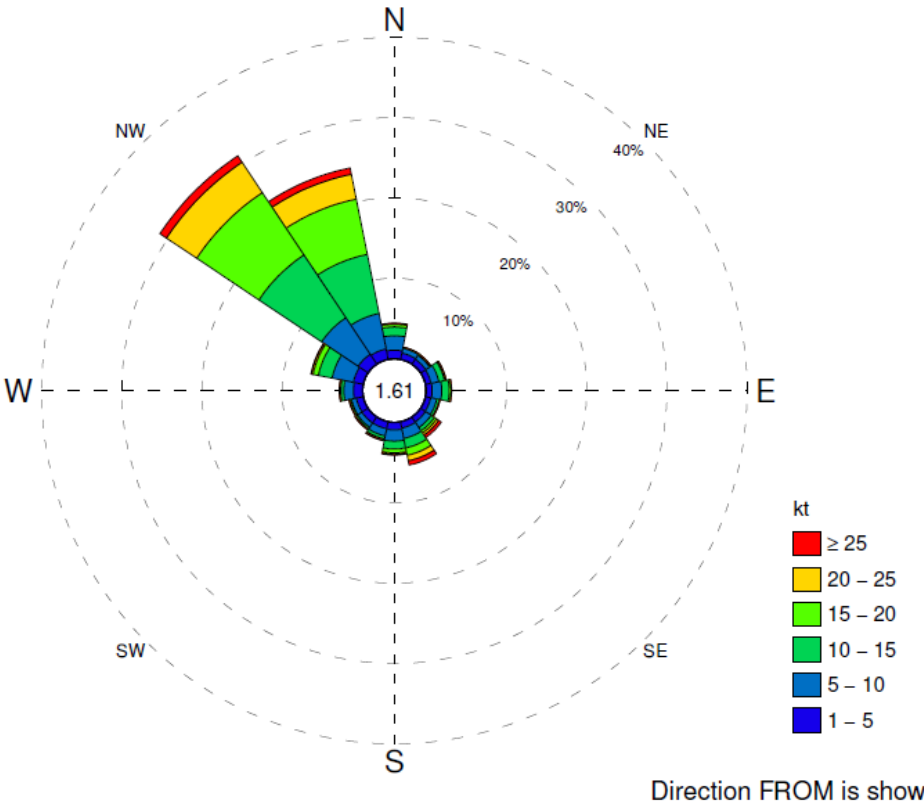


Figure 3-4: Wind rose for Monterey Regional Airport.

Figure 3-5 summarizes wind speeds offshore, recorded at the National Oceanic and Atmospheric (NOAA) National Data Buoy Center (NDBC) wave buoy 46042 located 27 nm west of Monterey Bay at latitude: 36.785°N, longitude 122.398°W. The data collected covers the years from 1987 through 2019.

Comparing with Figure 3-4 it can be seen that the offshore wind speeds are generally higher in terms of wind speed with the most frequent winds from northwesterly (NW) and north-northwesterly directions (NNW). High wind speeds can also occur from southeasterly (SE) to southerly (S) directions. An uptick in wind speeds from easterly (E) directions is also noticeable, which compares with the wind direction observed over land, Figure 3-4. Refer to Appendix A for wind roses by month.



% of Occurrence
Direction FROM is shown
Center indicates values below 1 kt
Total observations 262090

Wind Speed, kt	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	4.40	1.50	1.48	2.58	3.13	1.80	3.04	5.46	4.04	2.38	1.89	1.78	2.86	6.61	31.17	24.27	98.39
25							0.37	0.53							0.97	0.80	2.91
20	0.10						0.32	0.70	0.19					0.21	4.54	3.15	9.44
15	0.34			0.18	0.25		0.33	0.94	0.47	0.17	0.11		0.14	0.69	9.34	7.02	20.18
10	1.09		0.16	0.72	0.92	0.32	0.48	1.20	0.98	0.37	0.23	0.19	0.38	1.74	9.41	7.51	25.79
5	1.80	0.62	0.59	1.00	1.20	0.77	0.85	1.32	1.39	0.91	0.64	0.63	1.19	2.71	5.47	4.51	25.58
1	1.04	0.77	0.70	0.66	0.72	0.63	0.69	0.76	0.91	0.86	0.87	0.83	1.11	1.21	1.44	1.28	14.49
Total	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total

Figure 3-5: Offshore wind speeds for NDBC Buoy 46042 Monterey.

The offshore wind climate with a predominance of winds from WNW to NNW directions (occurring 62% of the time) means that Carmel Bay sees frequent wind-waves from northwesterly directions.

The offshore wave climate is described further in the following section.

4. Wave Climate

The Carmel shoreline is exposed to wind-waves generated by local storm systems as well as swell waves originating from distant storms over the Pacific. Figure 4-1 shows the general angles of wave incidence based on NOAA/NDBC wave data.

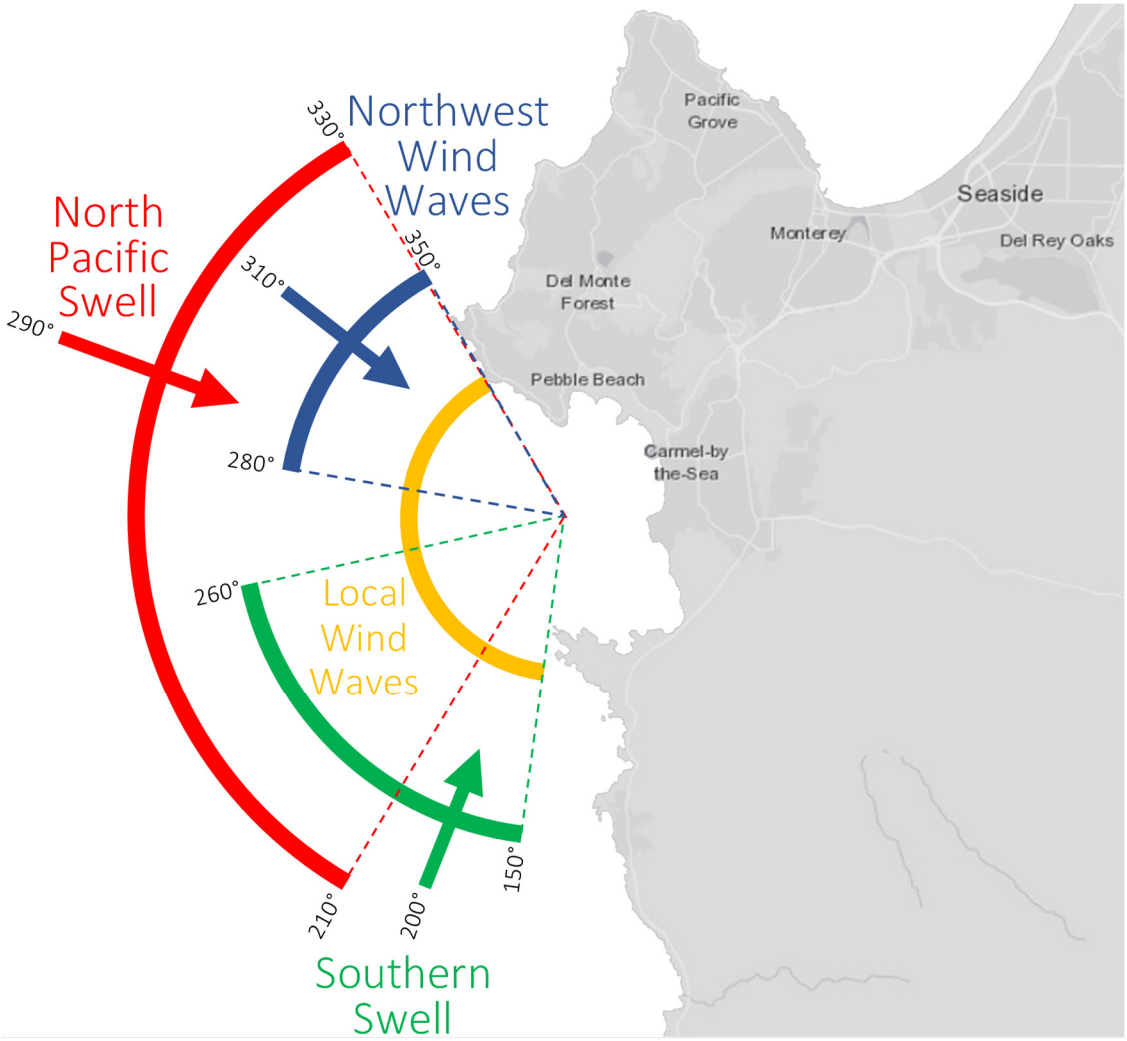


Figure 4-1: Angles of wave incidence at Carmel, adopted from USGS (2006).

There are four different wave systems that affect Carmel Bay: 1) North Pacific swell waves originating from distant storms over the North Pacific, 2) Southern swell originating from distant storms in the South Pacific, 3) Northwest wind waves generated by regional wind systems, and 4) Local wind waves which can occur from any direction over open water. North Pacific swell waves are generated by extra-tropical storm systems, mid-latitude low-pressure systems, and cold fronts over the North Pacific, USGS (2006). Southern swell is generated by storms in the Southern Hemisphere and occurs in the summertime. Swell waves are characterized by long wave periods, typically from 8 to 18 seconds. Northwest wind waves are generated by daily sea-breeze conditions and are more pronounced in the

spring and early summer months, USGS (2006). Wind waves are generated by regional and local wind conditions and produce waves with shorter periods, typically from 3 to 8 seconds. Local storms can occur from October through April.

4.1. Wave Statistics

Wave statistics reflecting the annual average conditions are presented in the following.

4.1.1. Wind-Waves

Wind-waves are waves generated by local storm systems. The most significant storms typically occur over the winter months from directions over the sector from south to northwest. Table 4-1 summarizes statistics for wave conditions for these storms, based on data from NDBC (2020) for the LLNR 297 wave buoy located 27 nm west of Monterey Bay, Station 46042, at lat/lon 36.785°N 122.398°W in a water depth of 5,400 feet (1,645.9 m).

Table 4-1: Distribution of wind-waves by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 2								0.0%	0.0%		0.0%
2 - 4	0.0%	0.0%	0.03%	0.0%	0.01%	0.2%	0.3%	2.4%	6.7%	0.5%	10.1%
4 - 6	0.0%	0.6%	0.7%	0.1%	0.1%	0.3%	0.5%	5.9%	39.1%	2.6%	50.0%
6 - 8	0.0%	0.9%	1.2%	0.3%	0.2%	0.1%	0.2%	2.6%	22.2%	1.6%	29.3%
8 - 10		0.7%	1.4%	0.3%	0.1%	0.1%	0.1%	0.7%	3.8%	0.2%	7.4%
10 - 12		0.5%	0.8%	0.11%	0.02%	0.0%	0.0%	0.1%	0.7%	0.02%	2.2%
12 - 14		0.2%	0.3%	0.0%	0.02%	0.0%	0.0%	0.01%	0.10%	0.0%	0.7%
14 - 16		0.06%	0.06%		0.0%				0.02%		0.1%
16 - 18		0.01%	0.01%	0.0%							0.0%
Total	**0.1%**	**3.0%**	**4.5%**	**0.9%**	**0.4%**	**0.7%**	**1.2%**	**11.7%**	**72.6%**	**4.9%**	**100%**

Table 4-2 summarizes peak wave periods for wind-waves by significant wave height and direction.

Table 4-2: Average peak period of wind-wave periods (in seconds) by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0 - 2								4.3	6.7	
2 - 4	5.3	4.5	4.3	4.3	7.2	6.9	7.2	6.8	6.5	5.0
4 - 6	5.2	5.2	5.3	5.8	6.7	7.2	7.3	6.9	6.8	6.1
6 - 8	6.1	5.8	6.0	6.5	7.3	7.3	7.3	7.2	7.3	7.1
8 - 10		6.6	6.7	7.1	7.2	7.2	7.5	7.4	7.5	7.4
10 - 12		7.1	7.2	7.2	7.2	7.5	7.0	7.4	7.6	7.5
12 - 14		7.5	7.4	7.3	7.7	7.7	7.7	7.7	7.7	7.7
14 - 16		7.7	7.6		7.7				7.7	
16 - 18		7.7	7.7	7.7						

4.1.2. Swell Waves

Swell waves are characterized by long wave periods, exceeding 8 seconds. At Carmel the primary direction of swell waves incidence is from west-northwest to northwest, Table 4-3. Swell waves from these directions are representative of North Pacific Swell (Figure 4-1). There is also a smaller percentage of swell arriving from southerly to south-southwesterly directions, representative of Southern Swell (Figure 4-1).

Incidence of swell waves can last from hours to several days, depending on the magnitude and duration of the storm system of origin. During an episode of swell, the waves with the longest wave periods will arrive first, followed by waves with progressively shorter periods, for example initial swell waves with 18 second periods, transitioning to swell with 15 second periods, then 13 second periods and so forth until the swell front dies down.

Table 4-3: Distribution of swell waves by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
0 - 2			0.0%	0.006%	0.002%	0.001%	0.001%	0.005%	0.0%		0.023%
2 - 4	0.0%	0.2%	1.7%	2.1%	0.9%	0.5%	1.2%	2.3%	1.5%	0.06%	10.5%
4 - 6	0.017%	0.3%	2.1%	2.2%	0.9%	0.8%	3.5%	9.1%	8.6%	0.3%	27.8%
6 - 8	0.002%	0.0%	0.4%	0.4%	0.2%	0.4%	3.0%	10.0%	11.2%	0.4%	26.0%
8 - 10		0.01%	0.1%	0.1%	0.1%	0.2%	1.9%	7.3%	7.6%	0.2%	17.4%
10 - 12	0.0%	0.02%	0.06%	0.03%	0.05%	0.1%	1.0%	4.1%	4.2%	0.06%	9.7%
12 - 14		0.03%	0.06%	0.03%	0.02%	0.06%	0.6%	2.1%	2.1%	0.03%	5.0%
14 - 16		0.03%	0.04%	0.01%	0.009%	0.04%	0.3%	0.9%	0.8%	0.01%	2.1%
16 - 18		0.02%	0.02%	0.004%	0.003%	0.020%	0.1%	0.4%	0.3%	0.01%	0.9%
18 - 20		0.006%	0.01%	0.000%	0.001%	0.007%	0.05%	0.2%	0.1%	0.0%	0.3%
20 - 22		0.003%	0.002%	0.0%		0.005%	0.05%	0.1%	0.0%	0.0%	0.2%
22 - 24			0.0%			0.004%	0.03%	0.02%	0.01%		0.1%
24 - 26						0.0%	0.013%	0.01%	0.000%		0.02%
26 - 28							0.0%	0.00%	0.000%		0.01%
28 - 30							0.0%	0.002%	0.000%		0.009%
30 - 32							0.0%	0.000%			0.001%
32 - 34							0.0%	0.0%			0.001%
34 - 36							0.0%				0.000%
Total	**0.0%**	**0.6%**	**4.4%**	**4.8%**	**2.1%**	**2.1%**	**11.8%**	**36.4%**	**36.6%**	**1.1%**	**100%**

The data summarized in Table 4-3 shows that around 70% of the offshore waves have significant wave heights in the range from 4 to 10 feet, and 99% of all waves are within the range from 2 to 16 ft significant wave height. Outside of these cases, the data indicates that the largest wave heights can be around 32 to 36 feet in height and will occur from westerly (W) and west-northwesterly directions (WNW).

Table 4-4 summarizes peak wave periods for swell waves by significant wave height and direction. The data shows that the largest (32 to 36 ft) waves indicated in Table 4-3 will have peak wave periods around 17.4 to 19.1 seconds. Aside from these, the data in the table shows that the peak wave period

is generally related to the wave height with smaller waves having shorter periods and larger waves having longer periods.

It should be noted that there is a group of data in Table 4-4 where long peak wave periods from 13 to 18.9 seconds occur for small to moderate wave heights. This is seen for waves from SE to SW having significant wave heights from 2 to 8 feet. Waves in this group are characteristic of Southern Swell, i.e. swell waves with long decay distance originating from distant storm systems. Swell waves of this type have a relatively small wave steepness (ratio of wave height to wave length). Larger waves from the same directions, SE to SW, with significant wave heights in the range from 10 to 24 feet characterize swell waves originating from storm systems further north in the Southern Hemisphere. Waves from these storm systems have a shorter decay distance and greater wave steepness.

Table 4-4: Average peak period of swell waves (in seconds) by significant wave height and direction.

H_S (feet)	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0 - 2			13.0	13.3	14.0	12.7	12.5	10.3	9.3	
2 - 4	16.8	14.5	14.4	14.7	14.4	13.1	12.3	11.2	9.7	10.1
4 - 6	15.7	14.6	15.3	15.6	15.0	13.4	12.8	12.0	10.0	10.0
6 - 8	18.9	14.8	15.8	16.1	14.0	12.5	13.2	12.9	10.5	9.7
8 - 10		10.9	12.5	13.2	10.7	11.6	13.5	13.4	11.1	9.9
10 - 12	10.5	9.1	9.4	9.5	9.8	12.2	13.9	14.0	11.8	11.0
12 - 14		9.2	8.8	9.1	10.3	12.8	14.0	14.4	12.5	11.2
14 - 16		9.1	9.1	9.3	10.8	13.4	14.6	14.7	13.1	11.8
16 - 18		9.5	9.5	10.0	10.8	14.4	15.2	15.1	13.2	11.2
18 - 20		10.0	9.7	10.0	12.1	15.3	15.4	15.6	13.1	12.0
20 - 22		10.1	9.5	9.8		16.3	15.8	16.0	13.8	11.9
22 - 24			9.1			17.7	16.1	16.6	14.0	
24 - 26						17.2	16.1	16.4	13.8	
26 - 28							16.6	17.2	14.8	
28 - 30							17.2	16.7	14.8	
30 - 32							19.1	19.1		
32 - 34							17.4	19.1		
34 - 36							19.1			

4.2. Wave Model Development

Coastal processes in Carmel Bay and at CRSB are primarily wave-driven, and include erosion, accretion, cross-shore sediment transport, and longshore sediment transport driven by wind- and swell waves and by wave-induced currents.

The Danish Hydraulic Institute (DHI) MIKE-21 Spectral Wave (SW) model was utilized to develop a regional wave model covering the area of Monterey Bay, Carmel, and Big Sur. The SW model simulates wave transformation of deep-water waves propagating to nearshore areas. Wave transformation effects resolved by the model include wave propagation by speed and direction, wave growth due to wind shear, shoaling and refraction due to variation of the seabed, diffraction and

reflection near structures, wave breaking in the surf zone, wave dissipation, and interaction between waves and currents.

4.2.1. Model Domain and Bathymetry

To account for the full offshore wave exposure outlined in Figure 4-1, the SW model domain extends approximately 20 miles west of Carmel Bay and 60 miles in the north-south orientation. Figure 4-2 shows the location of metocean gauges within the model domain outlined in blue.

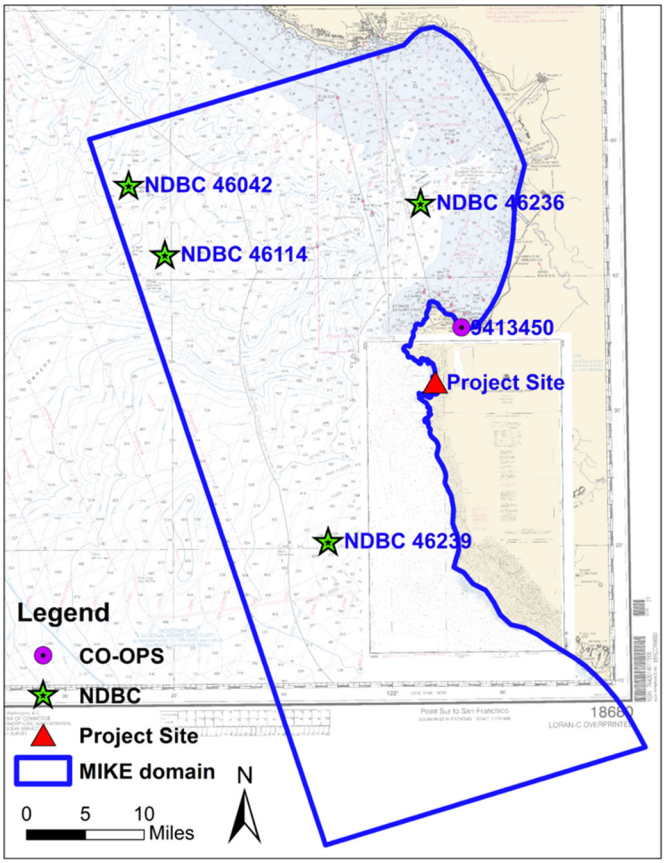


Figure 4-2: Metocean gauges and SW model domain.

Bathymetry data was obtained from NOAA's 1/3 arc-second (e.g. 10-meter resolution) coastal Digital Elevation Model (DEM) and was originally developed based on multi-agency hydrographic surveys (NOAA, 2012). The model bathymetry is referenced to the North American Vertical Datum of 1988 (NAVD88) datum. Figure 4-3 illustrates the regional seabed bathymetry (left) and the bathymetry in the vicinity of Carmel Bay (right). One of the main features of the regional bathymetry is the Monterey Bay Submarine Canyon, which is indicated by the undulating shape of darker blue colors in the figure on the left. Carmel Bay also features a submarine canyon, the Carmel Canyon, which is a spur off the Monterey Submarine Canyon. Within Carmel Bay, there is a segment of the canyon headed northeast towards Carmel Beach, while another segment is aligned southeast with a canyon head at CRSB and another at Monastery Beach. The canyon head at Monastery Beach comes close to shore and is said

to be literally a stone's throw from the beach. The submarine canyon heads have a major impact on sediment transport processes at Carmel as they effectively trap and remove sediment from the nearshore system.

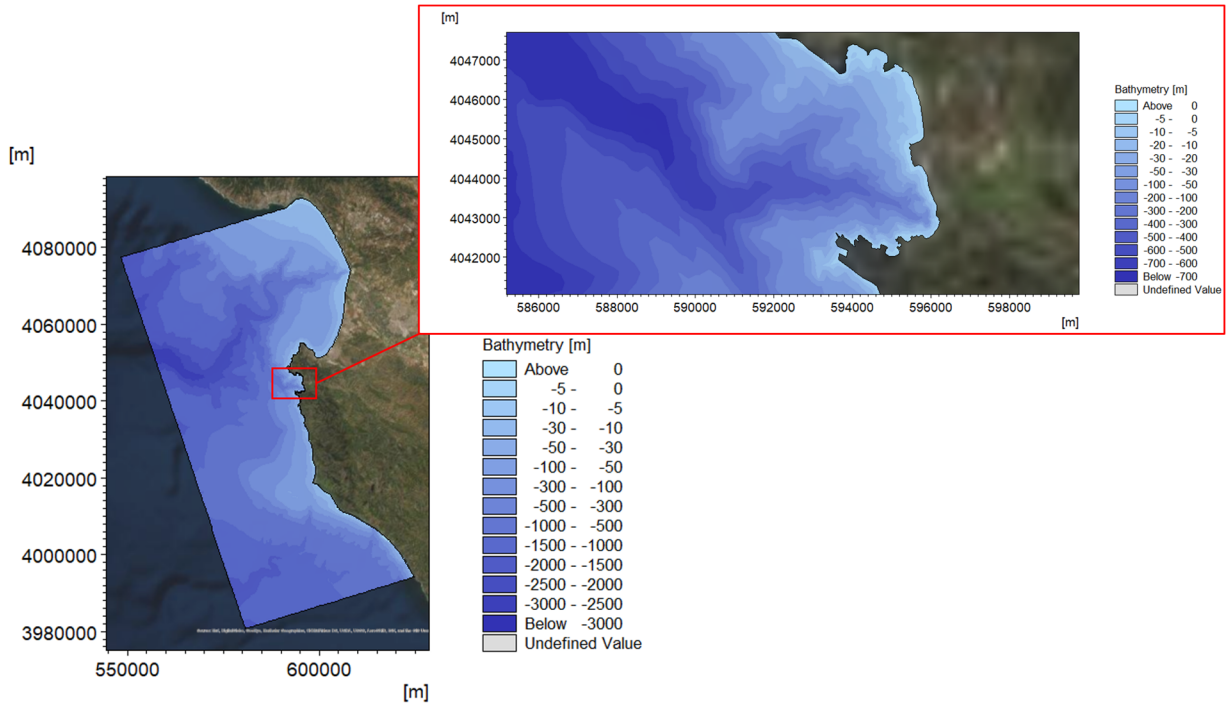


Figure 4-3: Regional model bathymetry (left), and local bathymetry (right).

4.2.2. SW Model Verification

Field measurements from wave buoys were utilized to evaluate the performance of the SW model. The SW model was run using wave measurements from NDBC wave buoy 46042 as the boundary condition. Within the model domain, the simulated significant wave heights and peak wave periods were compared with the measurements from other NDBC buoys (e.g. 46114, 46236, and 46239). The model verification included the period around December 2015. This winter can be characterized as a "very strong El Niño". Figure 4-4 through Figure 4-6 indicate that the SW model performs well in comparison with the field measurements. In these figures, the blue x's represent data recorded at NDBC wave boys while the red curves reflect data obtained via model simulation. The data shows that there is good agreement between observed and simulated data.

Following this model verification phase, the SW model was employed for multi-year simulation of wave data to support analysis of coastal processes at CRSB.

4.2.3. Conducted Wave Scenarios

Wave data recorded at NDBC wave buoy 46042 was used to characterize the offshore wave environment. A total of 156 scenarios was identified, accounting for approximately 94.5% of the total swell wave data recorded at the buoy.

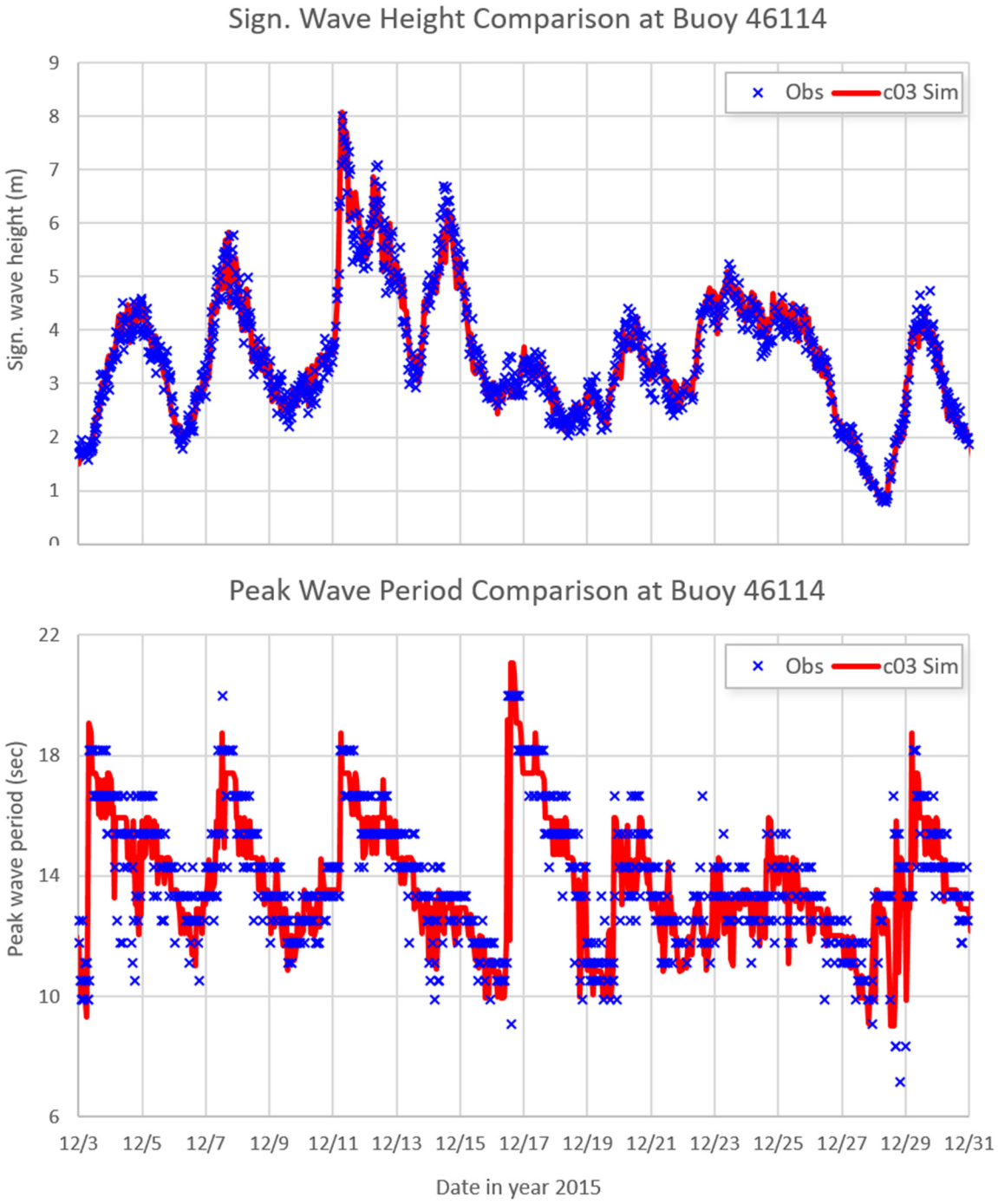


Figure 4-4: Comparison of simulated wave parameters with data from NBDC wave buoy 46114.

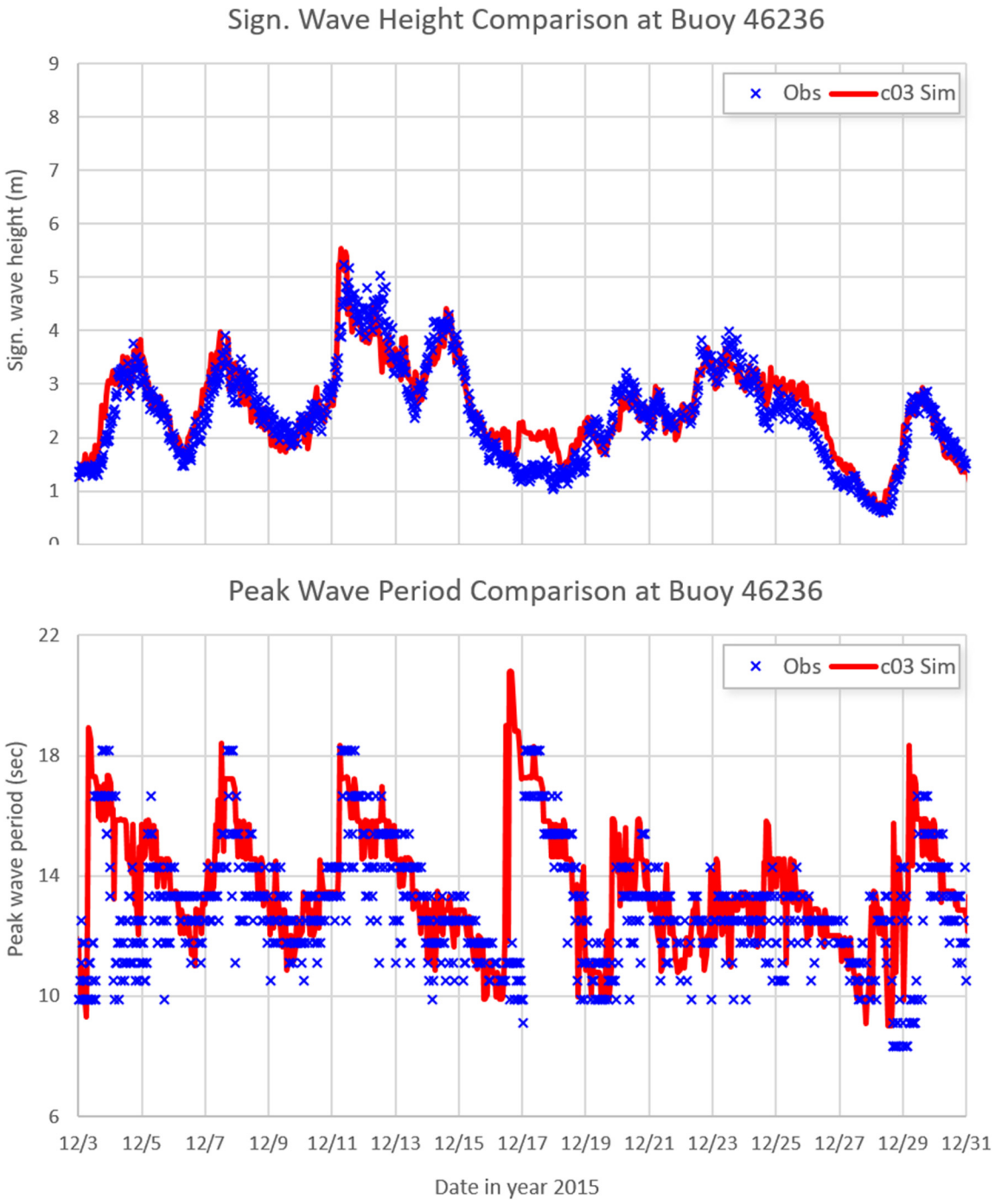


Figure 4-5: Comparison of simulated wave parameters with data from NDBC wave buoy 46236.

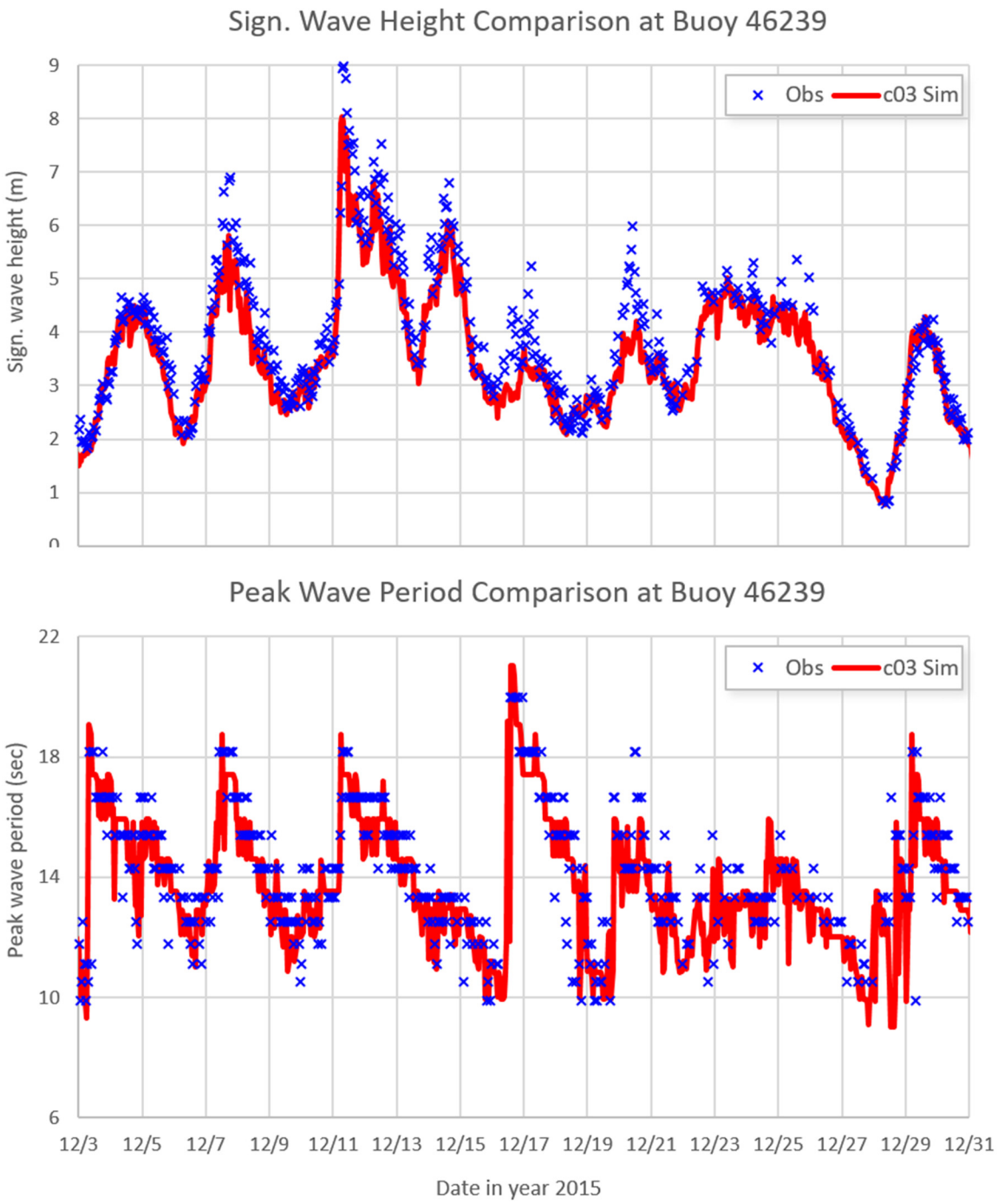


Figure 4-6: Comparison of simulated wave parameters with data from NDBC wave buoy 46239.

4.3. Wave Transformation

Figure 4-7 through Figure 4-9 illustrate three examples of regional swell wave transformation simulated with the SW model for swell waves from the northwest, west, and southwest.

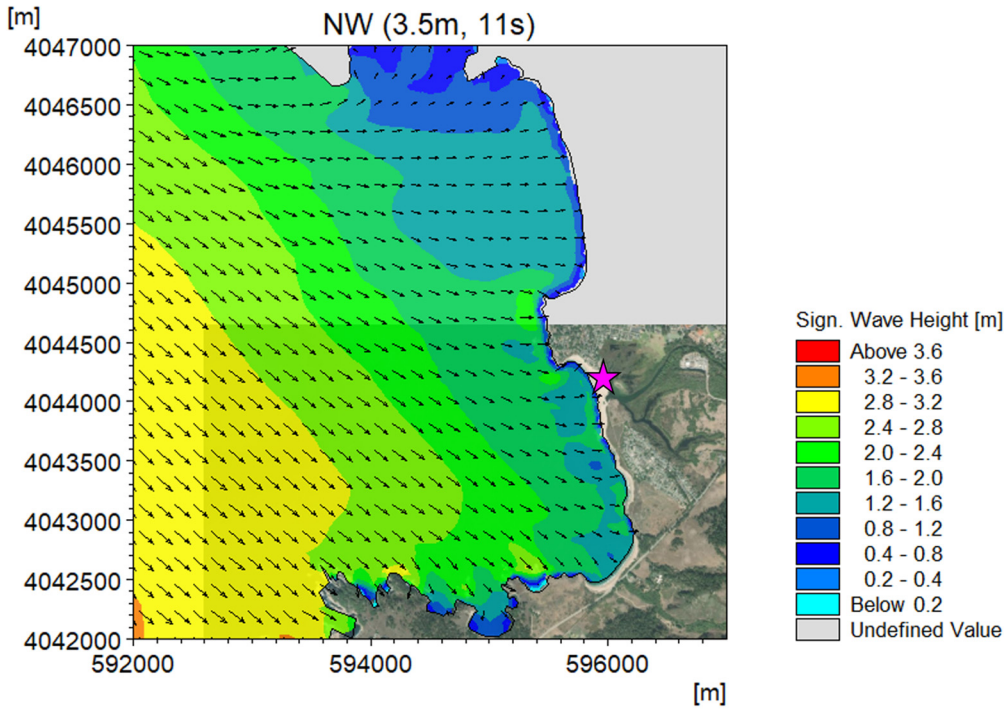


Figure 4-7: Illustration of swell wave transformation (offshore H_S=3.5m, T_P=11s, Northwest).

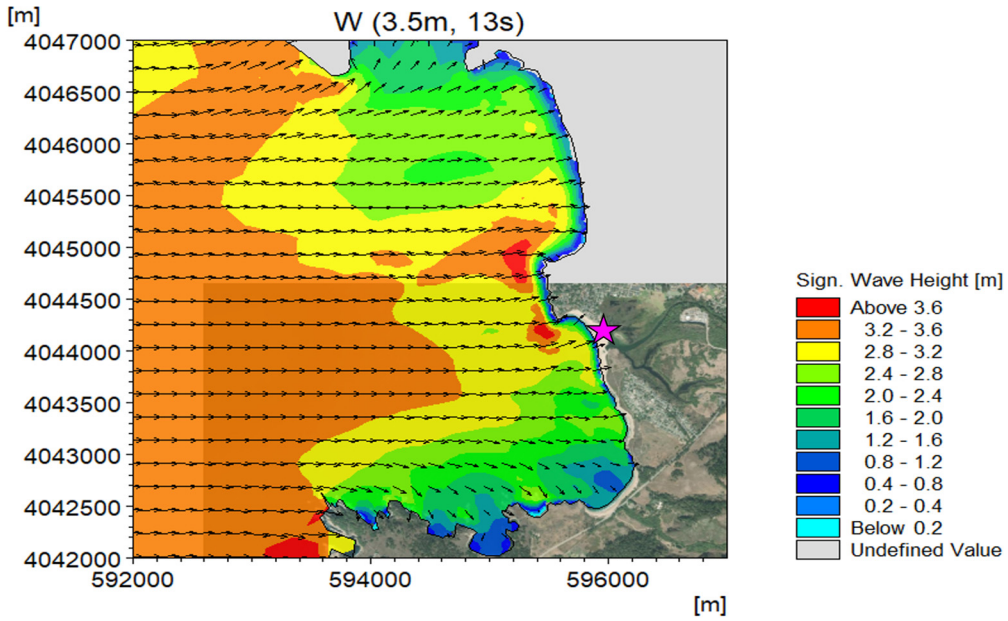


Figure 4-8: Illustration of swell wave transformation (Offshore H_S=3.5m, T_P=13s, West).

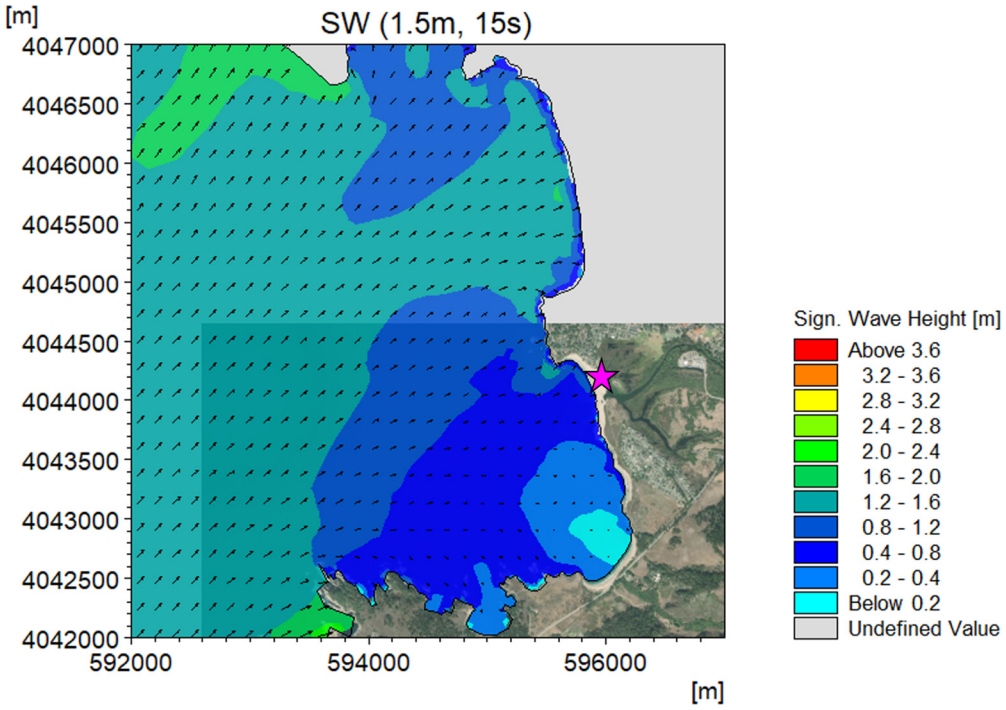


Figure 4-9: Illustration of swell wave transformation (Offshore H_S=1.5m, T_P=15s, Southwest).

The Carmel submarine canyon plays a significant role in how waves are transformed as the propagate from offshore waters to the shoreline, which is explained in the following.

Figure 4-10 shows wave transformation patterns for swell waves from directions approximately northwest to west-northwest, which has the highest percentage of occurrence per Table 4-3. Swell waves from this direction interval occur 36.6% + 36.4% = 73% of the time.

In the figure, blue colors are representative of wave crests while gray colors indicate wave troughs. Dark blue and dark gray hues indicate larger waves, while light blue and gray transitioning to white indicates decreasing wave heights. The distance between consecutive wave crests (or troughs) give an indication about wave lengths. Wave lengths are longer in deeper water and become gradually shorter as waves propagate into shallow water. Outlines of depth contours of the Carmel Canyon are indicated in black, which shows how the submarine canyon affects the incident swell waves.

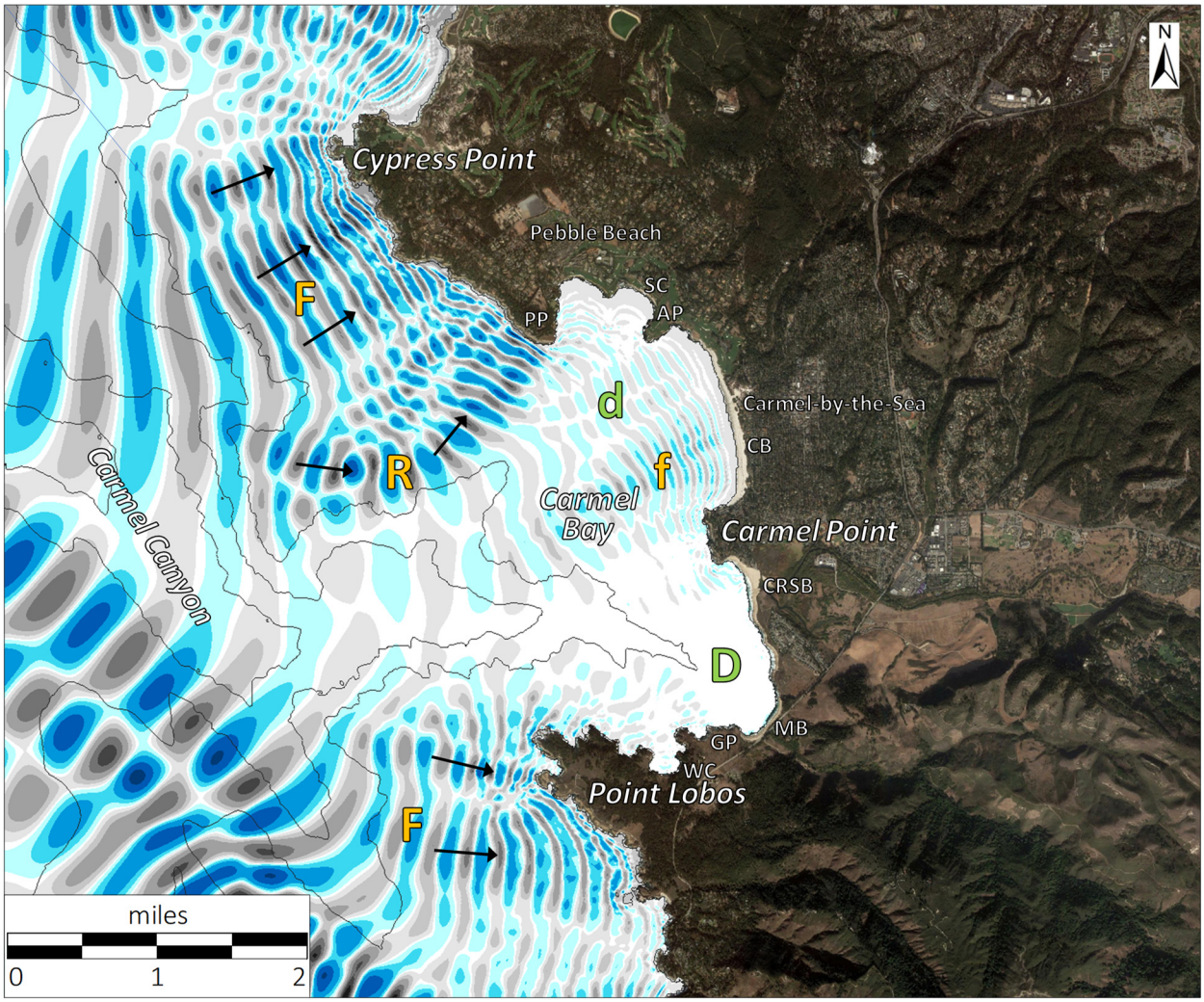


Figure 4-10: Transformation of swell waves arriving from northwest by west.

The figure shows that despite the direction of wave incidence being from northwest to west-northwest, wave refraction causes offshore waves to turn towards the cliffs between Cypress Point and Pescadero Point (PP) and also causes a focusing “F” of wave energy along this section of the coast. Incident waves also tend to converge on Point Lobos at the South end of Carmel Bay.

There is also an effect that wave energy reflects off the submarine canyon “R” and is directed towards Pescadero Point. The incident waves will tend to travel along the alignment of the submarine canyon. At the canyon heads waves tends to disperse. This occurs for waves propagating towards Arrowhead Point (AP), see “d” in the figure, and for waves propagating towards Carmel River State Beach and Monastery Beach at “D”. A slight focusing of waves occurs at Carmel Beach at “f”.

Figure 4-11 shows wave transformation patterns for swell waves from southerly to south-westerly directions. In this case the incident waves propagate across the submarine canyon in deeper water

and focus “F” on the shoreline between Cypress Point and Pescadero Point. Incident waves propagating along the south side of the canyon are reflected off the canyon wall where it turns into Carmel Bay at “R”, which causes focusing of waves towards Point Lobos by “F”. Waves propagating within the canyon become subject to dispersal in Carmel Bay near Arrowhead point at “d”, and in the area of CRSB and Monastery Beach at “D”. Slight focusing of incident wave energy occurs towards Carmel Beach at “f”.

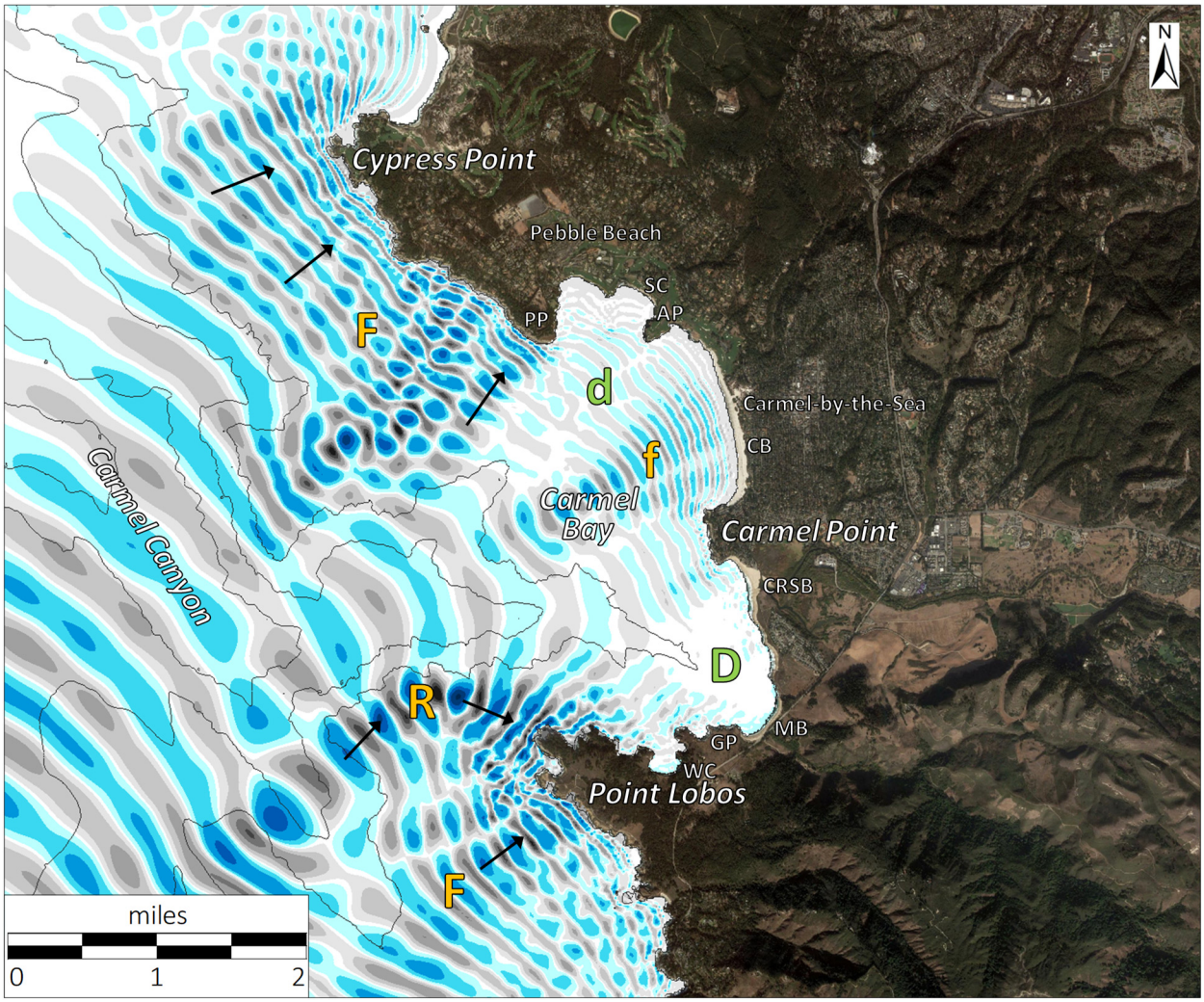


Figure 4-11: Transformation of swell waves arriving from south by west.

The ability of the submarine canyon to impact wave transformation is remarkable in that much the same effects result irrespective of whether the offshore waves arrive from northwesterly or southwesterly directions.

The focusing “F” of wave energy along the shoreline between Cypress Point and Pescadero Point is likely the explanation why this portion of the coast is particularly rugged. Conversely, the dispersal of

waves coming to the head of the canyon in Carmel Bay and towards Monastery Beach, means that the wave climate in these areas is much more calm than further offshore.

4.3.1. Focusing and Dispersal of Waves

How depth refraction transforms incident waves is illustrated in Figure 4-12. The black arrows indicate the direction of wave propagation. The two locations marked “D” can be taken as an idealized representation of the canyon heads shown in Figure 4-10 and Figure 4-11. The depth refraction patterns show that wave energy disperses at the canyon heads “D”. Conversely, there is a focusing “F” of wave energy between the canyon heads. The reason that the wave climate is more calm over the submarine canyon is that waves propagating through the canyon will tend to turn (refract) towards the side walls of the canyon. Consequently, the overall effect of the canyon is that it attenuates offshore waves as they enter Carmel Bay.

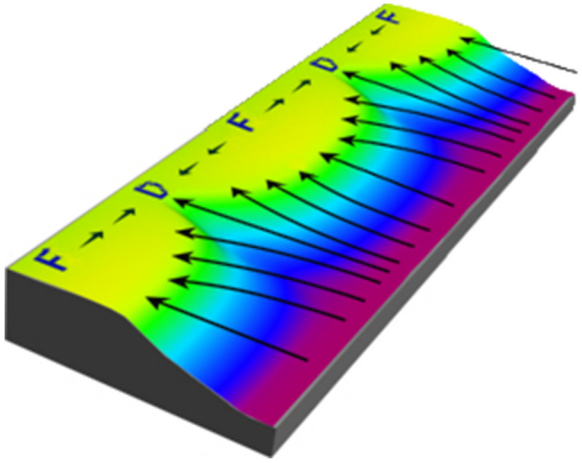


Figure 4-12: Refraction by a submarine canyon.

Table 4-5 shows how waves are affected by the submarine canyon in terms of their wave period, which translates to wave length. The table summarizes the ratio of water depth to wave length (h/L). Yellow color indicates shallow-water waves, which occur when $h/L < 0.04$. The solid blue color indicates deep water wave conditions when $h/L > 0.5$. The shading between yellow and blue indicates transitional conditions: $0.04 < h/L < 0.5$. In deep water, waves are not affected by the seafloor and are not subject to depth refraction and shoaling. As waves enter intermediate water depths, they begin to undergo wave transformation related to changes in water depth. These include depth-refraction, shoaling, and depth-limited wave breaking.

Table 4-5 shows that over the deeper part of the submarine canyon at water depths from 1,000 to 3,000 feet deep water wave conditions prevail, i.e. the incident waves propagate over the canyon and are not affected by it. In the shallower part of the canyon and near the canyon edge, swell waves transition to intermediate water depths where they become subject to refraction and shoaling. Wind-waves can propagate over the canyon without being affected. As waves propagate into the shallow areas near the shoreline and beach areas, they eventually become subject to shallow-water wave transformation effects including refraction, shoaling and depth-limited wave breaking.

Table 4-5: Influence of water depth on wave characteristics.

Zone	Water Depth (ft)	Wave Period (seconds)									
		Wind-Waves				Swell Waves					
		2	4	6	8	10	12	14	16	18	20
Beach to Intermediate depths	3	0.2	0.1	0.1	0.04	0.03	0.03	0.02	0.02	0.02	0.02
	30	1.5	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.05
	100	4.9	1.2	0.5	0.3	0.2	0.2	0.1	0.1	0.1	0.1
canyon edge	200	9.8	2.4	1.1	0.6	0.4	0.3	0.2	0.2	0.2	0.1
	300	14.6	3.7	1.6	0.9	0.6	0.4	0.3	0.3	0.2	0.2
submarine canyon interior	500	24.4	6.1	2.7	1.5	1.0	0.7	0.5	0.4	0.3	0.3
	1,000	48.8	12.2	5.4	3.1	2.0	1.4	1.0	0.8	0.6	0.5
	2,000	97.6	24.4	10.8	6.1	3.9	2.7	2.0	1.5	1.2	1.0
	3,000	146.5	36.6	16.3	9.2	5.9	4.1	3.0	2.3	1.8	1.5

4.3.2. Reflection by the Carmel Submarine Canyon

Per AGU (2005), wave reflection, R, and transmission, T, at a marine canyon can be described by:

$$R = \sqrt{\frac{\gamma}{1+\gamma}} \quad , \qquad T = \sqrt{\frac{1}{1+\gamma}}$$

and

$$\gamma = \left(\frac{h^2 l^2 - h_c^2 l_c^2}{2hlh_c l_c}\right)^2 sin^2(l_c W)$$

Where R and T are the ratios of reflected and transmitted wave energy, h is the water depth outside the canyon, h_c is the water depth inside the canyon, l and l_c represent the cross-canyon wave number outside and inside the canyon, and W is the width of the canyon.

These equations predict that when waves approach the submarine canyon at an oblique angle, nearly all of the wave energy is reflected. The critical angle, θ, for total reflection can be estimated as:

$$|\theta| = arcsin\left(\sqrt{h/h_c}\right)$$

For the Carmel submarine canyon, θ is in the range of 25° to 30°. This means that when waves approach the canyon at angles below this range they will be reflected off the canyon. When waves approach at oblique angles higher than θ there will be components of both reflection and transmission of wave energy across the canyon.

The above equations are derived for a box approximation of the canyon. In reality, the water depths outside and inside of the canyon vary, as does the width of the canyon and the angle of wave incidence. The wave-canyon interaction is therefore much more complex, as e.g. illustrated in Figure 4-10 and Figure 4-11.

5. Cliff Retreat Rates

Degradation and erosion of coastal cliffs at Carmel Bay an important role in the overall sediment budget. Cliff erosion is the second largest contributor of sediment to the littoral cell after the fluvial input from the Carmel River and San Jose Creek.

Figure 5-1 summarizes estimates of cliff retreat rates from USGS (2020). In the region from Cypress Point to Point Lobos cliff retreat rates are on the order of 4 to 8 inches per year (0.1 to 0.2 m/year), with the highest rates occurring along the most exposed areas of the coast (refer to areas where focusing of incident wave energy occurs marked with “F” in Figure 4-10 and Figure 4-11).



Figure 5-1: Overview of cliff erosion data, USGS (2020).

6. Shoreline Change

Shoreline change is another phenomenon that affects the overall sediment budget at Carmel Bay. While most of the pocket beaches and crenulate-shape bays are relatively stable, long-term shoreline recession has the effect of adding sand to the overall system. Beaches are subject to a seasonal (cyclical) variation where they tend to build up and widen in the summer and become narrower in the winter. Via this variation sediment is added to the littoral cell in the summer and released during the winter. The aggregate effect is a temporary storage of sediment within the littoral cell system. However, long-term shoreline recession will produce a net loss of sediment from the system.

Shoreline change at CRSB was evaluated based on historical aerial imagery. Figure 6-1 summarizes shoreline locations derived from aerial imagery recorded over the years from 1929 to 2020. The respective years included in the analysis are listed in Table 6-1. The table also indicates the color codes used to denote the shoreline locations in Figure 6-1.

Table 6-1: Aerial imagery dates and color code.

Date	Color Code	Source
1929-08-01		UCSB (2020)
1941-11-22		UCSB (2020)
1945-10-24		UCSB (2020)
1961-04-14		UCSB (2020)
1986-09-28		CCRP (2020)
1993-04-19		CCRP (2020)
2001-05-30		UCSB (2020)
2005-10-04		MCPW (2014)
2006-04-18		MCPW (2014)
2016-04-28 a)		NOAA (2020c)
2020-05-16		NM (2020)
a) El Nino year.		

The variety of the shoreline locations in Figure 6-1 reflect the seasonal and intra-annual variation of the shoreline as well as the long-term shoreline recession. The long-term recession rates were determined as the mean trend across the data for 58 transects along the shoreline at 50-ft spacing.

It is evident that the fluctuation of the shoreline location is smaller at the north end of the beach than at the south end. Removing the long-term recession trend from the data, the fluctuation of the shoreline varies from about 45 feet at the north, to 75 feet at the central location of the lagoon breach, to 150 feet at the south end.

This variation is not surprising, as the north end of the beach is more sheltered in the lee of Carmel Point and is therefore more stable. The portion of the beach fronting the river mouth is somewhat less

sheltered and exposed to larger waves and therefore exhibits more variation in the plan location of the shoreline. The shoreline segment located south of the river mouth is further exposed to wave action and also subject to significantly larger changes in sand volumes as pulses of sand deposited from the river move southward conveyed by the littoral transport.



Figure 6-1: Shoreline locations (1929 to 2020).

Figure 6-2 summarizes estimates of long-term shoreline change at Carmel River State Beach. The shoreline recession rates were developed based on aerial photography dating back to 1929. Refer to Table 6-1 for the specific dates.

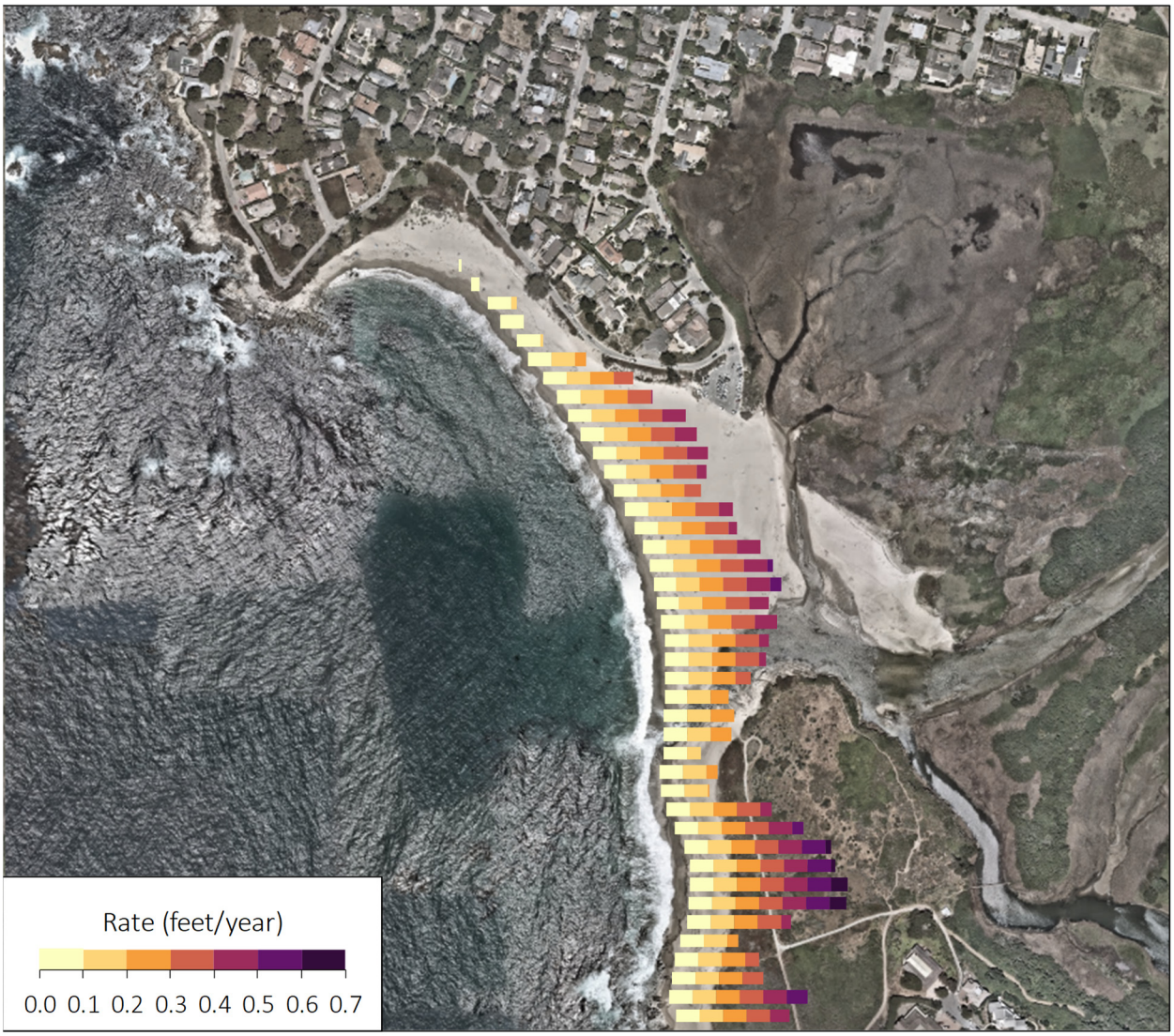


Figure 6-2: Long-term shoreline recession rates at Carmel River State Beach.

The results show that the northern part of the beach appears to be stable over the long-term. In this area, the beach is sheltered by the promontory at Carmel Point. It is conceivable that the long-term rate of shoreline recession in this area is tied to the cliff recession rate, which is on the order of a few inches per year. Moving south along the beach, it can be seen that the shoreline recession rate increases progressively, on the order of 0.4 to 0.5 feet per year at the river mouth, increasing to nearly 0.7 feet per year at the transition between Carmel River State Beach and Ribera Beach.

The shoreline recession trends shown in Figure 6-2 are consistent with estimates from USGS (2006, 2020), which are on the order of 0.3 to 0.9 feet per year (0.1 to 0.3 m/year). Figure 6-3 summarizes

the transects for which USGS estimates shoreline recession rates based on shoreline data for years (1876, 1933, 1945, and 1998).



Figure 6-3: Shoreline change transects from USGS (2020).

7. Sediment Grain Sizes

Sediment samples were acquired in connection with the studies reported in NPS (1972) and MG (2000). Table 7-1 provides a summary of the mean grain sizes determined from field samples. Note, phi-values converted to average diameter, d_{50}, per the Wentworth Classification Scale, Appendix B.

Figure 7-1 shows the variation of grain sizes with distance from the shore. It can be seen that the sediment gets coarser going from north to south from the north end of CRSB to Monastery Beach. The variation with water depth shows coarser sediment on the beaches and nearshore, decreasing in size as the water depth increases with the distance from the shore.

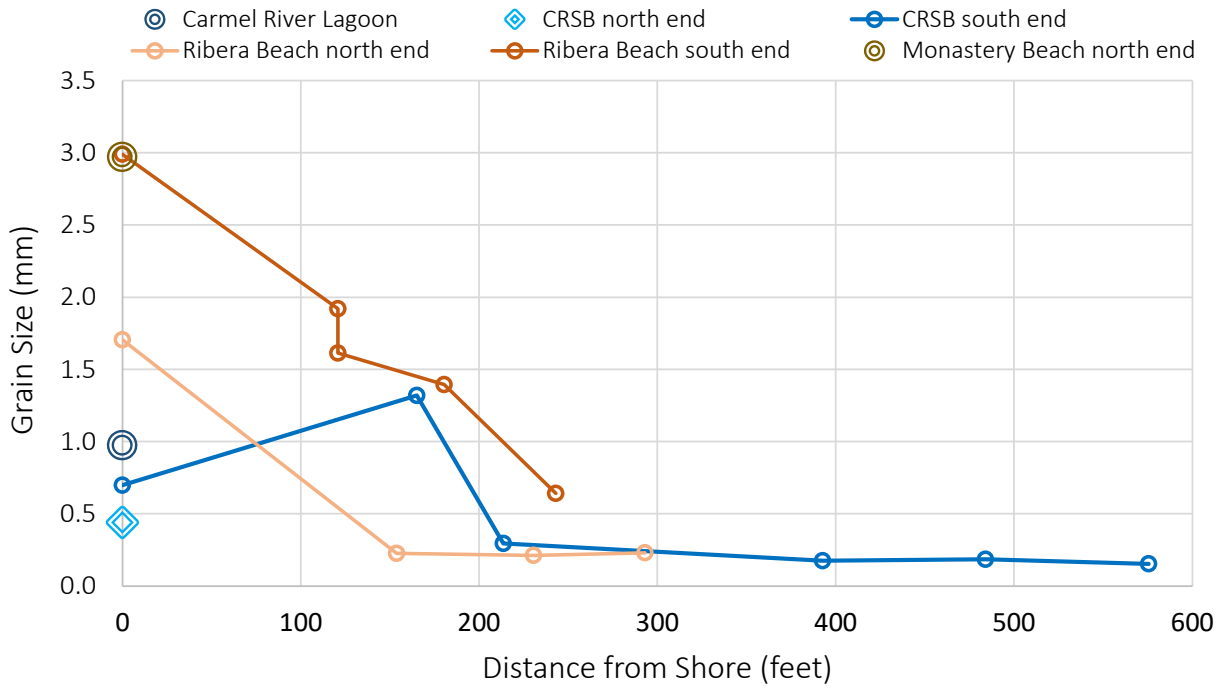


Figure 7-1: Overview of grain size samples from NPS (1972).

Figure 7-2 and Figure 7-3 shows examples of beach sand from Carmel River State Beach sampled on October 30, 2020. The sand grains are rounded, ranging from fine and medium sand to coarse sand with a few very fine pebbles (Figure 7-2) medium sand with fine pebbles (Figure 7-3).



Figure 7-2: CRSB beach sand.



Figure 7-3: CRSB beach sand.

Table 7-1: Sediment grain size based on sampling and sieve analysis.

Location	Sample/ Site #	Distance from shore (feet)	Water Depth (feet)	φ	Mean Grain Size d_{50} (mm)	Classification	Reference
Carmel River Lagoon	18	On beach	-	0.04	0.97	coarse sand	NPS (1972)
CRSB north end	13	On beach	-	1.18	0.44	medium sand	
CRSB south end	14	On beach	-	0.52	0.70	coarse sand	
	5	165.2	20	-0.40	1.32	very coarse sand	
	4	213.6	40	1.76	0.30	medium sand	
	3	392.6	60	2.52	0.17	fine sand	
	2	484.1	80	2.44	0.18	fine sand	
	1	575.5	95	2.71	0.15	fine sand	
Ribera Beach north end	15	On beach	-	-0.77	1.71	very coarse sand	
	8	153.7	26	2.15	0.23	fine sand	
	7	230.6	40	2.24	0.21	fine sand	
	6	293.1	65	2.12	0.23	fine sand	
Ribera Beach south end	16	On beach	-	-1.58	2.99	very fine pebbles	
	12	120.8	30	-0.94	1.92	very coarse sand	
	11	120.8	30	-0.69	1.61	very coarse sand	
	10	180.5	50	-0.48	1.39	very coarse sand	
	9	243.0	70	0.64	0.64	coarse sand	
Monastery Beach north end	17	0	0	-1.57	2.97	very fine pebbles	
Stillwater Cove, Pebble Beach	20	On beach	-	1.74	0.30	medium sand	MG (2000)
Carmel Beach (north)	21	On beach	-	0.57	0.67	coarse sand	
Carmel Beach (south)	22	On beach	-	1.87	0.27	medium sand	
CRSB (north)	23	On beach	-	0.68	0.62	coarse sand	
CRSB (central)	24C	On beach	-	0.96	0.51	coarse sand	
CRSB (south)	24S	On beach	-	-0.87	1.83	very coarse sand	
Monastery Beach	25	On beach	-	-0.66	1.58	very coarse sand	

Location	Sample/ Site #	Distance from shore (feet)	Water Depth (feet)	φ	Mean Grain Size d_{50} (mm)	Classification	Reference
Ribera Beach, south end	115	On beach	-	-1.04	2.06	very fine pebbles	NPS (1968)
Monastery Beach, north end	106	Back beach	-	-0.93	1.91	very coarse sand	
	107	Mid beach	-	-0.5	1.41	very coarse sand	
	108	Shoreline	-	-1.31	2.48	very fine pebbles	
Monastery Beach, central	109	Back beach	-	-0.74	1.67	very coarse sand	
	110	Mid beach	-	-0.82	1.77	very coarse sand	
	111	Shoreline	-	-1.09	2.13	very fine pebbles	
Monastery Beach, south end	112	Back beach	-	-1.02	2.03	very fine pebbles	
	113	Mid beach	-	-0.59	1.51	very coarse sand	
	114	Shoreline	-	-0.93	1.91	very coarse sand	

8. Carmel Littoral Cell

A littoral cell is a section along the coast where sediment processes are isolated from neighboring shoreline segments. A littoral cell exhibits a complete cycle of sedimentation including sources, losses, and transport paths. The Carmel littoral cell extends from Cypress Point to Point Lobos as illustrated in Figure 8-1. The net direction of sediment transport within the littoral cell is from north to south, GM (2000). North of Cypress Point the bluff is oriented approximately perpendicular to the average direction of incident waves. This means that material produced due to erosion of the cliffs in this area tends to move north towards Monterey or south into the Carmel littoral cell depending on how the incident waves deviate from the mean wave direction. The Carmel littoral cell terminates at Point Lobos around Monastery Beach (MB), where material is lost to the Carmel submarine canyon.

8.1. Sub-Cells

Within the Carmel littoral cell are sub-cells comprised of the pocket beaches and crenulate-shaped bays found along the shoreline. These features are located between rocky headlands which prevents sediment within these cells from moving along the coast. These coastal features are not true littoral cells, but exhibit a similar function by being able to retain sediment within a stable or quasi-stable cell. Examples of these are Carmel Beach (CB), Carmel River State Beach (CRSB), Monastery Beach (MB), Stillwater Cove (SC), and Whaler's Cove (WC).

Sediment transport patterns within the littoral cell, and sources and losses of sediment are described in the following.

8.2. Sediment Transport

Figure 8-1 provides an overview of the Carmel Littoral Cell and sub-cells within it. Seafloor elevation contours are indicated by the blue color bands with shallow water being light blue and deeper water dark blue. Within the littoral cell, sediment can be transported by waves, currents, streamflow, runoff, and by wind.

The arrows in Figure 8-1 indicate the predominant direction of the littoral transport. Yellow arrows indicate longshore transport, and red arrows indicate loss of sediment, while the black arrow indicates storage of sand via dune formation. The blue curves indicate streams that supply sediment to the shoreline areas.

Apart from the Carmel River, which is described later, sediment transported via streamflow, runoff, and wind comprises a smaller part of the overall system. Wave action is the most significant driver for movement of sediment within the littoral cell. Wave action contributes to erosion, cross-shore movement of sand onto beaches and movement of sand offshore, and longshore transport along the shoreline due to wave runup and rundown, and in the surf-zone via wave-induced currents.

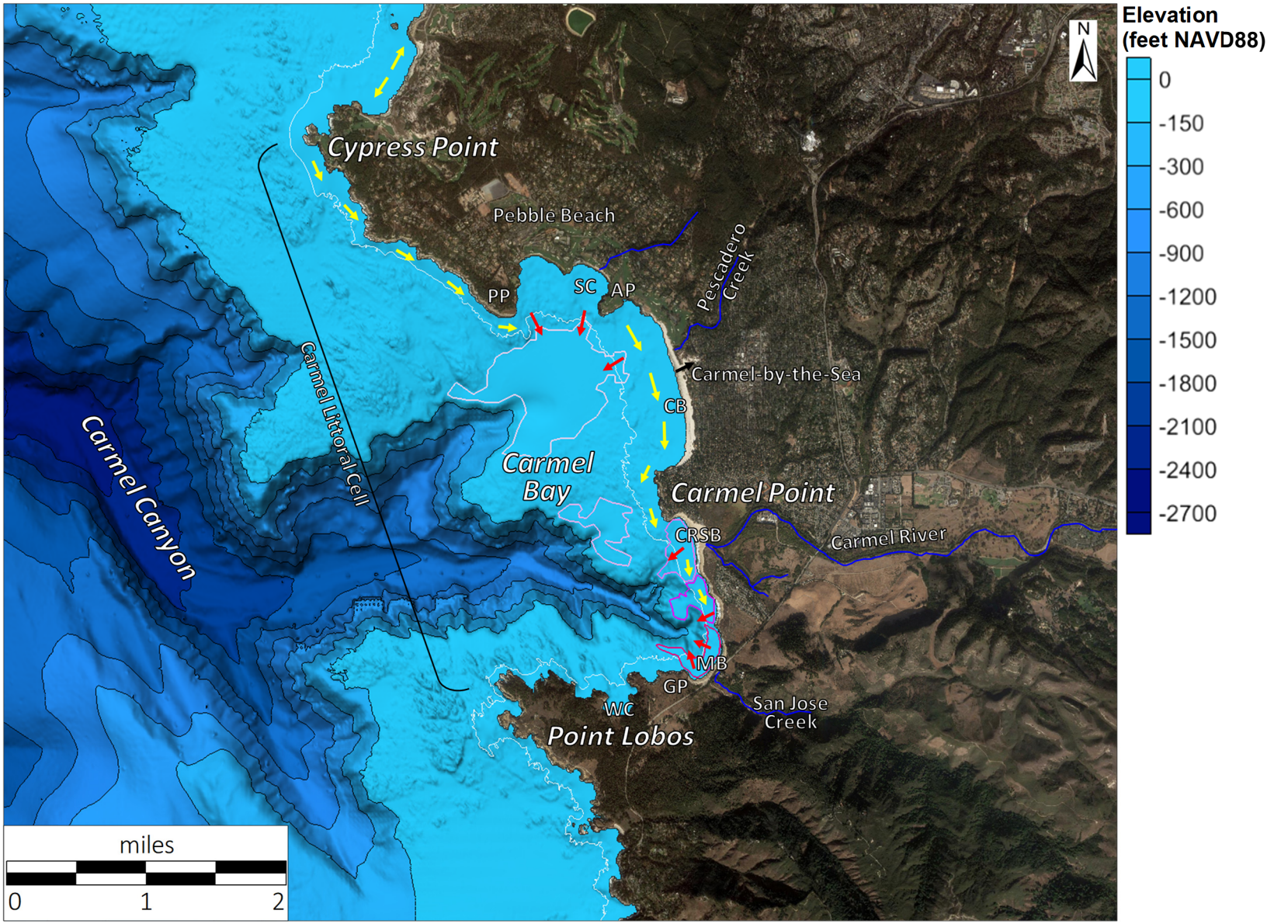


Figure 8-1: Overview of Carmel Littoral Cell.

Figure 8-2 illustrates the movement of sand particles along the shore due to wave-induced processes.

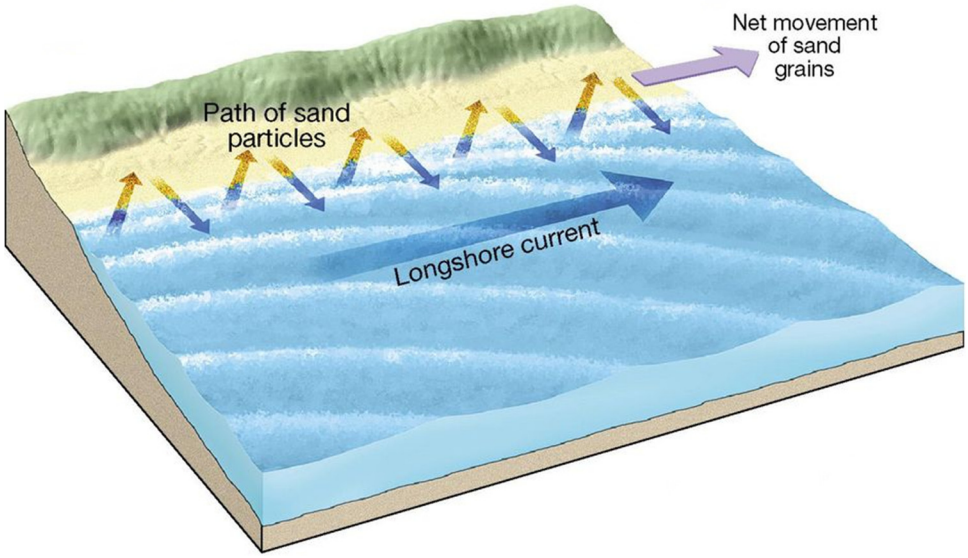


Figure 8-2: Wave-driven sediment transport along the shore.

In deep water, waves are unable to mobilize sediment on the seafloor. The depth at which this occurs is termed the closure depth. Figure 8-3 provides a summary of coastal terms and definition of the closure depth.

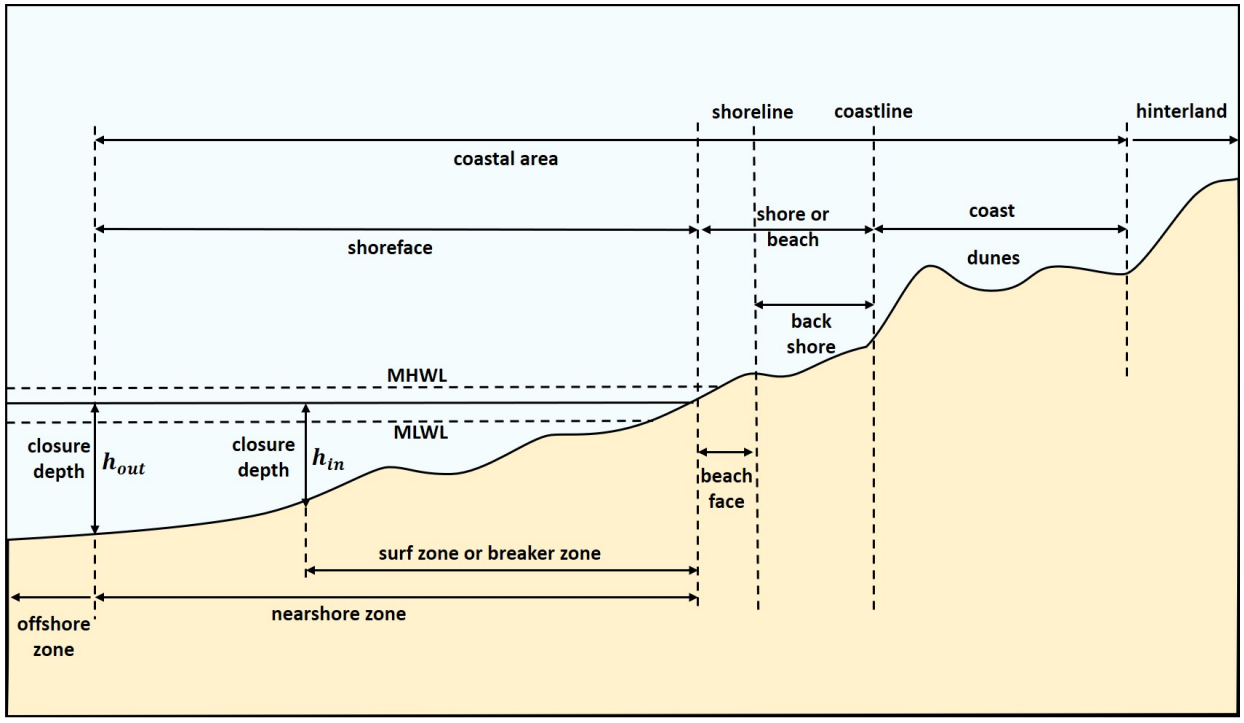


Figure 8-3: Definition of coastal terms and closure depth, adapted from SPM (1984).

Hallermeier (CEM, 2011), defines the closure depth as:

$$h_c = 2.28H_e - 68.5\left(\frac{H_e^2}{gT_e^2}\right)$$

Where H is effective significant wave height and T the effective wave period based on conditions exceeded only 12 hours per year (0.14% of the time). Birkemeier (CEM, 2011) suggested a simpler relationship given by:

$$h_c = 1.57H_e$$

The closure depth is indicated by the white line along the shore in Figure 8-1. At Carmel Bay the closure depth approximately follows the -45 to -50 feet NAVD88 elevation contour. The predominant zone of wave-induced longshore transport is between this line and the shoreline. Wave-driven sediment transport is limited seaward of the closure depth where water depths are so deep that waves cannot mobilize sediment on the seabed. In areas where the closure depth contour comes close to the shoreline, there is a limited potential for sand movement between adjacent areas. In these areas sediment exchange is sporadic and typically occurs during significant storm events.

8.3. Sand Sources and Loss of Sediment

The primary sources of sand input to the littoral cell include:

1. Sediment from gully erosion.
2. Sediment from sea cliff and bluff erosion.
3. Sand supplied by small streams, Pescadero Creek, San Jose Creek, and the Carmel River.
4. Onshore transport of sand, e.g. seasonal beach profile buildup due to swell waves.
5. Dune erosion, e.g. wind-blown sand transported from dunes to beach areas and surf zone.

Loss of sand from the littoral cell is due to the following mechanisms:

1. Longshore transport out of the system.
2. Offshore transport of sand, e.g. seasonal beach profile variation due to winter waves.
3. Offshore loss of sand to the Carmel Submarine Canyon.
4. Dune growth (on Carmel Beach).
5. El Niño effects. The warming (and expansion) of the ocean water produces a temporary rise of the mean sea level, which when coinciding with winter storms can produce widespread shoreline recession and beach narrowing (similar to sea-level rise).

6. Sea-level rise, e.g. shoreline recession and beach narrowing due to rise in water level.

The competing mechanisms of accretion and erosion produces a dynamic equilibrium of sediment within the littoral cell.

Elements of the Carmel Littoral Cell are described in the following.

8.4. Coastal Cliffs from Cypress Point to Pescadero Point

This portion of the coast consists of craggy coastal cliffs. There are a limited number of access points to the water and isolated pocket beach areas. The majority of the shoreline is rocky and swept free of sand. Due to reflection of long period swell waves as they pass over the Carmel submarine canyon, a portion of the incident waves are directed towards the coastal cliffs. This occurs for waves incident from both northwesterly and southerly directions, and means that the shoreline is continually exposed to wave action. Material dislodged from the cliffs by wave action and natural decomposition of the rock is transported southeast along the cliffs toward Pescadero Point and ultimately provides input of beach sand to Carmel Beach.

8.5. Stillwater Cove

Stillwater Cove is a sheltered inlet consisting of two pocket beaches perched between Pescadero Point and Arrowhead Point. Stillwater Cove is the moniker for the pocket beach to the east, which is sheltered by the Pescadero Rocks fronting the inlet. The pocket beach to the west is open to the bay and receives a higher degree of wave exposure. The shoreline in this area is rocky and consists of sections of steep bluff interspersed by narrow beaches and is aptly named Pebble Beach.

The primary source of sediment with Stillwater Cove comes from erosion of the bluff along the golf course. A ravine with a small inland drainage area has an outlet at the beach, but does not contribute a significant input of sediment to the beach.

Sediment coming from erosion of the cliffs between Cypress Point and Pescadero Point will tend to move along the bluff towards Stillwater Cove. A fraction of this material may enter the cove, but most of it is probably lost to the deeper portion of the bay at the entrance to the cove (refer to the two red arrows in Figure 8-1. The deposit of sand offshore from Stillwater Cove can be seen in the figure as a smooth appearance of the seafloor, as opposed to the irregular seabed within the cove which is indicative of a rocky substrate. Sediment lost to the deeper water outside of the cove will tends to migrate downslope towards the north arm of the submarine canyon where it is ultimately lost from the system. In this regard, the submarine canyon acts as a sediment trap, and sediment entering the canyon can be considered as lost from the littoral cell.

8.6. Carmel Beach

Carmel Beach is a crenulate-shaped bay suspended between Arrowhead Point and Carmel Point. The beach is approx. 400 feet wide and has an abundance of white sand. The characteristic white color of

the sand comes from the source of the material which is the granodiorite rock formations in the bay. Pescadero Creek also has an outlet on the beach via Pescadero Canyon. The drainage area for the creek is estimated to be around 567 acres and the sediment supply to the beach from this drainage area is therefore limited. There is enough sand on Carmel Beach that wind-blown sand transport has created an area of dunes along the beach of approximately 10 acres in size. Wind-blown sediment contributing to growth of the dunes is considered a loss of sediment from the littoral cells. Conversely, sand that is eroded from the dunes provides an input to the system.

The alignment of the beach is generally perpendicular to the average incident wave direction. During significant wave events, the surf zone can extend out past Carmel Point and sediment can be transported from Carmel Beach to the Carmel River State Beach area.

Over the summer months when the wave climate is mild, incident swell waves will transport sand onto the beach which can widen by around 200 feet over this period. Winter waves pull sand away from the beach out into deeper water and the beach can therefore become quite narrow in the winter months.

8.7. Carmel River State Beach

Carmel River State Beach features sweeping views of the beach and coastal cliffs. One of the most prominent features of the area is the lagoon formed at the outlet of the Carmel River.

The beach extends from the prominent headland at Carmel Point at the north and tapers out along the rocky shoreline to the south.

The sand at Carmel River State Beach is variable in color and size. Fine white sand is likely sand originating from Carmel Beach and breakdown of granodiorite formations along the shore. The coarser and more yellow sand is indicative of fluvial deposits coming down the Carmel River.

8.7.1. Carmel River Sand Supply

The Carmel River is a significant source of sediment to the littoral cell. Estimates of the sediment output from the river are on the order of 31,851 CY/year on average. The sediment output from the river varies seasonally and from year to year depending on rainfall amounts. The table below indicates estimates by Balance Hydrologics, BH (2021) for the amount of sand supplied to the CRSB by the Carmel River.

Table 8-1: Carmel River sand supply analysis summary, Balance Hydrologics, BH (2021).

Sand Supply Data	Metric tons per Year	Cubic Yard per Year
Average	38,719	31,851
Median	37,735	31,041
Standard Deviation	12,905	10,616
Maximum	89,934	73,980
Minimum	13,761	11,320

The data in Table 8-1 was developed using a numerical model of the Carmel River watershed developed by Balance Hydrologics for analysis of the sediment load on the Carmel River in response

to climate change and planned and completed dam removal projects. The data in the table is representative of the sand fraction of material (0.0625 to 2 mm) supplied to CRSB.

The estimates were obtained based on analysis of 98 random hydrographs referenced to the Robles Del Rio gage. Data was output from the model at the downstream node, representative of the Highway 1 bridge.

8.7.2. Sand Losses

As indicated by the red arrow in Figure 8-1, sand at the Carmel River State Beach may be lost due to downslope migration to the Carmel submarine canyon. The north arm of the canyon comes close to shore in this area, in proximity to the closure depth contour. There is evidence that significant wave events and outflow currents cause sediment to be transported into the submarine canyon. The mechanisms that can cause this to happen include:

1. Winter storm wave events, which draw sand away from the beach out into deeper water and over the edges of the submarine canyon.
2. Seepage flow from the Carmel River.
3. Flushing events when the Carmel River Lagoon breaches out into the bay.
4. Rip-currents producing strong outflows away from the beach, which carry sand offshore and into the canyon.

The net sediment transport direction at Carmel River State Beach is from the north to the south. However, incident swell can cause the littoral transport direction to be northerly, NPS (2019). Major pulses of sediment move south during storms from northwesterly directions, GM (2000).

8.8. Ribera Beach

Ribera Beach is a short stretch of beach between Carmel River State Beach and Monastery Beach. This beach runs along Ribera Road and is also referred to as the Middle Beach. The headlands framing the beach don't protrude as much out from shore and the beach is therefore relatively narrow with rock outcrops. The beach is perched against a narrow 300 ft long shore-parallel granodiorite outcrop on the seafloor, NPS (1972). The sand in this area is very coarse.

There is evidence of sand being transported along the shoreline in the form of sand chutes carved into the rock outcrops. These manifest as branching, rounded chutes carved into the rock terrace. The chutes are filled with sand and vary in width from 2 to 3 inches up to 10 feet wide, NPS (1968).

Diver surveys have identified a sand fall in this area, NPS (1968), which consists of a river of very coarse sand on the seabed aligned in a southwest direction towards the submarine canyon head. The sand river formation is the result of the longshore littoral transport being diverted seaward by the rock outcrop at the south end of the area, at the transition to Monastery Beach.

8.9. Monastery Beach

Monastery Beach (MB) is a pocket beach framed between the rocky shoreline to the north and Granite Point (GP) at its south end. The orientation of the beach is perpendicular to the average direction of incident waves. A key feature of the area is San Jose Creek which has a meandering outlet at the beach. The sand at this beach is likely a mix of sand from granodiorite decomposition, sand from the Carmel River transported along the shore, and sediment output from San Jose Creek. The net direction of sediment transport along Monastery Beach is to the north as indicated by the northward migration of San Jose Creek on the beach.

The Carmel Littoral Cell generally terminates at Monastery Beach by Granite Point. Only a very limited amount of sand is transported west past Granite Point. Evidence to this is the fact that Whaler's Cove contains very little sand. The majority of the shoreline in Whaler's Cove consists of rocky cliffs with very narrow patches of sandy beach at the back of the cove.

At Monastery Beach, the primary loss of sand is to the south arm of the Carmel submarine canyon, which comes close to shore in this area. The mechanisms that can convey sediment from shore out to the submarine canyon include:

1. Winter storm wave events, which draw sand away from the beach out into deeper water and into the canyon.

2. Outflow from San Jose Creek, which may produce turbidity flows out to the canyon.

3. Rip-currents producing strong outflows away from the beach, which carry sand offshore and into the canyon. Rip currents have been observed to achieve enough speed to break through the surf zone, NPS (1968). Rip-currents can occur at the rocky headland formations and along the beach. Cusp formations along the beach, which are known to occur at Monastery Beach are often indicative of rip-currents.

4. Sand chutes, consisting of rounded channels carved in the rock terrace have been observed around the canyon head, NPS (1968). These have an orientation perpendicular to shore suggesting that these have formed due to abrasion associated with wave-induced oscillation of the coarse sand on the seabed.

5. Sand falls consisting of rivers of very coarse sand on the seafloor, directed towards the head of the submarine canyon. Sand falls have been identified at the headland features at the north and south end of Monastery Beach, NPS (1968).

8.10. Carmel Canyon

The Carmel submarine canyon is the end destination of sediment transported out of the Carmel Littoral Cell. Once sediments enter the canyon, they will not reenter the system.

Several processes have been identified that document transport of sand from the seabed into the canyon in the area of Carmel River State Beach and Monastery Beach. These include:

1. Tidal circulation patterns, which may drive a net drift of fine sediment into the canyon.
2. Runnels in the bedrock of the seafloor. These are believed to be carved by abrasion from sand particles moving with the orbital motion of incident waves during significant wave events. The downslope grade of the seafloor produces a net flow of sediment towards and into the canyon.
3. Outflow events during Carmel River Lagoon breaching and/or during significant discharges from the Carmel River and San Jose Creek. In these cases, sediment can be flushed out into deeper water via hypopycnal and hyperpycnal flows (Figure 8-4). Hypopycnal flows occur during smaller outflow events and/or when the transported sediment consists of coarse material, which causes the material to be deposited in the deeper water fronting the beach. The freshwater outflow may initially consist of a lens atop the heavier seawater. Hyperpycnal flows can occur during significant outflow events. In this case, the sediment flows as a turbidity current downslope over the seabed towards the canyon.
4. Mass wasting along the edges of the canyon due to oversteepening of sediment deposits.
5. Seismic activity, which causes submarine landslides into the canyon. Earthquakes can also cause landslides on the seafloor, which subsequently move as turbidity flows downslope towards the canyon.

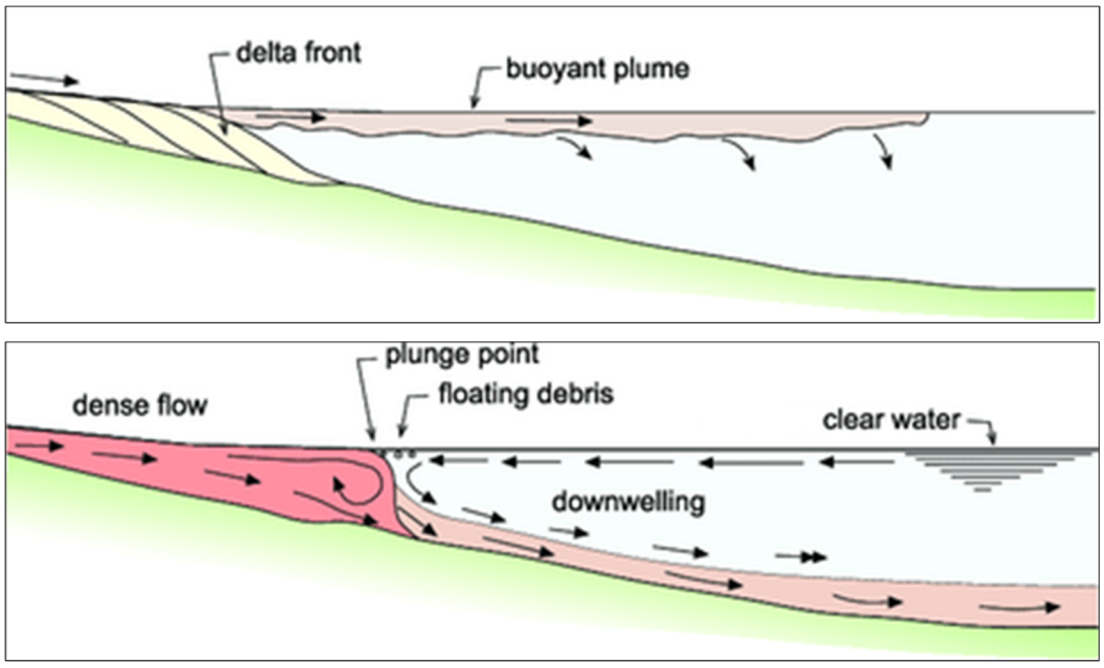


Figure 8-4: Illustrations of hypopycnal flow (upper) and hyperpycnal flow (lower).

8.11. Sediment Budget

Figure 8-5 presents an idealized version of the Carmel coast, summarizing sediment input and losses from the littoral cell. The littoral cell can be considered as a control volume along the shoreline. Sediment input to the system is denoted by arrows going into the cell marked with a “+” symbol. Sediment losses are indicated by arrows going out of the cell marked with a “÷” symbol.

The arrow on the left side indicates littoral transport into the cell, which is small to negligible where the littoral cell starts at Cypress Point. Likewise, the littoral transport leaving the system (arrow on the right) is also small where the littoral cell terminates at Point Lobos.

There is longshore littoral transport within the cell which can be to the north and south depending on winter storm and wave patterns, but with a net transport to the south (left to right in the figure).

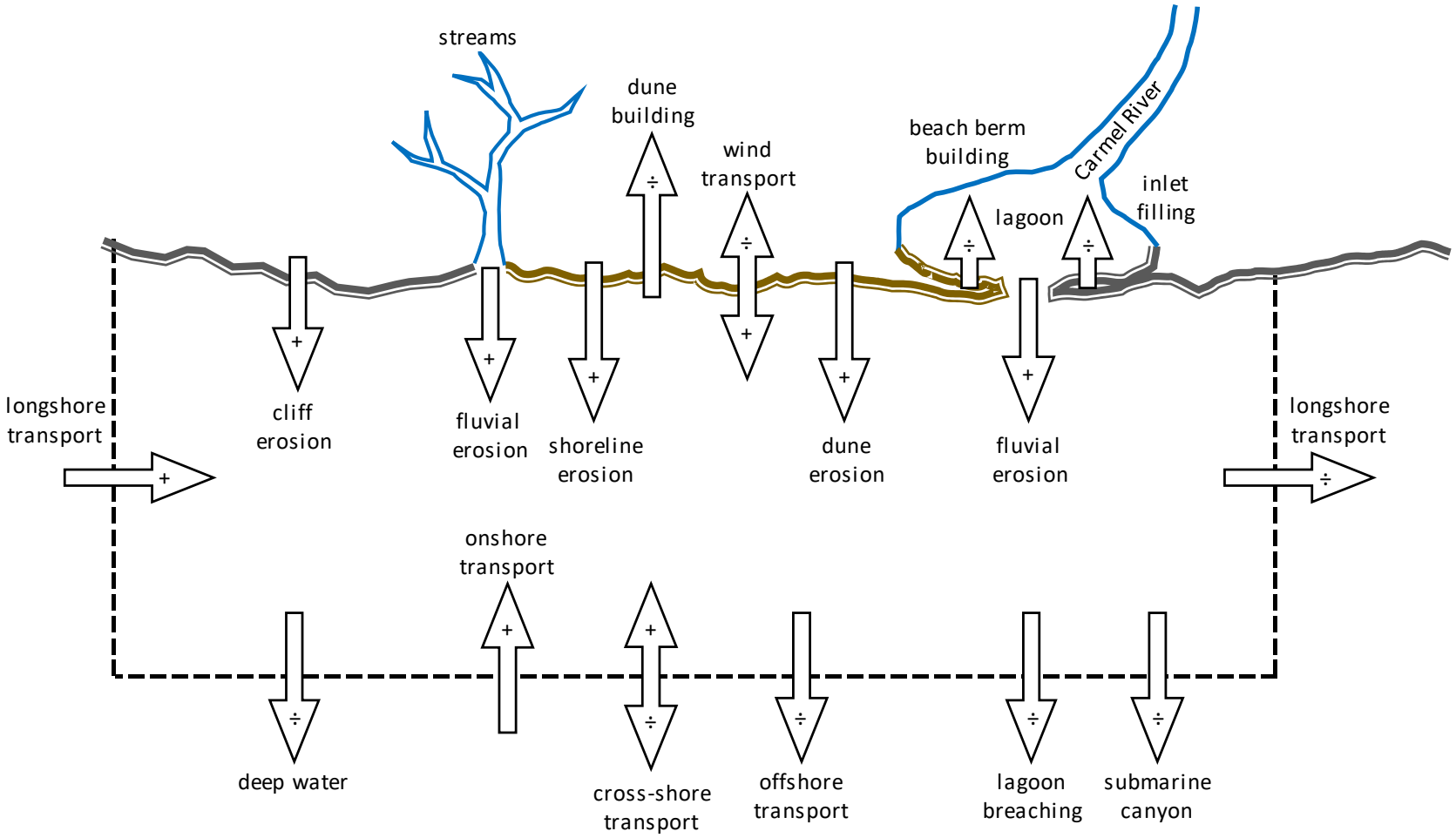


Figure 8-5: Littoral cell sediment sources and losses.

8.12. Sediment Input to Littoral Cell

The primary sources of sediment input to the cell include:

Cliff Erosion. Sediment created from erosion and weathering of the cliff formations along the coast and on the seabed. The erosive mechanisms include physical breakdown due to wave action, chemical breakdown, and due to biological processes. Refer to IMS (2007).

Fluvial sources. Sediment created from fluvial erosion conveyed to the littoral cell via gullies, streams, and rivers including Pescadero Creek, the Carmel River, and San Jose Creek.

Shoreline erosion. Sediment resulting from shoreline erosion is considered input to the littoral cell.

The Carmel River and lagoon comprises a separate system of sediment exchange within the littoral cell and a major source of sediment to the system. Sediment carried down the Carmel River provides input of sediment to the system. This source of sediment stems from fluvial erosion along the streambank and upland terrain within the drainage area of the river. The sediment load can vary significantly from year to year depending on several factors. Drought can reduce sediment output from the river, and upper portions of the watershed have historically been dammed off by the Los Padres Dam (1949). The San Clemente Dam (1921), and the Old Carmel River Dam (1880s). The latter two were removed around 2016 as part of the San Clemente Dam Removal Project. Increased sediment output from the Carmel River have been known to occur during wet years and following wildfires within the watershed.

8.13. Sediment Fluctuations

Wind transport of sand on the beach can contribute to sediment input to the littoral cell as well as loss of sediment from the cell. When wind-blown sand transport contributes to formation of dunes it is considered a loss from the system. When dunes are eroded due to wind or e.g. wave action it is considered an input to the system. Because the dune fields along Carmel Beach are relatively stable and not significantly expanding or eroding, the sediment exchange with the dune system can be considered a form of temporary storage of sediment within the littoral cell.

The Carmel River Lagoon also functions as a form of temporary storage of sediment within the littoral cell. During lagoon formation, seepage provides an input of sediment to the littoral cell. During breaching of the lagoon, sediment is also released into the system. Sandbar buildup resulting from wave action constitutes a loss of sediment from the system, but because these processes fluctuate, the overall sediment exchange with the Carmel Lagoon can be considered as temporary storage of sediment.

Cross-shore transport is another mechanism that fluctuates significantly seasonally and depending on the incident wave climate. Winter storm events often produce wave conditions that draw sediment out from the beach areas into deeper water. This movement of sediment can be considered as a temporary loss from the system. Swell waves tend to build up the beach profile. This onshore transport can be considered input of sediment to the system. Because these processes of sediment exchange

are dynamic and fluctuate seasonally, they can be considered as temporary storage or removal of sediment from the littoral cell.

8.14. Sediment Losses from Littoral Cell

Loss of sediment from the littoral cell is indicated by arrows pointing out from the cell shown in Figure 8-5.

One form of loss from the littoral cell includes sediment lost to deeper water. This process occurs when large winter storms draw sediment out from the beach areas into deeper water. Sediment that settles in water depths at the depth of closure may rarely if ever become re-mobilized and can be considered lost from the system. Another effect that contributes to this form of sediment loss is downslope sediment migration, which simply means that when sediment is mobilized, gravity will tend to move the sediment downhill. This effect is noticeable in areas offshore Pebble Beach, Stillwater Cover, Arrowhead Point, and Carmel Point. Refer to the areas outlined in purple in Figure 8-1 seaward of the closure depth contour (white contour line). The smooth appearance of these areas indicates a sandy substrate, as opposed to the irregular features on the seabed seen elsewhere, which are indicative of rocky substrate and/or outcrops of bedrock.

Breaching of the lagoon is another mechanism that can transport sand offshore into deep water past the depth of closure and/or into the submarine canyon. However, this effect is likely limited to the fraction of fine sediment. The sediment on the beach is coarse and probably does not leave the system with each breach.

The ultimate sink in the littoral cell system is the Carmel submarine canyon. Once sediment enters the canyon it will not return to the littoral cell.

Table 8-2 provides a sediment budget for the Carmel littoral cell. For simplicity, the analysis primarily captures major sediment contributions in the form of input from cliff and shoreline recession and streams. Losses account for sediment lost to deep water and lost to the submarine canyon. Temporary storage of sediment and seasonal sediment fluctuations are assumed to be quasi-steady and are not reflected in the breakdown. A cumulative total of sediment input and output is computed for shoreline reaches starting at Cypress Point, moving south along the shoreline to Point Lobos where the littoral cell ends.

Table 8-2: Carmel littoral cell sediment budget.

Area	Extent (yards)	Recession Rate (ft/yr)	Sediment Sources			Sediment Losses		Total
			Cliff Erosion (CY/yr)	Shoreline Recession (CY/yr)	Fluvial/ Streams (CY/yr)	Deep Water (CY/yr)	Carmel Canyon (CY/yr)	Cumulative Total (CY/yr)
Cypress Pt. to Pescadero Pt.	5,000	0.3	9,194					9,194
Pebble Beach	1,000	0.3	1,275					4,669
Stillwater Cove	1,000	0.3	1,755		3 a)	-17,400		627
Arrowhead Point	1,000	1.0	5,499					326
Carmel Beach	2,100	0.7		8,926	14 b)			9,265
Carmel Point	1,200	0.7	3,496			-12,000		761
Carmel River State Beach	1,000	1.0		7,379	31,851 c)		-14,000	25,991
Ribera Beach	800	0.3	1,540				-27,000	531
Monastery Beach	700	2.1		11,012	226 d)		-11,000	769
Granite Point	1,000	0.5	1,835			-1,800		804
Whaler's Cove	1,000	0.3	1,180			-1,200		785
Whaler's Cove to Point Lobos	2,500	0.3	4,519			-4,500		804
Total	**18,300**	**0.5 avg.**	**+30,293**	**+27,317**	**+32,094**	**-36,900**	**-52,000**	**+804**

a) Unnamed ravine/stream into Stillwater Cove.
b) Pescadero Creek.
c) Carmel River, based on simulations by Balance Hydrologics, BH (2021).
d) San Jose Creek, Balance Hydrologics, BH (2014b).

In Table 8-2 cliff and shoreline recession rates were estimated based on USGS (2020). The sediment load for the larger streams, the Carmel River and San Jose Creek were estimated based on past studies, BH (2014b). The sediment load for Pescadero Creek and smaller unnamed streams were scaled based on the size of their respective watersheds.

Sediment losses to deep water and to the submarine canyon were estimated based on NOAA seabed survey data from 1933 to 2008, NOAA (2020b).

9. Beach Morphology

Figure 9-1 provides an overview of lagoon states (natural and managed) over the period from 1991 to 2021, compiled based on data from the County of Monterey (2021), BH (2014a), and MPWMD (2005). The horizontal yellow bars indicate periods of lagoon closure, i.e. with no outlet to the ocean. This period can start as early as April and May, but typically occurs over the summer months from July through November, at times extending into December and January. Dashed yellow lines indicate years when the start date of lagoon closure is not known. The duration of lagoon closure was in these cases estimated based on historical aerial imagery. The blue squares indicate dates of County sandbar management to reduce flood risk. This management action is initiated when the lagoon water level is high or projected to reach flood stage and typically takes place in from November through January. The current sandbar management practice involves excavation of a pilot channel across the sandbar which enables the lagoon to breach if the water level rises to the point where it can become a potential flood hazard. The dark green squares indicate times when natural lagoon breaching has been observed, from (2014a). The squares in light green indicate dates of additional observations by Greg W. James reported in MPWMD (2005). It should be noted that there is not an active program to monitor and log natural breaching of the lagoon. The observations by Greg James, MPWMD (2005) give an idea about date range and frequency of natural breach events. Natural breach events have not been consistently logged since 2005.

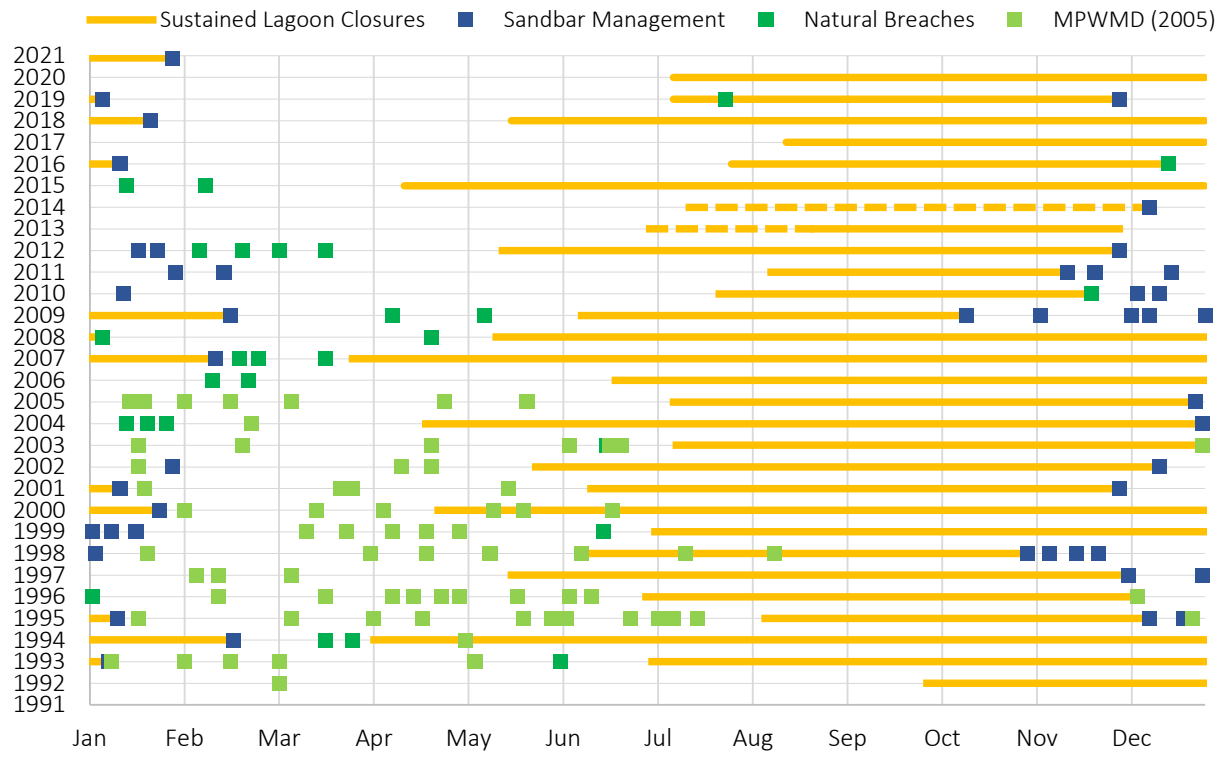


Figure 9-1: Overview of lagoon closures and breaches (1991-2021).

For the period from 2005 to 2021 there has likely been natural breach events with the same frequency as observed by Greg James in the years prior to 2005.

Figure 9-1 also shows how sandbar management has changed over time. It can be seen that the timing of County sandbar management has transitioned from October to February in earlier years to late November to January in recent years. The frequency of sandbar management (dark blue squares) has also decreased. Note several management actions in the years prior to 2012 and typically one action each water year thereafter. For example, the high lagoon water level in Oct/Nov of 1998 likely coincided with a period where the sandbar was in a mode of building up. The close spacing of breach events indicates that the lagoon breach closed off soon after each breach was made. With the practice of excavating a pilot channel, the County has been able to shift sandbar management actions to December and into January, which is the period when natural breach events typically commence each year after the period of sustained lagoon closure. Note e.g. no sandbar management in December 2016 where breaching occurred naturally.

9.1. Wave Statistics and Lagoon Morphology

Wave statistics are summarized in the following and compared to the interannual morphology of the Carmel Lagoon. The wave statistics are grouped into:

1) North Pacific swell, persistent with seasonal variation, occurring 88% of the time on an annual basis.

2) Southern swell, seasonal and episodic, occurring 12% of the time on an annual basis.

3) Northwest wind-waves, persistent and episodic, occurring 70% of the time annually. Sea breeze occurring daily. Peak wind events exceeding 30 knots cumulatively occur 0.19% (16 hours/year).

4) Southwest wind-waves, infrequent and episodic occurring (16%) of the time annually with peak wind events exceeding 30 knots cumulatively occurring 0.21% of the time (18 hours per year).

For comparison, the following data is provided in the figures per the legend below:



Figure 9-2 shows the variation of North Pacific swell relative to the interannual stages of lagoon morphology and additional metrics such as the Carmel River discharge which is indicated by the black curve and the scale on the right. The percent occurrence of North Pacific swell is indicated on the vertical scale on the left and by month along the horizontal axis. The data shows that the occurrence of North Pacific swell can vary considerably between years – as low as 2% in the summer months of

some years, and as high as 9% in January, March, and December in other years. It should be noted that the percent occurrence in a given year depends on the number of storms occurring over the North Pacific, which can vary from year to year. The average across all years (from 1991 through 2019) is indicated by the dark blue line.

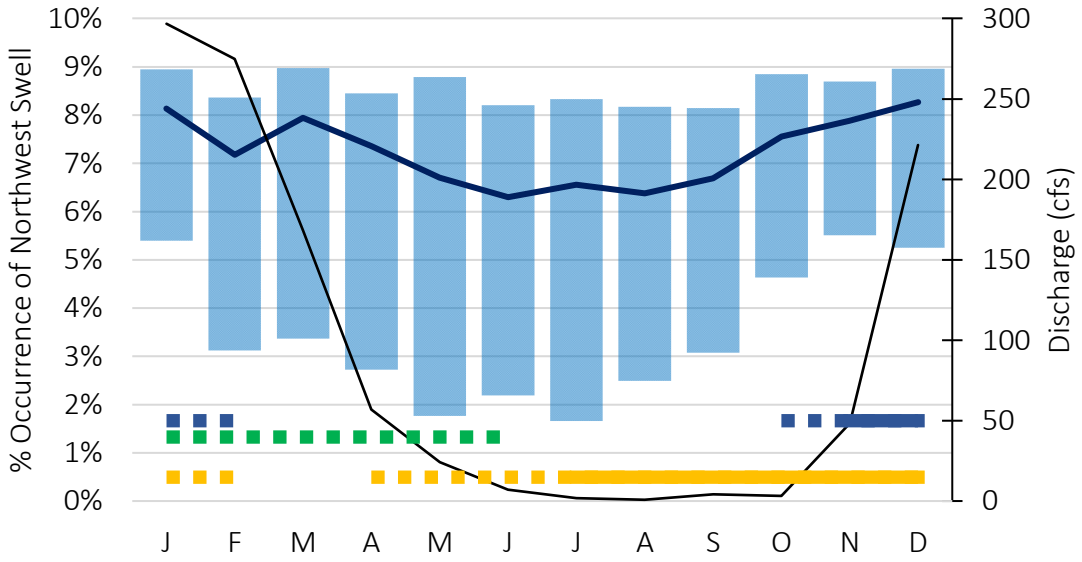


Figure 9-2: Patterns and occurrence of North Pacific swell.

The data shows that North Pacific swell occurs persistently but with lower frequency over the summer months, increasing in the winter months. The primary noticeable trend is perhaps that there is a lull in the percentage occurrence of swell over the period when the lagoon is closed, with an uptick in the months of November, December and January where most of the initial lagoon breaching takes place. It is therefore likely that swell waves plays a role in closing lagoon breaches, which is known to happen when the Carmel River discharge decreases to around 10 cfs or less.

Figure 9-3 shows the interannual and seasonal variation of southern swell. It can be seen that swell from southerly directions can occur in any month of the year. The data also shows that there are years when no southern swell occurs in January through May, and in October through December, i.e. the lower bound of percent occurrence is zero or very small. The data shows a general trend of southern swell activity increasing over the summer months, which could indicate that southerly swell waves contribute to natural closing of the lagoon seasonally, i.e. southern swell frequency increases over the time when natural breaches cease to occur (green dots) and lagoon closure commences (yellow dots). Note that permanent closure of the lagoon has been found to occur when the outflow decreases to around 10 cfs or less. Per the black line in the figure, this typically happens around June to July on average.

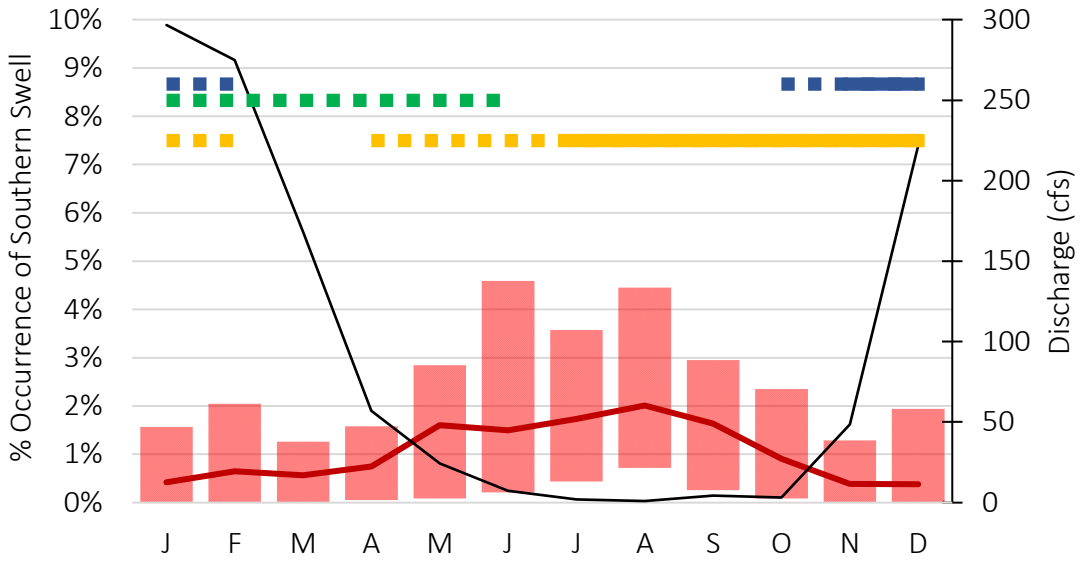


Figure 9-3: Patterns and occurrence of Southern swell.

Figure 9-4 shows the percent occurrence of northwest wind-waves interannually and seasonally. The average trend (dark blue line) shows a general increase in wind over the summer months, tapering off slightly over the winter months. October, as the only month, will have some years with very slight onshore wind (percentage lower bound is nearly zero).

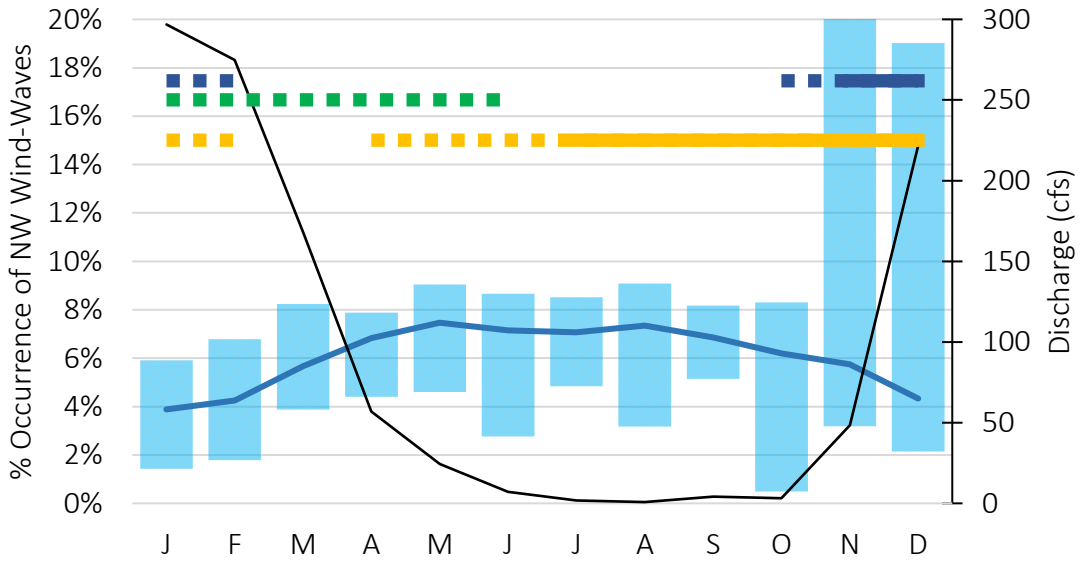


Figure 9-4: Patterns and occurrence of northwest wind-waves.

The most pronounced trend in the data is the substantial increase in wind events in the months of November and December. This trend coincides with the most frequent months of mechanical lagoon

breaching, which also occur in November and December. Another apparent driver is the increase in outflow from the Carmel River, typically peaking in December through February. The increase in discharge from the Carmel River, which can cause the lagoon to rise rapidly has the most direct relation to when mechanical breaching of the lagoon takes place. The magnitude and direction of sediment transport is dependent on the wave height and wave angle of incidence relative to the shoreline. Wind-waves have the potential to oblique angles of wave incidence dependent on the wind direction. The occurrence of northwest wind-wave events has the potential to significantly impact the morphology of the lagoon as these events can produce the following effects:

1) Strong southward sand transport, which can erode the beach and remove large quantities of sand from the sandbar in a short amount of time.

2) Northward sand movement along the northern end of the beach, which may promote lagoon migration to the north.

3) Southward sand transport along the central and southern part of the beach, which may promote lagoon migration to the south.

Figure 9-5 summarizes the interannual variation and seasonal variation of southwest wind-waves. The data shows a pretty consistent level of wind-wave events occurring over the months of January to December with a pronounced uptick in the frequency of wind events in December. All months of the year can have periods with little to no southerly wind, i.e. percentage lower bound is very small or zero (August is the only month which has had no southerly wind-wave events).

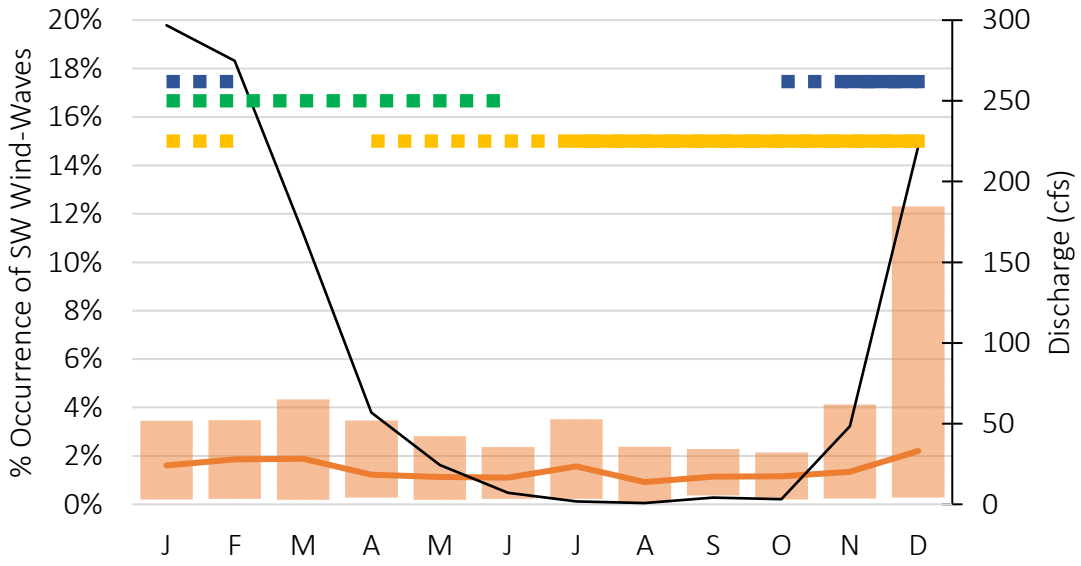


Figure 9-5: Patterns and occurrence of southwest wind-waves.

The increase in the frequency of wind-wave events does correlate with the common period of mechanical lagoon breaching in November and December, and shows that lagoon morphology can

be impacted by these events during these times. The potential impact of southwest wind-wave events on lagoon morphology is:

1) Pronounced northward sand transport along the beach, which may drive lagoon migration to the north.

The conclusions from Figure 9-2 to Figure 9-5 are:

- Swell waves place sand on the beach with the wave runup and promote closures of lagoon breach channels when the Carmel River discharge diminishes to 10 cfs or less.
- North Pacific Swell can decrease over the summer months but also remain fairly persistent, while Southern swell increases over the summer months. These, in combination with Carmel River discharge decreasing to 10 cfs or less results in seasonal closure of the lagoon in June to July in average years.
- While swell waves play a key role in closing off the lagoon breaches, it is the discharge of the Carmel River that keeps the breach open. Closure of breach channels has been observed to occur primarily when the river discharge decreases to 10 cfs or less.
- The windiest months (November and December) coincides with the time when initial breaching of the lagoon often occurs. The enhanced transport associated with the wind driven waves means that a higher degree or breach channel migration should be expected in this period.

10. Lagoon and Beach Morphology

Figure 10-1 provides an overview of the processes that shape the CRSB sandbar and lagoon planform. Incident wave crests and wave troughs are indicated by the light blue solid/dashed lines. The crenulate shape of the bay and seabed contours cause incident waves to refract and diffract. Refraction causes incident waves to turn so the direction of wave propagation is approximately perpendicular to the seabed contours. Diffraction is spreading of wave energy and occurs in the lee of the headland (Carmel Point) at the north end of the beach.

Refraction causes the incident waves to converge on the headland at Carmel Point and the rock outcrop located at the south end of CRSB at the transition to Ribera Beach (black arrows in figure). Diffraction occurs primarily in the lee of the headland at Carmel Point. Because of the dispersal of wave energy in this area, the northern portion of CRSB is an area of low wave energy compared to the beach to the south, which is an area of relatively high wave energy.

Summer swell waves tend to build up the beach, while winter storm waves pull sand off the beach into deeper water. The typical summer beach extent is indicated by the solid red line, while the narrower winter beach planform is indicated by the dashed red line. Because of the wave diffraction effects at the north end of the beach and the low wave energy versus high wave energy zones, there is less variation of the beach width at the northern (on the order of 80 feet) end and more variation at the center and south end of the beach (on the order of 140 feet) between the summer and winter planforms.

The general Carmel River and lagoon planform is indicated by the solid blue line. Example paths showing migration of lagoon breaches are indicated by the dashed blue lines. The breaches can migrate south if the wave-driven littoral transport is southward (yellow arrows); and can migrate north if the direction of littoral transport is to the north. Migration of lagoon breaches occur when there is a significant outflow from the lagoon (which keeps the breach channel open), while the littoral transport tries to close the beach. If the outflow from the lagoon weakens, the littoral transport can close off the breach. Closure of a breach can occur due to littoral transport (along the shoreline in the plan view), and also due to vertical buildup of sand deposited with wave runup.

Northward lagoon migration has historically reached the northern end of the beach where it terminates at the rock outcrop at Carmel Point. Southward migration is limited by the rock outcrops at the south end of the beach. If the beach level is high, these outcrops are typically buried under the sand but appear when the beach level lowers.

The driver behind the lagoon water level rise each season is inflow from the river. This causes the planar extent of the lagoon to widen out over the sandbar as the water level rises.

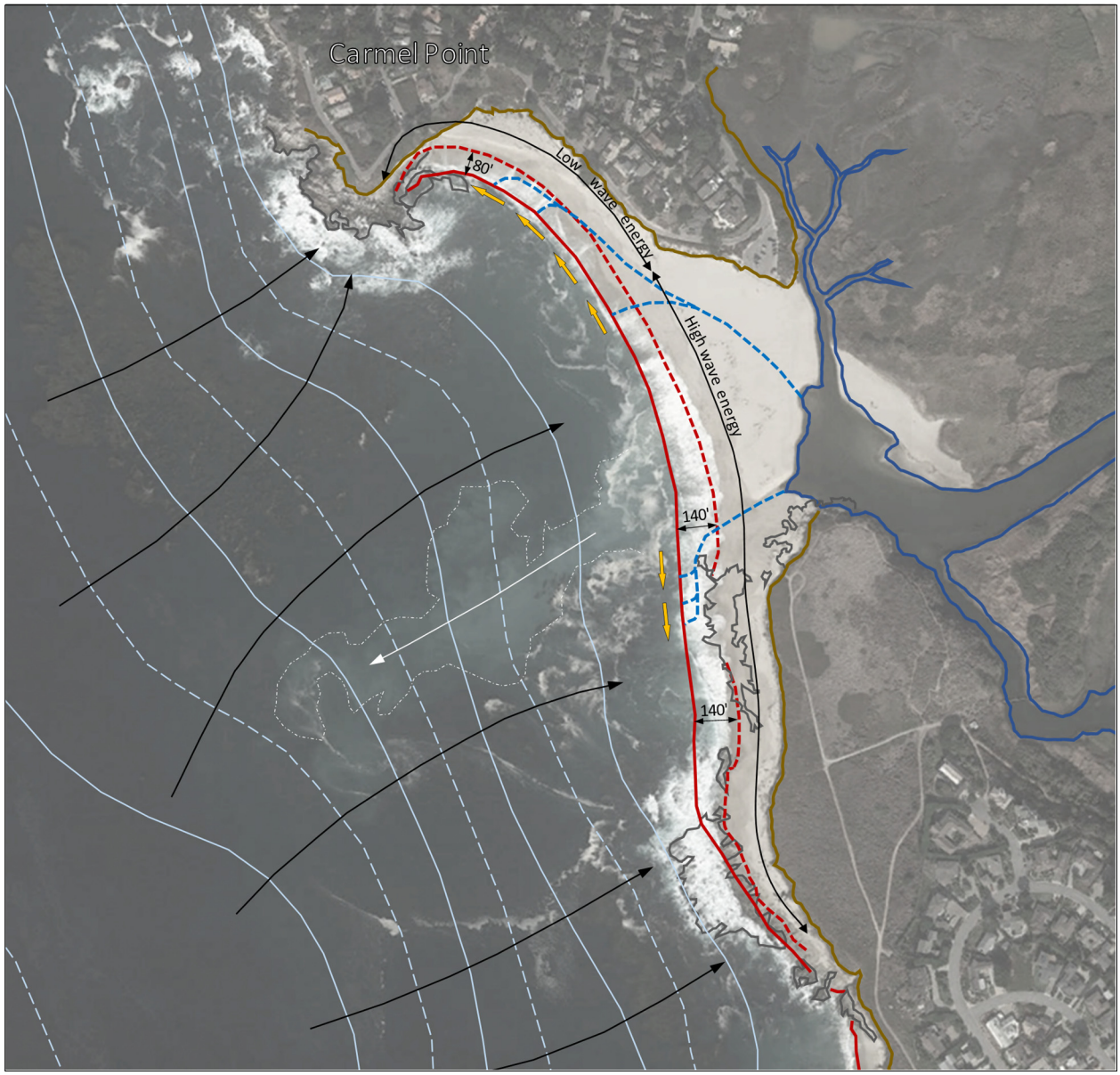


Figure 10-1: Overview of CRSB seasonal variation and lagoon morphology.

The plume outlined in white in Figure 10-1 indicates a rip current, which forms as a result of wave breaking in the surf zone. The rip current is directed offshore (white arrow) and can transport sand from the shore to deeper water.

10.1. Beach Profile Variation

Erosion and accretion along the shoreline causes the sandbar to narrow and widen, respectively. As demonstrated earlier, there is a seasonal trend to this as well as irregular, episodic events.

Cross-shore transport of sediment can manifest in a number of ways as described in the following.

Figure 10-2 shows an example of shoreline recession due to erosion. The dashed and numbered lines indicate a progression over time. Erosion usually affects the entire height of the beach profile. When the profile is subject to erosion there is a volumetric loss of sand, while wave runup and rundown has the effect of smoothening the profile. If the wave runup elevation does not reach the crest of the sandbar, a near vertical scarp often develops (4) in Figure 10-2.

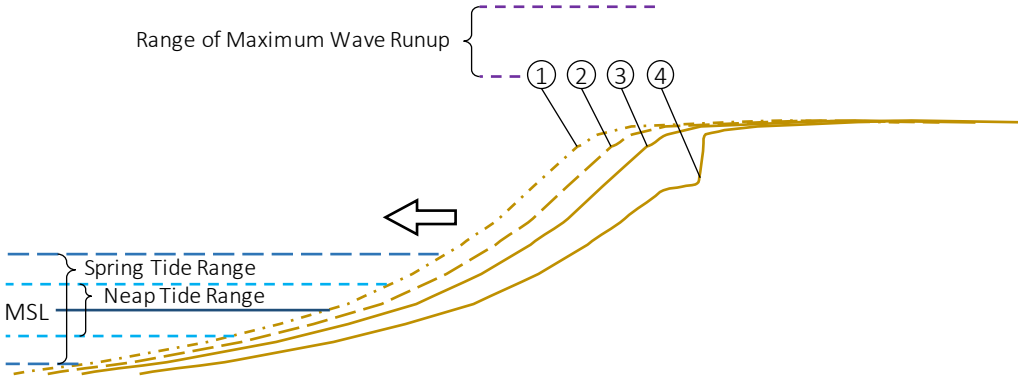


Figure 10-2: Beach erosion. Figure adapted from Weir (2006).

Figure 10-3 shows an example of vertical growth of the sandbar. In this case, the plan location of the shoreline is at an equilibrium, while sand deposited with wave runup produces vertical growth of the sandbar. Variations in the incident wave conditions can cause the beach face to flatten or steepen slightly as indicated in the figure. This mode of sandbar development usually also follows after lagoon breaching where the sandbar is eroded locally at the breach. In this case, both longshore sediment transport and cross-shore transport can work to close the breach, but it is primarily the vertical growth mode shown in Figure 10-3 that restores the sandbar to a new equilibrium elevation. In terms of the vertical buildup of the sandbar, both wave runup and tide levels can play a role. The historically highest sandbar elevations recoded at CRSB have been a result of sand deposited during significant wave runup events in combination with high tides.

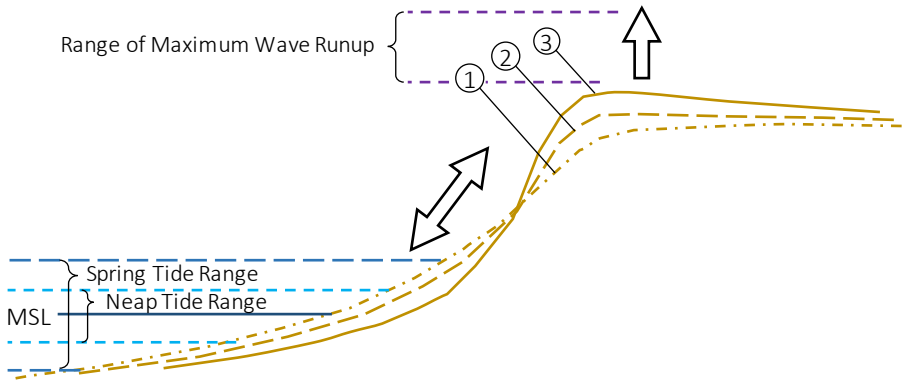


Figure 10-3: Sandbar vertical buildup. Figure adapted from Weir (2006).

Figure 10-4 shows a mode of horizontal sandbar growth. This can occur when wave runup does not overtop the sandbar and material transported by wave runup is instead deposited on the beach face resulting in seaward migration/widening of the sandbar. This mode of sandbar evolution can occur: 1) after the sandbar crest elevation has built up high; 2) during periods of milder wave climate with less wave runup; and 3) during neap tide cycles where the water level does not contribute much to the total wave runup elevation. During periods of neap tides the tide range is lower, as opposed to spring tides which exhibit the larger tide range (Figure 10-5).

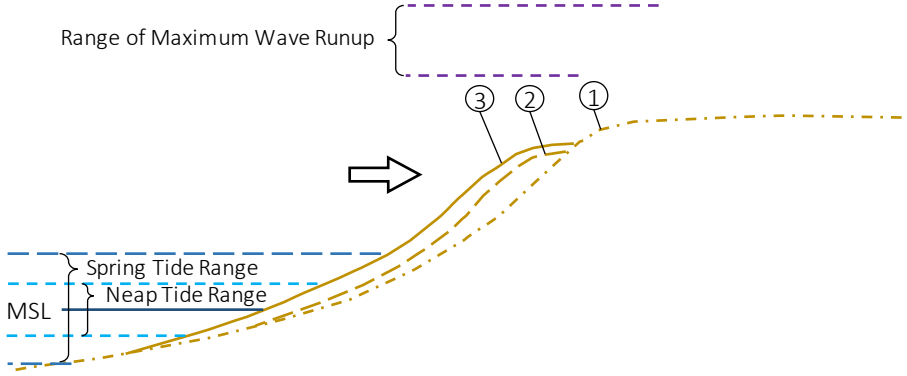


Figure 10-4: Sandbar widening. Figure adapted from Weir (2006).

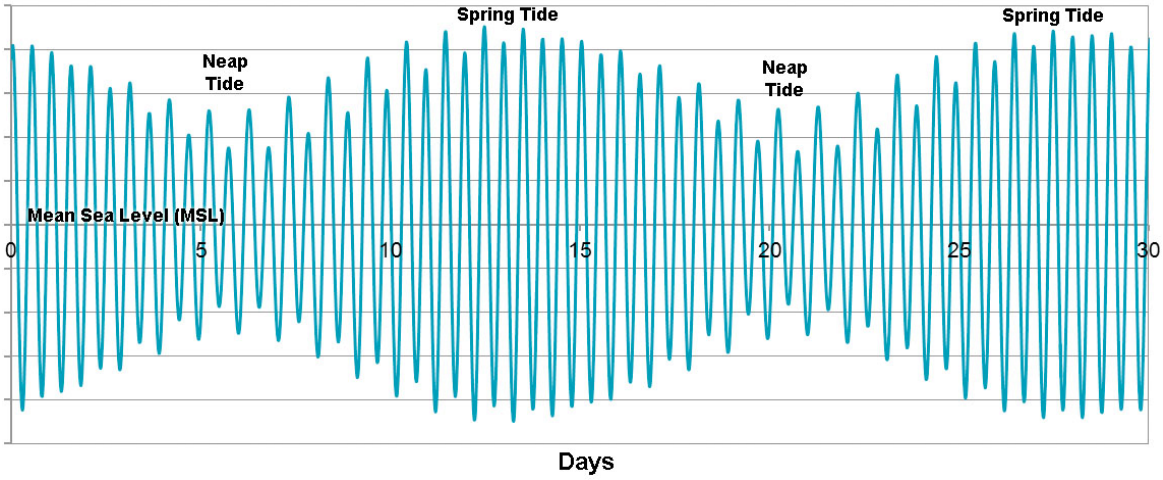


Figure 10-5: Monthly tide cycle of neap and spring tides.

Figure 10-6 shows an example of combined horizontal and vertical buildup of the sandbar, which occurs when incident waves are in a mode of accretion and able to overtop the sandbar.

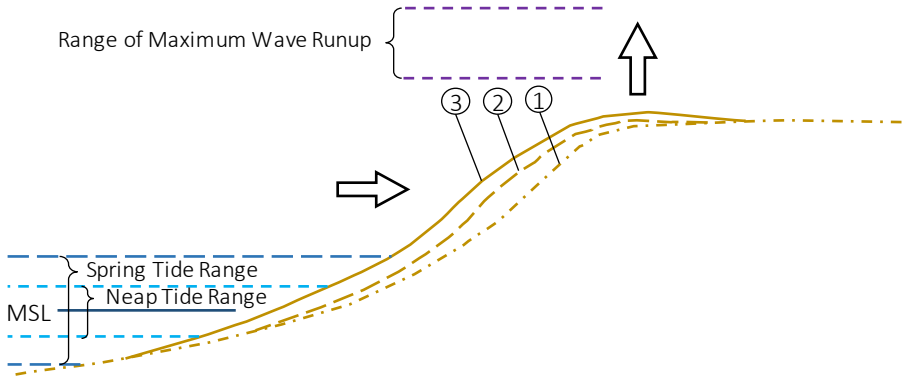


Figure 10-6: Sandbar horizontal and vertical growth. Figure adapted from Weir (2006).

10.2. Lagoon Breaching

Figure 10-7 shows mechanisms that can lead to breaching of the lagoon. From the ocean side, wave runup can erode the beach and wave overwash erode the sandbar to a point where the lagoon breaches. This mode of lagoon breaching is not common at CRSB, however, where wave runup tends to deposit sand and build up the sandbar. There have been a few cases where wave overtopping has filled up the lagoon without breaching it.

The most common mode of lagoon breaching is from the lagoon side when the lagoon water level rises to a point where it overtops the sandbar, or when the hydraulic head (active pressure) overcomes the weight of the sandbar (passive pressure).

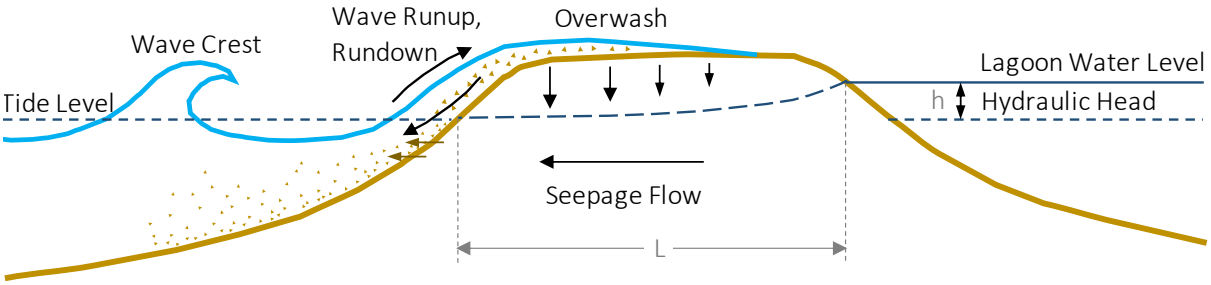


Figure 10-7: Parameters governing lagoon breaching. Figure adapted from Kraus (2008).

Close to the point of the lagoon breaching there is a significant seepage flow through the sandbar. The seepage can produce a couple of different effects that can affect when breaching occurs. One effect is removal of finer grained material over time where fines are winnowed out with the seepage flow. This mechanism is called suffusion. This process means that the porosity of the sandbar material can increase slightly over time (fines are removed), which theoretically reduces the resisting force of the sandbar, i.e. interstitial void space occupied by sand grains (with higher density) transitions to water-filled voids. However, washout of the fines also increases the permeability of the sand berm material so it can accommodate a higher hydraulic head before failing. A second effect of the seepage flow is that the pore pressure causes grains to separate at the beach face where the seepage flow enters the surf. This aids wave action in removal of sediment. The wave runup and rundown can have a filtering effect where smaller diameter material is removed and larger diameter material retained and deposited atop the sandbar (Figure 10-7). The net effect over time can be that the sandbar material transitions to larger diameter material.

Kraus (2008) describes the parameters governing breaching from the lagoon side, which occurs when the hydraulic head on the lagoon side is large enough to mobilize the weight of the sandbar damming up the breach channel. Kraus equates this balance as:

$$F_W \geq \kappa F_B$$

Where F_W is the hydrostatic force exerted by the water in the lagoon on the sandbar, given by:

$$F_w = \frac{1}{2}\rho g h \times hW$$

And the resisting force, F_B, being the weight of the sand on the sandbar given as:

$$F_B = (\rho_s - \rho)(1 - p)g \times hWL$$

In these equations, ρ is the density of water, ρ_s is the density of the sand, p is the porosity (about 0.4), and g is the gravitational acceleration. The hydraulic head, h, and the width of the sandbar, L, are as defined in Figure 10-7. The term hW is the hydraulic head h acting over the width of the lagoon breach channel, W. This term cancels out when equating F_W and F_B, which leads to the simplified expression for lagoon breaching when:

$$\frac{h}{L} \geq 2\kappa$$

The remaining factor, κ, is a site specific coefficient. For the Carmel Lagoon, Kraus (2008) estimated h/L on the order of 4 to 10%, i.e. κ = 2 to 5%. The κ accounts for uncertainties in the simplified breach criterion, which can include: 1) variation in hydraulic head due to tidal variation; 2) breaching promoted by seepage flow; 3) change in porosity; 4) change in grain size; 5) density difference between lagoon (fresh to brackish) and ocean water (saline); and 5) variation in the density of the sandbar material.

Lagoon breaching occurs when the hydraulic head exceeds the weight of the sandbar as described above, or if the lagoon water levels overtops the sandbar, which creates a channel that erodes the sandbar, providing for a further increase in erosion and flow until equilibrium is re-established.

11. Climate Change

Climate change can produce several potential impacts on the Carmel Lagoon. Climate change is predicted to produce a higher degree of irregularity in weather patterns with wider extremes. In recent years, California has experienced some of the driest years on record, and some of the wettest years as well. The increase in number and extent of wildfires in California can also have a potential impact on the lagoon system. Soil washing down from scorched areas within the watershed can cause a dramatic increase in the sediment load of the river.

In the following section, it is explored if sea-level rise can impact the lagoon system.

11.1. Sea-Level Rise

Table 11-1 summarizes select water level datums from Table 3-2 with adjustment for sea-level rise based on Table 3-4. The sea-level rise projection adopted for the analysis is the 1-in-200 chance projection with high emissions. This projection reflects a conservative outlook for climate change with limited efforts to curb emissions worldwide. The SWEL in the table is the 1% annual chance (1-year) still water level (without wave action). The BFE is the FEMA 1% annual chance coastal base flood elevation (including wave runup).

Table 11-1: Tidal datums with sea-level rise. Elevations in feet NAVD88.

Tidal Plane	Present	1-in-200 Chance Medium to High Risk Aversion Projection*		
		2030 (0.8' SLR)	2050 (1.9' SLR)	2100 (6.9' SLR)
Coastal BFE	+27.0	+27.8	+28.9	+33.9
Coastal SWEL	+8.2	+9.0	+10.1	+15.1
King Tide	+7.0	+7.8	+8.9	+13.9
MHW	+4.8	+5.6	+6.7	+11.7

* With high emissions.

Based on Table 3-4, the following rates of sea-level rise were determined as summarized in Table 11-2 projected by year, the amount of SLR, and the underlying rate of sea-level rise. The rate is given in feet per year and in inches per year for perspective. The data in Table 11-2 was applied to estimate potential SLR impacts at the CRSB, which is summarized in the three columns to the right in Table 11-2.

Table 11-2: Annual rate of sea-level rise.

Year	1-in-200 Chance SLR (feet)	Rate (feet/year)	Rate (inches/year)	Loss (CY/year) to Canyon	Loss (CY/year) due to SLR	Total Loss (CY/year)
2020	0.1	0.01	0.07	23,100	1,600	24,700
2030	0.8	0.05	0.56	23,100	2,200	25,300
2040	1.2	0.06	0.70	23,100	3,000	26,100
2050	1.9	0.07	0.84	23,200	4,000	27,200
2060	2.6	0.08	0.98	23,300	5,000	28,300
2070	3.4	0.09	1.12	23,400	6,300	29,700
2080	4.4	0.11	1.26	23,700	7,700	31,400
2090	5.5	0.12	1.40	23,900	9,400	33,300
2100	6.9	0.13	1.54	24,500	11,400	35,900

The *Bruun Rule*, devised by P. Bruun in 1962, relates shoreline erosion to sea level rise as shown in Figure 11-1 where R is shoreline recession, S is the amount of sea-level rise, L is the horizontal extent of the shoreline zone where active sediment transport occurs, B is the beach and dune height above mean sea level, and h is the closure depth beyond which significant sediment transport does not occur.

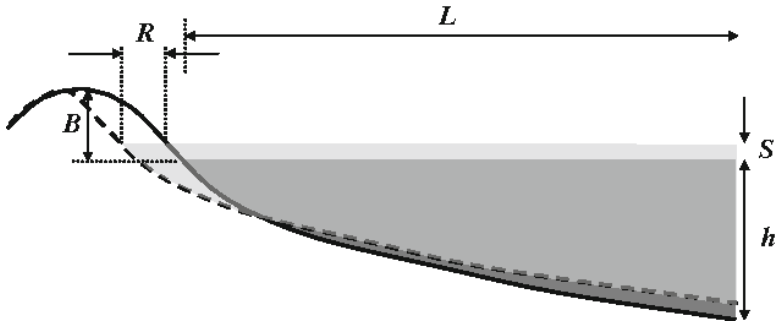


Figure 11-1: Schematic of Bruun Rule.

The Bruun Rule states that the sand deficit (dark gray area) needed to elevate the seabed to compensate for SLR can be balanced by shoreline erosion. The equation therefore predicts that sea-level rise can result in shoreline erosion and shoreline recession (R). However, this is for the case of a beach on the open coast which is different from the setting at Carmel. The CRSB is a crenulate-shaped beach formed due to wave diffraction between the headland (Carmel Point) and rocky downcoast shoreline along Ribera Beach (refer to Figure 10-1). Shoreline recession is therefore limited to the rate of cliff erosion, which is on the order of a few inches per year (refer to Section 5 and Figure 6-2).

The volume of sand needed to compensate for the deficit caused by SLR is instead supplied by the Carmel River. The three columns on the right side of Table 11-2 summarize the estimated annual loss of sediment to the Carmel Canyon, the loss associated with sea-level rise, and the sum of these as

the total annual loss. However, as the sediment supplied by the Carmel River is estimated to be on the order of 61,931 CY annually, the indication is that the CRSB can adapt to future sea-level rise.

Another outcome of the Bruun Rule shown in Figure 11-1 is that the beach elevation will rise in tow with sea-level rise. This occurs because the wave runup elevation increases with the rise in ocean level. The lagoon should therefore be expected to go through a similar transition.

In conclusion, the CRSB appears to be resilient to SLR hazards in the near-term as the Carmel River provides sufficient sediment annually to compensate for the sediment deficit caused by sea-level rise. However, it is also evident that the beach is dependent on the Carmel River sediment supply. So, to the extent that climate change alters the supply, the effect on the beach could be substantial.

12. Conclusions

The analysis has established the following sediment transport effects and drivers that affect the morphology of the CRSB lagoon.

12.1. Carmel Littoral Cell

The Carmel littoral cell is contained between Cypress Point and Point Lobos. The general littoral transport direction is from north to south. The main input of sediment to the system comes from: Breakdown and erosion of the granodiorite rock formations along the coast; The Carmel River provides sand to the Carmel River State Beach; and San Jose Creek similarly provides sand to Monastery Beach. The remaining creeks and streams in the area provide limited input of sand to the shoreline. The pocket beaches and crenulate bay shaped sections of shoreline: Stillwater Cove (SC), Carmel Beach (CB), Carmel River State Beach (CRSB), Monastery Beach (MB), and Whaler's Cove (WC) comprise quasi-stable littoral sub-cells. However, waves during winter storms can be large enough to induce longshore sand transport between these cells in a southward direction. Such storm events are infrequent and highly episodic.

CRSB can therefore be characterized as a quasi-stable littoral cell where the primary input of sand comes from the Carmel River and there is a secondary input of sand from Carmel Beach. Wave patterns at CRSB induce a circular pattern of sediment movement where the longshore transport at the shoreline is often in a northward direction, whereas the sediment transport direction in deeper water is in a southward direction. This circular pattern of sediment movement works to maintain the beach, although sand episodically moves southward past Ribera Beach towards Monastery Beach. The majority of sand volumes transported south are lost from the CRSB sub-cell and do not return. The magnitude of sand retained in the system at CRSB is therefore dependent on the wave climate from year to year, the occurrence of intermittent northwesterly wind-wave events (during which sand is lost from the sub-cell), and sand input from the Carmel River. The latter is the most important, as a decline in sediment output from the Carmel River will lead to depletion of sediment from the system; conversely an increase can aid in restoring the beach.

12.2. Carmel Canyon

The Carmel submarine canyon is a significant element of the Carmel Littoral Cell. Sand transport south along the coast is eventually lost to the submarine canyon in the area of Monastery Beach where the submarine canyon comes close to shore and is within the active portion of shoreline profile. Several mechanisms of sand loss to the submarine canyon have been identified, including: wave- and current-induced downslope migration of sand, submarine slope failures along the edge of the canyon, and rip currents. In the broader area from Pescadero Point down to CRSB large wave events during winter storms are capable of mobilizing sand to greater depths, which causes a loss of sand to the submarine canyon. Specific to CRSB, bursts of outflow from the Carmel River can wash sediment into the submarine canyon as well. The canyon acts as a sink for the littoral cell system, and sediment that enters the canyon is lost from the system.

12.3. Swell Waves

Swell waves approach the coast year-round. Swell waves originating from storm systems over the North Pacific primarily occur during the fall and winter months, while swell waves from storm systems in the Southern Hemisphere tend to occur over the summer months. Swell wave events follow a sequence where the longest waves roll in first followed by progressively shorter waves until the wave trains die out. Each episode of swell can last from hours to several days, depending on the magnitude and duration of the storm system of origin.

The Carmel submarine canyon has a pronounced effect on swell waves as they propagate from offshore waters to the shoreline. The canyon overall acts as a lens which focuses wave action along the cliffs from Cypress Point to Pescadero Point, at Point Lobos, and to a lesser degree focuses waves propagating towards Carmel Beach. Incident waves traveling along the canyon axis tend to disperse at the canyon heads in Carmel Bay, at CRSB, and at Monastery Beach, which produces a milder wave climate in these areas. The wave transformation caused by the canyon is to such a degree that incident swell waves end up having nearly the same angle of incidence at the shoreline irrespective of whether the swell arrives from northwesterly or southwesterly directions offshore. Wave transformation due to the submarine canyon is more significant the longer the wave periods of the incident waves, and therefore primarily affects swell waves.

12.4. Wind-Waves

The Carmel submarine canyon does not transform wind-waves to the same degree as swell waves. This is because the wave periods of wind-waves are significantly shorter than for swell waves. Waves associated with high winds from northwesterly directions can therefore cause intermittent bursts of sediment transport southward along the shoreline. These infrequent events can produce an exchange of sediment between the quasi-stable sub-cells of the system (SC, CB, CRSB, MB, and WC). Episodic wind events from southwesterly directions produce northward sediment transport along the shoreline. However, these events do not replenish sand to the littoral sub-cells, but rather tend to shift sand to the north within each sub-cell.

12.5. Wave Climate Interaction with Lagoon Breaching

Field observations have established that the primary agent in natural lagoon breaching is inflow to the Lagoon from the Carmel River. Swell waves have a key role in closing off lagoon breaches, but only when the discharge from the river decreases to 10 cfs or less. The primary role of swell waves is in building up the sandbar. Both swell waves and wind-waves can promote migration of lagoon breaches north or south depending on the incident wave direction; wind-waves probably more so than swell waves.

The frequency of swell wave and wind-wave action increases in November and December around the time when initial lagoon breaching often takes place. Because the wind/wave climate is episodic, it is not possible to predict if the lagoon breach will migrate north or south, and when an initial breach will

close. Swell waves combined with diminishing outflow from the Carmel River in the summer months result in seasonal closure of the lagoon in June to July in average years.

12.6. Sea-Level Rise

The CRSB and lagoon appear to be resilient to SLR hazards in the near-term as the Carmel River provides sufficient sediment annually to compensate for the sediment deficit caused by sea-level rise. However, it is evident that the beach is dependent on the Carmel River sediment supply. So, to the extent that climate change alters the sediment supply, the effect on the beach could be substantial.

References

AGU (2005). *Reflection and tunneling of ocean waves observed at a submarine canyon.* Authored by: Jim Thomson, WHOI-MIT Joint Program in Oceanography, Woods Hole, Massachusetts, USA and T. H. C. Herbers, Naval Postgraduate School, Monterey, California, USA. Geophysical Research Letters, Vol. 32, L10602, doi:10.1029/2005GL022834, 2005. American Geophysical Union. 0094-8276/05/2005GL022834.

BH (2014a). *The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report.* Prepared for: Monterey County Resource Management Agency. Prepared by: Edward D. Ballman, P.E. and Anne E. Senter. Balance Hydrologics, Inc. January 2014.

BH (2014b). *San Jose Creek Watershed Assessment.* Prepared for: Monterey Peninsula Regional Park District, 60 Garden Court #325, Monterey, Ca 93940. Authored by: Denis Ruttenberg and Barry Hecht, Balance Hydrologics, Inc. and Danny Hagans and Tara Zuroweste, Pacific Watershed Associates. Prepared by: Balance Hydrologics, Inc., 800 Bancroft Way, Suite 101, Berkeley, CA 94710. Final report submittal. March 31, 2014.

BH (2021). *Carmel River Sediment Load Estimates.* Analysis by Balance Hydrologics. Prepared for Monterey County, Denise Duffy & Associates, and Moffatt & Nichol. Prepared by: Balance Hydrologics, 800 Bancroft Way, Suite 101, Berkeley, California 94710. February 2021.

CCRP (2020). *California Coastal Records Project.* An aerial photography survey of the California Coastline. https://www.californiacoastline.org/

CEM (2011). *Coastal Engineering Manual.* Engineer Manual EM 1110-2-1100 Part II, IV). U.S. Army Corps of Engineers, Change 3 (28 Sep 11).

County of Monterey (2021). Carmel River Lagoon Water Years 2011-2021 Breach Information. Carmel River Lagoon Water Year 2011-2017 Breach Info & Timeline. County of Monterey, November 2021.

DD&A (2016) *Carmel Lagoon Ecosystem Protective Barrier, Scenic Road Protection Structure, and Interim Sandbar Management Plan Project.* Draft Environmental Impact Report. SCH#2014071050. Prepared for: County of Monterey. Prepared by: Denise Duffy & Associates, Inc. December 2016.

Dean (1973). *Heuristic models of sand transport in the surf zone.* Conference on Engineering Dynamics in the Surf Zone, Inst. Of Eng., Sydney, N. S. W., Australia.

FEMA (2017). *Flood Insurance Study.* Monterey County, California and Incorporated Areas. FEMA, Federal Emergency Management Agency. Flood Insurance Study Number: 06053CV001B. Version Number: 2.3.2.1. Revised: June 21, 2017.

FEMA (2018). *Flood Insurance Rate Map.* Monterey County, California and Incorporated Areas. City of Carmel-By-The-Sea (Number 060196), Monterey County (Number 050195). Panel: 0316, Suffix: H. National Flood Insurance Program. FEMA, U.S. Department of Homeland Security.

IMS (2007). *Development of Sand Budgets for California's Major Littoral Cells. Eureka, Santa Cruz, Southern Monterey Bay, Santa Barbara, Santa Monica (including Zuma), San Pedro, Laguna, Oceanside, Mission Bay, and Silver Strand Littoral Cells.* Kiki Patsch, Gary Griggs. January 2007. Institute of Marine Sciences, University of California, Santa Cruz. California Department of Boating and Waterways. California Coastal Sediment Management Workgroup.

ISU (2020). *Worldwide Wind Roses - Graphics and Tabular Data.* NOAA, Climate.gov. Iowa Environmental Mesonet, Iowa State University of Science and Technology. Department of Agronomy, 716 Farm House Ln, Ames, IA 50011. https://www.climate.gov/maps-data/dataset/worldwide-wind-roses-graphics-and-tabular-data

Kraus (2008). *Barrier beach breaching from the lagoon side, with reference to Northern California.* By: Nicholas C. Kraus, U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory,3909 Halls Ferry Road, Vicksburg, MS 39180 Nicholas.C.Kraus@usace.army.mil; Kiki Patsch, 2111 Bargamin LoopCrozet, VA 22932, kpatsch77@hotmail.com; and Sophie Munger, ERDC, Coastal and Hydraulics Laboratory, 3909 Halls Ferry Road, Vicksburg, MS 39180, Sophie.Munger@usace.army.mil. Article in Shore and Beach · January 2008.

MCPW (2014). *Carmel River Mouth Sand Bar Elevations.* Monterey County Public Works. Engineering Division, Survey/Minor Design Section. 312 East Alisal Street, Salinas, California 93901.

MG (2000). *Sediment distribution and transport along a rocky, embayed coast: Monterey Peninsula and Carmel Bay, California.* C.D. Storlazzi [a)], M.E. Field [b)]. [a)] UCSC/USGS Coastal Geology and Imaging Laboratory Co-operative, Department of Earth Sciences and Institute of Marine Sciences, A-360 Earth and Marine Sciences Building, University of California, 1156 High Street, Santa Cruz, CA 95064-1077, USA. [b)] UCSC/USGS Coastal Geology and Imaging Laboratory Co-operative, Coastal and Marine Geology Program, United States Geological Survey, A-316 Earth and Marine Sciences Building, University of California, 1156 High Street, Santa Cruz, CA 95064-1077, USA. Marine Geology. International Journal of Marine Geology, Geochemistry and Geophysics. Received 1 March 2000; accepted 28 July 2000.

MPWMD (2005). *Surface Water Dynamics at the Carmel River Lagoon Water Years 1991 through 2005.* Prepared by: Greg. W. James. Monterey Peninsula Water Management District. October 2005.

NDBC (2020). *National Data Buoy Center.* National Oceanic and Atmospheric Administration's Center of Excellence in Marine Technology. National Data Buoy Center, Bldg. 3205, Stennis Space Center, MS 39529.

NGS (2020). *VERTCON. Orthometric Height Conversion.* National Geodetic Survey. Communications and Outreach Branch, NOAA, N/NGS12, National Geodetic Survey, SSMC3 #9340,

1315 East-West Highway, Silver Spring, MD 20910-3282. https://www.ngs.noaa.gov/cgi-bin/VERTCON/vert_con.prl

NM (2020). *Nearmap.* High Resolution aerial imagery. 2019 Nearmap Ltd. / Nearmap US, Inc. https://www.nearmap.com/us/en

NOAA (2020a). *Tides and Currents*. Center for Operational Oceanographic Products and Services (CO-OPS), 1305 East-West Highway, Silver Spring, MD 20910-3281. Phone: (301) 713-2815. https://tidesandcurrents.noaa.gov/

NOAA (2020b). *Bathymetric Data Viewer.* Version: 2.19.0, last updated 5/18/2020, 9:23:13 PM. National Centers for Environmental Information, NOAA National Oceanic and Atmospheric Administration. https://maps.ngdc.noaa.gov/viewers/bathymetry/

NOAA (2020c). *Coastal LiDAR.* NOAA Office for Coastal Management. Data Access Viewer. https://coast.noaa.gov/dataviewer/#/

NPS (1968). *The Sediments in the Head of Carmel Submarine Canyon.* Thesis by: Steven Russell Wallin. United States Naval Postgraduate School. December 1968.

NPS (1972). *Sand Movement along Carmel River State Beach, Carmel, California.* Thesis by: Buford Fredrick Howell. September 1972. Naval Postgraduate School, Monterey, California.

NPS (2019). Morphology Changes to Carmel River State Beach in Relation to Waves and River Discharge. Thesis by: Jillian N. Coughlin, June 2019. Naval Postgraduate School, Monterey, California.

OPC (2018). *State of California Sea-Level Rise Guidance.* California natural resources agency, California Ocean Protection Council, 2018.

SPM (1984). *Shore Protection Manual.* Coastal engineering Research Center, Department of the Army, Waterways Experiment Station, 1984.

UCSB (2020). *Air Photos.* UCSB Library, University of California, Santa Barbara. FrameFinder web map app. https://mil.library.ucsb.edu/ap_indexes/FrameFinder/

USGS (2006). *National Assessment of Shoreline Change Part 3: Historical Shoreline Change and Associated Coastal Land Loss Along Sandy Shorelines of the California Coast.* Cheryl J. Hapke, David Reid, Bruce M. Richmond, Peter Ruggiero and Jeff List. Open-File Report 2006-1219. U.S. Department of the Interior. U.S. Geological Survey.

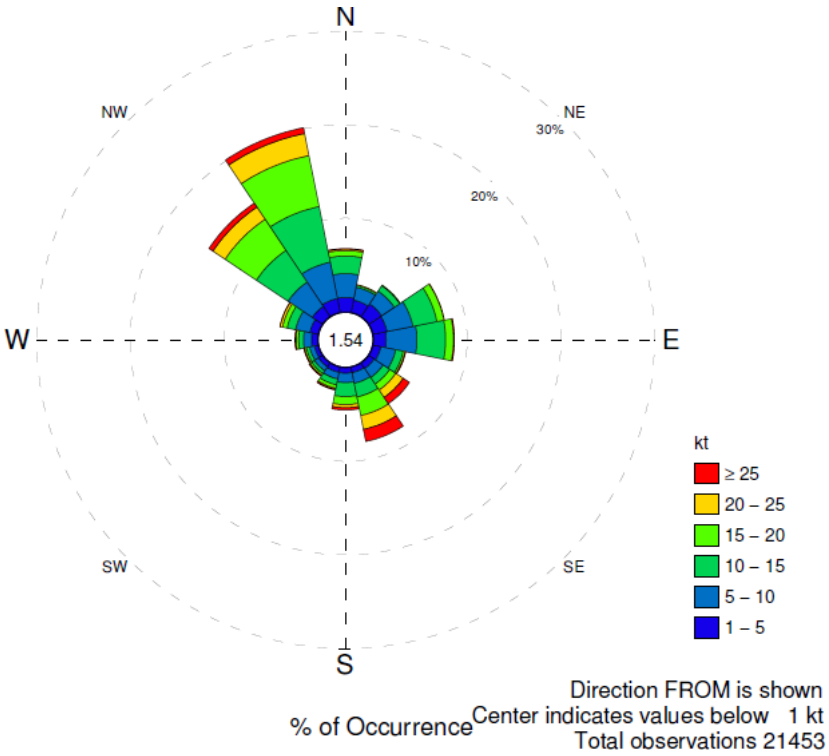
USGS (2020). *Coastal Change Hazards Portal.* https://marine.usgs.gov/coastalchangehazardsportal

Weir (2006). *Beach face and berm morphodynamics fronting a coastal lagoon.* Felicia M. Weir, Michael G. Hughes, Tom E. Baldock. Geomorphology 82 (2006) 331–346. Received 1 December 2005; received in revised form 19 May 2006; accepted 19 May 2006. Available online 20 July 2006.

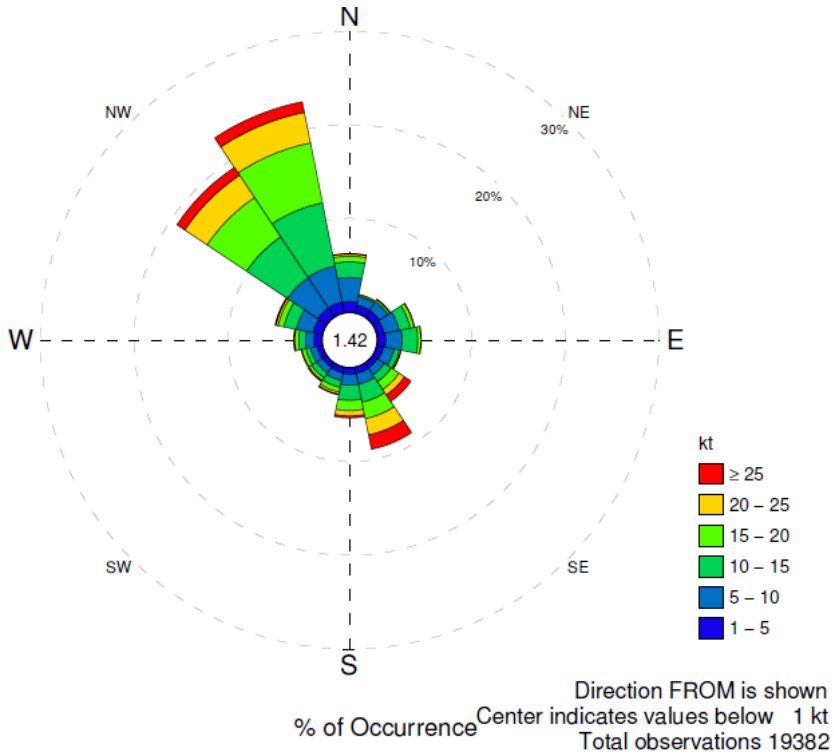
Appendix A:

Wind Roses

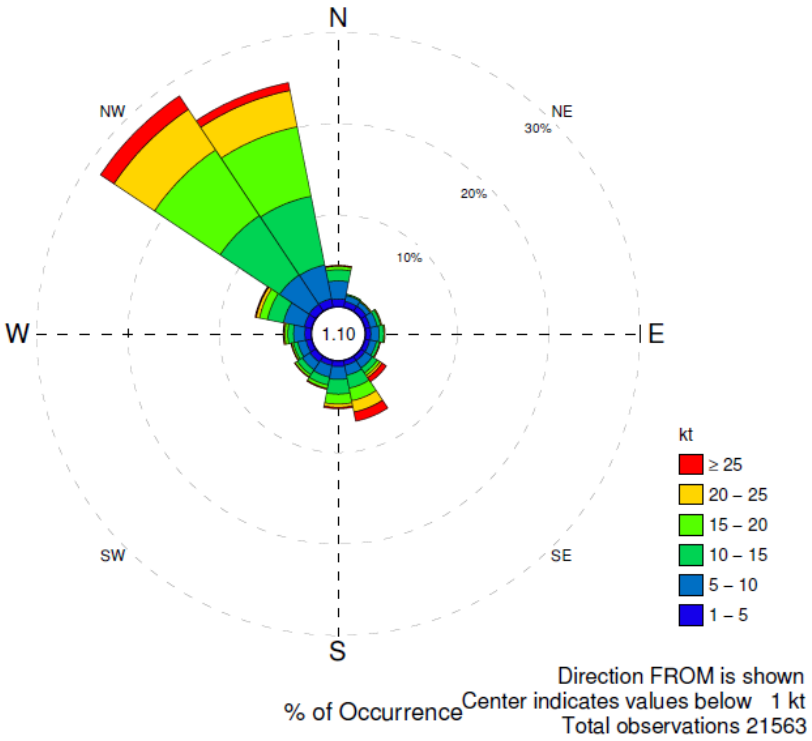
January



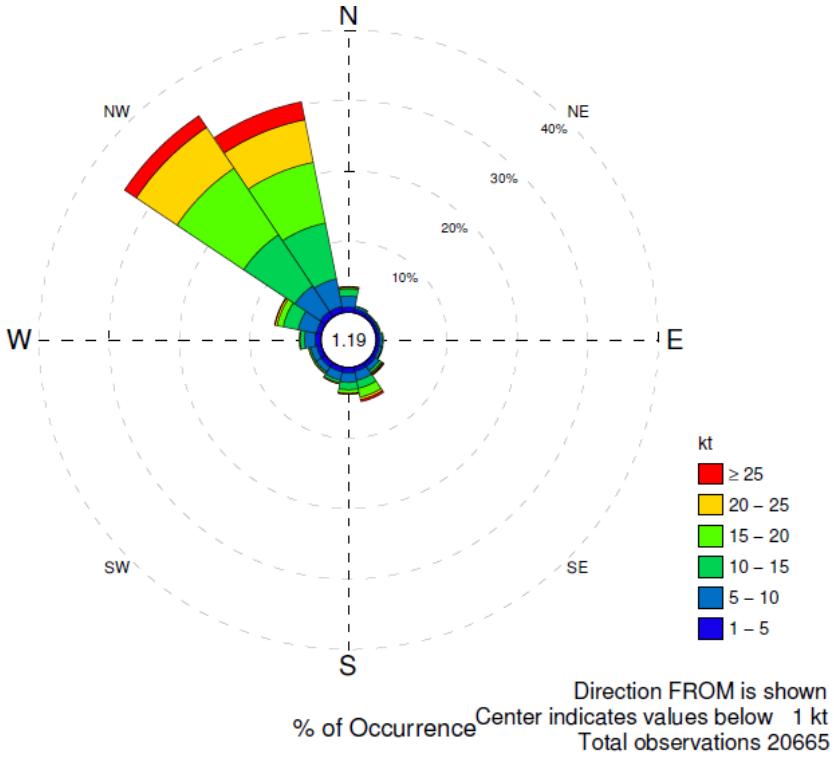
February



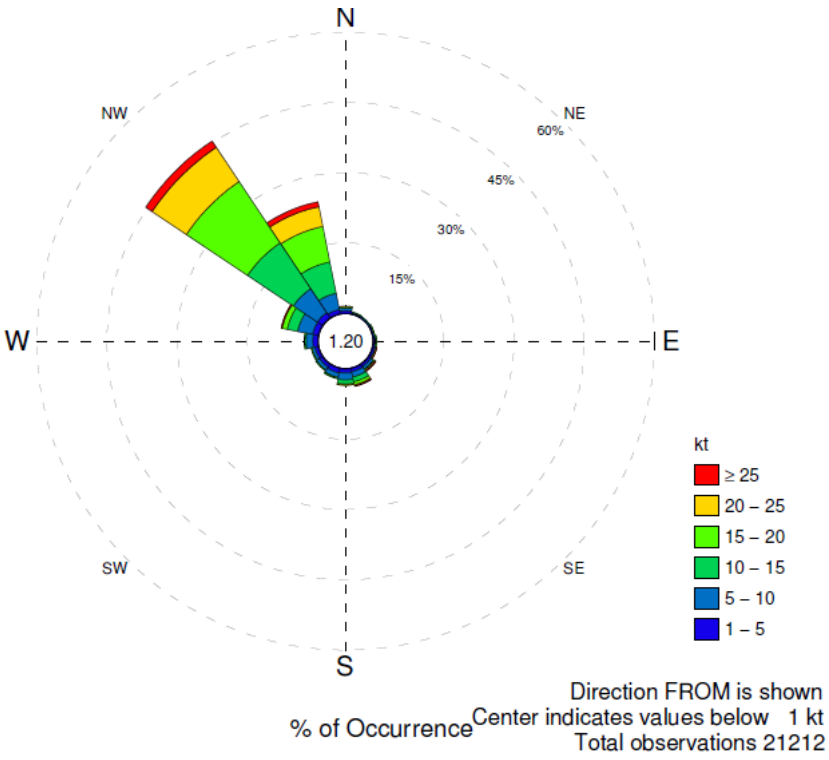
March


N
NE
E
SE
S
SW
W
NW
10%
20%
30%
1.10
kt
≥ 25
20 – 25
15 – 20
10 – 15
5 – 10
1 – 5
% of Occurrence
Direction FROM is shown
Center indicates values below 1 kt
Total observations 21563

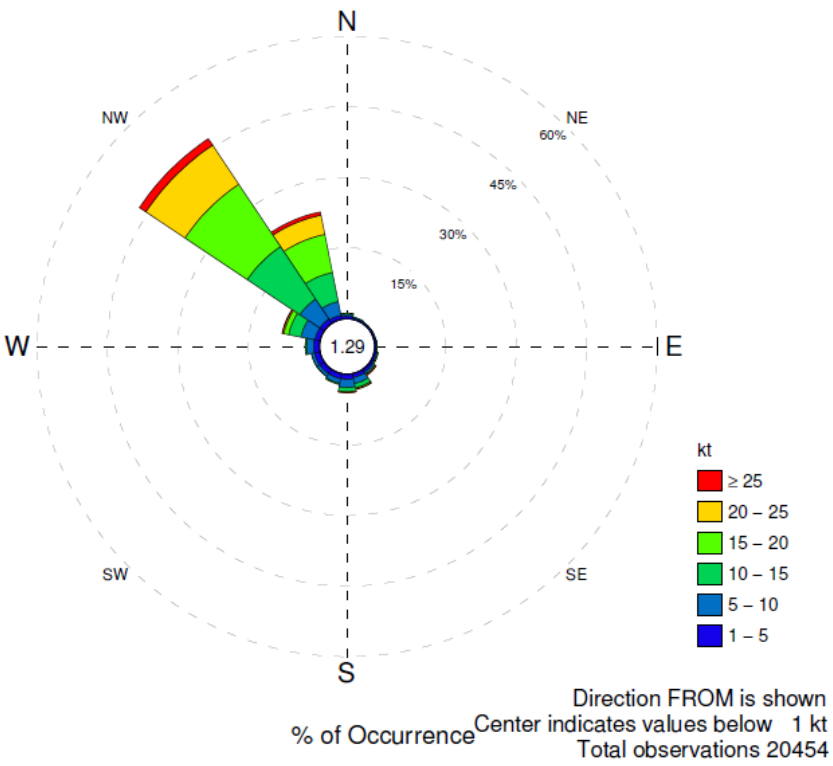
April


N
NE
E
SE
S
SW
W
NW
10%
20%
30%
40%
1.19
kt
≥ 25
20 – 25
15 – 20
10 – 15
5 – 10
1 – 5
% of Occurrence
Direction FROM is shown
Center indicates values below 1 kt
Total observations 20665

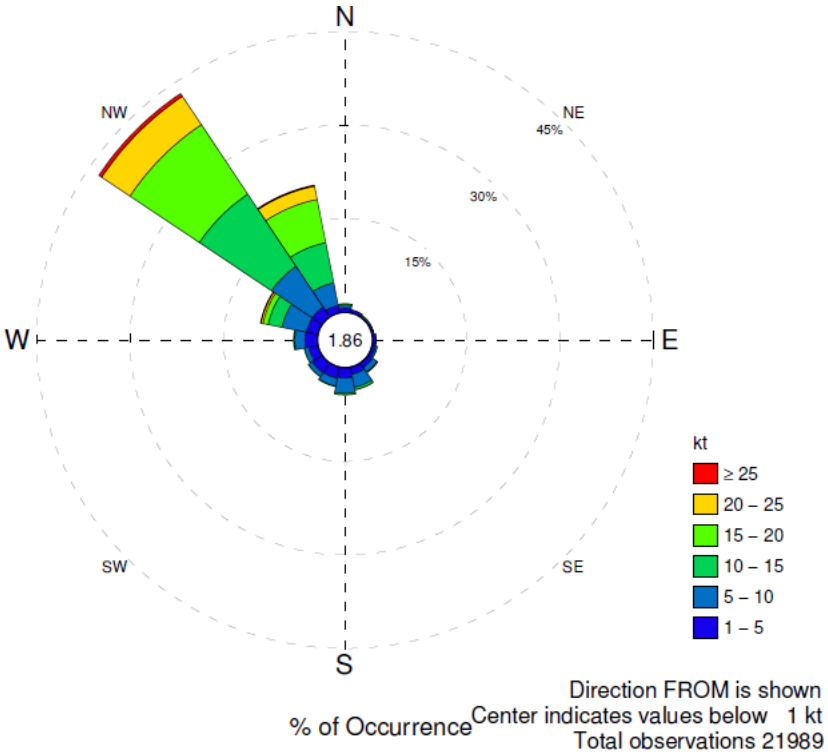
May


N
NE
E
SE
S
SW
W
NW
60%
45%
30%
15%
1.20
kt
≥ 25
20 – 25
15 – 20
10 – 15
5 – 10
1 – 5
% of Occurrence
Direction FROM is shown
Center indicates values below 1 kt
Total observations 21212

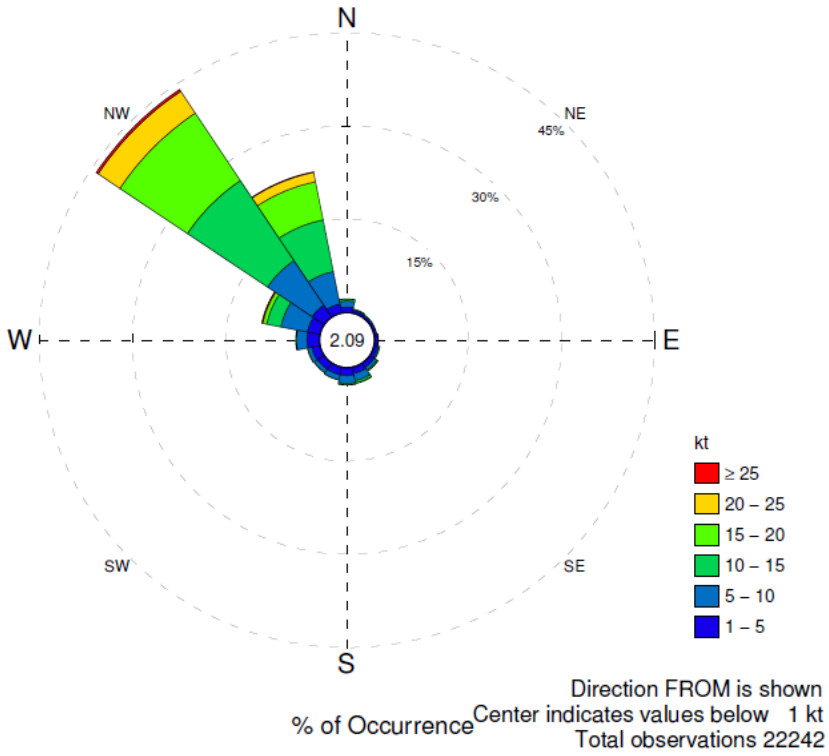
June


N
NE
E
SE
S
SW
W
NW
60%
45%
30%
15%
1.29
kt
≥ 25
20 – 25
15 – 20
10 – 15
5 – 10
1 – 5
% of Occurrence
Direction FROM is shown
Center indicates values below 1 kt
Total observations 20454

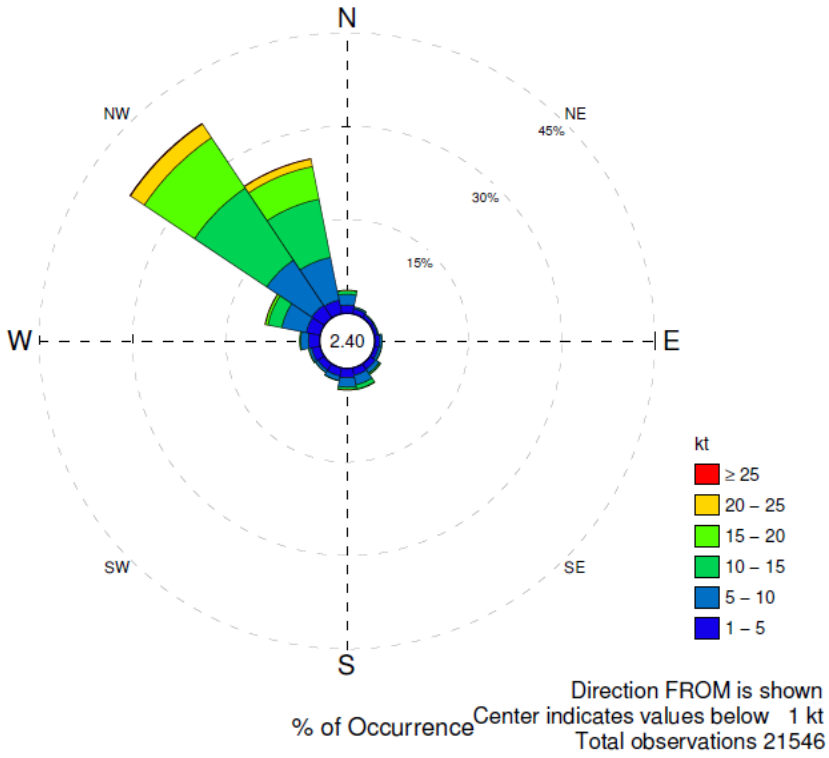
July


N
NE
E
SE
S
SW
W
NW
45%
30%
15%
1.86
kt
≥ 25
20 – 25
15 – 20
10 – 15
5 – 10
1 – 5
% of Occurrence
Direction FROM is shown
Center indicates values below 1 kt
Total observations 21989

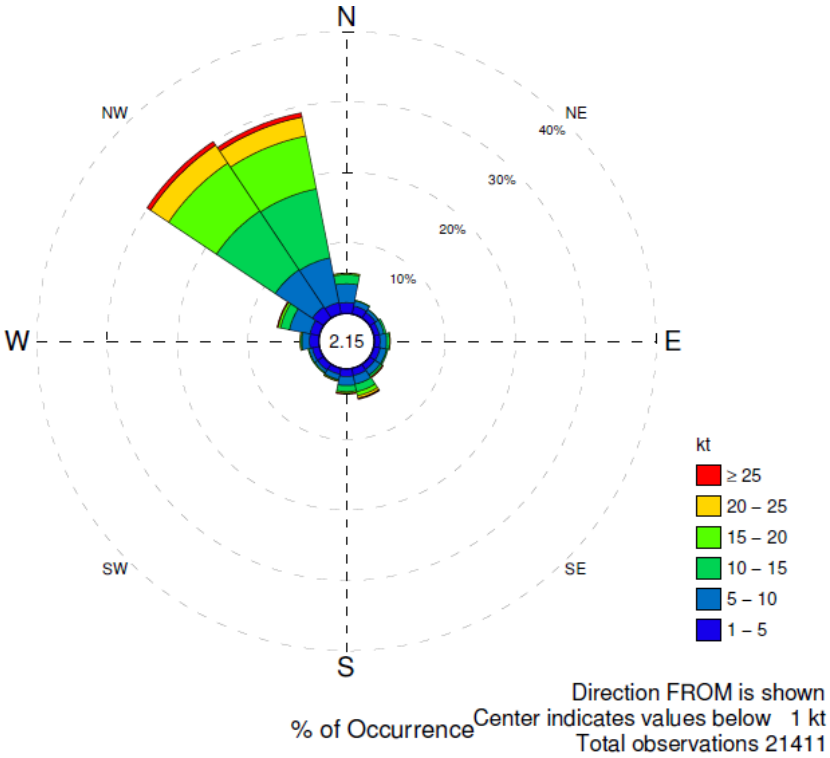
August


N
NE
E
SE
S
SW
W
NW
45%
30%
15%
2.09
kt
≥ 25
20 – 25
15 – 20
10 – 15
5 – 10
1 – 5
% of Occurrence
Direction FROM is shown
Center indicates values below 1 kt
Total observations 22242

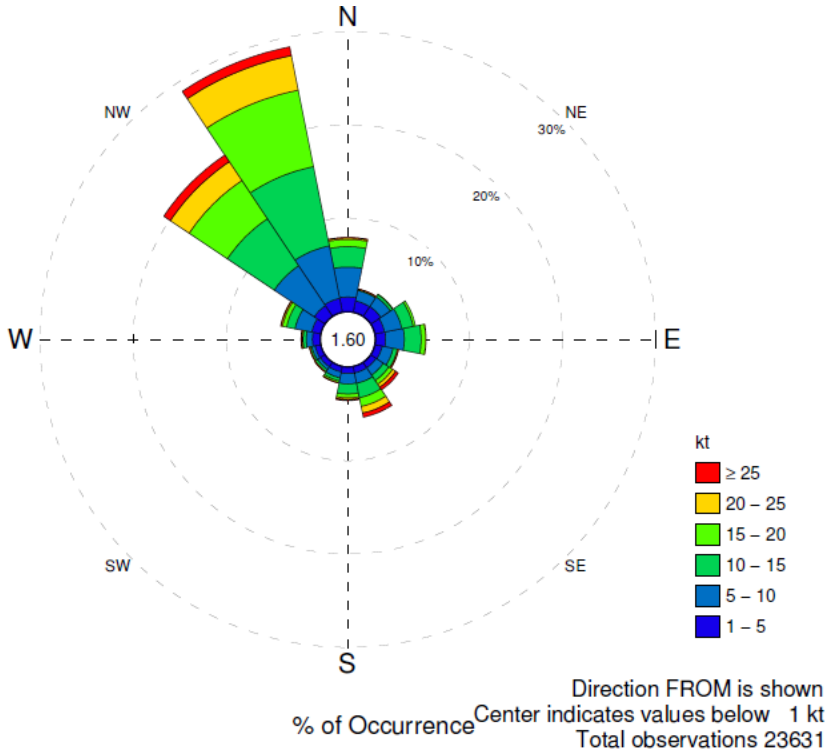
September



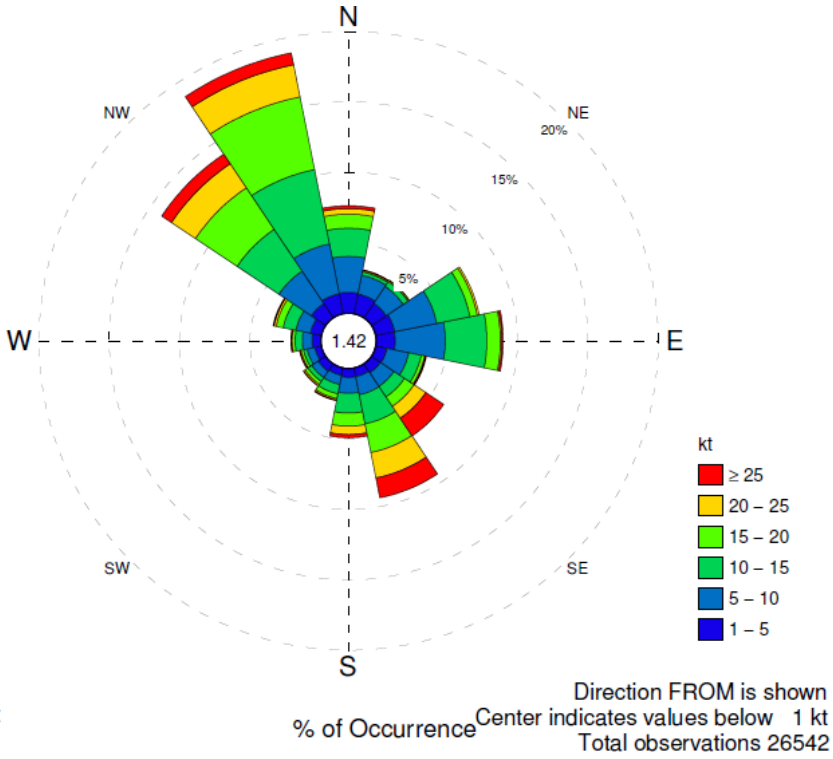
October



November

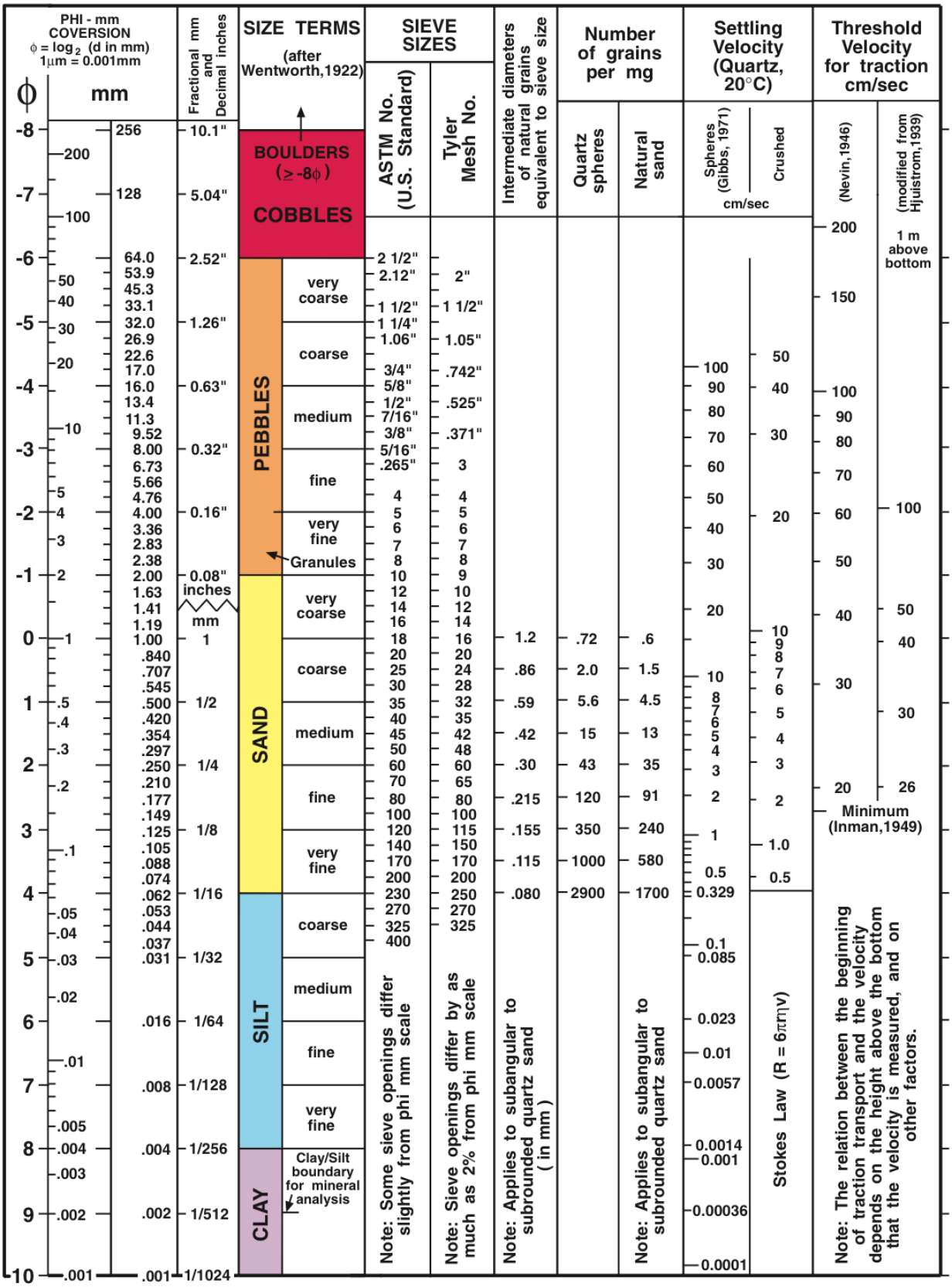


December



Appendix B:

Wentworth Classification Scale


PHI - mm COVERSION
$\phi = \log_2$ (d in mm)
1μm = 0.001mm
ϕ
mm
Fractional mm and Decimal inches
SIZE TERMS
(after Wentworth,1922)
BOULDERS (≥ -8ϕ)
COBBLES
PEBBLES
very coarse
coarse
medium
fine
very fine
Granules
SAND
very coarse
coarse
medium
fine
very fine
SILT
coarse
medium
fine
very fine
CLAY
Clay/Silt boundary for mineral analysis
SIEVE SIZES
ASTM No. (U.S. Standard)
Tyler Mesh No.
Note: Some sieve openings differ slightly from phi mm scale
Note: Sieve openings differ by as much as 2% from phi mm scale
Intermediate diameters of natural grains equivalent to sieve size
Note: Applies to subangular to subrounded quartz sand (in mm)
Number of grains per mg
Quartz spheres
Natural sand
Note: Applies to subangular to subrounded quartz sand
Settling Velocity (Quartz, 20°C)
Spheres (Gibbs, 1971)
Crushed
cm/sec
Stokes Law (R = 6πηv)
Threshold Velocity for traction cm/sec
(Nevin,1946)
(modified from Hjulstrom,1939)
1 m above bottom
Minimum (Inman,1949)
Note: The relation between the beginning of traction transport and the velocity depends on the height above the bottom that the velocity is measured, and on other factors.

Appendix C:

Wave Transformation Coefficients

H_S (m)	H_S (ft)	T_P (s)	Wave Direction (from)								
			SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1.5	4.9	5.0	0.02	0.08	-	-	-	-	0.58	0.50	0.34
1.5	4.9	7.0	0.03	0.07	-	-	0.82	0.91	0.82	0.66	0.38
1.5	4.9	9.0	0.05	0.10	-	0.47	0.85	0.95	0.86	0.62	0.34
1.5	4.9	11.0	0.07	0.13	0.24	0.46	0.81	0.93	0.82	0.56	0.30
1.5	4.9	13.0	0.08	0.15	0.26	0.44	0.76	0.90	0.76	0.49	-
1.5	4.9	15.0	0.10	0.16	0.26	0.41	0.71	0.88	0.71	0.45	-
1.5	4.9	17.0	0.11	0.17	0.28	0.40	0.66	0.85	0.68	0.42	-
1.5	4.9	19.0	-	0.18	0.28	-	-	-	0.66	0.40	-
2.5	8.2	5.0	0.02	0.07	-	-	-	-	-	0.36	-
2.5	8.2	7.0	0.03	0.08	0.21	-	-	0.76	0.69	0.54	0.34
2.5	8.2	9.0	-	0.10	0.21	0.47	0.80	0.90	0.81	0.57	0.33
2.5	8.2	11.0	-	0.13	0.24	-	0.79	0.92	0.80	0.54	0.30
2.5	8.2	13.0	-	0.15	0.26	-	0.75	0.90	0.76	0.49	0.27
2.5	8.2	15.0	-	0.16	0.26	-	0.70	0.88	0.71	0.45	-
2.5	8.2	17.0	-	0.17	0.28	-	0.66	0.85	0.67	0.42	-
2.5	8.2	19.0	-	-	-	-	-	0.81	0.65	0.40	-
3.5	11.5	7.0	0.03	0.09	-	-	-	-	-	0.43	-
3.5	11.5	9.0	-	0.10	0.22	-	-	-	0.74	0.52	-
3.5	11.5	11.0	-	-	-	-	0.77	0.88	0.77	0.51	0.29
3.5	11.5	13.0	-	-	-	-	0.74	0.89	0.75	0.48	-
3.5	11.5	15.0	-	-	-	-	0.70	0.87	0.71	0.44	-
3.5	11.5	17.0	-	-	-	-	-	0.84	0.67	0.42	-
3.5	11.5	19.0	-	-	-	-	-	0.81	0.65	0.40	-
4.5	14.8	9.0	0.05	0.11	-	-	-	-	-	0.47	-
4.5	14.8	11.0	-	-	-	-	-	0.84	0.74	0.48	-
4.5	14.8	13.0	-	-	-	-	-	0.87	0.73	0.46	-
4.5	14.8	15.0	-	-	-	-	-	0.86	0.70	0.43	-
4.5	14.8	17.0	-	-	-	-	-	0.84	0.67	0.41	-
4.5	14.8	19.0	-	-	-	-	-	-	0.65	-	-
4.5	14.8	19.0	-	-	-	-	-	-	0.65	-	-

Ratio of nearshore significant wave height to offshore significant wave height, H_S/H_0.

H_S (m)	H_S (ft)	T_P (s)	Wave Direction (from)								
			SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1.5	4.9	5.0	1.34	0.64	-	-	-	-	1.11	1.11	1.12
1.5	4.9	7.0	1.04	1.04	-	-	0.99	0.99	0.99	0.98	0.98
1.5	4.9	9.0	1.02	1.01	-	1.00	0.99	1.00	0.99	0.99	0.99
1.5	4.9	11.0	1.01	1.00	1.00	0.99	0.99	0.99	0.99	0.98	0.99
1.5	4.9	13.0	1.01	1.00	1.00	0.99	0.99	1.00	0.99	0.99	-
1.5	4.9	15.0	1.00	0.98	0.98	0.97	0.98	0.98	0.98	0.98	-
1.5	4.9	17.0	1.01	1.02	1.02	1.02	0.98	0.97	0.97	0.99	-
1.5	4.9	19.0	-	0.98	0.97	-	-	-	1.01	1.00	-
2.5	8.2	5.0	1.36	1.02	-	-	-	-	-	1.17	-
2.5	8.2	7.0	1.28	1.27	1.06	-	-	1.05	1.05	1.04	1.03
2.5	8.2	9.0	-	1.02	1.01	1.00	1.00	1.00	1.00	0.99	0.99
2.5	8.2	11.0	-	1.00	1.00	-	0.99	0.99	0.99	0.98	0.99
2.5	8.2	13.0	-	1.00	1.00	-	0.99	1.00	0.99	0.99	1.00
2.5	8.2	15.0	-	0.98	0.98	-	0.98	0.98	0.98	0.98	-
2.5	8.2	17.0	-	1.02	1.02	-	0.98	0.97	0.97	0.99	-
2.5	8.2	19.0	-	-	-	-	-	1.00	1.01	1.00	-
3.5	11.5	7.0	1.30	1.27	-	-	-	-	-	1.08	-
3.5	11.5	9.0	-	1.03	1.02	-	-	-	1.00	1.00	-
3.5	11.5	11.0	-	-	-	-	0.99	0.99	0.99	0.99	0.99
3.5	11.5	13.0	-	-	-	-	0.99	1.00	0.99	0.99	-
3.5	11.5	15.0	-	-	-	-	0.98	0.98	0.98	0.98	-
3.5	11.5	17.0	-	-	-	-	-	0.97	0.97	0.99	-
3.5	11.5	19.0	-	-	-	-	-	1.00	1.01	1.00	-
4.5	14.8	9.0	1.29	1.05	-	-	-	-	-	1.01	-
4.5	14.8	11.0	-	-	-	-	-	0.99	0.99	0.99	-
4.5	14.8	13.0	-	-	-	-	-	1.00	0.99	0.99	-
4.5	14.8	15.0	-	-	-	-	-	0.98	0.98	0.98	-
4.5	14.8	17.0	-	-	-	-	-	0.97	0.97	0.99	-
4.5	14.8	19.0	-	-	-	-	-	-	1.01	-	-
4.5	14.8	19.0	-	-	-	-	-	-	1.01	-	-

Ratio of nearshore peak wave period to offshore peak wave period, T_P/T_{P0}.

H_S (m)	H_S (ft)	T_P (s)	Wave Direction (from)								
			SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1.5	4.9	5.0	1.58	1.39	-	-	-	-	0.91	0.86	0.82
1.5	4.9	7.0	1.58	1.38	-	-	1.02	0.96	0.91	0.85	0.80
1.5	4.9	9.0	1.58	1.38	-	1.11	1.02	0.96	0.90	0.84	0.79
1.5	4.9	11.0	1.58	1.38	1.23	1.11	1.02	0.95	0.89	0.83	0.78
1.5	4.9	13.0	1.59	1.39	1.24	1.12	1.02	0.95	0.88	0.82	-
1.5	4.9	15.0	1.59	1.39	1.24	1.12	1.02	0.94	0.88	0.82	-
1.5	4.9	17.0	1.60	1.40	1.25	1.12	1.03	0.94	0.88	0.81	-
1.5	4.9	19.0	-	1.40	1.25	-	-	-	0.88	0.82	-
2.5	8.2	5.0	1.58	1.39	-	-	-	-	-	0.86	-
2.5	8.2	7.0	1.58	1.38	1.24	-	-	0.96	0.90	0.85	0.80
2.5	8.2	9.0	-	1.38	1.23	1.11	1.02	0.95	0.89	0.84	0.79
2.5	8.2	11.0	-	1.38	1.23	-	1.02	0.95	0.89	0.83	0.78
2.5	8.2	13.0	-	1.39	1.24	-	1.02	0.95	0.88	0.82	0.77
2.5	8.2	15.0	-	1.39	1.24	-	1.02	0.94	0.88	0.82	-
2.5	8.2	17.0	-	1.40	1.25	-	1.02	0.94	0.87	0.81	-
2.5	8.2	19.0	-	-	-	-	-	0.94	0.88	0.82	-
3.5	11.5	7.0	1.58	1.39	-	-	-	-	-	0.84	-
3.5	11.5	9.0	-	1.38	1.23	-	-	-	0.89	0.83	-
3.5	11.5	11.0	-	-	-	-	1.02	0.95	0.88	0.83	0.78
3.5	11.5	13.0	-	-	-	-	1.02	0.95	0.88	0.82	-
3.5	11.5	15.0	-	-	-	-	1.02	0.94	0.87	0.82	-
3.5	11.5	17.0	-	-	-	-	-	0.94	0.87	0.81	-
3.5	11.5	19.0	-	-	-	-	-	0.94	0.87	0.81	-
4.5	14.8	9.0	1.58	1.38	-	-	-	-	-	0.83	-
4.5	14.8	11.0	-	-	-	-	-	0.95	0.88	0.83	-
4.5	14.8	13.0	-	-	-	-	-	0.94	0.88	0.82	-
4.5	14.8	15.0	-	-	-	-	-	0.94	0.87	0.82	-
4.5	14.8	17.0	-	-	-	-	-	0.94	0.87	0.81	-
4.5	14.8	19.0	-	-	-	-	-	-	0.87	-	-
4.5	14.8	19.0	-	-	-	-	-	-	0.87	-	-

Ratio of nearshore wave direction to offshore wave direction, α/α_0.

This Page Intentionally Left Blank

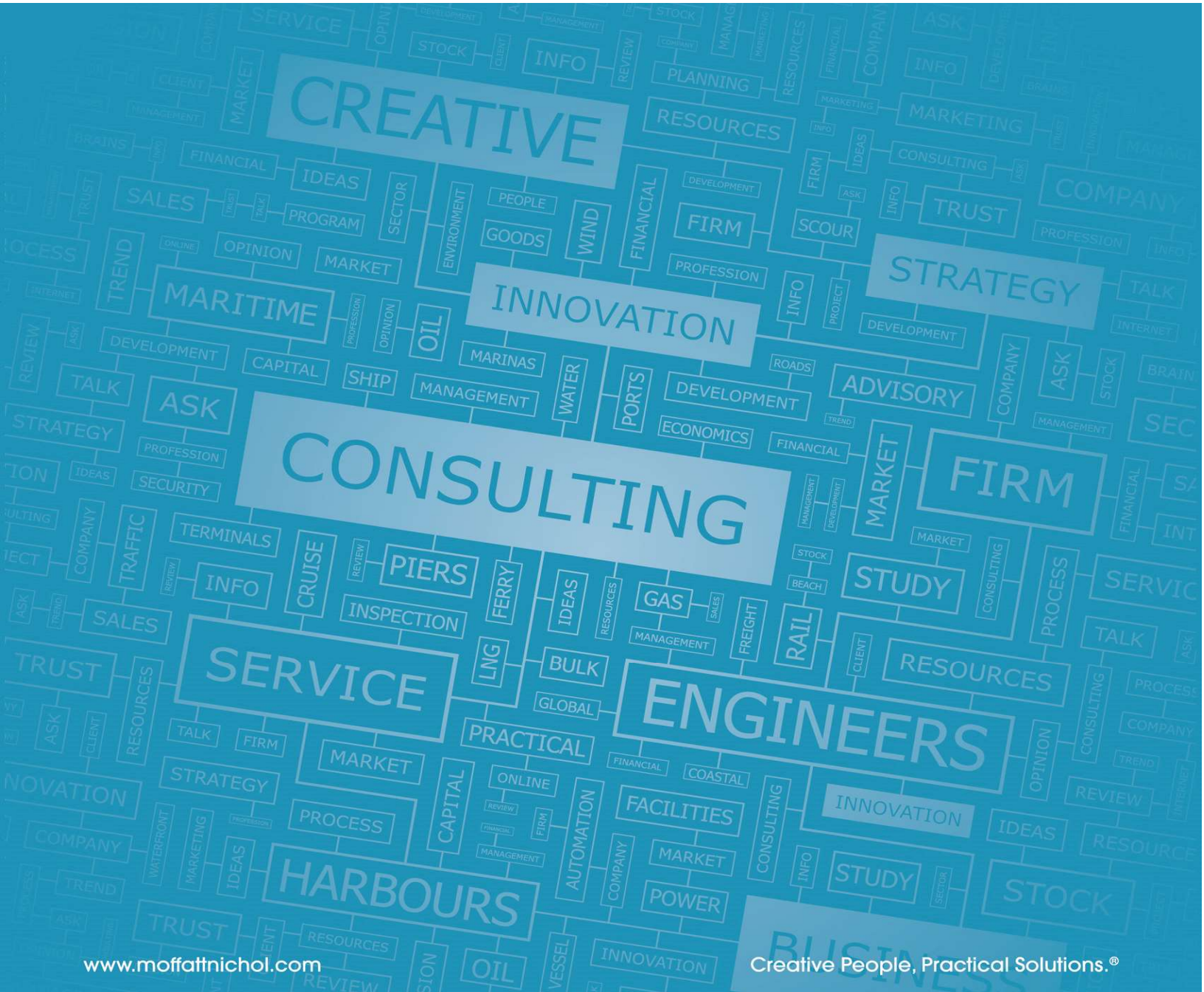
moffatt & nichol

Carmel River Lagoon

Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential

PREPARED FOR DENISE DUFFY & ASSOCIATES

DECEMBER 2022



Document Verification

Client	Denise Duffy & Associates
Project name	Carmel River Lagoon
Document title	Assessment of SRPS Mid-Slope Wall Alternative Beach Impact Potential
Document subtitle	
Status	Final
Date	December 21, 2022
Project number	11132
File reference	

Revision	Description	Issued by	Date	Checked
1	Final	M. Jorgensen	December 21, 2022	R. Dornhelm

Prepared by:
Moffatt & Nichol
2185 N. California Blvd., Suite 500
Walnut Creek, CA 94596-3500
T 925.944.5411
www.moffattnichol.com

Table of Contents

Document Verification i

Glossary iv

Executive Summary 1

1. Introduction 4
1.1. Project Objectives 5
1.2. Scope of Work 5
1.2.1. TAC Review Panel 5

2. Site Information 6
2.1. Carmel River Lagoon 6
2.2. Project Background 8
2.3. Need for Scenic Road Protection System 8

3. SRPS Beach Impact Potential 13
3.1. Bluff and Beach Profile 13
3.2. Wave Runup Analysis 18
3.3. Beach Erosion Potential 20
3.4. Recommended SRPS Location 22

4. Conclusions 29

References 31

Appendix A: Water Level Datums ..... A

List of Figures

Figure 1-1: Overview of lagoon closures and breaches (1991-2021). 4
Figure 2-1: Carmel River State Beach site location. 6
Figure 2-2: Carmel River State Beach and Carmel River Lagoon. 7
Figure 2-3: Aerial view of lagoon breach channel with northerly alignment along Scenic Road. 9
Figure 2-4: View of lagoon breach channel with northerly alignment along Scenic Road. 10
Figure 2-5: View of eroded beach and bluff toe along Scenic Road. 11
Figure 2-6: View of wave-induced bluff erosion along Scenic Road. 12
Figure 3-1: Bluff profiles and wave runup. 14
Figure 3-2: Closeup of hardpan. 15
Figure 3-3: Example rock outcrop. 16
Figure 3-4: Beach slope as a function of grain size, adopted from Komar (1998). 17
Figure 3-5: Parameters governing the influence of a wall, EurOtop (2018). 19
Figure 3-6: Beach response to wave action. 22
Figure 3-7: Accretion-Erosion distribution for waves in December and January. 24

Figure 3-8: Recommended location and height of SRPS mid-slope wall. 26

List of Tables

Table 3-1: Total water level estimated for extreme storm events. 20
Table 3-2: Distribution of wave runup elevation for accretionary waves. 27
Table 3-3: Distribution of wave runup elevation for erosive waves. 28

Glossary

BFE	{FEMA} Base Flood Elevation
BH	Balance Hydrologics
cfs	Cubic Feet per Second
CRL	Carmel River Lagoon
CRSB	Carmel River State Beach
CSUMB	California State University, Monterey Bay
DD&A	Denise Duffy & Associates
DEIR	Draft Environmental Impact Report
El.	Elevation
FEMA	Federal Emergency Management Agency
FIRM	{FEMA} Flood Insurance Rate Map
LiDAR	Light Detection and Ranging
MN	Moffatt & Nichol
MPWMD	Monterey Peninsula Water Management District
NAVD88	North American Vertical Datum of 1988
NDBC	National Data Buoy Center
NOAA	National Oceanic and Atmospheric Administration
NPS	Naval Postgraduate School
RP	Return Period
SRPS	Scenic Road Protection Structure
SWEL	{FEMA} Stillwater Elevation
TAC	Technical Advisory Committee
TWL	{FEMA} Total Water Level
YR	Year

Executive Summary

Introduction and Objectives

This report provides an assessment of the potential for impacts to the beach associated with incorporation of a wall at the base of the bluff along Scenic Road. In the Draft EIR (DEIR), DDA (2016), this option is referred to as the Scenic Road Protection Structure (SRPS) Mid-Slope Wall Alternative.

The functional objectives of the SRPS are as follows:

- Protect the base of the bluff along Scenic Road from eroding for cases when the Carmel River flows adjacent to the bluff. For context, it has been experienced in the past that the rapid outflow of water from the lagoon associated northerly breaches eroded a deep and wide channel along the base of the bluff.
- Protect the bluff along Scenic Road from wave-related impacts.
- Not impede natural formation of the lagoon and flow of the Carmel River to the north. This implies that the SRPS should not encroach significantly on the beach.

Additional objectives for the SRPS include that:

- The structure is as minimally intrusive as practical in terms of visual impact and public access.

In terms of the planar and vertical extent of the SRPS, the following considerations were adopted for guidance:

1. The SRPS should not impact the existing wetland area located at the northern end of the Carmel River State Beach (CRSB). The SRPS alignment should therefore commence at a distance from the wetland area.
2. During lagoon breach events where breach outflow caused erosion, impacts have been observed along Scenic Road and the CRSB parking lot. Based on this, it is recommended to terminate the SRPS alignment near the southern corner of the CRSB parking lot.
3. During erosion events it has been observed that the beach level can erode down to the marine terrace (hardpan). The base of the SRPS should therefore extend down to the marine terrace.
4. The minimum crest elevation of the SRPS should be equal to the Base Flood Elevation (BFE) of the lagoon to meet FEMA requirements to mitigate (fluvial) flood hazards. The BFE for the lagoon is +16 feet NAVD88. Adding a freeboard would further reduce potential flood hazards.
5. The bluff should be protected to address coastal flood hazards in the form of storm surge and wave runup, which can reach an elevation of +26.7 feet NAVD88 in a 1% annual chance storm event.

Findings and Conclusions

The results of the analysis provided herein lead to a proposed SRPS location along the base of the previously eroded bluff. Refer to Figure 3-8 for a typical cross-section along Scenic Road showing the proposed SRPS location in relation to beach levels, tide levels and estimated wave runup elevations.

The recommended crest elevation of the SRPS mid-slope wall is +20 feet NAVD88 in order to accommodate and provide a freeboard above the lagoon fluvial BFE at +16 feet NAVD88. Slope stabilization will be incorporated above El. +20 feet NAVD88 to protect the bluff against wave runup.

Installing the SRPS along the recommended alignment achieves the following:

- The SRPS won't encroach on or damage the existing bluff, as the bluff face has previously eroded back to this level (purple profile shown in Figure 3-8).
- At typical beach levels, the SRPS will be buried under the sand and will not pose a visual obstruction.
- When buried under the sand, the SRPS will not pose an obstruction to public access to the beach.
- With the proposed crest elevation of +20 feet NAVD88, the SRPS mid-slope wall will accommodate a lagoon water level up to +16 feet NAVD88 or higher (within the four-foot freeboard).
- The SRPS will prevent water flow from eroding the base of the bluff during a lagoon breach event.
- The mid-slope wall and slope stabilization above it will prevent wave runup from eroding the bluff.
- The SRPS will not negatively impact lagoon formation or the beach.

It should be noted that the time from December to January when lagoon breach and sandbar management commonly takes place embodies the most energetic and changeable conditions of the lagoon, sandbar, and ocean conditions. This is the time when:

- The lagoon can be subject to large inflows from the Carmel River leading to rapid changes in the lagoon water level.
- High water levels in the lagoon can approach flood stage for properties around the lagoon.
- The wave climate is the most dynamic. The passage of winter storm systems can generate high surf conditions, and swell waves from distant storm systems can be at their most energetic.

- Consequently, the beach and sandbar morphology are highly dynamic. Examples of this observed in the field, include the sandbar being overtopped by waves infilling the lagoon with seawater; intermittent formation of lagoon breaches and their closure due to sediment deposition by wave action; migration of breach openings north or south along the beach due to wave action and longshore littoral transport; and washout of large quantities of beach material during lagoon breach events.

An analysis of wave runup and beach erosion potential demonstrates that there is a potential for wave runup to interact with the SRPS if the beach level is lowered in connection with a northerly lagoon breach. Thornton (2006) estimates that northerly breach events occur every 9 years on average (in 11% of cases). Results of the beach erosion potential and wave runup analysis indicates that the sandbar would re-form when accretionary wave conditions are present. The analysis estimates that wave conditions are accretionary 60% of the time in December and January when lagoon breach and sandbar management commonly take place.

1. Introduction

The Carmel River Lagoon (CRL) undergoes an annual cycle of lagoon progression approximately as follows (per Figure 1-1) compiled based on data from the County of Monterey (2021), BH (2014), and MPWMD (2005):

1. Initial breaching, often in November through January. Initial breaching may be done mechanically (typically November to January), or occur naturally (typically December to January).

2. Intermittent breaching and closure, typically over the months from February through May.

3. Seasonal closure, in most years from around June through November.

Each year as the rainy season commences, the County will monitor the rise of the water level in the lagoon and perform sandbar management if inflows to the lagoon are projected to cause a flood hazard to shoreline properties along the lagoon. In this regard, inflows to the lagoon primarily consist of discharge from the Carmel River, but can also include local and regional precipitation events, and wave overtopping events.

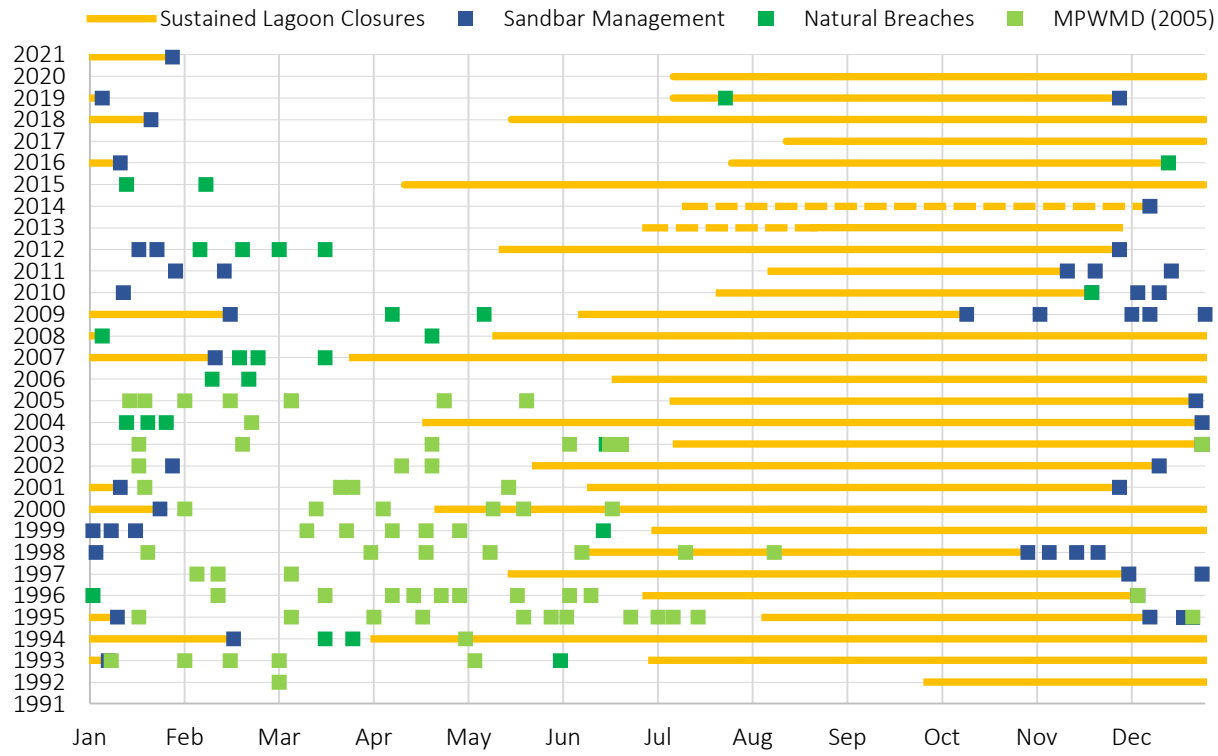


Figure 1-1: Overview of lagoon closures and breaches (1991-2021).

Discharge from the Carmel River typically diminishes or ceases over the summer months, which can cause the water level in the lagoon to drop as a result of seepage and evaporation. For this reason, there is a concerted effort to initiate early sustained closure of the lagoon in order to retain as much water as possible for the summer months.

1.1. Project Objectives

The objective of this report is to assess if incorporation of the SRPS could impact the beach fronting the structure.

1.2. Scope of Work

Denise Duffy & Associates is the prime consultant to the County of Monterey, leading a subconsultant team, which includes Moffatt & Nichol, Balance Hydrologics, Inc., Whitson Engineers, and an external Technical Advisory Committee.

Moffatt & Nichol was retained by Denise Duffy & Associates to develop an assessment of the SRPS Mid-Slope Wall Alternative beach impact potential. The assessment was conducted based on the analysis presented herein and prior studies on the CRSB and CRL.

1.2.1. TAC Review Panel

The work was peer reviewed by a Technical Advisory Committee (TAC) consisting of the following panel members:

1. Dr. Mara Orescanin, Professor of Coastal Oceanography at the Naval Postgraduate School (NPS). Dr. Orescanin has experience with the morphology of coastal lagoons, sandbar build-up, erosion, and sediment transport, and familiarity with the CRL gained from field work on the beach and lagoon.

2. Dr. Doug Smith, Professor of Hydrology and watershed restoration at California State University, Monterey Bay (CSUMB). Dr. Smith has experience in lagoon and river flooding cycles, river sediment transport and flow, and familiarity with the Carmel River and CRL.

3. Larry Hampson, (retired) engineer and consultant for the Monterey Peninsula Water Management District (MPWMD). Mr. Hampson has expertise with flood management, and sandbar management and longstanding experience with the historical setting of the CRL and on the ground knowledge gained from observations and field visits.

4. Jeff Hagar, consultant for Hagar Environmental Science. Mr. Hagar specializes in water resource management and aquatic species conservation, and has experience with monitoring of salmonoid habitat in lagoon ecosystems on the central coast, and specific expertise with steelhead trout on the San Lorenzo River at Santa Cruz, CA.

2. Site Information

2.1. Carmel River Lagoon

Figure 2-1 shows the location of Carmel River State Beach where the Carmel River Lagoon is located at the mouth of the Carmel River.

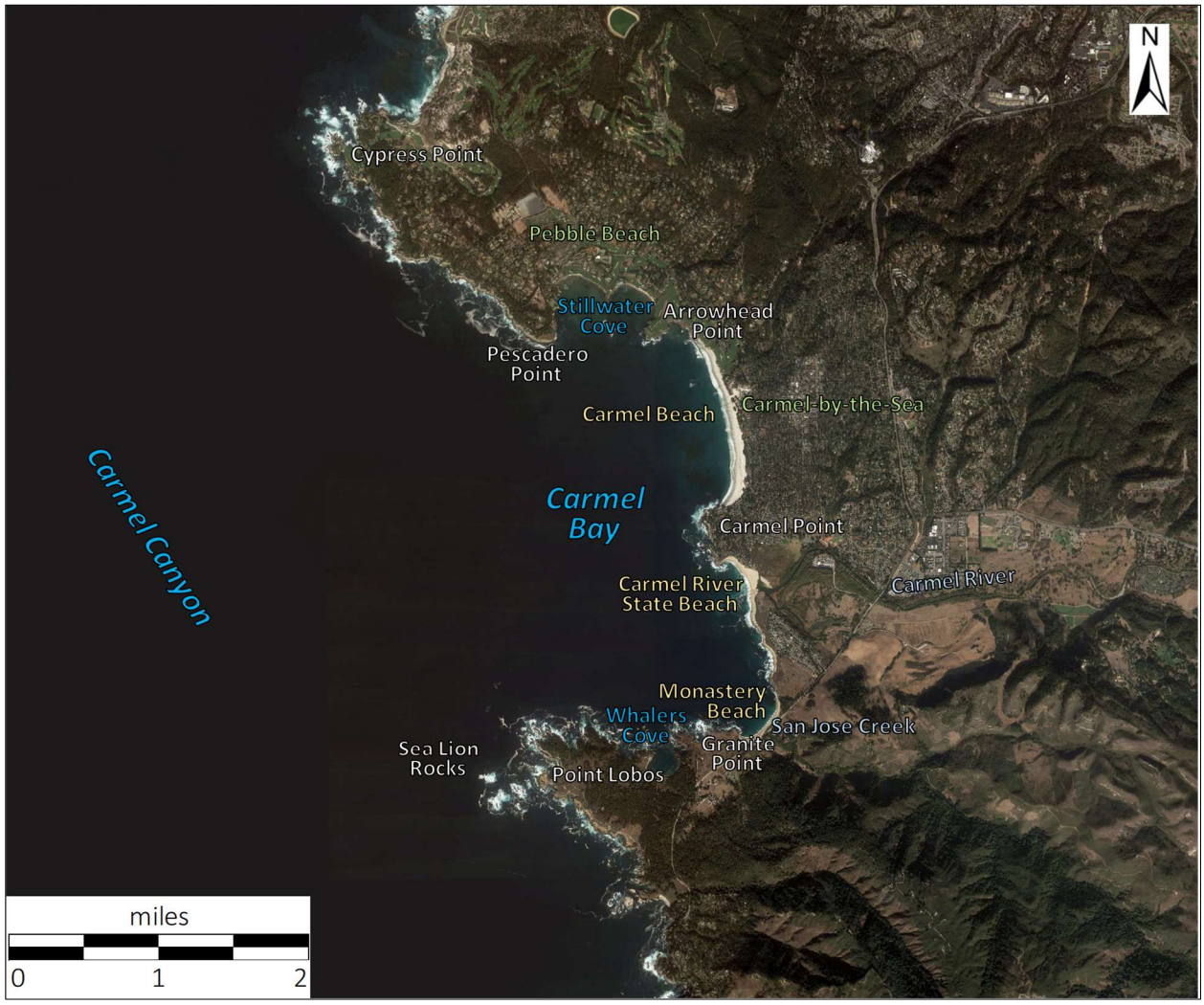


Figure 2-1: Carmel River State Beach site location.

The Carmel River drains approximately 250 square miles of the Santa Lucia and Sierra de Salinas Mountains into Carmel Bay. The Carmel River watershed has historically experienced large variations in seasonal and yearly discharge rates. A complex dynamic exists between the CRL and the Pacific Ocean. Figure 2-2 provides a closeup of the CRL and CRSB.

During times of low or no river discharge, waves build up the beach profile to form a sandbar along the CRSB shoreline. The sandbar closes off the mouth of the lagoon, which causes the lagoon water level to rise. Some amount of outflow from the lagoon to the Pacific occurs via groundwater seepage through the beach sand. The lagoon water body also loses water due to evaporation, primarily over the summer months. When river discharge is minimal, the lagoon water level recedes to a base elevation that persists over the dry summer months.

When river discharge increases in response to precipitation the lagoon water level can rise rapidly and potentially reach or exceed the defined flood stage. This can occur at any time from late fall to early spring.



Figure 2-2: Carmel River State Beach and Carmel River Lagoon.

Management of the lagoon water level has therefore been implemented to mitigate potential flood hazards to properties along the north side of the lagoon. The practices include monitoring of the lagoon water level and projected river inflows to the lagoon and sandbar management. Sandbar management involves excavation of a pilot channel through the sandbar that enables the lagoon to initiate a breach if the lagoon water level reaches the elevation of the pilot channel. If inflows to the lagoon do not pose

a flood hazard, no management action is carried out and the lagoon can breach naturally. Following a breach event (mechanical or natural), incident waves can build up the beach and reestablish the sandbar, which closes the lagoon outlet. This can occur progressively or quite rapidly depending on the wave conditions. When the annual rainy season ends, and depending on whether or not the outlet has been closed off naturally, the decision is made to mechanically close the outlet before the river flow subsides in order to maximize the volume of water stored in the lagoon leading into the dry season.

2.2. Project Background

The DEIR, DDA (2016) considered a wide range of alternatives for incorporation of an Ecosystem Protective Barrier along the edge of the Carmel River Lagoon, a protective structure along Scenic Road (SRPS), and guidelines for County Interim Sandbar Management planning. The present report focuses on the SRPS. Refer to DDA (2016) for the full evaluation provided in the Draft Environmental Impact Report.

In the DEIR, three alternatives were proposed for the SRPS as follows:

1. Rock revetment bluff protection on the beach fronting the bluff, extending from the wetland area at the north end of CRSB to the southern corner of the CRSB parking lot.

2. Full height secant pile wall, extending from the wetland area approximately to the public restroom facility by the CRSB parking lot. Rock revetment would be placed on the beach fronting the CRSB parking lot.

3. Mid-slope toe soldier pile wall extending from the wetland area approximately to the public restroom facility by the CRSB parking lot. Rock revetment would be placed on the beach fronting the CRSB parking lot.

Out of these alternatives, the mid-slope wall (3) was selected as the preferred alternative and adopted as the basis for the analysis provided in this report.

2.3. Need for Scenic Road Protection System

Figure 2-3 shows an aerial view of a northerly lagoon alignment with an open breach channel along Scenic Road (Photo: April 5, 2009, courtesy of Ed. Thornton, NPS). The outflow through the breach channel is estimated at around 80 cfs[1], which is at a level sufficient to keep the breach channel open. However, at discharge in this range (from 20 to 200 cfs), the mouth of the breach channel may close and reopen intermittently if exposed to wave action. The photo illustrates that the breach channel

[1] Based on USGS gauge records for Carmel River discharge.

follows the toe of the bluff. It can be noted that the breach channel is very shallow (sand bottom visible) compared to the deeper lagoon (dark green) where the bottom is not visible.



Figure 2-3: Aerial view of lagoon breach channel with northerly alignment along Scenic Road.

Figure 2-4 shows a view of the beach and bluff along Scenic Road featuring an open breach channel. In this case, the discharge was between 450 and 650 cfs, and it can be seen that the flow carved a deep and wide breach channel into the beach. The elevation of the beach face prior to the breach can be estimated by the height of the patch of beach remaining between the breach channel and the bluff. Scenic Road runs along the top of the bluff at approximately El. +37 feet NAVD88 (left side of photo) to El. +33 feet NAVD88 (center of photo). Note callouts a, b, c, d, and e in the figure, which point to key features that are identifiable in the following photo shown in Figure 2-5.



Figure 2-4: View of lagoon breach channel with northerly alignment along Scenic Road.

Figure 2-5 shows how the flow through the breach eroded the remaining beach along the bluff and widened the breach channel to a point where it cut into the base of the bluff. For reference, the peak discharge of around 650 cfs that caused the lagoon breach and erosion along the breach channel is a commonly occurring level of discharge that will be exceeded every year (on average).

The dashed black line in Figure 2-5 indicates the location of the beach face as seen in Figure 2-4. Note green vegetation in Figure 2-4, which covered the entire face of the bluff down to the beach face was eroded with patches of vegetation overhanging scarps cut into the bluff toe in Figure 2-5. Refer to the markers a-e in Figure 2-4 and Figure 2-5.



Figure 2-5: View of eroded beach and bluff toe along Scenic Road.

The dotted black line in Figure 2-5 illustrates how much further the erosion of the bluff progressed after wave action eroded the remainder of the lowered beach face and wave runup further eroded the bluff as shown in Figure 2-6. Erosion along the top of the bluff reached the edge of Scenic Road where the dotted line ends approximately at marker c.

Note the steep near-vertical scarps in Figure 2-6 that developed as a result of wave action eroding the bluff. This case analysis illustrates that there is a high risk of significant and potentially disastrous erosion along Scenic Road when the lagoon forms along the bluff and breaches to the north. This is demonstrated by the fact that the peak discharge from the lagoon was at a typical level and wave action was likewise representative of commonly occurring conditions. Had the level of discharge been higher, or the waves larger or occurring over a longer timespan, erosion of the bluff could easily have damaged Scenic Road.



Figure 2-6: View of wave-induced bluff erosion along Scenic Road.

The Draft Environmental Impact Report (DEIR), DD&A (2016) identified a low-profile mid-height wall alternative as the most feasible Scenic Road Protection System (SRPS), that achieves the following:

1. Will not impede formation of a lagoon breach channel with a northerly alignment along Scenic Road. A northerly alignment is preferred by agencies as the breach channel can develop a milder slope and hydraulic gradient, which may permit gradual outflow from the lagoon without leading to a catastrophic breach event where the entire lagoon drains over a short period of time. Any amount of time that the breach channel can serve as an outlet for the lagoon will go towards a longer residence time for juvenile fish in the lagoon in terms of their growth and transition from a freshwater to a saltwater environment.

2. Allows the lagoon to breach to the north without eroding the bluff along Scenic Road. This will aid in protecting Scenic Road, protecting infrastructure along the road, and public access along Scenic Road. Further, will help to preserve the natural vegetation over the face of the bluff; and

3. Prevents water flow and wave action from eroding the base of the bluff beyond its current state.

3. SRPS Beach Impact Potential

3.1. Bluff and Beach Profile

Figure 3-1 summarizes surveyed beach and bluff profiles in relation to water level datums and estimated wave runup elevations. In the figure, the yellow/tan curves are representative of beach profiles captured in County and NOAA Coastal LiDAR topographic survey data. The purple profile was surveyed in 2005 and is representative of the lowest beach and bluff profile recorded. In this case, the base of the bluff eroded down to approximately +8 feet NAVD88. The beach portion was not covered in the survey, likely because the beach was overwashed with waves. Refer e.g. to Figure 2-6 for an example of this condition. The dash-dot line included in the figure is an estimate of the beach level, which is surmised to be at or near the level of the marine terrace underlying the sandy beach deposits. The marine terrace is a hardpan consisting of hard, weathered material with rock outcrops. See Figure 3-2 for a closeup view of the marine terrace material and Figure 3-3 for an example of a rock outcrop.

Based on the estimated profile of the low beach level or hardpan, the sand deposits on the upper beach can be 12 to 13 feet in depth when the beach profile is at its highest, and 4 to 5.5 feet deep on the lower beach.

Figure 3-4 from Komar (1998) summarizes beach slope information for beaches on the West Coast. The figure includes data for the Carmel River, reported to have slopes ranging from about 1:4 to 1:7 (refer to X's along dashed line on the left side of the figure), representative of moderately protected to protected beaches. Based on the data Komar summarized in Figure 3-4, the grain size could range from about 0.55 mm to 0.80 mm, which is representative of coarse sand and consistent with the output from the Carmel River subject to the coastal processes of the beach environment.

Further included in Figure 3-1 are tidal water level datums from Appendix A, Table A-1. The following datums are shown: Mean Sea Level (MSL), Mean High Water (MHW), Mean Higher High Water (MHHW), King tides (KT), and the 1% Annual Chance Stillwater Elevation (SWEL) per FEMA (2017).

The solid black line at El. +27 feet NAVD88 indicates the coastal Base Flood Elevation, which indicates the highest elevation of wave runup in a 1% annual chance (100-year) flood event.

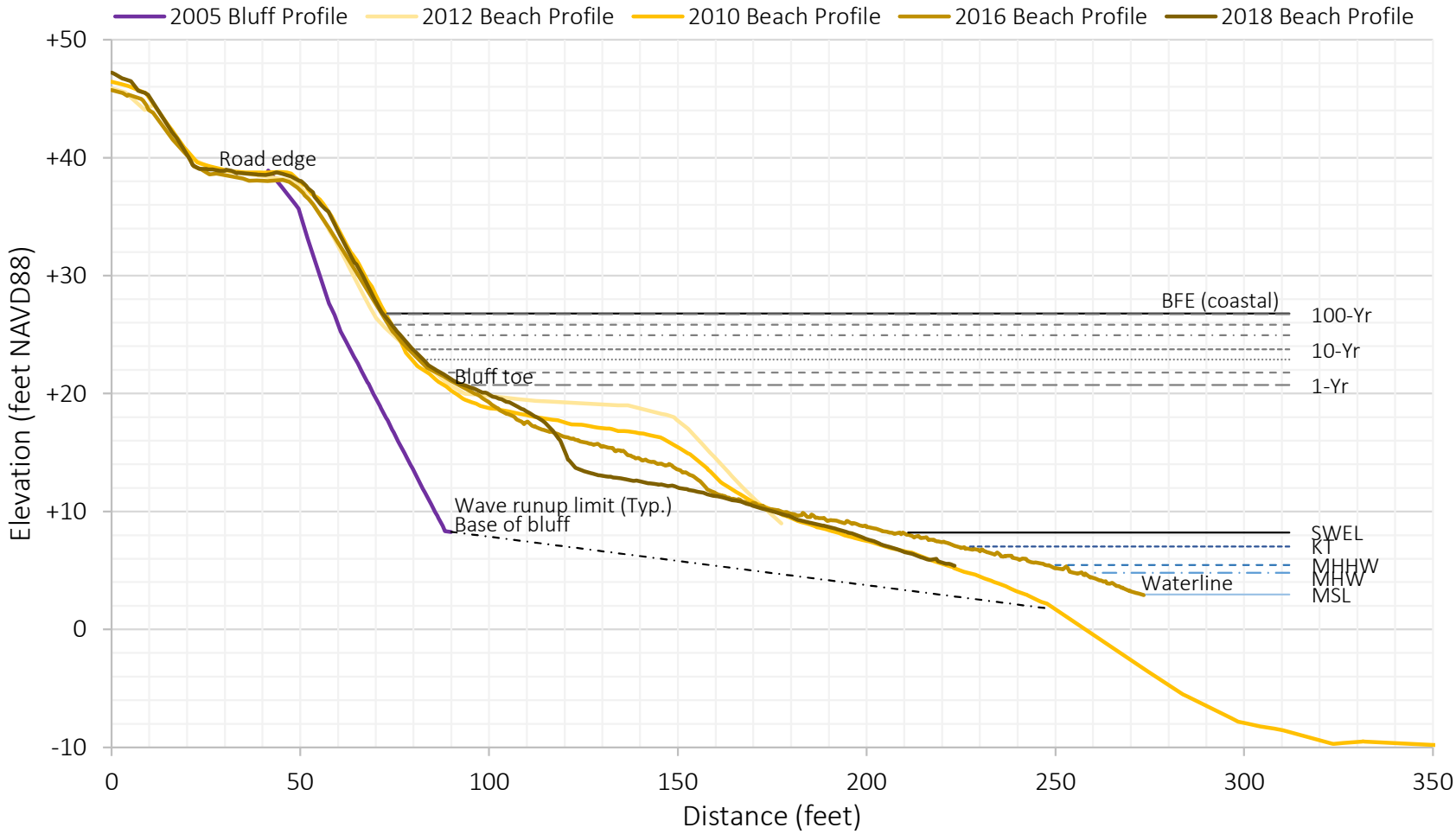


Figure 3-1: Bluff profiles and wave runup.



Figure 3-2: Closeup of hardpan.



Figure 3-3: Example rock outcrop.

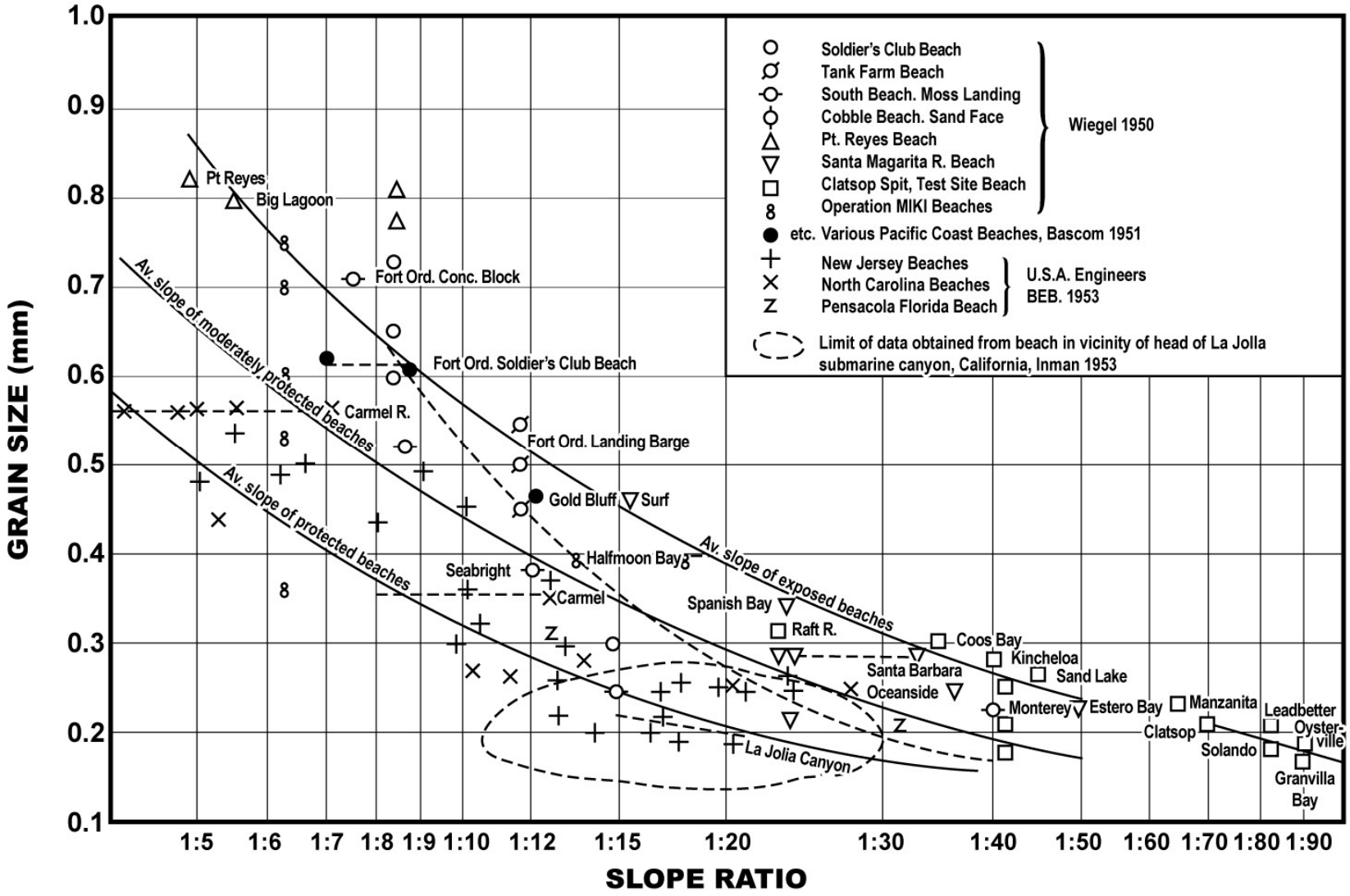


Figure 3-4: Beach slope as a function of grain size, adopted from Komar (1998).

3.2. Wave Runup Analysis

Estimates of wave runup at the shoreline follows the EurOtop (2018) guidance as follows.

The wave runup height, $R_{2\%}$, exceeded by two percent of incident waves is given by:

$$R_{2\%} = 1.65 H_{m0} \gamma_b \gamma_f \gamma_\beta \gamma_v \xi_m$$

With an upper limit of:

$$R_{2\%} = 1.00 H_{m0} \gamma_f \gamma_\beta \gamma_v \left(4.0 - \frac{1.5}{\sqrt{\gamma_b \xi_m}}\right)$$

Where H_{m0} is the spectral significant wave height at the structure toe; γ_f is an influence factor for the roughness of the slope; γ_b is an influence factor for a berm; γ_β is an influence factor to account for oblique wave angles relative to the shore; and γ_v is an influence factor to account for steep slopes and walls.

The spectral wave length, $L_{m-1.0}$, can be determined as:

$$L_{m-1.0} = g T_{m-1.0}^2 / 2\pi$$

Where g is the gravitational acceleration, and $T_{m-1.0}$ is the spectral wave period. The Iribarren number, ξ_m, is given by:

$$\xi_m = \frac{\tan \alpha}{\sqrt{\frac{H_{m0}}{L_{m-1.0}}}}$$

Where α is the slope of the shore or structure.

the influence factor for the roughness of the slope is taken as $\gamma_f = 1.0$ representative of a beach setting. The shoreline does not have a berm, so the influence factor for a berm is $\gamma_b = 1.0$. The influence factor to account for oblique wave angles relative to the shore can be described as follows for wave runup associated with short-crested waves:

$$\gamma_\beta = \begin{cases} 1 - 0.0022|\beta|, & 0° \le |\beta| < 80° \\ 0.824, & |\beta| > 80° \end{cases}$$

Where β is the angle of incidence (note $\beta = 0°$ is perpendicular to the shoreline).

And for long-crested (swell) waves:

$$\gamma_\beta = \begin{cases} 1.0, & |\beta| < 10° \\ cos^2(|\beta| - 10°), & |\beta| > 80° \end{cases}$$

With a minimum value of γ_β=0.6.

The SRPS wall structure is accounted for by a correction factor, γ_v, as follows:

$$\gamma_v = \exp\left(-0.56\frac{h_{wall}}{R_c}\right)$$

Where h_{wall} is the height of the wall, and R_c is the freeboard between the stillwater elevation and the crest of the wall as shown in Figure 3-5, where α denotes the slope angle relative to the horizontal and h is the water depth at the toe of the slope.

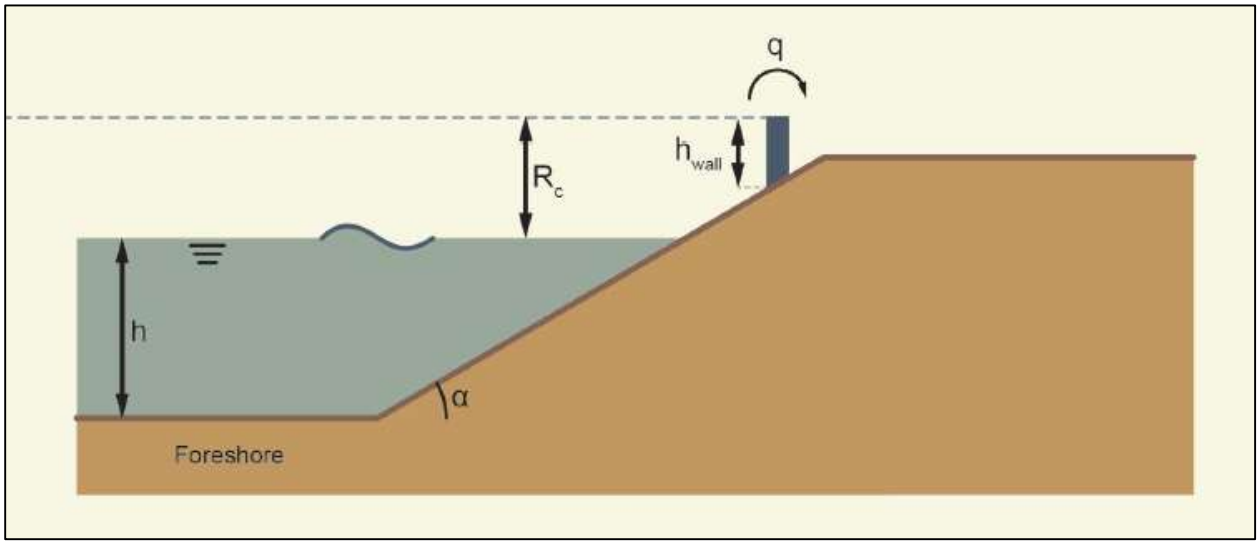


Figure 3-5: Parameters governing the influence of a wall, EurOtop (2018).

The maximum wave runup, R_{max}, is determined from:

$$R_{max} = 2.9\,\overline{R}$$

Where $\overline{R}$ is the average runup height, which is related to the 2% runup elevation as follows:

$$R_{2\%} = 2.2\,\overline{R}$$

The total water level (TWL) is determined as the still water elevation (SWEL) with the addition of the wave runup as follows:

$$TWL = SWEL + R_{max}$$

A second approach to estimating wave runup was via the method developed by Stockdon (2006), which has been demonstrated to yield good results for beaches with sandbars. Stockdon characterizes the 2% wave runup, R_2, as:

$$R_2 = 1.1\left(0.35\beta_f(H_0L_0)^{1/2} + \frac{\left[H_0L_0\left(0.563\beta_f^2 + 0.004\right)\right]^{1/2}}{2}\right)$$

Where H_0 is the deep-water wave height, L_0 is the deep-water wave length, and β_f is the slope of the beach profile relative to the horizontal.

Wave runup was evaluated based on wave data from National Data Buoy Center (NDBC) buoy 46042 Monterey, NDBC (2021).

Wave runup was also assessed for extreme wave conditions as summarized in Table 3-1.

Table 3-1: Total water level estimated for extreme storm events.

Recurrence Interval (years)	StillWater Elevation (ft NAVD88)	Offshore		Nearshore		Total Water Level (ft NAVD88)
		Significant Wave Height (ft)	Peak Wave Period (s)	Significant Wave Height (ft)	Peak Wave Period (s)	
100-YR RP	+8.2	37.9	21.0	25.2	20.4	+26.7
50-YR RP	+8.1	35.9	20.7	23.9	20.1	+25.8
25-YR RP	+7.9	33.9	20.4	22.6	19.9	+24.9
10-YR RP	+7.7	31.3	20.0	20.8	19.5	+23.7
5-YR RP	+7.5	29.3	19.8	19.5	19.3	+22.9
2-YR RP	+7.3	26.6	19.6	17.7	19.1	+21.8
1-YR RP	+6.9	24.7	19.5	16.4	19.0	+20.7

The wave runup elevations are plotted in Figure 3-1. It can be seen that the 1-YR (annual) wave runup elevation corresponds well with the height of the sandbar. This makes sense as it is the more frequently recurring wave conditions (below the 1-YR wave runup height) that play a role in the formation of the sandbar. At the upper end of the scale, it can be seen that the 100-yr wave runup could reach about halfway up the bluff. The estimated 100-year wave runup corresponds well with the coastal BFE as determined by FEMA (2017), which is at +27.0 feet NAVD88.

3.3. Beach Erosion Potential

In ASCE (1998) Ahrens and Hands presented a method to predict the threshold for cross-shore movement of sand onto a beach. They defined the ratio:

$$U_t = u_{dmax}/u_{crit}$$

Where u_{dmax} is the maximum near-bottom orbital velocity of incident waves, u_{crit} is the critical velocity required to initiate sediment movement under the wave, and Ut is a relation describing the stability of the beach material, given by:

$$U_t = -0.519 N_s^{0.447} (d_b/L_0)^{0.569} exp[-3.523(d_b/L_0)]$$

In this relation, d_b, is the water depth at which wave breaking takes place, L_0 is the deep-water wave length, and N_s is the stability number of the beach material in relation to the wave height.

The deep-water wave length is given by:

$$L_0 = g\frac{T^2}{2\pi}$$

Where g is the gravitational acceleration and T is the wave period.

The stability number, also termed the mobility number, is defined as:

$$N_s = H_b/\Delta d_{50}$$

Where H_b is the breaking wave height, d_{50} is the average diameter of the beach material, and Δ is the relative density of the beach material given by:

$$\Delta = \frac{\rho_s}{\rho_w} - 1$$

Where ρ_s is the density of the beach material and ρ_w is the density of seawater.

The relative depth of wave breaking is:

$$d_b/L_0 = 0.109\ ln[(1+x)/(1-x)]$$

Where $x = 2.69(H_0/L_0)^{0.72}$

The breaking wave height H_b at the depth of wave breaking d_b can then be determined from:

$$H_b/d_b = 0.171(L_0/d_b)\ tanh[0.73(2\pi\, d_b/L_0)]$$

The breaking wave height is also related to the offshore incident wave height H_0 via the relation:

$$H_b/H_0 = 0.46(H_0/L_0)^{-0.28}$$

Data for offshore wave heights and wave periods is recorded by NDBC buoys. The above equations provide a framework by which the potential to remove sand from the beach or deposit sand on the beach can be assessed for each incident wave. Large waves will e.g. start breaking far out from shore, while very small waves will break close to the shoreline.

Figure 3-6 summarizes the mobility of the beach material on the CRSB in relation to incident waves. The wave conditions consist of hourly wave data recorded at NDBC buoy 46042 Monterey, NDBC (2021). The black curve represents the average threshold of sediment mobility on the beach. Wave data falling below this curve produce accretion on the beach and buildup of the sandbar. Wave conditions above this curve cause erosion of the beach material. The region close to the black curve indicated by the gray lines is a transition region where slight shifts in the accretion/erosion regime can occur, e.g. due to variations in the size gradation of the beach material.

The blue bands in the figure categorize wind-waves with wave periods of 3-4, 4-5, 5-6, 6-7, and 7-8 seconds ranging from light blue to dark blue. Swell waves are indicated by the yellow bands with wave periods ranging from 8-12, 12-16, 16-20, and 20-25 seconds.

It can be seen that both wind-waves and swell waves can contribute to beach erosion and accretion depending on the incident wave parameters, mainly the wave height in relation to the wave period.

For reference, select extreme swell wave conditions are indicated by the yellow data points with black outline shown in the figure. These events have return periods (RP) ranging from 1 to 100 years and occur progressively farther away from the erosion threshold (black curve). Further added, are select storm-wave conditions for wind-generated waves with return periods ranging from 1 to 100 years. These are indicated by the blue data points with black outline. These wave conditions are also erosive (above the black curve).

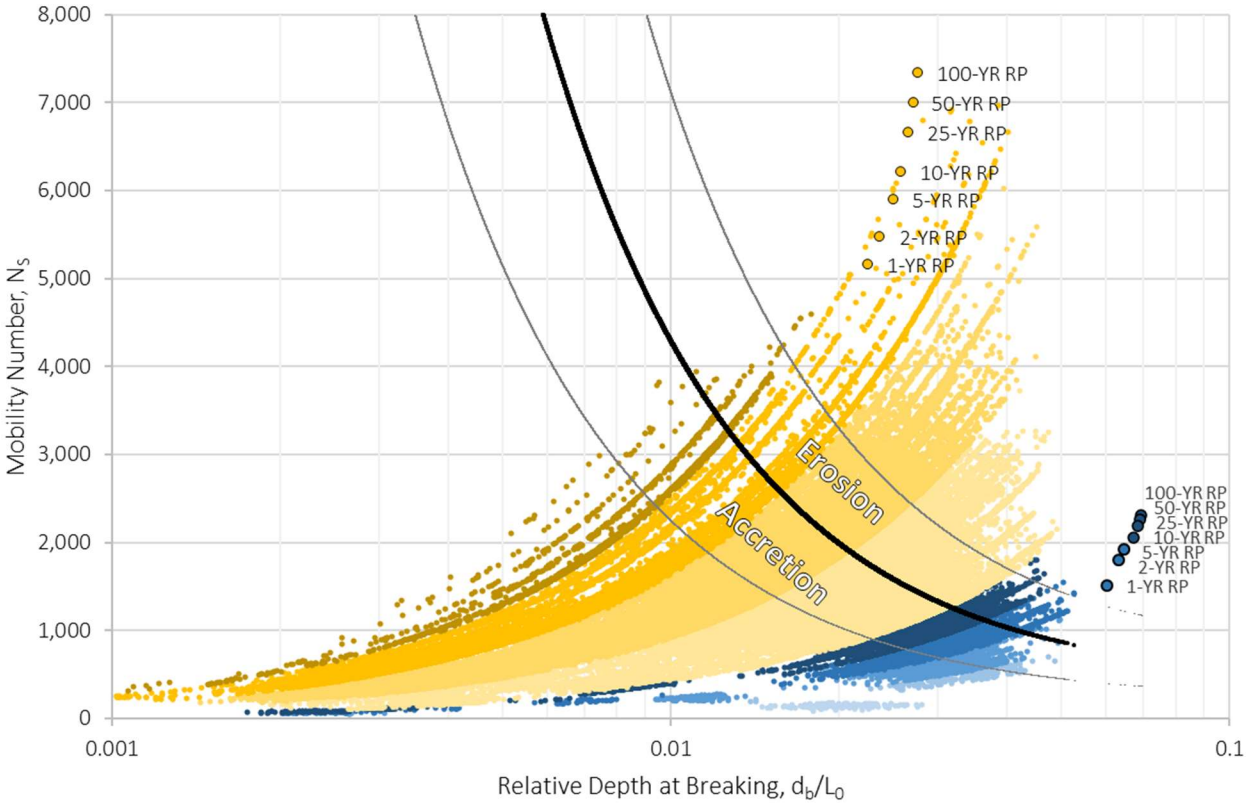


Figure 3-6: Beach response to wave action.

3.4. Recommended SRPS Location

The recommended location of the SRPS mid-slope wall is at the base of the previously eroded bluff line, approximately at El. +8 feet NAVD88. Refer to Figure 3-8. The recommended crest elevation of the wall is at +20 feet NAVD88, which is 4 feet above the fluvial BFE.

Installing the wall along this alignment achieves the following:

- The SRPS won't encroach on or damage the existing bluff, as the bluff face has previously eroded back to this level (purple profile shown in Figure 3-8).

- At typical beach levels, the SRPS mid-slope wall would be buried below the sand and would not present as a visual obstruction.
- Likewise, the wall would not pose an obstruction to public access to the beach.
- At the proposed height, the wall will accommodate a lagoon level up to +16 feet NAVD88 or higher (within the four-foot freeboard).
- The wall will prevent water flow from eroding the base of the bluff during a lagoon breach event; and
- The wall and slope stabilization will prevent wave runup from eroding the bluff.

The further inland the wall is located from potential wave runup, the less the potential for impact to the beach. And if located outside of the wave runup zone, could be demonstrated to cause no impact. If not impacted by waves, the wall would not contribute to wave reflection or scour, being some of the common concerns to be assessed for walls in the coastal environment.

This alternative was explored in the DEIR, DDA (2016) and was termed the SRPS Full Height Wall Alternative. This alternative places the wall alignment along the edge of Scenic Road and with the same crest elevation as the road, approximately elevation El. 38 feet NAVD88. A structure of this magnitude would require a comprehensive foundation solution and anchorage system, and while it would be able to retain the bluff and preserve vehicular access along Scenic Road it would not protect the portion of the bluff in front of the wall. The full height wall alternative would therefore not fully protect the existing bluff against erosion associated with lagoon breach events. Consequently, this alternative was rejected in the DEIR. Refer to DDA (2016).

The question is, would the SRPS mid-slope wall at the location proposed in Figure 3-8 have a potential to negatively impact the beach.

Figure 3-8 shows that the SRPS would be buried below the sand under most conditions and be located at the back of the beach where it would not actively interact with wave runup and beach morphological processes. The case when the SRPS could become exposed is after a lagoon breach event to the north. Based on historical observations, lagoon migration to the north along the bluff occurs in approximately 11% of cases, so about every 9 years on average, Thornton (2006).

In connection with a northerly lagoon breach, the beach level could erode down to about the base of the wall. This would be the situation shown in Figure 2-6. The photo demonstrates that under typical conditions of wave and tide level, wave runup would just about reach the base of the bluff where the SRPS mid-slope wall would be located.

Figure 3-7 summarizes the distribution of accretionary and erosive waves for the months of December and January, which is when lagoon breaches most commonly occur. Refer to Figure 1-1. The data shows that there would be a significant proportion of waves that would contribute to accretion and re-formation of the sandbar. However, the figure also shows that erosive waves could occur (portion of data points above the black curve). However, with the SRPS in place, episodes of erosive waves

would not be able to impact the bluff. Erosive waves would also be unlikely to significantly impact the beach level, which is likely to be near or at the level or the marine terrace hardpan following a lagoon breach event.

The large amounts of sand evacuated from the beach during a major breach event would be available to promote re-building of the sandbar and return of sand to the shoreline.

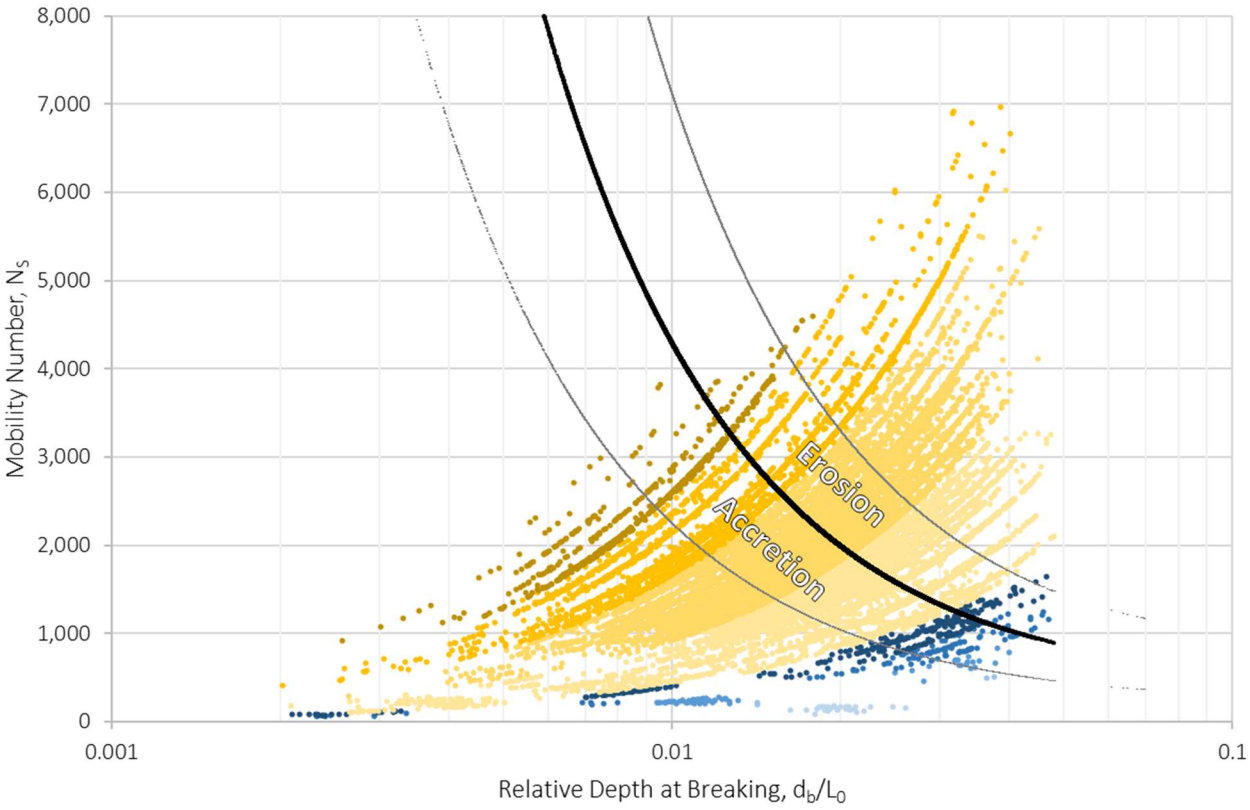


Figure 3-7: Accretion-Erosion distribution for waves in December and January.

Table 3-2 and Table 3-3 summarize wave runup by month of accretionary and erosive waves, respectively. The highest wave runup elevation of about +22 feet NAVD88 indicated in Table 3-3 shows that the wave record analysed encompasses conditions up to events with a recurrence interval of about 10 years (refer to Table 3-1). The 100-year wave runup elevation is estimated to be around El. +27 feet NAVD88.

The rightmost and leftmost columns in Table 3-2 and Table 3-3 show that both accretionary and erosive wave events can occur in the months of December and January. But show that there would be a propensity for accretionary wave conditions. Table 3-2 indicates that wave runup for about three quarters (72%) of incident accretionary waves in December and January would not reach the wall elevation. This was calculated as the summation of percentages below the dashed black line at El. +8 relative to the total percentage of accretionary waves in December and January.

A similar analysis for erosive waves (Table 3-3) shows that the wave runup of 1/3 of incident erosive waves would not reach the wall elevation (wave runup elevation below +8 feet NAVD88) and would consequently not interact with the wall. However, there would be a portion of erosive waves having a wave runup that could reach the base of the wall. As described above, these waves would likely not contribute to further erosion of the already lowered beach level. The SRPS would prevent these waves from further eroding the base of bluff.

The data presented above illustrates that there would be a good potential for the sandbar and beach to re-establish after having been washed out in connection with a lagoon breach. This is in agreement with what has been observed in the field, that a breach can close up shortly after a breach event when accretionary wave conditions are present. The analysis estimates that wave conditions are accretionary 60% of the time in December and January.

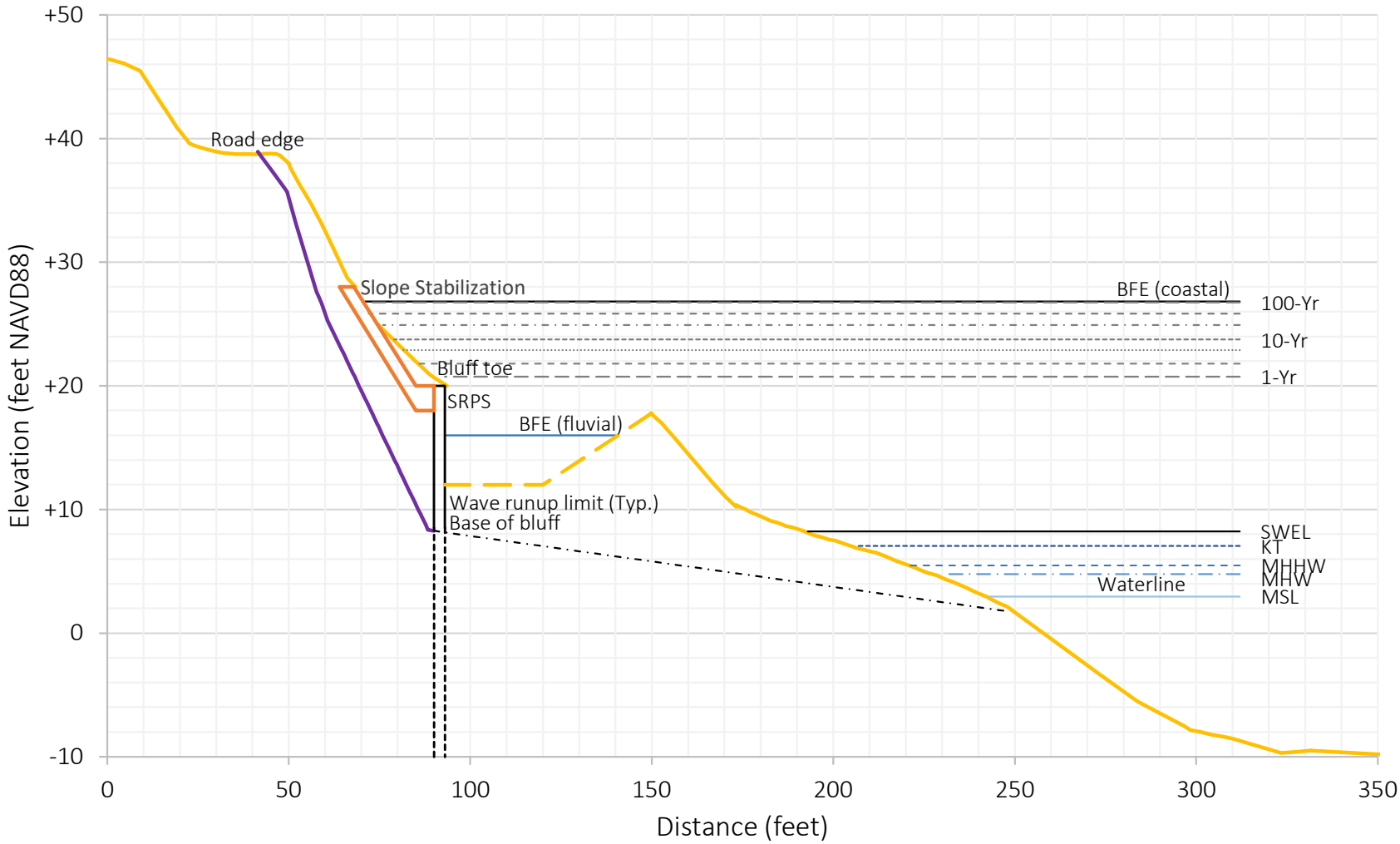


Figure 3-8: Recommended location and height of SRPS mid-slope wall.

Table 3-2: Distribution of wave runup elevation for accretionary waves.

Elevation	1	2	3	4	5	6	7	8	9	10	11	12
ft NAVD88	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
+27												
+26												
+25												
+24												
+23												
+22												
+21												
+20												
+19												
+18												
+17												
+16												
+15												
+14	0.002%	0.002%	0.001%								0.002%	0.002%
+13	0.013%	0.013%	0.003%	0.001%	0.001%				0.001%	0.001%	0.003%	0.014%
+12	0.059%	0.044%	0.017%	0.003%	0.001%				0.001%	0.011%	0.027%	0.073%
+11	0.200%	0.172%	0.073%	0.042%	0.015%	0.015%	0.014%	0.010%	0.025%	0.075%	0.121%	0.189%
+10	0.396%	0.376%	0.298%	0.198%	0.108%	0.087%	0.108%	0.072%	0.143%	0.314%	0.323%	0.419%
+9	0.688%	0.697%	0.698%	0.536%	0.331%	0.349%	0.456%	0.338%	0.555%	0.814%	0.763%	0.724%
+8	0.998%	0.851%	0.996%	0.969%	0.777%	0.808%	0.944%	0.931%	1.180%	1.369%	1.109%	0.982%
+7	0.978%	0.919%	1.093%	1.192%	1.368%	1.300%	1.529%	1.504%	1.558%	1.403%	1.153%	0.901%
+6	0.749%	0.725%	0.949%	1.043%	1.487%	1.473%	1.882%	1.801%	1.529%	1.176%	0.894%	0.689%
+5	0.505%	0.453%	0.754%	0.769%	1.087%	1.085%	1.396%	1.562%	1.218%	0.833%	0.661%	0.442%
+4	0.287%	0.286%	0.407%	0.520%	0.738%	0.643%	0.794%	1.000%	0.749%	0.500%	0.427%	0.318%
+3	0.145%	0.113%	0.150%	0.256%	0.477%	0.428%	0.544%	0.574%	0.347%	0.205%	0.202%	0.164%
+2	0.056%	0.041%	0.034%	0.070%	0.228%	0.218%	0.270%	0.234%	0.092%	0.037%	0.046%	0.057%
+1	0.010%	0.017%	0.010%	0.018%	0.039%	0.062%	0.063%	0.041%	0.003%	0.005%	0.010%	0.012%
0	0.004%	0.001%	0.001%	0.001%	0.003%	0.008%	0.005%	0.001%			0.002%	0.005%
Total	5.1%	4.7%	5.5%	5.6%	6.7%	6.5%	8.0%	8.1%	7.4%	6.7%	5.7%	5.0%

Table 3-3: Distribution of wave runup elevation for erosive waves.

Elevation	1	2	3	4	5	6	7	8	9	10	11	12
ft NAVD88	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
+27												
+26												
+25												
+24												
+23												
+22	0.002%											
+21	0.001%											0.001%
+20	0.001%	0.001%									0.001%	
+19	0.002%	0.002%									0.002%	0.002%
+18	0.007%	0.001%									0.001%	0.005%
+17	0.010%	0.002%		0.001%							0.003%	0.006%
+16	0.020%	0.004%	0.002%	0.001%							0.003%	0.015%
+15	0.044%	0.009%	0.011%	0.003%							0.011%	0.031%
+14	0.095%	0.034%	0.019%	0.003%						0.002%	0.021%	0.089%
+13	0.164%	0.080%	0.051%	0.013%	0.003%				0.001%	0.015%	0.058%	0.157%
+12	0.306%	0.195%	0.148%	0.050%	0.011%	0.008%	0.001%	0.002%	0.010%	0.059%	0.157%	0.274%
+11	0.460%	0.375%	0.298%	0.172%	0.048%	0.034%	0.006%	0.010%	0.045%	0.137%	0.277%	0.481%
+10	0.561%	0.487%	0.463%	0.346%	0.141%	0.116%	0.022%	0.030%	0.102%	0.278%	0.419%	0.664%
+9	0.558%	0.605%	0.562%	0.477%	0.254%	0.216%	0.063%	0.066%	0.141%	0.360%	0.516%	0.631%
+8	0.479%	0.493%	0.565%	0.496%	0.374%	0.359%	0.095%	0.086%	0.167%	0.332%	0.399%	0.473%
+7	0.317%	0.356%	0.407%	0.454%	0.406%	0.368%	0.116%	0.087%	0.143%	0.253%	0.270%	0.298%
+6	0.213%	0.217%	0.289%	0.303%	0.254%	0.277%	0.084%	0.060%	0.116%	0.180%	0.193%	0.209%
+5	0.104%	0.111%	0.141%	0.180%	0.173%	0.198%	0.047%	0.054%	0.066%	0.101%	0.099%	0.112%
+4	0.040%	0.043%	0.041%	0.078%	0.117%	0.120%	0.029%	0.018%	0.021%	0.024%	0.035%	0.035%
+3	0.013%	0.011%	0.006%	0.024%	0.042%	0.033%	0.015%	0.003%	0.003%	0.003%	0.004%	0.012%
+2	0.001%	0.001%			0.003%	0.008%	0.005%				0.002%	0.001%
+1							0.001%					
0												
Total	3.4%	3.0%	3.0%	2.6%	1.8%	1.7%	0.5%	0.4%	0.8%	1.7%	2.5%	3.5%

4. Conclusions

The findings of the analysis provided herein lead to a proposed SRPS mid-slope wall location along the base of the previously eroded bluff. Refer to Figure 3-8 for a typical cross-section along Scenic Road showing the proposed SRPS location in relation to beach levels, tide levels and wave runup elevations.

The recommended crest elevation of the SRPS mid-slope wall is +20 feet NAVD88 in order to accommodate and provide a freeboard above the lagoon fluvial BFE at +16 feet NAVD88. Slope stabilization will be incorporated above El. +20 feet NAVD88 to protect the bluff against wave runup.

Installing the SRPS along this alignment achieves the following:

- The SRPS won't encroach on or damage the existing bluff, as the bluff face has previously eroded back to this level (purple profile shown in Figure 3-8).
- At typical beach levels, the SRPS will be buried under the sand and will not pose a visual obstruction.
- When buried under the sand, the SRPS will not pose an obstruction to public access to the beach.
- With the proposed crest elevation of +20 feet NAVD88, the SRPS mid-slope wall will accommodate a lagoon water level up to +16 feet NAVD88 or higher (within the four-foot freeboard).
- The SRPS will prevent water flow from eroding the base of the bluff during a lagoon breach event.
- The mid-slope wall and slope stabilization above it will prevent wave runup from eroding the bluff.
- The SRPS will not negatively impact lagoon formation or the beach.

It should be noted that the time from December to January when lagoon breach and sandbar management commonly takes place embodies the most energetic and changeable conditions of the lagoon, sandbar, and ocean conditions. This is the time when:

- The lagoon can be subject to large inflows from the Carmel River leading to rapid changes in the lagoon water level.
- High water levels in the lagoon can approach flood stage for properties around the lagoon.

- The wave climate is the most dynamic. The passage of winter storm systems can generate high surf conditions, and swell waves from distant storm systems can be at their most energetic.

- Consequently, the beach and sandbar morphology are highly dynamic. Examples of this observed in the field, include the sandbar being overtopped by waves infilling the lagoon with seawater; intermittent formation of lagoon breaches and their closure due to sediment deposition by wave action; migration of breach openings north or south along the beach; and washout of large quantities of beach material during lagoon breach events.

An analysis of wave runup and beach erosion potential demonstrates that there is a potential for wave runup to interact with the SRPS if the beach level is lowered in connection with a northerly lagoon breach. Thornton (2006) estimates that northerly breach events occur every 9 years on average (in 11% of cases). Results of the beach erosion potential and wave runup analysis indicates that the sandbar would re-form when accretionary wave conditions are present. The analysis estimates that wave conditions are accretionary 60% of the time in December and January when lagoon breach and sandbar management commonly take place.

References

BH (2014). *The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report.* Prepared for: Monterey County Resource Management Agency. Prepared by: Edward D. Ballman, P.E. and Anne E. Senter. Balance Hydrologics, Inc. January 2014.

CE (1998). *Parameterizing Beach Erosion/Accretion Conditions.* By: John P. Ahrens, affiliate member and Edward B. Hands. Coastal Engineering 1998.

ASCE (1998). *Velocity Parameters for Predicting Cross-Shore Sediment Movement.* By: Ahrens, J.P and Hands, E.B. ASCE Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 124, No. 1, 16-20. 1998.

County of Monterey (2021). Carmel River Lagoon Water Years 2011-2021 Breach Information. Carmel River Lagoon Water Year 2011-2017 Breach Info & Timeline. County of Monterey, November 2021.

DDA (2016). *Carmel Lagoon Ecosystem Protective Barrier, Scenic Road Protection Structure, and Interim Sandbar Management Plan Project.* Draft Environmental Impact Report, SCH#2014071050. Prepared for: County of Monterey. Prepared by: Denise Duffy & Associates, Inc. December 2016.

EurOtop (2018). *Manual on wave overtopping of sea defences and related structures.* Van der Meer, J.W., Allsop, N.W.H., Bruce, T., De Rouck, J., Kortenhaus, A., Pullen, T., Schüttrumpf, H., Troch, P. and Zanuttigh, B., www.overtopping-manual.com. Second Edition 2018.

FEMA (2017). *Flood Insurance Rate Map.* Monterey County, California and Incorporated Areas. Panel 316 of 2050. Suffix: H. Version Number: 2.3.2.1. Map Number: 06053C0316H. Map Projection: Universal Transverse Mercator Zone 10N, North American Datum of 1983, North American Vertical Datum of 1988. FEMA, Federal Emergency Management Agency, National Flood Insurance Program. Map Revised: June 21, 2017. Reissued on July 27, 2018.

Komar (1998). *Beach Processes and Sedimentation.* Prentice-Hall, Inc. 544 pages. By: Komar, P.D., 1998.

MPWMD (2005). *Surface Water Dynamics at the Carmel River Lagoon Water Years 1991 through 2005.* Prepared by: Greg. W. James. Monterey Peninsula Water Management District. October 2005.

NDBC (2021). *National Data Buoy Center.* National Oceanic and Atmospheric Administration's Center of Excellence in Marine Technology. National Data Buoy Center, Bldg. 3205, Stennis Space Center, MS 39529.

Thornton (2006). *Littoral Processes and River Breachings at Carmel River Beach.* By: Edward B. Thornton, Naval Postgraduate School, Monterey, CA 93943.

Appendix A:

Water Level Datums

Coastal water level datums at the project site are summarized in the table below based on data from NOAA Station 9413450 at Monterey, NOAA (2021). The values in the upper and lower part of the table reflect water level extremes due to a combination of astronomical tide and meteorological effects producing storm surge (positive or negative). The values in the center portion of the table indicate datums for astronomical tides only. Further included in the table, reference to commonly used vertical datums: NGVD29 and NAVD88. The elevations for the one percent annual chance Stillwater Elevation (SWEL) and coastal/fluvial Base Flood Elevation (BFE) are from FEMA (2017). The coastal BFE represents the 100-year total water level (including wave runup) rounded to the nearest whole foot. The fluvial BFE is representative of the estimated 100-year water level in the Carmel River Lagoon.

Table A-1: Water Level Datums.

Water Level Datum	Feet NAVD88	Description
BFE (coastal) [a)]	+27.00	1% Annual Chance Coastal Base Flood Elevation.
BFE (fluvial) [b)]	+16.00	1% Annual Chance Fluvial Base Flood Elevation.
SWEL (100-yr)	+8.22	1% annual chance high water level.
50-yr	+8.06	2% annual chance high water level.
10-yr	+7.73	10% annual chance high water level.
5-yr	+7.56	20% annual chance high water level.
HAT	+7.18	Highest Astronomical Tide
KT	+7.04	King Tide
MHHW	+5.48	Mean Higher High Water
MHW	+4.78	Mean High Water.
MTL	+3.01	Mean Tide Level.
MSL	+2.97	Mean Sea Level.
NGVD29	+2.73	National Geodetic Vertical Datum of 1929.
MLW	+1.23	Mean Low Water.
MLLW	+0.14	Mean Lower Low Water.
NAVD88	0.00	North American Vertical Datum of 1988.
LAT	-1.77	Lowest Astronomical Tide.
5-yr	-1.85	20% annual chance low water level.
10-yr	-1.98	10% annual chance low water level.
50-yr	-2.15	2% annual chance low water level.
100-yr	-2.21	1% annual chance low water level.

a) FEMA Transect 60
b) FEMA Transect 61

APPENDIX H

Hydrological Studies

This Page Intentionally Left Blank

Memo

To: Richard Weber, P.E., Whitson Engineers

From: Eric Riedner, P.E. and Edward Ballman, P.E.

Date: May 28, 2013

Subject: Carmel River Lagoon EPB- Riverine Flooding Impacts Assessment

This memorandum summarizes the riverine flooding impacts assessment completed for a range of potential alignments and elevations that have been proposed for the Ecosystem Protective Barrier (EPB) project. The focus of this assessment is a hydraulic analysis comparing modeled water surface elevations for pre- and post-project conditions along the lower Carmel River during the 100-year flood event.[1]

This memo was prepared for use by Monterey County, the Monterey County Water Resources Agency (MCWRA), and the project team to aid in the selection of a preferred EBP alignment for further refinement and presentation in the final project reporting.

Hydraulic Model Description

The hydraulic model used to complete the analysis was provided by the MCWRA and was developed as the technical basis for the update to the FEMA Flood Insurance Study (FIS) made effective in 2009. The FEMA model was built on the Army Corps of Engineers HEC-RAS software platform and developed to use steady state flow calculations.

The portion of the model covering the lower Carmel River quantifies flooding hazards influenced by both riverine and lagoon flooding processes. According to the technical documentation provided with the model, calculated flood depths resulting from riverine flooding conditions were compared to a statistical analysis of measured annual peak stages in the lagoon with the final water surface profiles and flood hazard mapping based on the higher of the two results. During the 100-year flood event, riverine flooding was estimated to produce higher water surface elevations at all but the downstream-most cross section in the model (Section 3+80).[2]

The potential failure of uncertified levees separating the main channel from the north and south overbank areas was addressed in the FIS through developing multiple model runs for "with levee", "without north overbank levee", and "without south overbank levee" conditions. The respective flood elevations ("base flood elevation" or BFE) in the floodplain were defined using

[1] The 100-year flood is the flood event predicted to have a 1-percent chance of occurring in any given year. In fact, "1-percent chance flood event" is gaining acceptance as a more accurate name. However, this memo will use the more traditional terminology of the "100-year flood".

[2] The currently-effective Flood Insurance Rate Map shows an extended area of floodplain with a base flood elevation of 16 feet covering essentially all of the Lagoon area. This does not imply a flat flood surface elevation, but rather results from the mapping convention of rounding elevations to the nearest whole number.

the highest calculated water surface elevations from each model run. An overview of the FEMA modeling results for existing conditions along the lower Carmel River is provided in the FEMA FIRM (Flood Insurance Rate Map) panel attached as Figure 1.

Summary of Modeled EPB Alignments and Elevations

Potential impacts of the EPB to riverine hydraulics were assessed by modifying the currently-effective FEMA modeling for the changes in channel geometry associated with selected EPB alignment scenarios. Consistent with FEMA modeling guidelines, the original HEC-RAS model was run to demonstrate fidelity with the BFE information in the FIS and as shown on the FIRM panel for existing conditions. Once model performance for existing conditions was confirmed, the geometry of the channel cross-sections was modified to reflect the alignment of the EPB for the selected scenarios. The proposed alignments were imported into the modeling work map so that a vertical wall feature could be added to the respective cross-sections at the appropriate locations. Area behind the EPB was changed to "ineffective flow area", however, the underlying assumption in all cases was that final EPB heights would be such that overtopping from riverine flood events (as contrasted with lagoonal flood events) would not occur.

Two separate EPB scenarios were modeled in detail. These included EPB Alignment #2(as described in previous technical memorandums) and EPB Alignment #2 in conjunction with EPB Extension 3A. The two alignments are more fully described as:

EPB Alignment #2

The EPB Alternative 2A alignment extends along the southern limits of the Fourth Addition neighborhood from approximately the intersection of Carmelo Street and 17th Avenue to the eastern end of the Carmel Unified School District property. This alignment would be offset a minimum of 40 feet into the State Parks parcel. A more detailed description of the EPB Alternative 2A can be found in other technical memorandums prepared for this project.

This alignment was represented in the hydraulic model primarily using the "levee" feature that was added to represent the wall location across 11 modeled cross sections from Main Channel Sections 5+93 through 2+206[3]. A workmap including the barrier location in relation to the modeled cross sections is included as Figure 2[4].

EPB Alignment #2 in conjunction with EPB Extension #3A

An additional alignment providing flood protection for Mission Ranch was considered and would entail extension of the EPB to the east. The alignment was selected in a manner that it could afford protection to the improvements on the property, but still provide an outlet for flood flow release from the Mission Fields neighborhood in cases where the north overbank area is inundated.

[3] Stations are used to label the modeled cross sections and are measured along the average flow paths for each of the modeled reaches. Stationing along the main channel is measured relative to the mouth of the river with the disconnected overbank stationing measured from their convergence with the main channel.

[4] The topographic data used for the workmap is consistent with the cross-section data from the currently-effective FEMA hydraulic model.

This alignment was represented in the hydraulic model primarily using the "levee" feature that was added to represent the barrier location across 13 modeled cross sections including Main Channel Sections 5+93 through 2+595 and North Overbank Sections 3+41 and 5+74. This alignment is also shown in Figure 2.

These alignments were selected for detailed hydraulic modeling as they would represent the maximum encroachment into the floodplain of all the EPB configurations. Therefore, they would be expected to frame the maximum potential impact to base flood elevations.

Each alignment was modeled with top of wall elevations of 16[5] and 19 feet (all elevations are presented in NAVD-88) for a total of 6 analyzed project alternatives, although the modeling confirmed that there are no differences from a riverine flood hazard perspective between the two top of wall elevations. Following the conventions of the FIS, each alignment was run for the three different potential flood conditions (levees intact, north bank levee failure, and south bank levee failure). The downstream tailwater condition was kept the same across all model runs.

Modeling Results and Conclusions

The modeled 100-year water surface elevations for the two EPB alignments are summarized in the attached Table 1.

Modeling results for EPB Alignment #2 predict that water surface elevations would be higher in the lagoon by an average of less than 0.01 feet in the immediate vicinity of the EPB relative to existing conditions during the 100-year flood event. The maximum increase is 0.02 feet at Section 22+06, located near the eastern end of the barrier in this alignment. Very minor increases in base flood elevations would extend upstream roughly to the western limit of the Carmel Area Wastewater District Treatment Plant. Base flood elevations are not predicted to increase in the north overbank area. Modeling results are identical for both the 16- and 19-foot elevation top of wall alternatives.

Modeling results for EPB Alignment #2 in conjunction with Extension #3A predict that water surface elevations would be higher than for EPB Alignment #2 as is expected with the larger floodplain encroachment. The maximum increase in the vicinity of the Fourth Addition would continue to be 0.02 feet at Station 22+06. The maximum increase in main channel BFE is predicted at Station 27+85, just downstream from the CAWD Treatment Plant, with the maximum increase adjacent to the plant shown as 0.04 feet at Station 29+72. BFE values in the north overbank would only be slightly higher immediately adjacent to the Mission Ranch property, with a maximum increase of 0.02 feet at the downstream-most Section 3+41. Again, modeling results are identical for both the 16- and 19-foot elevation top of wall alternatives as long as riverine flood flows are excluded by the EPB.

While the model does not explicitly assess potential impacts to flow patterns and erosion, the model does indicate that the lagoon along the proposed EPB alignment is in a relatively low

[5] The top of wall elevation of 16 feet would have to be increased slightly at the eastern end of Alignment Extensions #3A and #3B to avoid overtopping from flood flows moving through the north overbank. However, this alternative will be referred to herein as having a 16-foot top of wall.

energy environment due to the downstream flow restriction at the beach. The model estimates velocities across the impacted cross sections are low, averaging 1.4 feet/second, and are anticipated to be lower along the EPB away from the predominant flow path along the main channel.

Closing

Again, the results presented in this memo should be considered preliminary and are intended to inform the selection of key design considerations used to define a preferred interior drainage design alternative. After the preferred project alternative is identified, the associated design concepts and analyses will be refined and summarized in the Planning and Feasibility Analysis Report.

Do not hesitate to contact us if you have any questions or comments on the information presented in this memo.

Table 1. Modeled 100-year maximum water surface elevations for the analyzed Alternative #2A and extended EPB alignments

	Modeled 100-year Water Surface Elevations				
		16-foot Top of Wall Elevation		19-foot Top of Wall Elevation	
Cross-Section	Existing Conditions	Alignment #2A	Extended Alignment	Alignment #2A	Extended Alignment
	feet	*feet*	*feet*	*feet*	*feet*
Main Channel					
3+80	14.70	14.70	14.70	14.70	14.70
5+93	15.45	15.45	15.45	15.45	15.45
7+91	15.48	15.48	15.48	15.48	15.48
9+97	15.54	15.55	15.55	15.55	15.55
11+96	15.54	15.55	15.55	15.55	15.55
14+03	15.57	15.57	15.57	15.57	15.57
15+98	15.62	15.62	15.62	15.62	15.62
18+00	15.64	15.64	15.64	15.64	15.64
19+95	15.67	15.68	15.68	15.68	15.68
22+06	15.74	15.76	15.76	15.76	15.76
23+75	15.75	15.76	15.76	15.76	15.76
25+95	15.78	15.79	15.81	15.79	15.81
27+85	15.93	15.94	15.99	15.94	15.99
29+72	16.41	16.42	16.45	16.42	16.45
31+83	17.18	17.18	17.20	17.18	17.20
33+89	17.86	17.86	17.87	17.86	17.87
35+31	18.50	18.50	18.50	18.50	18.50
36+78	19.08	19.08	19.08	19.08	19.08
37+05	19.12	19.12	19.13	19.12	19.13
37+66	19.35	19.35	19.35	19.35	19.35
North Overbank					
3+41	15.99	15.99	16.01	15.99	16.01
5+74	16.67	16.67	16.53	16.67	16.53
8+22	17.50	17.50	17.47	17.50	17.47
10+84	19.12	19.12	19.12	19.12	19.12
12+65	20.34	20.34	20.34	20.34	20.34
14+09	20.37	20.37	20.37	20.37	20.37
15+06	20.38	20.38	20.38	20.38	20.38
16+40	20.63	20.63	20.64	20.63	20.63
South Overbank					
3+63	15.43	15.43	15.43	15.43	15.43
4+71	15.65	15.65	15.65	15.65	15.65
6+85	16.01	16.02	16.02	16.02	16.02
8+03	16.08	16.08	16.08	16.08	16.08
9+16	16.10	16.10	16.10	16.10	16.10
10+46	16.11	16.11	16.11	16.11	16.11
12+72	16.14	16.15	16.15	16.15	16.15
14+30	16.20	16.20	16.20	16.20	16.20
17+09	16.30	16.31	16.31	16.31	16.31
20+99	16.46	16.46	16.46	16.46	16.46
24+82	16.63	16.64	16.64	16.64	16.64
26+34	16.73	16.74	16.74	16.74	16.74
28+40	16.89	16.90	16.90	16.90	16.90

Notes:

1. Cross-section numbering as per the currently-effective FEMA hydraulic model. See Figure 2 for location of the cross-sections.

2. Note that the top of the EPB for the 16-foot alternative would be raised above the predicted 100-year water surface at Stations3+41 and 5+74 in the North Overbank to preclude flood flows from overtopping the EPB at the upstream end.

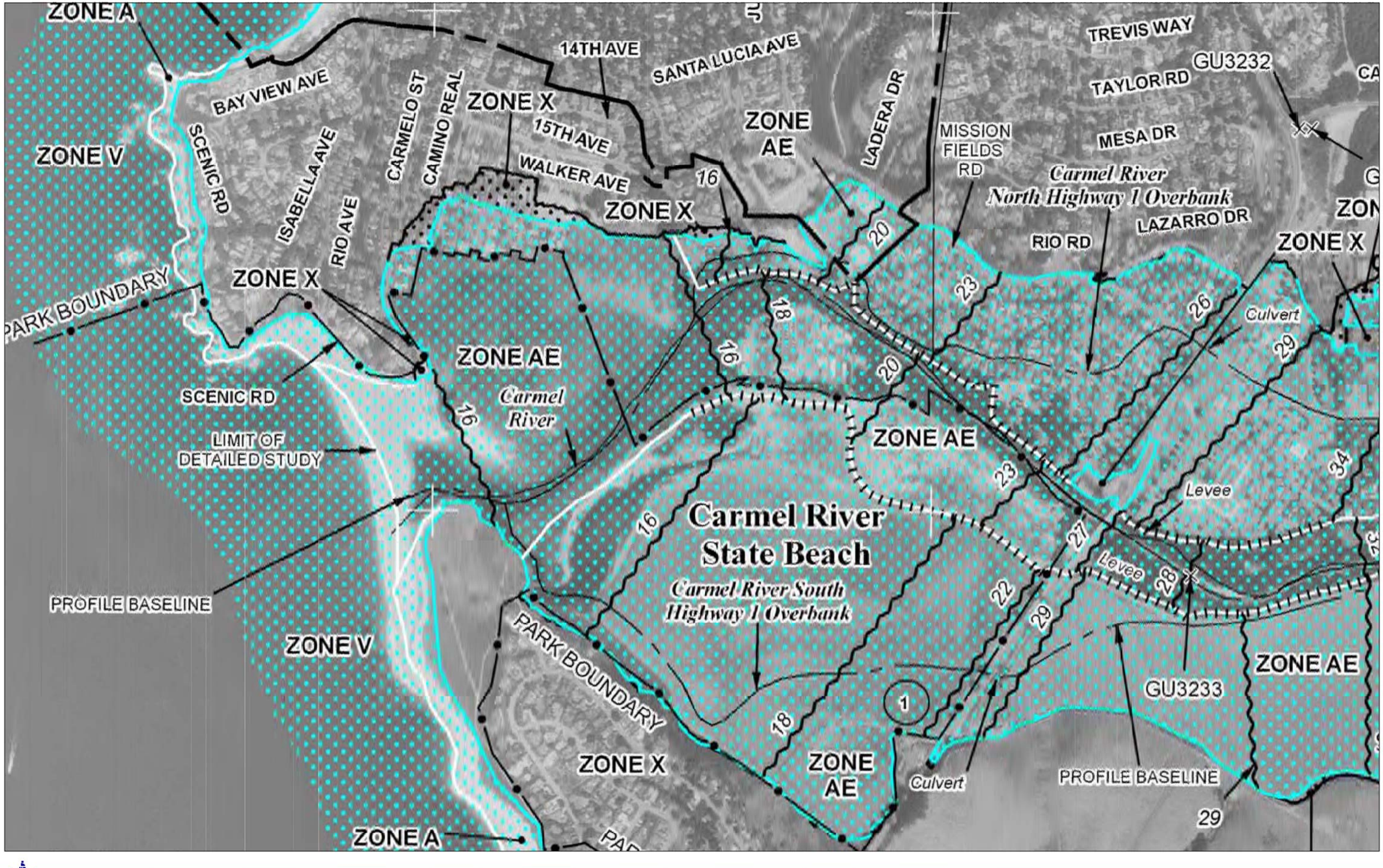


Figure 1. Detail from FEMA Flood Insurance Rate Map, Lower Carmel River Valley, County of Monterey.

Detail taken from FEMA FIRM Map Number 06053c0320G

Balance Hydrologics, Inc.

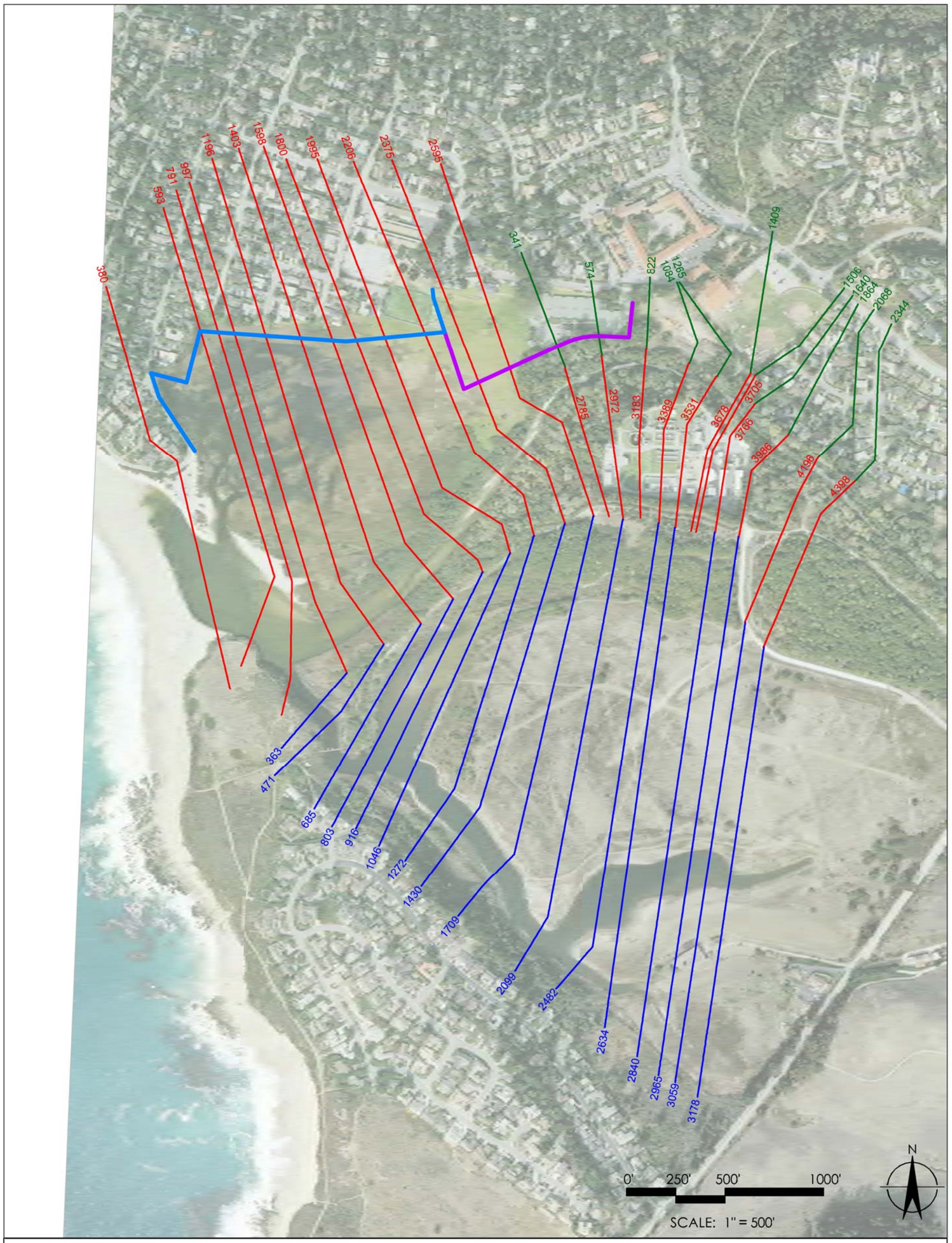
211067 Hydraulics Workmap Figure 1.dwg

0' 300' 600' 1200'

SCALE: 1" = 600'

N

©2013 Balance Hydrologics, Inc.



LEGEND

1265 — NORTH OVERBANK FEMA CROSS-SECTION AND LABEL

3389 — MAIN CHANNEL FEMA CROSS-SECTION AND LABEL

2840 — SOUTH OVERBANK FEMA CROSS-SECTION AND LABEL

ECOSYSTEM PROTECTIVE BARRIER ALIGNMENT #2

ECOSYSTEM PROTECTIVE BARRIER EXTENSION #3A

Balance Hydrologics, Inc.

Figure 2. HEC-RAS Model Workmap, Ecosystem Protection Barrier Project, County of Monterey

211067 Hydraulics Workmap 130417.dwg

©2013 Balance Hydrologics, Inc.

This Page Intentionally Left Blank



The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Breaching Dynamics for the Carmel River-Lagoon Biological Assessment Report

Prepared for:

Monterey County Resource Management Agency

Prepared by:

Edward D. Ballman, P.E. and Anne E. Senter

January 2014

Balance Hydrologics, Inc.®

TABLE OF CONTENTS

1 INTRODUCTION **1**

1.1 Project Description *1*

1.2 Purpose and Objectives of this Report *2*

1.3 Literature Review *2*

2 NATURALLY FUNCTIONING LAGOONS ALONG THE CALIFORNIA COAST **3**

2.1 Natural Sand Barrier Breaching Behavior *3*

2.2 Natural Perched Lagoon Morphology *4*

2.3 Natural Closed Lagoon Conditions *4*

2.4 Natural Surface Water-GW Interactions *5*

2.5 Ecosystem Benefits of a Naturally Functional Lagoon *6*

3 IMPLICATIONS OF IMPAIRED LAGOON BEHAVIOR **8**

3.1 Impaired Sand Bar Breaching Behavior *8*

3.2 Impaired Lagoon Morphology during Open Conditions *9*

3.3 Impaired Conditions during Lagoon Closure *9*

3.4 Impaired GW-Surface Water Interactions *10*

3.5 Ecosystem Effects of an Impaired Lagoon *10*

4 IMPAIRED PROCESSES IN CARMEL LAGOON **12**

4.1 Deleterious Impacts Related to Artificial Sand Bar Breaching Behavior *16*

4.2 Impaired Conditions Related to Artificial Sand Bar Breaching Behavior *16*

4.3 Impaired Lagoon Morphology during Open Conditions *21*

4.4 Impaired Conditions at Lagoon Closure *25*

4.5 Impaired GW-Surface Water Interactions *28*

4.6 Impaired Conditions Related to Carmel Lagoon Ecosystem Health *30*

5 ANTICIPATED RESPONSE OF CARMEL LAGOON TO PROJECT IMPLEMENTATION **32**

5.1 Anticipated Sand Bar Dynamics without Artificial Breaching *33*

5.2 Anticipated Lagoon Morphology *34*

5.3 Anticipated Conditions at Lagoon Closure *34*

5.4 Anticipated GW-Surface Water Interactions *35*

5.5 Anticipated Ecosystem Effects *35*

6 REFERENCES **36**

TABLE OF TABLES

Table 1. Carmel Lagoon first seasonal breach of each year **18**
Table 2. Carmel Lagoon breaching events and days open to ocean **22**
Table 3. Carmel Lagoon water surface elevations and estuary surface areas pre- and post-breaching **25**
Table 4. Carmel Lagoon final season closure dynamics **26**
Table 5. Carmel Lagoon perched morphology dynamics **27**

LIST OF FIGURES

Figure 1. Carmel Lagoon WSE and streamflow, WY2012 **15**

APPENDICES

Appendix A. Water surface elevations in Carmel Lagoon and streamflow in Carmel River at Highway 1 gage, WYs 1993-2012.

Appendix B. Compilation tables of riverine dynamics of breaches and closures, WYs 1993-2012.

1 INTRODUCTION

1.1 Project Description

Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sand bar Management Plan (ISMP) Project

The Carmel River Lagoon, located at the mouth of the Carmel River, is a very productive estuary which serves as rearing habitat for juvenile, federally listed South-Central California Coast steelhead. The Carmel River was designated as critical habitat for South-Central California Coast steelhead in September 2005. The ecosystem in and around the Carmel River Lagoon also supports other federally listed species such as the California red-legged frog, western snowy plover, and Smith's blue butterfly, and numerous other special-status species.

The Carmel River drains approximately 255 square miles of the Santa Lucia and Sierra de Salinas Mountains into the Carmel Bay. About 270 acres of the Carmel River Beach and Lagoon are owned by the State of California/California Department of Parks and Recreation (State Parks). Other property owners within the Lagoon include Carmel Area Wastewater District (16 acres), Carmel Unified School District (9 acres), City of Carmel-by-the-Sea (6 acres), and Homestead Inn/Mission Ranch (16 acres). Public and private stakeholders have worked together over the past decade to identify best management practices that would maintain the Carmel Lagoon in a more natural state (MPWMD, 2007).

The Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sand bar Management Plan (ISMP) Project (hereafter referred to as Project) is a comprehensive plan meant to promote improvement in ecological function of the Carmel Lagoon, including natural floodplain function and improvement of habitat for threatened and endangered species within the existing lagoon. The goal is to allow the lagoon to breach naturally, without increasing flood risk to private structures and public facilities. The EPB would provide protection from flooding to low-lying homes and other local Carmel-by-the-Sea infrastructure along the north edge of the Lagoon. The SRPS would provide protection along the northern sand cliffs from erosion associated with lagoon-ocean processes that might occur if sand bar management were to cease. The ISMP is an interim sand bar management plan meant to provide a short-term solution to potential flooding issues with select sand bar breaching actions that allow additional natural function in the lagoon while still protecting properties and infrastructure, with the understanding that the development

of the EPB and SRPS lead to potential long-term solutions that return the Lagoon, its sand bar, and associated riverine and ocean dynamics to more natural cycles.

1.2 Purpose and Objectives of this Report

The main objective of this report is to summarize both natural and impaired processes associated with the Carmel River Lagoon ecosystem from a riverine perspective. To do so, we present a descriptive hydrologic characterization of (1) how lagoon systems function naturally in Coastal California, (2) how current and past management practices impair Coastal California lagoon systems, (3) a quantitative and qualitative assessment of recent Carmel Lagoon function, and (4) an assessment of how implementation of the Project will work to restore more-natural functions in Carmel Lagoon. The term lagoon will be used in this report to represent both lagoonal and estuarine functions (i.e., systems closed and open to the ocean, respectively). Quantitative measures will be identified where possible to supplement qualitative findings from this and other lagoon systems.

1.3 Literature Review

Existing literature was reviewed to understand how naturally functioning lagoon systems along Coastal California promote healthy ecosystems for aquatic species, including steelhead. Further literature review revealed information on how management practices can negatively affected lagoon habitat.

2 NATURALLY FUNCTIONING LAGOONS ALONG THE CALIFORNIA COAST

Lagoons found along Coastal California have unique qualities with respect to semi-arid Mediterranean climate conditions, geologically active tectonics, relatively small watershed areas, and riverine processes associated with frequency and duration of lagoon openings and closures (Jacobs, et al., 2011). Streamflow plays a critical role via seasonal and episodic variability in the temporal pattern of lagoon openings and closures, and thus has a large effect on specific geomorphic and environmental conditions such as sand bar breaching behavior, lagoon morphology during open and closed conditions, groundwater-surface water interactions, and habitat quality. Such conditions are key drivers in the ability of aquatic and terrestrial species to successfully survive and thrive within this environment.

2.1 Natural Sand Barrier Breaching Behavior

The dynamics associated with a natural sand bar breach depend on the morphology of the sand bar itself, river discharge, and wave dynamics (Smith, 1990). In a naturally functioning lagoon ecosystem on the California coast, sand bar breaching occurs during the winter rainy season. Streamflows increase as rains begin. Depending on the watershed and precipitation patterns, flows may fill the lagoon to the point where riverine forces overcome sand bar stability and an outflow channel breach is created that releases impounded waters into the ocean.

Sand bar breaching can occur via an accumulation of low flows or from an abruptly larger flood flow. The outflow channel, once open, additionally provides a route for tidal flows to enter the lagoon. The morphology and elevation of the outflow channel to the ocean are important factors in the availability of lagoon habitat (NMFS, 2008; Alley, 2013), while water surface elevation (WSE), volume and depth of the lagoon are functions of streamflow as well as tidal fluctuations and ocean swells.

When low flows fill a lagoon to its full volume and then breach the sand bar, a sinuous outflow channel can develop, creating a pathway based on beach slope, sediment size, and longshore wave patterns (Smith, 1990; Thornton, 2005). Large flow events on the other hand, may create a breach at a point perpendicular to the bar resulting in a shorter and more direct outlet to the sea. But once a flood flow diminishes, it is likely that the outlet will migrate toward a pathway based on beach slope, sediment size, and longshore wave patterns.

2.2 Natural Perched Lagoon Morphology

Perched lagoon morphology is defined by NMFS (2008) as a lagoon with a WSE above mean high tide, and can refer to fresh water lagoons with closed sand bars as well as to lagoons where fresh water flows out to the ocean over the sand bar at the lagoon's mouth. Summer wave action that tends to deposit sand onto beaches helps build up beach berms (Jacobs et al., 2011). This elevational increase can create perched lagoon morphology by formation of a high berm combined with an outflow channel that provides the greatest ratio of fresh water to saline water during open-bar dynamics, as well as providing the highest lagoon WSE upon closure.

2.3 Natural Closed Lagoon Conditions

In Coastal California environments, with their associated dry-Mediterranean summers, streamflow generally decreases through the spring and into the summer months. As flow recedes, riverine processes are progressively less able to overcome the opposing ocean forces driving sand up and onto the bar. Eventually, this leads to the seasonal closure of the barrier bar at a point when river and any (generally small) groundwater (GW) inflows to the lagoon system are not sufficient enough to maintain an open outflow channel. The WSE associated with the final lagoon closure of the year is related to the morphology of the lagoon and whether the outlet channel is in a perched or non-perched state. When the outflow channel is perched (i.e. at a higher elevation and in an advantageous position that maximizes fresh water lagoon habitat), the initial WSE will be higher, thus accumulating an increasingly higher ratio of fresh water to brackish water while river discharge continues.

Because tidal exchange occurs until a sand bar closes, saline waters are generally present within the lagoon at closing. Salt water is denser than fresh water and thus tends to stratify into the lower layers of a lagoon. Conversion from highly saline conditions to more fresh water conditions occurs when fresh water river discharge forces salt waters against the inland side of the closed sand bar (Coates and Guo, 2003; NMFS, 2008). Because of stratification, a forcing mechanism exists at the boundary between the two layers. The upper wedge of fresh water pushes the salt water wedge against the porous sand bar. If there are enough fresh water flows, three processes can occur: entrainment, which carries a mixture of fresh water and salt water into the ocean if a shallow or intermittent channel remains open to the ocean; mixing, which de-stratifies the lagoon and blends the stratified layers together, moderating salinity values; and seepage of salt water through the permeable sand bar and out of the lagoon (Smith, 1990; Debler and Imberger, 1996; NMFS, 2008; Zhang et al, 2008). All of these processes can play a role in the conversion of a lagoon to fresh water. The

conversion can take more than a month after sand bar closure (Smith, 1990), and generally depends on continuation of fresh water flows into the lagoon.

An additional element in these complex systems is that of ocean waters entering the lagoon while the sand bar is closed. This occurs primarily through wave overtopping, but also through seepage into the lagoon through the sand bar—seepage can occur in either direction and is mainly a function of tides (Watson and Casagrande, 2004). Seepage out of the lagoon may happen when tides are out, while seepage into the lagoon may happen when tides bring waves onto the beach and against the sand bar.

Overtopping is a function of wave energy. Higher energy waves crash onto a sand bar and overtop it, adding small to large volumetric quantities of salt water to the lagoon (Thornton, 2005; Moffatt and Nichols, 2013). Along the California coast, wave energy decreases in the late spring and summer and increases in the fall and winter. The addition of salt water into the lagoon in late summer/early fall while the lagoon remains closed increases WSEs and salinity values in the lagoon, generally lowering water quality shortly before rains begin to contribute streamflows, which then provide relief with better water quality (Hayes et al., 2011).

2.4 Natural Surface Water-GW Interactions

Once a coastal lagoon is in a closed configuration, WSEs and water quality are governed by a balance of outflows (seepage through the bar and evaporation), the aforementioned salt water inflows, and fresh water inflows (stream baseflow and GW inflows).

With the degree of variability in Mediterranean climate conditions in California, most lagoon systems experience some degree of closure under natural conditions (Jacobs et al., 2011). From a fresh water fisheries perspective, ideal summer conditions would occur when waters of a closed lagoon system convert to fresh water before streamflows stop, be it in late spring or over the summer, depending on flow persistence. When streamflows cease, GW inflows from the local aquifer become the single source of additional fresh water influxes into the lagoon system, and must partially counteract evaporation rates and barrier bar seepage rates, at least to some degree, if fresh water conditions are to be maintained over the course of lagoon closure.

GW aquifer storage levels are predicated on antecedent hydrologic conditions of the previous and current year, and potentially over a longer time frame following drought conditions or excessive GW pumping. In a best-case scenario, there would be no GW

pumping or instream diversions, and aquifer storage capacities would be at potential maximums depending on precipitation and runoff. In many Coastal California settings, GW storage has been greatly reduced by mechanical pumping of water for agriculture and municipal uses. At the bottom of a coastal watershed, salt water and fresh water 'compete', such that salt water can encroach landward into fresh water aquifers. When fresh water aquifers are full enough, gradients that push seaward generally keep salt water intrusions from encroaching into fresh GW supplies (Jacobs et al., 2011). When excessive GW pumping creates over-drafting of the aquifer, a fresh water gradient reversal can occur, and seawater intrusions can infiltrate into local coastal water supplies. Such dynamics are of great concern to coastal communities (e.g. Johnson, 2007). GW inflows into lagoons become important particularly once surface flows cease for the summer, and are the only counteractive to evapotranspiration in terms of fresh water inflows.

Persistent GW seepage likely occurred in lagoons along the coast prior to GW extractions and continues today in some systems, potentially providing fresh water supplies for good quality habitat during yearly lagoon closures. Pumping likely has reduced GW contributions to lagoon ecosystems, depending on local conditions (PWA, 2007). A comparison of two instances showed that a GW gradient indicating a small but valuable GW input rate relative to the potentially progressive decline in water quality through the dry summer months has been found in Carmel Lagoon (Larson et al., 2006), while numerous springs and seeps in the vicinity of Elkhorn Slough have disappeared since the 1940's, likely due to GW pumping (Van Dyke and Wasson, 2005).

2.5 Ecosystem Benefits of a Naturally Functional Lagoon

Naturally functioning lagoon ecosystems provide myriad, year-round benefits to aquatic and terrestrial species, including high habitat diversity, abundant invertebrate food sources, and refugia from predators and other environmental stressors (Cannatta, 1998). Steelhead thrive in conditions where abundant invertebrates are found (Larson et al., 2005). Tolerance capability of invertebrates to salinity provides a good indicator of the ability of the system to support good rearing habitat for steelhead (NMFS, 2008; pers. comm. J. Pearson-Meyer, 2013).

In California when lagoons are opened in the winter season by river discharge, full mixing of fresh water and salt water can provide opportunities for fish to thrive (Smith, 1990). When lagoons close at the beginning of the dry season, river discharge generally is still flowing at low rates, in which case with enough end-of-season inflow the lagoon can naturally convert from stratified saline conditions to fresh water conditions. In fresh water conditions, studies have shown that steelhead smolts have a higher survival rate

and greater growth rates (Smith, 1990) as well as greater densities in lagoon systems (NMFS, 2008, Table 12). Steelhead smolt growth rates in Scott Creek Lagoon, California were higher than those rearing in the upper watershed, leading to conclusions that lagoon habitat conditions that promoted steelhead growth and survival were strong predictors of ocean survival (Hayes et al., 2008; Bond et al., 2008).

3 IMPLICATIONS OF IMPAIRED LAGOON BEHAVIOR

Lagoon ecosystems found along Coastal California have experienced high degrees of modification due to human interactions. Development of towns and cities and associated infrastructure has had multiple negative effects on these ecosystems (Van Dyke and Wasson, 2005). Impaired lagoon/estuarine ecosystems are not able to provide the full range of benefits to aquatic and terrestrial species that are required for healthy ecosystem function. Modifications leading to impaired lagoon ecosystem function include: alteration of the natural cyclical opening and closure of the lagoon by breaching and closing the sand bar artificially; encroachment onto the lagoon floodplain via infill, built structures, and agricultural uses; channelization of the river; diversions of streamflow; GW pumping; and loss of sediment supply via hardening of channel banks and damming.

Although each modification could be discussed in depth, this chapter will focus on alteration of the natural cyclical opening and closure of the lagoon by breaching and closing the sand bar artificially. The negative impacts associated with manipulation of natural barrier bar processes can propagate through each water year and potentially beyond, producing negative effects to bar morphology, sediment transport, water quality, and water volume in the coastal lagoons.

3.1 Impaired Sand Bar Breaching Behavior

Artificial barrier bar breaching can negatively affect lagoon health by promoting formation of a wide and deep outflow channel that removes large quantities of sand from the beach. This can cause fresh water to flush from a lagoon into the ocean prematurely and at a rapid rate, likely opening the lagoon earlier than if a natural breaching regime were in place. Once fresh water has been flushed, the often deep and direct outlet channel allows large quantities of seawater into the lagoon, which results in an abrupt increase in salinity levels that may not be tolerated by aquatic organisms, particularly juvenile fish.

Salinity gradients drive other water quality parameters such as temperature and dissolved oxygen. When salinity concentrations are high, lagoons stratify and the saline layer sinks to the bottom. Dissolved oxygen concentrations decrease, and high salinity promotes heat absorption, raising temperatures (NMFS, 2008). In Pescadero Creek, artificial sand bar breaching has led to steelhead die-offs, likely caused by very low dissolved oxygen concentrations (Smith, 1990; Sloan, 2006). Increased salinity can drive fish into shallower waters, exposing them to increased predation and potential

stranding, forcing out-migration of fish before they are ready for the ocean environment, and decreasing productive lagoon habitat (Smith, 1990; NMFS, 2008).

3.2 Impaired Lagoon Morphology during Open Conditions

Since wave action continually moves sand onto and off of beaches, and streamflows may not be large enough to keep a breach open, there are instances where artificial breaching is performed multiple times a year in order to promote an open lagoon condition (Smith, 1990; e.g. MPWMD, 2013). This intermittent disruption of lagoon waters suggests that what should be equilibrium conditions within the lagoon prior to natural opening are instead punctuated with large spikes of abruptly changing water quality. Eventually, streamflows may be large enough to keep an outlet channel open, yet if the channel has been artificially placed, it is unknown where a natural channel would have formed, where it potentially would have moved to, or what geometry such channels would have had in the case where natural breaching occurred.

When artificial breaches are cut across a beach directly perpendicular to the river mouth, this practice could affect any further evolving morphology of the outflow channel and the remaining beach berm. This action could propagate through the year, leading to a situation where the outflow channel is at a low elevation and ocean water tidal flows are able to move freely into and out of the lagoon. Fresh waters that form a lens on top of saline waters could then be carried out to sea when tides recede. This process could continue throughout the yearly open cycle until the sand bar closes for the summer (J. Pearson-Meyers, pers. comm., 2013).

3.3 Impaired Conditions during Lagoon Closure

Salinity measures provide strong evidence of whether a lagoon has converted to fresh water after bar closure. If the outflow channel geometry brought about by artificial sand bar breaching is wide and deep, fresh water accumulating in the lagoon is largely flushed with each tidal cycle, precluding the ability of the lagoon to retain high quality aquatic habitat. This flushing occurs because fresh water is less dense than salt water, so if the outlet elevation is low, more of the stratified fresh water lens is preferentially removed. Atkinson (2010) found that artificial breaching in the San Gregorio Lagoon consistently raised salinity values at sampling stations.

If streamflows are low at lagoon closure, high salinity concentrations can create very poor quality habitat conditions very quickly, which can lead to fish die-offs (Sloan, 2006). Persistent flows are needed over a long enough period of time to convert the lagoon to relatively fresh water after seasonal closure. However, when beginning at a deficit compared to what natural conditions might provide conversion of the lagoon to

a relatively fresh water condition may not be possible depending on a particular water year's streamflow condition and how long low flows persist upon closure.

Additional salinity impacts can emerge due to preferential evaporation of the fresh water lens and wave overtopping events, which occur regularly in fall and winter months along the California coast. GW becomes the only potential fresh water source once streamflows cease, a source that may be muted depending on local consumptive use and GW extraction practices. If so, an impaired GW condition can potentially magnify water quality impacts associated with outflow channel geometry brought about by artificial sand bar breaching.

3.4 Impaired GW-Surface Water Interactions

Lagoon WSEs are controlled by a number of factors when the barrier bar is closed including timing of riverine flow cessation, initial WSE at closure, GW supply in aquifer storage at the beginning of each dry-summer season, anticipated regional GW pumping, the hydraulic gradient of the GW aquifer and its relationship to sea level, through-bar seepage rates, and evaporation.

Lagoon WSE at the time of seasonal closure can have a direct effect on potential GW inflows, due to hydraulic gradient conditions at the coast between infiltrating seawater and fresh water aquifer storage (Johnson, 2007). If seawater intrusions are occurring, there is little chance that fresh water GW will be able to percolate out of the substrate. Lagoon stage and GW levels have been shown to have a strong correlation, as reported via Feeney (2002) in Watson and Casagrande (2004).

GW pumping can have negative effects on the overall watershed flow regime. These effects may manifest as early cessation of streamflows in early summer. A consequence may be diminished GW gradients, resulting in a reduction in GW flow into coastal lagoons if GW elevations were impaired by pumping. These considerations show that high WSE at lagoon closure is important because GW flows may not be consistent enough or of sufficient volume to help maintain lagoon water quality through a dry season.

3.5 Ecosystem Effects of an Impaired Lagoon

Artificial breaching at the beginning of the rainy season results in significant habitat losses that can reduce lagoon volume and area by as much as 80 percent of pre-breach values (Whitson, 2013). Depending on streamflow volume and breach timing, artificial breaching can occur hours to weeks prior to natural breaching. In all cases where artificial breaching occurs, aquatic habitat conditions are negatively affected. If

an artificial breach creates high rates of lagoon emptying, juvenile steelhead can be pushed into the ocean prematurely (Allen, 2013). Smith (1990) found that after artificial breaching, some steelhead were flushed from lagoons but some also remained; differences in lagoon morphology and topography may play a role in the ability of fish to find refugia under these circumstances.

In San Gregorio Lagoon, California, a sampling program showed that water quality declined when the barrier bar was breached repeatedly in the summer, preventing maintenance of the lagoon as a body of relatively fresh water. Survival rates declined; seining found reduced numbers of steelhead from early summer to late fall, and dead threespine stickleback fishes were found stranded in dewatered sections of the lagoon (Atkinson, 2010).

In a study covering water quality and habitat conditions in lagoon ecosystems along California's Central Coast, Smith (1990) concluded that the two most important management recommendations to promote high degrees of water and habitat quality were: (1) to pay close attention to the amount of streamflow diverted from the system, as a decrease in flows impacts the ability of lagoons to convert to fresh water conditions during the summer dry months, and (2) noted that in the case of the lagoon systems under study, Pescadero Creek, San Gregorio Creek, and Waddell Creek, artificial opening of the lagoons severely altered habitat conditions, adversely affecting steelhead abundance and growth rates.

This brief review of a small number of concepts and case studies is but an indication of the damage that has occurred in lagoon ecosystems due to modification and alteration of dynamic natural ecosystem regimes.

4 IMPAIRED PROCESSES IN CARMEL LAGOON

Having gained an appreciation of natural and impaired processes associated with Coastal California lagoons, a focused examination is now needed to understand how the Carmel River Lagoon ecosystem has been impacted by various management actions. Many studies have been conducted over the past 10 to 20 years to better grasp ecological conditions in the Carmel River watershed and the Carmel Lagoon (e.g. Watson et al., 2001; Watson and Casagrande, 2004; James, 2005; Thornton, 2005; Urquhart, 2013). Studies have been initiated in part by the Water Allocation Program Final Environmental Impact Report, prepared in 1990 for the Monterey Peninsula Water Management District (MPWMD), by subsequent California Environmental Quality Act monitoring requirements, which sought to insure compliance with mitigation measures (MPWMD, 2013), by the Caltrans mitigation bank project in 1997 that excavated the South Arm of the lagoon, and in order to document the Carmel River Lagoon Enhancement Project that excavate the South Arm an additional 3,000 feet toward Highway 1 in what is called the Odello West area (James, 2005).

The Carmel River Watershed has large variations in seasonal and yearly discharge rates, brought about in large part by the unique nature of the coastal California geographic location within a Mediterranean climate zone, as well as by the size, vertical extent, geology, and geomorphic structure of the watershed. Carmel Lagoon, located at the bottom of the watershed, serves as an ecological interface zone between the watershed and the ocean. The Lagoon is generally not connected to the ocean during times of very low or zero streamflow, when ocean waves build a barrier beach (sand bar) across the mouth of the lagoon and close the outflow channel. When river inflow is relatively low and the Lagoon is not open to the ocean, a dynamic equilibrium is reached between streamflow and groundwater inflows, outflow through the barrier beach, evapotranspiration, and ocean wave overtopping. In summer this leads to lower WSEs and in the fall prior to opening, abrupt increases in WSE can occur due to overtopping. As streamflows increase in the fall and early winter, Lagoon WSEs can rise to flood stage depending on precipitation patterns. When flooding does occur, infrastructure along the northern edge of the lagoon and within the Lagoon floodplain, are threatened before the sand bar would typically open naturally.

In response to the flooding scenario, since at least the early 20th century the sand bar has been mechanically managed (breached) in order to lower WSEs to below flood stage. Since 1973, emergency sand bar management has been carried out by the County of Monterey (County), Monterey County Water Resources Agency (MCWRA), and State Parks. On average in recent years, at least one artificial breach has occurred yearly, with as many as three or four management breaching actions occurring in some

years. When the annual rainy season ends and the sand bar may have not yet closed off naturally, the decision may be made to mechanically close the sand bar before streamflows subside entirely, in order to maximize the volume of water in the lagoon for the dry season. This practice seeks to mitigate early-season artificial breaches that opened the Lagoon and promoted deeper, wider outflow channels than might otherwise have formed.

Following the designation of the Carmel Lagoon as critical habitat for South-Central California Coast steelhead in 2005, concern has grown about adverse impacts in Carmel Lagoon associated with artificial breaching activities that, while serving to protect local infrastructure, also dramatically alter natural ecosystem functions in the lagoon. The National Marine Fisheries Service (NMFS) suggested a northerly sand barrier breach in winter 2005, as this pathway is known to maintain a higher WSE in the lagoon, thus providing better habitat (MPWMD, 2007). The northerly outflow channel was considered a success in that WSEs in the Lagoon were maintained at a higher elevation at high river flows that reached upwards of 5,000 cfs. An unintended consequence of the northerly outlet path was that erosion occurred along the toe of the local bluff, potentially threatening homes and the Scenic Road in Carmel-by-the-Sea. The erosion of the bluff likely occurred because of the confluence of high flood flows and ocean wave activity creating waves 22 to 26 feet in elevation. The bluffs experienced sloughing once the waves receded. A similar event occurred in 2008 when the outlet channel was directed to the south. In that case, the northern bluffs were eroded in a similar fashion independent of flood flows and outlet channel position.

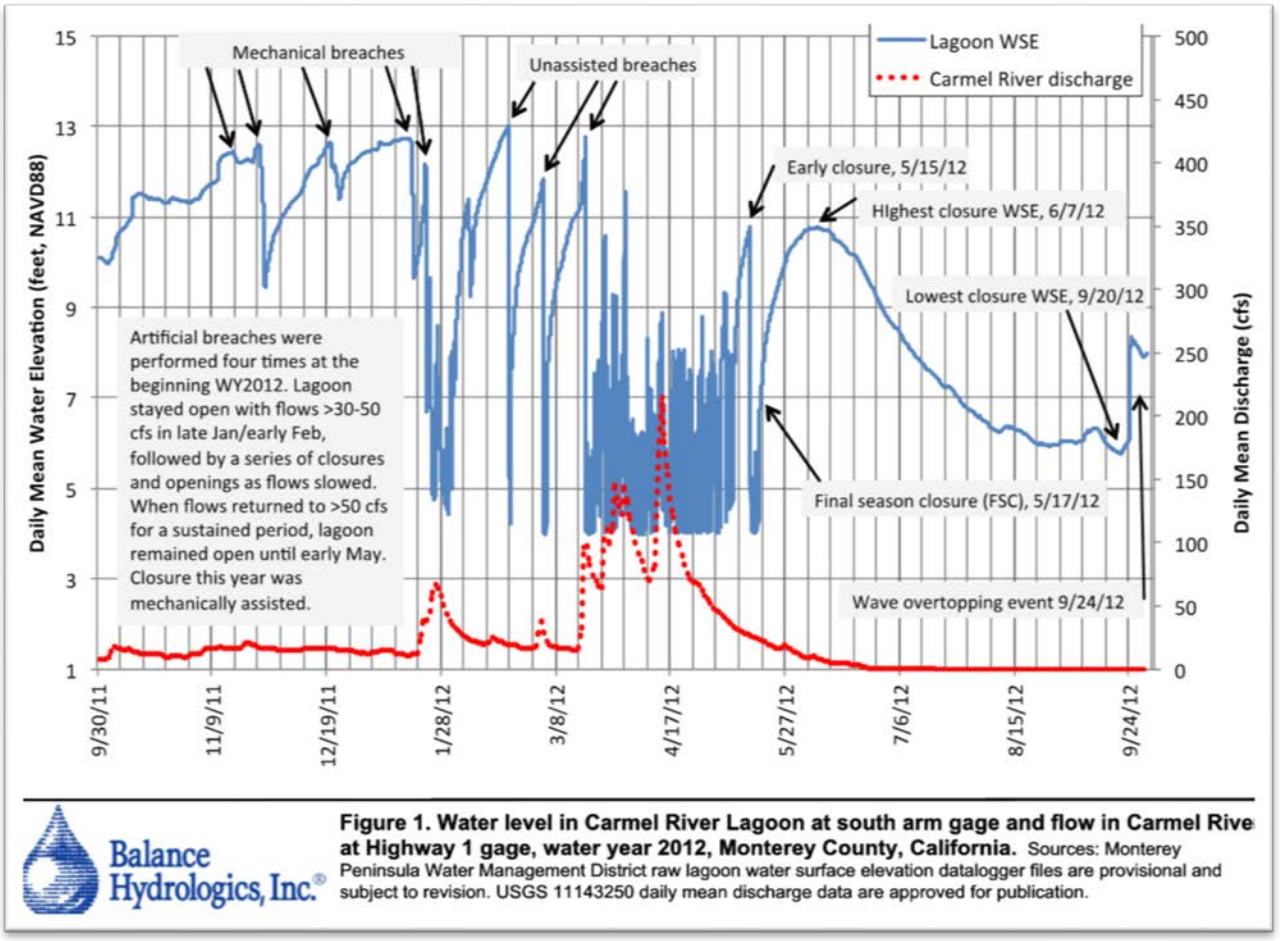
A technical advisory committee was formed to address maintaining the current level of protection for built infrastructure within the context of complying with the Endangered Species Act's requirements of reducing impacts to endangered species and returning the lagoon to a natural function state. The committee subsequently produced a long-term adaptive management plan for Carmel River State Beach and Lagoon (MPWMD, 2007). This document set in motion the development of potential solutions that would return the Lagoon to a more natural state that provides necessary ecological functionality for steelhead and other species that inhabit and depend on the system, while also ameliorating the potential increase in flood risk to surrounding infrastructure that could result from compliance with federal law. The current set of potential solutions is termed the Project in this document, as explained in the introduction. Technical studies including this one are addressing the complex natural, physical processes and interactions of the lagoon, beach, and ocean in order to provide the necessary studies needed for stakeholder to make informed decisions (e.g. Alley, 2013; Moffatt and Nichols, 2013; Whitson Engineers, 2013a,b).

From a riverine perspective, data associated with a 20-year record of Carmel River streamflows and Carmel Lagoon WSEs encompassing water years[1] (WY) 1993-2012, are presented in Appendices A and B. **Appendix A** contains WSE and streamflow data in graphical form. These figures and associated data in **Appendix B** can be used to compare general WY conditions, but should not be considered as an unimpaired dataset, as the Carmel River-Lagoon watershed has been heavily managed for decades, including within the timeframe of these data.

Summary statistics were collected into a series of tables and are reported herein as Tables 1-4. The tables consist of (1) flow and WSE values and relationships with lagoon breaching behavior, (2) WSE and lagoon surface area relationships pre- and post-breaching, (3) breaching events and days open to the ocean, (4) and lagoon closure dynamics.

Figure 1 of Appendix A, the WY2012 WSE and flow graphic, was annotated to help orient the reader with the information available in the 20 years of data found in Appendix A[2].

[1] Water years (WYs) are defined as October 1 of the preceding calendar year through September 30 of the named year. For example, WY 2012 encompassed October 1, 2011 through September 30, 2012.
[2] Figure 1 annotation data on artificial breaching dates and closure dates were taken from the 2011-2012 Annual Report for the MPWMD Mitigation Program (MPWMD, 2013).



Balance Hydrologics, Inc.®

Figure 1. Water level in Carmel River Lagoon at south arm gage and flow in Carmel Rive at Highway 1 gage, water year 2012, Monterey County, California. Sources: Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.

Appendix B contains specific date, time, and WSEs related to all breaches and closures as defined below. When compiling Appendix B, thresholds were defined in order to produce a consistent dataset. All referenced WSEs are reported in the NAVD88 datum[3]. Definitions are provided in the notes section of each WY summary table in Appendix B, and are explained here as follows:

- "Sustained closure" is from October 1st of each WY until the first breach.
- In a "temporary breach", the lagoon remains open to tidal influences for < 7 consecutive days.

[3] Water surface elevations (WSEs) in this study are based on the North American Vertical Datum of 1988 (NAVD88). Lagoon WSE is recorded in NGVD29, so all WSE records were adjusted upward by +2.74 feet based on information from the National Geodetic Survey. For instance, an NGVD29 elevation of 10.00 feet was adjusted to an NAVD88 elevation of 12.74 feet. Mean tide level in nearby Monterey Bay is 3.01 feet NAVD88.

- In a "sustained breach", the lagoon remains open to tidal influences for > 7 consecutive days.
- "In-season closures" occur when lagoon WSE > 11 feet persists for > 24 consecutive hours during the winter-spring time period in each WY when the lagoon is generally persistently open to the ocean rather than in a dry-summer closed state.
- "Early closures" occur when the lagoon is mostly closed and WSEs increase to a point that would be considered a final closure, but then the lagoon opens up again briefly for about a week to a month prior to final closure.
- "Final seasonal closure" (FSC) is when the lagoon closes for the last time with receding river flow and does not open again until the following WY. The date chosen is when obvious tidal influences cease.
- A "significant increase" in WSE occurs only in the dry season, and is almost always associated with a wave-overtopping event, but can also occur due to river flow. In either case, a rapid increase in lagoon WSE of 1-foot was selected as 'significant'.
- "Total days of closure" was calculated as the sum of the number of days between the start of a WY on October 1st and the initial breach, plus the number of days between final season closure and the end of the WY on September 30th, plus the number of days of temporary closures.

4.1 Deleterious Impacts Related to Artificial Sand Bar Breaching Behavior

The primary impacts related to the lagoon environment due to sand bar management and the artificial timing of lagoon breaching, are as follows: Impacted lagoon WSEs throughout the year during both open and closed conditions; rapidity and magnitude of lagoon drainage; extent of salt water intrusion; stratification dynamics in the lagoon; water quality in the lagoon; and habitat loss and deterioration for steelhead and California red-legged frogs, as well as other aquatic and terrestrial species. Further, physical impacts to the sand bar have a profound effect on: where the outlet channel forms and subsequently moves over the course of the open-lagoon condition; where river sediments transport offshore and deposit; where beach sands transport offshore and deposit. This leads to loss of sand necessary for the formation of the beach, bluffs and sand bars, and causes the breakdown or non-formation of natural protective barriers at the beach, bluffs and along the shoreline. All of these impacts will be discussed in greater detail in the following sections.

4.2 Impaired Conditions Related to Artificial Sand Bar Breaching Behavior

In the Carmel River-Lagoon ecosystem, among other similar Coastal California systems, riverine dynamics play an important role in lagoon dynamics and, at least to some

degree, drive "whether, when, and for how long" the lagoon is open, while the formation of the sand bar beach and configuration of the outlet channel are somewhat more wave-dominated processes (Jacobs et al., 2011). The dual role of river processes and ocean dynamics can be seen in the Carmel Lagoon during California's summer dry season, as streamflows dry up (in part due to GW extractions and streamflow diversions), and ocean forces deposit sands onto the beach that are structurally capable of keeping the lagoon closed. Likewise in the winter season, streamflows can gradually fill the lagoon and breach the sand barrier, or suddenly generate fresh water forces strong enough to overcome ocean forces for extended periods, depending on the timing, duration, and quantity of rainfall and runoff.

In the Carmel River Lagoon, artificial breaching has disrupted seasonal flow and sediment dynamics for decades, directly impacting aquatic and terrestrial habitat (PWA, 2007). Historical, artificial breaching actions have had consistently deleterious effects on Carmel Lagoon habitat conditions, which differ significantly from what would have occurred with a natural opening and closing regime (e.g., MPWMD, 2011).

Table 1 shows that in WYs 1993-2012, the first breach of each WY was mechanically assisted with the exception of WY2008. In WY2008the combination of flow conditions and wave action compromised safety. In WYs 1993-2000, management action generally occurred when WSE exceeded 11.5 feet (L. Hampson, pers. comm.), which assured that adjacent properties would not flood. From 2000-2010, management activities were not generally undertaken until lagoon WSE and streamflow forecasts showed that WSEs were likely to exceed 12.8 feet, the elevation at which houses would begin to flood. This threshold has gone up in recent years due to the adoption of adaptive management techniques including sandbag placement. Currently (WYs 2011 and 2012), a WSE of about 13.2 feet triggers breaching, with some room for maneuvering based on anticipated flow and/or wave action (CL-MOU-2012).

Table 1. Carmel Lagoon first seasonal breach of each year

Water Year[1]	Wate Year Type[2]	Date of first breach[3]	Days into WY	Mechanical or Natural[4]	Daily Mean Flow on day of breach	Date of assumed natural breach[5]	Days into WY	Days between mechancial breach and assumed natural opening of the lagoon outlet channel[6]	Number of days from first breach until lagoon summer closure[7]
		(date)	*(days)*		*(cfs)*	*(date)*	*(cfs)*		
2012	Dry	11/25/2011	56	Mechanical	18	12/16/2011	77	21	174
2011	Above Normal	11/24/2010	55	Mechanical	19	12/19/2010	80	25	238
2010	Above Normal	10/14/2009	14	Mechanical	759	10/14/2009	14	0	271
2009	Normal	2/16/2009	139	Mechanical	749	2/16/2009	139	0	91
2008	Normal	1/5/2008	97	Natural	509	1/5/2008	97	0	114
2007	Critically Dry	2/11/2007	134	Mechanical	29	2/16/2007	139	5	37
2006	Wet	12/28/2005	89	Mechanical	81	12/31/2006	92	3	170
2005	Wet	12/30/2004	91	Mechanical	532	12/30/2004	91	0	194
2004	Below Normal	12/30/2003	91	Mechanical	416	12/30/2003	91	0	120
2003	Normal	12/16/2002	77	Mechanical	1250	12/16/2002	77	0	197
2002	Below Normal	12/3/2001	64	Mechanical	402	12/3/2001	64	0	178
2001	Normal	1/11/2001	103	Mechanical	148	1/11/2001	103	0	141
2000	Above Normal	1/24/2000	116	Mechanical	1000	1/24/2000	116	0	100
1999	Normal	11/3/1998	34	Mechanical	21	11/23/1998	54	20	233
1998	Extremely Wet	12/6/1997	67	Mechanical	112	12/6/1997	67	0	270
1997	Above Normal	12/9/1996	70	Mechanical	27	12/10/1996	71	1	154
1996	Above Normal	12/13/1995	74	Mechanical	36	12/21/1995	82	8	184
1995	Extremely Wet	1/9/1995	101	Mechanical	445	1/9/1995	101	0	201
1994	Critically Dry	2/17/1994	140	Mechanical	106	2/18/1994	141	1	404
1993	Wet	1/3/1993	95	Mechanical	85	1/7/1993	99	4	173
Summary Statistics									
Average			85		337		90	4	182
Median			90		130		91	0	176
Maximum			140		1250		141	25	404
Minimum			14		18		14	0	37
Standard Deviation			33		367		30	8	79

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.
2. WY type as designated by MPWMD.
3. Date of first breach is defined as that in which the lagoon area > 2 feet in depth declines by > 20%.
4. The lagoon has been breached since the 1930's (CCoWS, Fall 2007), and in recent decades to prevent infrastructure flooding.
5. Date of assumed natural breach used an assumed seepage rate and known inflows that traced predicted changes in lagoon WSE and volume (Whitson Engineers, 2013b), and then calculating date of assumed breach, using a WSE of 15 feet as the arbitrary elevation at which breaching would occur.
6. Number of days where artificial breaching opened lagoon earlier than natural processes. Calculations were not performed in increments of less than a day.
7. First breach was mechanically initiated in each year of this analysis (with one exception in 2008 due to safety issues), even when days between mechanical and assumed natural opening of the outlet channel were zero.

An analysis of the day of mechanical breaching versus calculations estimating the day of natural breaching over WYs 1993-2012 showed that in nine of the 20 years analyzed (45% of the time), the lagoon was artificially breached at least one day earlier than the predictions calculated for the day of natural breaching. In three of those years artificial breaching occurred earlier than predicted by 20 days or more (Table 1). WYs 2011 and 2012 may have been anomalous, as alternative breaching techniques were being used

to create shallow, pre-graded outlet channels rather than a wide and deep outlet channel, resulting in lagoon WSEs staying above 9 feet upon the initial breach, as shown in Figure 1 (MPWMD, 2013). Alternatively, in WY1993, 1994, 1996, and 1999 WSEs initially fell to about 5 feet, resulting in essentially full evacuation of the lagoon. Artificial breaching significantly reduces lagoon volume, which has a negative effect on volumetric and surface area habitat that remains following emptying (Casagrande et al., 2002). Whitson Engineers (2013b) calculated a volume of 13.7 acre-feet at 4.74 feet of WSE versus a 382 acre-foot estimate for total volume when WSEs are at 12.74 feet (i.e. near the current artificial breaching threshold; CL-MOU-2012). At elevations of 15.74 feet, which would allow higher WSEs than typical breaching patterns now but well below a 17.5-foot Project EPB top of wall, lagoon volume is estimated as 804 acre-feet. This suggests that the implementation of the project could more than double the volume of the lagoon at a maximum WSE of 15.74 feet, providing an example of the significant increase in WSE during closed conditions, and likely additional days of closed lagoon habitat.

Review of mean daily flow on the day of breaching (Table 1) shows that in the nine years in which artificial breaches were performed at least one day prior to calculated predictions of natural breaches, flows were less than 110 cfs in each case. For the Carmel River-Lagoon system, a conservative estimate was calculated by James (2005) suggesting that natural breach events would occur when flows were 200 cfs or greater. According to NMFS, analyses showed that in the years 1989-2010, approximately 80% of the time artificial breaching occurred at flows lower than 200 cfs, providing an indication that the lagoon has been prevented from functioning naturally during those times.

One might conclude from reviewing Table 1 that as long as flows are above approximately 200 cfs, there are no negative impacts associated with artificial breaching. This conclusion would be incorrect. Artificial breaching creates effects to the beach that may last for months to years, and which affect natural processes year-round. When the barrier bar is artificially breached in high-flow years, the breach is often made at the shortest distance between the lagoon and the ocean, generally due west (James, 2005). This initial opening may 'set' the beach with a structurally altered bar morphology, causing evacuation of sand via sediment transport mechanisms that may have otherwise remained on the beach. These altered physical processes and the associated inherent instability likely cannot be reinstated quickly by new sand filling in the breach. Consequently, this may alter the beach for the entire year, and potentially beyond.

As specified in Section 4.1, there are numerous deleterious effects from artificial sand bar breaching that extend far beyond the simple act of mechanically opening the sand bar. For instance, once the sand bar is mechanically breached, all subsequent lagoon WSE fluctuations and sand bar opening-closure scenarios could be considered impaired. In most years, this impairment causes the lagoon to empty rapidly due to the initial position of the mechanically created outlet channel. For example, when the outlet channel position and orientation is mid-bar and straight out to the ocean (a condition that would not have occurred naturally), salt water intrusion into the lagoon is extensive during the upper spikes in tidal fluctuations. This behavior is easily seen in the magnitude in WSE differences on a daily basis in the figures in Appendix A. Lowest recorded WSEs have shifted slightly over the years, likely due to new equipment placement. In recent years, the water surface drops below the pressure transducer at the gage station in the southern arm of the lagoon at about 4 feet NAVD (James, 2013, pers. comm.). Water volume evacuation from the lagoon is very extensive at these levels (Whitson Engineers, 2013b). These intense cycles create significant disturbances to stratification dynamics as the lagoon begins to close, with higher ratios of salt water intrusion preventing important oligohaline conditions (where a gradient of fresh water to saline conditions establishes appropriate salinity and habitat conditions for aquatic species at more than one shallow depth) to form at the appropriate time, as should happen when perched-lagoon conditions prevail and tidal influences are muted. Stratification rather than oligohaline conditions leads to poor water quality for steelhead, California red-legged frogs, and other aquatic and terrestrial species that depend upon fresh water conditions within the lagoon over the summer months.

Impairment caused by a reduction in the fresh water lens can eliminate the fresh water habitat provided by the lagoon and can create an inhospitable environment because of low water levels, high salinities and low dissolved oxygen concentrations. The influx of seawater creates a salinity-stratified lagoon and alters potential lagoon productivity as well as water quality because the availability of fresh water may become compromised. When the denser seawater that has breached into the lagoon naturally sinks within the water column, it pushes fresh water to the surface, creating a narrow, shallow fresh water lens. Then, during subsequent breaches or tidal fluctuations of inflow and outflow in those times when the lagoon is not in a perched configuration, there is a greater likelihood that the heavier salt water will remain in place while the upper fresh water lens gets mixed or drains away. This type of situation leads to poor habitat and water quality conditions, and the only area in the lagoon that remains viable steelhead habitat is the small, shallow fresh water lens at the lagoon surface coupled with what amount may be replenished via fresh water groundwater influx (Casagrande and others, 2002; Watson and Casagrande, 2004). These conditions do not lead to the

oligohaline lagoon environment necessary to provide suitable habitat for steelhead and other aquatic species that over-summer in Carmel Lagoon.

From a physical perspective, mechanical breaching impacts the development and direction of an outlet channel that responds to ocean wave, longshore transport and riverine dynamics in its formation. Mechanical breaching does not allow natural development of the outlet channel in a physically-driven direction. With respect to a northerly position of the outlet channel, westerly mechanical breaching prevents delivery of riverine sediments just off-shore where such sediments might build up to attenuate wave dynamics against the northern bluffs. In addition, sand bar 'blow-out' results in loss of sand and gravels into the offshore canyon, rather than shoaling just off shore in the northerly direction. Removing or preventing offshore natural barriers to form increases the risk of ocean swells to the bluff and surrounding infrastructure. Lagoon seepage rates to the ocean may also be affected during the dry season due to removal of hardened sands on the lagoon side of the barrier bar that could potentially form. Mechanical breaching likely eliminates some of the potential for hardening of barrier beach sand on the lagoon side of the beach. Considering decades of artificial breaching—as illustrated very clearly over the last 20 years (Table 1)—it may take a number of years after artificial breaching ceases before the sand bar begins to behave naturally.

4.3 Impaired Lagoon Morphology during Open Conditions

Carmel Lagoon is primarily open to the ocean during each winter season (**Table 2**). The period of opening is directly related to flow conditions as well as to ocean dynamics (James, 2005; Jacobs et al., 2007). Occasional closures may occur as flows decrease near the end of the falling limb of a specific hydrograph (Appendix A), but this process is also dependent on the prevailing wet-season baseflow condition (which differs significantly from the dry season baseflow condition of 'no flow') and ocean dynamics. If average wet season baseflows are relatively elevated, closures are temporary, generally on the order of 2-7 days (Appendix B), but can occur multiple times a year depending on water year type and streamflow regime (Tables 1 and 2).

Table 2. Carmel Lagoon breaching events and days open to ocean

Water Year[1]	Number of artificial breaching events[2]	Number of other breaching events[3]	Wet season days open[4]	Wet season days closed[5]	Percent of time lagoon open to the ocean[6]
	(days)	*(days)*	*(days)*	*(days)*	*(%)*
2012	5	4	153	21	42
2011	5	0	227	12	62
2010	6	0	224	48	61
2009	1	2	87	5	24
2008	0	2	111	3	30
2007	1	3	21	17	6
2006	1	2	151	20	41
2005	1	0	193	2	53
2004	1	3	111	9	30
2003	1	1	197	1	54
2002	2	0	177	2	48
2001	1	0	142	0	39
2000	1	0	92	8	25
1999	8	0	196	38	54
1998	2	0	267	4	73
1997	1	0	155	0	42
1996	3	0	180	4	49
1995	1	0	202	0	55
1994	1	2	35	5	10
1993	1	1	172	2	47
Summary Statistics					
Average	2	1	155	10	42
Median	1	0	164	5	45
Maximum	8	4	267	48	73
Minimum	0	0	21	0	6
Standard Deviation	2	1	63	13	17

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.
2. Artificial breaching events were counted as (a) first breach of the year unless reported otherwise, and (b) when reports indicated additional mechanical breaches.
3. Other breaching events were counted when wet season lagoon closures were (a) > 1-2 days and (b) when flows were > 50 cfs prior to next opening (generally unassisted openings when later in the year)
4. Wet season days open is defined as number of days from first breach to final closure, not counting wet season days closed.
5. Wet season days closed is defined as those days when WSE remained > 11 feet (NAVD88) for longer than 24 hours.
6. Percent of time WY lagoon open to the ocean is defined as wet season days open minus wet season days closed divided by 365 days per year times 100.

In an unimpaired state, one might expect the days of open lagoon conditions to have the two following characteristics: (1) a long, sinuous outlet channel that prevents tides from rushing in and out of the lagoon and creating large WSE fluctuations that have adverse effects on water quality, and (2) a perched WSE condition in the lagoon such that the lower limit of WSE remains above the mean high tide elevation. Combined, these two states allow important fluxes (i.e. flow, sediment, salt water) to move into and out of the lagoon at a rate and intensity that is within the natural variability of the system, unlike those to which the lagoon has been subjected with sand bar management techniques of the past decades. When the conditions are such that the outlet channel is mechanically created in a pathway that would not have happened naturally and thus the lagoon is not in a perched state, the deleterious effects as enumerated in Section 4.1 and discussed in the last two paragraphs of Section 4.2

greatly affect natural lagoon functions. The fact that the lagoon is open to the ocean on average about 40-45% of each WY (Table 2) provides an indication of the proportion of the year when open-lagoon conditions that may be negatively affected by mechanical breaching. Further, impaired open conditions need directly to impaired closed conditions, a topic of discussion in Section 4.4.

Streamflows can be large enough to fill the lagoon rapidly (see Appendix A for a visual depiction of streamflows and lagoon WSEs for each WY 1993-2000), and then depending on continuing streamflows (whether large or small, both can be drivers of openings), the outflow channel stays open or ocean forces begin to overcome riverine processes. The sand bar can remain in place for some period of time or can open up and then reform when flows are low, as it takes a longer period of time to increase lagoon volumes and WSE to the point of the next breaching. This process is illustrated most clearly in the critically dry WYs of 1994 and 2007 (Appendix A, Figures 19 and 6, respectively). In WY2007, peak flow was low and overall yearly discharge was low, so lagoon openings were limited in duration and largely dominated by ocean processes working to deposit sand and close the lagoon. A slightly different pattern can be seen in WY1994, where the peak flow was large but quite short in duration and with total yearly discharge low also, resulting in a very similar short seasonal opening pattern for the lagoon.

The ideal lagoon morphology during open conditions would be to retain a perched condition, where lagoon WSEs of greater than about 6 feet persist when mean high tides are in, providing a minimum of about 41 acre-feet of volume (Whitson Engineers, 2013b). WY2005 (Appendix A, Figure 8) is an example of the ability of the lagoon to retain a WSE of greater than 6 feet. WY2005 represents the only WY in which WSEs remained above 6 feet for the entire lagoon opening, so in 19 of 20 years, perched conditions in the lagoon were not achieved.

In WY2005, Monterey County graded an outlet channel along a "non-traditional" north-northwesterly alignment based on consultation with National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS). The intent was that channel alignment would result in a decrease in both the rate of lagoon draw-down and a reduction in the total drop in lagoon level, thereby reducing impacts to the newly federally listed steelhead and the lagoon habitat that provides critical ecosystem functions for them. The longer more sinuous breach channel moderated flow rates and limited the total volume of lagoon draw-down. The project was a success, as lagoon WSEs maintained an extra foot or so in elevation throughout the entire lagoon open period, improving habitat quality and volume. In at least five years over the period 1993-2005, the outflow channel has been intentionally directly away

from the north end of the beach to avoid exposing the bluff area along Scenic Drive to erosive forces (MPWMD, 2007). This type of intervention would not be necessary with the Project SRPS in place, which would be intended to provide protection from erosion to Scenic Drive and local properties that sit atop the bluff.

When a perched morphology is not maintained and WSEs dip to 5 feet, approximately 14 acre-feet of lagoon water volume remains, a 65 percent reduction in volume compared to an elevation of 6 feet associated with a perched morphology. This reduction occurs when habitat quality is likely tenuous due to large quantities of fresh water evacuating the lagoon and flowing out to the ocean. Conversely, as tides come in, the outlet channel provides a pathway for salt water ingress. When fresh water streamflows are adequate, thorough mixing of the two—fresh water and salt water—prevents stratification and provides good quality habitat (Smith, 1990). When fresh water flows are not adequate, salt water influx raises salinity concentrations to levels that juvenile steelhead may not be able to tolerate (NMFS, 2008).

Another impact of the inability of the lagoon to maintain a perched morphology due to artificial breaching is that as much as 80 percent of lagoon surface area > 3 feet in depth is flushed from the system when the sand bar breach runs directly westward (**Table 3**). This depth within the lagoon habitat zone is particularly important for juvenile steelhead, as they become more susceptible to predation and thermal stress in shallow waters.

The rate of lagoon draining presents additional issues for salmonids and other aquatic organisms (**Table 3**). Rapid evacuation of lagoon waters can force fish into shallower waters, exposing them to increased predation and potential stranding in addition to forcing out-migration of fish before they are ready for the ocean environment (Smith, 1990; NMFS, 2008; Atkinson, 2010).

Table 3. Carmel Lagoon water surface elevations and estuary surface areas pre- and post-breaching

Water Year[1]	WSE before breaching, NAVD88[2]	Estuary surface area before breaching	WSE after breaching, NAVD88	Estuary surface area after breaching[3]	Rate of lagoon draining
	(ft)	*(acres)*	*(ft)*	*(acres)*	*(ft/hr)*
2012	12.2	69.9	6.7	8.6	0.7
2011	11.8	63.8	6.7	8.6	0.2
2010	13.3	89.3	6.1	5.7	1.5
2009	13.1	86.7	6.1	5.6	2.2
2008	15.4	135.1	5.9	5.6	1.2
2007	11.5	58.3	8.8	25.3	0.3
2006	11.4	56.8	6.4	7.1	0.0
2005	13.0	85.2	7.3	12.1	0.0
2004	13.2	88.7	6.1	5.6	0.7
2003	13.6	95.1	7.1	11.3	2.1
2002	13.4	92.0	5.6	3.9	0.9
2001	14.8	120.9	5.5	3.3	2.2
2000	14.1	105.2	6.9	9.5	0.4
1999	12.8	80.0	5.0	2.1	0.4
1998	12.4	73.1	6.6	7.9	0.4
1997	12.3	72.8	8.3	20.5	0.3
1996	11.7	61.9	5.7	3.9	1.1
1995	10.5	44.8	6.4	7.0	0.1
1994	11.7	62.1	6.5	7.3	0.1
1993	12.7	79.8	6.2	6.2	0.8
Summary Statistics					
Average	12.7	81.1	6.5	8.4	0.8
Median	12.7	79.9	6.4	7.1	0.6
Maximum	15.4	135.1	8.8	25.3	2.2
Minimum	10.5	44.8	5.0	2.1	0.0
Standard Deviation	1.2	22.1	0.9	5.6	0.7

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.
2. First breach of the year.
3. Surface area with depth > 3 feet, suitable for steeelhead habitat.

4.4 Impaired Conditions at Lagoon Closure

Carmel Lagoon has exhibited an impaired condition at lagoon closure in at least 17 of 20 years between WYs 1993-2012 (**Table 4 and 5**; Appendix A) because perched lagoon morphology was not present at that time, thus impeding the development and maintenance of high quality habitat for steelhead and other species during closed conditions in the lagoon.

NMFS and CDFW have indicated that a lagoon WSE of 6.74 NAVD88 (4 feet NGVD29) to 12.74 feet (10 feet NGVD29) is an optimal range for good quality habitat for steelhead (MPWMD, 2011), whereas in most of the recent years between WYs 1993-2012, closure WSEs have measured within the 4-foot to 5-foot range. Table 5 presents the lowest WSE prior to final season closure for these years. If the threshold of 6.74 feet is considered as the minimum WSE to qualify closure conditions as perched, then only one year, WY1998, would qualify as having closed with a perched condition. Conversations with NMFS have indicated that WY2005 exhibited a perched condition for the entire open cycle, so if that lowest WSE prior to closure would be selected as defining a perched condition, the WSE threshold would be 5.89 feet. To provide for uncertainties in WSE measures, it may be reasonable to set a WSE threshold of 5.75 feet as potentially qualifying as a perched condition at closing, although it is important to note that this value is 1 foot below the optimal range indicated by NMFS and CDFW. Using this criterion—defining 5.75 feet as lowest WSE prior to closing to constitute perched lagoon morphology—only three WYs qualify as perched: WYs 1998, 2000, and 2005.

Table 4. Carmel Lagoon final season closure dynamics

Water Year[1]	Date of final seasonal closure[2]	Days into WY	Daily Mean Flow at Closure	Highest WSE During Seasonal Closure	Lowest WSE During Seasonal Closure	Time Lagoon Closed in Dry Season	Annual Time Closed[3]
	(date)	*(days)*	*(cfs)*	*(ft)*	*(ft)*	*(days)*	*(%)*
2012	5/17/2012	229	25	10.8	5.8	191	58
2011	7/20/2011	292	28	9.7	8.2	126	38
2010	7/12/2010	284	28	10.2	6.3	93	39
2009	5/18/2009	229	25	11.4	6.3	273	76
2008	4/28/2008	210	17	11.0	5.9	251	70
2007	3/20/2007	170	27	12.3	5.3	327	94
2006	6/16/2006	258	46	10.1	6.3	194	59
2005	7/12/2005	284	15	8.7	5.8	170	47
2004	4/28/2004	210	15	10.0	5.1	245	70
2003	7/1/2003	273	10	8.0	5.4	167	46
2002	5/30/2002	241	12	10.0	5.3	186	52
2001	6/1/2001	243	14	9.9	5.6	223	61
2000	5/3/2000	215	73	10.7	5.7	265	75
1999	6/24/1999	266	17	10.5	5.4	131	46
1998	9/2/1998	336	18	8.9	7.2	94	27
1997	5/12/1997	223	24	9.9	5.5	210	58
1996	6/14/1996	257	13	10.4	5.5	181	51
1995	7/29/1995	301	15	9.4	5.6	163	45
1994	3/28/1995	178	19	10.7	5.4	325	90
1993	6/25/1993	267	18	8.8	5.5	191	53
Summary Statistics							
Average		248	23	10.1	5.8	200	58
Median		250	18	10.1	5.6	191	55
Maximum		336	73	12.3	8.2	327	94
Minimum		170	10	8.0	5.1	93	27
Standard Deviation		42	14	1.0	0.7	66	17

Notes

1. Water Year (WY) is defined as October 1 of one year to September 30 of each subsequent year, for instance WY 2012 encompassed Oct 1, 2011 through September 30, 2012.
2. Date of final seasonal closure is the latest date in the WY on which the lagoon is no longer subject to tidal influences.
3. Annual time closed is defined as the sum of time lagooon closed in dry season plus the number of days closed in the wet season (see Table 2 also).

Table 5. Carmel Lagoon perched morphology dynamics

Date of lowest WSE before closing	Lowest WSE (ft) before closing	Mean daily flow (cfs) at lowest WSE before closing
(date)	*(ft)*	*(cfs)*
5/17/2012	4.01	25
7/25/2011	4.04	26
7/12/2010	4.07	28
5/17/2009	4.10	26
4/27/2008	4.11	19
3/20/2007	4.13	27
6/14/2006	4.41	51
7/11/2005	5.89	16
4/28/2004	5.52	15
6/28/2003	5.06	13
5/29/2002	5.27	15
5/31/2001	5.00	16
4/16/2000	5.76	78
6/18/1999	5.27	26
6/9/1998	6.91	190
5/10/1997	5.59	25
6/11/1996	5.37	16
6/20/1995	5.38	85
3/28/1994	5.71	19
6/25/1993	5.56	18
Summary Statistics		
Average	5.1	37
Median	5.3	25
Maximum	6.9	190
Minimum	4.0	13
Standard Deviation	0.8	41

Considering the three qualifying WYs more closely (see Appendix A for graphical representation), WY1998 was dominated by riverine processes very late into the spring with a mean daily flow rate of 190 cfs on the day of lowest WSE prior to closure. Flows did not cease the entire summer, so it is very likely that fresh water conditions and a mixed lagoon environment prevailed through the dry closure season. In WY2000, a late flow peak likely helped fill the lagoon with fresh water as the sand bar closed, providing a perched condition and relatively large ratio of fresh water to salt water at time of closure. Flows in this year continued into late July, so it is likely that a mixed lagoon environment prevailed through at least the beginning of the dry closure season.

What makes WY2005 notable in terms of perched conditions is that WSEs were maintained at elevated levels for the entire open condition of the WY, as well as closing at a high WSE, thus providing a much enhanced fresh water condition for steelhead through the year. This season-long condition was very likely a direct result of the lagoon outflow pathway being directed to the north, thus maintaining an elevated WSE with sand bar morphology playing a primary role in this condition.

In an effort to address other primary water balance parameters related to hydrologic processes in the lagoon, a few points related to seepage and evaporation follow. Seepage rates from the lagoon into the barrier bar have been estimated as 8 and 12 cfs, which convert to 8 and 12 acre-feet of outflow per day if considering tides are out 50 percent of the time. These values were calculated for WY2005 and WY2009, respectively, when lagoon WSEs were on the order of 10.5 to 11.5 feet (MPWMD, 2011). The increase in seepage flow rates was conjectured to be due to artificial closure of the lagoon barrier bar at a higher elevation in WY2009, and possibly aided by additional lagoon storage capacity after the two South Arm phases of lagoon restoration were completed. Seepage rates of ocean water into the lagoon are unknown; overtopping events are the largest water influx into the lagoon in late fall (Appendix A and B).

Evaporation from the exposed areal water surface contributes to lower WSEs and potentially higher salinity concentrations. Carmel River Lagoon and the Lower Carmel Valley are classified in the evapotranspiration zone of upland central coast and Los Angeles basin in the California Irrigation Management Information System (CIMIS, 2010). Evapotranspiration rates for this zone average from a high of 6.51 inches/month in July to a low of 1.86 inches/month in January, for a total rate of 49.7 inches/year. Losses via seepage were estimated to be about 10 times greater than evaporation rates (Watson and Casagrande, 2004), so while this is a water balance output, it is relatively small.

4.5 Impaired GW-Surface Water Interactions

GW is pumped from the Lower Carmel River aquifer for consumptive uses. In past years, the shallow water aquifer has been pumped at a rate of about 11,000 acre-feet per year (PWA, 2007), while current GW withdrawals in the Lower Carmel Valley are on the order of 8,000-10,000 acre-feet per year from source areas AS3 and AS4 (MPWMD, 2011; MPWMD, 2013). AS3 and AS4 are the areas which correspond to the aquifer near the lagoon. Monitoring wells are located at three elevations within the near-shore aquifer and near the salt water-fresh water interface (Watson and Casagrande, 2004).

GW-surface water interactions are necessary to provide fresh water additions to the lagoon during closed conditions, as there are no other fresh water sources available once flows cease in the river. The ability of the aquifer to fill to a higher GW elevation is impaired if the lagoon has been mechanically breached throughout the wet season, as more fresh water is directed seaward rather than backwatering within and upstream of the lagoon, and percolating into the aquifer. Thus, the effects of breaching may lead to 2 or more feet of loss to GW elevation in the local aquifer, depending on position, and can cause the lower Carmel River surface flow to dry back and go subsurface at an earlier date. Lowered GW elevations can significantly reduce the amount of GW

flow into the lagoon after surface flows have ceased, thus effecting summer habitat conditions. NOAA staff worked up an approximate estimate of the GW lost due to mechanical breaching from storage in the aquifer by using a storativity value (percent of water stored per unit of volume) for the local aquifer along with lower aquifer acreage and a conservative change in aquifer elevation. For Carmel Lagoon, the GW aquifer surrounding and upstream of the lagoon potentially affected by lagoon levels was approximated as 1,400 acres. The storativity value for the local aquifer was roughly estimated as 0.2, or 20% of the volume (NOAA staff pers. comm. with Martin Feeney, 2003). A 2 feet of loss in aquifer elevation in the wet season was used by NOAA as potential GW losses. Thus, NOAA developed a calculation of 1400 acres * 0.2 storativity * 2 feet in aquifer elevation loss = 560 acre-feet of potential GW loss due to mechanical breaching activities, with potentially different magnitudes of loss if any of the variables are different than this assumed set. Further, as the fresh water lens diminishes due to evaporation and seepage, a higher initial GW elevation provides a more robust fresh water supply throughout the dry summer months and into late fall and early winter until rains begin again. A more robust GW-surface water connection provides higher water quality during closed conditions.

A restoration project to create additional lagoon volume by digging out the Odello West extension of the South Arm of Carmel Lagoon uncovered a fresh water spring in the far-eastern finger of the project site (Larson et al., 2006, see Fig. 4-5, Fig. 4-6). Subsequent salinity sampling showed that a strong linear relationship exists between increases in salinity and distance from the spring. A similar linear relationship was found from the South Arm to the river channel.

Varying degrees of fresh water lens development have been documented in studies conducted in recent years (i.e. Larson et al., 2006). In Anderson et al. (see Figure 3, 2007), a longitudinal profile of salinity and other water quality parameters from data collected in late October to early November, 2007, showed that the freshest water, at an acceptable salinity concentration of 2 ppt, was found only in the far-eastern corner of the Odello West South Arm. In Castorini et al. (see Figure 8, 2008), a longitudinal profile of salinity and other water quality parameters from data collected on October 9, 2008, indicated that a fresh water lens with a salinity concentration of 2 ppt was found spread over a larger area than in 2007, extending almost to the pipe in the South Arm. In both years a small fresh water lens was detected in the far North Arm also, suggesting that GW springs may exist at both ends of the lagoon, potentially providing some measure of refugia during the dry season.

Although fresh water has been documented as present in the lagoon late in the dry season, the areas in which it is found are small, likely leading to increased competition

between and among species for available food sources. It is quite possible that higher initial closure elevations (as was the case in WY2007 and WY2008), persistent streamflows further into the summer, and more GW inflows would result in greater volumes of fresh water throughout the dry season, creating high quality over-summer habitat by promoting growth of invertebrates that are primary steelhead food sources.

4.6 Impaired Conditions Related to Carmel Lagoon Ecosystem Health

Carmel Lagoon has been altered and modified for decades. Built infrastructure encroaches onto the lagoon floodplain as well as along much of the Carmel River corridor within the Lower Carmel Valley. The sand bar barrier between the lagoon and ocean is artificially manipulated on a consistent, yearly basis, causing evacuation of lagoon waters early in the WY. This results in tidally-open conditions that significantly increase flushing of fresh water from the system on a daily tidal basis, and closure conditions where a high ratio of highly saline ocean waters are present. Further, mechanical breaching disrupts formation of the outlet channel and sediment transport. Reestablishment of the natural beach-river transport regime is particularly important in order for sands to replenish the longshore bar to the north, which will then provide natural protection via wave energy dissipation especially during long period, large swell events. Such build-up of the longshore bar will eventually help to attenuate bluff erosion.

Upon closure, stratification of the lagoon persists until and if conversion to fresh water is achieved (NMFS, 2008). GW pumping is prevalent, extracting more water than is replenishing via infiltration and percolation into the aquifer on a yearly basis, and thus the aquifer is unable to supply as much GW inflow to the lagoon as in an unimpaired situation.

During the onset of stratified conditions, some habitat is present for juvenile steelhead in the shallow fresh water lens situated on top of the more saline lower lens. The ability of juveniles to utilize the entire water column in the lagoon is restricted by the highly saline, low dissolved oxygen, and higher temperature conditions in the lower lens. Aquatic invertebrate densities, the prey base for juvenile steelhead, are negatively correlated with increasing salinity. When conversion of a lagoon to fresh water is complete, steelhead have more abundant space and a broader prey-base leading to greater survival and growth rates (NMFS, 2008).

Steelhead run numbers are low in the Carmel River. The impact of current sand bar management activities lowers the quality of critically needed S-CCC steelhead habitat, negatively affecting the likelihood of S-CCC steelhead survival and recovery.

Restructuring the management of the lagoon sand bar to more closely resemble the natural physical processes and hydrologic cycle of the lagoon is necessary to minimize and avoid adverse effects to critical habitat in the lagoon year-round, as well as to minimize the direct loss of S-CCC steelhead juveniles when the lagoon drains quickly to the ocean.

5 ANTICIPATED RESPONSE OF CARMEL LAGOON TO PROJECT IMPLEMENTATION

In 2010, the MCWRA submitted an application to the USACE for a permit to manage the sand bar. In September 2011, Monterey County (RMA/Public Works) assumed a lead role for the Carmel Lagoon management. The USACE consulted with NMFS through the required section 7 consultation process under the federal ESA. During the consultation process, the NMFS affirmed that annual artificial breaching as proposed in the permit application would likely adversely affect S-CCC steelhead and destroy and adversely modify its critical habitat, and, therefore, a Jeopardy Opinion (JO) would be issued. A meeting with the NMFS and USACE to better define a solution to artificial breaching identified that the EPB and SRPS projects are viewed as their preferred projects with a means to achieving the following objectives:

- To improve the functions and values of the ecosystem in and around the Lagoon by allowing lagoon levels to rise and the lagoon to breach naturally (versus mechanically breaching the Lagoon)

- To reduce potential flood risks for existing public facilities and private structures in the low-lying developed areas located immediately to the north of, and within, the Lagoon as a result of predicted sea level rise during the next 50 years and reduction in mechanical breaching.

- To protect public infrastructure (e.g., Scenic Road embankment, State Parks restroom and parking facilities) from storm surge and scour resulting from a northerly-aligned channel.

The USACE and NMFS informed the MCWRA and County that issuance of a JO could be avoided if the application was withdrawn and a new application was filed for the EPB and SRPS projects. Therefore, the County withdrew its application for long-term sand bar management, and submitted new applications to all permitting agencies for approval of the EPB and SRPS projects, as well as a 5-year Interim Sand bar Management Plan, while the County and MCWRA completes the plans and construction of the projects. These applications were deemed incomplete pending technical studies, which are being completed as part of a feasibility study (completed June 2013) and this environmental review process.

In an effort to demonstrate the commitment to assess these projects and implement a long-term solution to mechanical breaching, the RMA worked with the USACE to develop a draft Memorandum of Understanding (MOU) that would include the USACE,

County, and NMFS as signatory agencies. This document was reviewed by the USFWS as a consulting agency to the USACE. In September 2011, a draft MOU was completed for management of the Carmel River Lagoon. The MOU:

- Establishes a long-term plan to balance protection of private property with protection of federally listed species
- Recognizes that mechanical managing the Carmel River Lagoon over the long run was not in the best interest of the County, USACE, and NMFS' protected resources
- Identifies two long-term solutions as alternatives to performing sand bar management: the EPB and the SRPS
- Agrees to allow an Interim Sand bar Management Plan (ISMP) for temporary (5 years) management of the sand bar while the County develops the EPB and SRPS projects (design, environmental review, and construction)
- Establishes a target schedule to complete the projects by 2018.

Because the County has managed the sand bar only under approved emergency permits, and due to the time necessary to assess the various options, the timeframe identified in the MOU for obtaining a non-emergency permit was extended to October 2013. The County is working to complete the required environmental documents consistent with the expectations of the permitting agencies. The MOU was approved by the Board of Supervisors (BOS) on June 11, 2013.

5.1 Anticipated Sand Bar Dynamics without Artificial Breaching

When river flows surpass about 30-50 cfs and remain within or above that flow range, it becomes much more likely that riverine processes are the driving mechanism of bar breaching (Rich and Keller, 2013). The tendency of breach location is likely related to the architecture of the barrier beach sand bar, sand supply, wind dynamics, and wave form and shape. The cessation of artificial breaching will allow for a more natural sediment transport regime. This would be manifest when the annual cycles of barrier bar building and opening experience more of the natural dynamics associated with river outflow, tides, wave action, cross-shore, and littoral and longshore transport (Moffatt and Nichol, 2013; J. Pearson-Meyers, pers. comm., 2013).

5.2 Anticipated Lagoon Morphology

Breach outflow channel width and depth are primarily a function of wave and littoral transport processes as well as inflow rate and lagoon volume prior to opening, so affects naturally-occurring channel widths and depths would vary according to ocean and flow conditions. Data from WY2005 indicates that perched lagoon morphology will occur in Carmel Lagoon when the outflow channel runs to the north (Appendix A, Figure 8). There is a tendency for outflows to migrate north, as determined in WYs 1993, 1996, 1997, and 2000 by Thornton's (2005) littoral processes study of existing data and aerial photos, and in 2005 as reported by MPWMD (2007). It is expected that a northerly route will likely develop more often than currently occurs once artificial breaching ceases. A natural channel might form to the south in some years, as outlet formation is dependent on the longshore current. Ocean wave patterns can change in some years, although an outlet channel to the south should occur with a lower frequency than to the north.

NMFS and CDFW have indicated that a lagoon WSE in the range of 6.74 to 12.74 feet NAVD88 (4 to 10 feet NGVD29) is an optimal range for steelhead (MPWMD, 2011) while a threshold value of 5.75 feet was used in Table 5 to assess the probability of perched conditions in recent years. Conditions in WY2005 provide evidence of a perched morphology that would promote a WSE that might be achieved regularly with a northerly configuration to the outflow channel. The northern beach has smaller sand grain-sizes and a lower slope than the southern portion of the beach (Moffat and Nichol, 2013), while longshore currents tend to carry sand to the north due to diffraction of waves around Steward's Cove (Thornton, 2005). Slopes on the northern portion of the beach are much lower than those on the south end of the beach: 12 percent versus 28 percent, respectively (Thornton, 2005). These observations provide an indication of why the lagoon outlet might tend to migrate to the north, as there may be less resistance in the architecture of smaller grain sizes, and the lower slopes may provide a path of least resistance to the ocean.

When higher WSEs prevail in the lagoon over the course of an open-lagoon winter season, the lagoon WSE should remain high upon closure and with a higher ratio of fresh water because tidal inflow cannot negotiate the sinuous outflow pathway easily, thus less salt water will enter and remain in the lagoon (J. Pearson-Meyers, pers. comm., 2013).

5.3 Anticipated Conditions at Lagoon Closure

Carmel Lagoon geology includes a bedrock sill at the northern and southern ends of the river mouth. This sill may play a role in maintaining lagoon WSE, particularly when the

outflow path is oriented to the north and a long and sinuous channel can form. Meandering outflow channels that flow across this bedrock sill, such as in Carmel Lagoon in water year 2005, are able to retain higher WSEs in the lagoon.

The higher WSE and continuing inflows until those dry up should provide a perched, fresh water lagoon at the beginning of the summer dry season that will remain as a fresh water system throughout the closure season and year-round.

5.4 Anticipated GW-Surface Water Interactions

There are a number of projects in progress associated with the Lower Carmel River and Lagoon, including Odello East floodplain restoration, retrofit of San Clemente Dam in the upper watershed, and GW infiltration into the floodplain aquifer on the Odello West floodplain area of the lower watershed at the lagoon (PWA, 2007). These projects will likely have effects on the Lagoon and its interaction with streamflow and local GW, and should provide net positive benefits to lagoon ecosystem health.

5.5 Anticipated Ecosystem Effects

The purpose of Project implementation is to restore the natural function of the lagoon by reducing the necessity to artificially breach the sand bar. Anticipated ecosystem effects should subsequently help restore the natural function of the lagoon and protect surrounding infrastructure. These effects include (1) more natural breaching cycles, (2) increased WSE in the lagoon while open in a northerly direction, (3) a higher ratio of fresh water to salt water, (4) conversion of the lagoon into a fresh water system during closure via the higher ratio of fresh water and streamflow prior to drying up in the summer, and (5) greater connectivity between the lagoon and the local GW. A return to naturally functioning lagoon ecosystem conditions should allow for steelhead and other aquatic and terrestrial species to thrive within a highly productive lagoon ecosystem.

6 REFERENCES

Alley, D.W., 2013, Fishery biological assessment of the effects upon steelhead in Carmel River Lagoon from Implementation of the Ecological Protection Barrier, Scenic Road Protection Structure and the Draft Interim Sand bar Management Plan (Discussion Draft 9/8/2013), 47 p.

Anderson, T., Clark, C., Croyle, Z., Maas-Baldwin, J., Urquhart, K., and Watson, F., 2007, Carmel lagoon water quality and steelhead soundings: Fall 2007, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2007-04, 26 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Atkinson, K.A., 2010, Habitat conditions and steelhead abundance and growth in a California lagoon, Master's thesis, San Jose State University, 123 p.

California Irrigation Management Information System (CIMIS), 2010, Reference evapotranspiration rates, prepared for the California Department of Water Resources, 4 p.

Carmel Lagoon Memorandum of Understanding (CL-MOU-2012), 2012, Flood prevention and habitat protection at the Carmel Lagoon, 20 p.

Casagrande, J., Watson, F., Anderson, T., and Newman, W., 2002, Hydrology and water quality of the Carmel and Salinas Lagoons, Monterey Bay, California 2001/2002, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2002-04, 111 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Coates, M.J., and Guo, Y, 2003, The salt wedge position in a bar-clocked estuary subject to pulsed inflows, Estuarine, Coastal and Shelf Science, 58: 187-196.

County of Monterey, U.S. Army Corps of Engineers, and National Marine Fisheries Service (CL-MOU-2012), 2012, (Draft) Flood prevention and habitat protection at the Carmel Lagoon, Memorandum of Understanding, 20 p.

Debler, W., and Imberger, J., 1996, Flushing criteria in estuarine and laboratory experiments, Journal of Hydraulic Engineering, Vol. 122, No. 12, p. 728-734.

Feeney, M., 2003, personal communication with NMFS personnel.

Hampson, L., 2013, Monterey Peninsula Water Management District personnel, personal communications.

Hayes, S.A., Bond, M.H., Hanson, C.V., Freund, E.V., Smith, J.J., Anderson, E.C., Ammann, A.J., and MacFarlane, R.B., 2008, Steelhead growth in a small Central California watershed: upstream and estuarine rearing patterns, Transactions of the American Fisheries Society, 137: 114-128. DOI: 10.1577/T07-043.1.

Jacobs, D.K., Stein, E.D., and Longcore, T., 2011, Classification of California estuaries based on natural closure patterns: templates for restoration and management: technical report 619.a prepared for Southern California Coastal Water Research Project, 72 p.

James, G.W., 2005, Surface water dynamics at the Carmel River lagoon, water years 1991 through 2005, Monterey Peninsula Water Management District, 152 p.

James, G.W., 2013, Monterey Peninsula Water Management District personnel, personal communications.

Johnson, T., 2007, Battling seawater intrusion in the Central and West Coast Basins, Technical bulletin 13, Water replenishment district of Southern California, p. 2. Accessed on September 29, 2013 at http://www.wrd.org/engineering/reports/TB13_Fall07_Seawater_Barriers.pdf.

Larson, J., Watson, F., Casagrande, J., and Pierce, B., 2006, Carmel River Lagoon enhancement project: water quality and aquatic wildlife monitoring 2005-06, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, 102 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Larson, J., Watson, F,. Masek, J., Watts, M., Casagrande, J., 2005, Carmel River Lagoon enhancement project: water quality and aquatic wildlife monitoring 2004-05, report to California Department of Parks and Recreation from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, 134 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Moffatt and Nichol, 2013, Carmel River Lagoon Biological Assessment, Coastal Engineering Analysis: Draft report prepared for Monterey County Department of Public Works, 21 p.

Monterey Peninsula Water Management District (MPWMD), 2013, 2010-2011 annual report for the MPWMD mitigation program, 170 p. Accessed on July 25, 2013 at http://www.mpwmd.net/programs/mitigation_program/annual_report/annual_reportrev1.htm.

Monterey Peninsula Water Management District (MPWMD), 2011, 2009-2010 annual report for the MPWMD mitigation program, 161 p. Accessed on July 25, 2013 at http://www.mpwmd.net/programs/mitigation_program/annual_report/annual_reportrev1.htm.

Monterey Peninsula Water Management District (MPWMD), 2007, Study plan for long term adaptive management of the Carmel River State Beach and Lagoon, 40 p. Accessed on September 25, 2013 at http://www.mpwmd.dst.ca.us/Mbay_IRWM/IRWM_library/CarmelBay/LongTermStudyPlanFinal2007-04-17.pdf

National Marine Fisheries Service (NMFS), 2008, Biological Opinion for water supply, flood control operations, and channel maintenance conducted by the US Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservations Improvement District in the Russian River watershed, F/SWR/2006/07316, 386 p.

Philip Williams and Associates, Ltd., and Ecosystem Management International (PWA), 2007, Supplemental Carmel River watershed action plan, prepared for the Planning and Conservation League Foundation in partnership with the Carmel River Watershed Conservancy, p. 106.

Rich, A., and Keller, E.A., 2013, A hydrologic and geomorphic model of estuary breaching and closure. Geomorphology, vol. 191, p. 64-74. DOI: 10.1016/j.geomorph.2013.03.003.

Smith, J.J., 1990, the effects of sand bar formation and inflows on aquatic habitat and fish utilization in Pescadero, San Gregorio, Waddell and Pomponio Creek estuary/lagoon

systems, 1985-1989. Report prepared under Interagency Agreement 84-04-324, between Trustees for California State University and the California Department of Parks and Recreation, 47 p. + 4 tables and 52 figures.

Thornton, E.B., 2005, Littoral processes and river breachings at Carmel River Beach, prepared for the Monterey Peninsula Water Management District,12 p.

Urquhart, K.U., 2013, Carmel River fisheries reports for water year 2012 and October through December water year 2013, Monterey Peninsula Water Management District, 34 p.

Van Dyke, E., and Wasson, K., 2005, Historical ecology of a Central California estuary: 150 years of habitat change, Estuaries, Vol. 28, No. 2, p. 173-189.

Watson, F., Newman, W., Anderson, T., Alexander, S., Kozlowski, D., 2001, Winter water quality of the Carmel and Salinas Lagoons, Monterey Bay, California 2000/2001, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2001-01, 42 p. Accessed on July 30, 2013 at http://ccows.csumb.edu/pubs/.

Watson F., and Casagrande, J., 2004, Potential effects of GW extractions on Carmel Lagoon, a report from the Central Coast Watershed Studies Team (CCoWS), The Watershed Institute, CSU-Monterey Bay, WI-2001-01, 42 p.

Whitson Engineers, 2013a, Carmel River Lagoon ecosystem protective barrier (EPB) and scenic road protection structure (SRPS) projects feasibility report, prepared for Monterey County Water Resources Agency and Monterey County Department of Public Works, 43 p.

Whitson Engineers, 2013b, Carmel River Lagoon EPB, SRPS, and ISMP updated stage-volume-area analysis, p. 4.

Zhang, J., Guo, Y., Shen, Y., Zhang, L., 2008, Numerical simulation of flushing of trapped slat water from a bar-blocked estuary, Journal of Hydraulic Engineering, 134:11(1671), DOI: 10.1061/(ASCE)0733-9429.

A report prepared for:

January 24, 2014

Monterey County Resource Management Agency
168 West Alisal Street, 2nd Floor
Salinas, California 93901

by

Edward D. Ballman, P.E.
Principal Civil Engineer

Anne E. Senter
Geomorphologist/Hydrologist

Balance Hydrologics, Inc.®

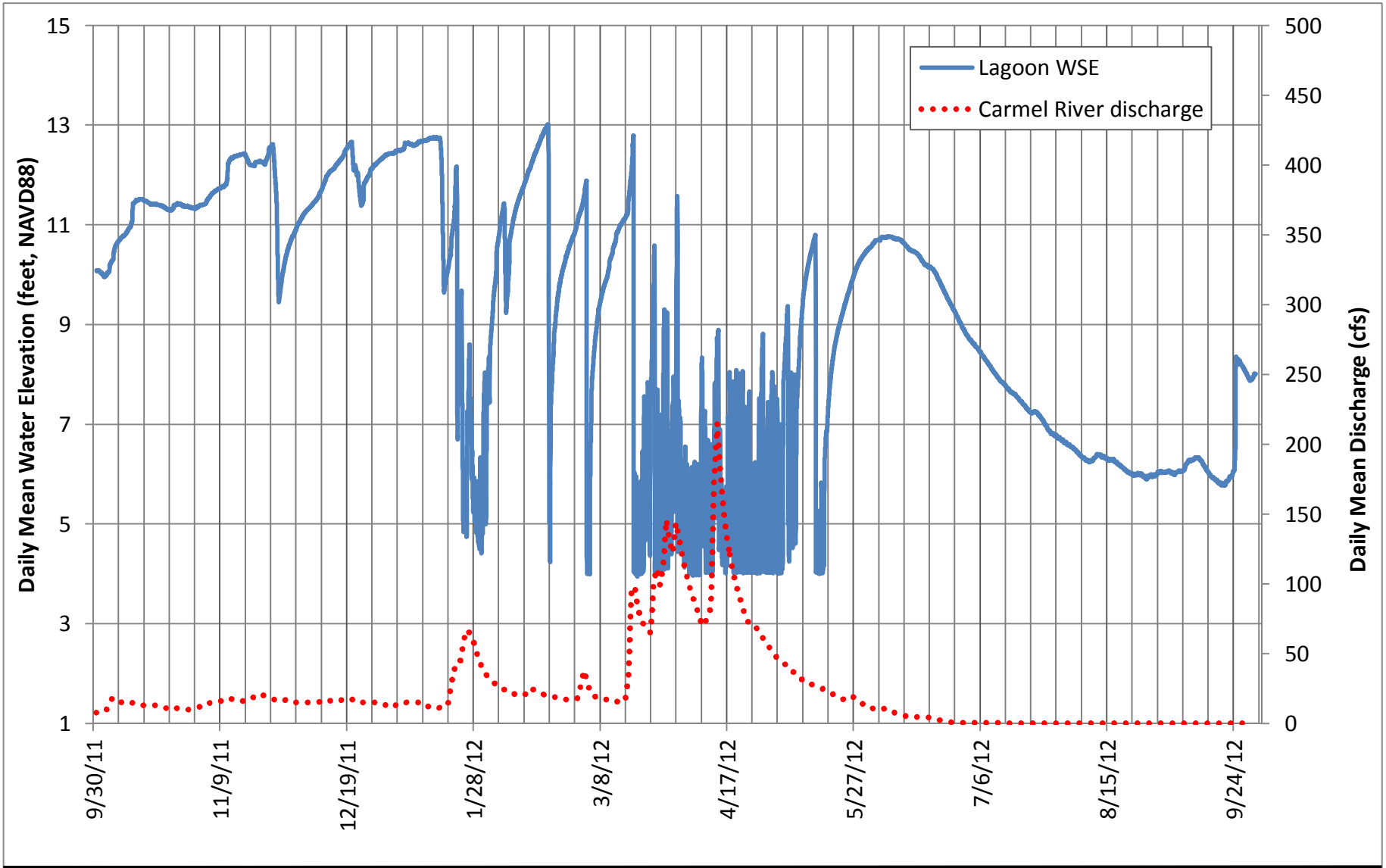
© 2014 Balance Project Assignment: 212151

800 Bancroft Way, Suite 101 ~ Berkeley, California 94710-2800 ~ (510) 704-1000 ~ *office@balancehydro.com*

APPENDICES

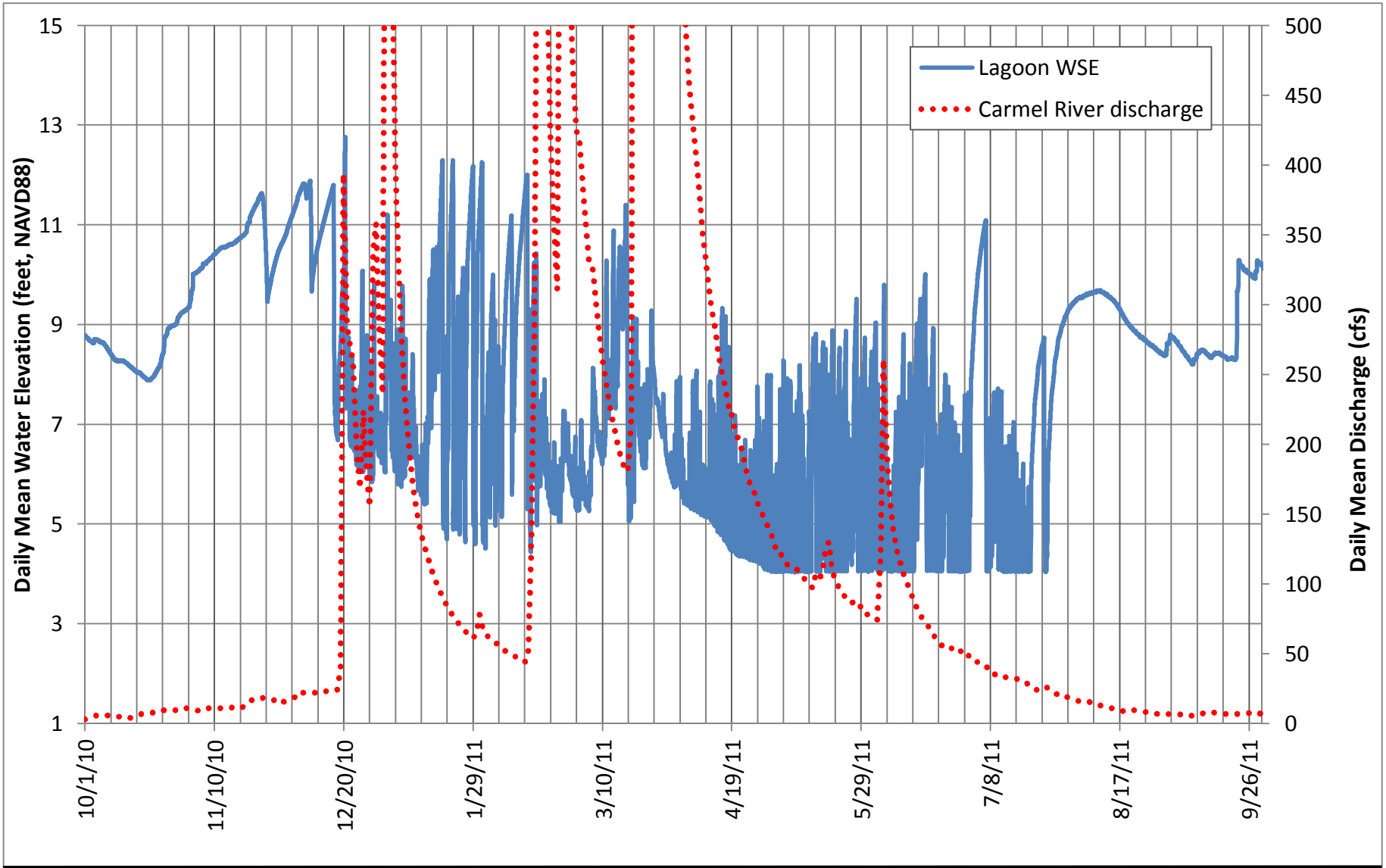
APPENDIX A

Water surface elevations in Carmel Lagoon and streamflow in Carmel River at Highway 1 gage, WYs 1993-2012



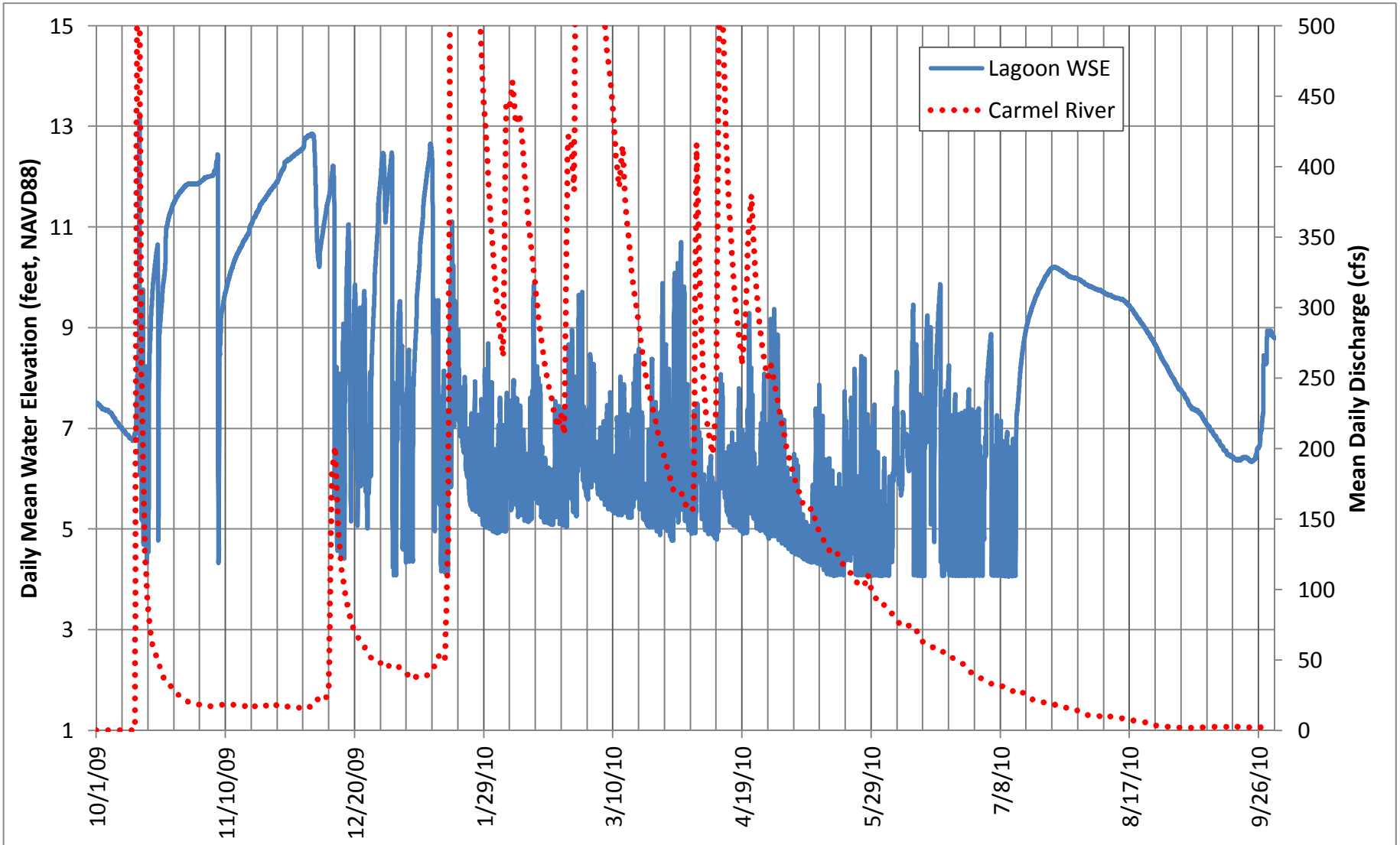
Balance Hydrologics, Inc.®

Figure 1. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2012, Monterey County, California. Sources: Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



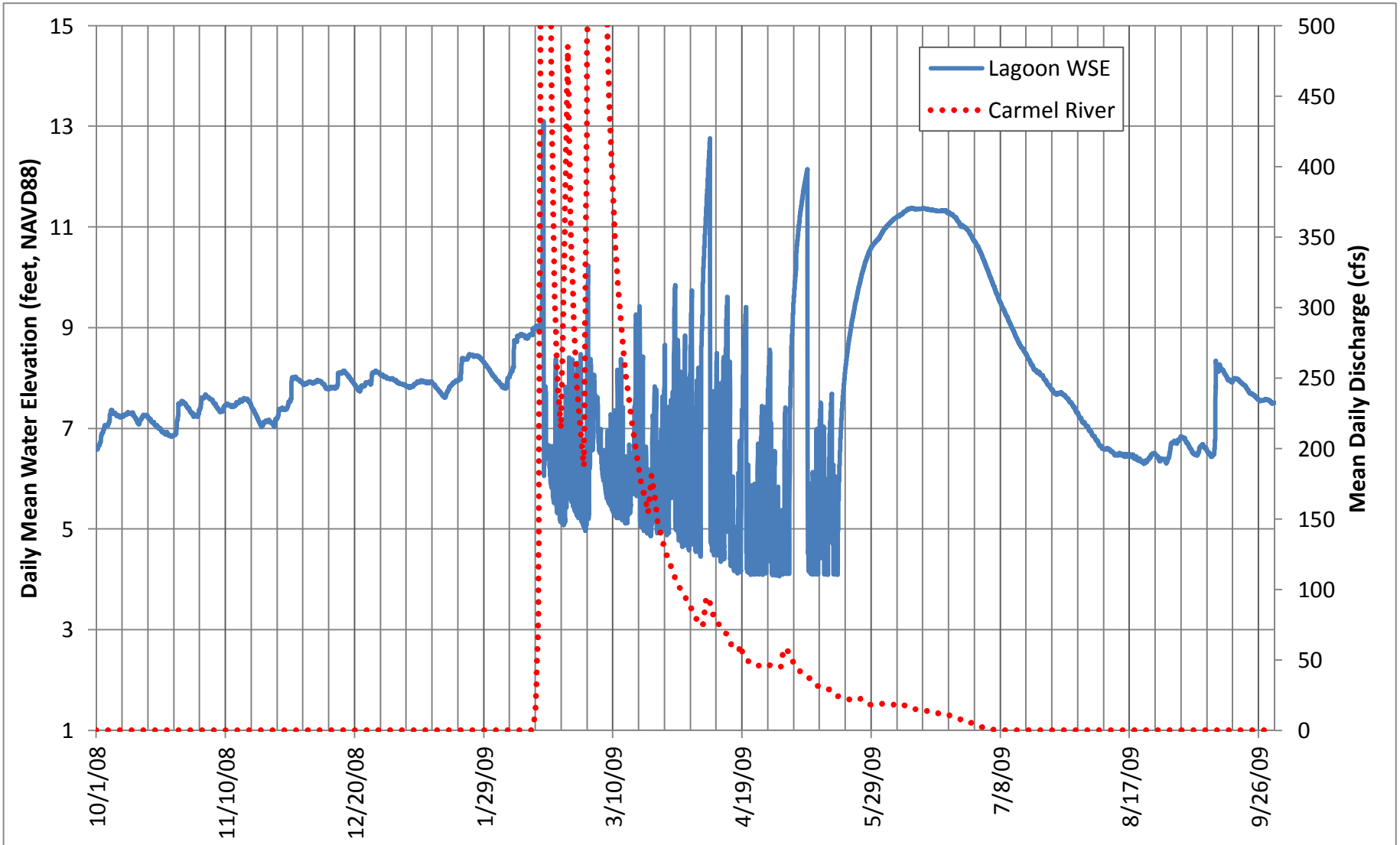
Balance Hydrologics, Inc.®

Figure 2. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2011, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



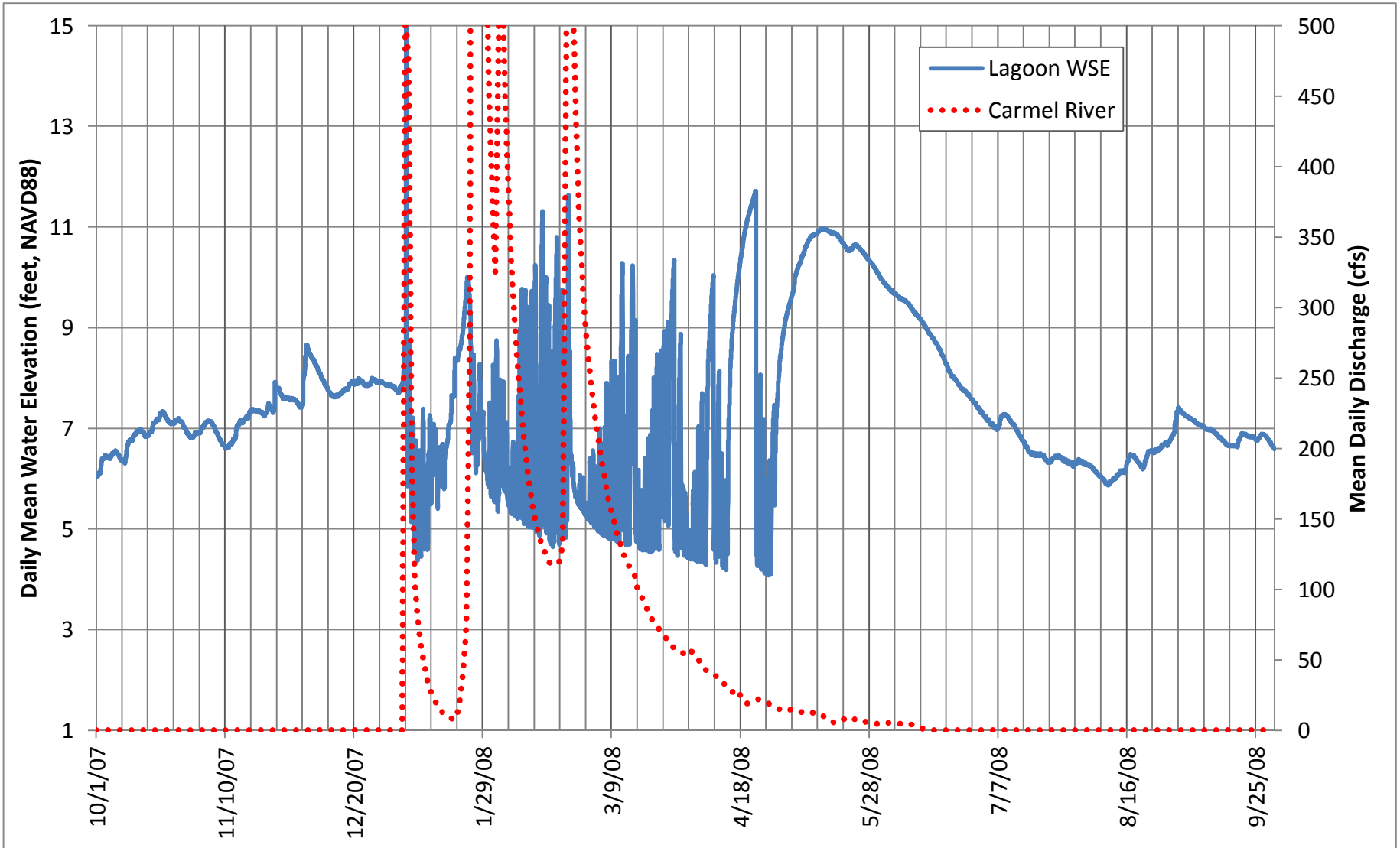
Balance Hydrologics, Inc.®

Figure 3. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2010, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



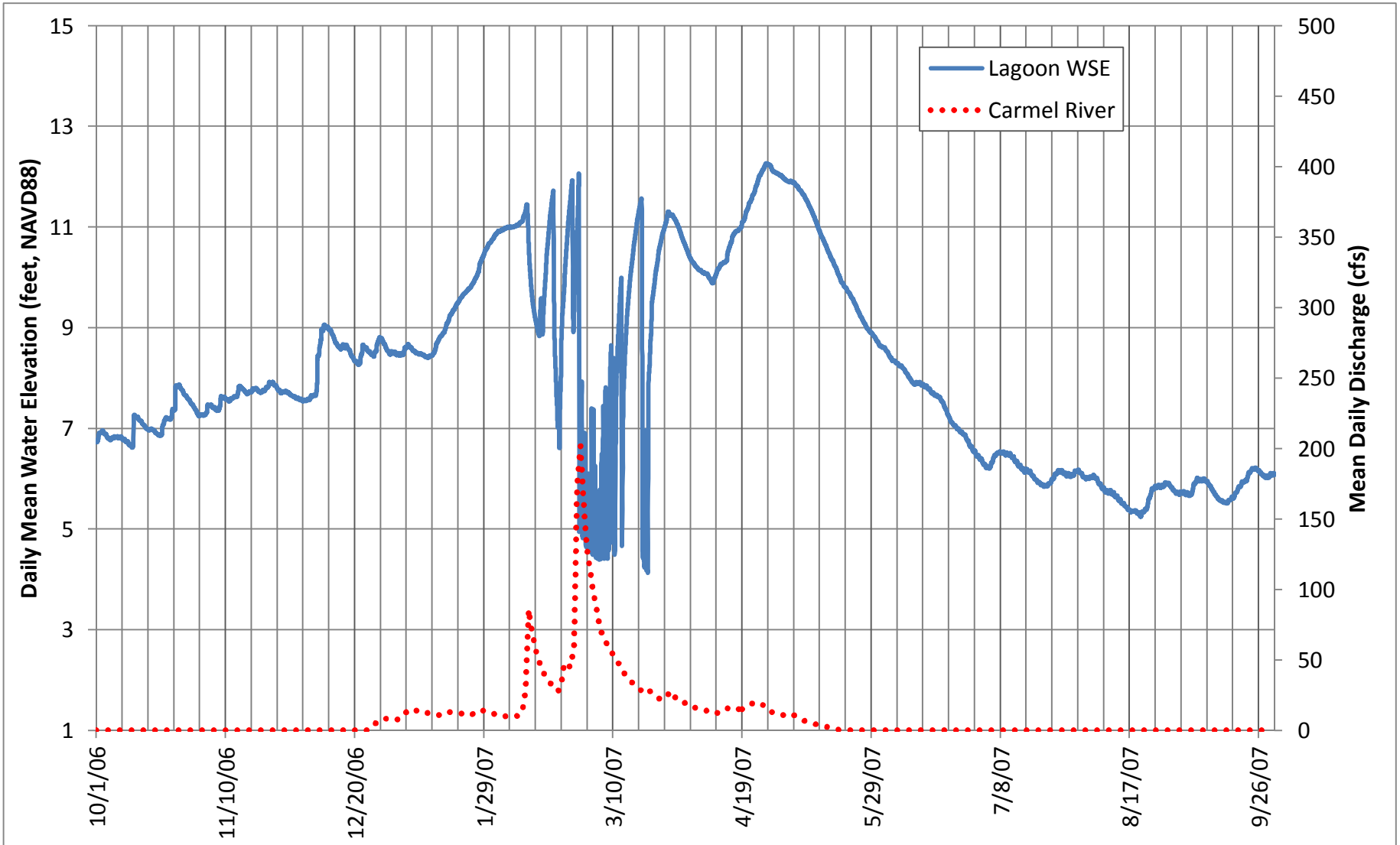
Balance Hydrologics, Inc.®

Figure 4. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2009, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



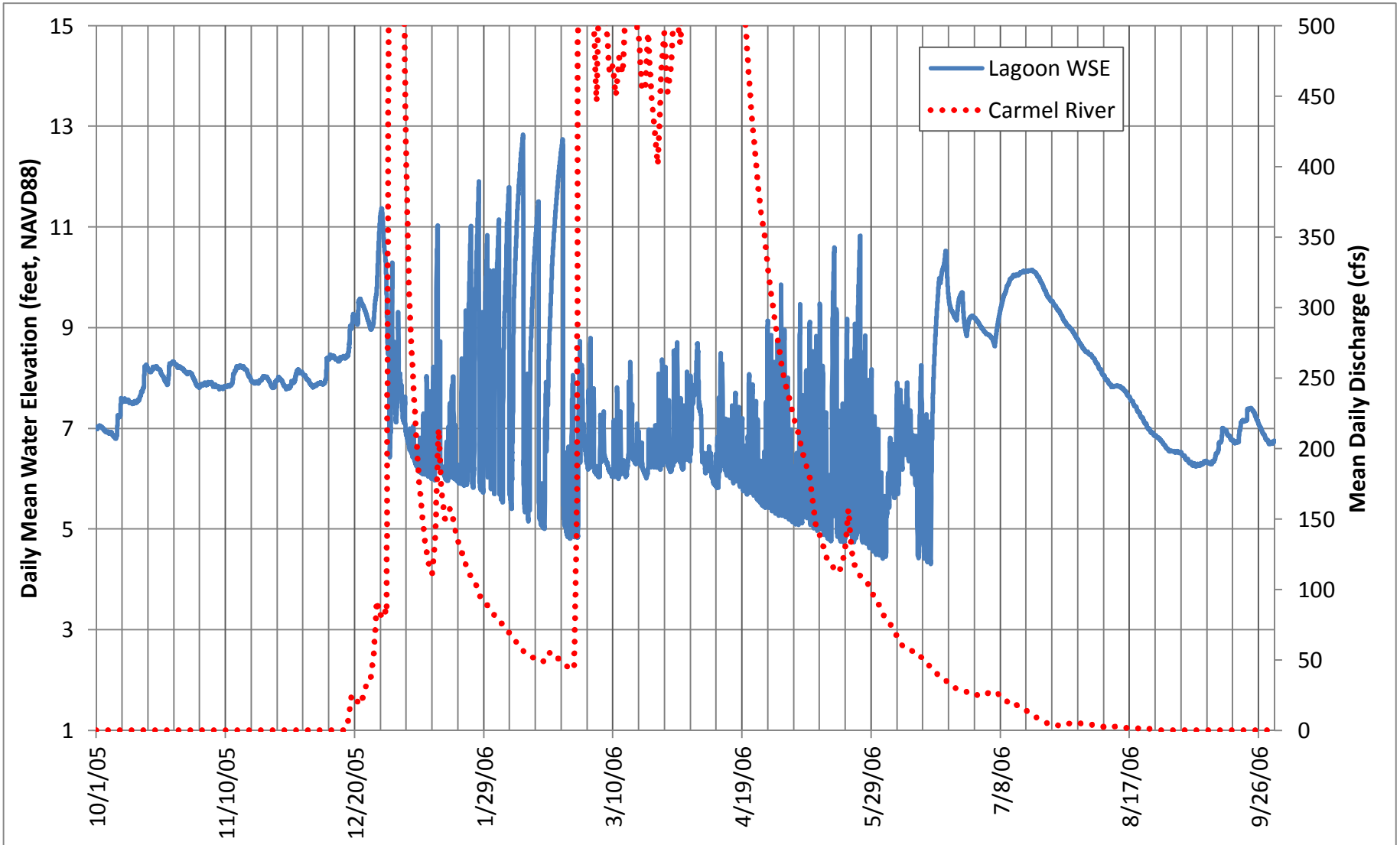
Balance Hydrologics, Inc.®

Figure 5. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2008, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



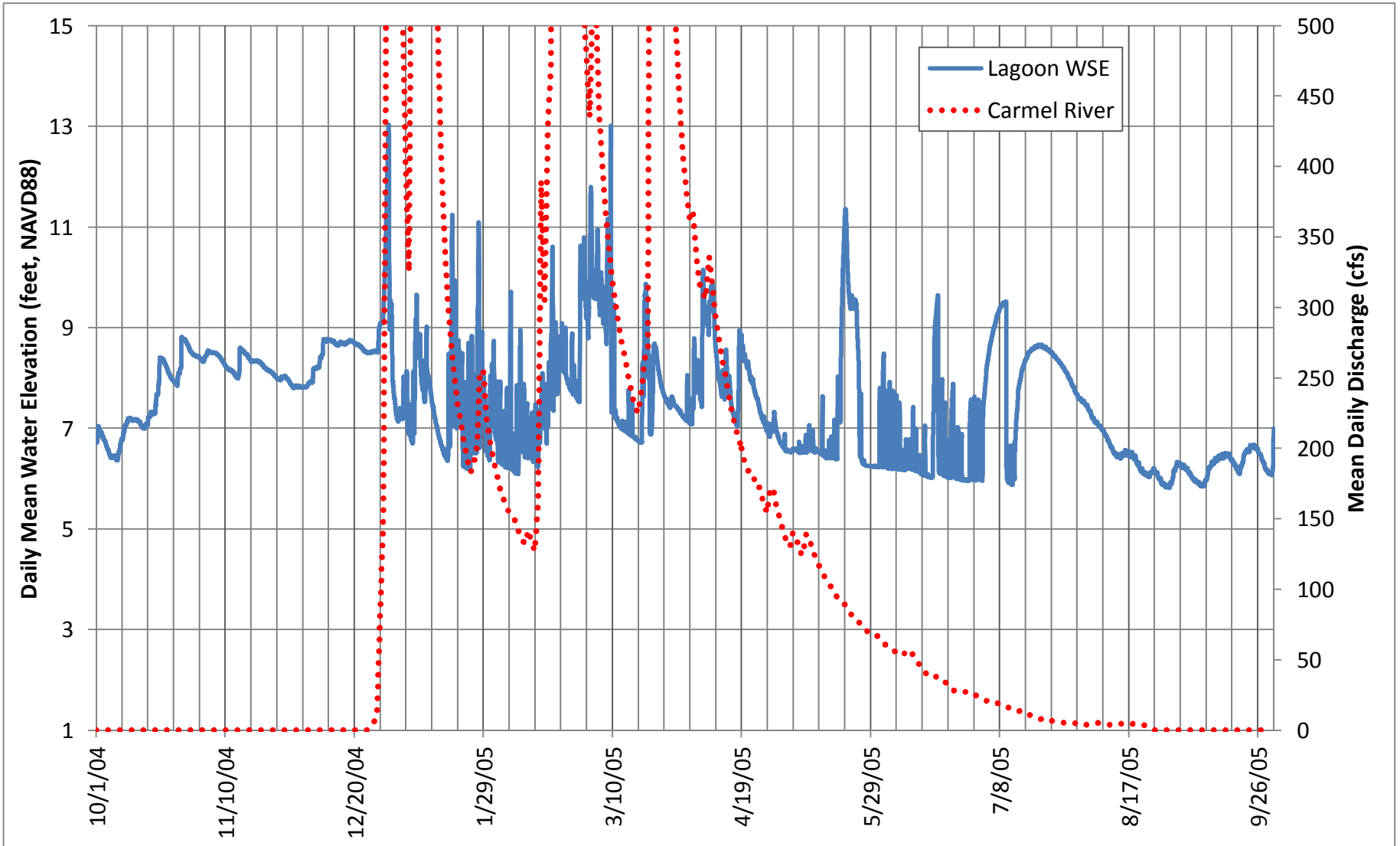
Balance Hydrologics, Inc.®

Figure 6. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2007, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



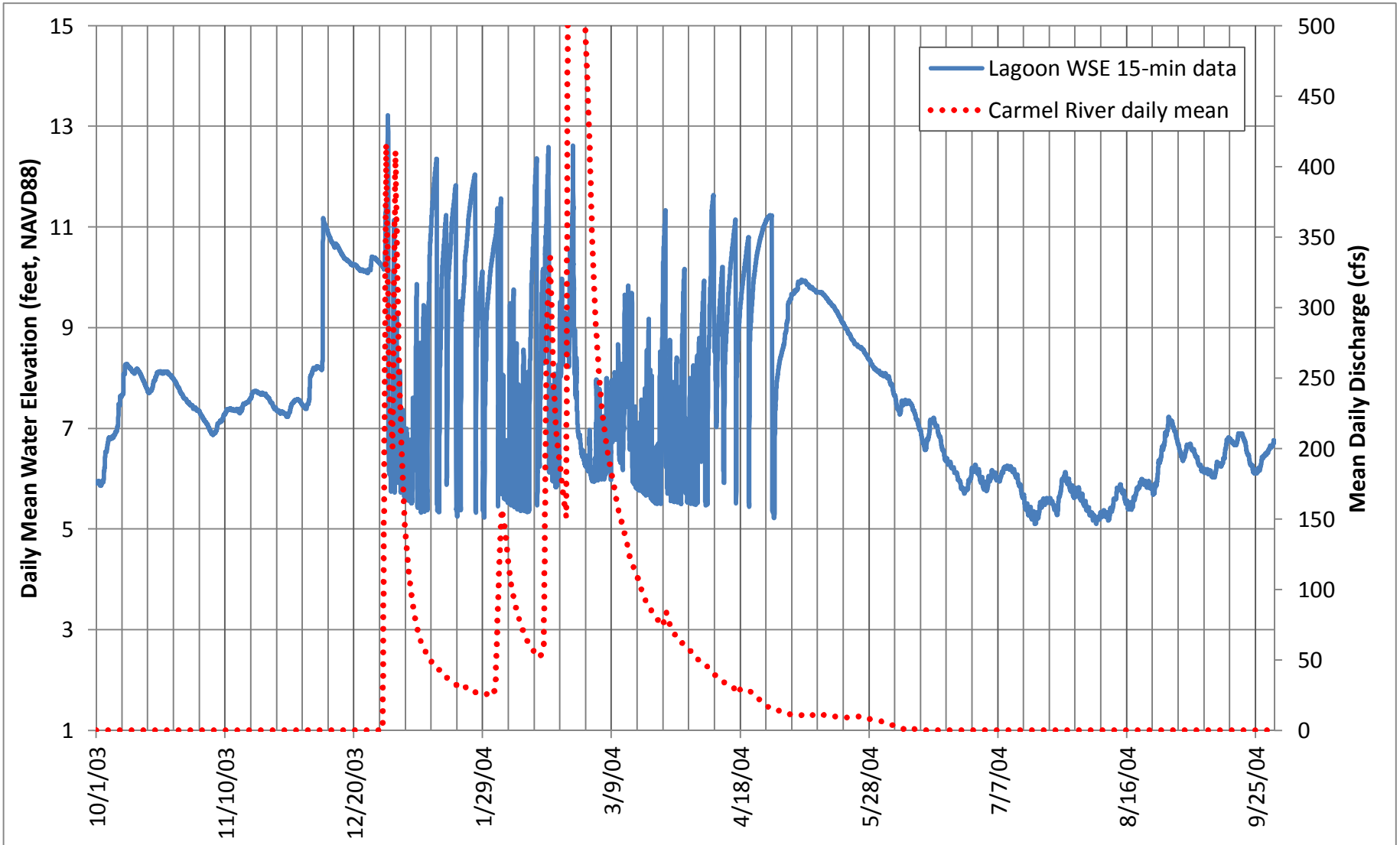
Balance Hydrologics, Inc.®

Figure 7. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2006, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



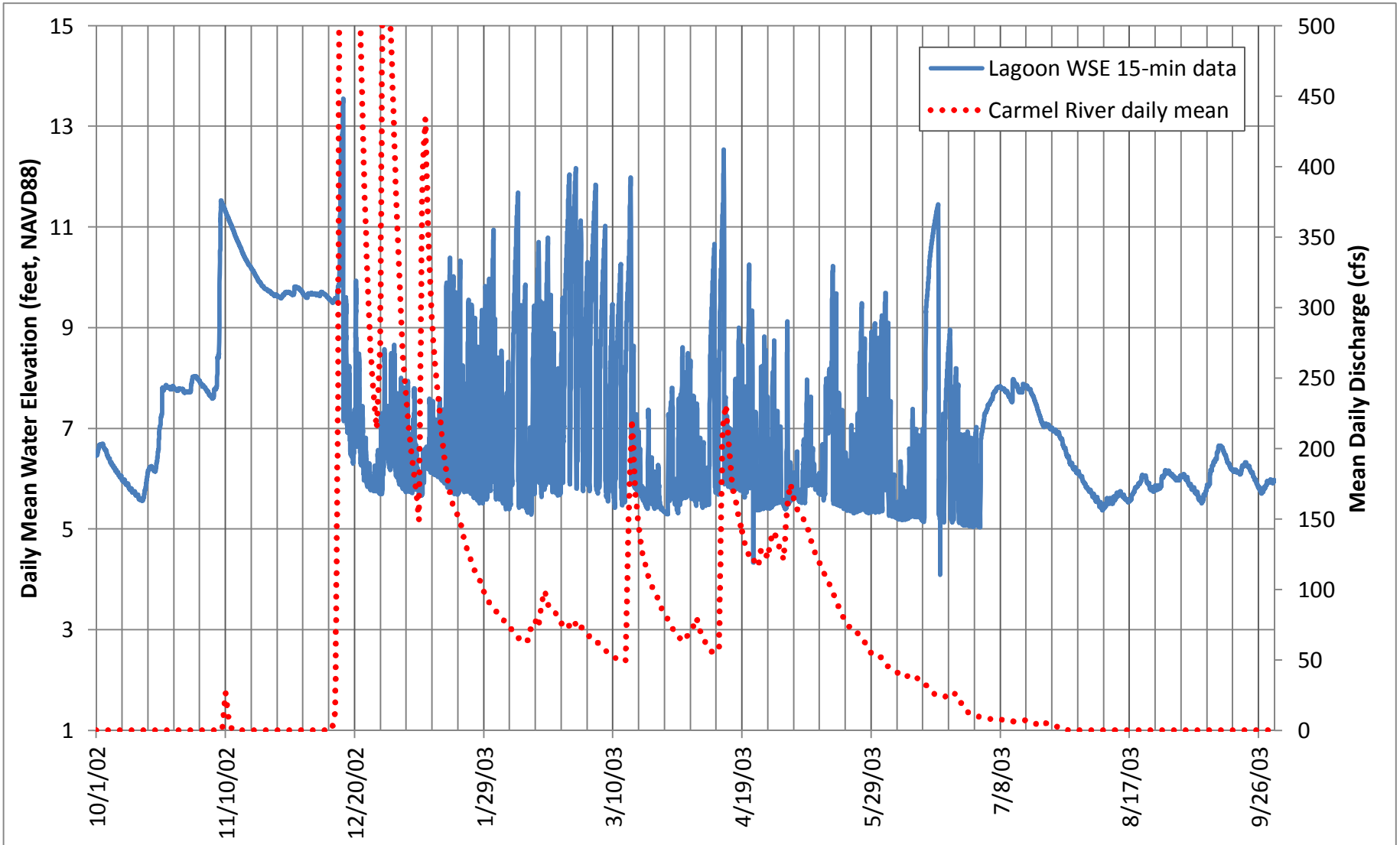
Balance Hydrologics, Inc.®

Figure 8. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2005, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



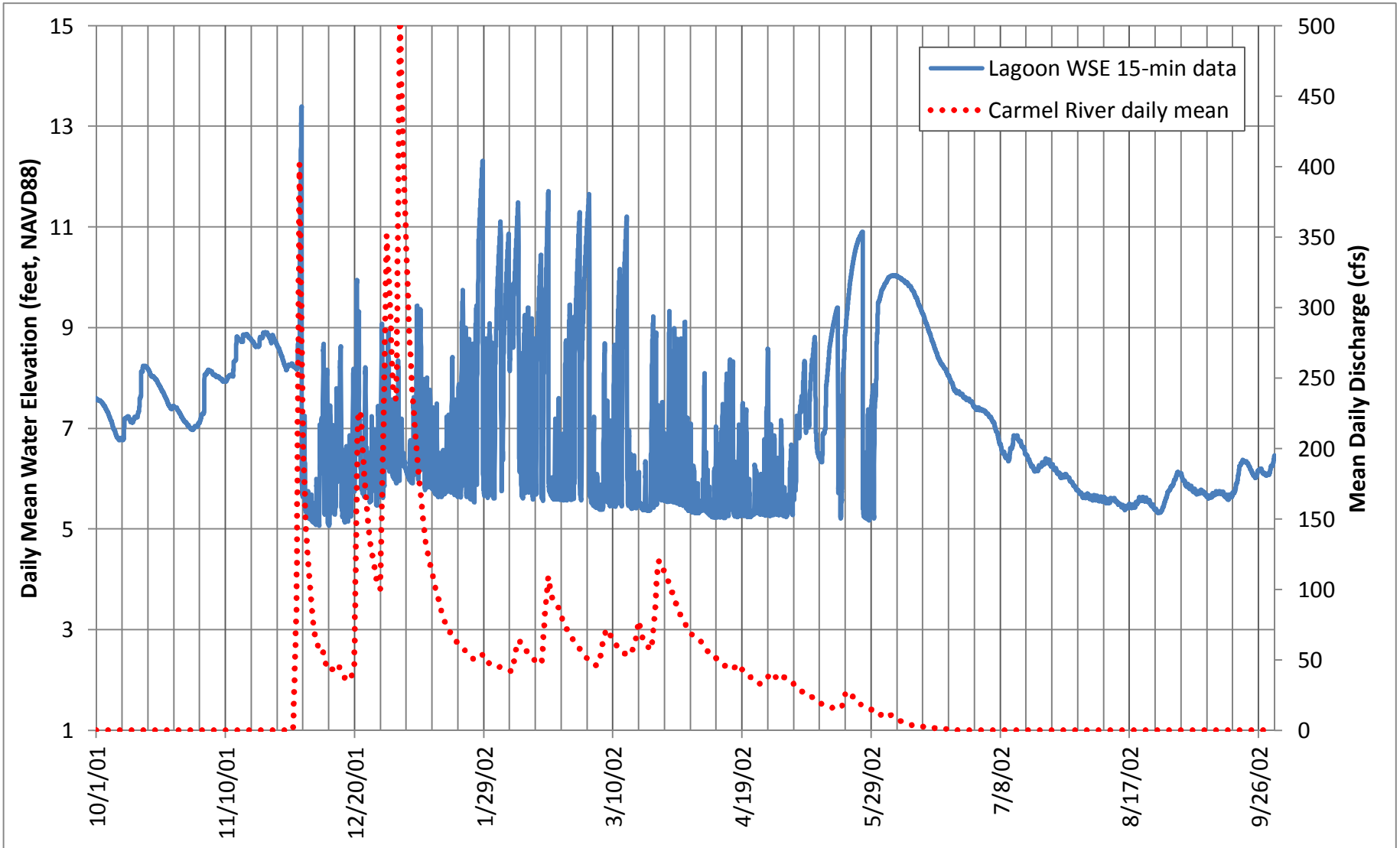
Balance Hydrologics, Inc.®

Figure 9. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2004, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



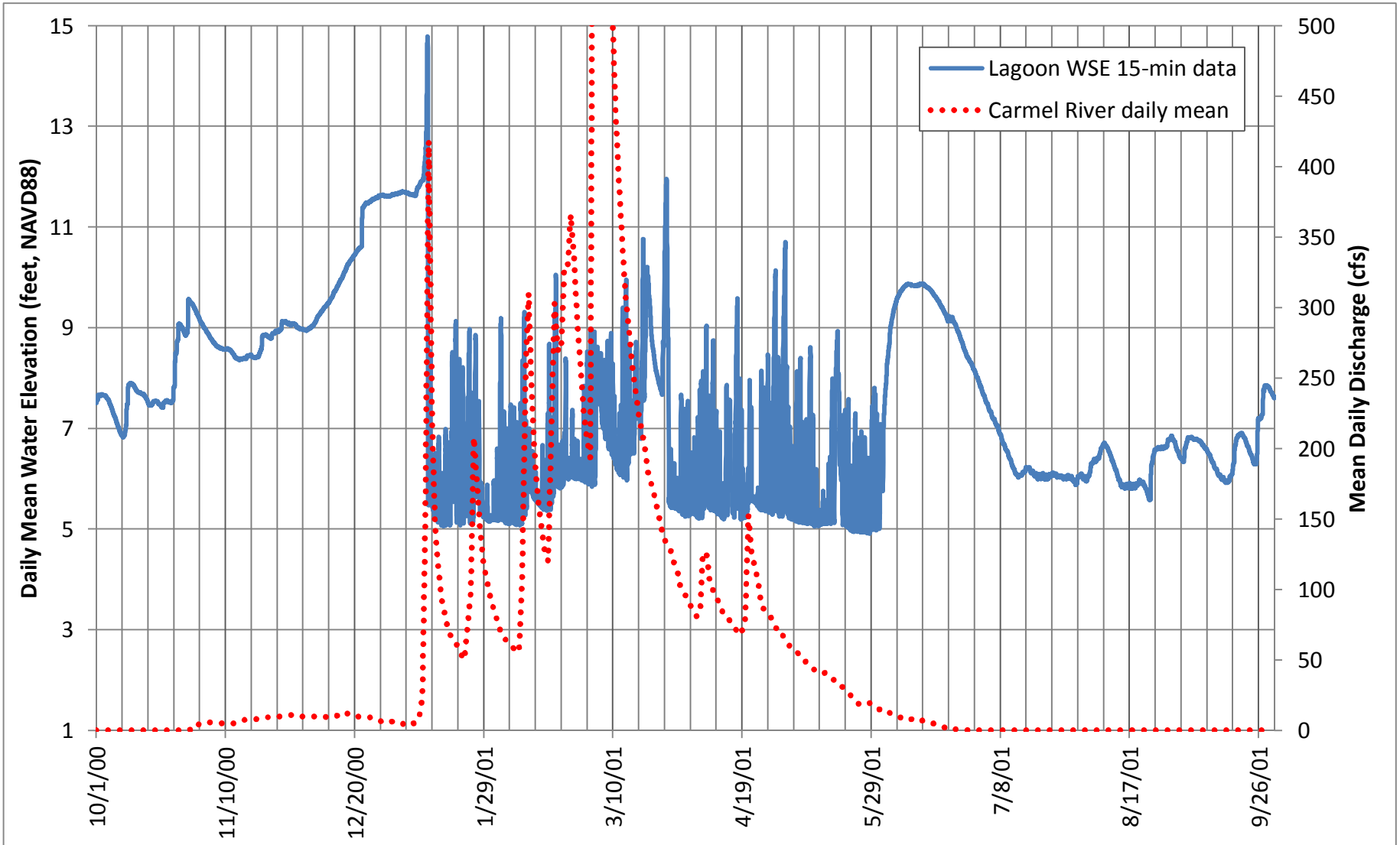
Balance Hydrologics, Inc.®

Figure 10. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2003, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



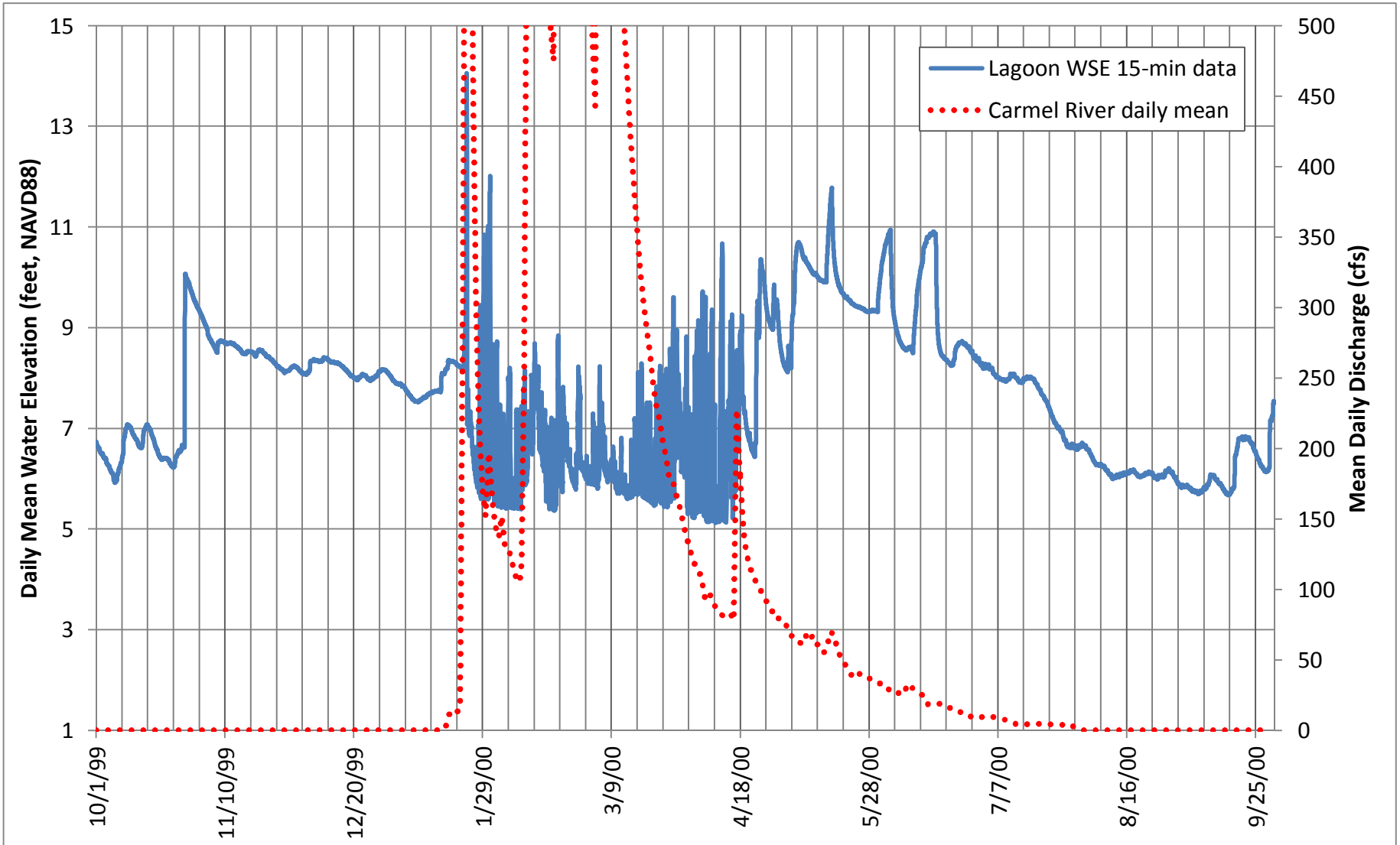
Balance Hydrologics, Inc.®

Figure 11. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2002, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



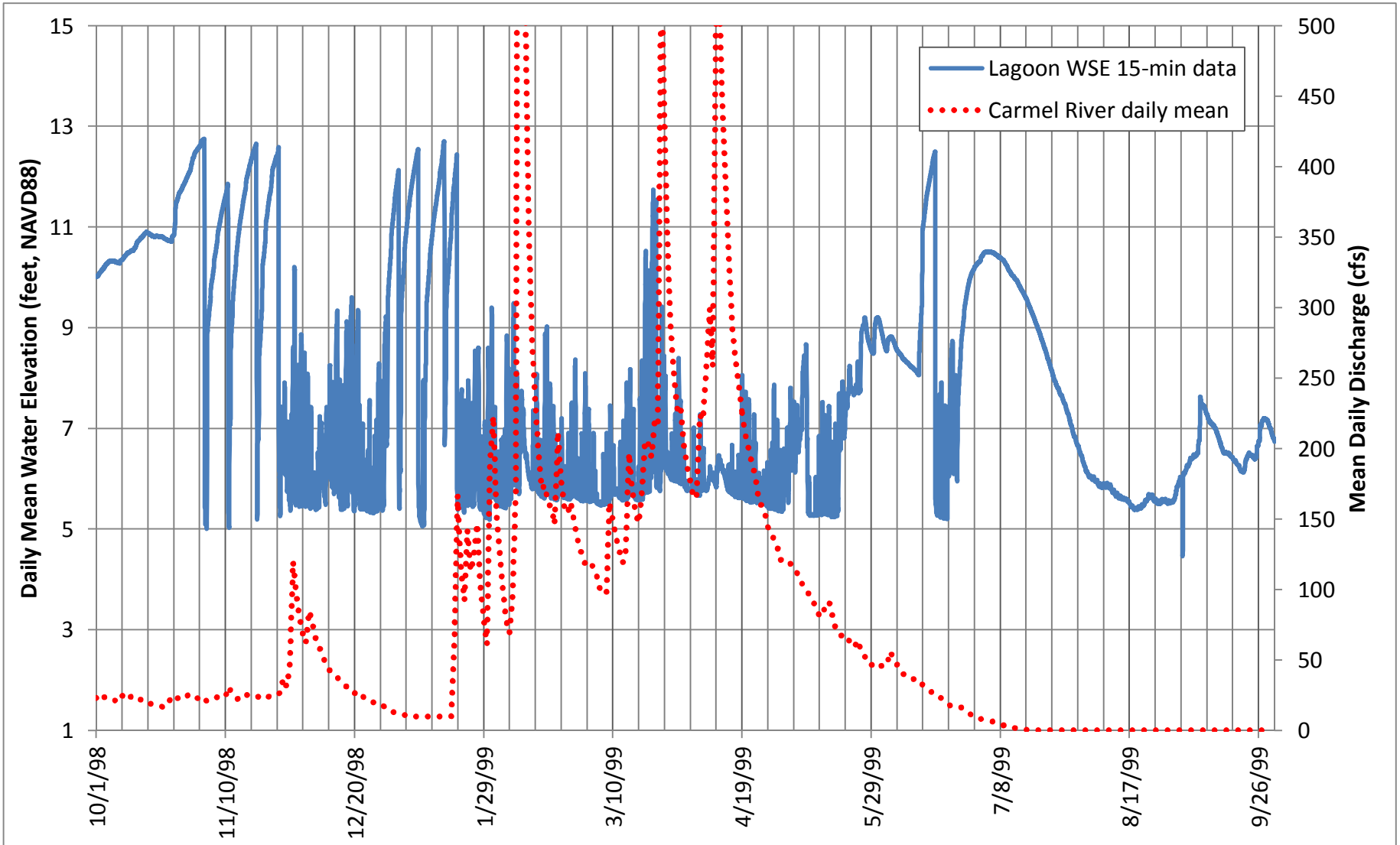
Balance Hydrologics, Inc.®

Figure 12. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2001, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



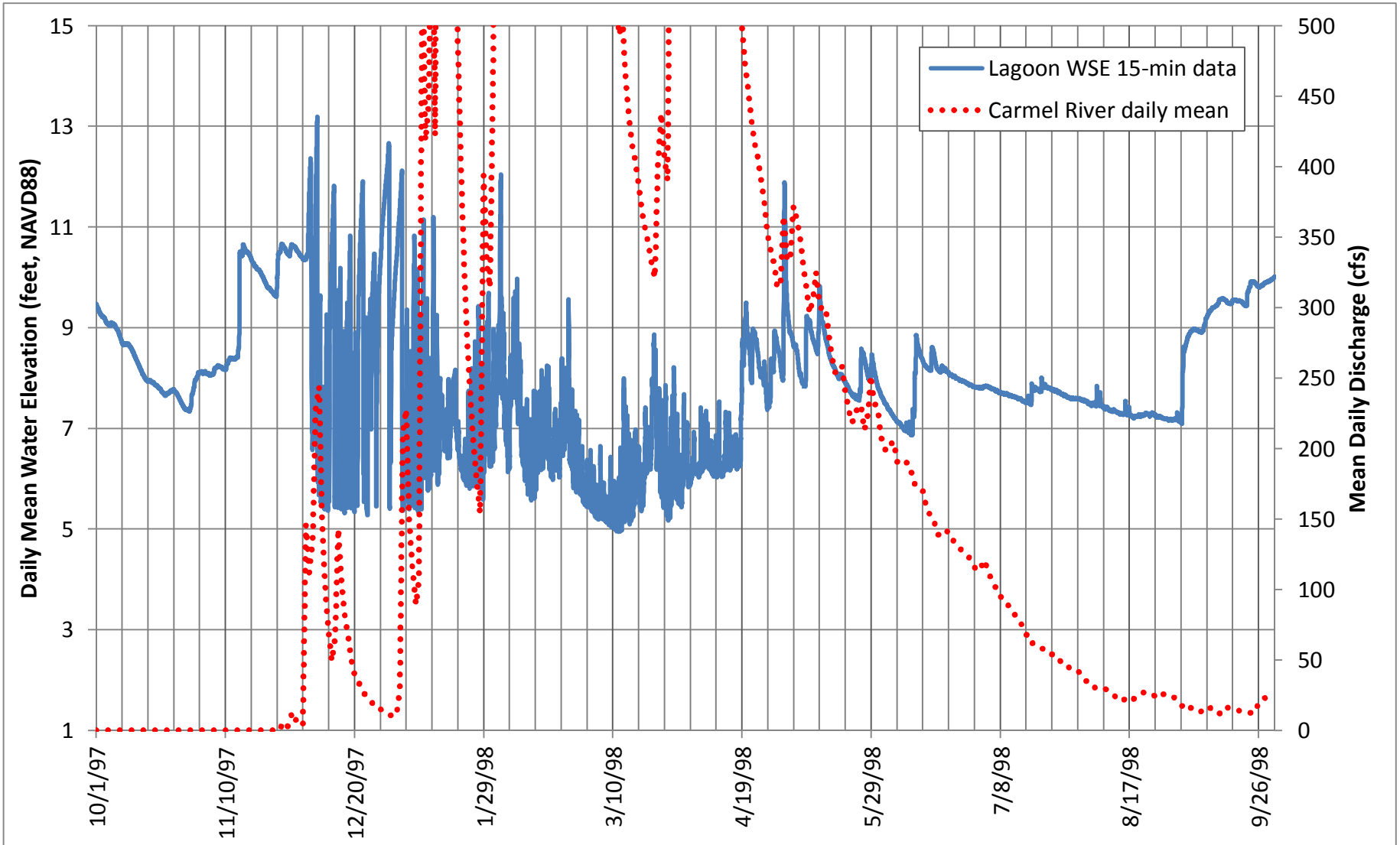
Balance Hydrologics, Inc.®

Figure 13. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 2000, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



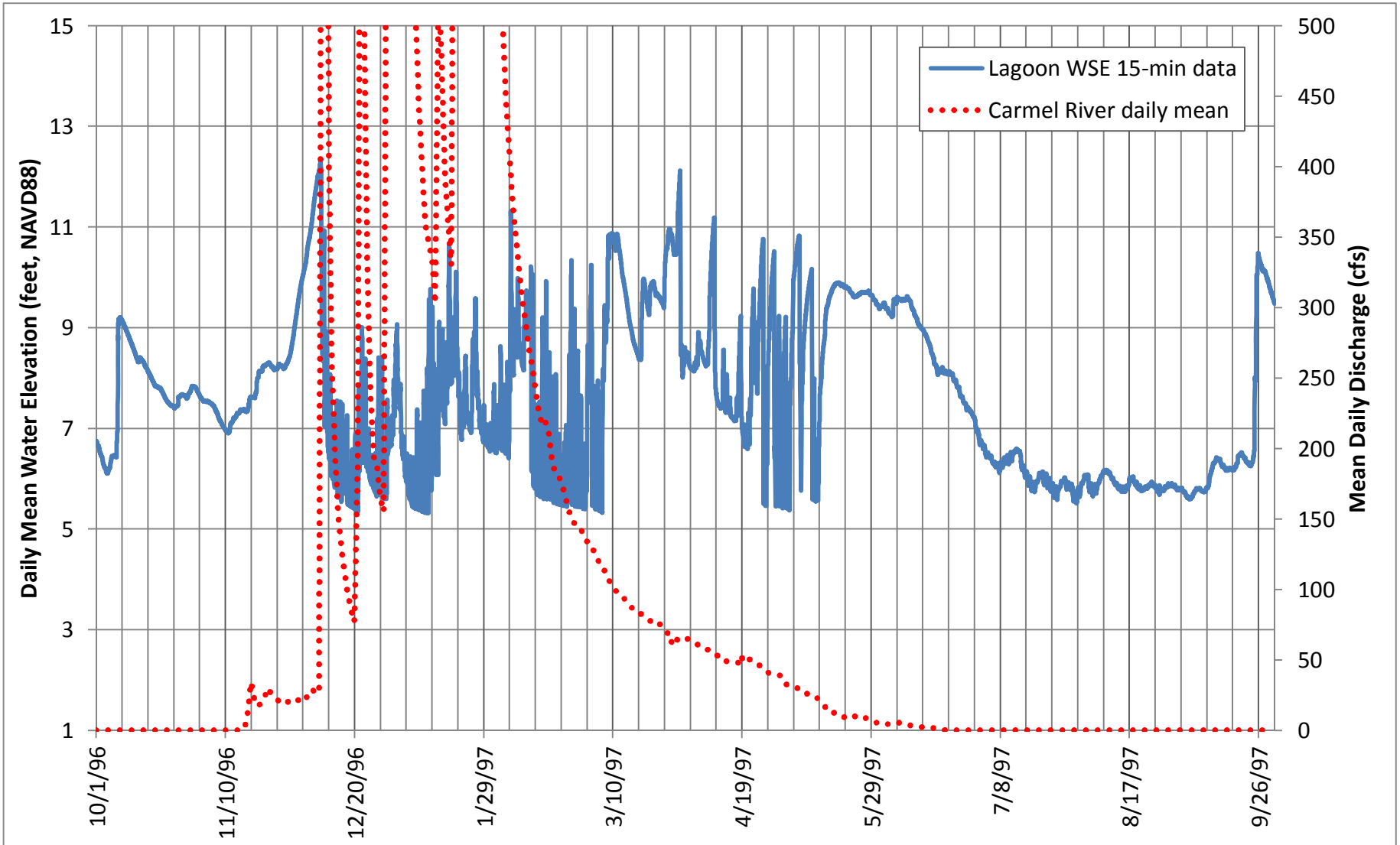
Balance Hydrologics, Inc.®

Figure 14. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1999, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



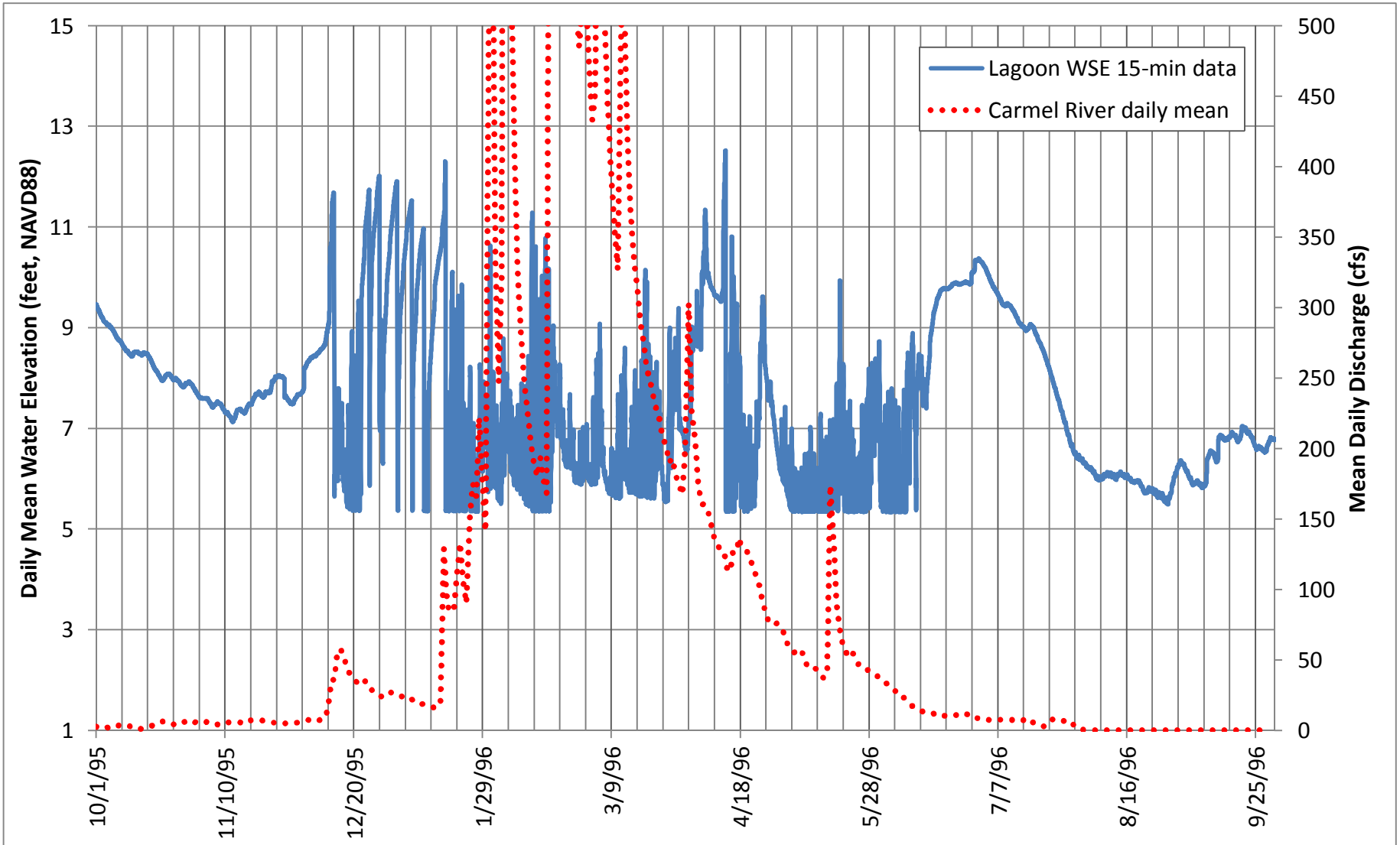
Balance Hydrologics, Inc.®

Figure 15. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1998, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



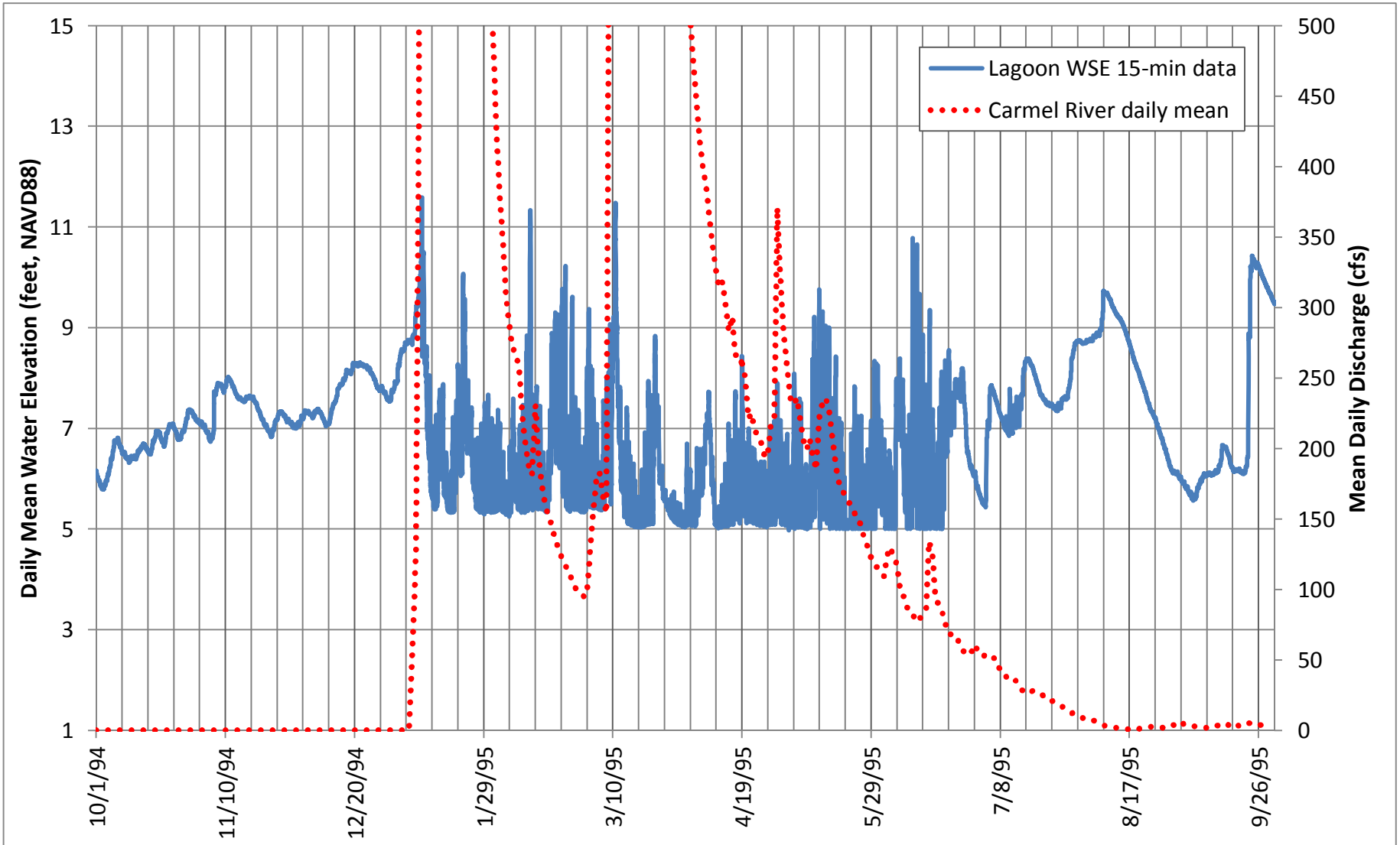
Balance Hydrologics, Inc.®

Figure 16. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1997, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



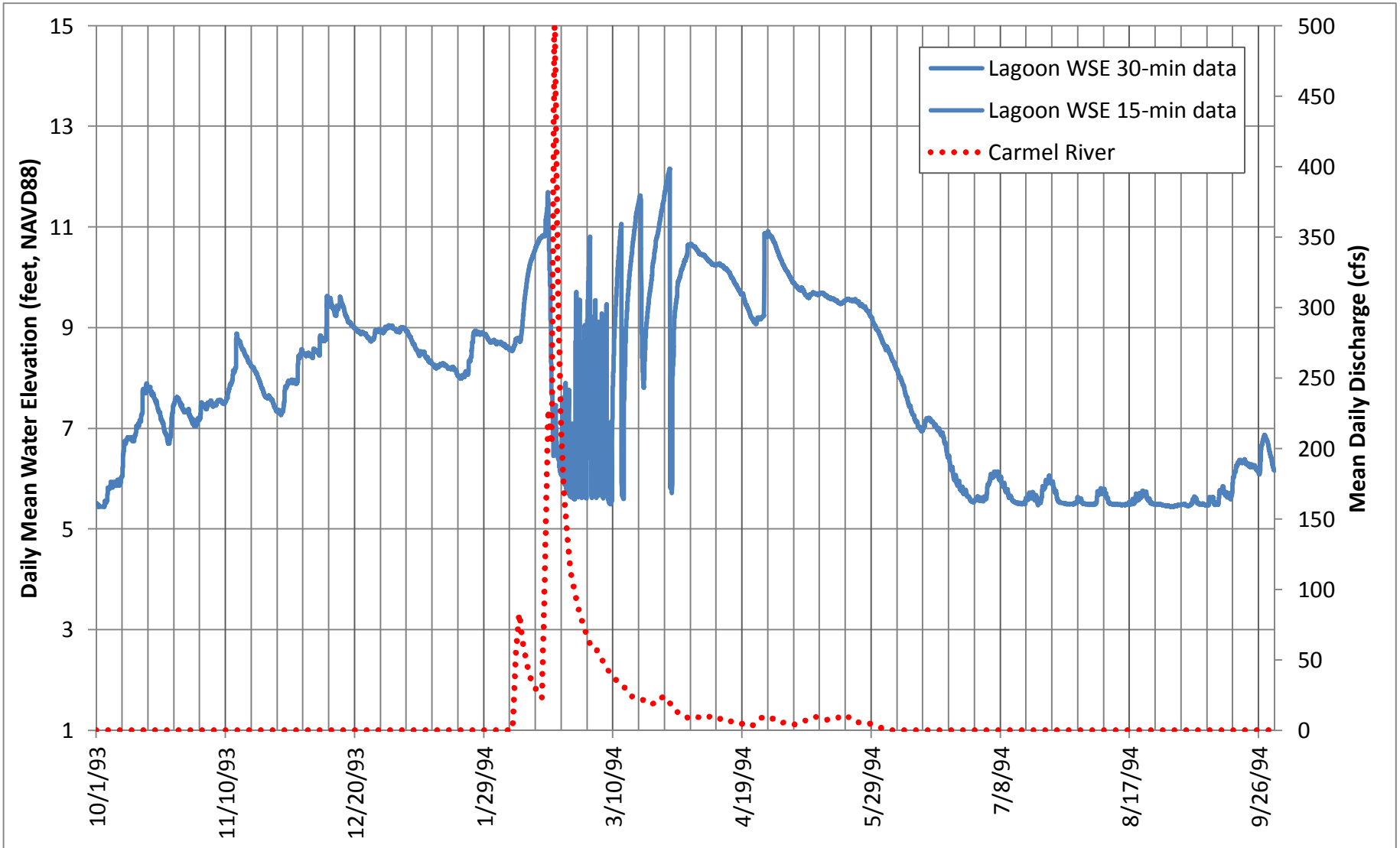
Balance Hydrologics, Inc.®

Figure 17. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1996, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



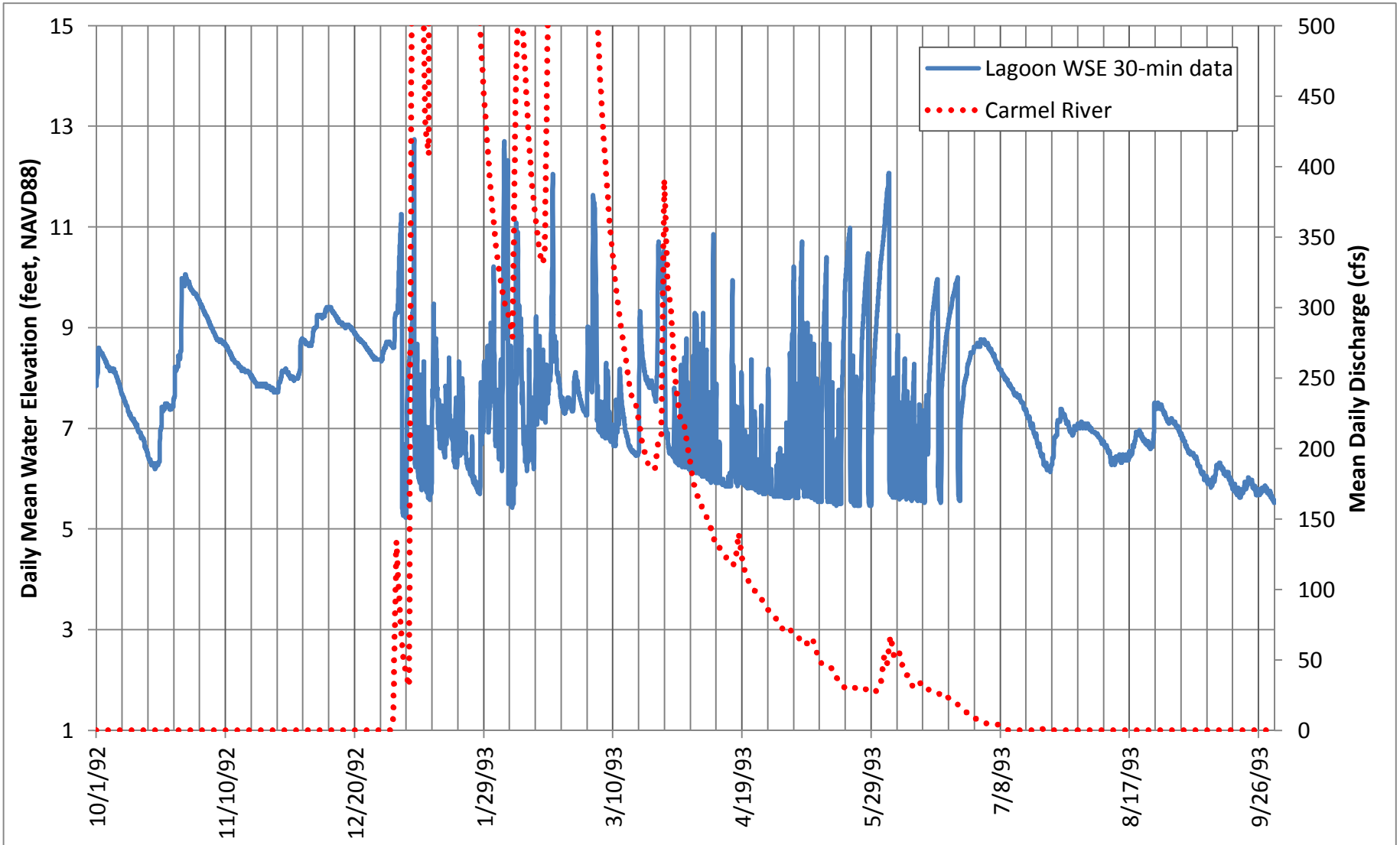
Balance Hydrologics, Inc.®

Figure 18. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1995, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



Balance Hydrologics, Inc.®

Figure 19. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1994, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.



Balance Hydrologics, Inc.®

Figure 20. Water level in Carmel River Lagoon at south arm gage and flow in Carmel River at Highway 1 gage, water year 1993, Monterey County, California. Monterey Peninsula Water Management District raw lagoon water surface elevation datalogger files are provisional and subject to revision. USGS 11143250 daily mean discharge data are approved for publication.

APPENDIX B

Compilation tables of riverine dynamics of breaches and closures, WYs 1993-2012

Table 1. WY 2012, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Temporary breach	Temporary breach	In-season closure	Temporary breach	Temporary breach	In-season closure	Sustained breach*	In-season closure	Temporary breach	In-season closure	Sustained breach	In-season closure	Sustained breach	In-season closure	Sustained breach	Early closure	Final Closure	WSE increase while closed
Mechnical, Natural, or Unknown		Mechanical	Mechanical		Mechanical	Mechanical		Mechanical		Natural		Natural		Natural		Natural	Mechanical	Mechanical	
Dry Season Events	10/1/2011 0:00																		
Date-Time of lowest lagoon WSE prior to breach	10/3/2011 15:30																		
Lowest lagoon WSE during closure, this WY	9.95																		
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach																			
Date-Time of lowest WSE prior to significant increase in WSE																			9/21/12 9:15
WSE (ft)																			5.78
Date-Time of highest WSE post-increase																			9/24/12 21:15
WSE (ft)																			8.36
Increase in WSE (ft)																			2.58
Likely mechanism with greatest influence on WSE increase process																			Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE																			0
Date-Time of most recent WSE > 11 ft prior to breach, this WY	11/16/2011 20:15																		
Time (days) between start of WY and first seasonal breach	46.8																		
Breachs and Closures during rainy season																			
Date-Time of highest WSE at time of breach		11/16/2011 20:15	11/25/2011 17:45		12/20/2011 16:00	1/17/2012 11:30		1/22/2012 17:30		2/6/2012 18:30		2/20/2012 14:30		3/3/2012 17:30		3/18/2012 13:30			
WSE (ft)		12.43	12.62		12.66	12.74		12.17		11.43		13.01		11.89		12.79			
Date-Time of lowest WSE directly following breach		11/19/2011 13:30	11/27/2011 15:30		12/23/2011 15:00	1/18/2012 18:15		1/23/2012 1:30		2/7/2012 9:15		2/21/2012 5:30		3/4/2012 0:15		3/18/2012 17:15			
WSE (ft)		12.19	9.45		11.38	9.64		6.69		9.24		4.24		4.00		4.03			
WSE pre-breach minus post-breach (ft)		0.23	3.17		1.28	3.10		5.47		2.19		8.77		7.88		8.76			
Time difference (days)		2.72	1.91		2.96	1.28		0.33		0.61		0.63		0.28		0.16			
Time difference (hours)		65.25	45.75		71.00	30.75		8.00		14.75		15.00		6.75		3.75			
Rate of WSE decline (ft/hr)		0.00	0.07		0.02	0.10		0.68		0.15		0.58		1.17		2.34			
Mean daily flow rate (cfs) on day of breach		16	18		17	11		39		25		20		38		96			
Mean daily flow rate (cfs) on day of lowest WSE following breach		17	17		15	12		39		24		20		30		96			
Likely mechanism with greatest influence on breaching process		Mechanical	Mechanical		Mechanical	Mechanical		Mechanical/Riverine		Mechanical		Unknown		Riverine		Riverine			
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				11/27/2011 15:30			1/18/2012 18:30		2/2/2012 3:15		2/7/2012 9:45		2/21/2012 5:30		3/4/2012 18:45				
WSE (ft)				9.45			9.64		7.43		9.23		4.24		3.99				
Date-Time of lagoon WSE fills to > 11 feet				12/3/2011 13:00			1/21/2012 17:45		2/5/2012 11:15		2/9/2012 10:00		2/29/2012 16:30		3/14/2012 11:00				
WSE (ft)				11.00			11.00		11.00		11.00		11.00		11.00				
Date-Time of lagoon falls below WSE > 11 feet				1/18/2012 9:00			1/22/2012 21:30		2/6/2012 22:30		2/20/2012 20:45		3/3/2012 18:30		3/18/2012 14:30				
WSE (ft)				10.97			10.83		10.99		10.93		10.85		9.76				
Time (days) of WSE > 11 feet				45.83			1.16		1.47		11.45		3.08		4.15				
Time (hours) of WSE > 11 feet				1100.0			27.8		35.3		274.8		74.0		99.5				
Mean daily flow rate (cfs) on day lowest WSE				17			12		33		24		20		30				
Mean daily flow rate (cfs) on day WSE > 11 feet				15			27		27		22		17		15				
Mean daily flow rate (cfs) on day WSE < 11 feet				12			39		25		20		38		96				
Likely mechanism with greatest influence on closure process				Ocean			Ocean		Ocean		Ocean		Ocean		Ocean				
Dry Season Closure																			
Date-Time of highest WSE at WY closure																	5/15/2012 1:15	6/7/2012 2:15	
WSE (ft)																	10.80	10.77	
Date-Time of lowest WSE during WY closure																	5/15/2012 16:15	9/20/2012 13:00	
WSE (ft)																	4.02	5.77	
Time (days) difference highest minus lowest WSE																	0.63	105.45	
Time (hours) difference highest minus lowest WSE																	15.00	2530.75	
Highest WSE at closure minus lowest WSE during closure in this WY																	6.77	5.00	
Rate of decrease in WSE (ft/day)																	0.452	0.002	
Mean daily flow rate (cfs) on day of highest WSE at closure																	27	27	
Mean daily flow rate (cfs) on day of lowest WSE of dry season																	n/a	0	
Likely mechanism with greatest influence on process																	Mechanical	Ocean	
End of WY																		9/30/2012 23:45	
Time (days) between final season closure and end of WY																		115.9	
Total days of lagoon closure in this WY (pre- and post-rainy season)																		162.7	
Totel days of closure including all partial closures																		184.0	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as temporary lagoon closing due to mechanical or ocean processes approximately 1 month to 1 week before than final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included the sum of days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the MPWMD WY 2012 fisheries report (Urquhart, 2013)

Table 2. WY 2011, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Temporary breach	In-season closure	Temporary breach	In-season closure	Sustained breach*	In-season closure	Sustained breach	In-season closure	Sustained breach	Final Closure
Natural, Mechanical or Unknown		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	Mechanical
Dry Season Events	10/1/2010 0:00										
Date-Time of lowest lagoon WSE prior to breach	10/21/2010 8:15										
Lowest lagoon WSE during closure, this WY	7.89										
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach											
Date-Time of lowest WSE prior to significant increase in WSE											
WSE (ft)											
Date-Time of highest WSE post-increase											
WSE (ft)											
Increase in WSE (ft)											
Likely mechanism with greatest influence on WSE increase process											
Mean daily flow rate (cfs) on day of highest WSE											
Date-Time of most recent WSE > 11 ft prior to breach, this WY	11/24/2010 16:00										
Time (days) between start of WY and first seasonal breach	54.7										
Breachs and Closures during rainy season											
Date-Time of highest WSE at time of breach		11/24/2010 16:00		12/9/2010 15:15		12/16/2010 20:45		1/29/2011 0:15		2/14/2011 17:45	
WSE (ft)		11.63		11.89		11.80		12.18		12.01	
Date-Time of lowest WSE directly following breach		11/26/2010 9:30		12/10/2010 1:30		12/18/2010 3:30		1/29/2011 3:30		2/14/2011 21:15	
WSE (ft)		9.46		9.66		6.69		4.97		5.30	
WSE pre-breach minus post-breach (ft)		2.16		2.22		5.11		7.21		6.71	
Time difference (days)		1.73		0.43		1.28		0.14		0.15	
Time difference (hours)		41.50		10.25		30.75		3.25		3.50	
Rate of WSE decline (ft/hr)		0.05		0.22		0.17		2.22		1.92	
Mean daily flow rate (cfs) on day of breach		19		15		17		51		21	
Mean daily flow rate (cfs) on day of lowest WSE following breach		17		15		16		51		21	
Likely mechanism with greatest influence on breaching process		Mechanical		Mechanical		Mechanical		Riverine		Mechanical	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours			11/26/2010 9:30		12/10/2010 1:30		1/26/2011 14:15		2/3/2011 5:30		
WSE (ft)			9.46		9.66		4.63		5.13		
Date-Time of lagoon WSE fills to > 11 feet			12/3/2010 0:45		12/13/2010 14:15		1/27/2011 21:00		2/13/2011 6:00		
WSE (ft)			11.00		11.00		11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet			12/9/2010 21:45		12/16/2010 22:15		1/29/2011 1:15		2/14/2011 19:30		
WSE (ft)			10.99		10.94		10.48		10.70		
Time (days) of WSE > 11 feet			6.88		3.33		1.18		1.56		
Time (hours) of WSE > 11 feet			165.0		80.0		28.3		37.5		
Mean daily flow rate (cfs) on day lowest WSE			18		22		67		61		
Mean daily flow rate (cfs) on day WSE > 11 feet			15		17		64		21		
Mean daily flow rate (cfs) on day WSE < 11 feet			15		17		51		21		
Likely mechanism with greatest influence on closure process			Ocean		Ocean		Ocean		Unknown		
Dry Season Closure											
Date-Time of highest WSE at WY closure											8/11/2011 1:45
WSE (ft)											9.69
Date-Time of lowest WSE during WY closure											9/8/2011 12:00
WSE (ft)											8.20
Time (days) difference highest minus lowest WSE											28.43
Time (hours) difference highest minus lowest WSE											682.25
Highest WSE at closure minus lowest WSE during closure in this WY											1.48
Rate of decrease in WSE (ft/day)											0.002
Mean daily flow rate (cfs) on day of highest WSE at closure											13
Mean daily flow rate (cfs) on day of lowest WSE of dry season											0
Likely mechanism with greatest influence on process											Ocean
End of WY											9/30/2011 23:45
Time (days) between final season closure and end of WY											50.9
Total days of lagoon closure in this WY (pre- and post-rainy season)											105.6
Totel days of closure including all partial closures											118.5

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD, 2010-2011 annual mitigation report

Table 3. WY 2010, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Sustained breach*	In-season closure	Sustained breach	In-season closure	Temporary breach	In-season closure	Sustained breach	In-season closure	Sustained breach	In-season closure	Sustained breach	Final Closure
Natural, Mechanical or Unknown		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	Natural
Dry Season Events	10/1/2009 0:00												
Date-Time of lowest lagoon WSE prior to breach	10/12/2009 5:00												
Lowest lagoon WSE during closure, this WY													
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach													
Date-Time of lowest WSE prior to significant increase in WSE	--												
WSE (ft)													
Date-Time of highest WSE post-increase													
WSE (ft)													
Increase in WSE (ft)													
Likely mechanism with greatest influence on WSE increase process													
Mean daily flow rate (cfs) on day of highest WSE													
Date-Time of most recent WSE > 11 ft prior to breach, this WY	10/14/2009 9:45												
Time (days) between start of WY and first seasonal breach	13.4												
Breachs and Closures during rainy season													
Date-Time of highest WSE at time of breach		10/14/2009 9:45		11/7/2009 15:30		12/7/2009 0:15		12/13/2009 10:15		12/31/2009 14:30		1/12/2010 14:45	
WSE (ft)		13.25		12.44		12.85		12.21		12.48		12.65	
Date-Time of lowest WSE directly following breach		10/14/2009 14:30		11/7/2009 22:15		12/9/2009 2:30		12/14/2009 3:15		12/31/2009 22:15		1/13/2010 20:00	
WSE (ft)		6.10		4.32		10.21		5.88		4.24		4.95	
WSE pre-breach minus post-breach (ft)		7.15		8.12		2.64		6.33		8.24		7.69	
Time difference (days)		0.20		0.28		2.09		0.71		0.32		1.22	
Time difference (hours)		4.75		6.75		50.25		17.00		7.75		29.25	
Rate of WSE decline (ft/hr)		1.51		1.20		0.05		0.37		1.06		0.26	
Mean daily flow rate (cfs) on day of breach		759		18		20		182		47		40	
Mean daily flow rate (cfs) on day of lowest WSE following breach		759		18		22		202		47		42	
Likely mechanism with greatest influence on breaching process		Mechanical/Riverine		Mechanical		Mechanical		Mechanical/Riverine		Riverine		Unknown	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours			10/20/2009 6:00		11/7/2009 22:15		12/9/2009 4:00		12/24/2009 1:30		1/7/2010 0:30		
WSE (ft)			4.78		4.32		10.21		5.01		4.35		
Date-Time of lagoon WSE fills to > 11 feet			10/22/2009 20:15		11/17/2009 14:15		12/10/2009 9:45		12/27/2009 5:00		1/9/2010 22:15		
WSE (ft)			11.00		11.00		11.00		11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet			11/7/2009 18:15		12/8/2009 7:00		12/13/2009 18:15		12/31/2009 17:30		1/13/2010 6:00		
WSE (ft)			10.39		10.98		10.44		10.42		10.79		
Time (days) of WSE > 11 feet			15.92		20.70		3.35		4.52		3.32		
Time (hours) of WSE > 11 feet			382.0		496.7		80.5		108.5		79.7		
Mean daily flow rate (cfs) on day lowest WSE			51		18		22		55		41		
Mean daily flow rate (cfs) on day WSE > 11 feet			37		18		21		48		38		
Mean daily flow rate (cfs) on day WSE < 11 feet			18		22		182		47		42		
Likely mechanism with greatest influence on closure process			Ocean		Ocean		Ocean		Unknown		Unknown		
Dry Season Closure													
Date-Time of highest WSE at WY closure													7/25/2010 2:45
WSE (ft)													10.21
Date-Time of lowest WSE during WY closure													9/23/2010 19:00
WSE (ft)													6.34
Time (days) difference highest minus lowest WSE													60.68
Time (hours) difference highest minus lowest WSE													1456.25
Highest WSE at closure minus lowest WSE during closure in this WY													3.86
Rate of decrease in WSE (ft/day)													0.003
Mean daily flow rate (cfs) on day of highest WSE at closure													18
Mean daily flow rate (cfs) on day of lowest WSE of dry season													2.3
Likely mechanism with greatest influence on process													Ocean
End of WY													9/30/2010 23:45
Time (days) between final season closure and end of WY													67.9
Total days of lagoon closure in this WY (pre- and post-rainy season)													81.3
Totel days of closure including all partial closures													129.1

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD, 2009-2010 annual mitigation report

Table 4. WY 2009, Riverine Dynamics of Breaches and Closures

	Sustained closure	Sustained breach*	In-season closure	Sustained breach	In-season closure	Sustained breach	Final closure	WSE increase while closed
Breach Type								
Mechnical, Natural, or Unknown		Mechanical		Natural		Natural	Natural	
Dry Season Events	10/1/2008 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/1/2008 0:15							
Lowest lagoon WSE prior to breach, in current WY	6.59							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach								
Date-Time of lowest WSE directly prior to overtopping	--							9/11/2009 11:15
WSE (ft)								6.44
Date-Time of highest WSE post-wave overtopping								9/12/2009 18:45
WSE (ft)								8.34
Increase in WSE (ft)								1.90
Likely mechanism with greatest influence on WSE increase process								Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE								
Date-Time of most recent WSE > 11 ft prior to breach, in current WY	none							
Time (days) between start of WY and first seasonal breach	138.6							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach		2/16/2009 13:30		4/9/2009 3:15		5/9/2009 7:30		
WSE (ft)		13.11		12.76		12.15		
Date-Time of lowest WSE directly following breach		2/16/2009 16:45		4/9/2009 9:45		5/9/2009 18:45		
WSE (ft)		6.08		4.71		4.15		
WSE pre-breach minus post-breach (ft)		7.03		8.05		7.99		
Time difference (days)		0.14		0.27		0.47		
Time difference (hours)		3.25		6.50		11.25		
Rate of WSE decline (ft/hr)		2.16		1.24		0.71		
Mean daily flow rate (cfs) on day of breach		749		91		38		
Mean daily flow rate (cfs) on day of lowest WSE following breach		749		91		38		
Likely mechanism with greatest influence on process		Mechanical/Riverine		Riverine		Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet			4/5/2009 18:00		5/3/2009 16:00			
WSE (ft)			4.53		4.11			
Date-Time of lagoon WSE fills to > 11 feet			4/7/2009 16:15		5/6/2009 14:45			
WSE (ft)			11.00		11.01			
Date-Time of lagoon falls below WSE > 11 feet			4/9/2009 4:00		5/9/2009 8:00			
WSE (ft)			11.44		11.95			
Time (days) of WSE > 11 feet			1.5		2.7			
Time (hours) of WSE > 11 feet			35.75		65.25			
Mean daily flow rate (cfs) on day lowest WSE			79		57			
Mean daily flow rate (cfs) on day WSE > 11 feet			74		45			
Mean daily flow rate (cfs) on day WSE < 11 feet			91		38			
Likely mechanism with greatest influence on process			Ocean		Ocean			

Dry Season Closure	
Date-Time of highest WSE at final WY closure	6/10/2009 4:15
WSE (ft)	11.37
Date-Time of lowest WSE during WY closure	8/21/2009 12:15
WSE (ft)	6.30
Time (days) difference highest minus lowest WSE	72.3
Time (hours) difference highest minus lowest WSE	1736
Highest WSE at closure minus lowest WSE during closure in this WY	5.07
Rate of decrease in WSE (ft/day)	0.003
Mean daily flow rate (cfs) on day of highest WSE at closure	16
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/2009 23:45
Time (days) between final season closure and end of WY	112.8
Total days of lagoon closure, from previous WY closure to this WY 1st breach	251.4
Totel days of closure including all partial closures	255.6

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD, 2008-2009 annual mitigation report

Table 5. WY 2008, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	In-season closure	Sustained breach	Final closure
Mechnical, Natural, or Unknown			Natural		Natural	Natural
Dry Season Events	10/1/2007 0:00					
Date-Time of lowest lagoon WSE prior to breach	10/1/2007 10:00					
Lowest lagoon WSE during closure, this WY	6.04					
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0					
Date-Time of lowest WSE directly prior to significant overtopping		12/3/2007 16:00				
WSE (ft)		7.41				
Date-Time of highest WSE post-wave overtopping		12/5/2007 10:15				
WSE (ft)		8.66				
Increase in WSE (ft)		1.25				
Likely mechanism with greatest influence on WSE increase process		Wave overtopping				
Mean daily flow rate (cfs) on day of highest WSE		0				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none					
Time (days) between start of WY and first seasonal breach	96.0					
Breachs and Closures during rainy season						
Date-Time of highest WSE at time of breach			1/5/2008 9:15		4/22/2008 20:30	
WSE (ft)			15.40		11.71	
Date-Time of lowest WSE directly following breach			1/5/2008 17:30		4/23/2008 9:30	
WSE (ft)			5.85		4.26	
WSE pre-breach minus post-breach (ft)			9.55		7.44	
Time difference (days)			0.34		0.54	
Time difference (hours)			8.25		13.00	
Rate of WSE decline (ft/hr)			1.16		0.57	
Mean daily flow rate (cfs) on day of breach			509		21	
Mean daily flow rate (cfs) on day of lowest WSE following breach			509		22	
Likely mechanism with greatest influence on process			Riverine		Unknown	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				4/13/2008 16:00		
WSE (ft)				4.19		
Date-Time of lagoon WSE fills to > 11 feet				4/19/2008 18:45		
WSE (ft)				11.00		
Date-Time of lagoon falls below WSE > 11 feet				4/22/2008 21:45		
WSE (ft)				10.99		
Time (days) of WSE > 11 feet				3.1		
Time (hours) of WSE > 11 feet				75.00		
Mean daily flow rate (cfs) on day lowest WSE				33		
Mean daily flow rate (cfs) on day WSE > 11 feet				21		
Mean daily flow rate (cfs) on day WSE < 11 feet				21		
Likely mechanism with greatest influence on process				Ocean		

Dry Season Closure	
Date-Time of highest WSE at final WY closure	5/13/2008 22:30
WSE (ft)	10.96
Date-Time of lowest WSE during WY closure	8/10/2008 6:45
WSE (ft)	5.87
Time (days) difference highest minus lowest WSE	88.34
Time (hours) difference highest minus lowest WSE	2120.25
Highest WSE at closure minus lowest WSE during closure in this WY	5.09
Rate of decrease in WSE (ft/day)	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure	11
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/2008 23:45
Time (days) between final season closure and end of WY	140.1
Total days of lagoon closure in this WY (pre- and post-rainy season)	236.0
Totel days of closure including all partial closures	239.1

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD 2007-2008 annual mitigation report

Table 6. WY 2007, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	WSE increase while closed	Temporary breach	In-season closure	Temporary breach	In-season closure	Sustained breach*	In-season closure	Temporary breach	Early closure	Final Closure
Mechnical, Natural, or Unknown				Mechanical		Natural		Natural		Natural	Natural	Natural
Dry Season Events	10/1/2006 0:00											
Date-Time of lowest lagoon WSE prior to breach	10/12/2006 3:45											
Lowest lagoon WSE during closure, this WY	6.61											
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0											
Date-Time of lowest WSE prior to significant increase in WSE		12/5/2006 23:45	1/10/2007 20:45									
WSE (ft)		7.56	8.43									
Date-Time of highest WSE post-increase		12/10/2006 16:00	2/11/2007 10:30									
WSE (ft)		9.06	11.45									
Increase in WSE (ft)		1.51	3.02									
Likely mechanism with greatest influence on WSE increase process		Wave overtopping	Riverine									
Mean daily flow rate (cfs) on day of highest WSE		0										
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none											
Time (days) between start of WY and first seasonal breach	133.4											
Breachs and Closures during rainy season												
Date-Time of highest WSE at time of breach				2/11/2007 10:30		2/19/2007 14:30		2/25/2007 10:45		3/18/07 22:45		
WSE (ft)				11.45		11.72		11.92		11.57		
Date-Time of lowest WSE directly following breach				2/15/2007 6:30		2/21/2007 12:00		2/25/2007 19:30		3/19/07 9:15		
WSE (ft)				8.84		6.61		8.92		4.42		
WSE pre-breach minus post-breach (ft)				2.62		5.11		3.01		7.15		
Time difference (days)				3.83		1.90		0.36		0.44		
Time difference (hours)				92.00		45.50		8.75		10.50		
Rate of WSE decline (ft/hr)				0.03		0.11		0.34		0.68		
Mean daily flow rate (cfs) on day of breach				29		32		45		30		
Mean daily flow rate (cfs) on day of lowest WSE following breach				50		28		45		28		
Likely mechanism with greatest influence on breaching process				Mechanical		Unknown		Riverine		Ocean		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					2/16/2007 7:30		2/20/2007 22:30		3/12/2007 20:15			
WSE (ft)					8.86		7.05		4.67			
Date-Time of lagoon WSE fills to > 11 feet					2/18/2007 8:30		2/24/2007 3:00		3/17/2007 8:30			
WSE (ft)					11.01		11.00		11.01			
Date-Time of lagoon falls below WSE > 11 feet					2/19/2007 16:15		2/25/2007 13:30		3/19/2007 0:00			
WSE (ft)					10.89		10.91		10.93			
Time (days) of WSE > 11 feet					1.3		1.4		1.6			
Time (hours) of WSE > 11 feet					31.75		34.50		39.50			
Mean daily flow rate (cfs) on day lowest WSE					44		29		47			
Mean daily flow rate (cfs) on day WSE > 11 feet					36		46		32			
Mean daily flow rate (cfs) on day WSE < 11 feet					32		45		28			
Likely mechanism with greatest influence on closure process					Ocean		Ocean		Ocean			
Dry Season Closure												
Date-Time of highest WSE at WY closure										3/27/2007 3:45	4/26/2007 22:45	
WSE (ft)										11.30	12.25	
Date-Time of lowest WSE during WY closure										4/8/2007 0:15	8/20/2007 11:45	
WSE (ft)										10.07	5.25	
Time (days) difference highest minus lowest WSE										11.85	115.54	
Time (hours) difference highest minus lowest WSE										284.50	2773.00	
Highest WSE at closure minus lowest WSE during closure in this WY										1.24	7.01	
Rate of decrease in WSE (ft/day)										0.004	0.003	
Mean daily flow rate (cfs) on day of highest WSE at closure										25	17	
Mean daily flow rate (cfs) on day of lowest WSE of dry season										14	0	
Likely mechanism with greatest influence on process										Ocean	Mechanical	
End of WY											9/30/2007 23:45	
Time (days) between final season closure and end of WY											157.0	
Total days of lagoon closure in this WY (pre- and post-rainy season)											290.5	
Totel days of closure including all partial closures											306.7	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD 2006-2007 annual mitigation report and Perry et al. 2006-07 CCoWS report

Table 7. WY 2006, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	In-season closure	Temporary breach	In-season closure	Sustained breach	Early Closure	Final Closure
Mechnical, Natural, or Unknown			Mechanical		Natural		Natural	Natural	Natural
Dry Season Events	10/1/2005 0:00								
Date-Time of lowest lagoon WSE prior to breach	10/4/2005 9:00								
Lowest lagoon WSE during closure, this WY	6.91								
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0								
Date-Time of lowest WSE prior to significant increase in WSE		12/9/2005 4:15							
WSE (ft)		7.89							
Date-Time of highest WSE post-increase		12/21/05 15:30							
WSE (ft)		9.58							
Increase in WSE (ft)		1.69							
Likely mechanism with greatest influence on WSE increase process		Wave overtopping							
Mean daily flow rate (cfs) on day of highest WSE		20							
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none								
Time (days) between start of WY and first seasonal breach	88.5								
Breachs and Closures during rainy season									
Date-Time of highest WSE at time of breach			12/28/2005 11:45		2/10/2006 5:45		2/22/2006 12:15		
WSE (ft)			11.35		12.83		12.74		
Date-Time of lowest WSE directly following breach			12/30/2005 22:45		2/10/2006 20:15		2/23/2006 1:30		
WSE (ft)			6.42		5.33		5.06		
WSE pre-breach minus post-breach (ft)			4.93		7.49		7.68		
Time difference (days)			2.46		0.60		0.55		
Time difference (hours)			59.00		14.50		13.25		
Rate of WSE decline (ft/hr)			0.08		0.52		0.58		
Mean daily flow rate (cfs) on day of breach			81		57		49		
Mean daily flow rate (cfs) on day of lowest WSE following breach			82		57		47		
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Riverine		Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				2/6/2006 17:15		2/15/2006 21:00			
WSE (ft)				5.40		5.08			
Date-Time of lagoon WSE fills to > 11 feet				2/8/2006 6:00		2/19/2006 23:00			
WSE (ft)				11.01		11.00			
Date-Time of lagoon falls below WSE > 11 feet				2/10/2006 6:45		2/22/2006 14:00			
WSE (ft)				10.75		11.35			
Time (days) of WSE > 11 feet				2.0		2.6			
Time (hours) of WSE > 11 feet				48.75		63.00			
Mean daily flow rate (cfs) on day lowest WSE				69		49			
Mean daily flow rate (cfs) on day WSE > 11 feet				63		55			
Mean daily flow rate (cfs) on day WSE < 11 feet				57		49			
Likely mechanism with greatest influence on closure process				Ocean		Ocean			
Dry Season Closure									
Date-Time of highest WSE at WY closure							6/21/2006 5:15	7/17/2006 9:00	
WSE (ft)							10.53	10.14	
Date-Time of lowest WSE during WY closure							7/6/2006 7:30	9/4/2006 18:45	
WSE (ft)							8.63	6.31	
Time (days) difference highest minus lowest WSE							15.09	49.41	
Time (hours) difference highest minus lowest WSE							362.25	1185.75	
Highest WSE at closure minus lowest WSE during closure in this WY							1.89	3.83	
Rate of decrease in WSE (ft/day)							0.005	0.003	
Mean daily flow rate (cfs) on day of highest WSE at closure							36	13	
Mean daily flow rate (cfs) on day of lowest WSE of dry season							27	0	
Likely mechanism with greatest influence on process							Mechanical	Ocean	
End of WY								9/30/2006 23:45	
Time (days) between final season closure and end of WY								75.6	
Total days of lagoon closure in this WY (pre- and post-rainy season)								164.1	
Totel days of closure including all partial closures								183.9	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in MPWMD 2005-2006 annual mitigation report and the Larson et al. 2005-06 CCoWS report

Table 8. WY 2005, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained breach*	Early closure	Final closure
Breach Type					
Mechnical, Natural, or Unknown			Mechanical	Natural	Natural
Dry Season Events	10/1/2004 0:00				
Date-Time of lowest lagoon WSE prior to breach	10/7/2004 11:30				
Lowest lagoon WSE during closure, this WY	6.37				
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0				
Date-Time of lowest WSE prior to significant increase in WSE		10/16/2004 0:15			
WSE (ft)		6.99			
Date-Time of highest WSE post-increase		38281.36			
WSE (ft)		8.39			
Increase in WSE (ft)		1.39			
Likely mechanism with greatest influence on WSE increase process		Wave overtopping			
Mean daily flow rate (cfs) on day of highest WSE					
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none				
Time (days) between start of WY and first seasonal breach	90.7				
Breachs and Closures during rainy season					
Date-Time of highest WSE at time of breach			12/30/2004 16:00		
WSE (ft)			13.03		
Date-Time of lowest WSE directly following breach			1/2/2005 0:45		
WSE (ft)			7.27		
WSE pre-breach minus post-breach (ft)			5.76		
Time difference (days)			2.36		
Time difference (hours)			56.75		
Rate of WSE decline (ft/hr)			0.10		
Mean daily flow rate (cfs) on day of breach			532		
Mean daily flow rate (cfs) on day of lowest WSE following breach			642		
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					
WSE (ft)					
Date-Time of lagoon WSE fills to > 11 feet					
WSE (ft)					
Date-Time of lagoon falls below WSE > 11 feet					
WSE (ft)					
Time (days) of WSE > 11 feet					
Time (hours) of WSE > 11 feet					
Mean daily flow rate (cfs) on day lowest WSE					
Mean daily flow rate (cfs) on day WSE > 11 feet					
Mean daily flow rate (cfs) on day WSE < 11 feet					
Likely mechanism with greatest influence on closure process					
Dry Season Closure					
Date-Time of highest WSE at WY closure				7/10/2005 0:45	7/20/2005 1:45
WSE (ft)				9.52	8.66
Date-Time of lowest WSE during WY closure				7/11/2005 23:30	8/29/2005 13:00
WSE (ft)				5.87	5.81
Time (days) difference highest minus lowest WSE				1.95	40.47
Time (hours) difference highest minus lowest WSE				46.75	971.25
Highest WSE at closure minus lowest WSE during closure in this WY				3.64	2.85
Rate of decrease in WSE (ft/day)				0.08	0.003
Mean daily flow rate (cfs) on day of highest WSE at closure					8.6
Mean daily flow rate (cfs) on day of lowest WSE of dry season					0
Likely mechanism with greatest influence on process					Ocean
End of WY					9/30/2005 23:45
Time (days) between final season closure and end of WY					72.9
Total days of lagoon closure in this WY (pre- and post-rainy season)					163.6
Totel days of closure including all partial closures					165.5

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Larson et al. 2004-05 CCoSW report

Table 9. WY 2004, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	In-season Closure	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Sustained breach	Early Closure	Final Closure	WSE increase while closed
Mechnical, Natural, or Unknown			Mechanical		Natural		Natural		Natural	Natural	Natural	
Dry Season Events	10/1/2003 0:00											
Date-Time of lowest lagoon WSE prior to breach	10/2/2003 12:00											
Lowest lagoon WSE during closure, this WY	5.86											
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0											
Date-Time of lowest WSE prior to significant increase in WSE		12/8/2003 6:00										8/24/04 14:15
WSE (ft)		8.17										5.71
Date-Time of highest WSE post-increase		12/10/2003 12:45										8/29/04 2:15
WSE (ft)		11.18										7.23
Increase in WSE (ft)		3.01										1.53
Likely mechanism with greatest influence on WSE increase process		Wave overtopping										Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE		0										0
Date-Time of most recent WSE > 11 ft prior to breach, this WY	12/11/2003 9:15											
Time (days) between start of WY and first seasonal breach	90.6											
Breachs and Closures during rainy season												
Date-Time of highest WSE at time of breach			12/30/2003 15:00		1/14/2004 17:30		1/20/2004 17:30		1/26/2004 15:30			
WSE (ft)			13.22		12.35		11.82		12.0			
Date-Time of lowest WSE directly following breach			12/31/2003 1:00		1/15/2004 0:30		1/21/2004 4:00		1/26/2004 22:30			
WSE (ft)			6.09		5.36		5.25		5.3			
WSE pre-breach minus post-breach (ft)			7.13		6.99		6.57		6.72			
Time difference (days)			0.42		0.29		0.44		0.29			
Time difference (hours)			10		7		10.5		7			
Rate of WSE decline (ft/hr)			0.71		1.00		0.63		0.96			
Mean daily flow rate (cfs) on day of breach			416		45		34		28			
Mean daily flow rate (cfs) on day of lowest WSE following breach			249		44		32		28			
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Riverine		Unknown		Unknown			
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				1/11/2004 21:00		1/17/2004 21:00		1/22/2004 4:45		4/20/2004 19:00		
WSE (ft)				5.37		5.88		5.4		5.44		
Date-Time of lagoon WSE fills to > 11 feet				1/13/2004 1:00		1/19/2004 8:30		1/24/2004 11:00		4/25/2004 6:30		
WSE (ft)				11.0		11.01		11.0		11.00		
Date-Time of lagoon falls below WSE > 11 feet				1/14/2004 19:00		1/20/2004 18:30		1/26/2004 18:15		4/27/2004 20:30		
WSE (ft)				9.9		10.57		8.77		10.88		
Time (days) of WSE > 11 feet				1.75		1.42		2.30		2.58		
Time (hours) of WSE > 11 feet				42.0		34.0		55.25		62.0		
Mean daily flow rate (cfs) on day lowest WSE				57		41		30		29		
Mean daily flow rate (cfs) on day WSE > 11 feet				49		36		29		20		
Mean daily flow rate (cfs) on day WSE < 11 feet				45		34		28		16		
Likely mechanism with greatest influence on closure process				Ocean		Ocean		Ocean		Ocean		
Dry Season Closure												
Date-Time of highest WSE at WY closure											5/7/2004 3:30	
WSE (ft)											9.95	
Date-Time of lowest WSE during WY closure or following break											7/18/2004 13:45	
WSE (ft)											5.10	
Time (days) difference highest minus lowest WSE											72.43	
Time (hours) difference highest minus lowest WSE											1738.25	
Highest WSE at closure minus lowest WSE during closure in this WY											4.85	
Rate of decrease in WSE (ft/day)											0.003	
Mean daily flow rate (cfs) on day of highest WSE at closure											11	
Mean daily flow rate (cfs) on day of lowest WSE of dry season											0	
Likely mechanism with greatest influence on process											Ocean	
End of WY											9/30/2004 23:45	
Time (days) between final season closure and end of WY											146.8	
Total days of lagoon closure in this WY (pre- and post-rainy season)											237.5	
Totel days of closure including all partial closures											245.5	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events as reported in the Smith et al. 2003-04 CCoSW report

Table 10. WY 2003, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	WSE increase while closed	Sustained breach*	In-season Closure	Sustained breach	Final Closure
Mechnical, Natural, or Unknown				Mechanical		Natural	Natural
Dry Season Events	10/1/2002 0:00						
Date-Time of lowest lagoon WSE prior to breach		10/15/2002 9:30					
Lowest lagoon WSE during closure, this WY		5.56					
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach		0					
Date-Time of lowest WSE prior to significant increase in WSE		10/15/2002 9:30	11/6/2002 0:30				
WSE (ft)		5.56	7.59				
Date-Time of highest WSE post-increase		10/22/2002 16:00	11/8/2002 17:15				
WSE (ft)		7.86	11.53				
Increase in WSE (ft)		2.30	3.94				
Likely mechanism with greatest influence on WSE increase process		Wave overtopping	Wave overtopping				
Mean daily flow rate (cfs) on day of highest WSE		0	0				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	11/12/2002 1:45						
Time (days) between start of WY and first seasonal breach	76.5						
Breachs and Closures during rainy season							
Date-Time of highest WSE at time of breach				12/16/2002 12:15		6/18/2003 19:45	
WSE (ft)				13.55		11.45	
Date-Time of lowest WSE directly following breach				12/16/2002 15:15		6/19/2003 0:15	
WSE (ft)				7.14		5.29	
WSE pre-breach minus post-breach (ft)				6.41		6.16	
Time difference (days)				0.13		0.19	
Time difference (hours)				3.00		4.50	
Rate of WSE decline (ft/hr)				2.14		1.37	
Mean daily flow rate (cfs) on day of breach				1250		25	
Mean daily flow rate (cfs) on day of lowest WSE following breach				1250		25	
Likely mechanism with greatest influence on breaching process				Mechanical/Riverine		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					6/14/2003 8:45		
WSE (ft)					5.1		
Date-Time of lagoon WSE fills to > 11 feet					6/17/2003 11:45		
WSE (ft)					11.0		
Date-Time of lagoon falls below WSE > 11 feet					6/18/2003 20:45		
WSE (ft)					10.7		
Time (days) of WSE > 11 feet					1.4		
Time (hours) of WSE > 11 feet					33.0		
Mean daily flow rate (cfs) on day lowest WSE					33		
Mean daily flow rate (cfs) on day WSE > 11 feet					27		
Mean daily flow rate (cfs) on day WSE < 11 feet					25		
Likely mechanism with greatest influence on closure process					Ocean		
Dry Season Closure							
Date-Time of highest WSE at WY closure							7/11/2003 22:30
WSE (ft)							7.98
Date-Time of lowest WSE during WY closure or following break							8/8/2003 15:45
WSE (ft)							5.37
Time (days) difference highest minus lowest WSE							27.72
Time (hours) difference highest minus lowest WSE							665.25
Highest WSE at closure minus lowest WSE during closure in this WY							2.61
Rate of decrease in WSE (ft/day)							0.004
Mean daily flow rate (cfs) on day of highest WSE at closure							6.8
Mean daily flow rate (cfs) on day of lowest WSE of dry season							0
Likely mechanism with greatest influence on process							Ocean
End of WY							9/30/2003 23:45
Time (days) between final season closure and end of WY							81.1
Total days of lagoon closure in this WY (pre- and post-rainy season)							157.6
Totel days of closure including all partial closures							158.9

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Casagrande and Watson 2002-03 CCoSW report

Table 11. WY 2002, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	WSE increase while closed	Sustained breach*	In-season Closure	Sustained breach	Early Closure	Final Closure
Breach Type								
Mechnical, Natural, or Unknown				Mechanical		Mechanical	Natural	Natural
Dry Season Events	10/1/2001 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/8/2001 2:30							
Lowest lagoon WSE during closure, this WY	6.76							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0							
Date-Time of lowest WSE prior to significant increase in WSE		10/8/2001 2:30	10/31/2001 0:15					
WSE (ft)		6.76	6.97					
Date-Time of highest WSE post-increase		10/16/2001 0:45	11/4/2001 17:00					
WSE (ft)		8.24	8.16					
Increase in WSE (ft)		1.48	1.19					
Likely mechanism with greatest influence on WSE increase process		Wave overtopping	Wave overtopping					
Mean daily flow rate (cfs) on day of highest WSE		0	0					
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none							
Time (days) between start of WY and first seasonal breach	63.6							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach				12/3/2001 14:15		1/28/2002 16:45		
WSE (ft)				13.39		12.32		
Date-Time of lowest WSE directly following breach				12/3/2001 22:30		1/29/2002 6:45		
WSE (ft)				5.64		5.65		
WSE pre-breach minus post-breach (ft)				7.75		6.67		
Time difference (days)				0.34		0.58		
Time difference (hours)				8.25		14.0		
Rate of WSE decline (ft/hr)				0.94		0.48		
Mean daily flow rate (cfs) on day of breach				402		53		
Mean daily flow rate (cfs) on day of lowest WSE following breach				402		54		
Likely mechanism with greatest influence on breaching process				Mechnical/Riverine		Mechnical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					1/26/2002 21:00			
WSE (ft)					5.88			
Date-Time of lagoon WSE fills to > 11 feet					1/27/2002 15:45			
WSE (ft)					11.00			
Date-Time of lagoon falls below WSE > 11 feet					1/28/2002 18:30			
WSE (ft)					10.56			
Time (days) of WSE > 11 feet					1.11			
Time (hours) of WSE > 11 feet					26.75			
Mean daily flow rate (cfs) on day lowest WSE					50			
Mean daily flow rate (cfs) on day WSE > 11 feet					53			
Mean daily flow rate (cfs) on day WSE < 11 feet					53			
Likely mechanism with greatest influence on closure process					Ocean			
Dry Season Closure								
Date-Time of highest WSE at WY closure						5/26/2002 9:15	6/4/2002 11:15	
WSE (ft)						10.90	10.04	
Date-Time of lowest WSE during WY closure or following break						5/26/2002 20:15	8/25/2002 21:45	
WSE (ft)						5.25	5.31	
Time (days) difference highest minus lowest WSE						0.46	82.44	
Time (hours) difference highest minus lowest WSE						11.00	1978.50	
Highest WSE at closure minus lowest WSE during closure in this WY						5.65	4.73	
Rate of decrease in WSE (ft/day)						0.514	0.002	
Mean daily flow rate (cfs) on day of highest WSE at closure						18	11	
Mean daily flow rate (cfs) on day of lowest WSE of dry season						18	0	
Likely mechanism with greatest influence on process						Ocean	Ocean	
End of WY							9/30/2002 23:45	
Time (days) between final season closure and end of WY							118.5	
Total days of lagoon closure in this WY (pre- and post-rainy season)							182.1	
Totel days of closure including all partial closures							183.7	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Casagrande et al. 2001-02 CCoSW report

Table 12. WY 2001, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained breach*	Final Closure
Breach Type				
Mechnical, Natural, or Unknown			Mechanical	Natural
Dry Season Events	10/1/2000 0:00			
Date-Time of lowest lagoon WSE prior to breach	10/9/2000 10:30			
Lowest lagoon WSE during closure, this WY	6.82			
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0			
Date-Time of lowest WSE prior to significant increase in WSE		10/21/2000 16:30		
WSE (ft)		7.41		
Date-Time of highest WSE post-increase		10/26/2000 15:30		
WSE (ft)		9.08		
Increase in WSE (ft)		4.96		
Likely mechanism with greatest influence on WSE increase process		Wave overtopping		
Mean daily flow rate (cfs) on day of highest WSE		0		
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none			
Time (days) between start of WY and first seasonal breach	102.68			
Breachs and Closures during rainy season				
Date-Time of highest WSE at time of breach			1/11/2001 16:15	
WSE (ft)			14.78	
Date-Time of lowest WSE directly following breach			1/11/2001 20:30	
WSE (ft)			5.47	
WSE pre-breach minus post-breach (ft)			9.31	
Time difference (days)			0.18	
Time difference (hours)			4.25	
Rate of WSE decline (ft/hr)			2.19	
Mean daily flow rate (cfs) on day of breach			148	
Mean daily flow rate (cfs) on day of lowest WSE following breach			148	
Likely mechanism with greatest influence on breaching process			Mechnical/Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				
WSE (ft)				
Date-Time of lagoon WSE fills to > 11 feet				
WSE (ft)				
Date-Time of lagoon falls below WSE > 11 feet				
WSE (ft)				
Time (days) of WSE > 11 feet				
Time (hours) of WSE > 11 feet				
Mean daily flow rate (cfs) on day lowest WSE				
Mean daily flow rate (cfs) on day WSE > 11 feet				
Mean daily flow rate (cfs) on day WSE < 11 feet				
Likely mechanism with greatest influence on closure process				
Dry Season Closure				
Date-Time of highest WSE at WY closure				6/13/2001 5:30
WSE (ft)				9.87
Date-Time of lowest WSE during WY closure or following break				8/23/2001 5:45
WSE (ft)				5.58
Time (days) difference highest minus lowest WSE				71.01
Time (hours) difference highest minus lowest WSE				1704.25
Highest WSE at closure minus lowest WSE during closure in this WY				4.29
Rate of decrease in WSE (ft/day)				0.003
Mean daily flow rate (cfs) on day of highest WSE at closure				8.5
Mean daily flow rate (cfs) on day of lowest WSE of dry season				0
Likely mechanism with greatest influence on process				Ocean
End of WY				9/30/2001 23:45
Time (days) between final season closure and end of WY				109.8
Total days of lagoon closure in this WY (pre- and post-rainy season)				212.4
Totel days of closure including all partial closures				212.4

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Some breaching and/or closure events were reported in the Watson et al. 2000-01 CCoSW report

Table 13. WY 2000, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	Early Closure	Final Closure
Mechnical, Natural, or Unknown			Mechanical	Natural	Natural
Dry Season Events	10/1/1999 0:00				
Date-Time of lowest lagoon WSE prior to breach	10/6/1999 18:00				
Lowest lagoon WSE during closure, this WY	5.93				
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0				
Date-Time of lowest WSE prior to significant increase in WSE		10/25/1999 4:45			
WSE (ft)		6.23			
Date-Time of highest WSE post-increase		10/28/1999 18:00			
WSE (ft)		10.07			
Increase in WSE (ft)		3.84			
Likely mechanism with greatest influence on WSE increase process		Wave overtopping			
Mean daily flow rate (cfs) on day of highest WSE		0			
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none				
Time (days) between start of WY and first seasonal breach	115.1				
Breachs and Closures during rainy season					
Date-Time of highest WSE at time of breach			1/24/2000 2:15		
WSE (ft)			14.05		
Date-Time of lowest WSE directly following breach			1/24/2000 22:30		
WSE (ft)			6.85		
WSE pre-breach minus post-breach (ft)			7.2		
Time difference (days)			0.84		
Time difference (hours)			20.25		
Rate of WSE decline (ft/hr)			0.36		
Mean daily flow rate (cfs) on day of breach			1000		
Mean daily flow rate (cfs) on day of lowest WSE following breach			1000		
Likely mechanism with greatest influence on breaching process			Mechnical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					
WSE (ft)					
Date-Time of lagoon WSE fills to > 11 feet					
WSE (ft)					
Date-Time of lagoon falls below WSE > 11 feet					
WSE (ft)					
Time (days) of WSE > 11 feet					
Time (hours) of WSE > 11 feet					
Mean daily flow rate (cfs) on day lowest WSE					
Mean daily flow rate (cfs) on day WSE > 11 feet					
Mean daily flow rate (cfs) on day WSE < 11 feet					
Likely mechanism with greatest influence on closure process					
Dry Season Closure					
Date-Time of highest WSE at WY closure				4/24/2000 11:15	5/6/2000 2:30
WSE (ft)				10.35	10.70
Date-Time of lowest WSE during WY closure or following break				5/2/2000 18:45	9/16/2000 10:45
WSE (ft)				8.11	5.67
Time (days) difference highest minus lowest WSE				8.31	133.34
Time (hours) difference highest minus lowest WSE				199.50	3200.25
Highest WSE at closure minus lowest WSE during closure in this WY				2.24	5.03
Rate of decrease in WSE (ft/day)				0.011	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure				102	65
Mean daily flow rate (cfs) on day of lowest WSE of dry season				75	0
Likely mechanism with greatest influence on process				Ocean	Ocean
End of WY					9/30/2000 23:45
Time (days) between final season closure and end of WY					147.9
Total days of lagoon closure in this WY (pre- and post-rainy season)					263.0
Totel days of closure including all partial closures					271.3

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 2000

Table 14. WY 1999, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Sustained breach*	In-season Closure	Temporary breach	In-season Closure	Temporary breach	In-season Closure	Sustained breach	Early Closure	Temporary breach	Final Closure
Mechnical, Natural, or Unknown			Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	Natural	Natural	Natural
Dry Season Events	10/1/1998 0:00																	
Date-Time of lowest lagoon WSE prior to breach	10/1/1998 0:00																	
Lowest lagoon WSE during closure, this WY	10.01																	
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	23																	
Date-Time of lowest WSE prior to significant increase in WSE		10/24/1998 9:45																
WSE (ft)		10.71																
Date-Time of highest WSE post-increase		11/3/1998 12:00																
WSE (ft)		12.75																
Increase in WSE (ft)		2.04																
Likely mechanism with greatest influence on WSE increase process		Riverine																
Mean daily flow rate (cfs) on day of highest WSE		22																
Date-Time of most recent WSE > 11 ft prior to breach, this WY	10/25/1998 9:15																	
Time (days) between start of WY and first seasonal breach	33.5																	
Breachs and Closures during rainy season																		
Date-Time of highest WSE at time of breach			11/3/1998 12:00		11/10/1998 18:15		11/19/1998 13:00		11/26/1998 13:00		1/2/1999 15:45		1/8/1999 17:45		1/16/1999 18:45		6/17/1999 20:00	
WSE (ft)			12.75		11.86		12.65		12.59		12.13		12.55		12.70		12.50	
Date-Time of lowest WSE directly following breach			11/4/1998 6:30		11/11/1998 4:30		11/19/1998 22:00		11/27/1998 0:30		1/2/1999 22:45		1/10/1999 1:00		1/16/1999 23:30		6/18/1999 13:30	
WSE (ft)			5.00		5.02		5.19		5.26		5.40		5.05		6.67		5.27	
WSE pre-breach minus post-breach (ft)			7.75		6.84		7.46		7.33		6.73		7.50		6.03		0.73	
Time difference (days)			0.77		0.43		0.38		0.48		0.29		1.30		0.20		17.50	
Time difference (hours)			18.50		10.25		9.00		11.50		7.00		31.25		4.75		7.23	
Rate of WSE decline (ft/hr)			0.42		0.67		0.83		0.64		0.96		0.24		1.27		0.41	
Mean daily flow rate (cfs) on day of breach			21		24		24		25		13		10		10		27	
Mean daily flow rate (cfs) on day of lowest WSE following breach			21		31		24		27		13		10		10		26	
Likely mechanism with greatest influence on breaching process			Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical		Mechanical	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				11/4/1998 6:30		11/11/1998 4:30		11/19/1998 22:00		12/28/1998 1:45		1/2/1999 22:45		1/10/1999 1:00				
WSE (ft)				5.00		5.02		5.19		5.40		5.40		5.05				
Date-Time of lagoon WSE fills to > 11 feet				11/8/1998 2:15		11/14/1998 9:30		11/22/1998 13:15		12/31/1998 16:15		1/5/1999 4:45		1/13/1999 8:00				
WSE (ft)				11.00		11.00		11.02		11.00		11.00		11.00				
Date-Time of lagoon falls below WSE > 11 feet				11/10/1998 20:15		11/19/1998 15:00		11/26/1998 14:00		1/2/1999 17:15		1/8/1999 18:45		1/16/1999 21:00				
WSE (ft)				10.80		10.98		8.60		9.97		9.46		10.89				
Time (days) of WSE > 11 feet				2.75		5.15		3.99		1.98		3.54		3.45				
Time (hours) of WSE > 11 feet				66.00		123.50		95.75		47.50		85.00		82.75				
Mean daily flow rate (cfs) on day lowest WSE				21		31		24		17		13		10				
Mean daily flow rate (cfs) on day WSE > 11 feet				24		22		22		15		11		10				
Mean daily flow rate (cfs) on day WSE < 11 feet				24		24		25		13		10		10				
Likely mechanism with greatest influence on closure process				Ocean		Ocean		Ocean		Ocean		Ocean		Ocean				
Dry Season Closure																		
Date-Time of highest WSE at WY closure																5/27/1999 0:00		7/4/1999 6:00
WSE (ft)																9.20		10.52
Date-Time of lowest WSE during WY closure or following break																6/12/1999 17:30		8/18/1999 13:00
WSE (ft)																8.06		5.38
Time (days) difference highest minus lowest WSE																16.73		45.29
Time (hours) difference highest minus lowest WSE																401.50		1087.00
Highest WSE at closure minus lowest WSE during closure in this WY																1.14		5.14
Rate of decrease in WSE (ft/day)																0.003		0.005
Mean daily flow rate (cfs) on day of highest WSE at closure																53		7.2
Mean daily flow rate (cfs) on day of lowest WSE of dry season																34		0
Likely mechanism with greatest influence on process																Unknown		Ocean
End of WY																		9/30/1999 23:45
Time (days) between final season closure and end of WY																		88.74
Total days of lagoon closure in this WY (pre- and post-rainy season)																		122.2
Totel days of closure including all partial closures																		159.8

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1999

Table 15. WY 1998, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	In-season Closure	Temporary breach	In-season Closure	Sustained breach	Final Closure
Mechnical, Natural, or Unknown			Mechanical		Mechanical		Mechanical	Unknown
Dry Season Events	10/1/1997 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/29/1997 21:00							
Lowest lagoon WSE during closure, this WY	7.34							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0							
Date-Time of lowest WSE prior to significant increase in WSE		11/9/1997 17:45						
WSE (ft)		8.16						
Date-Time of highest WSE post-increase		11/15/1997 12:00						
WSE (ft)		10.65						
Increase in WSE (ft)		2.49						
Likely mechanism with greatest influence on WSE increase process		Ocean						
Mean daily flow rate (cfs) on day of highest WSE		0						
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none							
Time (days) between start of WY and first seasonal breach	66.4							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach			12/6/1997 10:15		12/30/1997 16:45		1/3/1998 17:30	
WSE (ft)			12.36		12.66		12.12	
Date-Time of lowest WSE directly following breach			12/7/1997 0:45		12/30/1997 22:15		1/3/1998 23:30	
WSE (ft)			6.57		5.40		5.36	
WSE pre-breach minus post-breach (ft)			5.79		7.26		6.76	
Time difference (days)			0.60		0.23		0.25	
Time difference (hours)			14.5		5.5		6	
Rate of WSE decline (ft/hr)			0.40		1.32		1.13	
Mean daily flow rate (cfs) on day of breach			112		12		29	
Mean daily flow rate (cfs) on day of lowest WSE following breach			135		12		29	
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Mechanical		Mechanical	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				12/26/1997 18:45		12/30/1997 22:15		
WSE (ft)				5.45		5.40		
Date-Time of lagoon WSE fills to > 11 feet				12/28/1997 14:30		1/2/1998 15:45		
WSE (ft)				11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet				12/30/1997 18:30		1/3/1998 18:45		
WSE (ft)				9.88		10.10		
Time (days) of WSE > 11 feet				2.17		1.07		
Time (hours) of WSE > 11 feet				52.0		25.7		
Mean daily flow rate (cfs) on day lowest WSE				18		12		
Mean daily flow rate (cfs) on day WSE > 11 feet				15		11		
Mean daily flow rate (cfs) on day WSE < 11 feet				12		29		
Likely mechanism with greatest influence on closure process				Ocean		Ocean		
Dry Season Closure								
Date-Time of highest WSE at WY closure								6/12/1998 0:00
WSE (ft)								8.85
Date-Time of lowest WSE during WY closure or following break								8/31/1998 2:30
WSE (ft)								7.16
Time (days) difference highest minus lowest WSE								80.10
Time (hours) difference highest minus lowest WSE								1922.50
Highest WSE at closure minus lowest WSE during closure in this WY								1.69
Rate of decrease in WSE (ft/day)								0.001
Mean daily flow rate (cfs) on day of highest WSE at closure								172
Mean daily flow rate (cfs) on day of lowest WSE of dry season								23
Likely mechanism with greatest influence on process								Unknown
End of WY								9/30/1998 23:45
Time (days) between final season closure and end of WY								110.99
Total days of lagoon closure in this WY (pre- and post-rainy season)								177.4
Totel days of closure including all partial closures								180.7

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1998

Table 16. WY 1997, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	WSE increase while closed	Sustained breach*	Final closure	WSE increase while closed
Mechnical, Natural, or Unknown			Mechanical	Natural	
Dry Season Events	10/1/1996 0:00				
Date-Time of lowest lagoon WSE prior to breach	10/4/1996 11:15				
Lowest lagoon WSE during closure, this WY	6.10				
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0				
Date-Time of lowest WSE prior to significant increase in WSE		10/4/1996 11:15			9/17/1997 23:45
WSE (ft)		6.10			6.16
Date-Time of highest WSE post-increase		10/8/1996 9:30			9/25/1997 22:00
WSE (ft)		9.20			10.48
Increase in WSE (ft)		3.10			4.32
Likely mechanism with greatest influence on WSE increase process		Ocean			Ocean
Mean daily flow rate (cfs) on day of highest WSE		0			0
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none				
Time (days) between start of WY and first seasonal breach	69.6				
Breachs and Closures during rainy season					
Date-Time of highest WSE at time of breach			12/9/1996 13:15		
WSE (ft)			12.34		
Date-Time of lowest WSE directly following breach			12/10/1996 4:30		
WSE (ft)			8.34		
WSE pre-breach minus post-breach (ft)			4		
Time difference (days)			0.64		
Time difference (hours)			15.25		
Rate of WSE decline (ft/hr)			0.26		
Mean daily flow rate (cfs) on day of breach			27		
Mean daily flow rate (cfs) on day of lowest WSE following breach			879		
Likely mechanism with greatest influence on breaching process			Mechanical		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours					
WSE (ft)					
Date-Time of lagoon WSE fills to > 11 feet					
WSE (ft)					
Date-Time of lagoon falls below WSE > 11 feet					
WSE (ft)					
Time (days) of WSE > 11 feet					
Time (hours) of WSE > 11 feet					
Mean daily flow rate (cfs) on day lowest WSE					
Mean daily flow rate (cfs) on day WSE > 11 feet					
Mean daily flow rate (cfs) on day WSE < 11 feet					
Likely mechanism with greatest influence on closure process					

Dry Season Closure	
Date-Time of highest WSE at WY closure	5/18/1997 23:00
WSE (ft)	9.89
Date-Time of lowest WSE during WY closure or following break	7/31/1997 16:00
WSE (ft)	5.51
Time (days) difference highest minus lowest WSE	73.71
Time (hours) difference highest minus lowest WSE	1769.00
Highest WSE at closure minus lowest WSE during closure in this WY	4.38
Rate of decrease in WSE (ft/day)	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure	13
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/1997 23:45
Time (days) between final season closure and end of WY	135.0
Total days of lagoon closure in this WY (pre- and post-rainy season)	204.6
Totel days of closure including all partial closures	204.6

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1997

Table 17. WY 1996, Riverine Dynamics of Breaches and Closures

Breach Type	Sustained closure	Sustained breach*	In-season closure	Temporary breach	In-season closure	Temporary breach	In-season closure	Sustained breach	Final closure
Mechnical, Natural, or Unknown		Mechanical		Mechanical		Mechanical		Natural	Natural
Dry Season Events	10/1/1995 0:00								
Date-Time of lowest lagoon WSE prior to breach	11/12/1995 10:15								
Lowest lagoon WSE during closure, this WY	7.12								
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	2.50								
Date-Time of lowest WSE prior to significant increase in WSE									
WSE (ft)									
Date-Time of highest WSE post-increase									
WSE (ft)									
Increase in WSE (ft)									
Likely mechanism with greatest influence on WSE increase process									
Mean daily flow rate (cfs) on day of highest WSE									
Date-Time of most recent WSE > 11 ft prior to breach, this WY	12/13/1995 2:45								
Time (days) between start of WY and first seasonal breach	73.8								
Breachs and Closures during rainy season									
Date-Time of highest WSE at time of breach		12/13/1995 18:30		12/24/1995 19:30		12/27/1995 22:30		1/2/1996 9:45	
WSE (ft)		11.68		11.74		12.01		11.91	
Date-Time of lowest WSE directly following breach		12/14/1995 0:15		12/24/1995 22:30		12/28/1995 2:15		1/2/1996 14:30	
WSE (ft)		5.65		5.86		6.95		5.37	
WSE pre-breach minus post-breach (ft)		6.03		5.88		5.06		6.54	
Time difference (days)		0.24		0.13		0.16		0.20	
Time difference (hours)		5.75		3		3.75		4.75	
Rate of WSE decline (ft/hr)		1.05		1.96		1.35		1.38	
Mean daily flow rate (cfs) on day of breach		36		35		28		25	
Mean daily flow rate (cfs) on day of lowest WSE following breach		36		35		24		25	
Likely mechanism with greatest influence on breaching process		Mechanical		Riverine		Riverine		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours			12/21/1995 19:30		12/24/1995 22:30		12/29/1995 0:15		
WSE (ft)			5.36		5.86		6.30		
Date-Time of lagoon WSE fills to > 11 feet			12/23/1995 15:00		12/26/1995 10:00		12/31/1995 16:45		
WSE (ft)			11.00		11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet			12/24/1995 20:45		12/28/1995 0:00		1/2/1996 12:30		
WSE (ft)			10.64		10.69		10.77		
Time (days) of WSE > 11 feet			1.24		1.58		1.82		
Time (hours) of WSE > 11 feet			29.8		38.0		43.8		
Mean daily flow rate (cfs) on day lowest WSE			34		35		24		
Mean daily flow rate (cfs) on day WSE > 11 feet			35		28		27		
Mean daily flow rate (cfs) on day WSE < 11 feet			35		24		25		
Likely mechanism with greatest influence on closure process			Ocean		Ocean		Ocean		
Dry Season Closure									
Date-Time of highest WSE at WY closure									7/1/1996 0:15
WSE (ft)									10.37
Date-Time of lowest WSE during WY closure or following break									8/28/1996 19:00
WSE (ft)									5.49
Time (days) difference highest minus lowest WSE									58.78
Time (hours) difference highest minus lowest WSE									1410.75
Highest WSE at closure minus lowest WSE during closure in this WY									4.88
Rate of decrease in WSE (ft/day)									0.003
Mean daily flow rate (cfs) on day of highest WSE at closure									8.5
Mean daily flow rate (cfs) on day of lowest WSE of dry season									0
Likely mechanism with greatest influence on process									Ocean
End of WY									9/30/1996 23:45
Time (days) between final season closure and end of WY									91.98
Total days of lagoon closure in this WY (pre- and post-rainy season)									165.8
Totel days of closure including all partial closures									170.4

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1996

Table 18. WY 1995, Riverine Dynamics of Breaches and Closures

	Sustained closure	Sustained breach*	Final Closure	WSE increase while closed
Breach Type				
Mechnical, Natural, or Unknown		Mechanical	Natural	
Dry Season Events	10/1/1994 0:00			
Date-Time of lowest lagoon WSE prior to breach	10/1/1994 21:15			
Lowest lagoon WSE during closure, this WY	5.96			
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0			
Date-Time of lowest WSE prior to significant increase in WSE				9/6/1995 9:30
WSE (ft)				5.59
Date-Time of highest WSE post-increase				9/24/1995 0:30
WSE (ft)				10.43
Increase in WSE (ft)				4.84
Likely mechanism with greatest influence on WSE increase process				Wave overtopping
Mean daily flow rate (cfs) on day of highest WSE				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none			
Time (days) between start of WY and first seasonal breach	101.3			
Breachs and Closures during rainy season				
Date-Time of highest WSE at time of breach		1/10/1995 6:15		
WSE (ft)		10.51		
Date-Time of lowest WSE directly following breach		1/12/1995 1:15		
WSE (ft)		6.39		
WSE pre-breach minus post-breach (ft)		4.12		
Time difference (days)		1.79		
Time difference (hours)		43		
Rate of WSE decline (ft/hr)		0.10		
Mean daily flow rate (cfs) on day of breach		6070		
Mean daily flow rate (cfs) on day of lowest WSE following breach		746		
Likely mechanism with greatest influence on breaching process		Mechanical/Riverine		
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				
WSE (ft)				
Date-Time of lagoon WSE fills to > 11 feet				
WSE (ft)				
Date-Time of lagoon falls below WSE > 11 feet				
WSE (ft)				
Time (days) of WSE > 11 feet				
Time (hours) of WSE > 11 feet				
Mean daily flow rate (cfs) on day lowest WSE				
Mean daily flow rate (cfs) on day WSE > 11 feet				
Mean daily flow rate (cfs) on day WSE < 11 feet				
Likely mechanism with greatest influence on closure process				
Dry Season Closure				
Date-Time of highest WSE at WY closure			8/9/1995 0:00	
WSE (ft)			9.73	
Date-Time of lowest WSE during WY closure or following break			9/6/1995 9:30	
WSE (ft)			5.59	
Time (days) difference highest minus lowest WSE			28.40	
Time (hours) difference highest minus lowest WSE			681.50	
Highest WSE at closure minus lowest WSE during closure in this WY			4.14	
Rate of decrease in WSE (ft/day)			0.006	
Mean daily flow rate (cfs) on day of highest WSE at closure			3.7	
Mean daily flow rate (cfs) on day of lowest WSE of dry season			3	
Likely mechanism with greatest influence on process			Ocean	
End of WY			9/30/1995 23:45	
Time (days) between final season closure and end of WY			52.99	
Total days of lagoon closure in this WY (pre- and post-rainy season)			154.3	
Totel days of closure including all partial closures			154.3	

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
Mechanical breach on January 9, 1995 in anticipation of flood flows, James, 2005 (p 10)

Table 19. WY 1994, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained Breach*	In-season closure	Temporary breach	In-season closure	Temporary breach	Final closure
Breach Type								
Mechnical, Natural, or Unknown			Mechanical		Natural		Natural	Natural
Dry Season Events	10/1/1993 0:00							
Date-Time of lowest lagoon WSE prior to breach	10/3/1993 12:00							
Lowest lagoon WSE during closure, this WY	5.44							
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0							
Date-Time of lowest WSE prior to significant increase in WSE		11/6/1993 8:15						
WSE (ft)		7.43						
Date-Time of highest WSE post-increase		11/13/1993 10:45						
WSE (ft)		8.87						
Increase in WSE (ft)		1.44						
Likely mechanism with greatest influence on WSE increase process		Ocean						
Mean daily flow rate (cfs) on day of highest WSE		0.00						
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none							
Time (days) between start of WY and first seasonal breach	139.9							
Breachs and Closures during rainy season								
Date-Time of highest WSE at time of breach			2/17/1994 22:15		3/18/1994 15:00		3/27/1994 17:00	
WSE (ft)			11.69		11.62		12.15	
Date-Time of lowest WSE directly following breach			2/19/1994 15:45		3/19/1994 14:30		3/27/1994 20:00	
WSE (ft)			6.45		7.80		5.81	
WSE pre-breach minus post-breach (ft)			5.24		3.82		6.34	
Time difference (days)			1.73		0.98		0.13	
Time difference (hours)			41.5		23.5		3	
Rate of WSE decline (ft/hr)			0.13		0.16		2.11	
Mean daily flow rate (cfs) on day of breach			106		22		20	
Mean daily flow rate (cfs) on day of lowest WSE following breach			203		22		20	
Likely mechanism with greatest influence on breaching process			Mechanical/Riverine		Riverine		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				3/13/1994 9:00		3/19/1994 15:45		
WSE (ft)				5.6		7.8		
Date-Time of lagoon WSE fills to > 11 feet				3/16/1994 20:30		3/24/1994 7:45		
WSE (ft)				11.00		11.00		
Date-Time of lagoon falls below WSE > 11 feet				3/18/1994 17:45		3/27/1994 18:00		
WSE (ft)				10.93		10.05		
Time (days) of WSE > 11 feet				1.89		3.39		
Time (hours) of WSE > 11 feet				45.3		81.3		
Mean daily flow rate (cfs) on day lowest WSE				31		22		
Mean daily flow rate (cfs) on day WSE > 11 feet				24		20		
Mean daily flow rate (cfs) on day WSE < 11 feet				22		20		
Likely mechanism with greatest influence on closure process				Ocean		Ocean		
Dry Season Closure								
Date-Time of highest WSE at WY closure								4/3/1994 3:45
WSE (ft)								10.66
Date-Time of lowest WSE during WY closure or following break								8/29/1994 16:45
WSE (ft)								5.44
Time (days) difference highest minus lowest WSE								148.54
Time (hours) difference highest minus lowest WSE								3565.00
Highest WSE at closure minus lowest WSE during closure in this WY								5.22
Rate of decrease in WSE (ft/day)								0.001
Mean daily flow rate (cfs) on day of highest WSE at closure								8.2
Mean daily flow rate (cfs) on day of lowest WSE of dry season								0
Likely mechanism with greatest influence on process								Ocean
End of WY								9/30/1994 23:45
Time (days) between final season closure and end of WY								180.83
Total days of lagoon closure in this WY (pre- and post-rainy season)								320.8
Totel days of closure including all partial closures								326.0

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1994

Table 20. WY 1993, Riverine Dynamics of Breaches and Closures

	Sustained closure	WSE increase while closed	Sustained Breach*	In-season Closure	Sustained Breach	Final Closure
Breach Type						
Mechnical, Natural, or Unknown			Mechanical		Natural	Natural
Dry Season Events	10/1/1992 0:00					
Date-Time of lowest lagoon WSE prior to breach	10/19/1992 6:00					
Lowest lagoon WSE during closure, this WY	6.19					
Mean daily flow rate (cfs) on day of lowest WSE prior to 1st reported breach	0					
Date-Time of lowest WSE prior to significant increase in WSE		10/24/1992 8:30				
WSE (ft)		7.38				
Date-Time of highest WSE post-increase		10/28/1992 17:00				
WSE (ft)		10.06				
Increase in WSE (ft)		2.68				
Likely mechanism with greatest influence on WSE increase process		Wave overtopping				
Mean daily flow rate (cfs) on day of highest WSE		0				
Date-Time of most recent WSE > 11 ft prior to breach, this WY	none					
Time (days) between start of WY and first seasonal breach	98.5					
Breachs and Closures during rainy season						
Date-Time of highest WSE at time of breach			1/7/1993 11:00		6/3/1993 13:30	
WSE (ft)			12.74		12.07	
Date-Time of lowest WSE directly following breach			1/7/1993 19:30		6/3/1993 19:30	
WSE (ft)			6.23		5.71	
WSE pre-breach minus post-breach (ft)			6.51		6.36	
Time difference (days)			0.35		0.25	
Time difference (hours)			8.5		6	
Rate of WSE decline (ft/hr)			0.77		1.06	
Mean daily flow rate (cfs) on day of breach			697		47	
Mean daily flow rate (cfs) on day of lowest WSE following breach			697		47	
Likely mechanism with greatest influence on breaching process			Mechanical		Riverine	
Date-Time of lowest lagoon WSE prior to next WSE > 11 feet for > 24 hours				5/28/1993 15:00		
WSE (ft)				5.46		
Date-Time of lagoon WSE fills to > 11 feet				6/2/1993 3:30		
WSE (ft)				11.02		
Date-Time of lagoon falls below WSE > 11 feet				6/3/1993 14:50		
WSE (ft)				8.66		
Time (days) of WSE > 11 feet				1.47		
Time (hours) of WSE > 11 feet				35.3		
Mean daily flow rate (cfs) on day lowest WSE				28		
Mean daily flow rate (cfs) on day WSE > 11 feet				53		
Mean daily flow rate (cfs) on day WSE < 11 feet				47		
Likely mechanism with greatest influence on closure process				Ocean		

Dry Season Closure	
Date-Time of highest WSE at WY closure	7/3/1993 1:00
WSE (ft)	8.77
Date-Time of lowest WSE during WY closure or following break	9/30/1993 23:30
WSE (ft)	5.52
Time (days) difference highest minus lowest WSE	89.94
Time (hours) difference highest minus lowest WSE	2158.50
Highest WSE at closure minus lowest WSE during closure in this WY	3.25
Rate of decrease in WSE (ft/day)	0.002
Mean daily flow rate (cfs) on day of highest WSE at closure	4.9
Mean daily flow rate (cfs) on day of lowest WSE of dry season	0
Likely mechanism with greatest influence on process	Ocean
End of WY	9/30/1993 23:45
Time (days) between final season closure and end of WY	89.95
Total days of lagoon closure in this WY (pre- and post-rainy season)	188.4
Totel days of closure including all partial closures	189.9

Notes

Water year (WY) is defined as the time period beginning October 1st of a given year and ending September 30th the following year
All WSE elevations are in NAVD88, feet
Breach types are based on professional judgement, available records, and personal communications with staff knowledgeable of breaching operations
* indicates breach data used for rate of lagoon draining in Table 3
Sustained closure is defined from October 1st of each water year until the first breach
Temporary breach is defined as lagoon being open to tidal influence for < 7 consecutive days
Sustained breach is defined as the lagoon remaining open to tidal influences for > 7 consecutive days
In-season closure is defined as the time period during the wet season (approximately October - May of each WY) when lagoon WSE > 11 feet persists for > 24 hours
Early closure is defined as lagoon closing due to mechanical or ocean processes shortly (approximately 1 week to 1 month early) before a final closure
Final closure is defined as lagoon closed to ocean processes until the following water year
Significant increase in WSE is defined as an increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Wave overtopping is defined as increase in lagoon WSE of > 1 foot when flows are zero and lagoon is closed to the ocean
Total days of lagoon closure included days between start of WY and 1st breach, days between final season closure and end of WY, and days of in-season closures
No record of breaching and/or closing events for WY 1993

This Page Intentionally Left Blank

BALANCE HYDROLOGICS, Inc.

Memo

To: Erin Harwayne, Denise Duffy & Associates

From: Scott Brown

Date: July 29, 2016

Subject: Carmel River Lagoon EPB- Potential impacts to the CAWD wastewater treatment facility and Mission Ranch.

You have asked that Balance assess selected potential hydrologic impacts of the proposed Ecosystem Protective Barrier (EPB) project on the CAWD Wastewater Treatment Plant located just south of the Carmel River, west of Highway 1. Specifically, you have asked that we address the change in flood water surface elevation and the potential for associated significant impacts, increases in seepage through the uncertified levee (or berm) that surrounds the facility, and additional inundation of areas that may impact CAWD operations or the Mission Ranch area.

Background

The EPB is a proposed wall structure planned along the perimeter of the northern portion of the Carmel River Lagoon intended to reduce flood impacts to adjoining neighborhoods during periods when water levels in the lagoon are at or near their peak (typically due to closed barrier beach conditions at the mouth of the lagoon, though could also affect high water levels during flood stage of the River, as discussed below). The proposed EPB alignment is shown in Figure 1.

The CAWD water treatment facility is located adjacent to and south of the Carmel River and west of Highway 1. The facility is separated from the River and from the floodplain to the south by uncertified levees that protect the facility, at least in part, from inundation during flooding events of the Carmel River.

The Mission Ranch property is located upstream of the proposed EPB alignment along the northern side of the eastern end of the lagoon and, in part, north of an uncertified levee that separates the area from the Carmel River. The potentially impacted area includes a large open field, currently used occasionally as a pasture for sheep grazing, a parking lot, a tennis clubhouse and "quadplex" buildings, and six tennis courts (Whitson, 2013).

Carmel River and Lagoon flood impacts

Two aspects of the EPB project have the potential to increase flood levels and cause significant impacts. First, changes in management of the barrier beach would allow higher sustained water elevations within the lagoon, which would increase the area subject to flooding, potentially affecting low-lying buildings and other facilities adjacent to the lagoon (those not protected by the new EPB).

Second, the proposed EPB would constrict flood inundation areas on the north side of the Carmel River, and as such, would have the potential to result in increased flood water surface elevations. In order to analyze the magnitude and location of these potential increases, Balance Hydrologics modeled pre- and post-project conditions under several different scenarios, and prepared a summary of the results (Riedner and Ballman, 2013). While that memo generally described the magnitude and location of increases, it did not specifically assess the potential impact related to the uncertified levee that surrounds the CAWD facility or structures on the Mission Ranch property.

The following discussion addresses these two issues for both the CAWD Wastewater Treatment Facility and the Mission Ranch property, building in part on results presented in the earlier memorandum[1].

CAWD

The CAWD Wastewater Treatment Facility ('CAWD facility'), is located adjacent to the main Carmel River channel, separated from the channel by an uncertified levee with a top elevation of about 18 feet NAVD. Elevations within the facility typically range from about 15.5 to 18 feet NAVD, though one depression on the property is as low as 13.6 feet NAVD. Water level in the lagoon has risen as high as 15.4 feet NAVD in the past (Whitson, 2013), and as such, changes in management of the barrier beach that result in higher lagoon water elevations could result in increased flooding at the project site.

Prior to 2011, the barrier beach was typically mechanically breached when the lagoon reached a level of about 12.7 feet NAVD, and since 2011 a sand plug has been left in place with a top elevation of 12.7 feet NAVD to facilitate a more natural river over-topping and breaching at that elevation (Whitson, 2013). Estimates of a typical elevation for fully natural beach dynamics and breaching cover a wide range, but would likely fall within the range of 13 to 16 feet NAVD (Whitson, 2013). The elevation of the top of the uncertified levee that surrounds the CAWD facility is greater than 16 feet NAVD along the full perimeter, though some sections are as low as 17 to 18 feet NAVD. As such an increase in breaching elevation to 16 feet would not cause surface flooding at CAWD. However, there is uncertainty in the estimates of natural breaching elevation, and it may be possible that the elevation would be greater than 16 feet in some years, which could cause flooding at the CAWD facility if the berm were overtopped. This potential impact could be reduced to less-than-significant by:

a. setting an emergency action trigger elevation that would provide a better constraint on the maximum lagoon elevation relative to the CAWD facility, or alternatively,
b. by raising the level of the berm surrounding the CAWD facility.

In addition to potential flooding related to beach barrier management, the EPB would constrict the flood plain, potentially raising flood levels in the Carmel River at the location of the CAWD facility. Table 1 presents an excerpt of the previous modeling results (Riedner and Ballman, 2013), showing the magnitude of the predicted increase in the base flood elevation (BFE) on the

[1] For brevity, the details of the modeling effort are not discussed in the current memo. For specifics, see the Hydraulic Model Description section of Riedner and Ballman, 2013.

Carmel River per hydraulic modelling using the currently-effective FEMA HEC-RAS model base.[2] The CAWD facility is located between cross-sections 27+85 and 39+86 along the main channel of the Carmel River. As discussed in the earlier memo, changes in BFE as a result of the EPB are predicted to be small overall (less than an inch). Specifically, the maximum increase in main channel BFE (0.02 feet) is predicted at Station 22+06, downstream from the CAWD Treatment Plant, with projected increases adjacent to the plant of 0.01 feet or less (Stations 29+72 to 41+96; see Figure 1 for cross-section locations).

Table 1 presents the elevation of the top of the uncertified levee on the main channel side of the CAWD facility at the location of each cross-section, and estimates the pre- and post-project freeboard for the 100-year flood based on the calculated BFE from the previous modeling[3]. As shown, the greatest anticipated increases in BFE are in the downstream portion of the CAWD facility, where the uncertified levee has and would continue to have freeboard. Upstream of section 33+89 there are two locations where the pre-project flood level exceeds the elevation of the levee (at 36+78 and 39+86), but at these locations there is not expected to be an increase in BFE as a result of the proposed EPB project.

Mission Ranch

As stated in the EPB Feasibility Report (Whitson, 2013), portions of Mission Ranch lie within the 100-year floodplain and may be affected by increased flood levels as a result of floodplain constriction caused by the EPB. Under the EPB (no extension) scenario, there is a predicted slight increase (0.01 feet) in the 100-year flood elevation in the area of Mission Ranch (Riedner and Ballman, 2013). That impact seems to be entirely confined to the area within the open fields (‘sheep field’), and doesn't extend upstream as far as the tennis courts. As such, the slight increase in BFE in that area does not represent a significant impact.

The Mission Ranch area could, however, be impacted by sustained higher lagoon water elevation as a result of changes in beach barrier management allowable under the EPB scenario. Post-project, sustained lagoon water levels may reach as high as 16 feet NAVD. The feasibility report (Whitson, 2013) states that the ground surface immediately adjacent to some buildings near the tennis courts and parking lot are at 15.9 feet, and thus may be impacted by higher sustained lagoon water levels. The potential impact could be mitigated through implementation of either of the following measures:

a. Establishment and implementation of emergency action levels that would allow for barrier beach management when lagoon water level approaches trigger elevations that would impact Mission Ranch infrastructure.
b. Construction of an EPB extension that would protect facilities within the Mission Ranch area.

[2] The BFE is defined by FEMA as the water surface elevation for the 1-percent chance flood event (also known as the “100-year flood”).

[3] For the purposes of this assessment, we used the maximum potential increase as a result of the EPB. The previous memo included analysis of an extension of the EPB surrounding Mission Ranch which is not part of the current proposed project, but provides a conservatively high estimate of the potential flood elevation impact, and is therefore appropriate for an EIR-level analysis.

It is important to note that the 'sheep field' to the west of the Mission Ranch infrastructure is at a lower elevation (about 12.5 to 13.5 feet NAVD) and would be inundated more frequently and to a greater extent than under current conditions. Increased inundation in this area, however, would not specifically threaten built infrastructure.

Groundwater impacts

The ground surface at the CAWD facility (within the perimeter levee) is predominantly between 15.5 and 18 feet NAVD, though at one spot in the southwest corner there is a depression with a bottom elevation at 13.6 feet NAVD. In this regard it is appropriate to consider potential impacts from higher sustained water levels in the lagoon that may result in higher groundwater levels at the CAWD facility, which could impact CAWD operations and/or infrastructure. For example, in a comment letter to Carl Holm (Buikema, 2013), CAWD states that "elevating groundwater levels within 20 feet of the surface in and around the Treatment Plant property may have an effect on both the future construction of facilities as well as maintenance costs."

Groundwater data from several wells near CAWD suggest that local, shallow groundwater elevations closely track water level in the lagoon (Woyshner and others, 2015), and as such higher groundwater levels at CAWD are likely as a result of higher sustained water level in the Lagoon. A monitoring well adjacent to the CAWD facility (MPWMD 'CAWD dewater'; located near the northeast corner of the treatment plant grounds) suggests that existing groundwater levels adjacent to the lagoon and CAWD facility already reach an elevation of over 14 feet NAVD, less than 4 feet below ground surface at the location of the well (Figure 2)[4]. This suggests that CAWD may already need to dewater in order to maintain groundwater levels at their stated 20' below ground surface, though no information was available as to whether there is, or is not, an active dewatering program at CAWD.

Figure 3 compares the water level measured at the 'CAWD dewater' well against the concurrent water level reported for the Lagoon, as recorded by MPWMD[5]. Because water level in the lagoon can fluctuate rapidly (after a breach or when open to tidal effects) there is considerable scatter in the data at lower lagoon elevations (below about 10 feet NAVD). However, at higher lagoon water elevations, the scatter converges toward a near one-to-one relationship. In fact the sharp break at the lower-right edge of the data represents a clear indication of the "hydraulic floor" effect caused by the lagoon relative to water levels in the well. Given these conditions, we expect that higher sustained lagoon elevations as a result of the EPB would correspond directly to higher water levels in the CAWD dewater well.

[4] It is important to note that the monitoring well has a depth of 50 feet, with an unknown screened interval. As such, water elevations in the monitoring well at 6 feet below ground surface suggest only that groundwater has the potential to be that close to the surface within the CAWD facility, barring no significant obstruction to groundwater flow in the vertical direction (as might be expected in the compacted fill on which the facility was constructed). Buikema (2013) states that geotechnical investigations within the facility (no date or citation provided) found groundwater between 25 and 55 feet below ground surface. In order to provide a conservatively high estimate of the impact, we assume that groundwater level measured at the CAWD dewater well corresponds to the actual depth to groundwater within CAWD.

[5] Raw lagoon water surface elevation datalogger files, provided by Monterey Peninsula Water Management District, are provisional and subject to revision.

Post-project, estimated maximum sustained lagoon water elevation may reach as high as 16 feet[6], raising groundwater levels adjacent to the CAWD facility by a similar amount, and potentially resulting in seepage at the ground surface in locations where elevations within the facility are less than 16 feet. The following analysis offers a first approximation estimate of the magnitude of the potential impact, and estimates the effort that would be required to maintain water levels near the CAWD dewater well at pre-project levels[7].

Figure 2 shows monthly monitoring data from the 'CAWD dewater' well. While water levels have been as high as 14.2 feet NAVD (in 2005), levels more regularly reach only to about 12 feet NAVD, and this number is used as a representative baseline condition of an average annual maximum. Post-project, sustained water levels have the potential to approach 16 feet NAVD. In order to maintain water levels adjacent to and within the CAWD facility at pre-project levels, some amount of pumping would likely be required during periods when lagoon water levels are between 12 and 16 feet[8].

Design of a full-scale dewatering plan to mitigate this potential impact is outside the scope of this analysis, and would need to be coordinated with CAWD in order to meet and mesh with their operational needs. However, we can estimate the effort that would be needed to maintain water level near the CAWD well below 12 feet NAVD under a potential post-project 16 foot elevation high-stand in the lagoon. A simple conceptual model of the post-project groundwater conditions at CAWD can be represented by a bounded aquifer scenario, where the lagoon represents a 'constant head' boundary (i.e. a boundary at which no drawdown would occur as a result of pumping from the aquifer; see Figure 4a). Standard hydrogeologic equations can be used to estimate the amount of pumping that would be needed to maintain groundwater levels at 12 feet NAVD (near the CAWD dewater well) when the lagoon is at 16 feet NAVD, as discussed below.

The CAWD dewater well is approximately 60 feet from the open water of the Lagoon on the opposite side of the levee. When groundwater is pumped from a well adjacent to a constant head boundary, induced recharge from the open-water feature will tend to suppress the amount of drawdown (water-level drop) that occurs relative to a case in which groundwater is pumped from a non-bounded aquifer. The recharge effect can be calculated by modeling a condition where the open-water feature is represented by a 'recharge image well' of equal distance from and on the opposite of the recharge boundary, injecting water to the aquifer at a rate equal to the discharging

[6] Whitson (2013) provides a summary of the estimated 'natural breach height' concluding that this elevation would vary between 13 and 16 feet NAVD 1988. For the purpose of this analysis, we use the upper end of that range in order to provide a conservatively high estimate of potential groundwater pumping needed to mitigate the impact of the higher water level at the CAWD facility.

[7] As explained below, we use the CAWD dewater well as an index for the purposes of assessing the potential feasibility of mitigation. A full dewatering plan would involve additional wells and/or perimeter drains and would need to be coordinated with CAWD in order to meet all of their operational goals and/or mesh with their existing dewatering operations, to the extent that they exist.

[8] We have no formal documentation that CAWD currently requires dewatering to reduce impacts under existing conditions, though it is certainly possible. If so, the simplified analysis herein would be considered additional capacity above and beyond what is already being provided. A more detailed analysis can and should be provided prior to design of potential mitigation strategies. The analysis herein is simply for EIR impact analysis and assessment of feasibility that the potential impact could be mitigated.

well (Figure 4b). Total drawdown at a given observation point is a result of the difference between the independent drawdown of the primary (discharging) well and the image (recharging) well, represented by the following equation (after Ferris and others, 1962):

$$s_t = \frac{Q}{4\pi \mathrm{T}} * [W(u)_p - W(u)_i]$$

Where:

$s_t = total\ drawdown\ at\ observation\ point$
$Q = rate\ of\ discharge/recharge$
$T = transmissivity\ of\ the\ aquifer$
$W(u)_{p,i} = 'well\ function' of\ pumping, image\ well$

And:

$$u_p = \frac{r_p^2 S}{4\mathrm{Tt}}$$

$$u_i = \frac{r_i^2 S}{4\mathrm{Tt}}$$

Where:

$r_{p,i} = distance\ from\ observation\ point\ to\ pumping, image\ well$
$S = storativity\ of\ the\ aquifer$
$T = transmissivity\ of\ the\ aquifer$
$t = time\ since\ beginning\ of\ pumping$

Solving the above equation for Q results in:

$$Q = \frac{s_t 4\pi \mathrm{T}}{[W(u)_p - W(u)_i]}$$

In this case, all values are known or can be estimated except for the rate of discharge needed to produce a four-foot drawdown (16 feet minus 12 feet NAVD) near the CAWD dewater well. There are no readily-available estimates of transmissivity (the ease at which groundwater can move through an aquifer) for the berm surrounding CAWD or the material on which the facility was constructed. However, as a first-order assessment, we can use estimates derived for other nearby wells to approximate conditions at the CAWD facility. Fugro (1993) conducted 72-hour pump test of a well near Rio Road (about 0.85 miles east of the CAWD facility). They concluded that transmissivity of the aquifer in which the well is screened (50-150 feet below ground surface) is approximately 120,250 gallons per day per foot of saturated aquifer (gpd/ft), or 0.186 square feet per second. The same aquifer test yielded an estimate of storativity of 0.00153 (storativity is a unitless value).

For the calculation of u, we use the following values:

$r_p = 10\ feet$ *(theoretical observation point near the pumping well)*
$r_i = 110 feet$ *(distance to the image well)*

$S = 0.00153$
$T = 0.186\ ft^2/s$
$t = 86{,}400\ s$ *(10 days; assuming equilibrium by that time)*

Thus:

$u_p = 5.95 \times 10^{-7}$
$u_i = 3.15 \times 10^{-4}$

And[9]*:*

$W(u)_p = 12.55$
$W(u)_i = 7.94$

The needed discharge, then, to draw down water level to below 12 feet NAVD within an approximate 10-foot radius[10] of the CAWD dewater well when the lagoon is at 16 feet NAVD, is calculated as follows:

$$Q = \frac{s_t 4\pi \mathrm{T}}{[W(u)_p - W(u)_i]}$$

$$Q = \frac{4 * 4 * 3.14 * 0.186}{[12.55 - 7.94]}$$

$$Q = 2.0\ cubic\ feet\ per\ second\ (910\ gallons\ per\ minute)$$

Without developing a full dewatering plan it is difficult to estimate the total amount of pumping that would be needed at the site to fully dewater to 12 feet (or another trigger point that would meet CAWD operational goals). With additional testing of the CAWD dewater well and information about existing dewatering schemes (if any), as well as more specific information about the operation goals for groundwater at CAWD, a detailed plan could be developed using readily available groundwater modeling packages. The results of the preliminary analysis above, however, do suggest that groundwater pumping rates near the perimeter of the inside of the berm would not be unreasonably high such that they would preclude a successful mitigation strategy.

Additionally, it is important to note that the estimate above is likely conservatively high due to two factors. First, the transmissivity of the levee material (compacted fill) is likely lower than the estimate that was used, potentially by an order of magnitude. Performing a standard 72-hour pump test of the CAWD dewater well itself would help to refine the parameters, and should be included as part of the development of a mitigation dewatering plan. Second, the analysis assumes a sustained lagoon water elevation of 16 feet NAVD, when in reality this elevation

[9] Values for 'W' as a function of 'u' (calculated based on the above equations) were selected from tabulated W(u) values for Theis solution in Domenico and Schwartz, 1990.

[10] The calculation shown here provides an estimate of pumping needed to draw water down to 12 feet NAVD on the lagoon side of the well. Because the recharge effects of the lagoon diminish with distance, it would only take 1.8 cfs of pumping to draw down water level 10 feet from the CAWD dewater well on the opposite side from the lagoon.

would typically be sustained only for a short period just prior to the barrier beach naturally breaching.

For the purposes of this discussion, we are discounting potential seepage impacts related to increases in water level during river flood events, as the water surface increase is very small (see discussion above) and is not likely to be sustained for a long enough period of time to significantly affect groundwater seepage rates through the levee.

Closing

The results presented in this memo were intended for an EIR-level analysis to assess the mitigability of potential hydrologic impacts. Additional analysis may be required after project approval to provide guidance during final project design and to better refine mitigation strategies and implementation.

Do not hesitate to contact us if you have any questions or comments on the information presented in this memo.

References

Buikema, B., 2013, Comments to Carl Holm in response to the feasibility discussion of the Carmel Lagoon Ecosystem Protective Barrier. Letter from Barbara Buikema, Carmel Area Wastewater District, dated May 13, 2013, 3p.

Domenico, P.A. and F.W. Schwartz, 1990, *Physical and Chemical Hydrogeology*, John Wiley & Sons, New York, 824 p.

Ferris, J.G., D.B. Knowles, R.H. Brown and R.W. Stallman, 1962, Theory of aquifer tests, U.S. Geological Survey Water-Supply Paper 1536 E, 174p.

Fugro West, Inc., 1993, Hydrogeologic investigation, Carmel River Aquifer System Subunit 4, test well installation and aquifer testing: Consulting memorandum from Robert Marks to Joe Oliver, prepared for Monterey Peninsula Water Management District, 11 p. + appendices.

Riedner, E., and Ballman, E., 2013, Carmel River Lagoon EPB—Riverine Flooding Impacts Assessment. Balance Hydrologics technical memorandum to Whitson Engineers, 7p.

Whitson Engineers, 2013, Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) projects feasibility report. Consulting report prepared for the Monterey County Water Resources Agency and the Monterey County Department of Public Works, 43p.

Woyshner, M., Parke, J., and Hecht, B., 2015, Baseline groundwater monitoring at the mouth of the Carmel River for the proposed floodplain restoration and enhancement project, water years 2012 through 2015, Monterey County, California. Consulting report prepared by Balance Hydrologics, Inc. for the Big Sur Land Trust, 22p.

Table 1. Potential impact of EPB on flood elevations at the CAWD water treatment plant, Carmel, California.

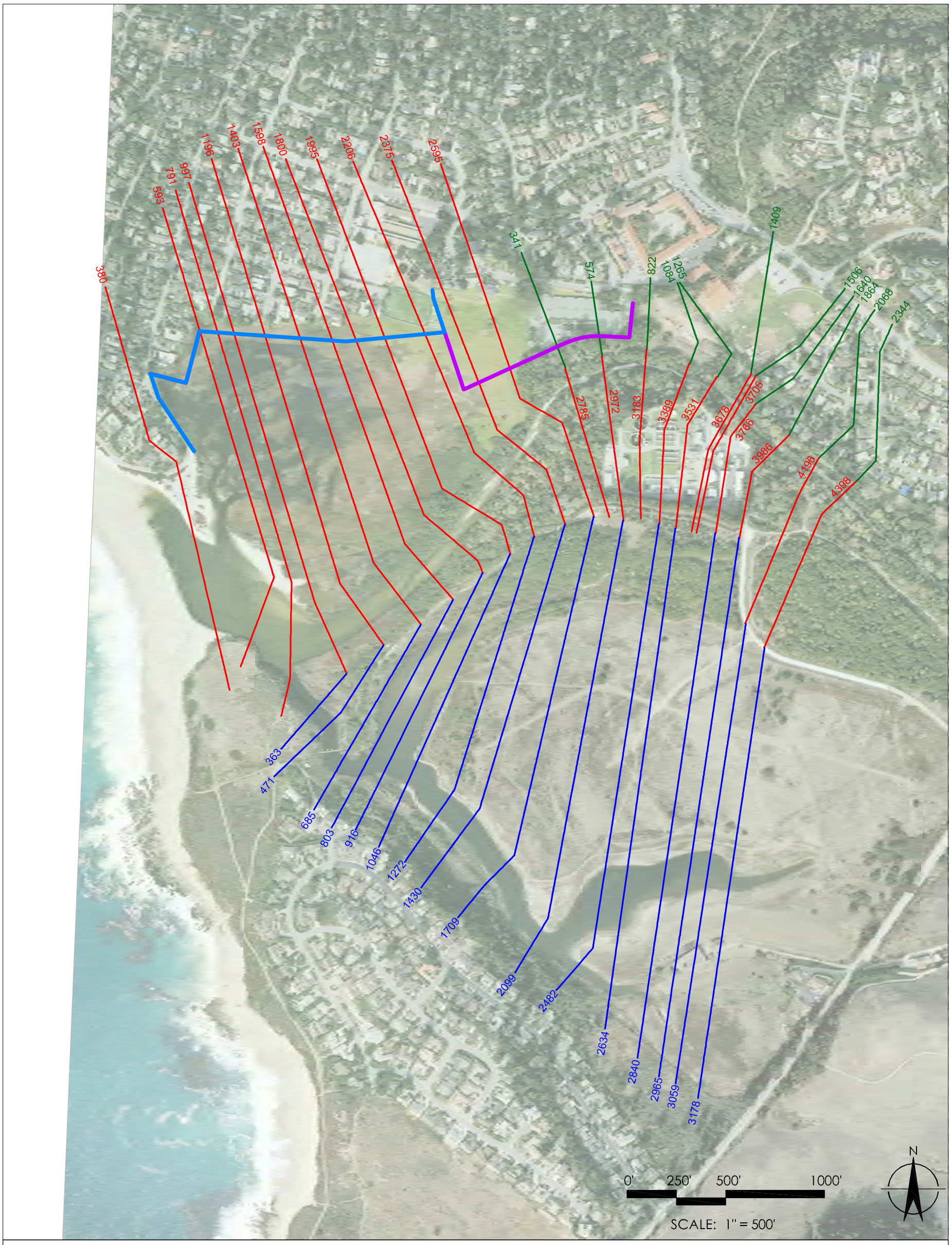
Modeling results compiled from analysis by Riedner and Ballman, 2013.

Model cross-section station (feet)	Elevation of top of uncertified CAWD levee at cross section (feet NAVD)	Pre-project 100-year water surface elevation (feet NAVD)	Pre-project freeboard (feet)	Post-project 100-year water surface elevation[1] (feet NAVD)	Post-project freeboard (feet)	Change in flood elevation (feet)	Comments
15+98	--	15.62	--	15.62	--	0.00	
18+00	--	15.64	--	15.64	--	0.00	
19+95	--	15.67	--	15.68	--	0.01	
22+06	--	15.74	--	15.76	--	0.02	
23+75	--	15.75	--	15.76	--	0.01	
25+95	--	15.78	--	15.79	--	0.01	
27+85	--	15.93	--	15.94	--	0.01	just downstream of the CAWD uncertified levee
29+72	17.5	16.41	1.09	16.42	1.05	0.01	
31+83	18.0	17.18	0.82	17.18	0.8	0.00	
33+89	20.0	17.86	2.14	17.86	2.13	0.00	
35+31	19.0	18.50	0.50	18.50	0.5	0.00	
36+78	19.0	19.08	-0.08	19.08	-0.08	0.00	
37+05	20.0	19.12	0.88	19.12	0.87	0.00	
37+66	20.0	19.35	0.65	19.35	0.65	0.00	
39+86	18.0	19.47	-1.47	19.47	-1.47	0.00	
41+96	25.0	19.79	5.21	19.78	5.22	-0.01	upstream of CAWD facility
43+98	20.0	19.99	0.01	19.99	0.01	0.00	
45+86	--	20.17	--	20.17		0.00	

Notes:

[1] EPB alignment #2, as analyzed in Riedner and Ballman, 2013.

© 2016 Balance Hydrologics, Inc.



LEGEND

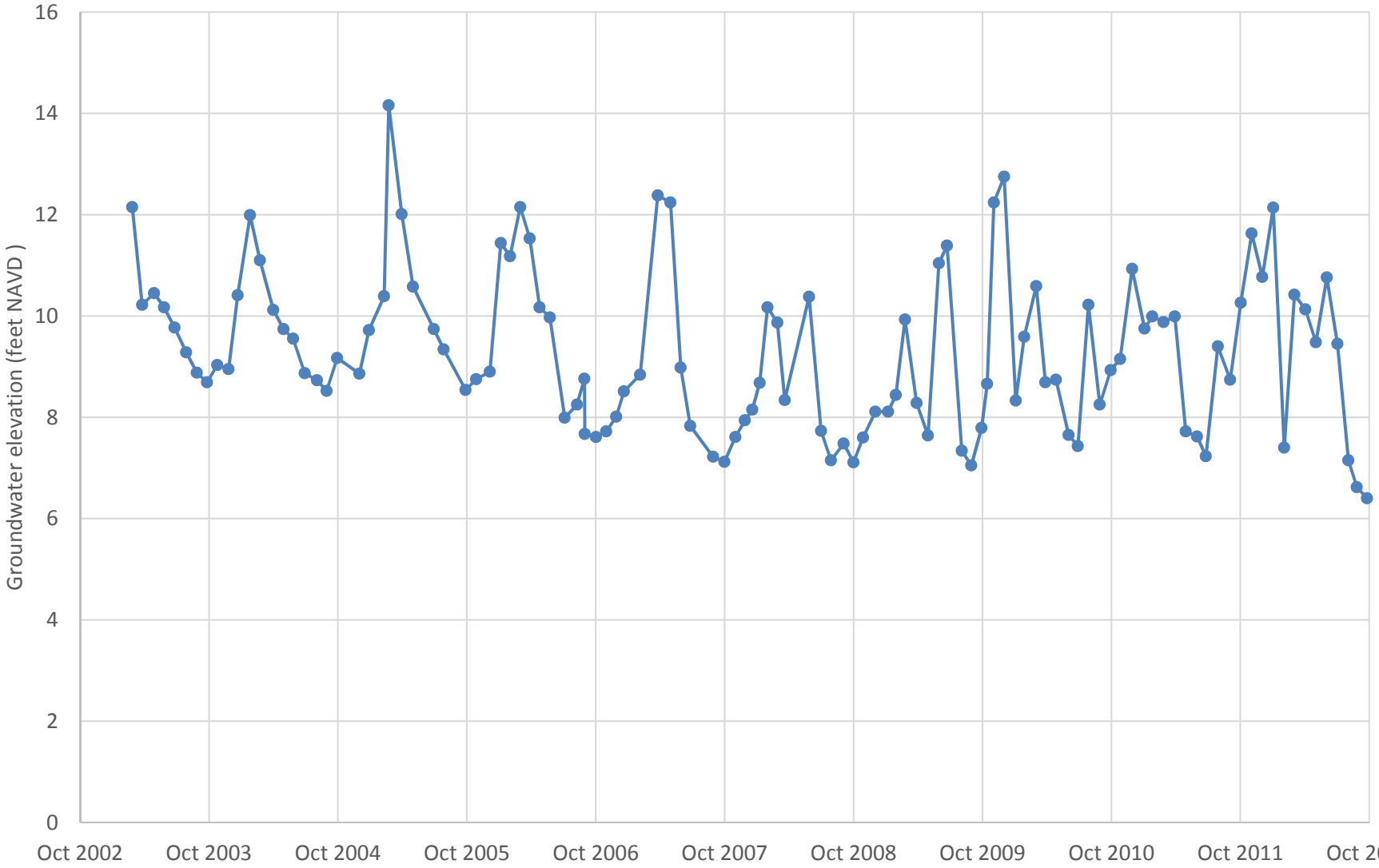
1265	NORTH OVERBANK FEMA CROSS-SECTION AND LABEL		ECOSYSTEM PROTECTIVE BARRIER ALIGNMENT #2
3389	MAIN CHANNEL FEMA CROSS-SECTION AND LABEL		ECOSYSTEM PROTECTIVE BARRIER EXTENSION #3A
2840	SOUTH OVERBANK FEMA CROSS-SECTION AND LABEL		

Balance Hydrologics, Inc.

Figure 1. Location of proposed Ecosystem Protective Barrier and hydrologic modeling cross sections relative to the CAWD Wastewater Treatment Facility and the Mission Fields area. Note that EPB Extension #3a was analyzed previously, but is not proposed as part of the current project.

211067 Hydraulics Workmap 130417.dwg

©2013 Balance Hydrologics, Inc.



Balance Hydrologics, Inc.®

Figure 2. Groundwater elevations as measured at the 'CAWD dewater well', adjacent to the CAWD Water Treatment Facility, Carmel, California. Ground surface at the well is approximately 18 feet NAVD. Note that groundwater elevation regularly exceeds 12 feet NAVD. Groundwater monitoring data provided by MPWMD.

© 2016 Balance Hydrologics, Inc.

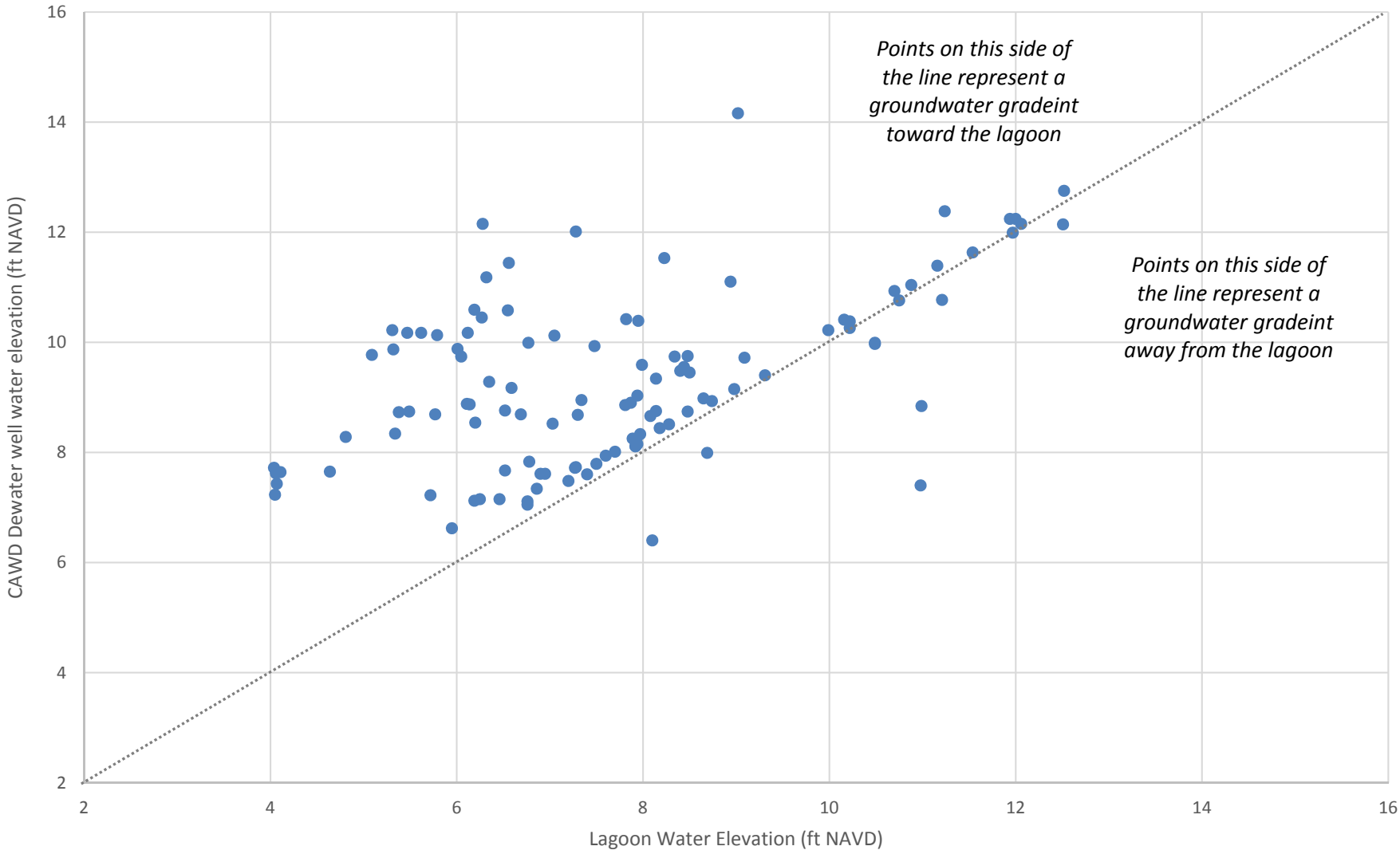
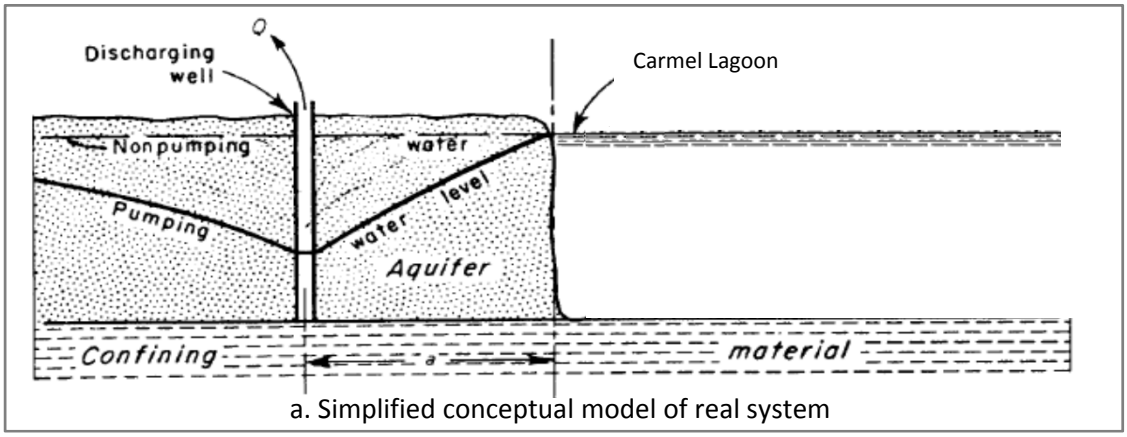
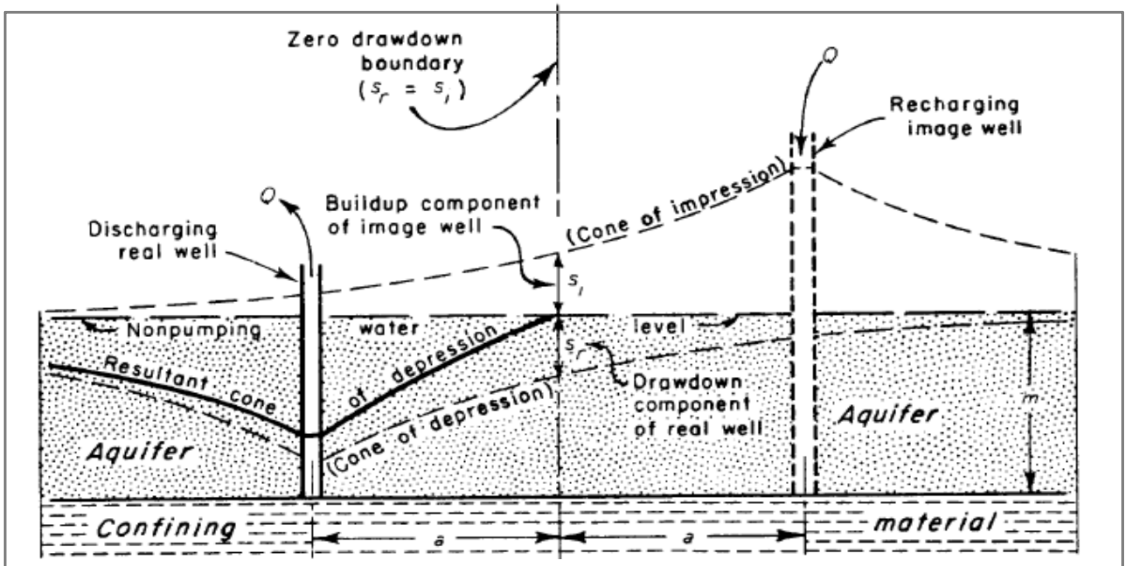


Figure 3. Water elevation in the Carmel Lagoon compared to groundwater elevations as measured at the 'CAWD dewater well', adjacent to the CAWD Water Treatment Facility, Carmel, California. Graph shows data (approximately monthly) for 2003 to 2012. There is considerable scatter at lower lagoon water elevations, but the data converge toward a near one-to-one correlation at high lagoon water elevations.

© 2016 Balance Hydrologics, Inc.



a. Simplified conceptual model of real system



b. Modeled representation or real system

(adapted from Ferris and others, 1962)

Figure 4. Simplified conceptual model of groundwater condtions near CAWD (a), and hydrogeologic representation for calculation purposes (b).

© 2016 Balance Hydrologics, Inc.

Memo

To: Josh Harwayne, Denise Duffy & Associates, Inc.

From: Eric Riedner, P.E. and Edward Ballman, P.E.

Date: August 7, 2015

Subject: DRAFT Summary of Estimated Interior Side Hydrologic Conditions, EPB Project, County of Monterey

The following memo summarizes the anticipated hydrologic conditions that would result after implementation of the proposed Ecosystem Protective Barrier Project (EPB). Our focus is on identifying the various factors that influence water levels on the interior side of the barrier, estimating the likely range of ponding depths, and qualitatively assessing potential water-quality impacts. Anticipated hydrologic conditions are characterized for both the winter rainy season and summer dry season.

Winter Rainy Season

During the rainy season both surface and shallow groundwater flows from the upland drainage area would be the primary contributor to ponding along the interior side of the EPB. These inflows would pond behind the EPB until discharged to the lagoon by seepage under the barrier, through culverts located along the barrier, and/or by pumping. Variability in the rate of seepage under the barrier would largely be a function of water levels in the lagoon which vary significantly during the winter months. Similarly, flow released through the culverts that penetrate the barrier would be controlled by flap gates that remain closed during periods of relatively high water levels in the lagoon. Pumps would be used to control the depth of ponding landward of the EPB during moderate to large storm events or during times of elevated stages in the lagoon.

Ponding depths during the winter months are anticipated to be variable and dependent on both the frequency and magnitude of storm events as well as the stage in the lagoon. During wetter than average years it is possible that water levels landward of the EPB remain at or slightly above the proposed culvert invert and pump trigger elevation of 10.5 feet[1] over extended periods of time (i.e. weeks or months). During periods of drought ponding depths would be comparable to dry season conditions described below and it would be possible for the water level to recede below elevation 7 feet, leaving the area interior of the EBP completely dry for short periods of time (i.e. days or weeks). Peak water elevations landward of the EPB could potentially reach as high as 13 feet (NAVD-88) during large storm events, but would be drawn down rapidly (i.e. hours) due to pumping.

Relative to existing conditions the EPB would slow the rate of flow towards the lagoon and potentially concentrate pollutants in areas subject to frequent ponding along the barrier. This potential impact could be mitigated through a range of water-quality treatment BMPs (e.g.

[1] All elevations in this memo are referenced to NAVD-88.

bioretention basins, vegetated swales, etc.) sited at the ends of the roads that route surface runoff towards the lagoon. With proper mitigation measures, overall pollutant loadings to the lagoon environment would be markedly reduced from existing conditions.

Summer Dry Season

During the dry season, groundwater would be the primary source of inflow to the inside of the EPB, with the groundwater gradient generally conveying flows towards the lagoon. However, a relatively rapid rise in lagoon stage during the summer months would have the potential to block seepage flows from upland areas or even reverse the direction of the groundwater flow from the lagoon toward the landward side of the EPB.

Water levels on the interior side of the EPB are anticipated to track very closely to water levels in the lagoon with a head differential expected to be less than one foot during periods of relatively static water surface elevations. A review of the MPWMD lagoon stage data indicates that water levels in the lagoon most frequently range between 5 and 9 feet during the summer months. This compares to a low elevation of 7 feet along the EPB that could remain inundated or desiccated for extended periods of time (i.e. weeks or months) dependent on conditions in the lagoon. Lagoon levels occasionally rise above 9 feet during the summer months, in which case water levels landward of the EPB could be expected to occasionally rise as high as the pump trigger elevation of 10.5 feet.

Dry season discharges to the landward side of the EPB would predominantly consist of shallow groundwater inflow that would pose minimal risk of contributing pollutants into the system.

Closing

In summary, during the rainy season, the proposed EPB project is anticipated to result in somewhat high water elevations on the landward side of the barrier relative to existing conditions. During the dry season, hydrologic conditions are expected to be comparable to existing, with water elevations generally well below the pump trigger elevation of 10.5 feet. Potential impacts of pollutant loadings to the area landward of the barrier are limited to winter stormwater runoff that can be readily mitigated through water quality treatment BMPs.

Carmel Area Wastewater District

P.O. Box 221428 Carmel California 93922 ❖ (831) 624-1248 ❖ FAX (831) 624-0811

Barbara Buikema
General Manager
Edward Waggoner
Operations Superintendent
Robert R. Wellington
Legal Counsel

RECEIVED
AUG 19 2016
MONTEREY COUNTY
PLANNING

Board of Directors
Gregory D'Ambrosio
Michael K. Rachel
Robert Siegfried
Charlotte F. Townsend
Ken White

August 17, 2016

Ms. Melanie Beretti
Monterey County Resource
Management Agency
168 W. Alisal, 2nd Floor
Salinas, CA 93901

Dear Ms. Beretti:

Thank you, Melanie, for meeting with us last Friday, August 12, 2016. Prior to the meeting, you had provided us with a draft analysis of what the County called "Impact HYD-6" and proposed "Mitigation Measure HYD-6." The County's proposed measure HYD-6 would place numerous burdens on CAWD, including the determination of necessary infrastructure to mitigate impacts of flooding and seepage, and the proposed operation and funding of de-watering the CAWD facility in perpetuity.

This letter confirms CAWD's statement at that meeting that CAWD does not accept the proposed mitigation HYD-6. CAWD cannot accept a mitigation that would place burdens on CAWD to mitigate the flood and seepage impacts of the County's project.

CAWD is best positioned to provide information on the conditions at the CAWD facility. Based on our data we believe there is no question that the County's proposed EPB would cause flooding at CAWD.

At the meeting, the County provided a draft report from Balance Hydrologics dated June 23, 2016. We have looked briefly at the draft report. CAWD's position is that the analysis is inadequate and flawed in material ways. At a minimum, CAWD should have been consulted during the analysis. CAWD has not heard from the County on any substantive issues related to the EPB for more than a year.

The County's documentation continues to refer to a levee surrounding the CAWD facility. We have repeatedly rebutted that claim. There is no levee

surrounding our facility. There is a roadway that runs the perimeter of the facility. It is not a certified levee. There is a levee on State Parks property. However, the CAWD treatment plant is on the wrong side of that levee for it to provide any protection from flooding.

CAWD again offers to work with the County on these issues. Feel free to contact me to set up a meeting at which CAWD can provide current information to the County's technical advisers.

Regards

B. Buikema

B. Buikema
General Manager

cc: Carl Holm, Mo. County RMA



CARMEL LAGOON INTERIM EPB ON-PROPERTY LINE DRAINAGE ANALYSIS

Prepared for:

Denise Duffy and Associates
947 Cass Street, Suite 5
Monterey, California 93940

Prepared by:

Balance Hydrologics

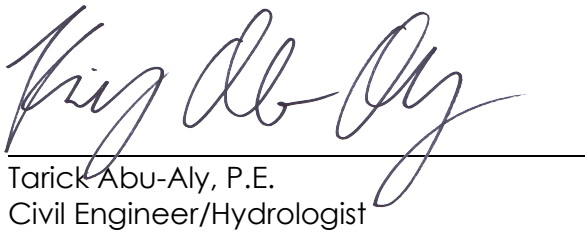
April 2023

April 14, 2023

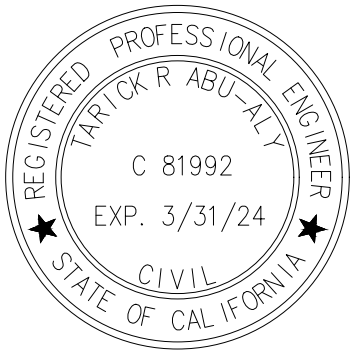
A REPORT PREPARED FOR:

Denise Duffy and Associates, Inc.
947 Cass Street, Suite 5
Monterey, California 93940
(831) 373-4341

by



Tarick Abu-Aly, P.E.
Civil Engineer/Hydrologist



Balance Hydrologics

© 2023 Balance Hydrologics, Inc.
Project Assignment: 212151 Phase 2

800 Bancroft Way, Suite 101 ~ Berkeley, California 94710-2251 ~ (510) 704-1000 ~ office@balancehydro.com

< This page intentionally left blank >

TABLE OF CONTENTS

1 INTRODUCTION 1

2 SETTING 6

2.1 Carmel Lagoon Environs 6

2.2 Climate 7

2.3 FEMA Mapping 7

2.4 Soils and Geology 9

3 FLOOD FREQUENCY ANALYSIS 10

4 TOPOGRAPHIC ANALYSIS 14

4.1 Wall Alignment 14

4.2 Fourth Addition Neighborhood 18

5 2D RAIN-ON-GRID MODELING 21

5.1 Modeling Overview 21

5.2 Hydrologic Parameters 21

5.2.1 Rainfall 21

5.2.2 Land Use 23

5.3 Hydraulic Parameters 23

5.3.1 Model Topography and Roughness 23

5.3.2 2D Model Mesh Parameterization 24

5.3.3 Boundary Conditions 25

5.3.4 Model Run Matrix 26

5.4 Modeling Assumptions 26

6 SEEPAGE FLOW ANALAYSIS 27

6.1 Sandbag Wall 28

6.2 Garden Wall 29

7 MODEL RESULTS 31

7.1 Hydraulic Modeling 31

7.2 Seepage Flow Analysis 36

8 DISCUSSION 37

8.1 Lagoon Flooding 37

8.2 Stormwater Runoff 37

8.3 Level of Flood Protection 38

8.4 Seepage *39*

9 CONCLUSIONS **40**

10 LIMITATIONS **41**

11 REFERENCES **42**

LIST OF TABLES

Table 2-1	NOAA Atlas 14 point precipitation frequency estimates.	7
Table 2-2	Carmel lagoon stage frequency analysis from NHC (2006).	9
Table 3-1	Carmel lagoon annual peak water levels by water year (MPWMD, 2023).	10
Table 3-2	Revised flood frequency analysis comparison.	12
Table 4-1	Minimum LAG by street	19
Table 5-1	Land use parameters used in the rain-on-grid model.	23
Table 5-2	Model run matrix.	26

LIST OF PHOTOS

Photo 1-1	Temporary sandbag barrier along Carmel Lagoon.	2
Photo 1-2	Typical CMU block wall shown in white on left side of image.	3

LIST OF FIGURES

Figure 1-1	Study area overview. The Garden Wall alignment is shown in red. The orange and purple lines represent the EPB proposed project from the DEIR.	4
Figure 2-1	FEMA flood insurance rate map of the project area.	8
Figure 3-1	Carmel Lagoon monthly peak water levels (MPWMD, 2023).	11
Figure 3-2	Computed annual probabilities for lagoon water levels based on the revised Bulletin 17C analysis.	12
Figure 4-1	Plan view of proposed Garden Wall alignment. Source: Whitson Engineers.	14
Figure 4-2	Garden Wall profile. Source: Whitson Engineers.	15
Figure 4-3	Potential flow path around Western Garden Wall terminus. Looking south on Camino Real towards the lagoon.	16
Figure 4-4	Potential flow path around eastern Garden Wall terminus. Looking southeast on Monte Verde towards the lagoon.	17
Figure 4-5	Potential flanking around intersection of Monte Verde Street and 16th Avenue.	18
Figure 4-6	Topography of the Fourth Addition. Source: 2018 LiDAR.	19
Figure 5-1	SCS Type 1 synthetic rainfall distribution.	22
Figure 5-2	2D model domain.	25
Figure 6-1	Sandbag barrier flow net. Streamlines are shown in blue and equipotential lines shown in black.	29
Figure 6-2	Garden Wall flow net. Streamlines are shown in blue and equipotential lines shown in black. The buried footing decreases the number of flow channels and increases the number of equipotential drops.	30

Figure 7-1 Comparison of maximum flood depth for the 2-year rainfall event (left) and the 100-year rainfall event (right) for the 13 feet lagoon WSE scenario. 31
Figure 7-2 Comparison of maximum flood depth for the 10-year rainfall event with a lagoon WSE of 13 feet (left) and a lagoon WSE of 15 feet (right). The maximum inundation extent is significantly larger with the higher lagoon WSE. 32
Figure 7-3 Monte Verde and Camino Real WSE time series for all design storms with a lagoon WSE of 13 feet. 33
Figure 7-4 Monte Verde and Camino Real WSE time series for all design storms with a lagoon WSE of 14 feet. 34
Figure 7-5 Monte Verde and Camino Real WSE time series for all design storms with a lagoon WSE of 15 feet. 35

APPENDICES

Appendix A Web Soil Survey Report

1 INTRODUCTION

The Carmel Lagoon Ecosystem Protective Barrier (EPB), Scenic Road Protection Structure (SRPS), and Interim Sandbar Management Plan (ISMP) Project (Project) is a regional flood protection project with a goal of maintaining the existing level of flood protection for low-lying homes and public infrastructure along the lagoon while the frequency of mechanical management of the sandbar is reduced in compliance with regulatory requirements (DDA, 2016). Flooding sources along the lagoon include riverine flooding from the Carmel River, large ocean swells, and stormwater runoff. Current Monterey County (County) management activities to reduce potential flood impacts from rising lagoon levels include mechanical management of the sandbar and the seasonal construction of a sandbag barrier along the property lines of homes and three street ends (Camino Real, River Park Place, and Monte Verde Street) adjacent to the lagoon (**Photo 1-1**).



Photo 1-1 **Temporary sandbag barrier along Carmel Lagoon**.
Photo looking south along Monte Verde Street into the lagoon. Two culverts can be seen on the left and right side of the image. A portable pump is stationed in the center. Photo taken on December 5, 2022.

The proposed EPB project component (proposed project) would maintain existing flood protection for low-lying homes and infrastructure along the northern edge of the lagoon through construction of a barrier along the northern edge of the lagoon. Several alternative concepts for the EPB were analyzed in the Draft Environmental Impact Report (DEIR) for the project including realigning the EPB near the property line and constructing a variable height EPB (DDA, 2016). At this time, the County and its project partners are interested in analyzing the feasibility of an interim flood protection solution to include in the DEIR, while the other EPB alternatives are being considered. The Interim EPB on Property Line Alternative, alternatively referred to herein as the "Garden Wall" alternative, would involve the construction of a low-height concrete masonry unit (CMU) block wall along the property line of four properties that border the lagoon (an example of the type of proposed wall can be seen in **Photo 1-2**). The Garden Wall would be

constructed along the same alignment as the temporary sandbag barrier, in effect replacing the sandbag barrier with a more permanent piece of infrastructure. Sandbags would still be placed seasonally within the County right-of-way at the three street ends that abut the lagoon. The top of the Garden Wall would be set at elevation 16 feet[1] (the current 100-year FEMA Base Flood Elevation).



Photo 1-2 Typical CMU block wall shown in white on left side of image. Carmel lagoon on the right.

The primary purpose of this technical study is to evaluate the level of flood protection achieved by the Garden Wall alternative. Flood protection provided by the Garden Wall will primarily benefit the Fourth Addition Neighborhood, which is located immediately north of the lagoon and has a history of flooding. The Fourth Addition encompasses an area bordered by Carmel Lagoon to the south, 16th Avenue to the north, and includes

[1] Unless otherwise noted, all elevations referred to in this report are relative to the North American Vertical Datum of 1988 (NAVD 88).

homes along Camino Real, River Park Place, and Monte Verde Street. An overview of the study area can be seen in **Figure 1-1**.

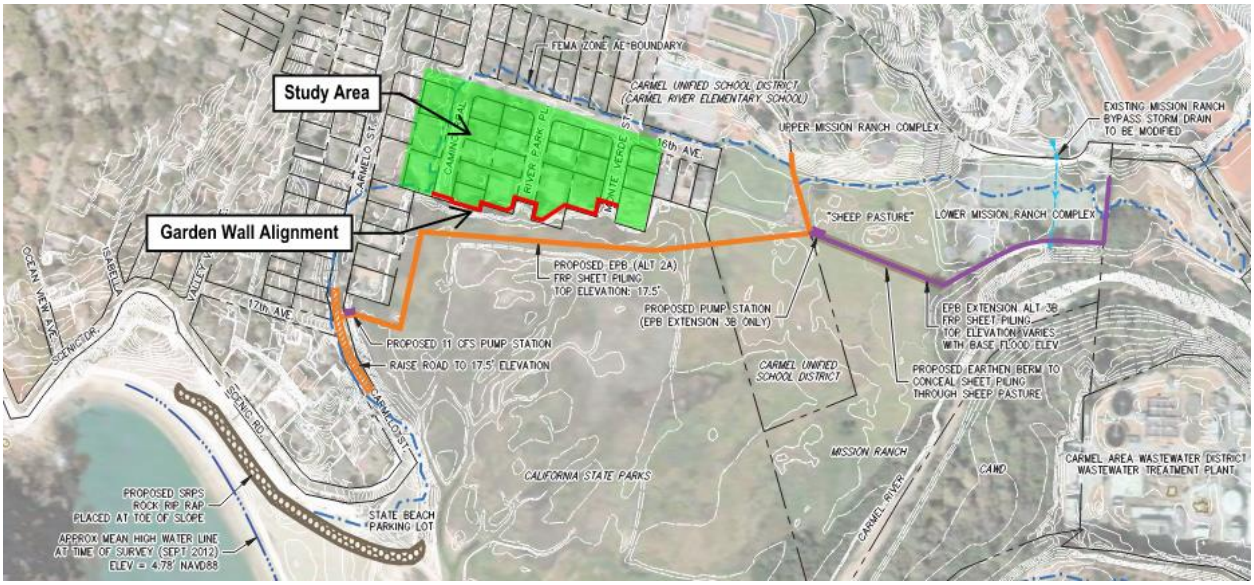


Figure 1-1 **Study area overview.** The Garden Wall alignment is shown in red. The orange and purple lines represent the EPB proposed project from the DEIR.

Flood risks for the Fourth Addition neighborhood can be separated into two main sources: flooding due to rising lagoon levels and flooding due to stormwater runoff that builds up behind the temporary sandbag barrier and cannot drain to the lagoon. The sandbag barrier includes culverts to gravity drain stormwater runoff when lagoon levels are low, however, when lagoon levels are high, gravity drainage is not possible. To address this, the County provides portable pumps at the end of each cul-de-sac as can be seen in **Photo 1-1**.

The modeling presented herein is intended to estimate the extent and recurrence of flooding due to stormwater runoff, rising lagoon stage, and a combination of those two factors with the Garden Wall in place. The primary analysis tool used in this study was the US Army Corps of Engineers HEC-RAS software (Version 6.3.1). The model was developed using the two-dimensional (2D) rain-on-grid function within HEC-RAS, which allowed for detailed 2D modeling of rising lagoon stage and rainfall simultaneously. Additionally, it has been speculated that seepage under the sandbag barrier may be a cause of flooding in the Fourth Addition, and this report investigates that concern as it relates to

the Garden Wall. This report is focused on the Garden Wall alternative only and did not analyze the proposed project or any of the existing DEIR alternatives.

2 SETTING

2.1 Carmel Lagoon Environs

The Carmel River watershed has large variations in seasonal and yearly discharge rates, brought about in large part by its coastal California geographic location within a Mediterranean climate zone, as well as by the size, vertical extent, geology, and geomorphic structure of the watershed. Carmel Lagoon, located at the bottom of the watershed, serves as an ecological interface zone between the watershed and the ocean. The seasonal nature of precipitation plays a large role in controlling the dynamics of the lagoon. The lagoon is generally not connected to the ocean during times of very low or zero streamflow, when ocean waves build a barrier beach (sand bar) across the mouth of the lagoon and close the outflow channel. When river inflow is relatively low and the lagoon is not open to the ocean, a dynamic equilibrium is reached between streamflow and groundwater inflows, outflow through the barrier beach, evapotranspiration, and ocean wave overtopping (Ballman and Senter, 2014). As streamflow increases in the fall and early winter, lagoon water surface elevations (WSEs) increase, building up hydrostatic pressure until the structural integrity of the sand bar fails and the river mouth breaches to the ocean. The breach may open and close intermittently throughout the winter as flows fluctuate. Typically, without intervention, moderate river flows are sufficient to breach the sandbar and keep the river mouth open, however, occasionally, antecedent ocean conditions can enlarge the sandbar and make it resistant to breaching. In this scenario, rapid increases in lagoon WSE are possible from rising river flows and/or large wave events that can result in flooding of homes and infrastructure along the northern lagoon boundary before the sand bar will breach naturally.

In response to this flooding scenario, since at least the early 20th century, the sand bar has been mechanically managed (breached) in order to lower WSEs to below flood stage. Since 1973, emergency sand bar management has been carried out by the County of Monterey (County), Monterey County Water Resources Agency (MCWRA), and State Parks (Whitson, 2013). On average in recent years, at least one artificial breach has occurred yearly, with as many as three or four management breaching actions occurring in some years. When the annual rainy season ends and the sand bar may have not yet closed off naturally, the decision may be made to mechanically close the sand bar before streamflows subside entirely, in order to maximize the volume of water in the lagoon for the dry season. This practice seeks to mitigate early-season artificial breaches that opened the lagoon and promoted deeper, wider outflow channels than might otherwise have formed. Beginning in 2011, the County began managing a natural

breach, by carving a pilot channel with sand plug, in consultation with regulatory agencies (Whitson, 2013).

2.2 Climate

The climate at the site can be characterized as Mediterranean, with cool, wet winters and hot, dry summers typical of central California coastal regions. The mean annual precipitation (MAP) at the site is 24 inches (MCWRA, 1997). Rainfall totals for a 24-hour storm recurrence, as estimated by NOAA Atlas 14, are listed in **Table 2-1**.

Table 2-1 NOAA Atlas 14 point precipitation frequency estimates.

Recurrence Interval, Duration	Precipitation Estimate (inches)
2-year, 24-hour	1.84
10-year, 24-hour	2.38
100-year, 24-hour	4.65

2.3 FEMA Mapping

The study area is located within the mapped flooding extent of the Carmel River. The Flood Insurance Rate Map (FIRM) for the study area is shown below in **Figure 2-1**. The area encompasses Special Flood Hazard Areas (SFHAs) classified as Zone AE (100-year floodplain with mapped Base Flood Elevations) and shaded Zone X (500-year floodplain).

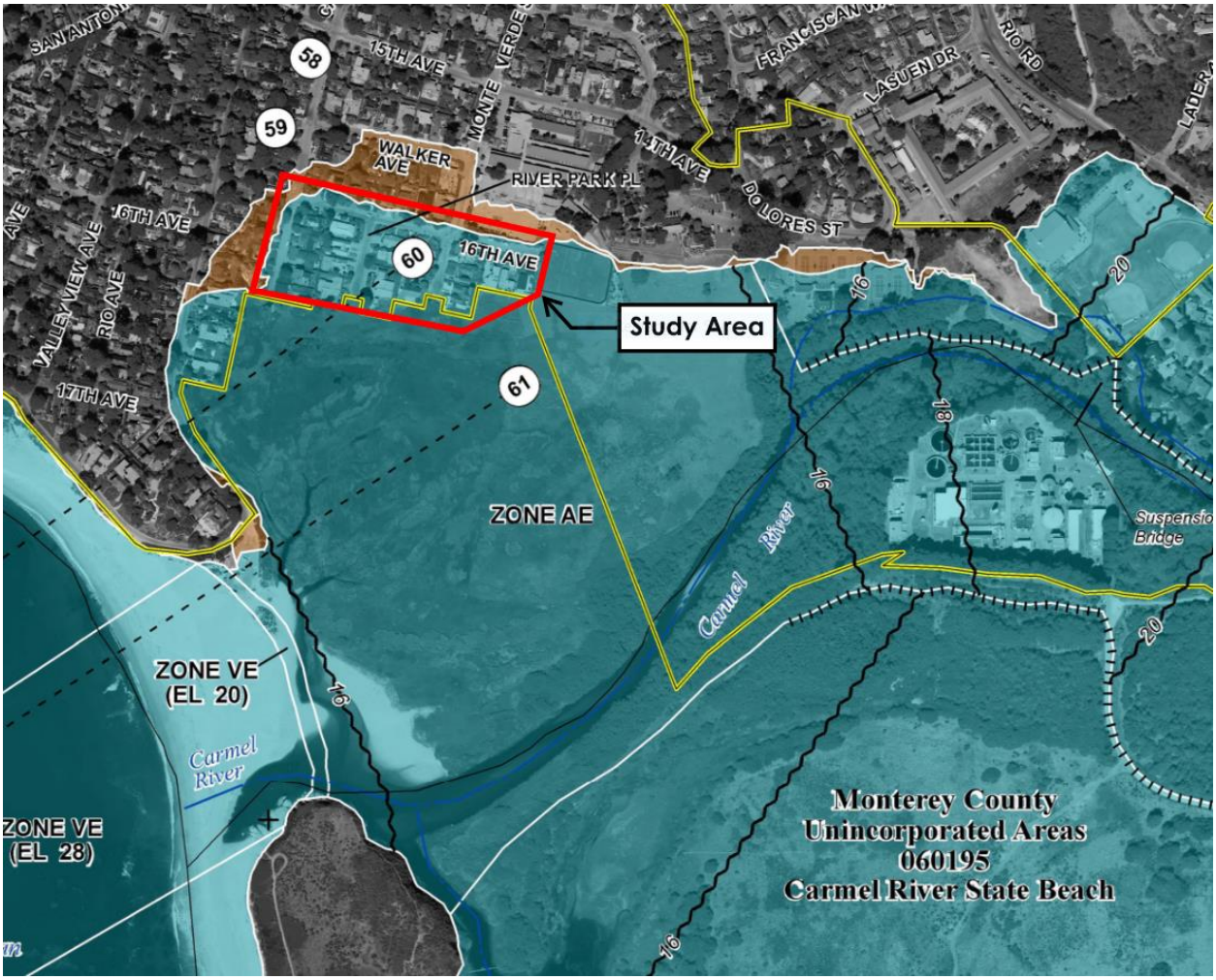


Figure 2-1 FEMA flood insurance rate map of the project area.

The Fourth Addition neighborhood has a mapped Base Flood Elevation (BFE) of 16 feet NAVD 88. The SFHA boundaries, BFEs, and water surface profiles in the currently effective Flood Insurance Study (FIS) were based on hydraulic modeling completed in 2006 during a restudy of the Carmel River (NHC, 2006). In NHC (2006) lagoon flood elevations and recurrence intervals were separated from those of the Carmel River because lagoon flooding is dependent on many different factors not necessarily related to Carmel River flow. To estimate BFEs for the lagoon, a statistical analysis of lagoon stage[2] was performed. The lagoon flood elevations derived from statistical analysis were compared to the results of the hydraulic modeling of the Carmel River and the higher of the two values for each annual exceedance probability was used as the published BFE (**Table**

[2] The effective BFEs for the lagoon were based on water level data collected by the Monterey Peninsula Water Management District (MPWMD) for the period 1992-2005. A total of 13 years.

2-2). Note that the decision to map the lagoon 100-year BFEs at elevation 16 feet appears to be a conservative choice, possibly to account for the uncertainty in the relatively brief period of available data.

Table 2-2 Carmel lagoon stage frequency analysis from NHC (2006).

Annual Exceedance Probability (Recurrence Interval)	FFA of Lagoon WSE[1] (feet)	HEC-RAS Model Normal Depth Calculation	
		River Discharge (cfs)	WSE[1] (feet)
0.2 (500-year)	16.2	32,600	16.4
1 (100-year)	15.4	22,700	14.7
2 (50-year)	15.0	18,500	13.8
10 (10-year)	14.1	9,500	10.6

1. Datum conversion from NGVD 29 to NAVD 88 is +2.82 feet
2. Values highlighted in gray are the FEMA published flood elevations

2.4 Soils and Geology

The soils underlying the project area and the contributing watershed to the north of the Fourth Addition are mainly comprised of two soil types: Oceano loamy sand and Gorgonio sandy loam, both of which are characterized as Hydrologic Soil Group (HSG) A; this designation applies to soils that have low runoff potential when thoroughly wet, saturated hydraulic conductivities that exceed 5.67 inches per hour, and sufficient depths to groundwater or impermeable layers such that infiltration is likely (NHC, 2006).

Moving to the south, beneath the alignment of the Garden Wall and within the lagoon itself, the soil types transition to Aquic Xerofluvents and Alviso Soils, which are classified as HSG C/D with limited infiltration capacity and high runoff potential. The Web Soil Survey report from NRCS is included as **Appendix A**.

3 FLOOD FREQUENCY ANALYSIS

As stated in Section 2.3, the existing FEMA flood elevations for the 10-year, 50-year, and 100-year recurrence events are based on a statistical analysis of lagoon stage records for the period 1992 to 2005 (13 years). Since the 2006 FEMA analysis, an additional 17 years of lagoon stage data was collected by the Monterey Peninsula Water Management District (MPWMD), resulting in over 30 years of lagoon stage data. The annual peak lagoon water levels for each Water Year (WY) are shown in **Table 3-1**.

Table 3-1 Carmel lagoon annual peak water levels by water year (MPWMD, 2023).

Water Year	Time of Occurrence (Month/Calendar Year)	Water Levels (NAVD 88)	Water Year	Time of Occurrence (Month/Calendar Year)	Water Levels (NAVD 88)
1992	Feb 92	11.8	2008	Jan 08	15.5
1993	Feb 93	12.8	2009	Feb 09	13.1
1994	Mar 94	12.2	2010	Oct 09	13.3
1995	Jan 95	11.7	2011	Dec 10	12.8
1996	Apr 96	12.6	2012	Feb 12	13.1
1997	Dec 96	12.5	2013	Dec 12	14.0
1998	Dec 97	13.3	2014	Mar 14	8.4
1999	Jan 99	12.8	2015	Feb 15	13.3
2000	Jan 00	14.1	2016	Jan 16	13.8
2001	Jan 01	14.8	2017	Dec 16	14.1
2002	Dec 01	13.6	2018	Jan 18	13.4
2003	Dec 02	13.6	2019	Jan 19	13.7
2004	Dec 03	13.3	2020	Dec 19	15.1
2005	Dec 04	13.1	2021	Jan 21	15.7
2006	Feb 06	12.9	2022	Dec 21	13.5
2007	Apr 07	12.3			

The data in **Table 3-1** shows that in the past 30 years, a peak stage of 13 feet was exceeded 20 times (66% of years), a peak lagoon stage of 14 feet was exceeded 7 times (23% of years), and a peak stage of 15 feet was exceeded 3 times (10% of years). Monthly peak water levels are shown in **Figure 3-1**.

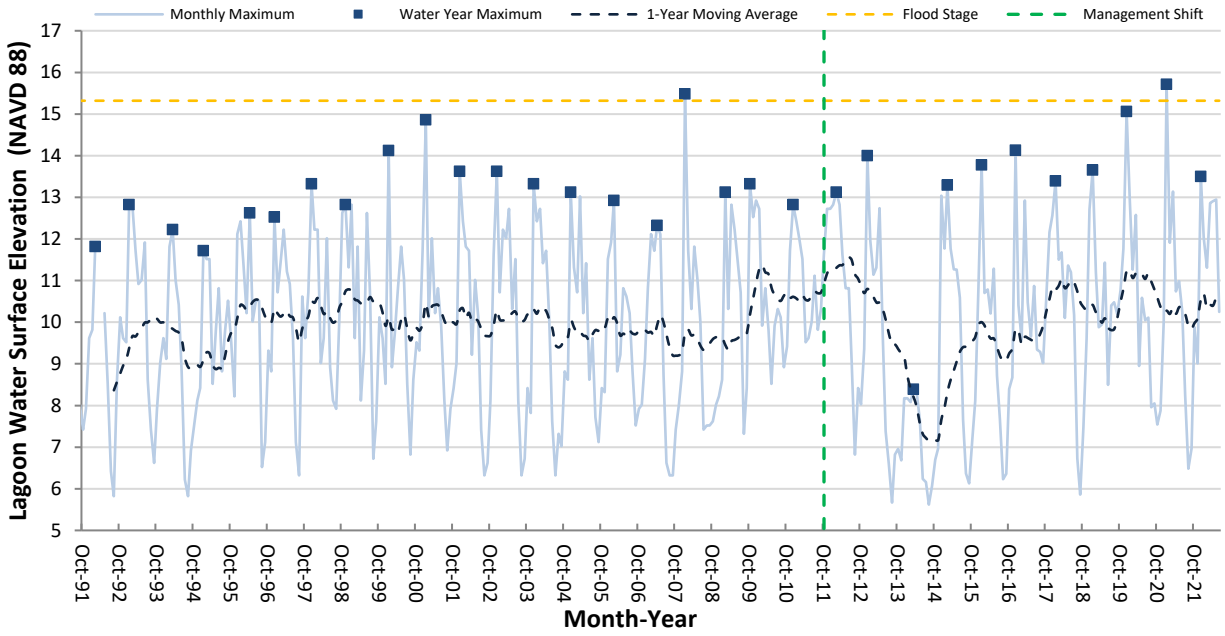


Figure 3-1 Carmel Lagoon monthly peak water levels (MPWMD, 2023).

The data in **Figure 3-1** shows a seasonal pattern of high and low lagoon levels, with peak WSEs occasionally exceeding flood stage[3]. These flood events occur when the sand bar closing the river mouth does not breach as expected and rapid rises in WSE are possible before breaching occurs. Unusually low lagoon levels were recorded in WY 2014. Examination of a 12-month moving average of lagoon WSEs showed a trend towards overall higher lagoon levels in the more contemporary period, with a peak WSE of 15 feet exceeded twice in the past three water years.

To account for the additional 17 years of stage data collected since the 2006 FEMA study, a flood frequency analysis was rerun on the full 30-year record (WY 1992 to 2022) using the US Army Corps of Engineers' HEC-SSP software, following the Bulletin 17C guidelines outlined in USGS (2019). Although this method is typically used to estimate peak flow recurrence, the statistical equations are applicable to a continuous record of stage as well. The analysis considers the singular peak WSE event in the lagoon for each water year and calculates the annual probability of exceedance. The results of the statistical analysis are shown in **Table 3-2** and a plot of the computed probability curve is shown in **Figure 3-2.**

[3] Flood stage is defined by the National Weather Service as elevation 15.3 feet (NAVD 88 datum).

Table 3-2 Revised flood frequency analysis comparison.

Annual Exceedance Probability (% Chance-Return Period)	FEMA Published BFEs (2006) (feet)	Revised BFEs (2023) (feet)	Difference (feet)
0.2 (500-year)	16.4	16.9	+0.5
1 (100-year)	15.4	16.1	+0.7
2 (50-year)	15.0	15.7	+0.7
5 (20-year)	--	15.1	--
10 (10-year)	14.1	14.7	+0.6
20 (5-year)	--	14.2	--
50 (2-year)	--	13.3	--

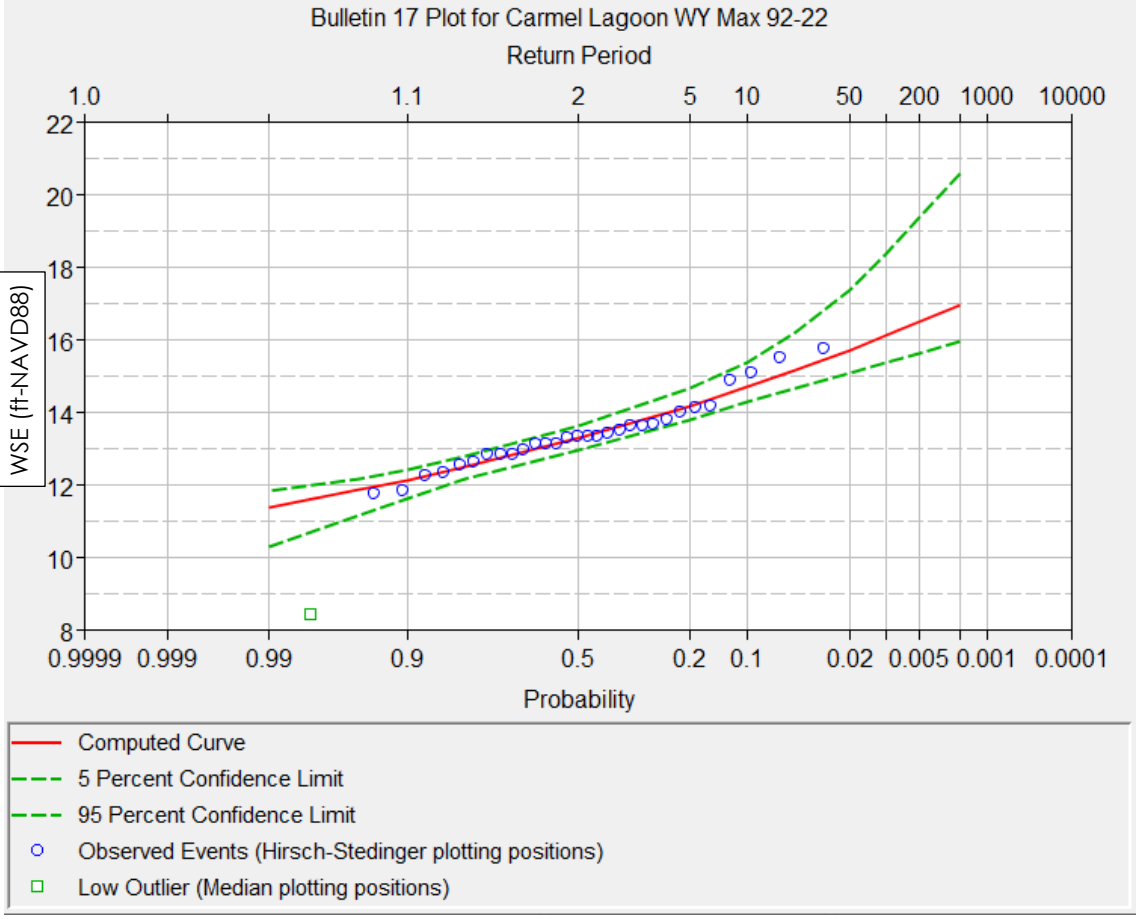


Figure 3-2 Computed annual probabilities for lagoon water levels based on the revised Bulletin 17C analysis.

Table 3-2 shows that the additional 17 years of data results in an overall increase in peak WSEs for each recurrence interval, compared with those estimated by FEMA in 2006. This can potentially be explained by the overall trend of higher peak lagoon levels in the recent decade. However, several sources of uncertainty remain when discussing the statistical probability of any one lagoon elevation being exceeded each year, such as:

1. The data is divided into two distinct periods with different sandbar management protocols before and after 2011 which may affect the statistical analysis.
2. The 30-years of data include sandbar management actions in one form or another. Therefore, the data does not reflect what WSEs are possible with a natural, unmanaged sandbar.
3. The peak WSE in the lagoon is controlled by the elevation of beach sand at the river mouth, which is the result of a complex combination of oceanic and riverine processes that may not necessarily follow a statistical trend.

Nevertheless, the record provides a robust dataset of 30-years of lagoon stage data that encompasses a range of climactic, oceanic, and riverine conditions. Additionally, this revised analysis followed the same procedure used in developing the FEMA BFEs in NHC (2006). The updated flood elevations and recurrence intervals in **Table 3-2** were used when assessing the level of flood protection gained by the Garden Wall as described in subsequent sections.

4 TOPOGRAPHIC ANALYSIS

The topographic data for this technical analysis was based on LiDAR data collected by the USGS for Monterey County in 2018. This data was supplemented by an aerial topographic map developed by Whitson Engineers in 2012. The topographic data was used as a primary input to the 2D model. An analysis of the existing topography as it relates to the Garden Wall is summarized below.

4.1 Wall Alignment

The Garden Wall alignment, shown below in **Figure 1-1**, will match the alignment of the temporary sandbag barrier placed along the property lines. Two permanent sections of CMU block wall will be installed along the four properties that border the lagoon. The temporary sandbag barriers across the cul-de-sacs at the end of Camino Real, River Park Place, and Monte Verde Street would continue to be placed by the County during the wet season, October to April, at this time. When the sandbag barriers are in place, two 11-inch inside diameter culverts with gate valves protrude through each of the sandbag barriers to facilitate stormwater drainage when lagoon levels are low. The gate valves are closed when lagoon levels are high to prevent backflow. It is assumed this practice would continue if the Garden Wall alternative were constructed.



Figure 4-1 Plan view of proposed Garden Wall alignment. Source: Whitson Engineers.

The top of Garden Wall is planned to be at elevation 16 feet. The existing ground elevations along the wall alignment range from 12.7 to 15.5 feet (**Figure 4-2**).

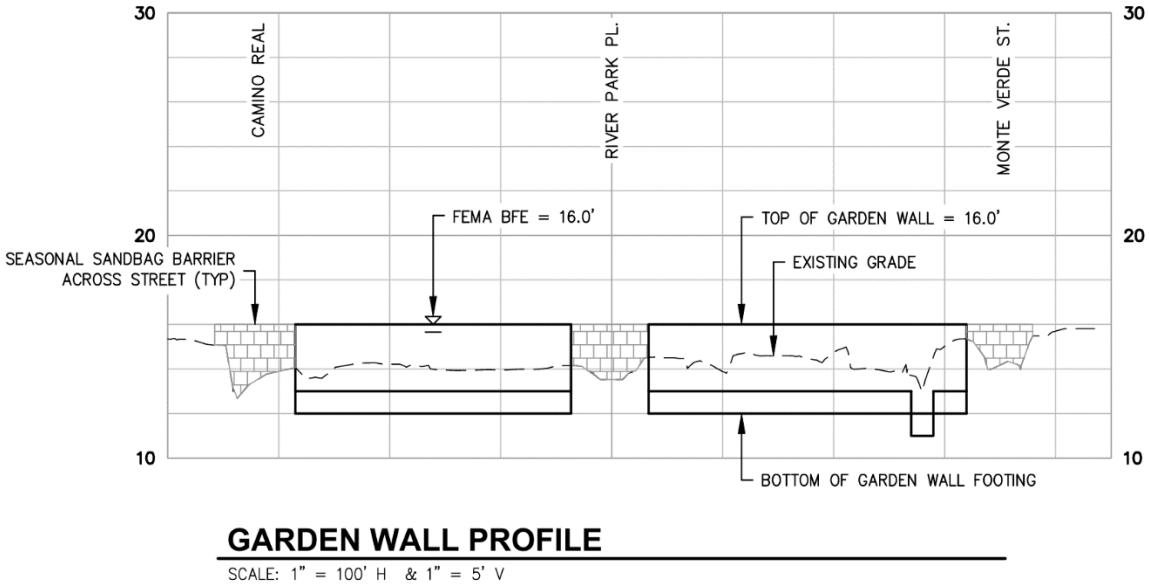


Figure 4-2 Garden Wall profile. Source: Whitson Engineers.

The primary purpose of the Garden Wall is to protect homes and infrastructure from flooding due to rising lagoon levels. Critically, the effectiveness of the wall at holding back flood waters is limited by the minimum elevation along the entire wetted boundary of the lagoon that can be overtopped. The intent behind setting the top of Garden Wall at elevation 16 feet was to protect against lagoon flooding up to the FEMA published 100-year BFE. As can be seen in **Figure 4-2**, the terminal extents of the wall do not tie off to high ground above elevation 16 feet and are therefore susceptible to being outflanked by rising lagoon levels. A detailed analysis of the existing topography resulted in three locations where the Garden Wall can be outflanked at lagoon levels less than 16 feet:

1. At the western end of the proposed Garden Wall alignment, the temporary sandbag barrier ties off to a planted mound in the front yard of 26372 Camino Real. The controlling elevation in this yard is approximately 15.3 feet and the Garden Wall can be outflanked at lagoon levels above this elevation as shown in **Figure 4-3**.

2. At the eastern end of the proposed Garden Wall alignment, the temporary sandbag barrier ties off to a perimeter fence at 26361 Monte Verde Street. Here,

the minimum elevation just east of the perimeter fence is approximately 15.1 feet and a flow path exists between the sandbag barrier and a stone wall (**Figure 4-4**).

3. As lagoon levels increase above elevation 15 feet, the sports field at Carmel River Elementary School and the eastern end of 16th Avenue become inundated. As lagoon levels continue to rise, the intersection of 16th Avenue and Monte Verde Street becomes inundated. An analysis of the existing topography identifies a low point at this intersection of 15.8 feet (**Figure 4-5**). If lagoon levels rise above 15.8 feet, flooding of the Fourth Addition is possible via water entering through the elementary school property to the east.

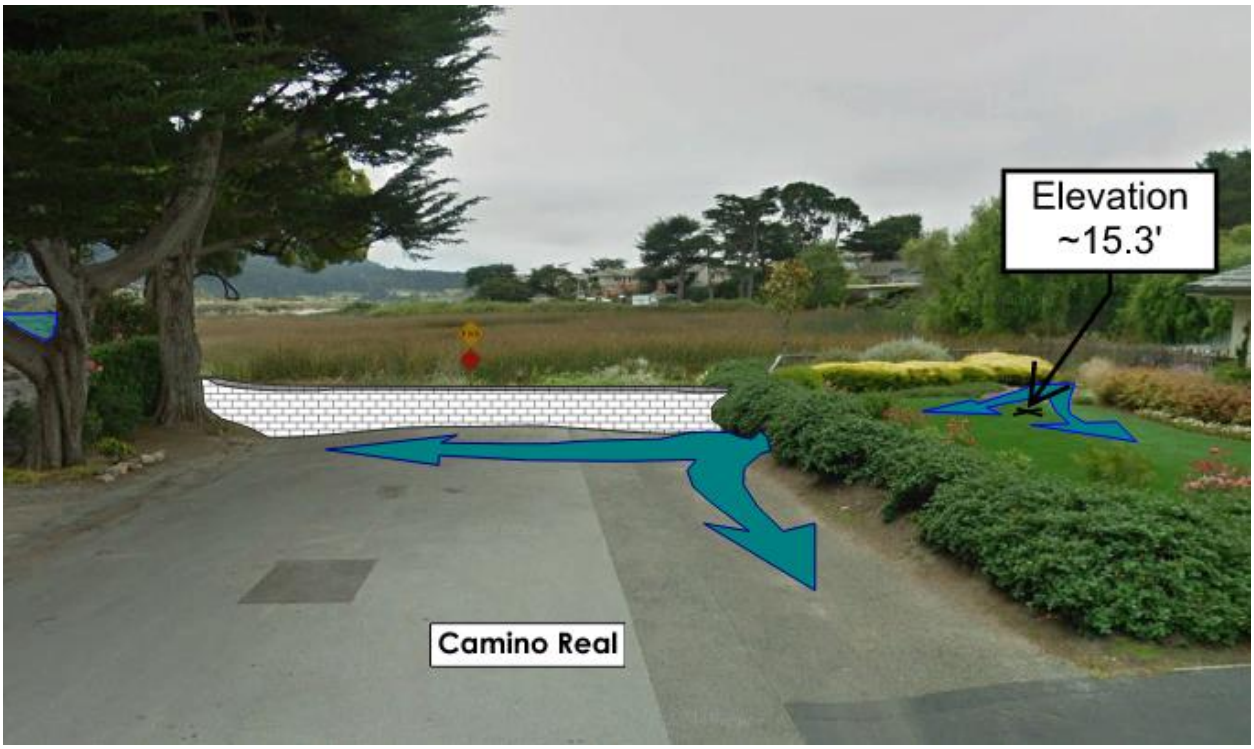


Figure 4-3 Potential flow path around Western Garden Wall terminus. Looking south on Camino Real towards the lagoon.



Figure 4-4 Potential flow path around eastern Garden Wall terminus. Looking southeast on Monte Verde towards the lagoon.

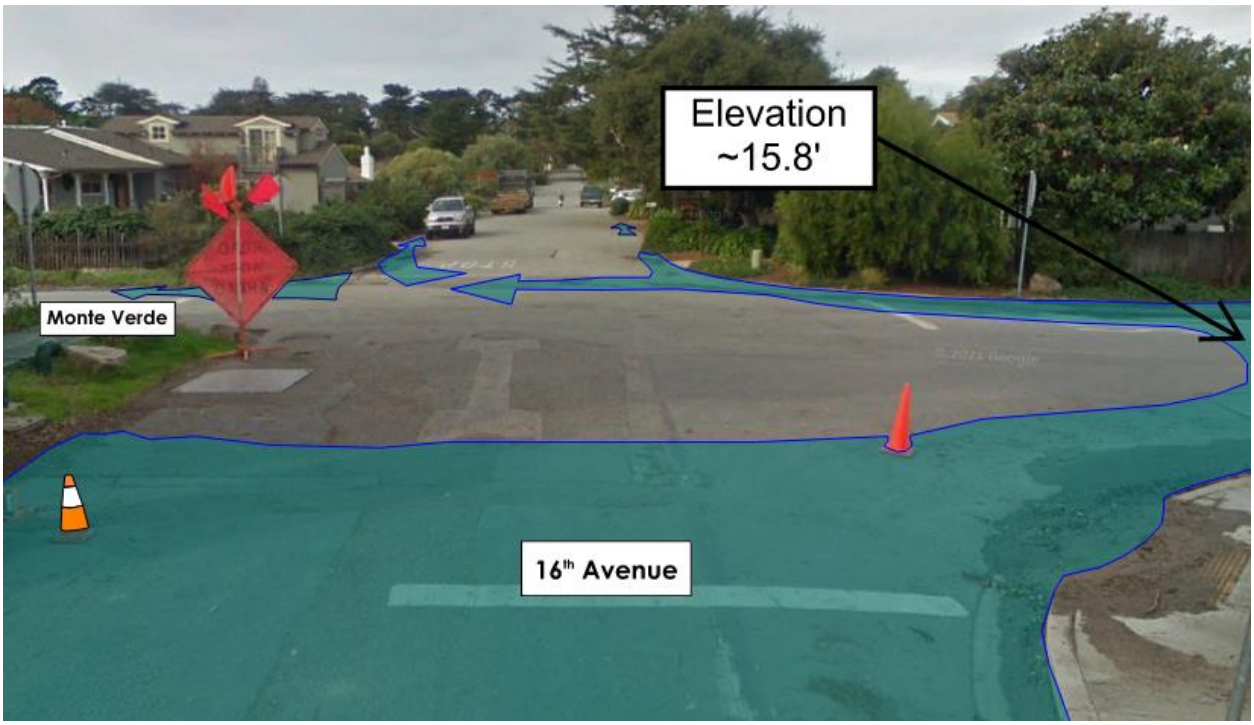


Figure 4-5 Potential flanking around intersection of Monte Verde Street and 16th Avenue, looking west.

The lowest point identified along the Garden Wall alignment was elevation 15.1 feet, just beyond the eastern terminus of the wall. Comparing this elevation to the revised flood frequency analysis in **Section 3**, shows that the wall as currently conceived has a maximum 20-year level of flood protection.

4.2 Fourth Addition Neighborhood

The ground elevations within the Fourth Addition range from just below 13 feet to above 16 feet (see **Figure 4-6**, below). The lowest elevation north of the Garden Wall alignment is elevation 12.8 feet, observed at the end of the cul-de-sac on River Park Place. Within County streets, River Park Place has the lowest elevations on average, while Monte Verde Street has the highest elevations. The lowest elevations within the residential properties occur between Camino Real and River Park Place adjacent to the lagoon.

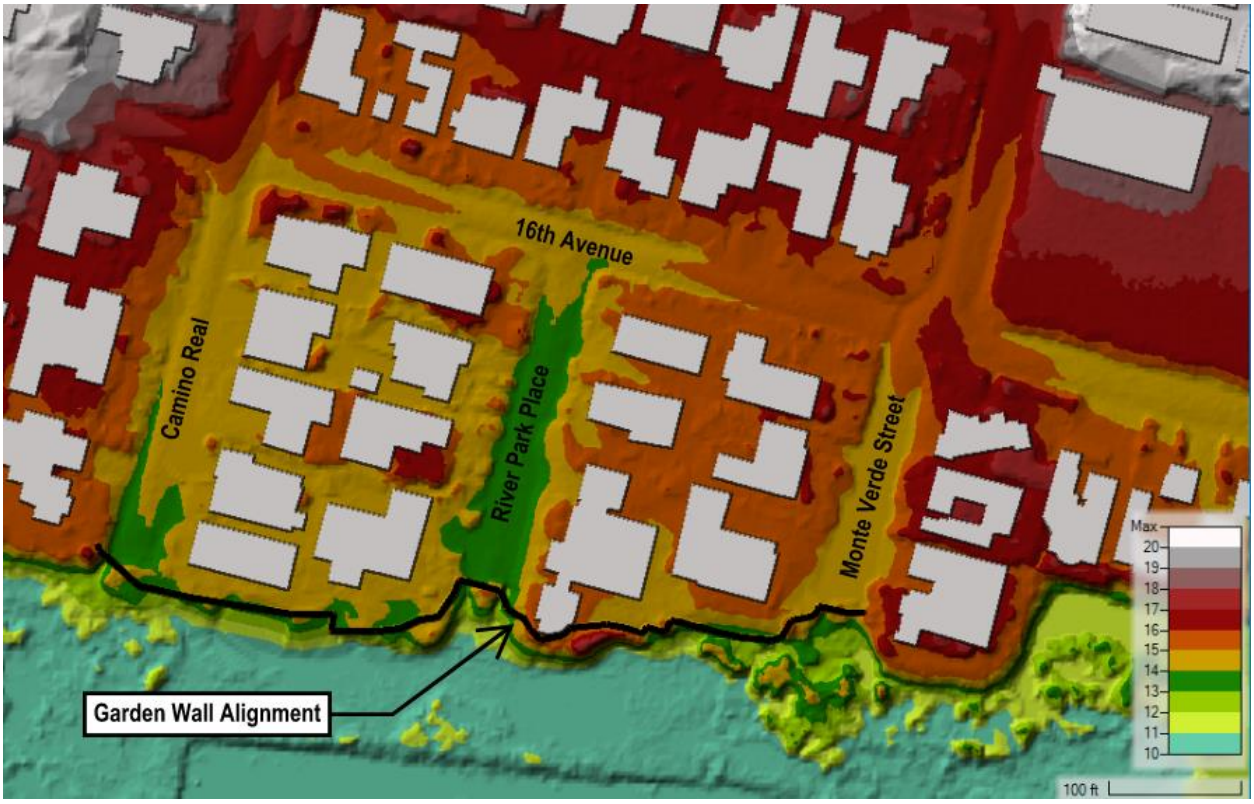


Figure 4-6 Topography of the Fourth Addition. Source: 2018 LiDAR.

Lowest Adjacent Grade (LAG) is defined by FEMA as the elevation of the lowest ground surface that touches any of the exterior walls of a building. In this case, LAG was estimated from the LiDAR data for each property in the study area. Of the roughly 30 residences that fall within the Fourth Addition, the minimum LAG was computed for each street as shown in **Table 4-1**, below.

Table 4-1 Minimum LAG by street

Street	LAG Elevation (feet)
Camino Real	14.1
Monte Verde	14.9
River Park Place	14.2

The minimum LAG was used as a proxy for the flooding threshold in the modeling analysis. For example, if the model predicted a water surface elevation above the minimum LAG on a particular street, then that street was assumed to be "flooded". This flooding definition is specific to this analysis and differs from other definitions of "flood stage". A preferable threshold for flooding would be the First Floor Elevation (FFE) of each residence, defined by FEMA as the elevation of the top of the lowest finished floor in a building. FFE surveys could be conducted at a later date to give further precision to the analysis.

5 2D RAIN-ON-GRID MODELING

5.1 Modeling Overview

The purpose of this 2D hydraulic modeling analysis was to estimate the extent and depth of flooding within the study area under certain scenarios. To allow for a dynamic analysis of both stormwater runoff and lagoon flooding simultaneously, the decision was made to model the system using the U.S. Army Corps of Engineer's HEC-RAS program in rain-on-grid mode. Rain-on-grid allows a user to parameterize a rainfall event within the model space such that precipitation is applied directly to the 2D model domain. The user can apply spatial data to delineate runoff parameters such as infiltration rate and imperviousness. Model predicted runoff can then be routed through the 2D model space simultaneously with traditional riverine flooding sources, such as the Carmel River. Another benefit of rain-on-grid in this application is the fact that the Fourth Addition Neighborhood is not serviced by any storm drain infrastructure; flow from the contributing watershed to the north of the lagoon flows over land to the south until it discharges into the lagoon or ponds within the Fourth Addition.

A total of nine different scenarios were modeled to reasonably bracket flood risk from lagoon flooding, stormwater runoff, and a combination of these two factors. Three different design rainfall events were considered for the runoff calculations: the 2-year, 10-year, and 100-year events. On the lagoon side, three different water surface elevations were considered: elevation 13 feet, elevation 14 feet, and elevation 15 feet. These reflect the 2-year, 5-year, and 20-year events respectively based on the revised flood frequency analysis. Lagoon levels above 15 feet were not considered because topographic analysis showed that flooding would occur regardless of the Garden Wall configuration. Each rainfall event was modeled alongside each lagoon water surface elevation to approximate the magnitude of the effect lagoon tailwater elevation has on stormwater drainage, resulting in a total of nine model runs. The key model input parameters are summarized below.

5.2 Hydrologic Parameters

5.2.1 RAINFALL

The analysis was centered on modeling the extent and depth of flooding during singular rainfall events of varying intensity and different tailwater conditions with the Garden Wall in place. The chosen rainfall events for the model were the 2-year, 10-year, and 100-year events. These design storms were intended to mimic low, moderate, and high levels of precipitation, respectively. To determine the total amount of rainfall for the various

events, 24-hour rainfall depths were obtained from NOAA Atlas 14 Point Precipitation Frequency Estimates, as shown in **Table 2-1**. The total rainfall depth was then distributed over the 24-hours using the SCS Type 1 synthetic rainfall distribution to develop design storms for input into HEC-RAS. The Type 1 storm, developed by the NRCS for use in southern Pacific maritime climates, produces a steeply peaked hyetograph with over 50% of the total rainfall falling by the 10th hour (**Figure 5-1**).

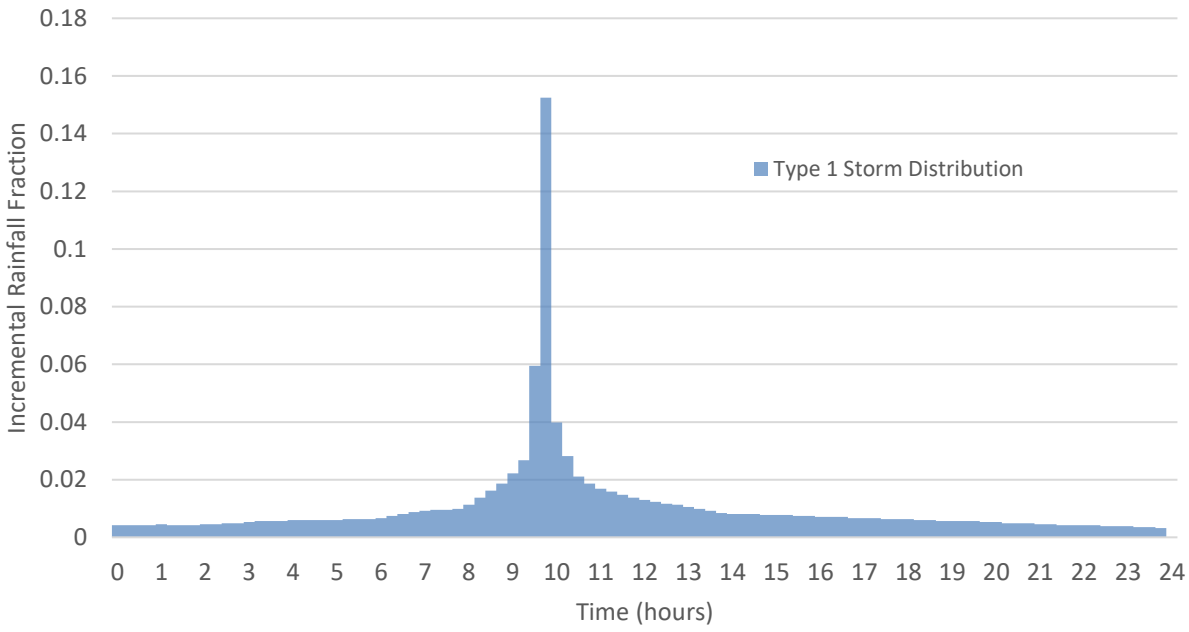


Figure 5-1 SCS Type 1 synthetic rainfall distribution.

5.2.2 LAND USE

To allow for the HEC-RAS model to convert rainfall into runoff, several parameters were required to characterize the land uses within the area being modeled, namely infiltration rate and impervious percentage. Infiltration rate was parameterized using the SCS Curve Number methodology (NRCS, 1986). Curve numbers were assigned to each defined area based on the land use type and the underlying Hydrologic Soil Group. Impervious percentage defines the fraction of a defined area where rainfall will not infiltrate into the ground and will directly produce runoff. Impervious percentages assigned to the model areas ranged from 0% for parks and greenspace to 50% for the residential neighborhood, to 100% for paved surfaces. The impervious surface percentages represent an average value for each land use type as measured from aerial maps. The lagoon was given a curve number of 100 because it will act as functionally impervious when fully wetted. **Table 5-1** shows the impervious percentages and Curve Numbers assigned to the various land use types within the model domain.

Table 5-1 Land use parameters used in the rain-on-grid model.

Land Use	Imperviousness	Curve Number
Lagoon	0%	100
Residential	50%	61
School	50%	61
Streets	100%	98

5.3 Hydraulic Parameters

5.3.1 MODEL TOPOGRAPHY AND ROUGHNESS

The source of the model topography was the 2018 LiDAR. Minor modifications were made to the LiDAR surface to smooth imperfections resulting from vegetation and structure removal in the point cloud during processing. Individual structures were inserted to the model terrain as high ground, delineated along the approximate perimeter of each structure, so that they would behave as flow obstructions. The Garden Wall was manually defined in the model as a trapezoid with a 2 feet top width and a top elevation of 16 feet.

Manning's roughness values were assigned to each defined model area. In general, the assigned manning's n-values were slightly higher than the standard literature values to

reflect the high relative roughness of sheet flow resulting from stormwater runoff. For example, a road surface may behave as hydraulically "smooth" when there is 1-2 feet of water depth flowing on top of it, however, when the flow depth is only a few inches of sheet flow, that same road can appear "rough" from a hydraulic perspective. The housing blocks were also assigned high roughness values to reflect the many obstacles to flow entering and exiting each property.

5.3.2 2D Model Mesh Parameterization

The 2D model domain was drawn to encompass the contributing watershed upslope of the lagoon as seen in **Figure 5-2**. When precipitation is applied to the model domain, runoff will flow and accumulate downslope according to the topography.

The base cell size used within the 2D model space was 50 feet by 50 feet. To improve the model resolution within the roadways, where overland flow will mainly occur, the sizing of the grid cells was reduced to 20 feet by 20 feet. Cell size along the alignment of the Garden Wall was reduced as well, to allow for more accurate model computation along the interface between the developed area and the lagoon.

To account for the culverts that the County installs within the sandbag barrier at the end of each cul-de-sac, two 11-inch inside diameter culverts were explicitly parameterized in the model at the end of each street. No data on the invert elevations of the culverts were available, so the culvert invert elevations were set to the minimum gutter elevations on either side of the roadway. The culverts were parameterized with flap gates, so that no backwatering could occur from the lagoon.

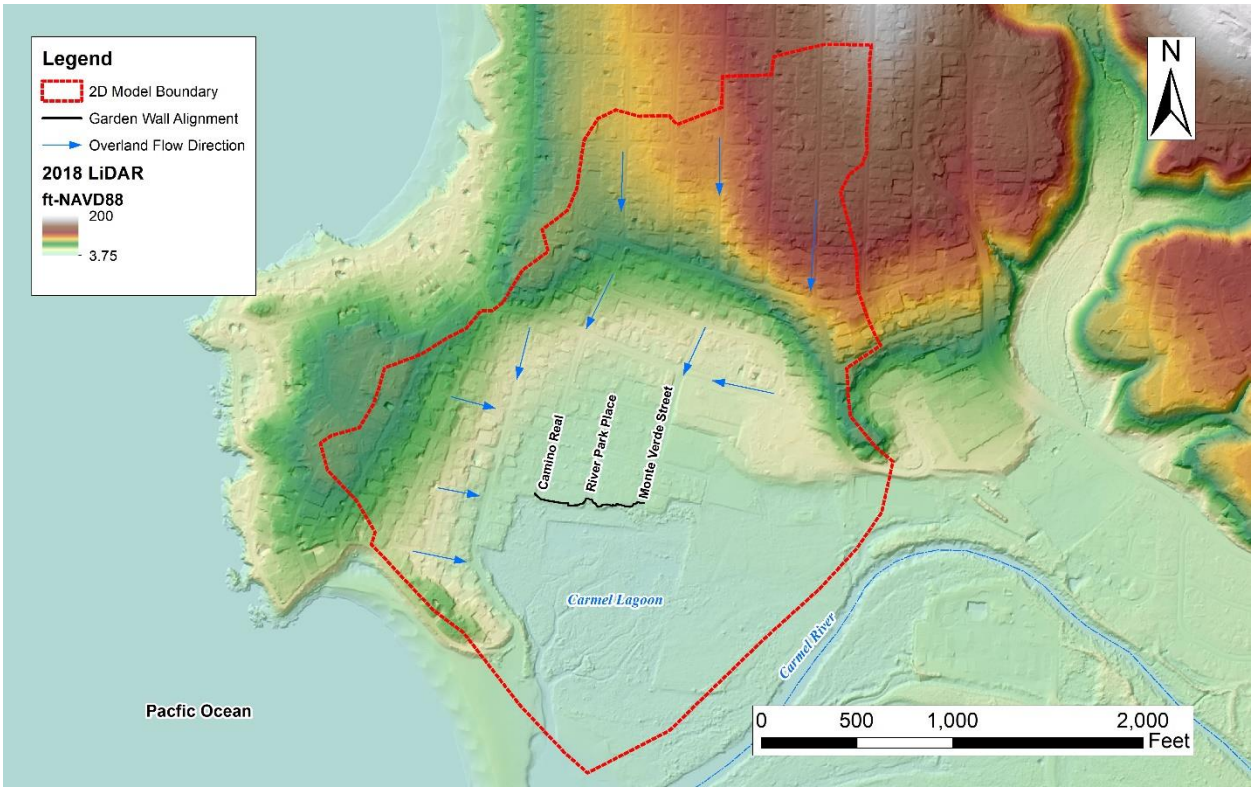


Figure 5-2 2D model domain.

5.3.3 Boundary Conditions

Lagoon WSE was included in the model as a stage boundary condition along the southern perimeter of the model mesh. As with the rainfall scenarios, three lagoon WSEs were selected to represent low, moderate, and high levels of flooding. The WSEs selected to represent these scenarios were 13, 14, and 15 feet, respectively. The purpose of the variable lagoon WSE was to model the effect that higher lagoon stage has on culvert performance while trying to drain the stormwater runoff from a given rainfall event. It should be noted that lagoon elevations selected were within the level of protection provided by the Garden Wall; we did not analyze situations where outflanking or overtopping of the wall would occur as it was assumed that the entire Fourth Addition would become inundated up to the lagoon WSE under these conditions regardless of rainfall (see **Section 4.1** for a discussion on the mechanism for the wall to be outflanked).

Rainfall was included in the model as a precipitation boundary condition. The 24-hour rainfall distributions for the three rainfall scenarios outlined in **Section 5.2.1** were distributed across the entire model domain.

5.3.4 Model Run Matrix

The nine modeling scenarios performed for this study, representing the various combinations of rainfall intensity and lagoon stage, are shown in **Table 5-2** below.

Table 5-2 Model run matrix.

Rainfall Event	Rainfall Depth	Lagoon WSE		
		13 feet	14 feet	15 feet
2-year, 24-hour	1.84	X	X	X
10-year, 24-hour	2.84	X	X	X
100-year, 24-hour	4.65	X	X	X

5.4 Modeling Assumptions

The model included several simplifying assumptions due to incomplete information at this early phase of project conceptualization. It should be noted that hydraulic modeling studies of this type are by their nature complex and include inherent sources of uncertainty. The results of this study are intended to serve mainly as a decision-making tool to reasonably bracket flood risk and assess relative changes in flooding response due to different scenarios at the neighborhood-scale. The model predicted depths, velocities, and water surface elevations at the scale of an individual property should not be interpreted as prescriptive. A summary of the assumptions made during the development of the model is included below:

1. The Garden Wall alignment is the same as the temporary sandbag barrier and the top of wall is set at an elevation of 16 feet;
2. The Garden Wall is completely impervious. Seepage is calculated separately in subsequent sections;
3. Each cul-de-sac has two 11-inch culverts that drain to the lagoon and inflow to the Fourth Addition from the lagoon is prevented by including flapgates;
4. The source of model topography is the 2018 County LiDAR. It is assumed that the overland flow drainage patterns inherent in the model are reasonably accurate; and,
5. Pumping is not included in the model.

6 SEEPAGE FLOW ANALAYSIS

To analyze whether seepage beneath the Garden Wall may play a significant role in flooding, we performed a seepage analysis on both the temporary sandbag barrier and the Garden Wall. The first step in this analysis was to develop flow nets for the two conditions. Flow nets are a graphical technique that allow for a simplified visualization of two-dimensional seepage from areas of high hydraulic head to lower hydraulic head; in this instance, they represent scenarios where the water surface elevation of the lagoon exceeds the water surface elevation in the Fourth Addition. To conservatively estimate the head difference, we assumed that the Fourth Addition side of the wall was dry and that the lagoon was ponded up to elevation 15 feet.

To determine the depth that seepage would likely occur beneath the wall, we consulted soil column data provided in the NRCS' Web Soil Survey to identify the depth to a restrictive layer (such as clay or bedrock) where seepage would likely not occur at any significant rate. The average soil column depth of the dominant soil types in the vicinity of the Garden Wall are 150 cm or 5 feet as mapped by the NRCS; however, boring logs obtained for the project indicate clayey sand deposits to a significant depth (Pacific Geotechnical Engineering, 2013). There are some practical limitations to the depth at which seepage can occur at significant rates. For example, the flow path groundwater takes from the lagoon to the Fourth Addition gets substantially longer the deeper one assumes the flow to be acting. At some point north of the Garden Wall, the existing grades within the Fourth Addition rise above the assumed lagoon WSE and seepage flow would not be expressed on the surface. As a rough estimate for this analysis, we assumed seepage under the wall would be most significant up to a depth of 10 feet below ground surface (bgs).

The saturated hydraulic conductivity (K) used in the analysis was calculated by averaging the values presented in the Web Soil Survey for the two dominant soil types - Alviso Silty Clay Loam and Gorgonio Sandy Loam[4]. The resulting transmissivity used in the seepage calculation was 7.1 inches per hour.

The flow nets were developed by sketching perpendicular equipotential lines and streamlines. Equipotential lines represent lines of constant head while streamlines

[4] A third dominant soil type, Aquic Xerofluvents, is shown in Web Soil Survey, however no data is available on its saturated hydraulic conductivity.

represent the path that seepage flow takes through the soil. The flow nets were sketched according to the following rules:

- Streamlines enter and leave pervious surfaces perpendicular to those surfaces;
- Streamlines are parallel to but cannot touch impervious surfaces;
- Streamlines are parallel to the flow direction;
- Equipotential lines are drawn perpendicular to streamlines such that the resulting cells are approximately square, and the intersections are 90-degree angles; and,
- Equipotential lines enter and leave impervious surfaces perpendicular to those surfaces.

Using the ratio of the number of streamlines (Nf) to equipotential lines (Np) obtained from the flow net, the saturated hydraulic conductivity (K) of the underlying soil, and an assumed head difference on both sides of the wall (H), we used the following equation to calculate the flowrate per unit width beneath the wall.

$$q = K*H*(N_f/N_p) \ [ft^3/s/ft]$$

To convert the unit seepage rate to a total volumetric flow rate, we applied the unit seepage rate across the total length of the Garden Wall (540 feet). For both scenarios, we discounted the length of sandbag barrier that runs across the cul-de-sacs, because it was assumed that the sandbags are bearing directly on a paved surface and that no seepage flow would occur through the pavement.

The general characteristics of the sandbag and garden walls were determined from information provided by Monterey County and Whitson Engineers, respectively.

6.1 Sandbag Wall

The flow net for the sandbag barrier, shown below in **Figure 6-1**, reflects a typical scenario for an impermeable barrier overlying permeable soil. For this analysis, we have discounted any interstitial seepage through the sandbag wall itself.

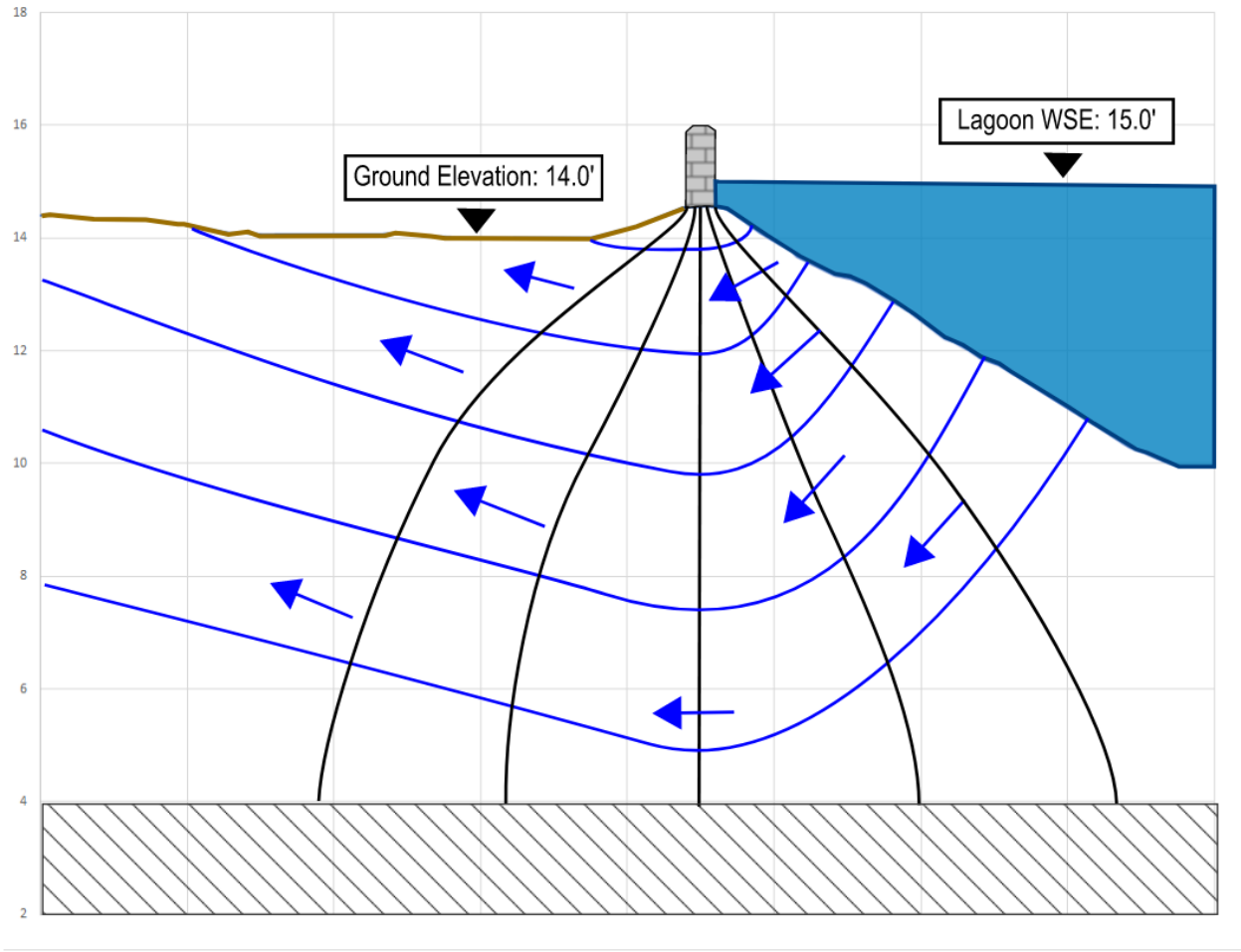


Figure 6-1 Sandbag barrier flow net. Streamlines are shown in blue and equipotential lines shown in black.

The number of streamlines computed for the sandbag barrier was Nf = 6 and the number of equipotential drops was Np = 6.

6.2 Garden Wall

The flow net for the proposed Garden Wall is shown below in **Figure 6-2**. The main difference between the two conditions is that the Garden Wall will have a concrete footing buried roughly 1.5 feet below ground and effectively serve as a cut-off-wall for seepage from a depth of 0 to 1.5 feet bgs. The effect of the buried portion of the wall on the flow net is a decrease in the number of streamlines (shown in blue) and an increase in the number of equipotential lines (shown in black).

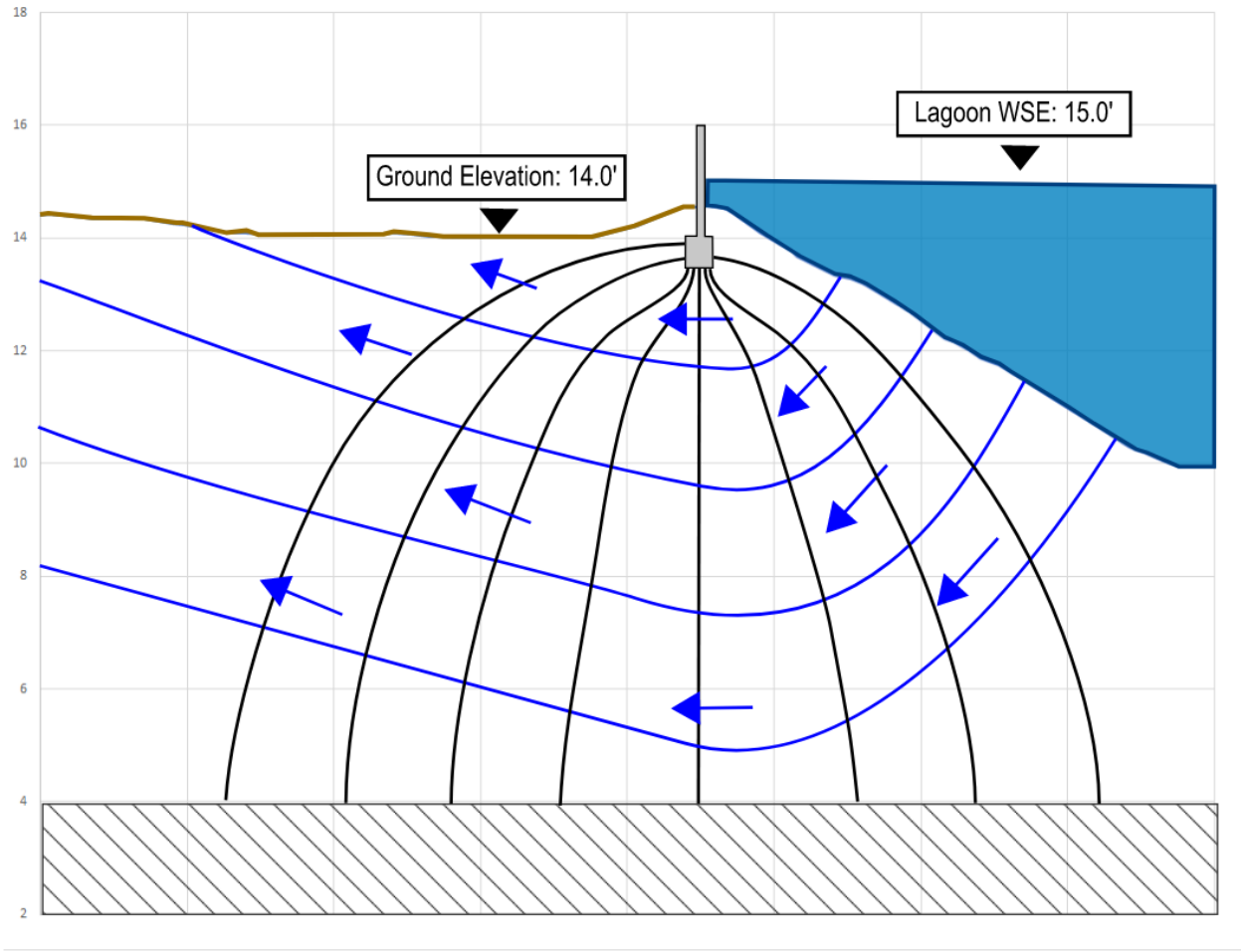


Figure 6-2 **Garden Wall flow net. Streamlines are shown in blue and equipotential lines shown in black. The buried footing decreases the number of flow channels and increases the number of equipotential drops.**

The number of streamlines computed for the Garden Wall was Nf = 5 and the number of equipotential drops was Np = 9.

7 MODEL RESULTS

7.1 Hydraulic Modeling

This section summarizes the key results from the HEC-RAS modeling across the nine scenarios that were analyzed. The main outputs of the HEC-RAS model are 2D visual representations of the flow depths and velocities within the model domain at each of the model timesteps.

The difference in maximum inundation extent between the 2-year rainfall event and the 100-year rainfall, both with a lagoon tailwater elevation of 13 feet, can be seen in **Figure 7-1**. Both scenarios show flooding due to stormwater runoff within the Fourth Addition, even with favorable lagoon levels, although the extent of flooding is much more significant in the 100-year event. It is important to note that the model does not consider pumping at the street ends which can potentially accelerate the rate at which stormwater is discharged to the lagoon.

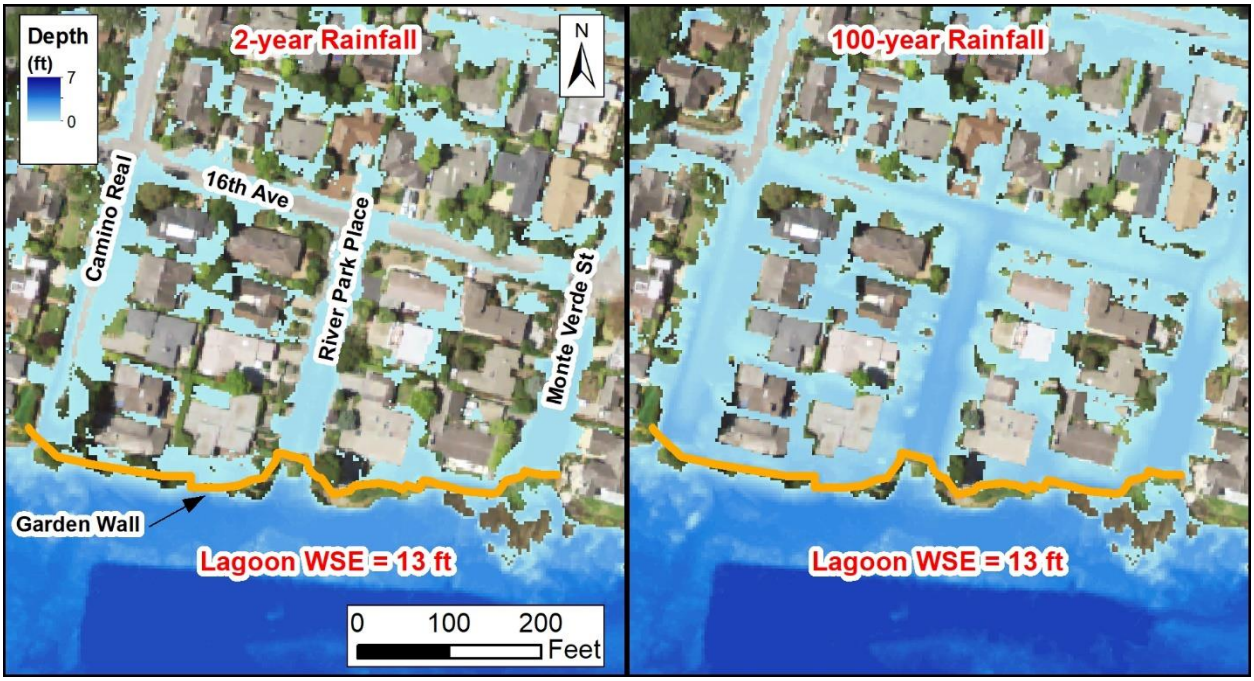


Figure 7-1 Comparison of maximum flood depth for the 2-year rainfall event (left) and the 100-year rainfall event (right) for the 13 feet lagoon WSE scenario.

Similarly, we can compare the 10-year rainfall results for two different lagoon tailwater conditions, 13 feet and 15 feet, to show the effect of lagoon elevation on stormwater drainage (**Figure 7-2**). A lagoon elevation of 15 feet means that stormwater runoff cannot

be discharged via gravity flow until the ponding within the Fourth Addition reaches higher than 15 feet, well above the LAG for many homes on Camino Real and River Park Place. In such cases, the only way to drain the water more quickly is through pumping.

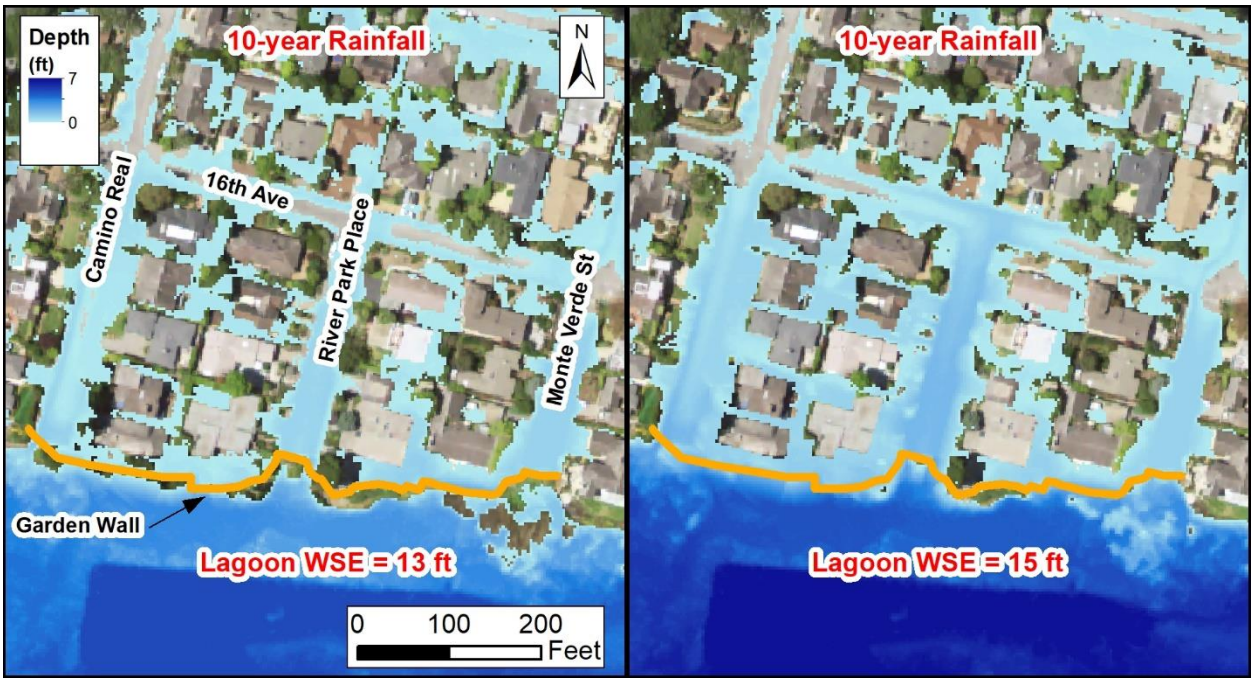


Figure 7-2 Comparison of maximum flood depth for the 10-year rainfall event with a lagoon WSE of 13 feet (left) and a lagoon WSE of 15 feet (right). The maximum inundation extent is significantly larger with the higher lagoon WSE.

To better encapsulate the temporal component of the modeling, graphical plots were developed to visualize the results. **Figure 7-3** through **Figure 7-5** show a timeseries of WSE at the end of Camino Real and Monte Verde Street for each rainfall scenario and each lagoon tailwater elevation[5]. If the model predicted WSE rises above the calculated minimum LAG for a given street, then that street is assumed to be flooded.

[5] The results for River Park Place were substantially similar to those of Camino Real and therefore omitted for clarity.

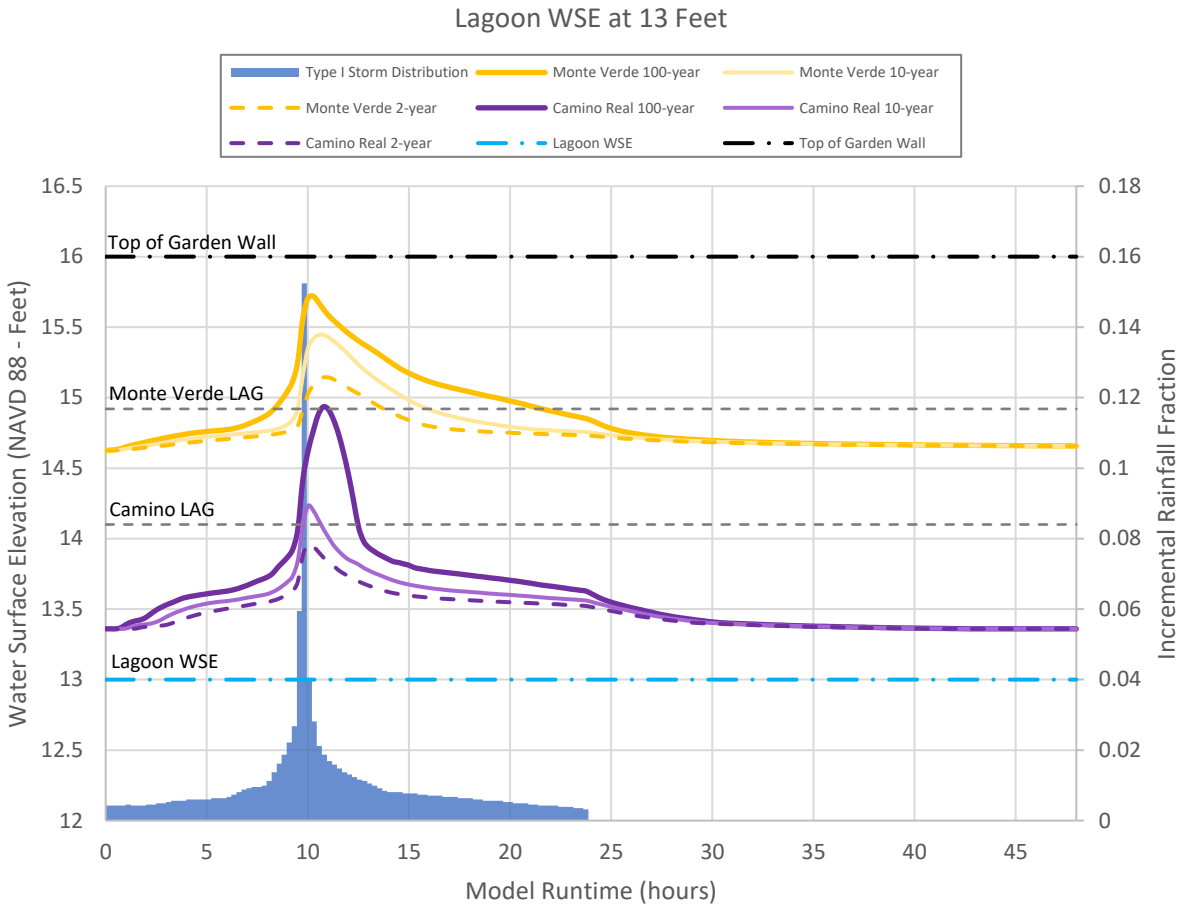


Figure 7-3 Monte Verde and Camino Real WSE time series for all design storms with a lagoon WSE of 13 feet.

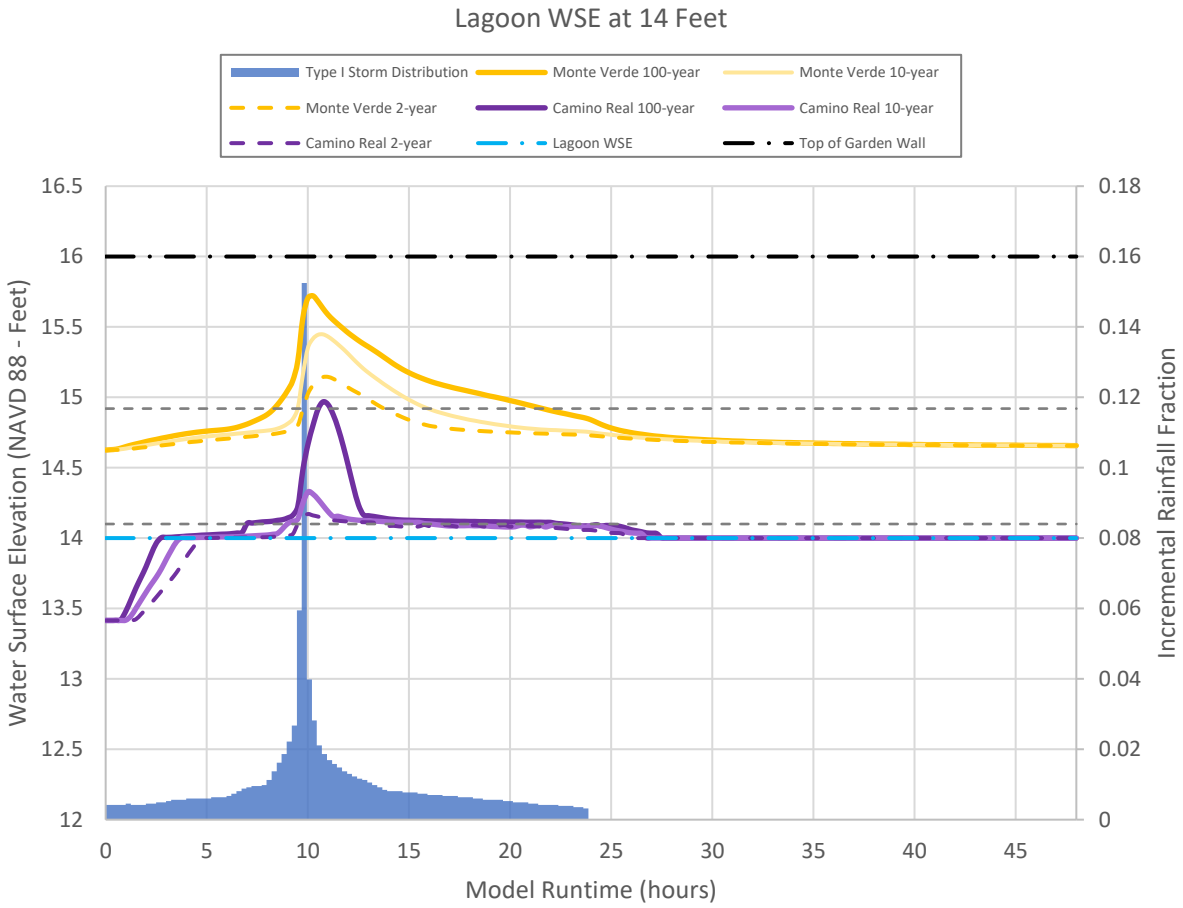


Figure 7-4 Monte Verde and Camino Real WSE time series for all design storms with a lagoon WSE of 14 feet.

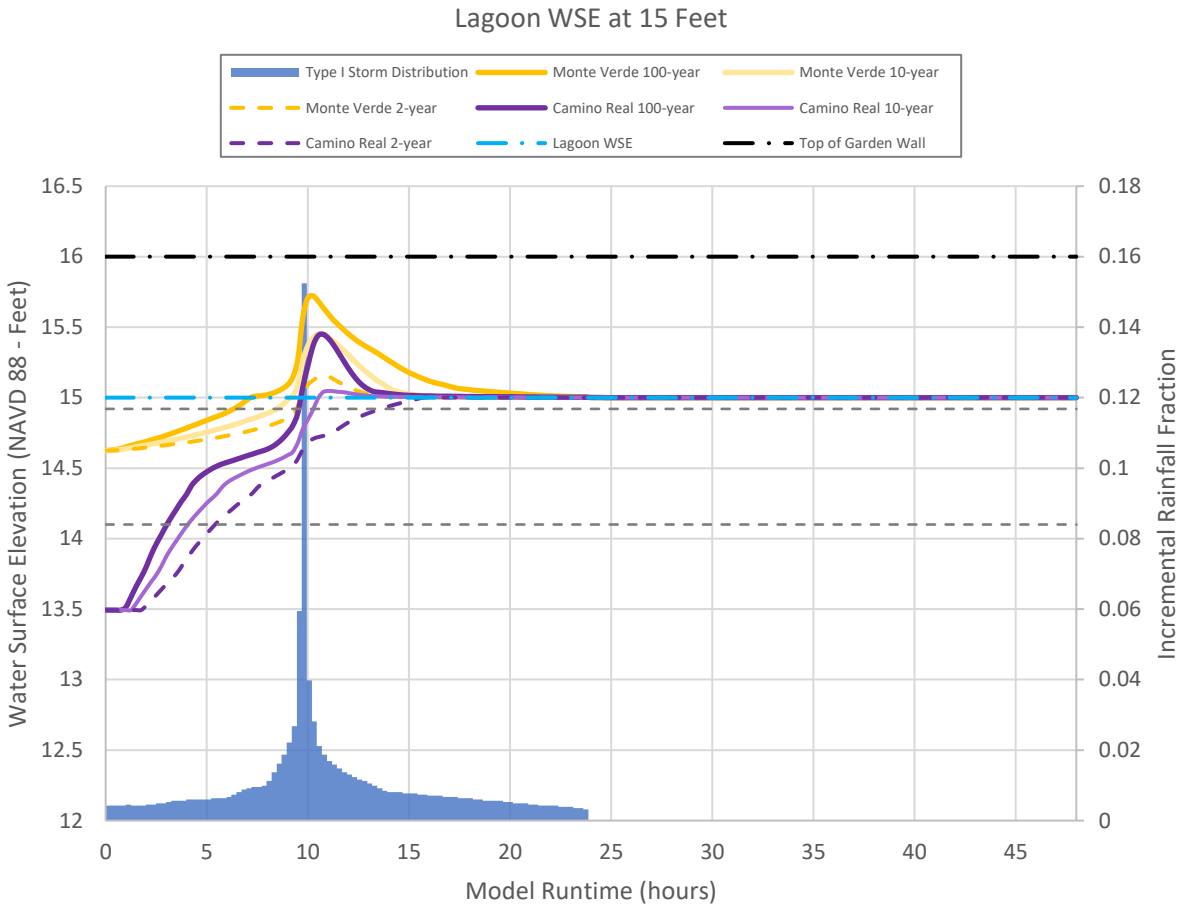


Figure 7-5 Monte Verde and Camino Real WSE time series for all design storms with a lagoon WSE of 15 feet.

The results show that flooding, defined as WSE rising above the minimum LAG for a given street, occurs in every scenario except for the 2-year rainfall event with a lagoon tailwater elevation of 13 feet at Camino Real. Monte Verde WSEs are predicted to rise above the LAG in the 2-year event and above. Flood elevations at Camino Real appear to be more sensitive to lagoon WSE, due to the overall lower terrain elevations, while Monte Verde results do not change significantly with rising lagoon levels. At lower lagoon levels, the model predicted duration of flooding is longer at Monte Verde than at Camino Real, potentially because Monte Verde Street is on the main flow path running north-south draining the upper watershed.

7.2 Seepage Flow Analysis

The results of the seepage flow analysis show that the rate of seepage is lower with the Garden Wall versus the sandbag barrier. When applied across the 540-foot Garden Wall alignment, the seepage flowrate for the sandbag barrier is 0.089 cfs while the Garden Wall is 0.049 cfs. This intuitively makes sense due to the inclusion of a concrete footing with the Garden Wall that would impede the flow of water through the uppermost part of the soil column.

By applying the calculated seepage rate as an inflow to the Fourth Addition, we can model how long it would take for water at a constant rate to flood the minimum LAG of 14.1 feet at Camino Real (there is an estimated 0.17 acre-feet of storage volume below elevation 14.1 feet). At the rates calculated above, it would take approximately 23 hours to reach elevation 14.1 feet for the sandbag barrier scenario, and approximately 42 hours to reach the same elevation for the Garden Wall scenario.

8 DISCUSSION

8.1 Lagoon Flooding

The modeling shows that rising lagoon levels alone would not cause flooding with the Garden Wall alternative in place until lagoon levels rise above 15.1 feet NAVD 88. Analysis of lagoon stage data provided by MPWMD shows that elevation 15.1 feet was equaled or exceeded three times between water years 2008 and 2022, and average lagoon levels have been trending upwards since 2015. A revised flood frequency analysis of the lagoon stage records showed that a lagoon elevation of 15.1 feet has an approximate 20-year recurrence interval. This analysis did not consider the effects of sea level rise, which are expected to push average lagoon elevations higher in the coming decades.

For the Garden Wall alternative, flood risk from the lagoon can be reduced by sealing the ends of the wall and implementing structural changes to the intersection of 16th Avenue and Monte Verde Street, such that the Fourth Addition has some type of physical barrier above elevation 16 feet around the entire perimeter of the developed area. This would provide flood protection from rising lagoon levels up to the FEMA BFE of 16 feet; however, this would not address flooding issues due to limited stormwater drainage north of the wall and could potentially lead to higher flood levels from upland watershed runoff.

8.2 Stormwater Runoff

Stormwater runoff was shown to cause flooding in nearly all modeled scenarios. This in part reflects the lack of a municipal storm drain system within the Fourth Addition. Occasional high intensity rainfall combined with highly impervious, urbanized land cover can result in significant runoff volumes that must be conveyed within gutters along County streets or spread out as overland flow. This runoff ultimately ponds within the Fourth Addition as the lowest point in the watershed before draining to the lagoon. The Garden Wall alternative does not include any stormwater drainage improvements over the existing conditions.

At lower lagoon levels, when the culverts can discharge freely, the size of the culvert controls the maximum discharge rate into the lagoon. The two 11-inch culverts that are placed at the ends of each street have limited capacity for drainage. This can be seen in the model results with a lagoon WSE of 13 feet. In these scenarios, Monte Verde is predicted to flood in the 2-year rainfall event and above and Camino Real is predicted

to flood in the 10-year rainfall event and above. Pumping water at the street ends, as is the current County practice, can mitigate some of this flooding.

As lagoon WSE increases, the culverts can only discharge when the WSE on the Fourth Addition side of the wall is higher than that in the lagoon (a positive head differential is required for gravity flow). Higher lagoon WSEs particularly affect Camino Real and River Park Place since their existing grades are lower overall than Monte Verde, resulting in a greater depth of flooding. Comparing the model results for the 2-year rainfall event with a lagoon WSE of 13 feet versus 15 feet shows that the WSE on Camino Real increases by over 1 foot between the two scenarios. At a lagoon WSE of 15 feet, the entire area north of the wall must pond to above elevation 15 feet to drain positively to the lagoon. That would inundate much of the terrain between River Park Place and Camino Real. At these lagoon levels, the only option to drain stormwater from north of the wall is to pump the water out and discharge it over the wall south into the lagoon.

The rain-on-grid stormwater runoff modeling is sensitive to many factors, including assumed rainfall intensity, imperviousness, and infiltration rates. Higher or lower runoff volumes may be observed, if the physical characteristics of the watershed differ from what was assumed. Additionally, apparent drainage patterns in the LiDAR topography dictate modeled flow directions for runoff and may differ from the existing conditions. Uncertainty regarding these parameters should be taken into consideration when assessing the model results.

8.3 Level of Flood Protection

The results of this study demonstrate that the Fourth Addition is at risk of flooding from rising lagoon levels, stormwater runoff, and a combination of these two factors. Framing flood risk in terms of a statistical chance of flooding in any given year is made more difficult by the complexity of the processes involved and the interdependency of the two flooding sources with different probabilities of occurrence.

If we isolate the lagoon flooding source independently, the proposed Garden Wall has a 20-year level of flood protection according to a statistical analysis of gage records. As outlined in **Section 4.1**, the level of lagoon flood protection is limited by low points along the Garden Wall alignment. However, without the Garden Wall, or some other flood protection barrier, flood risk has the potential to be even higher as there would be nothing stopping the lagoon from flooding low areas below elevation 15 feet more

frequently. Without a wall, lagoon levels would be expected to reach the minimum LAG on Camino Real of 14.1 feet in 20% of years (5-year recurrence).

With regards to flooding due to stormwater runoff, the Garden Wall does not provide any drainage improvements over the existing conditions. The modeling shows that flooding is possible even under the most favorable lagoon tailwater conditions during the 2-year rainfall event. Therefore, the Garden Wall provides less than 2-year flood protection for stormwater runoff. Pumping, or other physical stormwater management actions, were not considered when assessing the level of protection of the Garden Wall.

8.4 Seepage

The seepage calculations show that seepage under the Garden Wall is not likely to contribute significantly to flooding of the Fourth Addition. Assuming a constant lagoon WSE of 15 feet, it was calculated to take 42 hours for enough seepage to occur to cause flooding of Camino Real. It is important to view these results in conjunction with the historical lagoon stage data to determine if this duration of ponding is realistic. In the three most recent periods where the lagoon WSE exceeded an elevation of 15 feet, the maximum period of inundation above 15 feet was 2.75 hours and the average across the three events was 1.5 hours. This shows that the duration of ponding required to create a flood risk to homes through seepage alone is far beyond what regularly occurs, even during high flooding events.

It is important to note that seepage in this case is defined as subsurface flow percolating through the soil layers from one side of the wall to the other. Other situations can cause water to flow underneath the wall such as improper footing installation or a piping soil failure.

The inputs to the seepage calculation were estimated based on the best available data, but uncertainty remains due to a lack of detailed site-specific subsurface data along the wall alignment, namely transmissivity and defining the depth at which seepage flow would no longer occur at appreciable levels.

9 CONCLUSIONS

This study presents a modeling framework for estimating flood protection gained by the Garden Wall alternative. The results demonstrate that the wall as currently conceived provides roughly 20-year level of flood protection from rising lagoon levels. Analysis of the existing topography showed that increasing the level of flood protection up to elevation 16 feet is possible by addressing physical low points along the wall perimeter. That would increase the level of flood protection to the 50-year recurrence, according to the revised flood frequency analysis presented in **Section 3**.

The Garden Wall alternative does not provide any stormwater drainage improvements over the existing conditions. The rain-on-grid modeling showed that even frequently occurring storms are enough to overwhelm the drainage capacity of the temporary culverts and that pumping is required to prevent flooding of homes and infrastructure. At low relative lagoon levels, stormwater drainage can be improved by enlarging the culverts placed at the end of each cul-de-sac. At high relative lagoon levels, the only way to improve drainage is through pumping.

Seepage was shown not to be a primary concern with the Garden Wall scenario, largely due to the limited head differential that is possible with a wall along the property line. This differs from past analyses of the EPB proposed project which included an EPB within the lagoon and a much greater potential head difference.

10 LIMITATIONS

As is customary, we note that readers should recognize that hydrologic and hydraulic modeling of any site is a difficult and inexact art, and a variety of physical factors can affect the results from what has been presented herein; in particular, differences in observed rainfall patterns, topographic variability, physical obstructions, and drainage patterns. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the exact conditions present. More extensive studies or an increased level of design can reduce the inherent uncertainties associated with such studies. If the client wishes to further reduce the uncertainty beyond the level associated with this study, Balance Hydrologics should be notified for additional consultation.

Analyses and information included in this report are intended for stormwater management planning and evaluating flood risk reduction strategies at the scale of an entire neighborhood. Model results viewed within the context of an individual property should not be considered as prescriptive.

11 REFERENCES

Ballman, E., and Senter, A., 2014, The Geomorphic Role of Riverine Processes in Carmel Lagoon Water Surface Elevation and Sand Bar Dynamics for the Carmel River-Lagoon Biological Assessment Report: Balance Hydrologics, Inc. consulting report prepared for the Monterey County Resource Management Agency, multi-paged.

Denise Duffy & Associates, Inc., 2016, Carmel Lagoon Ecosystem Protective Barrier, Scenic Road Protection Structure, and Interim Sandbar Management Plan Project Draft Environmental Impact Report: Consulting report prepared for the County of Monterey, multi-paged.

[USGS] England, J.F., et al., 2019, Guidelines for Determining Flood Flow Frequency – Bulletin 17C

Monterey County Water Resources Agency (MCWRA) Staff, 1997, Water Resources Data Report Water Year 1994-1995, Figure 2.3.

Monterey Peninsula Water Management District (MPWMD), 2023, Carmel River Lagoon Water Levels, available online at https://www.mpwmd.net/environmental-stewardship/carmel-river-lagoon/lagoon-water-levels/.

Natural Resources Conservation Service, United States Department of Agriculture, 1986, Urban Hydrology for Small Watersheds, Technical Release 55, P. 2-1 – 2-12.

Northwest Hydraulic Consultants (NHC), 2006, Technical Support Data Notebook: Flood Insurance Restudy of Carmel River, Monterey County, California: Consulting report prepared for the Federal Emergency Management Agency, p. 179-183.

Pacific Geotechnical Engineering, 2013, Feasibility Geotechnical Investigation, Proposed Ecosystem Protection Barrier and Scenic Road Protection Structure, Monterey County, California: report prepared for Whitson Engineer, 49 p.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture, Web Soil Survey, available online at http://websoilsurvey.nrcs.usda.gov/ .

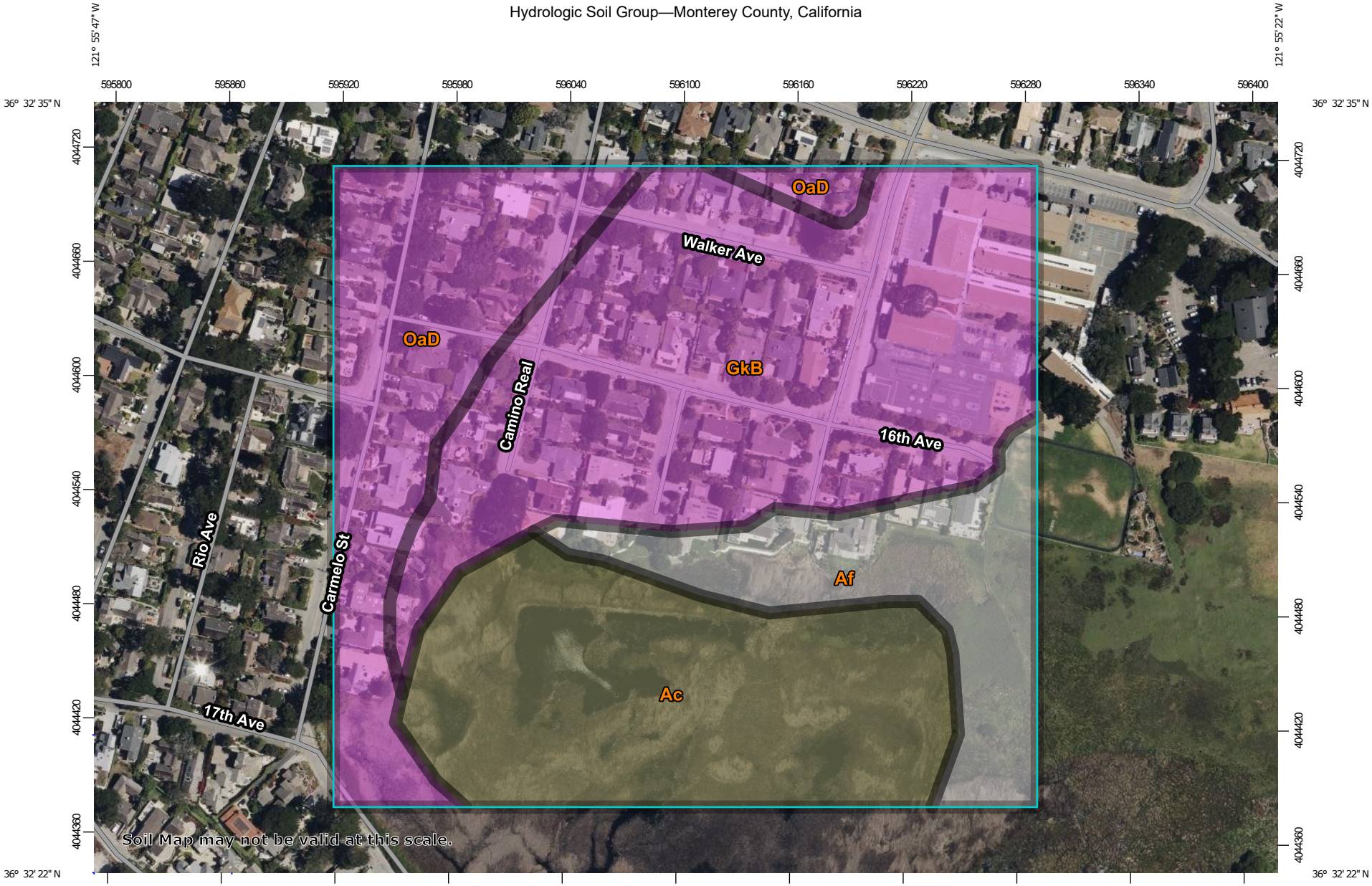
Whitson Engineers, 2012, Project Aerial Topographic Map for Ecosystem Protection Barrier Project, Monterey County, California, 1" =100'.

Whitson Engineers, 2013, Carmel River Lagoon Ecosystem Protective Barrier (EPB) and Scenic Road Protection Structure (SRPS) Projects Feasibility Report: Consulting report prepared for the Monterey County Water Resources Agency and Monterey County Department of Public Works, multi-paged.

APPENDICES

APPENDIX A

Web Soil Survey Report



Map Scale: 1:2,860 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monterey County, California
Survey Area Data: Version 19, Sep 14, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 11, 2022—May 29, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ac	Alviso silty clay loam	C/D	8.1	26.1%
Af	Aquic Xerofluvents		4.2	13.5%
GkB	Gorgonio sandy loam, 0 to 5 percent slopes	A	12.5	40.4%
OaD	Oceano loamy sand, 2 to 15 percent slopes	A	6.2	20.0%
Totals for Area of Interest			**31.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

This Page Intentionally Left Blank