Draft Integrated Feasibility Report and Environmental Impact Statement/Environmental Impact Report

Redwood City Harbor Navigation Improvement
Feasibility Report and Integrated EIS/EIR

Contract No. W912P7-11-D-0004
Task Order No. 0013



Prepared for:
U.S. Army Corps of Engineers, San Francisco District

Prepared by:
HydroPlan LLC, in collaboration with
GAIA
Moffatt and Nichol

June 2015

This page was intentionally left blank.

Abstract

This is a feasibility report that describes the planning process for improving navigation efficiency at the Port of Redwood City, California. The Report is integrated with an Environmental Impact Statement in compliance with the National Environmental Policy Act and an Environmental Impact Report in compliance with the California Environmental Quality Act. A comprehensive range of structural and non-structural alternatives was identified and evaluated in terms of potential impacts on the natural and built environments. The recommended plan consists of deepening the Redwood City Harbor and San Bruno Shoal Channels from -30 feet MLLW to -32 feet MLLW and slightly realigning the Redwood City Harbor Channel to avoid sensitive environmental features of Bair and Greco Islands. The recommended plan maximizes net national economic development benefits and was identified as the National Economic Development Plan. The Recommended Plan avoids adverse environmental impacts to the maximum extent practicable and includes mitigation measures to offset impacts when necessary.

Executive Summary

ES.1 Purpose and Intended Uses of This Document

This document describes investigations and alternatives to improve navigation efficiency at Redwood City (RWC) Harbor and San Bruno Shoal (SBS) Channel, evaluations of the potential environmental impacts of such improvements, and identification of a tentatively selected plan. It integrates the following elements:

- Requirements of the United States Army Corps of Engineers (USACE) feasibility study planning process;
- An Environmental Impact Statement (EIS) prepared in compliance with the National Environmental Policy Act (NEPA); and
- An Environmental Impact Report (EIR) prepared in compliance with the California Environmental Quality Act (CEQA).

The purpose of the Redwood City Harbor Navigation Study is to evaluate alternatives for improving the efficiency of navigation to the Port. This document was prepared by the USACE, San Francisco District, in collaboration with the Port of Redwood City, the non-federal sponsor of the Redwood City Harbor Navigation Project.

The purpose of this DEIS/DEIR is to evaluate the potential significant environmental impacts of the alternatives proposed in the feasibility study. The integrated DEIS/DEIR will be used to support Congressional authorization of the recommended plan for improvements to the Redwood City Harbor Navigation Project.

This DEIS/DEIR will also be used by CEQA lead agencies to ensure that they have met the requirements of CEQA before deciding whether to issue discretionary permits over which they have authority. It may also be used by other state, regional, and local agencies, which may have an interest in resources that could be affected by the project.

ES.2 Study Area

Redwood City Harbor is located on the southwest side of San Francisco Bay, approximately 18 miles south of San Francisco, California (***Figure ES-1***). It is within the corporate limits of Redwood City, in San Mateo County. The study area includes the existing Federal navigation channel and turning basins at Redwood City Harbor, extending from the mouth of Redwood Creek to deep water in the San Francisco Bay. The Federal navigation channel at San Bruno Shoal in San Francisco Bay is also included in the study area, having been added to the Federal project by the 1945 authorizing legislation. It is located north of Redwood City and lies within the corporate boundaries of the cities of both Brisbane and South San Francisco, California. Both channels are currently authorized to be maintained at -30 feet Mean Lower Low Water (MLLW).

Potential dredged material placement sites that have been considered for this study[1] include:

- Montezuma Wetland Restoration Project,
- Cullinan Ranch Tidal Restoration Project,
- Eden Landing Pond Complex,
- Alviso Pond Complex
- San Francisco Deep Ocean Disposal Site, which is also part of the study area but is located about 50 miles offshore from the Golden Gate Bridge.

The SBS Channel overlays three petroleum pipelines (***Figure ES-1***). Deepening of the SBS Channel would require that these pipelines be relocated.

Bair Island and Greco Island are adjacent to the harbor and are considered to be in the project area because of their proximity to the channel. Bair Island is operated by the U.S. Fish and Wildlife Service (USFWS) and is the site of a restoration project. The bay water around Bair Island and the harbor is within the Don Edwards Marine Protected Area (***Figure ES-2***).

[1] Other potential placement sites were considered during the planning process, but were screened from further consideration.



Figure ES-1. Study Area



Figure ES-2. Redwood City Channel, Turning Basins, and Bair and Greco Islands

ES.3 Port Commodities and Traffic

The Port of Redwood City specializes in bulk, neo-bulk, and liquid cargoes. Cargo volumes have been variable over the life of the Port, reflecting economic trends and resulting demand for bulk goods (***Figure ES-3***). During the past 10 years, cargo volumes peaked at 1.9 million metric tons (MMT) in 2005 and then dropped to a low of 842,727 metric tons in 2010.

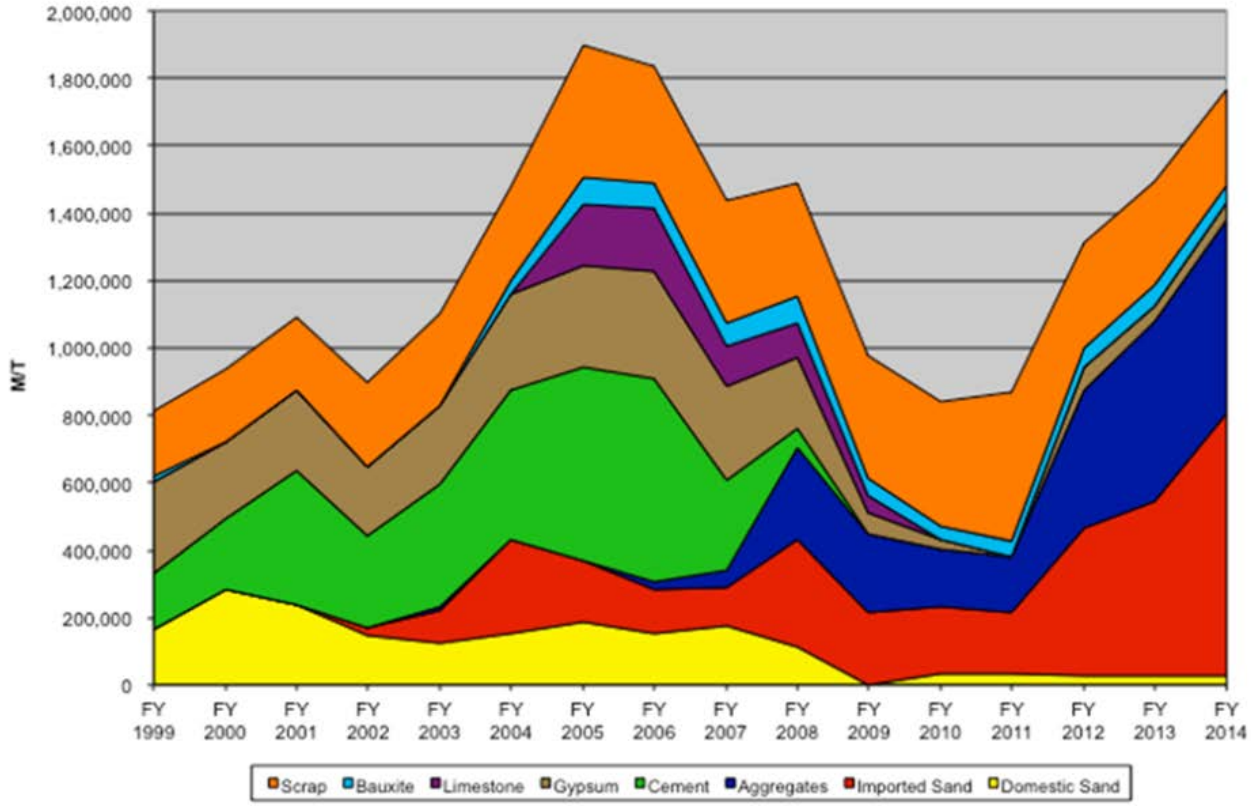


Figure ES-3. Tonnage by Commodity for Port of Redwood City

Bulk construction aggregates and scrap metal commodities have been supported by the Port and are expected to continue into the future. The latest statistics show that 1.7 MMT of commodities passed through the Port between 1 July 2013 and 30 June 2014.

The future fleet forecast assumed a 2.8 percent annual growth in overall commodity tonnage, the same as the overall trend over the last 15 years. At the projected 2.8 percent annual growth rate, commodities are expected to grow to a projected level of 2.5 MMT by 2025. The Port's existing infrastructure can accommodate a total throughput of 3.5 million tons per year.

Table ES-1 describes the commercial traffic to the Port of Redwood City for the period from 2002 through 2014. It should be noted that barges in earlier years were typically 2,000 to 3,000 tons/barge of domestic sand dredged from San Francisco Bay. However, barges in later years have typically carried between 3,000 and 5,000 tons of aggregates lightered from larger vessels. Ships ranged from 20,000 to 35,000 tons - more in recent years.

Table ES-1. Port of Redwood City Commercial Traffic

Fiscal Year	Cargo Metric Tons	Vessel Calls: Barges	Vessel Calls: Ships	Vessel Calls: Total
2014	1,784,659	25	64	89
2013	1,493,190	19	51	70
2012	1,319,198	26	48	74
2011	871,940	11	36	47
2010	842,727	16	33	49
2009	986,727	11	37	48
2008	1,487,064	65	50	115
2007	1,436,626	94	46	140
2006	1,833,022	91	60	151
2005	1,908,172	96	60	156
2004	1,484,720	88	54	142
2003	1,111,000	58	42	100
2002	899,652	65	30	95

ES.4 Redwood City and San Bruno Shoal Channels

The Redwood City Harbor channel extends approximately 5 miles from the Port of Redwood City to deep water in San Francisco Bay (***Figure ES-2***). The channel includes two turning basins: Turning Basin #1 is an outer basin nearest the bay, and Turning Basin #2 is an inner basin nearest the Port. A connecting channel joins the two turning basins. The width of the channel and turning basins ranges from 300 feet to 900 feet. The San Bruno Shoal Channel, located 9 miles northwest of the Port, is also part of the Federal Redwood City Harbor project. It spans approximately 3.5 miles and connects with deep water in San Francisco Bay to the north and south.

The average sedimentation rate for the Redwood City Harbor Channel is about 183,000 cubic yards per year (2004 – 2012 period of record). There are indications that the accretion rate is not constant throughout the year, but varies either seasonally, or in response to storm events. The channel has been scheduled for maintenance dredging by USACE on a two-year dredging cycle since 1965. However, the USACE's ability to dredge the channel to the full authorized depth of -30 feet MLLW depends on receipt of sufficient Federal funds.

Recent channel maintenance dredging occurred in 2004, 2005, 2008, 2012 and 2014 (***Table ES-2***), usually with clamshell-bucket equipment. Maintenance dredged material from the channel has typically been less than 80 percent sand and has been placed at the SF-11 (Alcatraz) disposal site. Additionally, a "knockdown" was performed in late 2009 when sediment in areas

with the greatest shoaling was moved to areas of the channel with less shoaling, thereby increasing the limiting navigation depth.

ES-1. Redwood City Harbor Channel Dimensions and Historical Maintenance Dredging

Channel Section	Authorized Depth (MLLW)	Length (feet)	Width (feet)	Area (acre)	Maintenance Frequency (years)	Last Dredged (FY)
Entrance Channel	30	13,900	300-350	103.7	2	2014
Outer Turning Basin	30	2,200	400-900	30.3	2	2014
Connecting Channel	30	1,300	400	11.9	2	2014
Inner Turning Basin	30	1,700	900	35.1	2	2014
San Bruno Channel	30	1,800	510	21.1	Infrequently	2005

San Bruno Shoal Channel rarely requires maintenance dredging. Surveys of the channel between 2002 and 2014 show that the channel has undergone periods of accretion and erosion, with little net change in channel depth. The channel has been maintained via a hopper dredge at approximately 10-year intervals and was last dredged in 2005. Prior to 2005, less than 3.5 percent of the channel area was shallower than the authorized project depth. The parts that were in need of maintenance required only 16,000 cubic yards of sediment to be removed.

ES.5 Need for Action

The major problem at Redwood City Harbor is transportation cost inefficiencies. The existing navigation project channels at Redwood City Harbor and San Bruno Shoal do not allow for the efficient operation of the vessel fleet that calls on the Port. A large majority of vessels calling on the Port have design drafts that are greater than the authorized channel depth of -30 feet MLLW. Having to wait for favorable tide is inefficient, requiring the practices of light loading or lightering[2] larger vessels and waiting for favorable tide conditions in order to access the Port.

Three classes of commercial vessels call on the Port: Handysize, Handymax, and Panamax vessels. The design drafts for these vessels range from 33 to 46 feet (***Table ES-3***). Because fully loaded vessels exceed the available draft in the channel, vessels must be only partially loaded or light-loaded. For example, a Panamax vessel must take off approximately 2,000 metric tons

[2] Lightering is the practice of transferring cargo from one vessel to another in order to reduce the vessel draft so that it can safely navigate a channel with limited depth.

of material to reduce its draft by 1 foot. Light loading results in increased transportation costs that are ultimately passed on to consumers.

Table ES-2. Port of Redwood City Vessel Characteristics

Vessel Type/Class	Approximate Dead Weight Tonnage (DWT)	Length Range (feet)	Beam Range (feet)	Draft (feet)	Number in Port (07/2012-06/2013)	Percent Loaded (07/2012-06/2013)
Handysize	10k-35k	426-492	(variable)	33	7	75-85%
Handymax	35k-59k	492-656	(variable)	36-39	16	37-65%
Panamax	60k-80k	<965	<106	<39.5	30	21-58%

The future without project condition fleet is projected to have the following average annual mix:

- 6 - 10 Handysize
- 12 Handymax
- 50 Panamax (still light-loaded).

The design drafts of all of these vessels exceed the current channel depths in Redwood City and San Bruno Shoal Channels and vessels will continue to incur partial and light loading costs in the future.

ES.6 Planning Objective, Opportunity, and Constraints

Planning Objective

The Congressional authority for this report indicates that its purpose is "To improve the efficiency of deep draft navigation at the Redwood City Harbor and San Bruno Shoal Channels." With that charge, and based on existing and future conditions, the specific planning objective of this study is to:

> **Increase efficiencies of deep draft navigation and transportation of goods to and from the Port of Redwood City.**

Opportunity

Deepening the RWC and SBS Channels would represent an opportunity to support the goals of the San Francisco Bay Long Term Management Strategy for Dredged Sediment (LTMS). The LTMS was developed by the USACE, the U.S. Environmental Protection Agency (USEPA), the San Francisco Bay Conservation and Development Commission, and the San Francisco Bay Regional Water Quality Control Board (RWQCB). The plan addresses San Francisco, San Pablo, and Suisun Bays. It seeks to maximize beneficial reuse of dredged material and limits in-Bay

placement of dredged material to 1.25 million cubic yards per year (mcy/year). In view of this strategy, this study has the following opportunity:

Support the Goals of the San Francisco Bay Long Term Management Strategy for Dredged Sediment

Planning Constraints

A planning constraint is a restriction that limits the range of measures or actions that might be implemented to meet the study objectives. Constraints can be related to resource, legal, or policy considerations. The planning constraints identified for this study are:

1) Avoid or minimize adverse impacts to environmental resources at the RWC and SBS Channels.

2) Avoid impacts to the USFWS Bair Island unit of the Don Edwards San Francisco Bay Wildlife Refuge and the Port of Redwood City infrastructure.

3) Avoid adverse impacts to vessel operating safety at the RWC and SBS Channels. Any realignment or deepening should avoid creating conditions that result in unsafe operating conditions or additional navigation hazards.

4) Avoid impacts to the San Mateo Bridge**.**

ES.7 Alternatives

The planning process consisted of identifying appropriate management measures based on the planning objectives, formulating alternative plans by combining management measures, screening and evaluating alternative plans, and identifying the TSP.

Management measures are the “building blocks” for all alternative plans. They are specific actions/ideas/programs/regulations that can be taken to address specifically targeted objectives. Management measures were crafted to address specific project objectives and then evaluated qualitatively. Both structural and non-structural management measures were identified. The complete set of management measures was screened to identify those that best met the planning objectives and merited further evaluation. Retained management measures were then combined to form a set of 17 preliminary alternative plans, in addition to the No Action Plan. The preliminary plans consist of combinations of three channel depths (-32, -34, and -37 feet MLLW) and five dredged material placement sites (Cullinan Ranch, Montezuma Wetland Restoration Project, San Francisco Deep Ocean Disposal Site (SF-DODS), Eden Landing Pond Complex, and Alviso Pond Complex) (***Table ES-4***).

Table ES-4. Summary of Preliminary Alternatives

Alt No.	Dredging Option (feet MLLW)	Placement Site Use (cy)							
		Cullinan	Montezuma	SF-DODS	Eden Landing	Alviso – Pond A2W Delivery	Alviso – Pond A9 Delivery	Total Volume (cy)	Formulation Strategy
A-1	A (-32')	1,765,000						1,765,000	100% Beneficial Reuse; lowest cost permitted site
A-2	A (-32')		1,765,000					1,765,000	100% Beneficial Reuse; maximum Montezuma use
A-3	A (-32')		46,000*	1,719,000				1,765,000	Placement at SF-DODS with an allowance for wetland foundation material placement at Montezuma
A-4	A (-32')		46,000*		1,719,000			1,765,000	Maximum South Bay Beneficial Reuse; maximum Eden Landing use with an allowance for wetland foundation material placement at Montezuma
A-5	A (-32')		46,000*			1,719,000		1,765,000	Maximum South Bay Beneficial Reuse, maximum Alviso use with an allowance for wetland foundation material placement at Montezuma
B-1	B (-34')	2,800,000	1,161,000					3,961,000	100% Beneficial Reuse; assuming 1 Year of Cullinan use
B-2	B (-34')		81,000*	3,880,000				3,961,000	Most cost-effective approach
B-3	B (-34')	3,000,000		961,000				3,961,000	Maximum Cullinan use; remainder to most cost-effective site
B-4			3,961,000					3,961,000	100% Beneficial Reuse, maximum Montezuma use
B-5	B (-34')		81,000*		3,880,000			3,961,000	Maximum South Bay Beneficial Reuse; maximum Eden Landing use with an allowance for wetland foundation material placement at Montezuma
B-6	B (-34')		81,000*			3,880,000		3,961,000	Maximum South Bay Beneficial Reuse;

Alt No.	Dredging Option (feet MLLW)	Placement Site Use (cy)							
		Cullinan	Montezuma	SF-DODS	Eden Landing	Alviso – Pond A2W Delivery	Alviso – Pond A9 Delivery	Total Volume (cy)	Formulation Strategy
									maximum Alviso use with an allowance for wetland foundation material placement at Montezuma
C-1	C (-37')	2,800,000	4,915,000					7,715,000	100% Beneficial Reuse; high Cullinan use
C-2	C (-37')		138,000*	7,577,000				7,715,000	Most cost-effective approach
C-3	C (-37')	3,000,000		4,715,000				7,715,000	100% Beneficial Reuse; maximum Cullinan use and supporting SF-DODS use
C-4	C (-37')		7,715,000					7,715,000	100% Beneficial Reuse; maximum Montezuma use
C-5	C (-37')		138,000*		7,577,000			7,715,000	Maximum South Bay Beneficial Reuse; maximum Eden Landing use with an allowance for wetland foundation material placement at Montezuma
C-6			138,000*			7,577,000		7,715,000	Maximum South Bay Beneficial Reuse; maximum Alviso use with an allowance for wetland foundation material placement at Montezuma

*Volume that represents 5% of the dredged material from the RWC Channel deepening that is assumed to be unsuitable for wetland cover.

Final Placement Site Evaluation

The evaluation of potential placement sites focused on site availability, capacity, and the permit status. Although highly desirable due to their proximity to the dredging sites, both Eden Landing and Alviso Pond Complex sites are still in the early development phase. The Environmental Impact Reports for the sites have not been completed. Even though the site owners indicate that the sites could be ready by 2018, it is not certain that permitting would be complete and the facilities for transporting the dredged material would be constructed and operational by that time. Additionally, there is no proponent that has come forward at this time to finance the operations required to offload and transport the dredged material to the site. Therefore, both the Alviso Pond Complex and Eden Landing sites are not being considered further at this time. As a result, Alternatives A-4, A-5, B-5, B-6, C-5 and C-6 are not being carried forward for evaluation at this time. However, if either Alviso Pond Complex or Eden Landing sites were to be permitted and available by 2018 and were found to be cost effective, use of these sites will be reconsidered. To advance the potential use of the Alviso Pond Complex or Eden Landing, the impacts of using these sites have been evaluated in the main integrated report and ***Appendix A*** to the extent possible with available information.

The two upland beneficial reuse sites, Cullinan Ranch Tidal Restoration Project and Montezuma Wetlands Restoration Project, are already available and permitted, as is the ocean disposal site SF-DODS, so these were retained for use in the final array of alternatives. However preliminary cost numbers on using both Cullinan and Montezuma in combination for placement sites were not cost effective. It was less expensive to use only one or the other. As a result both alternatives B-1 and C-1 were also not carried further for continued evaluation.

Analysis of the impacts of channel deepening determined that a slight realignment of the RWC Channel was necessary to avoid or minimize impacts to adjacent tidal mudflats. The current alignment of the channel near the entrance closely follows the border of outer Bair Island. The realignment would slightly shift the channel (approximately 6 feet) in an easterly direction away from outer Bair Island. As a result, the screened alternatives listed in ***Table ES-5*** include this slight realignment of the RWC Channel.

Table ES-5. Screened Alternative Plans

Alternative	Channel Depth	Placement Site
A-1	32	Cullinan*
A2	32	Montezuma*
A-3	32	SF-DODS*
B-3	34	Cullinan*
B-4	34	Montezuma
B-2	34	SF-DODS*
C-3	37	Cullinan*
C-4	37	Montezuma
C-2	37	SF-DODS*

* 5% of dredged RWC Channel dredged material was placed at Montezuma and remainder was placed at site shown in table.

ES.8 Identification of the NED Plan

National economic development (NED) benefits are defined as increases in the net value of the national output of goods and services, expressed in monetary units. The NED plan is the plan that maximizes net NED benefits, consistent with the Federal objective. Net NED benefits are calculated by subtracting the average annual costs of an alternative from its average annual benefits.

Cost estimates were prepared for the screened alternative plans to include the costs of dredging and hauling the material to placement sites, mobilization and demobilization, planning engineering and design, construction management, contingency, operations and maintenance, and relocations.

The costs and benefits of deepening to -32, -34, and -37 feet MLLW were analyzed to determine annual project costs, annual NED benefits, and annual net NED benefits. ***Table ES-6*** provides the results of the economic evaluation and provides the basis for identification of the NED plan, which is highlighted in green.

Table ES-6. Economic Analysis of Alternative Plans

Placement Site	Alternative	Depth (ft)	Total Project Cost ($1,000)	Annual Benefits ($)	Annual Project Costs ($)	Annual Net Benefits ($)	Benefit to Cost Ratio	Result
Montezuma	A-2	32	75,950	3,950,000	3,600,000	350,000	1.1	Retain
	B-4	34	161,680	7,540,000	7,653,000	-113,000	1.0 (rounded)	Not carried forward
	C-4	37	315,150	8,110,000	14,769,000	-6,659,000	0.5	Not carried forward
Cullinan	A-1	32	73,588	3,950,000	3,501,500	448,500	1.1	Retain
	B-3	34	148,070	7,540,000	7,085,500	454,500	1.1	Retain
	C-3	37	300,450	8,110,000	14,156,000	-6,046,000	0.6	Not carried forward
SF-DODS	**A-3**	**32**	**73,150**	**3,950,000**	**3,483,000**	**466,800**	**1.1** (1.134 rounded)	**Retain (NED Plan)**
	B-2	34	151,050	7,540,000	7,209,750	330,250	1.1 (1.0458 rounded)	Retain
	C-2	37	292,950	8,110,000	13,843,500	-5,733,500	0.6	Not carried forward

The NED plan was identified as Alternative A-3: Channel Deepening to 32 feet with dredged material placed at the SF-DODS. This plan had the greatest net NED benefits (and the highest benefit to cost ratio. The NED plan will provide significant deep draft navigation benefits via a reduction of light loading and lightering operations, which will realize greater efficiencies and transportation cost savings. The NED Plan and all the other plans that resulted in positive annual net benefits were retained for further evaluation.

Four Accounts Evaluation of Alternatives

The remaining alternatives were further evaluated in three categories (also called accounts) of effects: Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). The EQ, RED, and OSE accounts are described below and the results of the evaluation are summarized in ***Table ES-7***.

- ***Environmental Quality (EQ) Account*** addresses ecological, cultural, and aesthetic effects associated with implementation of the alternative plans.
- ***Regional Economic Development (RED)*** is based on regional jobs created as a result of project construction.
- ***Other Social Effects (OSE)*** relates to navigational and public safety.

Table ES-7. Evaluation Results Using Four Planning Accounts

	Montezuma	Cullinan		SF-DODS	
Depth	**32 (A-2)**	**32 (A-1)**	**34 (B-3)**	**32 (A-3)**	**34 (B-2)**
1. NED: Annual Net Benefits	$350.0k	$448.5k	$454.5	$466.8k	$330.3
2. EQ: Environmental Impacts	Low	Low	Low	Medium	Medium
3. RED: Regional Job Creation	Low	Low	Low	Low	Low
4. OSE: Navigational Safety/Environmental Justice (EJ)	Safe/No EJ impact	Safe/No EJ impact	Safe/No EJ impact	Safe/No EJ impact	Safe/No EJ impact

Planning Criteria Evaluation

Table ES-8 provides a final summary of the evaluation using USACE's four planning criteria: completeness, effectiveness, efficiency and acceptability of the alternatives. Plans that are incomplete (i.e., those that don't have viable placement sites) and plans that are ineffective at reducing transportation costs, were eliminated from the final array of alternatives, therefore all remaining alternatives are complete and effective. Efficiency was evaluated based on the net benefits of the plans. Plan A-3: Channel Deepening to 32 feet with dredged material placed at SF-DODS, maximized net NED benefits at $1.5M.

Acceptability will be confirmed prior to finalizing this report. Based on this evaluation, the Tentatively Selected Plan is dredging to 32 feet and placement of dredged material in SF-DODS. This is also the NED Plan.

Table ES-8. Planning Criteria Evaluation

Placement Sites	Montezuma	Cullinan		SF-DODS	
Channel Depths	**32 (A-2)**	**32 (A-1)**	**34 (B-3)**	**32 (A-3)**	**34 (B-2)**
Completeness: *Actions of others required*	Complete Available Capacity Permitted	Complete Available Capacity Permitted	Complete Available Capacity Permitted	Complete Available Capacity Permitted	Complete Available Capacity Permitted
Effectiveness: *Transportation Cost Savings*	Meets objective	Meets objective	Meets objective	Meets objective	Meets objective
Efficiency: *Net Benefits*	$350,000	$448,500	$454,500	$466,800	$330,250
Compliance with Fed Law	Meets objective	Meets objective	Meets objective	Meets objective	Meets objective
Result	**Drop**	**Drop**	**Drop**	**TSP**	**Drop**

ES.9 Summary of Environmental Impacts and Mitigation

Table ES-9 shows the maximum level of impact that would be expected associated with each project alternative.

Table ES-9. Comparison of Impacts by Project Alternative

	ALTERNATIVE										
Environmental Resource	**A-1**	**A-2**	**A-3**	**B-1**	**B-2**	**B-3**	**B-4**	**C-1**	**C-2**	**C-3**	**C-4**
Air Quality and Greenhouse Gases	-3/ B**	-3/ B**	-3/ B**	-3/ B**	-3/ B**	-3/ B**	-3/ B**	-3/ B**	-3/ B**	-3/ B**	-3/ B**
Biological Resources	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Cultural Resources	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Geology/Soils/Seismicity	0	0	0	0	-0	0	0	-1	-1	-1	-1
Hazards and Hazardous Materials*	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0
Land Use	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Noise	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Recreation	-1	0	0	-1	0	-1	0	-1	0	-1	0
Socioeconomics	B	B	B	B	B	B	B	B	B	B	B
Transportation and Navigation**	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B
Utilities and Service Systems*	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1
Water Quality and Hydrology	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2

The level of impact assigned to each alternative is based on the highest impact that could occur, even if that impact would occur at only one site in the alternative (for alternatives that contain more than one placement site).

Impact Rating:
-3 = significant and unavoidable adverse impact
-2 = significant but mitigable adverse impact
-1 = adverse but not significant impact
0 = negligible or no impact
B = beneficial
* Second rating would apply if dredges are electrically powered, or an electric offloader is used, or sediment is pumped directly to the site via an electrically-powered cutterhead dredge
** First rating is for construction phase/second rating is for post-construction phase

Based on the impact assessment, the expected impacts of the alternative plans are summarized below.

No Impact or No Significant Impacts to the Following Resources

- Aesthetics
- Hazards and Hazardous Materials
- Land Use and Planning
- Mineral Resources
- Public Services
- Recreation
- Socioeconomics/Population/Housing
- Transportation/Navigation/Traffic
- Utilities/Service Systems

With Mitigation, No Significant Impact to the Following Resources

- Air Quality and Green House Gases
- Cultural Resources
- Geology/Soils/Seismicity
- Noise and Vibration

Significant and Unavoidable Impacts

- Biological Resources
- Water Quality

Significant and unavoidable impacts to biological and water quality resources would be the result of turbidity caused by use of the jet sled construction method for relocation of the pipelines crossing the SBS Channel. Two alternative methods for relocating the pipelines, use of clamshell excavation or directional drilling, would have less than significant impacts.

ES.9 Major Conclusions and Findings

The tentatively selected plan is the NED Plan, identified generally as the **32 foot depth deepening at both Redwood City Harbor and San Bruno Shoal Channels with a slight realignment at Redwood City Harbor to avoid sensitive environmental features of Bair Island and Greco Island including the peripheral mudflats.** The plan features are described below.

- Both channels will be deepened from -30 feet to -32 feet MLLW. The side slopes of both channels will be maintained at 3H:1V. An additional one foot of paid overdepth will be allowed; an additional one foot of overdepth will be allowed but not paid.

- The channel at Redwood City Harbor would range from 350 feet wide near the entrance to 288 feet throughout the rest of the channel. The channel alignment at the turn into Redwood City Harbor will retain the existing width but will be slightly shifted as follows:
    - From Station 80+00 to Station 122+ 00 the channel will be realigned 6 feet to the east away from Bair Island.
    - From Station 127+00 to Station 140+00 the channel will be realigned 6 feet towards the west to avoid impacts to adjacent Greco Island mudflats.
    - From Station 140+00 to Station 155+00 the channel will be shifted 6 feet away from Bair Island.
    - From Station 155+00 to Station 162+00 the channel will be reduced in width by 12 feet so as to avoid impacts to the RWC port facilities and Bair Island.
    - From Station 162+00 to the end of the turning basin, the channel width was reduced by six feet on the Bair Island side only so as to avoid adverse impact to Bair Island.
- The SBS Channel will remain approximately 500 feet wide and 29,850 feet (5.65 miles) long and will not be realigned. Some extension may be required to ensure a smooth transition to the existing channel bottom.
- At approximately station 38+00 on SBS Channel, 10 inch and 12 inch petroleum pipelines that will be adversely impacted due to their location relative to the new deepened channel will be lowered (relocated) to accommodate the increased channel depth. These two pipelines are owned by Kinder Morgan.
- At approximately station 148+70 on the SBS Channel, a ten inch petroleum pipeline owned by the Shell Oil Company that will also be impacted by the deepened channel will be lowered (relocated) to accommodate the increased channel depth.

ES.10 Areas of Controversy

One issue of known controversy has been identified. As documented in USEPA's comment letter received during the scoping period, resource and regulatory agencies are targeting 100 percent beneficial reuse for deepening projects (the USEPA letter is provided in ***Appendix K***). The USACE's policy for determining the NED Plan requires that national economic development benefits be maximized, which in turn requires use of the lowest cost placement site. For this project, the lowest cost placement option is disposal at SF-DODS. An NED Plan relying primarily on SF-DODS for dredged sediment placement would be controversial.

Should the Eden Landing or possibly Alviso ponds become available as a dredged sediment placement site by the time the proposed Project is ready to go to construction, they may be a less expensive location for dredged sediment placement than SF-DODS.

ES.11 Regulatory Requirements

Implementation of the Tentatively Selected Plan (TSP) requires compliance with applicable federal, state and local statutes and policies pertaining to dredging and dredged material placement activities, and protection of aquatic and terrestrial resources. Some of these laws require the USACE to obtain permits, certifications, or approvals from other agencies before taking action. The status of coordination required for key federal and state laws applicable to the TSP and for which permits or certifications are required are described below.

Federal Laws

National Environmental Policy Act (NEPA): The USACE will request a 401 Water Quality Certification pertaining to the proposed action concurrent with the Draft EIS/EIR. With issuance of a WQC from the RWQCB, the USACE would be in full compliance with this Act.

Endangered Species Act (ESA): The USACE has been coordinating with USFWS and National Marine Fisheries Service (NMFS) through informal meetings and discussions. An ESA Section 7 Biological Assessment will be prepared and appended to this integrated feasibility report and EIS/EIR. The biological assessment will include the USACE's determination of the listed species that may be adversely affected by the proposed project. Formal Section 7 Consultation will be initiated following the release of the Draft EIS/EIR. The USFWS is expected to complete a Biological Opinion in regard to the TSP to complete the consultation requirements. With issuance of a Biological Opinion from the USFWS, the USACE would be in full compliance with this Act.

Fish and Wildlife Coordination Act (FWCA): The USFWS and CDFW have participated in evaluating the proposed project and USACE is considering all recommendations proposed by the agencies. A Coordination Act Report (CAR) will be requested. When complete, it will be appended to this integrated feasibility report and EIS/EIR. With issuance of a final CAR from USFWS and CDFW, the USACE would be in full compliance with this Act.

Magnusun-Stevens Fishery Conservation and Management Act: An Essential Fish Habitat Assessment will be prepared and appended to this integrated feasibility report and EIS/EIR. The NMFS is expected to issue EFH Conservation Recommendations to avoid, minimize, mitigate, or otherwise offset any identified adverse effects of the project prior to the issuance of the Record of Decision (ROD). The RWC project will be in full compliance with this Act once a response is provided to the EFH conservation recommendations.

Coastal Zone Management Act (CZMA): The USACE will prepare a draft CZMA federal consistency determination and submit documentation of compliance with applicable chapters

of the CZMA to the San Francisco Bay Conservation and Development Commission (BCDC) after release of the draft EIS/EIR. The USACE will be in full compliance with the CZMA when the BCDC issues a consistency determination.

Rivers and Harbors Act: The USACE does not issue itself Section 10 permits, however, it may issue a Section 10 permit to the non-federal sponsor, if required. The USACE will ensure compliance with Section 10 before completion of the NEPA process.

Clean Air Act (CAA): A General Conformity Applicability Analysis pertaining to the proposed action is included in this document (***Appendix A***). This consists of calculation of the foreseeable indirect emissions for each alternative. Foreseeable indirect emissions include operational emissions as well as the incremental increase in emissions from recurring operations and maintenance (O&M) dredging. The direct emissions for each alternative plus the indirect emissions are compared to the Federal deminimis levels. If the emissions from the project (including mitigation measures) fall below Federal de minimis levels then no Conformity Determination will be needed. If emissions exceed deminimis levels, a General Conformity Analysis will be prepared. When the EPA issues a Conformity Determination the USACE will be in compliance with the Clean Air Act.

State Laws

California Environmental Policy Act (CEQA): This EIS is intended to fulfill the requirements of CEQA and the CEQA Guidelines, although as a federal agency, the USACE is not required to comply with CEQA.

California Endangered Species Act (CESA): This document analyzes impacts to species listed under CESA to facilitate issuance of a WQC.

Contents

1 Study Information 1-1

1.1 Study Authority 1-1

1.2 Purpose and Need for Project 1-2

1.3 Project Sponsor and Participants 1-2

1.4 History of Investigations in the Study Area 1-3

1.5 Existing Programs, Studies, and Projects 1-3

1.5.1 San Francisco Bay Long Term Management Strategy for Dredged Material Placement 1-3

1.5.2 South Bay Salt Pond Restoration Project 1-3

1.5.3 South Bay Shoreline Study 1-4

1.6 Planning Process Overview 1-5

1.7 Report Organization 1-6

1.8 NEPA/CEQA Documentation 1-7

2 Problem Identification and Planning Objectives 2-1

2.1 Study Area 2-1

2.2 Port Commodities and Traffic 2-5

2.3 Redwood City and San Bruno Shoal Channels 2-8

2.4 Navigation Problems 2-12

2.5 Navigation-Related Opportunities 2-14

2.6 Planning Objectives 2-15

2.7 Planning Constraints 2-16

3 Alternatives 3-1

3.1 Future Without Project Condition 3-1

3.2 Management Measures 3-2

3.3 Initial Screening of Management Measures 3-2

3.4 Measures Retained for Further Consideration 3-12

3.5 Plan Formulation Strategy 3-14

3.5.1 Dredging Management Measures 3-14

3.5.2 Placement Measures 3-14

3.5.3 Placement Site Screening Criteria 3-15

3.5.4 Screening of Potential Placement Sites 3-16
3.5.5 Placement Site Screening Results 3-24
3.6 Focused Array of Alternatives 3-24
4 Affected Environment, Environmental Consequences, and Mitigation Measures 4-1
4.1 Introduction 4-1
4.2 Overview of the Affected Environment 4-1
4.2.1 Project Location 4-1
4.2.2 Project Overview 4-5
4.2.3 Construction Process 4-11
4.2.4 Overall Physical, Environmental, and Social Setting of Study Area 4-32
4.3 Project Alternatives Analysis Considerations 4-42
4.4 Overall Regulatory Setting 4-51
4.5 Evaluation of Alternative Plans 4-51
4.5.1 No Action/No Project Alternative 4-53
4.5.2 Comparison of Impacts by Dredging Option and Placement Site 4-55
4.5.3 Comparison of Project Alternatives 4-63
5 NEPA/CEQA Considerations and Other Required Analyses 5-1
5.1 Unavoidable Adverse Impacts/Unavoidable Significant Impacts 5-1
5.2 Issues of Known Controversy 5-2
5.3 Relationship of Short-Term Uses and Maintenance/Enhancement of Long-Term Productivity 5-3
5.4 Irreversible and Irretrievable Commitments of Resources 5-4
5.5 Growth-Inducing Impacts 5-5
5.6 Environmental Justice 5-6
5.6.1 Affected Environment 5-6
5.6.2 Potential Effects on Environmental Justice Populations 5-12
5.7 Energy Resources 5-14
5.8 Cumulative Impacts 5-16
5.8.1 Assessment Methodology and Thresholds 5-16
5.8.2 Summary of All Cumulative Impacts for Each Resource 5-21
5.8.3 Contextual Relationship between Alternatives and Cumulative Impacts 5-25

5.9 Environmentally Superior/Environmentally Preferable Alternative 5-26
6 Identification of the Tentatively Selected Plan 6-1
6.1 Final Array of Alternative Plans 6-1
6.1.1 Final Evaluation of Placement Sites 6-1
6.2 Descriptions of the Nine Final Alternative Plans 6-4
6.3 Evaluation Criteria 6-6
6.3.1 NED Analysis 6-7
6.3.2 Four Accounts Evaluation 6-8
6.3.3 Planning Criteria Evaluation 6-9
6.4 Identification of the Tentatively Selected Plan (TSP) 6-10
6.4.1 Four Accounts Evaluation of the TSP 6-10
6.4.2 Planning Criteria Evaluation of the TSP 6-11
7 Public Involvement, Review, and Coordination 7-1
7.1 Public Involvement 7-1
7.1.1 Scoping Meeting 7-1
7.2 Institutional Involvement 7-1
7.2.1 Interagency Meeting 7-1
7.3 Report Circulation 7-2
7.4 Public Views and Responses 7-2
8 List of Preparers 8-1
9 Compliance with Applicable Laws, Policies, and Plans 9-3
9.1 Federal Laws 9-3
9.1.1 National Environmental Policy Act (NEPA) 9-3
9.1.2 Clean Water Act (CWA), Section 401 Water Quality Certification 9-3
9.1.3 Clean Water Act (CWA), Section 404 9-4
9.1.4 Endangered Species Act 9-4
9.1.5 Fish and Wildlife Coordination Act (FWCA) 9-5
9.1.6 Magnusun-Stevens Fishery Conservation and Management Act 9-5
9.1.7 Coastal Zone Management Act (CZMA) 9-6
9.1.8 Rivers and Harbors Act 9-6
9.1.9 Clean Air Act (CAA) 9-6

9.2 State Laws 9-7
9.2.1 California Environmental Policy Act (CEQA) 9-7
9.2.2 California Endangered Species Act (CESA) 9-7
10 Recommended Plan 10-1
10.1 Plan Components 10-1
10.2 Dredging Considerations 10-2
10.2.1 Dredging Volumes 10-2
10.2.2 Disposal of Dredged Material at SF-DODS 10-3
10.3 Equipment and Construction Considerations 10-3
10.3.1 Equipment 10-3
10.3.2 Construction Considerations 10-5
10.4 Real Estate Requirements 10-6
10.5 Pipeline Relocations 10-6
10.6 Local Betterments 10-7
10.7 Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) 10-7
10.8 Cost Apportionment 10-8
11 Recommendations 11-1
12 References 12-1
13 Index 13-1

Tables

Table 1-1. Study Authorizations 1-1
Table 1-2. Location of NEPA/CEQA Sections in this Report 1-7
Table 2-1. Port of Redwood City Commercial Traffic 2-6
Table 2-2. Redwood City Harbor Channel Dimensions and Historical Maintenance Dredging 2-9
Table 2-3. Port of Redwood City Vessel Characteristics 2-13
Table 3-1. Target Objectives and Accompanying Management Measures 3-3
Table 3-2. Summary of Initial Screening Results 3-12
Table 3-3. Initial Array of Potential Placement Sites 3-15
Table 3-4. Placement Site Screening Results 3-24
Table 3-5. Summary of Project Alternatives 3-26
Table 4-1. Estimated Maximum Volume of Sediment to be Dredged Compared to the Volume used in the Cost Estimate 4-6

Table 4-2. Placement Site Operations 4-22
Table 4-3. Estimated Annual Post-Construction Maintenance Dredging Sediment Volume ... 4-29
Table 4-4. Deep Draft Vessel Call Projections 4-32
Table 4-5. Summary of Impacts and Mitigation Measures 4-43
Table 4-6. Comparison of Dredging Volumes and Project Construction Durations 4-53
Table 4-7. Comparison of Impacts by Dredging Option and Placement Site 4-57
Table 4-8. Comparison of Impacts by Project Alternative 4-64
Table 4-9. Construction Phase Air Pollutant Emissions Associated with Each Alternative 4-66
Table 5-1. Socioeconomic Data by Jurisdiction and Project Site, Redwood City Harbor Navigation Improvement Project 5-9
Table 5-2. Cumulative Impacts – Current and Reasonably Foreseeable Future Projects 5-18
Table 6-1. Economic Analysis of Alternative Plans 6-8
Table 6-2. Evaluation Results Using Four Planning Accounts 6-9
Table 6-3. Planning Criteria Evaluation 6-10
Table 8-1. List of Preparers 8-1
Table 10-1. Redwood City Navigation Improvement Project Cost Apportionment 10-8

Figures

Figure 1-1. South Bay Salt Pond Restoration Projects: Eden Landing, Ravenswood, and Alviso 1-4
Figure 1-2. SMART Planning Process 1-6
Figure 2-1. Study Area 2-2
Figure 2-2. Redwood City Channel and Bair and Greco Islands 2-3
Figure 2-3. Port of Redwood City 2-4
Figure 2-4. Tonnage by Commodity for Port of Redwood City 2-5
Figure 2-5. Sediment Volume Change in RWC Harbor channel 2004-2014 (Delta Modeling Associates, 2014) 2-10
Figure 2-6. Sedimentation “Hot Spots” on the Redwood City Harbor Channel 2-11
Figure 2-7. Typical Clamshell Dredge 2-12
Figure 3-1. Conceptual Cross Section of Realigned Channel 3-8
Figure 3-2. Typical Bottom Cut Channel Cross Section 3-8
Figure 3-3. South Bay Salt Pond Restoration – Potential Placement Sites 3-18
Figure 3-4. San Francisco Deep Ocean Disposal Site (SF-DODS) 3-23
Figure 4-1. Sub-bays of San Francisco Bay 4-2
Figure 4-2. Eden Landing Ponds 4-3
Figure 4-3. Alviso Pond Complex 4-4
Figure 4-4. Montezuma Wetland Restoration and Cullinan Ranch Restoration Sites 4-5
Figure 4-5. Proposed RWC Channel Realignment at -32 feet MLLW Depth 4-8
Figure 4-6. Typical Offloader Facilities 4-11
Figure 4-7. Hydraulic Cutterhead Dredge 4-18

Figure 4-8. Typical Bottom Dump Scow 4-38
Figure 6-1. Sites Retained in the Final Alternatives 6-3
Figure 10-1. Conceptual Depiction of Overcut Dredging 10-2
Figure 10-2. Conceptual Depiction of Overdepth Grade Dredging 10-3

Appendices

Appendix A: Affected Environment Resource Assessment
Appendix B: Civil Design
Appendix C: Cost Engineering
Appendix D: Geotechnical Engineering
Appendix E: Water Resources Engineering
Appendix F: Real Estate
Appendix G: Regulatory Setting
Appendix H: Species of Concern
Appendix I: Sediment Data
Appendix J: Economics
Appendix K: NEPA/CEQA Scoping Meeting Summary

1 Study Information

This document describes investigations and alternatives to improve navigation efficiency at Redwood City (RWC) Harbor and San Bruno Shoal (SBS) Channel, evaluations of the potential environmental impacts of such improvements, and identification of a tentatively selected plan. It integrates the following elements:

- Requirements of the United States Army Corps of Engineers (USACE) feasibility study planning process;
- An Environmental Impact Statement (EIS) prepared in compliance with the National Environmental Policy Act (NEPA); and
- An Environmental Impact Report (EIR) prepared in compliance with the California Environmental Quality Act (CEQA).

This report documents a single purpose deep draft navigation study of the Redwood City Harbor Project.

1.1 Study Authority

There have been a number of reports since 1882 for Redwood Creek, California. Federal authorizations for improvements are listed in ***Table 1-1***:

Table 1-1. Study Authorizations

Document Containing Report	Authorization	Recommendations
H. Doc. No. 307; 61st Congress, 2nd Session	June 25, 1910	5- foot deep channel
H. Doc. No. 142; 70th Congress, 1st Session	July 3, 1930	20- foot deep channel
River and Harbors Committee Doc. No. 10, 73rd Congress, 1st Session	Aug. 30, 1935	27-foot deep channel and added a Turning Basin
H. Doc. No. 94; 79th Congress, 1st Session	Mar. 2, 1945	30-foot deep channel; enlarged Turning Basin in Redwood Creek; added the dredging of a 30-foot deep channel across San Bruno Shoal.
H. Doc No. 104, 81st Congress, 1st Session	1949	Changed name to Redwood City Harbor (from Redwood Creek) and further enlarged both turning basin and the channel connecting to the upstream end of the main navigation channel

Deepening the RWC and SBS Channels to the authorized depth of -30 feet Mean Lower Low Water (MLLW) was completed in 1965. The study documented in this report was authorized by House Resolution 2511 adopted May 7, 1997:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Redwood City Harbor, California, published as House Document 104, 81st Congress, 1st Session, and any other pertinent reports to determine whether modifications of the recommendations contained therein are advisable at the present time in the interest of navigation improvements and related purposes at Redwood City Harbor, California, with particular reference to providing increased depths to accommodate new, larger vessels that now call on the port."*

1.2 Purpose and Need for Project

The existing navigation project channels at RWC Harbor and SBS, as currently authorized, do not allow for the efficient operation of the existing vessel fleet that calls on the Port. The purpose of this Redwood City Harbor Navigation Improvement Feasibility Report and Integrated EIS/EIR is to document investigations to determine the extent of Federal interest in plans that would improve navigation at RWC and SBS Channels and evaluate the potential environmental impacts of such plans. This report: (1) assesses the environmental and socio-economic conditions associated with the existing navigation project; (2) develops a range of alternative plans for navigation improvements at RWC and SBS Channels; (3) assesses the environmental and socioeconomic impacts of each alternative plan; and (4) identifies the Recommended Plan for implementation.

1.3 Project Sponsor and Participants

The Non-Federal Sponsor (NFS) is the Port of Redwood City. The Port was established under Redwood City's Charter as a department of the City and is managed by the Board of Port Commissioners, whose five members are appointed by the City Council. The Port operates from its own revenue and receives no tax dollars. Its' performance in FY 2014 showed increases in both tonnage and record-setting revenue. Cargo tonnage increased 19 percent over last year to almost 1.8 million tons. Vessel traffic also increased to 64 ship calls for the year. Financially, the Port's increased activity generated a nine percent increase in operating revenue for a record total of $6.8 million. And operating income after expenses also increased over last year by 26 percent.

A feasibility cost sharing agreement was signed in July of 2008 with a 50/50 cost share for the feasibility study. The Port of Redwood City will also satisfy the terms of local cooperation for implementation and operation of the recommended plan.

1.4 History of Investigations in the Study Area

A Reconnaissance Study was conducted by USACE in 1998 and confirmed the Federal Government's interest in navigation improvements at the Port of Redwood City. The Reconnaissance Study recommended that the next step, a Feasibility Study, be undertaken to evaluate alternatives to improve navigation, including deepening the channels.

1.5 Existing Programs, Studies, and Projects

1.5.1 San Francisco Bay Long Term Management Strategy for Dredged Material Placement

The San Francisco Bay Long Term Management Strategy (LTMS) for dredged sediment was developed by the San Francisco District, USACE, U.S. Environmental Protection Agency (USEPA), San Francisco Bay Conservation and Development Commission (BCDC), and the San Francisco Bay Regional Water Quality Control Board (RWQCB). The plan addresses San Francisco, San Pablo, and Suisun Bays. Its objectives are to:

- Maintain in an economically and environmentally sound manner those channels necessary for navigation in San Francisco Bay and Estuary and eliminate unnecessary dredging activities in the Bay and Estuary;
- Conduct dredged material disposal in the most environmentally sound manner;
- Maximize the use of dredged material as a resource; and
- Establish a cooperative permitting framework for dredging and disposal applications.

The Plan was adopted in 2002 with a certified EIS/EIR and Record of Decision (ROD) in 2004. It established a policy for placement of dredged material - 40 percent upland, 40 percent ocean, and 20 percent in-Bay disposal. The LTMS Management Committee, in the 12-year review of the LTMS in 2012, described its intent to continue to rely on the 40-40-20 goal and further reduce in-Bay and ocean disposal and achieve 80 percent or greater beneficial reuse placement. Since 2012, the goal has been to limit total annual in-Bay placement of dredged material from all sources to no more than 1.25 million cubic yards (mcy).

The San Francisco District, USACE, and the RWQCB have prepared an Environmental Assessment (EA) and EIR to address the potential environmental effects of the maintenance dredging of federal navigation channels in San Francisco Bay and the associated placement of dredged material for the period from 2015 through 2024. The document is intended to serve as the basis for issuance of a Clean Water Act (CWA) Section 401 water quality certification (WQC) by the Regional Water Quality Control Board (RWQCB) and to support decision making by USACE, the Regional Water Board, and other agencies regarding implementation of its recommendations.

1.5.2 South Bay Salt Pond Restoration Project

The South Bay Salt Pond Restoration Project (SBSPR Project) located in South San Francisco Bay was initiated in 2004 with Cargill Salt's sale of 15,100 acres of industrial salt ponds to the U. S. Fish and Wildlife Service (USFWS) and California's Department of Fish and Wildlife (CDFW). The

goals are to restore the ponds and aging levees into marsh habitat while improving flood protection and public recreational access. The Project comprises the Alviso Complex (8,000 acres), the Eden Landing Complex (5,500 acres) and the Ravenswood Complex (1,600 acres). ***Figure 1-1*** shows the location and general outline of the Project.

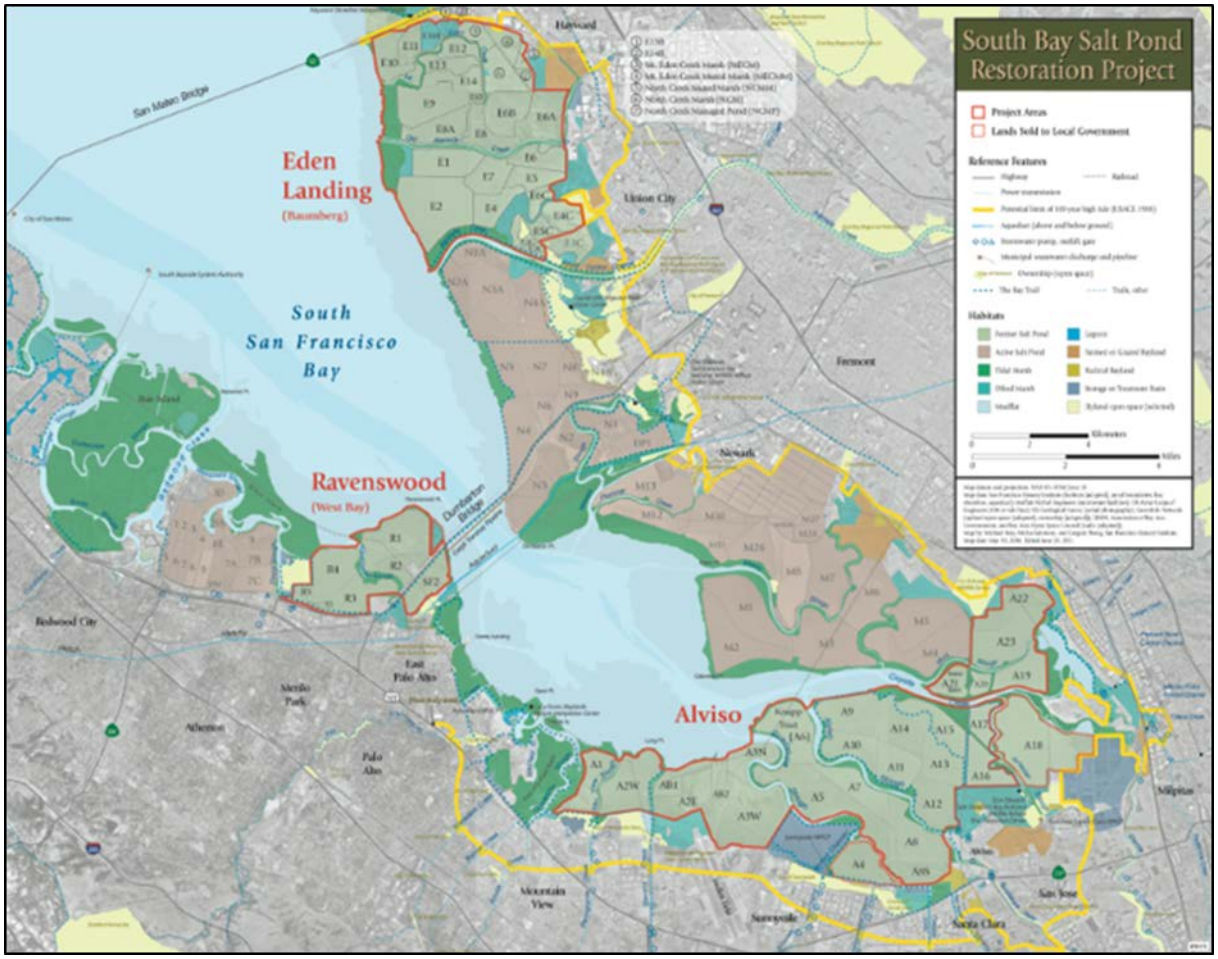


Figure 1-1. South Bay Salt Pond Restoration Projects: Eden Landing, Ravenswood, and Alviso

1.5.3 South Bay Shoreline Study

The South San Francisco Bay Shoreline Study (Shoreline Study) is being conducted by the USACE together with the Santa Clara Valley Water District and the State Coastal Conservancy to identify and recommend flood risk management and ecosystem restoration projects along South San Francisco Bay. Santa Clara County's shoreline is at risk from coastal flooding caused by extreme storm events combined with high tides with increasing risks in the future as sea levels rise. Potential flood damages in Santa Clara County are among the highest in the state.

The Shoreline Study is looking at the feasibility of options for managing flood risk along the South Bay shoreline as well as undertaking ecosystem restoration and expanding public access.

The goal of the Shoreline Study is to protect the parts of Santa Clara County's shoreline with the highest potential damages and threats to human health and safety from flooding, using a combination of flood protection levees and wetlands. This approach involves using natural infrastructure to provide increased flood protection and restored Bay habitats, as well as a flood protection system that can evolve in the future.

The Shoreline Study is being coordinated with the SBSP Project. Once completed, the Shoreline Study recommended plan will likely impact areas surrounding the proposed Alviso Pond Complex Restoration Project.

1.6 Planning Process Overview

This study utilized the USACE six step planning process which consists of the following:

1. specification of water and related land resources problems and opportunities;
2. inventory, forecast, and analysis of water and related land resources conditions within the study area;
3. formulation of alternative plans;
4. evaluation of the effects of the alternative plans;
5. comparison of the alternative plans; and
6. selection of the Recommended Plan based upon the comparison of the alternative plans.

In 2011, USACE adopted a new planning paradigm intended to reduce the time and cost required for completion of a feasibility study. SMART (**S**pecific, **M**easurable, **A**ttainable, **R**isk informed and **T**imely) Planning is a risk-based approach that applies the appropriate level of detail, data collection, and model development necessary to manage risk and uncertainty at acceptable levels and conduct and deliver the study. SMART Planning consists of completing a series of decision milestones during the development of a feasibility study (***Figure 1-2***). The traditional USACE six step planning fundamentals process is still utilized, but five decision milestones are incorporated as described below:

1. Alternatives Milestone: The alternatives have been formulated and screened to identify the final set of alternatives to be evaluated in detail.
2. Tentatively Selected Plan (TSP) Milestone: The final alternatives have been evaluated and compared and the TSP is identified.
3. Agency Decision Milestone: Following the concurrent public, technical, policy, and legal review of the draft feasibility report and accompanying environmental documentation, the USACE endorses the recommended plan.

4. Civil Works Review Board Milestone: All public and agency comments have been addressed and the feasibility report and environmental documentation have been finalized. The final report is approved for release for public and agency review.
5. Chief's Report Milestone: the Chief of Engineer's Report is prepared and submitted to Congress for authorization.

An initial step in each milestone is to identify the planning decisions that will be required to complete the milestone, assess the risks associated with the planning decisions, and develop a work plan that applies the level of effort to the planning tasks that is appropriate to control risks to acceptable levels. The SMART Planning process was utilized for completion of the Redwood City Harbor Navigation Improvement Feasibility Study.

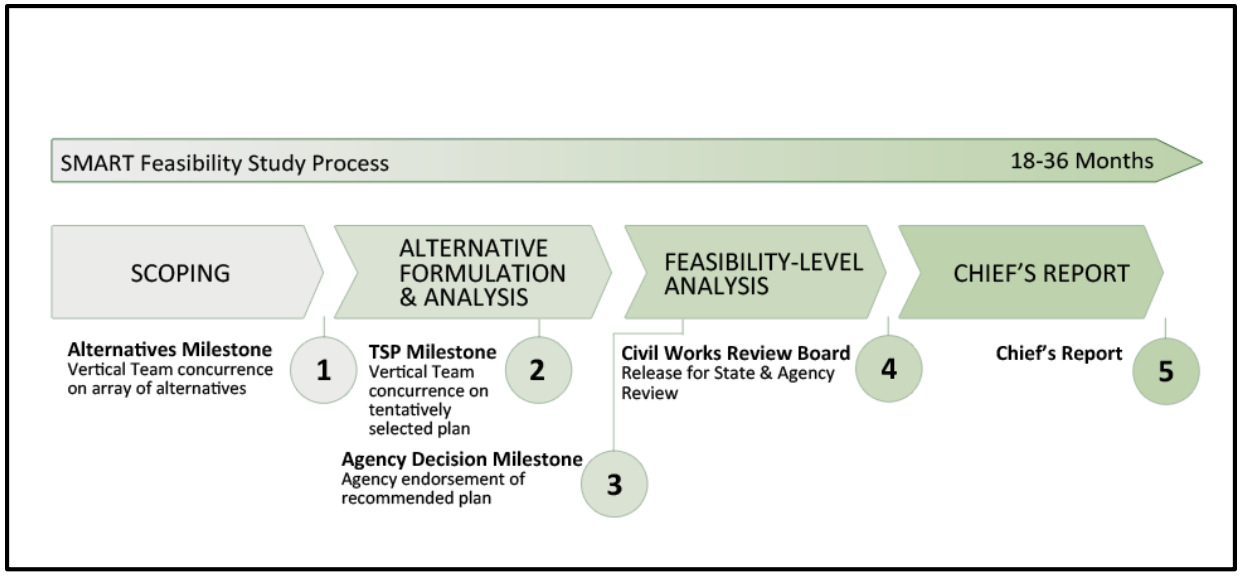


Figure 1-2. SMART Planning Process

1.7 Report Organization

The chapter headings and order in this report generally follow the six step planning process and the outline of a DEIR/DEIS as follows:

- **Chapter 2, Need for and Objectives of Action**, covers the first step in the planning process (specification of water and related land resources problems and opportunities). It also covers the second step of the planning process (inventory of existing conditions and forecast of future conditions) to the extent necessary to establish the future "without-project condition" prior to development of the alternatives. The "without-project condition" also serves as the basis for defining the No Action (NEPA)/No Project (CEQA) alternative required to be analyzed as part of the EIS/EIR.
- **Chapter 3, Alternatives**, describes the process of identifying and screening structural and non-structural management measures, formulating alternative plans, and identifying a final set of alternative plans to be evaluated in detail.

- **Chapter 4, Affected Environment and Environmental Consequences and Mitigation Measures**, is required for NEPA/CEQA documentation. It covers the second step of the planning process (inventory, forecast and analysis of water and related land resources) in greater detail than what was provided in Chapter 2. Chapter 4 also covers the fourth step of the planning process (evaluation of the effects of the alternative plans).
- **Chapter 5, Other Required Analyses**, presents other required NEPA and CEQA analyses.
- **Chapter 6, Identification of the Tentatively Selected Plan** describes the evaluation and comparison of the alternatives and provides the rational for selection of the TSP.
- **Chapter 7, Public Involvement**, discusses public involvement, review, and consultation.
- **Chapter 8, List of Preparers**, provides a list of individuals involved in the preparation of this document, and their respective areas of responsibility.
- **Chapter 9, Compliance with Applicable Laws, Policies, Plans and Regulations**, describes how the study as well as the Recommended Plan comply with applicable regulatory requirements and USACE policies and guidance.
- **Chapter 10, Recommended Plan**, presents a more detailed description of the Recommended Plan and summarizes the basis for that recommendation
- **Chapter 11, Recommendation**, describes the study recommendations
- **Chapter 12, References**, provide the list of references
- **Chapter 13, Index**

1.8 NEPA/CEQA Documentation

Because this report is an integrated Feasibility Report and EIS/EIR, information required for the EIS/EIR is found throughout the document. As required by CEQA, the ***Table 1-2*** presents where the various elements of the EIS/EIR can be found in this report.

Table 1-2. Location of NEPA/CEQA Sections in this Report

NEPA/CEQA Section	Location in this Document
Purpose and Need	Chapter 1
Project Description/Description of Alternatives	Chapter 3 & Chapter 6
Environmental Setting	Chapter 4 & Appendix A
Environmental Effects	Chapter 4 & Appendix A
Mitigation Measures	Chapter 4 & Appendix A
Areas of Known Controversy	Chapter 5
Growth Inducing Impacts	Chapter 5

2 Problem Identification and Planning Objectives

2.1 Study Area

Redwood City Harbor is located on the southwest side of San Francisco Bay, approximately 18 miles south of San Francisco, California (***Figure 2-1***). It is within the corporate limits of Redwood City, in San Mateo County. The study area includes the existing Federal navigation channel and turning basins at Redwood City Harbor, extending from the mouth of Redwood Creek to deep water in the San Francisco Bay. The Federal navigation channel at San Bruno Shoal in San Francisco Bay is also included in the study area, having been added to the Federal project by the 1945 authorizing legislation. It is located north of Redwood City and lies within the corporate boundaries of the cities of both Brisbane and South San Francisco, California. Both channels are currently authorized to be maintained at -30 feet MLLW.

Potential dredged material placement sites that have been considered for this study[3] include:

- Montezuma Wetland Restoration Project,
- Cullinan Ranch Tidal Restoration Project,
- Eden Landing Pond Complex,
- Alviso Pond Complex
- San Francisco Deep Ocean Disposal Site (SF-DODS), which is also part of the study area but is located about 50 miles offshore from the Golden Gate Bridge.

Bair Island and Greco Island are adjacent to the harbor (***Figure 2-2***) and are considered to be in the project area because of their proximity to the channel. Bair Island is operated by the USFWS and is the site of a restoration project. The bay water around Bair Island and the harbor is within the Don Edwards Marine Protected Area.

[3] Other potential placement sites were considered during the planning process, but were screened from further consideration.



Figure 2-1. Study Area



Figure 2-2. Redwood City Channel and Bair and Greco Islands

Port facilities adjacent to the study area include two office complexes, a conference center, a restaurant, and public access facilities (boat launch, walkways, restrooms, and parking). The Port maintains three berth facilities at a depth of 34 feet MLLW, and a small facility used to unload cement and aggregates via barge (***Figure 2-3***).

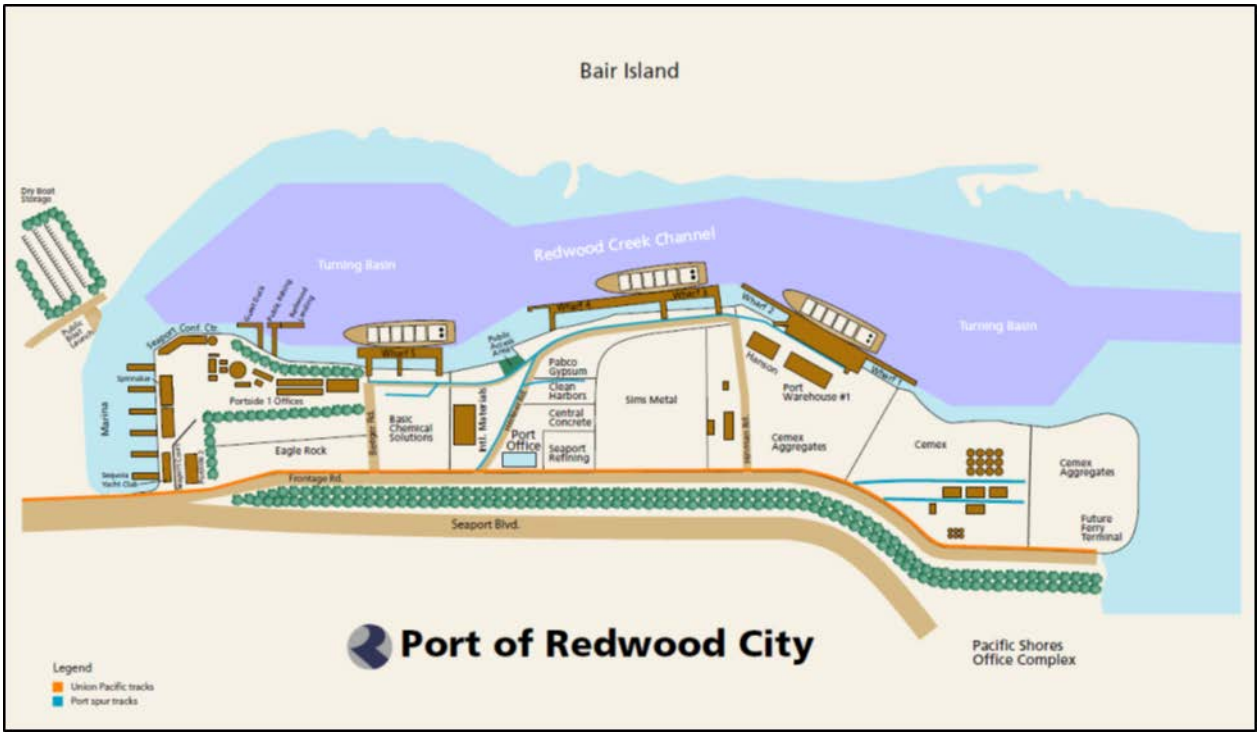


Figure 2-3. Port of Redwood City

Union Pacific Railway tracks are located directly alongside the Port facilities. U.S. Highway 101 is approximately one mile south of the Harbor. The area surrounding the Harbor is zoned as General Industrial (GI), Industrial Restricted (IR), and Industrial Park (IP). The area southwest of the Harbor, on the east side of HWY 101, is zoned Commercial General (CG), Commercial General Restricted (CG-R), and Planned Community District (CMD).

The SBS Channel overlays three petroleum pipelines. (***Figure 2-1***). They consist of a 10-inch diameter Shell petroleum line, and 10-inch and 12-inch Kinder-Morgan petroleum lines. Subsurface utility locating information provided a clear identification of the Shell petroleum line. It was located between 3.8 and 6.2 feet below the bottom of the channel; the channel in this area had a bottom elevation ranging from -30 feet MLLW to -33 feet MLLW. The Kinder-Morgan petroleum lines were located in the horizontal plane; however, the sub-bottom profiling was unable to confidently determine the pipeline depths. A filled-in trench ranging from 20 to 30 feet in width was found, with the bottom of the trench at depths between 2.8 and 6.8 feet below the bottom of the channel. While it is assumed that the pipelines would have been laid into the bottom of the trench, no pipeline could be confidently located within

the trench. Channel depths in this area ranged from -29 feet MLLW to approximately -33 feet MLLW. Deepening of the SBS Channel would require that these pipelines be relocated.

2.2 Port Commodities and Traffic

The Port of Redwood City specializes in bulk, neo-bulk, and liquid cargoes. Cargo volumes have been variable over the life of the Port, reflecting economic trends and resulting demand for bulk goods (***Figure 2-4***). During the past 10 years, cargo volumes peaked at 1.9 million metric tons (MMT) in 2005 and then dropped to a low of 842,727 MMT in 2010.

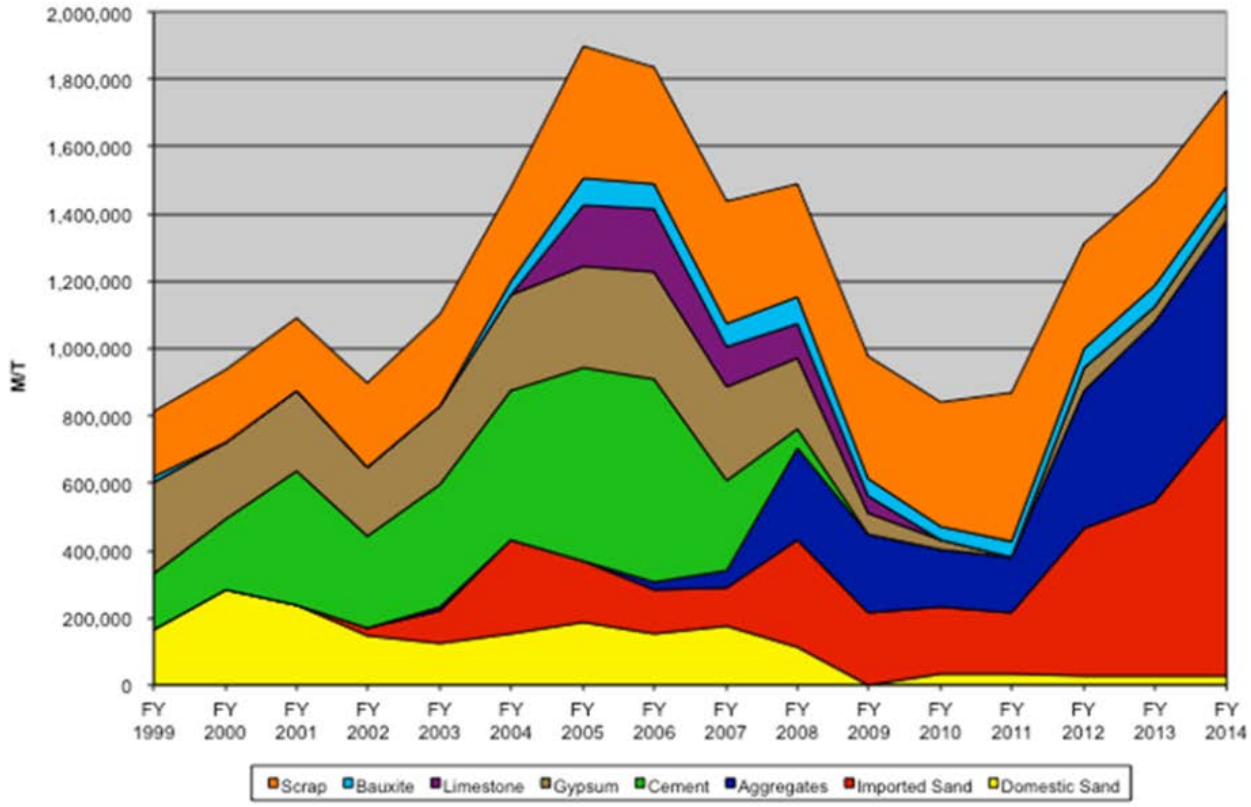


Figure 2-4. Tonnage by Commodity for Port of Redwood City

Bulk construction aggregates and scrap metal commodities have been supported by the Port and are expected to continue into the future. The latest statistics show that 1.7 MMT of commodities passed through the Port between 1 July 2013 and 30 June 2014. The future fleet forecast assumed a 2.8 percent annual growth in overall commodity tonnage, the same as the overall trend over the last 15 years. At the projected 2.8 percent annual growth rate, commodities are expected to grow to 2.5 MMT by 2025. The Port's existing infrastructure can accommodate a total throughput of 3.5 million tons per year.

Table 2-1 describes the commercial traffic to the Port of Redwood City for the period from 2002 through 2014. It should be noted that barges in earlier years were typically 2,000 to 3,000 tons/barge of domestic sand dredged from San Francisco Bay. However, barges in later years

have typically carried between 3,000 and 5,000 tons of aggregates lightered from larger vessels. Ships ranged from 20,000 to 35,000 tons - more in recent years.

Table 2-1. Port of Redwood City Commercial Traffic

Fiscal Year	Cargo Metric Tons	Vessel Calls: Barges	Vessel Calls: Ships	Vessel Calls: Total
2014	1,784,659	25	64	89
2013	1,493,190	19	51	70
2012	1,319,198	26	48	74
2011	871,940	11	36	47
2010	842,727	16	33	49
2009	986,727	11	37	48
2008	1,487,064	65	50	115
2007	1,436,626	94	46	140
2006	1,833,022	91	60	151
2005	1,908,172	96	60	156
2004	1,484,720	88	54	142
2003	1,111,000	58	42	100
2002	899,652	65	30	95

The future without project condition fleet is projected to have the following average annual mix:

- 6 - 10 Handysize
- 12 Handymax
- 50 Panamax (still light-loaded).

Even though other nearby ports in the San Francisco Bay area have greater authorized depths, it is not anticipated that shippers will prefer them over Redwood City for shipping bulk construction aggregates and scrap metal for the following reasons:

- Redwood City's loading and offloading infrastructure is better suited for handling the construction materials and scrap metal than the other nearby ports.
- Redwood City is the only deep draft port in South San Francisco Bay, strategically located between San Francisco and Silicon Valley. These areas have a large demand for the construction materials that pass through the Port. Trucking material from more distant ports would substantially increase transportation costs. For example, trucking material from the Port of Richmond (53 miles from the South San Francisco Bay area)

would cost about $14 per ton. For a 30,000 ton shipment, the additional trucking cost would be $420,000.

- The ports in the San Francisco Bay area have market "niches" or specialization for some types of cargo. This specialization is expected to continue into the future due to available infrastructure at each port, and the assumption that as profit-maximizing entities, shippers are currently using the ports with the least cost to ship their materials and will continue to do so. The Port of Oakland handles almost all of the region's containerized cargo; Richmond handles liquid bulk, some dry bulk, and autos (which are also handled in Benicia at a private terminal); and Redwood City is primarily dry bulk. When there is overlap it may be due to competition, size of market, or inland transportation costs. An example of competition and size of market is exported recycled metal which is handled in Oakland and Redwood City by two competing companies, neither of which could handle the combined volume of export demand alone.

The Port anticipates future increases in cement, gypsum, bulk cargo, and sand and gravel. A historical commodity for the Port included cement, which has not been shipped through it since 2009 due to economic hardships in the construction industry. The demand for cement in both southern and northern California is currently met by railway transport from southern California. It is anticipated that cement imports will increase in the future as the construction industry recovers from the recession, and the demand for cement exceeds the capacity of railway transport and the supply in southern California. Also, Cemex invested significant capital in their cement unloader constructed at the Port of Redwood City in 1999. Currently, the Port of Redwood City has the only cement marine terminal capable of unloading ships with cement in the San Francisco Area. The maximum historic cement throughput at the Port was 650,000, and the Port is permitted for up to 850,000 tons. The ports of Stockton and West Sacramento also have facilities equipped for unloading, storage, and distribution of imported cement but they are generally too far away to be competitive in the San Francisco Bay Area market.

The movement of sand and gravel aggregates used to make redi-mix concrete for the construction industry is also expected to increase in the future. The growing Silicon Valley economy is driving a boom in construction from San Francisco to San Jose, and is not projected to slow in the foreseeable future. Local northern California supply for sand and gravel is diminishing, costly to truck through congested San Francisco traffic, and insufficient to supply existing and future projected demand. Aggregates imported from the Orco mine in Vancouver Island, Canada have been used in residential and commercial construction since 2003.

The Orca quarry is permitted to produce 6.6 million tons per year. These aggregates have exceeded building specifications and become more widely accepted in the industry, and the U.S. Department of Transportation has found this sand to be durable during seismic events. In 2011 the tonnage of construction aggregate material shipped to Redwood City doubled in one

year to 850,000 tons and has grown steady every year since then to reach 1.3 million tons in 2014. CSL International has recently added four Panamax ships with self-unloading conveyors which can unload 35,000 - 40,000 tons at the Port of Redwood City in 18 - 24 hours. The high quality material from the Orca quarry, and the highly efficient transportation system that brings it to the Port of Redwood City, makes this material competitive with locally available material for the production of redi-mix concrete. bThe Port is becoming the leading supplier of this sand to plants in the South San Francisco Bay area. The Port now processes 1.5 million tons per year and expects to increase this to 2.5 million tons per year by 2025. The docks are in place to handle this volume of sand and gravel and the Port is working on land-side improvements (Phase 2 of the Wharves 1 and 2 Reconstruction Project) to expand their throughput based on the recently improved docks.

Gypsum imports are also expected to grow as the construction industry recovers from the recession. Prior to the recession, gypsum was imported from Mexico and then trucked to Newark, California where it was used to make gypsum wall board to satisfy demand in the Bay Area. The demand in the Bay Area was partially met by shipping finished gypsum wallboard from a plant in Las Vegas to Newark. Production at the Las Vegas, Nevada plant far exceeded demand in southern Nevada and Arizona due to local economic conditions. As the demand by the construction industry increases in both the Bay Area and southern Nevada markets, gypsum wallboard production in Newark will resume and result in an increase in gypsum imports through the Port of Redwood City.

There are no plans for the Port to attempt to handle hazardous, toxic, or radioactive waste material as it would be difficult to permit.

2.3 Redwood City and San Bruno Shoal Channels

The Redwood City Harbor channel extends approximately 5 miles from the Port of Redwood City to deep water in San Francisco Bay (***Figure 2-2***). The channel includes two turning basins: Turning Basin #1 is an outer basin nearest the Bay, and Turning Basin #2 is an inner basin nearest the Port. A connecting channel joins the two turning basins. The width of the channel and turning basins ranges from 300 feet to 900 feet. The SBS Channel, located 9 miles northwest of the Port, is also part of the Federal Redwood City Harbor project. It spans approximately 3.5 miles and connects with deep water in San Francisco Bay to the north and south.

The average sedimentation rate for the RWC Channel is about 183,000 cubic yards per year (2004 – 2012 period of record). There are indications that the accretion rate is not constant throughout the year, but varies either seasonally, or in response to storm events. The channel has been scheduled for maintenance dredging by USACE on a two-year dredging cycle since 1965. However, the USACE's ability to dredge the channel to the full authorized depth of -30 feet MLLW depends on receipt of sufficient Federal funds.

Recent channel maintenance dredging occurred in 2004, 2005, 2008, 2012 and 2014 (***Table 2-2***), usually with clamshell-bucket equipment. Maintenance dredged material from the channel has typically been less than 80 percent sand and has been placed at the SF-11 (Alcatraz) disposal site. Additionally, a "knockdown" was performed in late 2009 when sediment in areas with the greatest shoaling was moved to areas of the channel with less shoaling, thereby increasing the limiting navigation depth.

Table 2-2. Redwood City Harbor Channel Dimensions and Historical Maintenance Dredging

Channel Section	Authorized Depth (MLLW)	Length (feet)	Width (feet)	Area (acre)	Maintenance Frequency (years)	Last Dredged (FY)
Entrance Channel	30	13,900	300-350	103.7	2	2014
Outer Turning Basin	30	2,200	400-900	30.3	2	2014
Connecting Channel	30	1,300	400	11.9	2	2014
Inner Turning Basin	30	1,700	900	35.1	2	2011
San Bruno Channel	30	1,800	510	21.1	Infrequently	2005

SBS Channel rarely requires maintenance dredging. Surveys of the channel between 2002 and 2014 show that the channel has undergone periods of accretion and erosion, with little net change in channel depth. The channel has been maintained via a hopper dredge at approximately 10-year intervals and was last dredged in 2005. Prior to 2005, less than 3.5 percent of the channel area was shallower than the authorized project depth. The parts that were in need of maintenance required only 16,000 cubic yards of sediment to be removed.

Figure 2-5 (Delta Modeling Associates, 2015) depicts the relative sediment volume (shown on the Y axis) through time in the RWC Channel following periods of accretion and dredging. The zero relative volume on the Y axis is equal to that observed in January, 2006, after dredging occurred in late fall of 2005. Dark blue dots show the relative sediment volume in the channel calculated from the surveys of the channel and are connected by an assumed linear sediment deposition trend between surveys (black dotted lines). Red dots show estimated sediment volumes before and after dredging. The vertical red lines are the reported dredge volumes.

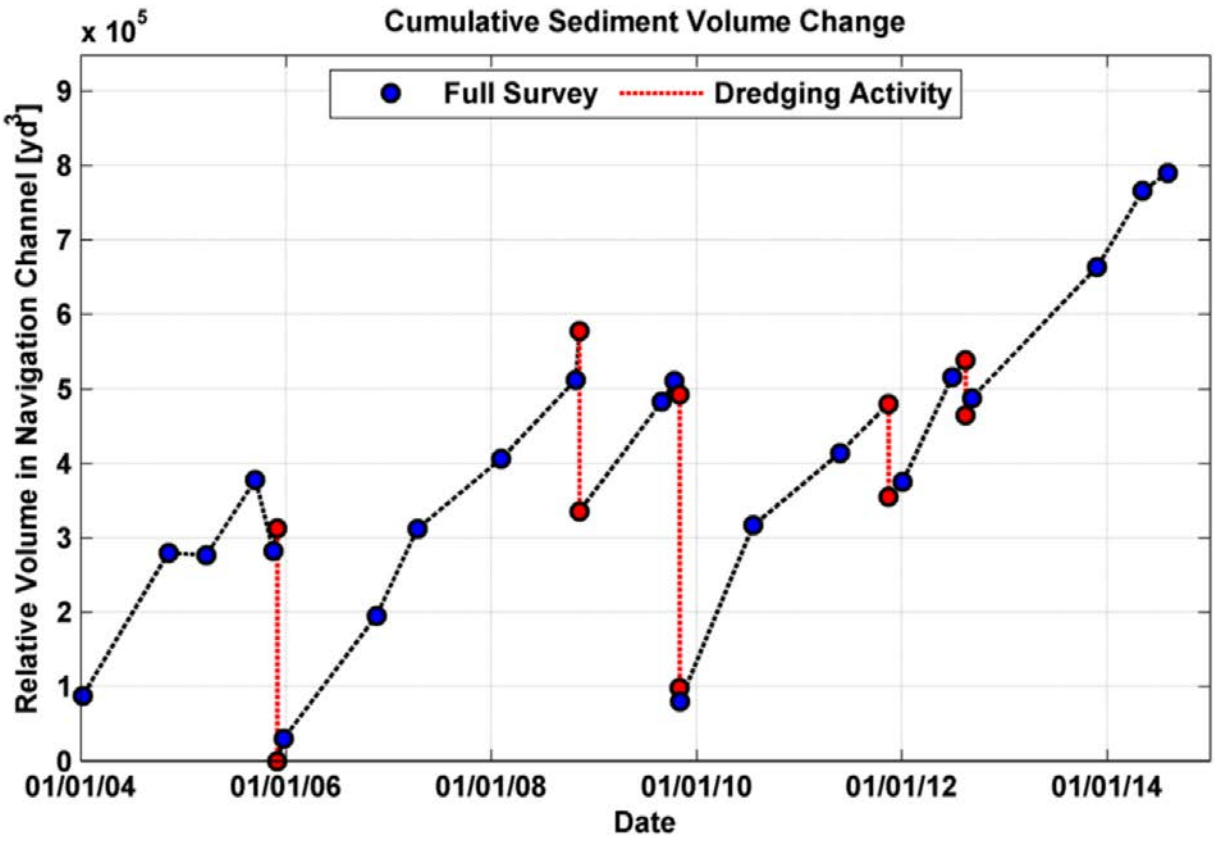


Figure 2-5*. *Sediment Volume Change in RWC Harbor channel 2004-2014 (Delta Modeling Associates, 2014)

Figure 2-6 (Delta Modeling Associates, 2014) depicts relative shoaling throughout the RWC Channel calculated from surveys of the channel. Two "hot spots" were identified that have the greatest cumulative sediment deposition. They are both on the western side of the channel, one southeast of Bair Island and the other on the entrance channel, circled in the Figure.

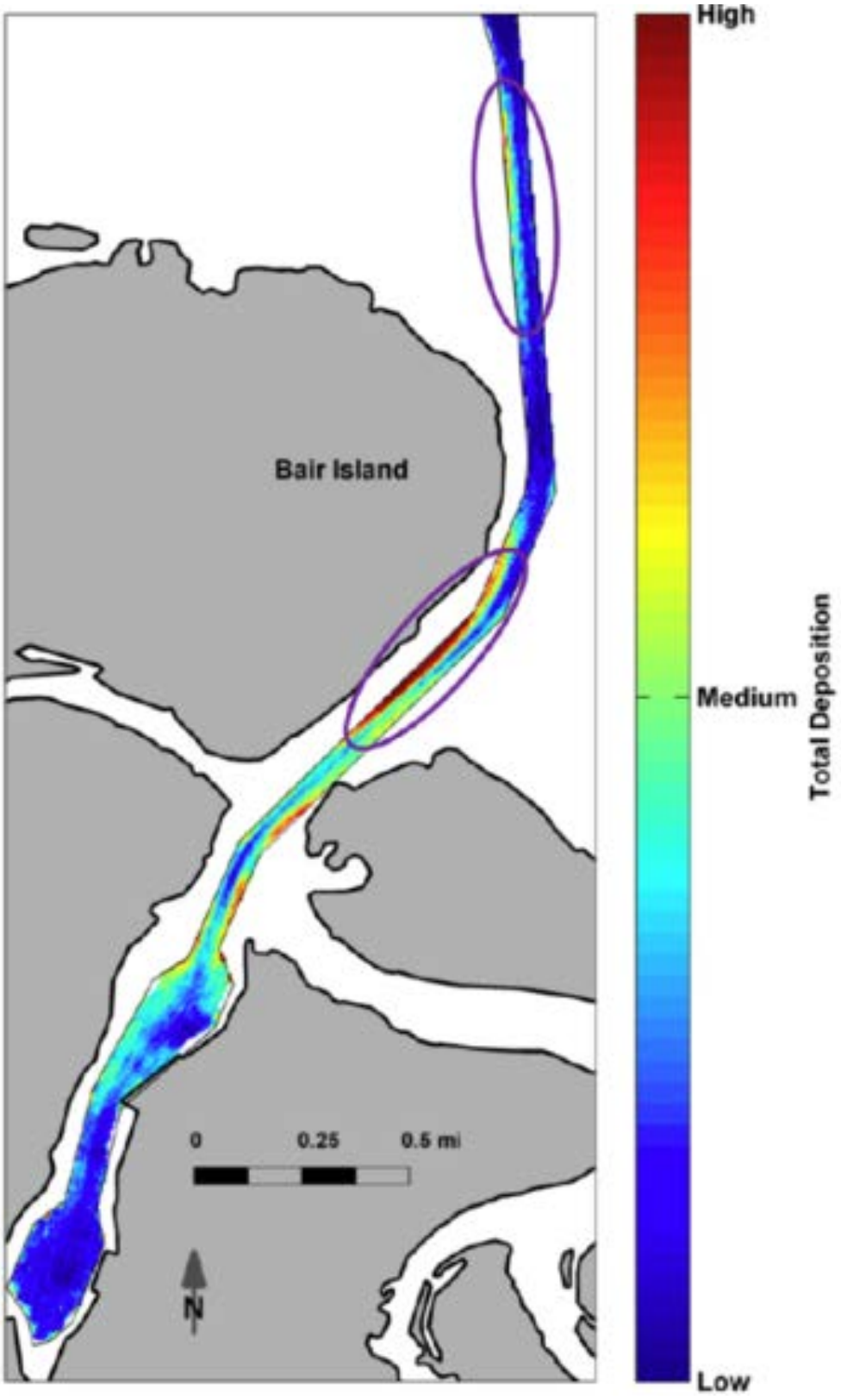


Figure 2-6. Sedimentation "Hot Spots" on the Redwood City Harbor Channel

The planned future maintenance dredging is described in the Draft Environmental Assessment and Environmental Impact Report for the Federal Navigation Channels in San Francisco Bay, fiscal years 2015-2024. As laid forth therein, Redwood City would be dredged every 1 to 2 years using a clamshell dredge (***Figure 2-7***). The SBS Channel would be maintained every 4 to 10 years during the 50-year planning period.

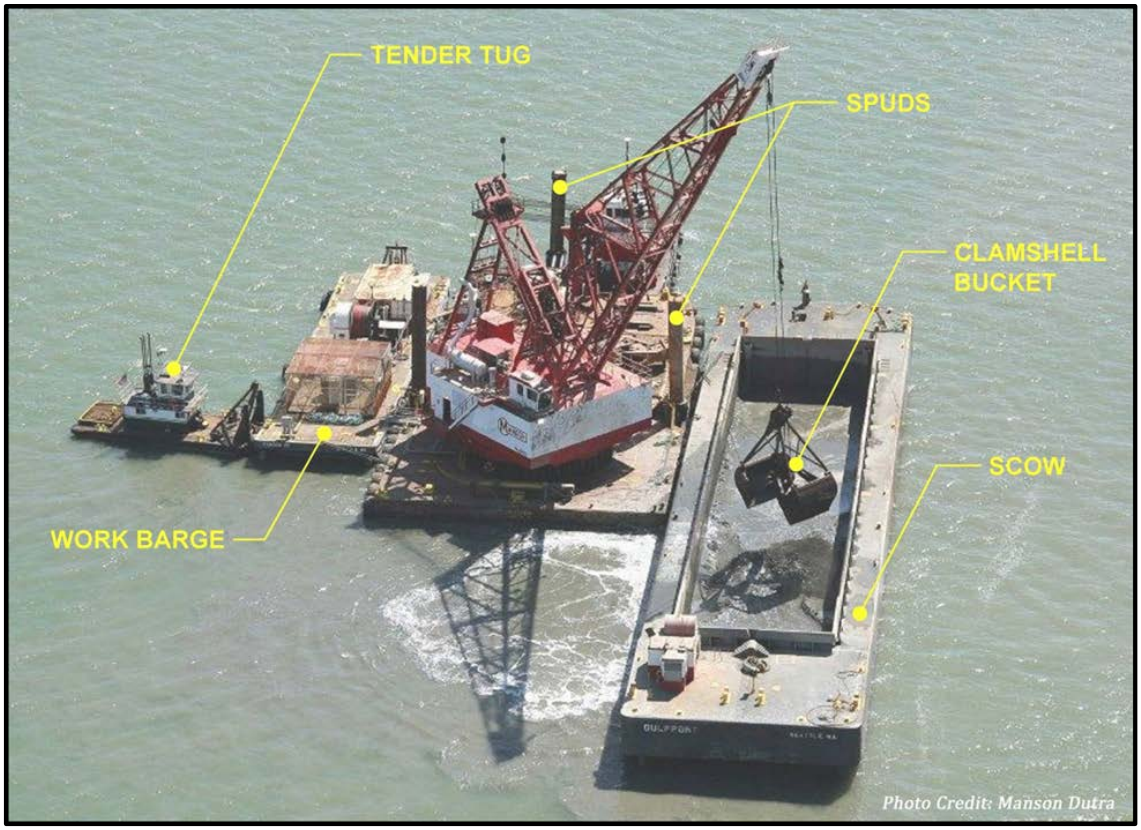


Figure 2-7. Typical Clamshell Dredge

2.4 Navigation Problems

The existing navigation project channels at RWC and SBS Channels do not allow for the efficient operation of the vessel fleet that calls on the Port. A large majority of vessels calling on the Port have design drafts that are greater than the authorized channel depth of -30 feet MLLW. Having to wait for favorable tide is inefficient, requiring the practice of light loading or lightering[4] larger vessels in order to access the Port.

The design vessel for the Port of Redwood City is the CSL Tecumseh, a Panamax type vessel. Handysize, Handymax, and Panamax vessels call on the Port. The design drafts for these vessels range from 33 to 46 feet (***Table 2-3***). Because fully loaded vessels exceed the available draft in

[4] Lightering is the practice of transferring cargo from one vessel to another in order to reduce the vessel draft so that it can safely navigate a channel with limited depth.

the channel, vessels must be only partially loaded or light-loaded. For example, a Panamax vessel must take off approximately 2,000 metric tons of material to reduce its draft by 1 foot.

Table 2-3. Port of Redwood City Vessel Characteristics

Vessel Type/Class	Approximate Dead Weight Tonnage (DWT)	Length Range (feet)	Beam Range (feet)	Draft (feet)	Number in Port (07/2012-06/2013)	Percent Loaded (07/2012-06/2013)
CSL Tecumseh (design vessel)	71.4k	751	105	45	n/a	n/a
Handysize	10k-35k	426-492	(variable)	33	7	75-85%
Handymax	35k-59k	492-656	(variable)	36-39	16	37-65%
Panamax	60k-80k	<965	<106	<39.5	30	21-58%

Between 2012 and 2013, Panamax vessels coming into Port were as little as 21 percent full, and on average 44 percent full. Since the existing channel depth does not allow for fully loaded vessels, suppliers must either send a larger number of light-loaded vessels, lighter onto barges prior to entering the Port, or make multiple trips in order to fill orders for materials.

Between 2012 and 2013, more than 90 percent of vessels were partially loaded coming in to or departing from the Port of Redwood City because of the limited available channel depth. In order to operate more efficiently, outgoing vessels may partially load at Redwood City and then stop at a nearby Port with adequate draft to finish loading, a process called topping-off. This requires that the top-off materials be diverted from Redwood City to a second port (often Richmond Harbor), and then loaded at the second port. Additionally, incoming vessels may lighter onto barges to reduce draft so as not to exceed the available channel depth. All of these activities add transportation, docking, and loading fees.

Incoming vessels that are fully loaded often have to be partially unloaded onto barges (or lightered) in the Bay before entering the Port. This adds barge, dockage, and other fees to their cost. It is estimated that every barge required to help unload a vessel adds $60,000 for every 5,400 tons of materials moved to barges.

Even with light loading, lightering, and topping off, vessels may need to wait until high tide to have sufficient available draft to cross through the RWC channel. High tides occur twice daily, about 12 hours apart. Often, incoming and outgoing vessels have to wait in the Bay until high tide in order to ensure sufficient channel depth for safe passage.

Approximately 48 to 72 vessels are expected to call on the Port each year. Out of a total of 53 deep draft vessel calls in 2013, 23 of the actual vessel calls had drafts less than 28 ft. The remaining 30 vessel calls came into the Port at 28 feet or greater, indicating that these calls had

to use tides in order to meet the required under-keel clearance of 2 feet. Overall, the actual vessel calls ranged in draft from 19.4 feet to 33.3 feet.

The turning basins at Redwood City Harbor provide only the minimal area necessary for turning and maneuvering of the existing fleet of modern vessels. There are two turning basins in Redwood City Harbor, and both have maximum widths of 900 feet. The design draft vessel, CSL Tecumseh, is 751 feet in length. With a 50-foot safety margin fore and aft, 900 feet of turning basin width provides very limited space for turning. Because of the very tight maneuvering required to navigate the turning basins, the bar pilots restrict use of the basins to daylight hours only. Delays due to the daylight restrictions can range from 12-18 hours, so these restrictions add further to transportation cost inefficiencies. However, since the fleet of vessels calling on Redwood City is not expected to change in the future, the problem is not anticipated to worsen.

2.5 Navigation-Related Opportunities

Support the Goals of the San Francisco Bay Long Term Management Strategy for Dredged Sediment

Deepening the RWC and SBS Channels would represent an opportunity to support the goals of the San Francisco Bay LTMS. The LTMS seeks to maximize beneficial reuse of dredged material and limits in-Bay placement of dredged material to 1.25 mcy/year. USACE is one of many users of the in-Bay sites and its maintenance dredging program is about ½ to ¾ the total limit for in-Bay placement. New work material from a deepening project would exceed the in-Bay disposal limit. The authority to enforce LTMS target goals exists pursuant to the WQC provisions found in Section 401 of the CWA. The designated deep ocean disposal site (SF-DODS) is available for placement of new work dredged material when beneficial reuse is not feasible.

The SBSP Restoration Project is poised to potentially play a key role in meeting the goals of the LTMS in the future. The 50-year implementation plan for the restoration project was divided into two phases. Phase II planning commenced in 2012 with a study of how dredged material and other types of imported material could be used to accelerate the restoration process. The concept was to use dredged or other material to raise the bottom elevation of subsided ponds designated to be restored as tidal habitat and to improve pond levees. The study was completed in a report entitled *The South Bay Salt Pond Restoration Project Beneficial Reuse Feasibility Study* (Moffatt & Nichol 2015). It discusses the needs, concept, and suggested implementation strategies for delivering dredged material to the South Bay pond complexes. It describes and recommends Eden Landing as the pilot beneficial reuse site using dredged material from the Redwood City Harbor deepening project. The introduction of the Beneficial Reuse Feasibility Report states.

> *As the largest wetland restoration project on the West Coast, the SBSP provides a rare opportunity to beneficially reuse millions of cubic yards of dredged and upland material generated in the San Francisco Bay area. In a climate currently where approximately 2.5 mcy of dredged material (annualized) is generated every year, the SBSP has the capacity*

to be the next significant beneficial reuse site in the Bay Area, and in turn provide the Bay Area with a cost-competitive means to achieve its Long Term Management Strategy (LTMS) beneficial reuse goals.

2.6 Planning Objectives

Federal Objective: A plan recommending Federal action is to be the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the National Economic Development (NED) plan), unless the Secretary of the department or head of an independent agency grants an exception to this rule. Exceptions may be made when there are overriding reasons for recommending another plan, based on other Federal, State, local and international concerns (ER 1105-2-100). Because this is a single purpose navigation project, NED benefits are evaluated in terms of reduced navigation costs.

Non-federal Objectives: The non-federal sponsor seeks to deepen the federal channels and turning basins to improve the efficiency and sustainability of deep draft navigation at the Redwood City Harbor and San Bruno Shoal.

Also, in order to achieve the LTMS goals for dredged material and to mitigate the increasing costs of the handling and placement of dredged material from port projects, the non-federal sponsor is seeking to use the critical mass of dredged material from the project to start site preparation of a beneficial reuse site for dredged material in South San Francisco Bay.

Planning objectives are statements that describe the desired results from solving problems and realizing opportunities. Planning objectives ultimately provide focus for the formulation of alternatives.

The Congressional authority for this report indicates that its purpose is "To improve the efficiency of deep draft navigation at the Redwood City Harbor and San Bruno Shoal Channels." With that charge, and based on existing and future conditions, the specific planning objective of this study is to:

Increase efficiencies of deep draft navigation and transportation of goods to and from the Port of Redwood City.

An objective related to expansion of the turning basins was also considered. However, because the turning basins are bounded to the north by Bair Island, a protected natural area that is part of the Don Edwards San Francisco Bay National Wildlife Refuge, and by the Port of Redwood City's wharves to the south, expansion is not feasible. And even though space restrictions in the turning basin cause maneuvering delays, it is not expected that the turning basin will create an additional constraint on the future fleet of vessels (consisting of the current vessel types using the channel) calling on the Port, beyond the constraints caused by the limited channel depth. Therefore, because of the space restrictions that prevent turning basin expansion and

the fact that the future fleet will still be capable of maneuvering in the turning basin (albeit with delays), objectives and alternatives for addressing this problem were not pursued.

The non-federal sponsor seeks to deepen the Federal channels and turning basins to improve the efficiency and sustainability of deep draft navigation at the Redwood City Harbor and San Bruno Shoal. Also, in order to achieve the Long Term Management Strategy Plan goals for dredged material and to mitigate the increasing costs of the handling and placement of dredged material from port projects, the non-Federal sponsor is seeking to use dredged material from the project to start site preparation of a beneficial reuse site for dredged material in South San Francisco Bay.

2.7 Planning Constraints

A planning constraint is a restriction that limits the range of measures or actions that might be implemented to meet the study objectives. Constraints can be related to resource, legal, or policy considerations. The planning constraints identified for this study are:

1) **Avoid or minimize adverse impacts to environmental resources at the RWC and SBS Channels.**

San Francisco Bay and nearby areas are home to a diverse array of species. More than 250 species of birds, 120 species of fish, 81 species of mammals, 30 species of reptiles, and 14 species of amphibians regularly occur in the San Francisco Estuary (USFWS & CDFW 2007). It is an essential resting place, feeding area, and wintering ground for millions of birds on the Pacific Flyway. Nearly half of the state's waterfowl and shorebirds and two-thirds of the state's salmon pass through the Bay during their migrations. A number of endemic, endangered, threatened, and rare wildlife species or subspecies reside within the San Francisco Bay Area.

Special Status species within the Project Area are discussed in ***Appendices A and H***. Among the approximately 100 species considered vulnerable in the Bay are the federally endangered Delta smelt (*Hypomesus transpacificus*) and Longfin smelt (*Spirinchus thaleichthys*), species that may be particularly vulnerable to sediment disturbing activities. To avoid impacts to listed fish species, including delta and longfin smelt, dredging work would be restricted to certain periods ("environmental windows") that the LTMS has identified as appropriate for minimizing impacts of dredging activities.

Maintenance dredging work at Redwood City Harbor is not currently subject to environmental work windows for listed bird species as per a coordination letter from the USFWS dated May 28, 2004 that states, "Maintenance dredging of Redwood City harbor and the adjacent Federal navigation channel are not likely to adversely affect the least tern, California clapper rail [now Ridgway's rail], and salt marsh harvest mouse and would not be subject to a timing window."

2) **Avoid impacts to USFWS Bair Island unit of the Don Edwards San Francisco Bay Wildlife Refuge and Port of Redwood City infrastructure.**

Don Edwards San Francisco Bay National Wildlife Refuge is managed as part of the San Francisco Bay National Wildlife Refuge Complex, which includes seven other Wildlife Refuges. It consists of 30,000 acres in South San Francisco Bay and includes parts of Bair and Greco Islands which are located to the north and south of RWC Channel, respectively.

Greco Island covers a total area of 817 acres and includes tidal marsh and mudflats. The island is preserved and managed for its natural resources and wildlife habitat for native species, including harbor seals (Phoca vitulina), Ridgway's rail (*Rallus obsoletus*), and double crested cormorant (*Phalacrocorax auritus*).

Bair Island is a 3000-acre marsh that borders the north side of the RWC Channel (***Figure 2-2***). It is the largest undeveloped island in the San Francisco Bay, and was historically used for farming, grazing and salt production. It consists of three subunits: the Inner, Middle and Outer Bair Islands. In 1996, all three islands were deeded to the larger Don Edwards San Francisco Bay National Wildlife Refuge and in 1997, the Bair Island Ecological Reserve was established on 1,985 acres of the Middle and Outer islands. Bair Island provides critical habitat for the endangered Ridgway's rail and the Salt marsh harvest mouse (*Reithrodontomys raviventris*) and is an important stop for birds on the Pacific Flyway. Habitat restoration work was undertaken between 1997 and 2014, and the refuge now includes a pedestrian walkway and observation platforms.

Bair Island provides critical habitat for a variety of species, including the endangered Ridgway's rail and the Salt marsh harvest mouse, and is an important stop for birds on the Pacific Flyway. Millions of both Federal and local dollars have already been spent in restoring Bair Island.

The Port recently completed major improvements to its wharf infrastructure. Reconstruction of wharves 1 and 2 was completed in 2014 for a cost of $15-20 million. Wharves 3 and 4 were constructed in the mid-1980s, and wharf 5 was constructed in the mid-1960s. The Port is currently conducting a re-fendering study for wharves 3, 4 and 5, and anticipates construction beginning in late fall 2015, at an estimated cost of $2-3 million.

3) **Avoid adverse impacts to vessel operating safety at the RWC and SBS Channels. Any realignment or deepening should avoid creating conditions that result in unsafe operating conditions or additional navigation hazards.**
4) **Avoid impacts to the San Mateo Bridge.**

The San Mateo Bridge crosses the San Francisco Bay just north of Redwood City, intersecting the shipping route between San Bruno Shoal and Redwood City Harbor. Any structural modifications to the bridge would be cost prohibitive.

3 Alternatives

This chapter explains how management measures were identified, combined to form an initial set of alternative plans, and screened to arrive at a focused array of alternatives that merit further evaluation. This process was guided by the objectives and constraints outlined in ***Chapter 2***. The evaluation of the focused array is described in ***Chapters 4 and 5***. Comparison of the alternatives and identification of the tentatively selected plan (TSP) is documented in ***Chapter 6***.

3.1 Future Without Project Condition

The future without project condition (or the No Action alternative) is a set of assumptions about what is expected to happen in the future in the absence of federal action to improve navigation efficiency to the Port of Redwood City. It is the benchmark against which the action alternatives are compared. Assumptions included in this without condition are:

Commodities

- The Port anticipates future increases in cement, gypsum, bulk cargo, and sand and gravel.
- Break bulk cargo (large pieces of scrap metal or wind turbines) is also a possibility for future exports from the Port.
- Even though other nearby ports in the San Francisco Bay area have greater authorized depths, it is not anticipated that shippers will prefer them over Redwood City for shipping bulk construction aggregates and scrap metal.
- There are no plans for the Port to attempt to handle hazardous, toxic, radioactive waste material as obtaining the necessary permits would be difficult.

Tonnage. The future fleet forecast assumed a 2.8 percent annual growth in overall commodity tonnage, the same as the overall trend over the last 15 years. At the projected 2.8 percent annual growth rate, commodities are expected to grow to 2.5 MMT by 2025.

Fleet. The future without project condition fleet is to remain unchanged from the current fleet as described in ***Section 2.2***.

Port Calls. Approximately 48 to 72 vessels are expected to call on the Port each year.

Lightering and Light Loading. Lightering is the process of transferring cargo between vessels of different sizes to reduce a vessel's draft in order to enter Port facilities. Light loading refers to vessels carrying less cargo than their design allows for in order to reduce their draft so that they can safely access a channel. Both lightering and light loading are already in place at the Port of Redwood City and are expected to continue in the future without project condition.

Use of Favorable Tides. Use of favorable tides refers to vessels entering a channel at high tide so that they can come in at a deeper draft than they would be able to at low tide due to inadequate channel depth. This practice is already in place at the Port of Redwood City and is expected to continue in the future without project condition.

Navigation Channels. RWC and SBS Channels will continue to be in place and function within existing authorized depths of -30 feet (MLLW).

Turning Basin. Even though space restrictions in the turning basins cause maneuvering delays, it is not expected that the turning basins will create additional constraints on the future fleet of vessels (consisting of the current vessel types using the channel) calling on the Port, beyond the constraints caused by the limited channel depths.

Maintenance Dredging. Maintenance dredging will continue to occur every 1 to 2 years at RWC Channel and every 4 to 10 years at the SBS Channel.

3.2 Management Measures

Management measures are the "building blocks" for all alternative plans. They are specific actions/ideas/programs/regulations that can be taken to address specific objectives or constraints. Management measures can be either structural or non-structural and receive equal consideration. When beginning the planning process, an interagency and interdisciplinary planning charette was conducted to brainstorm specific management measures for Redwood City Harbor.

The management measures developed during this charette and their corresponding objective and or constraint are provided in ***Table 3-1***.

3.3 Initial Screening of Management Measures

The eighteen measures noted in ***Table 3-1*** were evaluated and screened qualitatively using existing information/data as well as discussions with the San Francisco Bar Pilots and the Port of Redwood City. The efficiency of each measure in addressing the objective it was created to address was analyzed as well as its' effectiveness in achieving the objective. The subsections that follow summarize the initial screening process to identify those measures that would not be useful to pursue. Measures that were found to hold promise for providing strong benefits relative to costs were retained for further consideration.

Table 3-1. Target Objectives and Accompanying Management Measures

Measures to accommodate vessels	Objective
1) Deepen channels at Redwood City Harbor and San Bruno Shoal	Increase efficiencies of deep draft navigation and transportation of goods to and from the Port of Redwood City.
2) Build a lock or dam structure at the Redwood City Harbor	
3) Dredge a separate shallow lane for lighter ships at the Redwood City Harbor	
Measures that would address shoaling	
4) Realign the channel at San Bruno Shoal	
5) Significantly realign the channel entrance at Redwood City Point (to reduce shoaling)	
Nonstructural Measures that improve efficiency	
6) Relocate Port facilities (piers) to deeper water, and dock boats in San Francisco Bay	
7) Congestion fees	
8) Traffic management	
9) Lightering and Light Loading	
10) Use of favorable tides and daylight transit	
11) Increase utilization and capacity of related intermodal transportation systems such as highways and rail	
Measures crafted to avoid adverse impacts to Bair Island and Port Infrastructure	**Constraint**
12) Slightly realign the channel entrance at Redwood City Point	Avoid adverse impacts to Bair Island
13) Bottom-cut the channel near the Port of Redwood City's facilities (the southern end of the channel)	Avoid adverse impact to Port infrastructure
Measures for Dredged Material Placement	**Opportunity**
14) Place dredged material at placement sites for beneficial reuse	Maximize beneficial reuse of dredged material to support the goals of the LTMS
15) Place dredged material in-Bay at passive sediment transport sites for beneficial reuse	
16) Place dredged material in-Bay at designated open-water disposal sites.	Other options for placement of dredged material
17) Place material at aquatic transfer facilities (ATF's)	
18) Place dredged material at the San Francisco Deep Ocean Disposal Site (SF-DODS)	

Objective: To increase efficiencies of deep draft navigation and transportation of goods to and from the Port of Redwood City.

The following structural and non-structural management measures were developed and subjected to screening based on how well they are expected to address this target objective.

1. **Deepen RWC and SBS Channels.** This structural measure was retained because it would likely be very efficient and effective at achieving the target objective. Approximately 73 percent of vessels that called on the Port in calendar years 2011 and 2012 and 100 percent of the vessels in 2013 had design drafts that exceeded the existing depth of -30 feet MLLW. Deepening the channels would reduce the need for light loading, lightering, topping off, or waiting for high tide by vessels calling on the Port. More commodities moved per trip results in greater efficiency and in turn, greater cost savings.

2. **Build a lock or dam structure at RWC.** This structural measure was screened out because it would not address the lack of available depth for deep draft vessels. Also, the scale and cost of construction is not efficient and it is unlikely to be environmentally acceptable. A lock and dam structure is utilized when navigating water bodies of differing elevations. These structures are mostly used in rivers, such as where natural rivers connect two different bodies of water. The structure is not suited for the San Francisco Bay and RWC Channel since moving vessels along the bay does not require an elevation change. Constructing a lock and dam would not solve the need for a deeper draft depth.

Furthermore, this measure would require building lock structures over 11 miles of South San Francisco Bay since the channel at San Bruno Shoal would also have to be altered to accommodate the larger vessels. The measure would likely also require major reconstruction of the current Port infrastructure. The Panama Canal construction cost $5 billion. Though the scale of this project was much larger, and a lock and dam system for RWC and SBS channels would only be a fraction of the cost, the proxy still shows that dredging would likely be a far less expensive endeavor than this measure. Finally, environmental compliance for this measure is highly unlikely with potential and significant adverse impacts to the Endangered Species Act (ESA), CWA, etc.

3. **Dredge a separate shallow lane for lighter ships at RWC**. This structural measure was screened out because it does not address the study objective of accommodating deep draft vessels in the RWC and SBS Channels and reducing NED navigation transportation costs. The measure may be effective at addressing traffic congestion, however, this is not a study problem since there is low traffic volume at the Port (approximately four to six vessels a month call on the Port). In addition, the cost of constructing a second shipping lane would be extremely high and may not even be physically possible since the land surrounding the Port is already built up. Further, the

adjacent Bair Island restoration project would likely be negatively impacted by widening for a second lane of traffic because it would encroach on the restoration site.

4. **Realign the SBS Channel.** This measure was screened out because it was judged to be ineffective at reducing shoaling. A review of the current bathymetry of the middle portion of San Francisco Bay indicates that the SBS Channel alignment is already in the optimal location to take advantage of as much natural deep water as possible (Delta Modeling Associates 2015). Realigning the channel would not reduce the amount of dredging necessary to achieve the selected project depth, nor would realignment reduce future maintenance dredging and in fact may increase future maintenance dredging because of increased shoaling.

5. **Significantly realign the channel entrance at RWC Harbor**. The current alignment of the channel near the entrance closely follows the border of Outer Bair Island. This measure would shift the channel alignment in an eastern or southeastern direction away from Outer Bair Island. This measure was initially considered as a potentially effective way to reduce the negative impacts of shoaling at RWC Harbor.

Historical hydrographic surveys from 2004 to 2012 were examined to identify regions of shoaling in the RWC Channel (Delta Modeling Associates 2015). The analysis showed that pronounced shoaling has occurred near the entrance of the channel. The review of hydrosurvey data also showed that sedimentation rates are variable, with periods of net erosion and periods of net accretion.

Sediment transport modeling was performed to evaluate the effects of both deepening the RWC and SBS Channels, as well as realigning the channel at the entrance portion near Bair Island (Delta Modeling Associates 2015). The model was calibrated and validated using recorded data for water level, flow, salinity, sediment concentration, and hydrographic survey data. Future dredging requirements resulting from the potential deepening and realignment were estimated by simulating the continual erosion, deposition and transport of sediment throughout the entire Bay-Delta system. The projected quantities of material to be dredged and placed over the lifespan of the project factor into the alternative plan selection process by providing the data needed to develop both construction costs and future maintenance costs. Fundamental results and conclusions are described below:

- Model validation was performed and demonstrated that the model was sufficiently accurate for investigating sedimentation in the navigation channels over a wide range of conditions.
- For the RWC Channel, an estimated deposition rate of 183,000 cubic yards (cy) per year was derived using available historic hydrosurvey data.

- It was concluded that increasing the project depth would also increase the existing sedimentation rate and future dredging requirements beyond those necessitated solely from the new, deeper design template. Specifically, at RWC Channel, deepening would result in the following changes to sedimentation rates:
  - ✓ 13 percent increase in sedimentation rate (207,000 cy/year) by going to a depth of -32 feet MLLW
  - ✓ 51 percent increase in sedimentation rate (276,000 cy/year) by going to a depth of -37 feet MLLW

  At SBS Channel:

  - ✓ 54 percent increase in sedimentation rate by going to a depth of -32 feet MLLW
  - ✓ 86 percent increase in sedimentation rate by going to a depth of -37 feet MLLW
  - ✓ At SBS only, the predicted sedimentation increases may underestimate the increases in dredging requirements.
- The proposed significant channel realignment was predicted to have little effect on sedimentation in the RWC Channel

The sediment transport modeling results demonstrated that significant realignment of the entrance channel, combined with channel deepening would not reduce shoaling. In addition, it would be costly to dredge a section of the outer harbor that is currently not maintained as part of the existing channel.

6. **Relocate Port facilities (docks and piers) to deeper water and dock boats in the Bay.** This measure was screened out because Port facilities would have to be constructed very far away from the landside Port facilities in order to be built in deep water. The cost of relocating Port facilities and maintaining them in deep water would be cost prohibitive with significant environmental impacts. Given that the commodities would still have to be transported to landside facilities in light loaded vessels, costs would likely increase in relation to benefits.

7. **Congestion fees**. Congestion fees would be charged when high traffic results in delays in unloading or loading cargo. Congestion fees are designed to provide market-based disincentives to using congested vessel routes during peak operating times. The Port does not experience high traffic or congestion. This measure was screened out because congestion in the channels is not a problem.

8. **Traffic management.** The Port does not experience high traffic or congestion. Non-structural traffic management measures were screened out because they do not address the study objectives.

9. **Lightering/light loading.** Lightering is the process of transferring cargo between vessels of different sizes to reduce a vessel's draft in order to enter Port facilities. Light loading refers to vessels carrying less cargo than their design allows for in order to reduce their draft so that they can safely access a channel. This non-structural measure is already in place at the Port of Redwood City and is part of the existing and future without project condition, so it will not be considered further in the development of alternative plans.

10. **Use of favorable tides.** Use of favorable tides refers to vessels entering a channel at high tide so that they can come in at a deeper draft than they would be able to at low tide due to inadequate channel depth. This non-structural measure is already in place at the Port of Redwood City and is part of the existing and future without project condition, so it will not be considered further in the development of alternative plans.

11. **Increase utilization and capacity of related intermodal transportation systems such as highways and rail**. This non-structural measure was screened out because it is likely that Port users are currently using the most cost effective intermodal transportation systems. Movement of commodities through the Port to the ultimate end users involves not only the types of ships and channel conditions, but also the location of the Port, the loading, offloading, and storage facilities at the Port, the location of the end users of commodities shipped through the Port, and the availability of highway or railroad transportation. Over time, free market drivers have forced users of the Port to search out and utilize the most cost effective methods for intermodal transport of commodities. It is unlikely that significant additional cost savings will be available. Furthermore, greater use of highway and rail transport of commodities would result in greater air pollution emissions relative to navigational transport of commodities.

Constraint: Avoid adverse impacts to Bair Island

The following structural management measure was developed and subjected to screening based on how well it is expected to addresses this constraint.

12. **Slightly realign the channel entrance at Redwood City Point.** This measure was retained because it may be an effective way to avoid adverse impacts to the adjacent Bair Island Restoration Project. The current alignment of the channel near the entrance closely follows the border of outer Bair Island. This measure would shift the channel to avoid impacts to Bair and Greco Islands (***Figure 3-1***). From station 80+00 to station 122+00, the channel would be realigned 6 feet away from Bair Island. From Station 127+00 to station 140+00, the channel would be realigned 6 feet away from Greco

Island. From station 140+00 to station 155+00, the channel would be realigned 6 feet away from Bair Island.

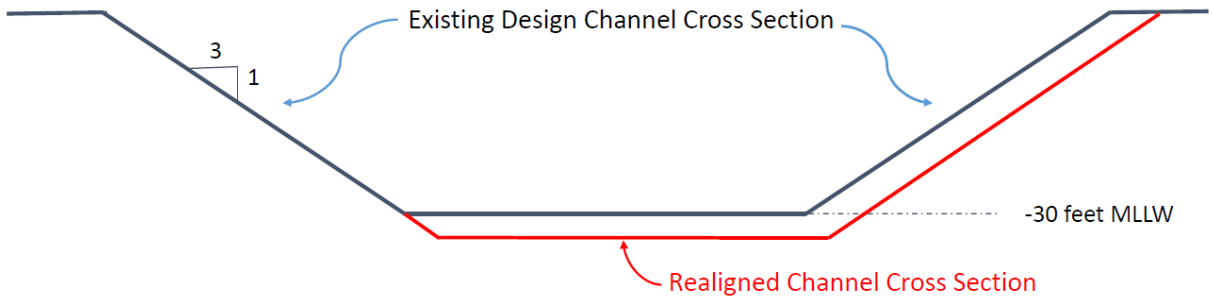


Figure 3-1. Conceptual Cross Section of Realigned Channel

Constraint: Avoid impacts to USFWS Bair Island unit of the Don Edwards San Francisco Bay Wildlife Refuge and Port of Redwood City infrastructure.

The following structural management measure was developed and subjected to screening based on how well it is expected to addresses this constraint.

13. **Bottom cut the channel toe near the Port of Redwood City facilities (southern end of the channel)**. The measure was retained because it may be an effective way to avoid adversely impacting Bair Island and landside infrastructure at the Port of Redwood City if the channel is deepened. This construction method would result in a reduced bottom width of the channel; the top width would remain the same (***Figure 3-2***). A detailed slope stability analysis will be conducted during final engineering and design to ensure that any modifications would not lead to significant sloughing. Modeling will be conducted to ensure navigational safety is not compromised with reduced bottom width.

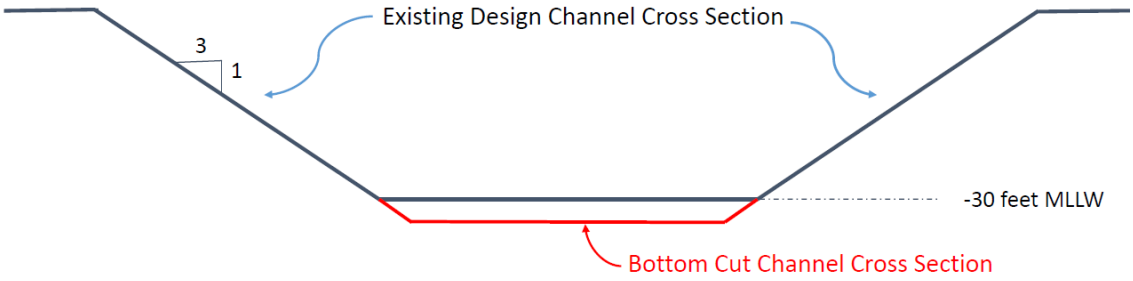


Figure 3-2. Typical Bottom Cut Channel Cross Section

Bottom cutting would be required from station 155+00 to station 162+00. From station 162+00 to the end of the turning basin, bottom cutting would be required on the Bair Island side only.

Opportunity: Support the goals of the San Francisco Bay Long Term Management Strategy.

The following measures were developed and subjected to screening based on how well they are expected to address this opportunity.

14. **Place dredged material at placement sites for beneficial reuse.** This measure involves transporting dredged material from the channels onto the upland edge of restoration sites in the South San Francisco Bay area for beneficial reuse by others for environmental restoration purposes. It was retained because it would be effective at addressing the opportunity to increase beneficial reuse of dredged material.

15. **Place dredged material in-Bay at passive sediment transport sites for beneficial reuse.** Recent studies of sea level rise in the San Francisco Estuary have indicated that the majority of tidal marshes surrounding the Bay are likely to lose marsh plant communities by 2100 because natural accretion rates will not keep pace with sea level rise. This management measure would place dredged material in natural channels in the Bay with the intention of relying on natural sediment transport processes to move the material from mudflats to feed marsh restoration sites. For this study, In-Bay placement near the Dumbarton Bridge (Passive Sediment Transport) at three separate target locations was considered as an option. The three sites considered are very close to the dredging project and would likely be a low-cost beneficial reuse choice (Delta Modeling Associates 2014). They could also serve as a fallback if mechanical problems or other factors limit use of other preferred beneficial reuse sites.

The three target sites would be located in a natural channel approximately five miles from the RWC channel in open water within San Francisco Bay, just south of the Dumbarton Bridge. Capacity is currently estimated at 350,000 cy per year. The sediment would be clamshell dredged at the site, placed in scows and then bottom-dumped into the natural deep-water channel and dispersed into the marsh and elsewhere by tidal action. It is likely that only easily dispersed sediments, such as unconsolidated fine sediments, would be considered for this site. In addition to the type of material, the wind, waves, tides and currents would be factors in the sediment dispersal. Also, it may be necessary to physically knock down or remove high spots (similar to Alcatraz).

A three-dimensional hydrodynamic wave and sediment transport model was applied as part of the LTMS to examine sediment dispersal throughout the San Francisco Bay and the Sacramento-San Joaquin Delta (Delta Modeling Associates 2014). One focus of the sediment transport modeling effort was to examine the sediment dispersal following dredged material placements. The model evaluated shallow-water dredged material placements in less dispersive areas adjacent to existing marshes or breached salt ponds and indicated an increase in deposition rates within these areas through natural dispersal of the placed sediment. At some locations within the Bay, dredged material

placement was effective at supplying sediment to the surrounding mudflats and breached salt ponds resulting in increased accretion rates. These model results suggest dredged material placement in strategic locations may be used in a nature-based strategy to augment sediment supply to mudflats, marshes, and breached salt ponds surrounding San Francisco Bay.

Despite its promising benefits, this management measure was removed from further consideration for this study for the following reasons:

- Hydraulic modeling studies have demonstrated that only 25 percent of the placed material is dispersed with the majority remaining where it was initially placed;
- Placement at this location has the potential to destroy benthic habitat and it could affect species use in the natural deep water habitat; and
- Available technical information is currently insufficient to assess and evaluate just how effective and efficient this measure would be.

Other measures for placement of dredged material

The following measures were developed and subjected to screening based on how well they are expected to meet the needs of the channel deepening project.

16. **Place dredged material in-Bay at designated open-water disposal sites**. SF-11 Alcatraz is the only in-Bay placement site that was considered. SF-11 Alcatraz is an existing and permitted site which has historically been used as a disposal site for maintenance dredged material from both RWC and SBS Channels. It is located in open Bay waters near Alcatraz Island. It is proximal to both SBS and RWC Channels. Although the site is not considered to be available because it is not designated for use by new projects and does not have capacity to receive the material, it was tentatively retained during earlier screenings.

Currently, the site's annual and monthly capacity limits are already filled by existing operations and maintenance (O&M) projects, including the existing RWC Project. In emergency situations, it is possible to apply for a permit from the Dredged Material Management Office (DMMO) to place up to 250,000 cy of material at the site. "A dredging emergency is a situation that poses an immediate danger to life, health, property, or essential public service and that demands action by the Board more quickly than the Board's normal permit procedures would allow" (CEPA 2015). Given its low capacity, it would never be suitable for use as a stand-alone disposal site. It is also not considered a beneficial reuse site. SF-11 Alcatraz was therefore eliminated from continued consideration for construction dredging although it may be used for future long term maintenance dredging.

17. **Place dredged material in-Bay at aquatic transfer facilities (ATFs).** There are two types of ATF that can be created; unconfined or confined via a structural enclosure that would isolate the dredged material from the surrounding water. An example of a confined ATF would be walls constructed of steel sheet piles with the tops of the piles visible at both high and low tides. Steel sheet pile walled enclosures would require periodic inspection to ensure no displacement is occurring and cathodic protection is replaced as needed. Periodic assessments of the perimeter walls for scour or shoaling adjacent to the sheet piles would be required. An unconfined or confined ATF in San Francisco Bay could be utilized to transport and place sediment for beneficial use at upland sites. An unconfined in-Bay ATF will facilitate dredge delivery vessels (scows and hopper dredges) to deposit dredged material into the ATF basin. Material placed in the ATF basin would then be re-dredged (probably using a cutterhead dredge) and pumped to the upland site through a transfer pipeline. Construction and maintenance dredging of an access channel may be required to allow access for fully loaded haul scows and hopper dredges to the in-Bay ATF basin.

The proponent for the ATF will be via a separate project or enterprise and not a direct component or feature of the RWC project. Consequently, site preparation would not be required and the Project would only be responsible for transporting the dredged material to the ATF site and would not incur any expense for moving the material to the upland site. The measure may also be effective at meeting the study objective of prioritizing beneficial reuse of dredged material since material could potentially be reused beneficially at upland sites.

The Bay Farm Borrow Pit is an in-Bay placement site, located in South San Francisco Bay, adjacent to Bay Farm Island and is close to the SBS channel. It is considered an ATF option. Historically, developers removed material from this site to use as fill for construction projects around the Bay. The site is not currently designated for any type of dredged material placement, including use as an aquatic transfer facility. Site managers and USEPA Region 9 indicate that the site is not available to receive material. A permit to designate the site as an ATF is not possible because there are no projects that would use the site as a transfer facility. Discussions with USEPA Region 9 indicate that resource agencies assign value to the existing habitat and therefore it is also unlikely that the site would be designated for sub-tidal restoration. Placing dredged material here to restore the site to its former elevation would have a negative impact on the existing habitat. Finally, the City of Alameda objects to the use of the site as a dredged material placement site. Therefore, this management measure was eliminated from further consideration.

18. **Place dredged material at San Francisco Deep Ocean Disposal Site (SF-DODS).** SF-DODS is located in the Pacific Ocean, approximately 50 miles west of the Golden Gate Bridge. The site is approximately 90 miles from RWC Harbor and approximately 80

nautical miles from SBS Channel. The site was established in 1994 by the LTMS agencies and is managed by the USEPA. Use of the site is generally considered an environmentally superior alternative to disposal in San Francisco Bay.

While LTMS goals and environmental compliance considerations recommend beneficial reuse of as much dredged material as possible, it is accepting of dredged material placement at this site. Additionally, the site is currently available, permitted, and has adequate capacity.

3.4 Measures Retained for Further Consideration

Of the eighteen management measures evaluated, thirteen were dropped as a result of the initial screening process described above and five were retained for further study to form the basis for the alternative plan development. ***Table 3-2*** summarizes the results of the screening process.

Table 3-2. Summary of Initial Screening Results

Management Measure	Screening Rationale	Result
1. Deepen channels at Redwood City Harbor and San Bruno Shoal	► 100 percent of vessels from July 2012 to June 2013 had design drafts greater than the existing depth of 30 ft. ► Based on the vessels calling on the Port light-loaded, approximately 70 percent of commodities would benefit from deepening. ► Deepening would reduce the need for vessels currently calling on the Port to lighter, light load, or wait for high tide, resulting in greater efficiency and cost savings.	Retain
2. Build a lock or dam structure at Redwood City Harbor.	► Not effective because there is no elevation change in the study area. ► It would require major reconstruction of Port infrastructure at a high prohibitive cost.	Drop
3. Dredged a separate shallow lane for lighter ships at Redwood City Harbor.	► Does not address a planning objective. ► Intended to ease congestion, which is not a problem at the Port. ► It would adversely impact landside Port infrastructure.	Drop
4. Realign the channel at San Bruno Shoal	► Review of current bathymetry indicates that the channel is already in the optimal location to take advantage of as much natural deep water as possible. ► Realigning the channel would not reduce the amount of dredging necessary to achieve the selected project depth, nor would realignment reduce future maintenance dredging and in fact may increase future maintenance dredging because of increased shoaling.	Drop

Management Measure	Screening Rationale	Result
5. Significantly realign the channel entrance at Redwood City Harbor	► Hydraulic Modeling results recently completed demonstrated that a significant realignment of the entrance channel would actually increase the sediment deposition rate.	Drop
6. Relocate Port Facilities to deep water and dock boats in the Bay.	► The measure would not be efficient. Commodities would still have to be transported to landside facilities, resulting in no cost savings.	Drop
7. Congestion fees	► Do not address objective. High traffic is not a problem at the Port.	Drop
8. Traffic management		Drop
9. Light Loading/Lightering	► Already part of existing condition	Drop
10. Use of favorable tides and daylight transit		Drop
11. Increase use and capacity of related intermodal transportation systems such as highways and rail	► Does not address study objective and is not efficient. It would require double handling of cargo from vessel to truck, incurring additional cost. ► Increases traffic congestion on overland networks and increased air pollution.	Drop
12. Slightly realign the channel entrance at Redwood City Point	► A slight realignment would allow deepening to minimize impacts to the mudflats and avoid impacts to Bair Island	Retain
13. Bottom cut channel toe near Port infrastructure if the channel is deepened	► Bottom width would be reduced ► Top width would remain as-is ► Modeling required to insure navigational safety	Retain
14. Place dredged material at placement sites for beneficial reuse	► Meets both USACE policy guidelines that favor increased beneficial reuse of dredged material as well as LTMS goals	Retain
15. Place dredged material in-Bay at passive sediment transport sites for beneficial reuse	► New concept, Information to evaluate is lacking ► Inconsistent with LTMS	Drop
16. Place dredged material in-Bay at designated open-water disposal sites	► Contrary to USACE policy and LTMS goals ► SF-11 not designated for new work dredging ► Limited capacity	Drop
17. Place material at aquatic transfer facilities (ATF's)	► No sites are available	Drop
18. Place dredged material at SF-DODS	► Site currently available and permitted to receive dredged material. While not highly desirable option still in line with LTMS recommendations	Retain

As a result of this screening, three dredging management measures and two placement measures were retained during the screening process for further consideration.

Retained Dredging Management Measures

- Deepen RWC and SBS Channels;
- Slightly realign the channel entrance at Redwood City Point; and
- Bottom cut channel toe near Port infrastructure if the channel is deepened.

Retained Placement Management Measures

- Place dredged material at placement sites for beneficial reuse; and
- Place dredged material at SF-DODS.

3.5 Plan Formulation Strategy

Navigation projects that require dredging must identify strategies to address two issues: 1) removal of the dredged material from the channel and 2) placement of the material at an appropriate site. Therefore, the formulation of alternative plans will consider the three dredging management measures and the two placement measures that have been retained.

3.5.1 Dredging Management Measures

The three dredging measures carried forward include:

- Deepening the channels at SBS and RWC Harbor;
- Slightly realigning the channel entrance to RWC Harbor; and
- Bottom-cutting the channel toe as needed to avoid Port infrastructure and impacts to Bair Island.

Slightly realigning the channel and bottom-cutting the channel toe are measures that are dependent upon dredging. They are not standalone measures – they minimize impacts to Bair Island and Port infrastructure if the channel is deepened. Therefore, all three measures are included in each alternative.

Three depths were selected for the evaluation of economic benefits associated with channel deepening. The selected depths were -32 feet MLLW, -34 feet MLLW and -37 feet MLLW. These three depth were evaluated to identify the depth that resulted in the greatest net NED benefits[5].

3.5.2 Placement Measures

After the screening of management measures (***Table 3-2***) two management measures were retained for placement of dredged material: placement for beneficial reuse, and deep ocean disposal. A wide range of specific sites were compiled for each of these placement management measure (***Table 3-3***).

[5] Net NED benefits are calculated by subtracting the average annual project costs from the average annual NED benefits.

Table 3-3. Initial Array of Potential Placement Sites

Placement Management Measure	Specific Sites
Placement for beneficial reuse	• Ravenswood Pond Complex • Alviso Pond Complex • Eden Landing Pond Complex • Crown Memorial State Beach • Oakland International Airport • Montezuma • Cullinan Ranch • California Delta Islands and Levees
Deep Ocean Disposal	• SF-DODS

3.5.3 Placement Site Screening Criteria

Existing data on dredged material chemistry and physical characteristics within the channels to be dredged was compared with the type of material that could be accepted at each placement site. Placement site managers were consulted to the extent possible and the capacity of each site was compared to the dredged material volumes for several dredging depths. Screening criteria used to identify potential placement sites that merit further consideration are described below:

- ***Site Availability***
  - *Metric*: Year the site is available. Sites that would be available and could be permitted by the estimated project base year of 2018 were retained.
- ***Capacity***
  - *Metric*: The volume of dredged material that can be placed on the site. Sites that do not have enough capacity to receive at least 1 mcy[6] of material (approximately equivalent to the estimated volume to be dredged for a 32 foot depth) were screened out.
- ***Material Compatibility***
  - *Metric*: Specific sites have material composition specifications (both physical as well as chemical) that must be met to allow placement.

3.5.3.1 *Material Characterization*

The physical and chemical characteristics of the dredged material were evaluated for suitability for placement at the alternative sites based on available information. In general, the sediment that would be dredged from RWC Channel is predominantly silt and clay, with 2

[6] If a site is being considered to supplement placement at a beneficial reuse site and placement at the site would improve the benefit to cost ratio, a site with less than 1 mcy capacity would be retained.

percent or less sand and gravel (USACE 2014b). The sediment to be dredged from SBS Channel contains a higher percentage of sands – up to 30 percent.

It is assumed that the material dredged from both, RWC and SBS Channels, is suitable for placement at one of the available sites and upland placement in a land fill would not be required. The following factors support this assumption.

- The biological (toxicity) testing generally showed that the contaminated sediment was statistically no more toxic than the reference sediment from SF-DODS.
- There are portions of The Inner Turning Basin (by "eyeball" method, probably something like 2/3 of the area) that had only slightly elevated levels of PCBs that would not require landfill disposal

Therefore, for plan formulation, it was assumed that no dredged material from this Project will require placement in an upland landfill. Sediment sampling is being performed to determine the quality of the sediment to be dredged and to verify this planning assumption. However, the results are not available at this writing. The results of the sediment sampling will be incorporated into the final report.

3.5.4 Screening of Potential Placement Sites

3.5.4.1 *Ravenswood Pond Complex*

This site is located within San Francisco Bay along its western shore and is the closest proposed placement site to Redwood City Harbor. The site is part of the Don Edwards San Francisco Bay National Wildlife Refuge and is owned by the USFWS. Bordered by a portion of Greco Island to the north and the Dumbarton Bridge to the south, it consists of four former salt ponds, comprising 240 acres in the process of being restored. These ponds are part of the proposed Phase 2 restoration component of the SBSP Restoration Project, the largest wetland restoration project on the West Coast. Proposed restoration efforts are described in the Draft Phase 2 South Bay Salt Pond Restoration Project EIS/EIR.

There are a number of factors that preclude Ravenswood from further consideration:

- *Environmental Considerations/Timing.* The Ravenswood ponds are currently an ideal location for snowy plovers to thrive as they prefer un-vegetated habitat with a 360 degree view of their surroundings. The existing snowy plover habitat at the site cannot be disturbed until equivalent habitat has re-established across the Bay at Eden Landing Pond Complex. The estimated time for this to occur is 10 years.
- *Capacity.* Site managers indicate that the current capacity at Ravenswood is only 300,000 cy; the minimum quantity to be dredged would be approximately 1 mcy. Any use of this site will require use in combination with additional sites. The site may be considered for future O&M material once it becomes available.

- *Cost.* The Ravenswood site cannot accept hydraulically dredged material. The site is relatively confined and includes a number of natural channels that require protection. Dredged material would have to be dredged with clamshells, loaded onto barges, off-loaded from the barges into a re-handling area and dried to reduce moisture content to sufficiently to prevent free moisture when the material is loaded into trucks. The material would then be trucked to the site for precise placement. The multiple handling steps and inefficient transport process significantly escalates project costs.

Ravenswood was therefore dropped from further consideration.

Figure 3-3 displays Ravenswood Pond Complex and two other South Bay Salt Pond Restoration Project beneficial reuse placement sites being considered: Eden Landing Pond Complex and Alviso Pond Complex.

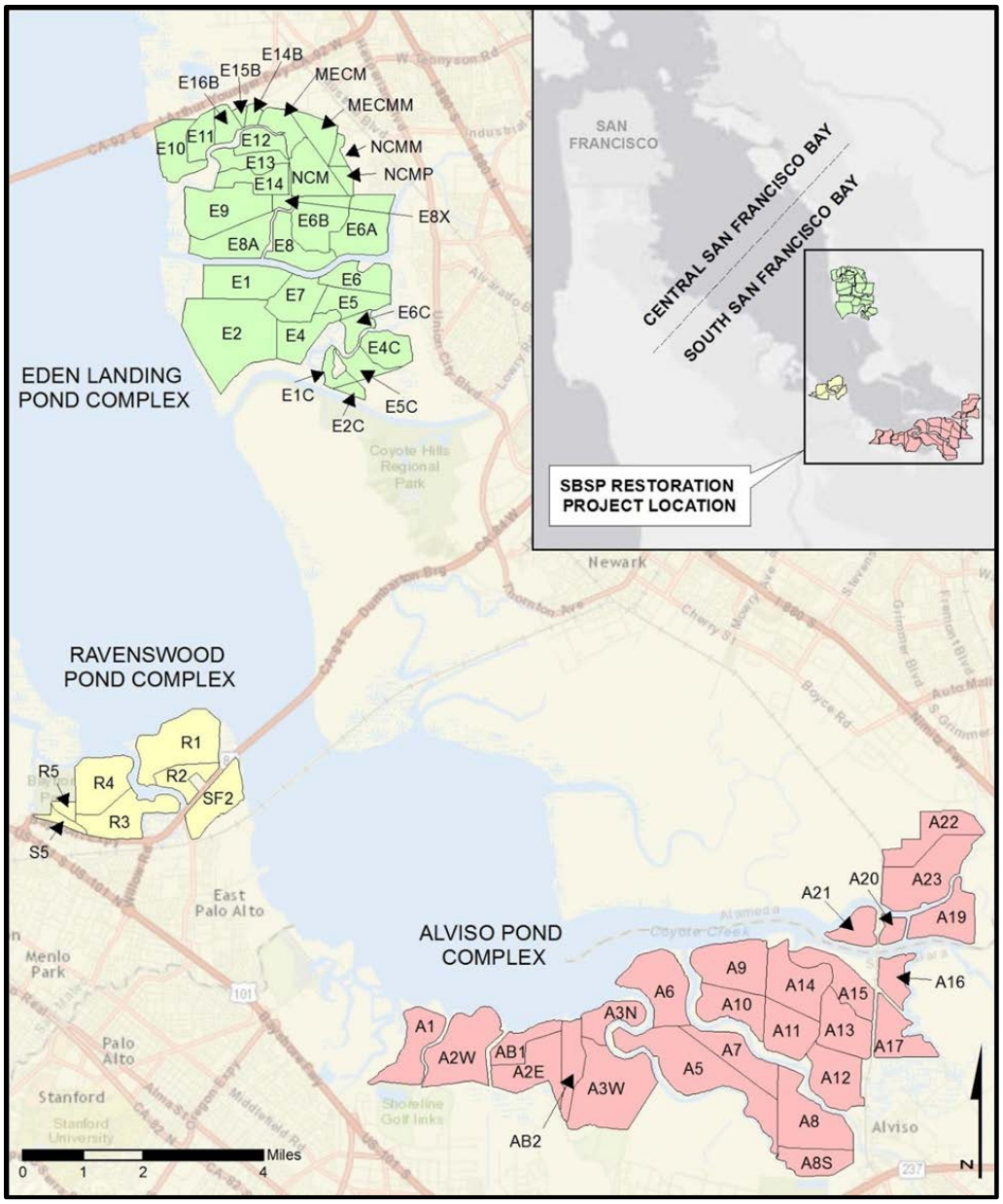


Figure 3-3. South Bay Salt Pond Restoration – Potential Placement Sites

3.5.4.2 *Alviso Pond Complex*

The Alviso Pond Complex site is a component of Phase 2 of the SBSP Restoration Project. This site is the furthest of the SBSP Restoration sites from both the RWC and SBS channels but is still relatively close. There are three groups of ponds being considered for placement of dredged material:

- Ponds A1 through A2W
- Ponds A5 through A8S
- Ponds A9 through A15

Sediment delivered to the ponds would be used to raise the bottom elevation of the ponds to accelerate tidal marsh development.

Ponds A8 and A8S have a combined capacity of 8 mcy which is sufficient for the highest amount of dredged material that would be produced by any of the alternative plans being considered. These two ponds are the highest priority at Alviso as they have significant subsidence. Further northwest, Ponds A1/A2W (Mountain View Ponds) are also considered a priority due to the need for material to cap existing mercury-laden soil deposits.

Operational considerations for Alviso are similar to those for Eden Landing. Additionally, due to the possibility of disturbing mercury-laden sediments, a monitoring plan for the decant water will be required if sediment is placed into Ponds A8 or AS. Species of concern in this area include steelhead, Longfin smelt, green sturgeon and Ridgeway's rail (formerly California clapper rail).

Alviso was retained for consideration due to high environmental merits, particularly if the sediments can be used to cap existing mercury laden soils which will reduce the potential for mercury exposures to sensitive wildlife and additionally save local agencies annual monitoring costs.

3.5.4.3 *Eden Landing Ponds*

Eden Landing Ecological Reserve is a former salt pond site that is also part of Phase 2 of the SBSP Restoration Project. The southern portion of this site (referred to in this document as the Eden Landing Ponds, or simply Eden Landing) could receive dredged sediment from the RWC Project. No sediment is proposed to be placed in the northern half of the Eden Landing Ecological Reserve.

The South Bay Salt Pond Restoration Beneficial Reuse Feasibility Study (Moffatt & Nichol 2015) describes the value of Eden Landing as a pilot beneficial reuse project to launch the infrastructure necessary for the delivery of dredged material further south to the Alviso Pond Complex. It is located on the eastern shore of South San Francisco Bay located approximately seven to ten miles away from the RWC channel. Eden Landing is the only beneficial reuse site that is close enough both to the RWC and SBS Channels to allow direct hydraulic delivery of sediment from the dredge. The site would also be able to accept material off-loaded from barges at an off-shore off-loader.

Material would be delivered to the Bayfront levee via pipeline and then placed by others as appropriate for environmental restoration of the former salt ponds. Dredged material delivered to this site must meet wetland cover (wetland surface) specifications. The site can accept Young Bay Mud, sands, and Old Bay Mud, and can therefore accept material from both the RWC and SBS channels. Site managers also indicate that the site may be available in 2018 (Project Year Zero), and that the site has capacity for between 3M to 7 mcy of material. Eden Landing would most likely use ponds E1, E2, E4 and E7 (Bay Ponds), although additional

sediment capacity is available at ponds located to the east and south of these four ponds. Primary emphasis for placement will be on ponds E1 and E2, which are on the Bay shoreline.

There are concerns regarding Eden Landing's availability when dredging of RWC and SBS Channels first commences. If available, the RWC Project would deliver material to the site and placement would be accomplished by the site owner. The site owner would charge a tipping fee that would cover capital improvements and operations required to manage and place the dredged material. These improvements may include weirs, water control structures, internal berms, monitoring of decant water, etc.

The RWC Project may or may not need to provide its own off-loader. If sediment is delivered to an off-loader, the off-loader could be installed by the site owner or the RWC Project. If the site owner installs the off-loader, the cost will be reflected in the tipping fee. Material delivered by the RWC Project could be used to construct a landmass (alternative flood control structure), provide ecotone (wetland to upland transition) habitat, accelerate tidal marsh development by increasing the elevation of the ponds, or create habitat features such as nesting islands.

Eden Landing was retained for consideration despite possible availability concerns since it is the closest placement option to the Project site (which would reduce transport time and costs) and because of the beneficial environmental aspects of its use.

3.5.4.4 *Crown Memorial State Beach*

Crown Memorial State Beach is located on the northeast side of South San Francisco Bay on Alameda Island, in close proximity to the SBS Channel. The 2.5 mile beach was restored in 1982 after wind and wave action eroded the beach. Sand is added periodically to maintain the beach. Based on specifications provided by East Bay Parks, Crown Memorial Beach requires clean sand. The material in the SBS Channel is predominantly silty sand, not clean sand, and the material in the RWC Channel consists predominantly of high plasticity clay, not sand. Since the material from the channels is not compatible with placement at this site, it was dropped from further consideration.

3.5.4.5 *Oakland International Airport*

Oakland International Airport is located on the northeast side of the South San Francisco Bay, in close proximity to the SBS Channel. It does not have enough capacity to receive the quantity of material associated with the deepening project. In addition, the silty sand and high plasticity clay material from the RWC and SBS Channels is not compatible with the needs of this site (construction of stone columns and/or deep soil mixing used in ground improvements or construction at the Oakland International Airport). Therefore, this site was dropped from further consideration.

3.5.4.6 *Montezuma Wetlands Restoration Project*

Montezuma Wetlands Restoration Project is a privately owned, ongoing restoration effort. It is currently at the tail end of the Phase 1 construction. About 1 mcy capacity remains in Phase 1

and the remainder of the dredged material would be placed in Phase II, which will provide an additional capacity of 4.5 mcy. Phases 3 and 4 will accommodate additional 2.5 and 5.5 mcy of dredged material placement capacity, respectively.

Montezuma Wetland Restoration Project accepts both wetland cover and wetland non-cover (foundation) quality material from new work and maintenance projects. This site is currently accepting sediment and has an off-loader in place and operating. The project site comprises approximately 2,400 acres at the eastern edge of Suisun Marsh, approximately 17 miles southeast of Fairfield, California (***Figure 2-1***). It is the furthest beneficial reuse placement site from the RWC Project. Ground elevations at the site have subsided up to 10 feet since its tidal marshlands were diked and drained for agricultural purposes more than 100 years ago. All site preparation, monitoring, and reporting is handled by the Montezuma Wetland Restoration Project, which charges a tipping fee for accepting dredged sediment. The tipping fee includes use of the off-loader.

The Montezuma restoration project was retained for further consideration. It is a beneficial reuse site that has both the needed capacity to serve as a stand-alone placement site for the dredging effort and is currently permitted and accepting both cover and non-cover material. The biggest drawbacks are its distance from the RWC Project (62 and 51 miles respectively from RWC and SBS Channels) and the relatively high tipping fee. Delivery of wetland non-cover material may require delivery of sufficient wetland cover material to provide a minimum three foot cap over the wetland non-cover material. Alternatively, wetland non-cover material may have a higher tipping fee.

3.5.4.7 *Cullinan Ranch Tidal Restoration Project*

Cullinan Ranch Tidal Restoration Project is a wetland restoration site that comprises more than 1,500 acres and is located in western Solano County near the City of Vallejo. It is located between State Highway 37 and Dutchman Slough. It is considered a beneficial reuse site and is currently permitted and available. Cullinan Ranch is a former hay/cattle farm that is being restored to tidal marsh. It has a total capacity of 3 million cy of dredged sediment. The sediment will be used to raise up to 290 acres of the site to marsh plain elevation. The site has two permitted off-loader locations, both located in the Napa River, north and south of the mouth of Dutchman Slough, respectively. Both locations are accessible by large scows. The dredged sediment would be delivered to the chosen off-loader location by barge, and then pumped approximately 1 mile from the off-loader into the site. The off-loader could be provided by the site owner or the RWC Project.

The site will charge a small tipping fee to cover the costs of placement (infrastructure and operational costs). The actual tipping fee will depend on whether the RWC Project supplies its own off-loader or not. The average travel distances to the site from RWC and SBS Channels to this site are 46 and 35 miles, respectively. Cullinan Ranch was retained for further

consideration as it is a beneficial reuse site. The site is expected to be available until 2020. The site will be retained for further consideration.

3.5.4.8 *California Delta Island and Levees*

The California Bay Delta consists of a web of channels and reclaimed islands at the confluence of the Sacramento, San Joaquin, Cosumnes, Mokelumne, and Calaveras Rivers and the outlet for Central Valley rivers to the San Francisco Bay. Much of the land is below sea level and is outlined by a network of 1,100 miles of levees constructed during the past 150 years to manage the flow of water through the Delta. The network is a mix of federal and non-federal levees and most do not meet USACE levee construction standards and could fail at water levels well below the top of the structures. Historically, the delta was defined by tidal wetlands, primarily comprised of peat soils. However, nearly 95 percent of the historic wetland habitat in the delta has been converted to agricultural and urban uses.

There are concerns that widespread failure of the deficient Delta levees could cause salt water from San Francisco Bay to intrude into the Delta, effectively shutting down the water supply for the 25 million Californians who depend on water pumped from the Delta. This concern resulted in two broad USACE initiatives. The first was the Calfed Levee Stability Program and the second is the California Bay Delta study. All the studies recommend the repair/build-up of existing levee network which will require significant amounts of material that could conceivably be partially provided by the dredging at RWC Channel. The Delta project levees are generally located from the vicinity of Montezuma Wetlands and further to the east. The cost of transporting dredged material to Montezuma and the Delta levees would be greater than the cost of using Cullinan Ranch. Therefore, this site was dropped from further consideration.

3.5.4.9 *San Francisco Deep Ocean Disposal Site (SF-DODS)*

SF-DODS (***Figure 3-4***) is an existing, permitted open ocean disposal site located approximately 90 miles from the RWC Channel and 80 miles from the SBS Channel. The SF-DODS was authorized by the USEPA in 1994 and remains co-managed by the USACE and USEPA Region 9. The site is in approximately 8,200 to 9,840 feet of water on the continental slope off San Francisco. SF-DODS spans an area of approximately 8.6 square miles, and has a disposal capacity of 4.8 mcy of dredged material per year.

Disposal is limited to suitable dredged material from the San Francisco Bay region and other nearby harbors or dredging sites. While the capacity exists, it is quite distant from the RWC Project.

SF-DODS was retained for consideration. Despite the long distance to the site (68 and 57 miles respectively from RWC Channel and SBS Channel) and the fact that it is not a beneficial reuse site, SF-DODS was retained because it is readily available, permitted, and has the most capacity for both long-term and annual placement.

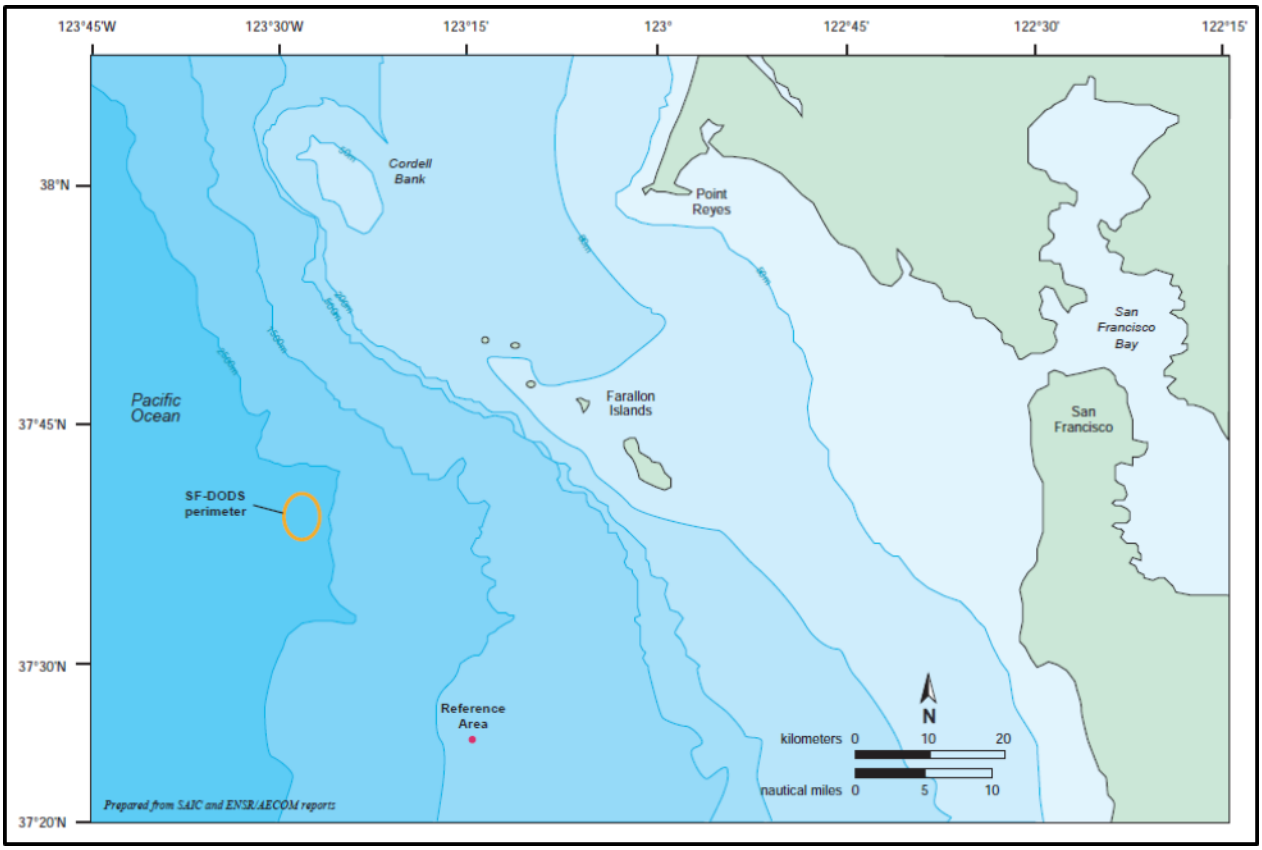


Figure 3-4. San Francisco Deep Ocean Disposal Site (SF-DODS)

3.5.5 Placement Site Screening Results

The results of the placement site screening process are summarized in ***Table 3-4***.

Table 3-4. Placement Site Screening Results

Placement Site Measure	Screening Rationale	Screening Outcome
Ravenswood Pond Complex	► Not available until 2023 ► Limited capacity (500,000 cy)	Dropped
Eden Landing Pond Complex	Currently available ► Capacity is 3 to 7 mcy Capacity of 3 mcy ► Material is compatible with restoration needs Beneficial reuse; material is compatible	Retained
Alviso Pond Complex	► Material is compatible with restoration needs ► Capacity is 34 mcy	Retained
Crown Memorial State Beach	► Not compatible; requires clean sand	Dropped
Oakland International Airport	► Not enough capacity ► Material is not compatible	Dropped
Montezuma Wetlands	► Currently available ► Beneficial Reuse ► Material is compatible with restoration needs	Retained
Cullinan Ranch	► Currently available ► Capacity of 3 mcy ► Beneficial reuse; material is compatible ► Material is compatible with restoration needs	Retained
California Bay Delta	► Furthest location of beneficial reuse sites ► Costly to move	Dropped
SF-DODS	► Available now ► Has capacity for entire project volume ► Material is compatible	Retained

3.6 Focused Array of Alternatives

The focused array of alternatives consists of seventeen action alternatives and the No Action plan. The action alternatives include measures to deepen the channels (-32, -34 and -37 feet MLLW) while avoiding impacts to Bair Island Restoration and the Port facilities, and placement of various quantities of dredged material from the project at five prospective locations. The alternative plans are summarized in ***Table 3-5***. This table shows the estimated sediment volume that would be delivered to each placement site under each alternative. The actual volume of sediment delivered to each placement site would be determined by the actual volumes dredged; the actual volumes dredged could change

based, in part, on shoaling during construction and the amount of overdepth actually achieved. Alternatives A-1 through A-5 incorporate Dredging Option A (-32 feet), Alternatives B-1 through B-6 include Dredging Option B (-34'), and Alternatives C-1 through C-6 would use Dredging Option C (-37').

For all dredging depths, it was assumed that 95 percent of the dredged material from RWC Channel and 100 percent of the material from SBS Channel would be wetland cover quality and could be placed at any of the alternative placement sites. The remaining 5 percent of dredged material from RWC Channel was assumed to be wetland non-cover quality and could be placed at either Montezuma or Cullinan. Montezuma was chosen because it is fully set up to receive dredged sediment; at Cullinan an offloader would have to be set up for the sediment, and that is not cost effective if only a small quantity of sediment is being delivered.

Where possible, alternatives were developed for placement of the dredged material for each depth at each of the five placement sites forming 15 alternatives. However, Cullinan has a capacity of 3 mcy which is adequate to accommodate all the material resulting from the -32 feet MLLW deepening, but not all the material for -34 or -37 feet MLLW. Therefore, alternatives were developed for placing 3 mcy at Cullinan and the remaining material at either Montezuma or SF-DODS for the -34 and -37 feet MLLW depths as shown in ***Table 3-5***. The alternatives that include placing all dredged material at Montezuma or a combination of Cullinan and Montezuma would provide 100 percent beneficial reuse of the dredged material.

Table 3-5. Summary of Project Alternatives

Alt No.	Dredging Option (feet MLLW)	Placement Site Use (cy)							
		Cullinan	Montezuma	SF-DODS	Eden Landing	Alviso – Pond A2W Delivery	Alviso – Pond A9 Delivery	Total Volume (cy)	Formulation Strategy
A-1	A (-32')	1,765,000						1,765,000	100% Beneficial Reuse; lowest cost permitted site
A-2	A (-32')		1,765,000					1,765,000	100% Beneficial Reuse; maximum Montezuma use
A-3	A (-32')		46,000*	1,719,000				1,765,000	Placement at SF-DODS with an allowance for wetland foundation material placement at Montezuma
A-4	A (-32')		46,000*		1,719,000			1,765,000	Maximum South Bay Beneficial Reuse; maximum Eden Landing use with an allowance for wetland foundation material placement at Montezuma
A-5	A (-32')		46,000*			1,719,000		1,765,000	Maximum South Bay Beneficial Reuse, maximum Alviso use with an allowance for wetland foundation material placement at Montezuma
B-1	B (-34')	2,800,000	1,161,000					3,961,000	100% Beneficial Reuse; assuming 1 Year of Cullinan use
B-2	B (-34')		81,000*	3,880,000				3,961,000	Most cost-effective approach
B-3	B (-34')	3,000,000		961,000				3,961,000	Maximum Cullinan use; remainder to most cost-effective site
B-4			3,961,000					3,961,000	100% Beneficial Reuse, maximum Montezuma use
B-5	B (-34')		81,000*		3,880,000			3,961,000	Maximum South Bay Beneficial Reuse; maximum Eden Landing use with an allowance for wetland foundation material placement at Montezuma
B-6	B (-34')		81,000*			3,880,000		3,961,000	Maximum South Bay Beneficial Reuse;

Alt No.	Dredging Option (feet MLLW)	Placement Site Use (cy)							
		Cullinan	Montezuma	SF-DODS	Eden Landing	Alviso – Pond A2W Delivery	Alviso – Pond A9 Delivery	Total Volume (cy)	Formulation Strategy
									maximum Alviso use with an allowance for wetland foundation material placement at Montezuma
C-1	C (-37')	2,800,000	4,915,000					7,715,000	100% Beneficial Reuse; high Cullinan use
C-2	C (-37')		138,000*	7,577,000				7,715,000	Most cost-effective approach
C-3	C (-37')	3,000,000		4,715,000				7,715,000	100% Beneficial Reuse; maximum Cullinan use and supporting SF-DODS use
C-4	C (-37')		7,715,000					7,715,000	100% Beneficial Reuse; maximum Montezuma use
C-5	C (-37')		138,000*		7,577,000			7,715,000	Maximum South Bay Beneficial Reuse; maximum Eden Landing use with an allowance for wetland foundation material placement at Montezuma
C-6			138,000*			7,577,000		7,715,000	Maximum South Bay Beneficial Reuse; maximum Alviso use with an allowance for wetland foundation material placement at Montezuma

*Volume that represents 5% of the dredged material from the RWC Channel deepening that is assumed to be unsuitable for wetland cover.

4 Affected Environment, Environmental Consequences, and Mitigation Measures

4.1 Introduction

This Chapter presents an overview of the affected environment and a description of the proposed Project[7] activities (***Section 4.2***), briefly describes the alternatives analysis process and regulatory setting (***Sections 4.3 and 4.4***, respectively), and then describes the No Action/No Project Alternative and provides a summary of the alternatives evaluation (***Section 4.5***). The detailed description of the affected environment, significance criteria, and impact assessment is provided in ***Appendix A.***

4.2 Overview of the Affected Environment

The Project is located in San Francisco Bay. San Francisco Bay is a shallow estuary that drains water from approximately 40 percent of California. Water from the Sacramento and San Joaquin River watersheds passes through the Bay to the Pacific Ocean. San Francisco Bay is characterized by wide shallow areas flanking a central natural deep water channel. The deep channel is a remnant of the ancient drowned river valley that constitutes San Francisco Bay. Portions of the natural deep water channel (former river alignment) have been deepened further to support deep draft vessel navigation.

Shallow water reclamation by infilling along the margins has reduced the original Bay from approximately 700 square miles to its present size of approximately 400 square miles. The central portion of the San Francisco Bay has an average depth of 43 feet. The northern and southern areas have an average depth of 15 to 17 feet, respectively. The Bay's deepest waters lie at the Golden Gate where depths exceed 360 feet (University of Rhode Island and USEPA 2015). San Francisco Bay is commonly divided into four areas: Suisun Bay, North Bay (or San Pablo Bay), Central Bay, and South Bay. ***Figure 4-1*** shows the approximate basin boundaries for the four sub-bays. The Central Bay is the deepest portion of the Bay; the North Bay (San Pablo Bay) is the shallowest. The main part of the Bay measures 3 to 12 miles wide east-to-west and somewhere between 48 miles and 60 miles north-to-south. It is the largest Pacific estuary in the Americas.

4.2.1 Project Location

The Project is primarily located within San Francisco Bay; SF-DODS is located in the Pacific Ocean approximately 50 miles west of the Golden Gate. To the west of the Bay are the hills of the San Francisco and Marin peninsulas; to the east lie the Richmond, Berkeley, and Hayward-Fremont Hills; to the south are the San Bonito and Santa Clara Valleys; and to the north are San Pablo Bay and the Napa and Sonoma Valleys. Substantial portions of San Francisco Bay

[7] Chapters 4 and 5 address important requirements of NEPA and CEQA. In these chapters, Project activities or impacts refer to the activities or impacts of the action alternatives.

shoreline have been converted to urban, transportation, agricultural, and industrial uses; nonetheless many areas of the Bay retain their natural character and contain mudflats and tidal marshes, and other sensitive habitat.



Figure 4-1. Sub-bays of San Francisco Bay

As described in ***Chapter 3***, the project area consists of two dredging locations (RWC Channel and SBS Channel), three placement sites (Cullinan, Montezuma, and SF-DODS), two potential placement locations (Eden Landing ponds and Alviso ponds), and the water areas connecting these sites. Cullinan, Montezuma, Eden Landing ponds, and Alviso ponds are beneficial reuse sites that would use dredged sediment to aid the restoration of tidal salt marsh habitat (wetland reuse). SF-DODS is a disposal site. ***Figure 2-1*** shows the dredging locations and San Francisco Bay placement sites. The only Project feature that is outside of ***Figure 2-1*** is SF-DODS, which is shown in ***Figure 3-4*****.** The dredging locations and the two potential placement sites (Eden Landing and Alviso) are located in South San Francisco Bay (***Figures 4-2 and 4-3***). Cullinan and Montezuma are located in the Napa River Estuary just north of San Pablo Bay and the eastern margin of Suisun Bay near the confluence of Suisun Bay and the Sacramento-San Joaquin River Delta, respectively (***Figure 4-4***). All dredging locations and beneficial reuse placement sites are located along the shoreline, and are either in or adjacent to sensitive

habitat, as described below. Typical habitats at and in the vicinity of the beneficial reuse sites include open water, mudflat, and tidal marsh.



Figure 4-2. Eden Landing Ponds

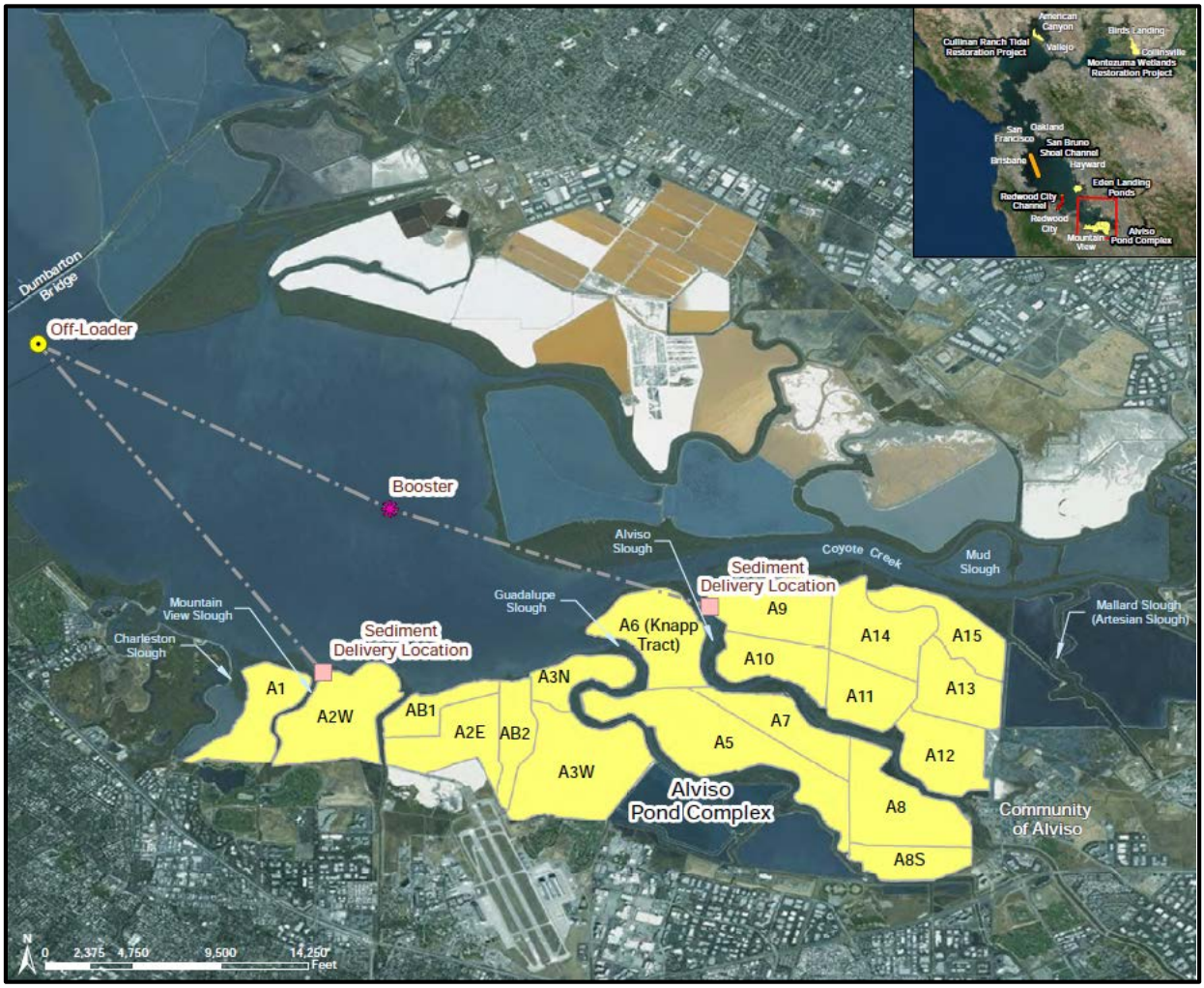


Figure 4-3. Alviso Pond Complex

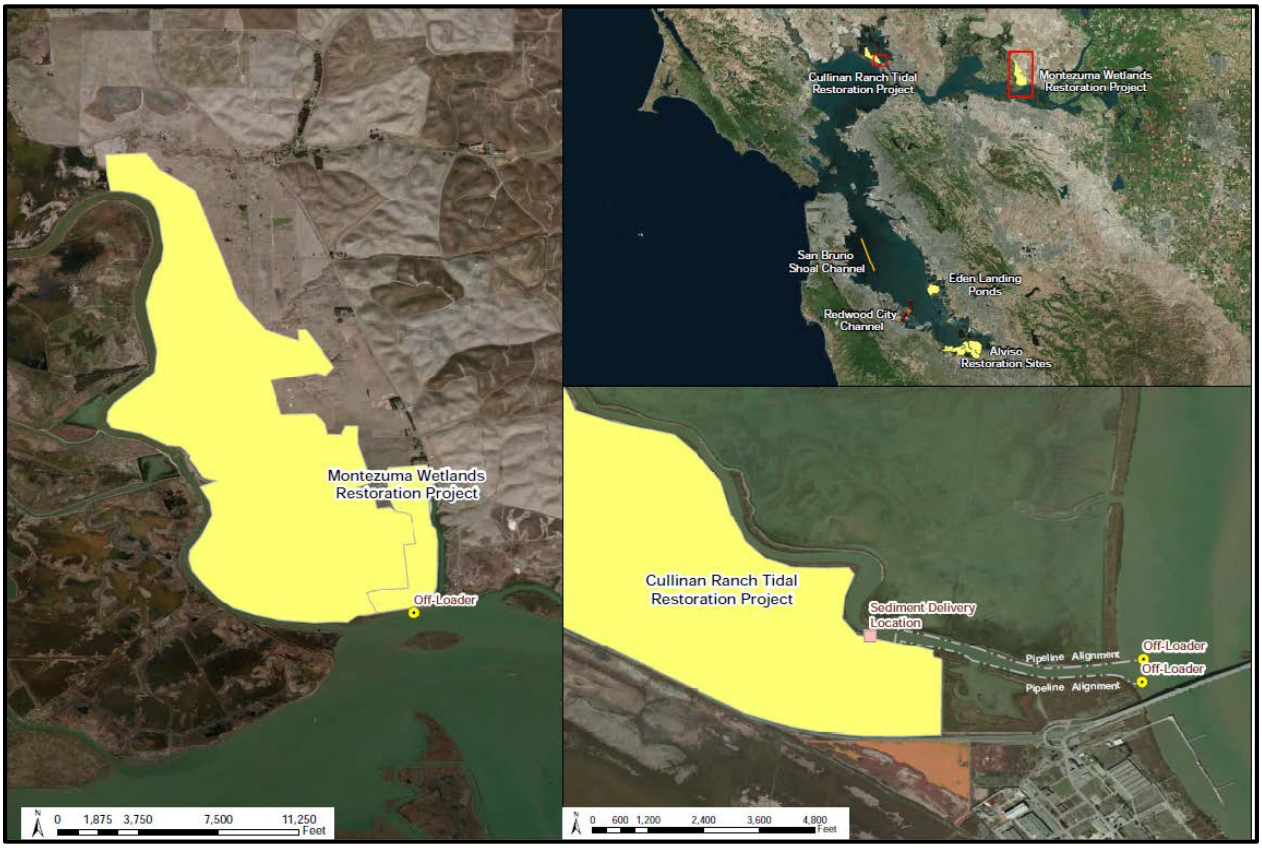


Figure 4-4. Montezuma Wetland Restoration and Cullinan Ranch Restoration Sites

4.2.2 Project Overview

The Project would consist of dredging two channel locations from their current authorized depth of -30 feet MLLW to a nominal depth of -32, -34, or -37 feet MLLW (Dredging Options A, B, and C, respectively), and reusing and/or disposing of the dredged sediment. Lowering three existing pipelines that cross the SBS Channel would also be required. Dredging of SBS Channel would require lengthening the channel to connect it to the naturally deeper water to the north and south. Lengthening would extend an estimated 3,300 feet to the north, and 2,200 feet to the south.

Dredging may include up to two feet of overdepth.[8] The volume of sediment to be dredged depends on the depth. ***Table 4-1*** shows the estimated volume of sediment to be dredged in cubic yards (cy). The estimated volume to be dredged analyzed for the purposes of the EIS/EIR is the in-place (bank cut) volume with a 20 percent bulking factor, and assumes two feet of overdepth. This is the maximum volume that could be dredged at each of the three depths. Experience has shown that dredgers more typically dredge the equivalent of approximately 1 foot of overdepth, and the cost estimate for each of the three dredging depths was based on

[8] "Overdepth" refers to the fact that, in dredging to attain a given minimum depth, some additional sediment will be removed due to inaccuracies in the dredging operation.

the assumption that only 1 foot of overdepth would be dredged. However, to evaluate the maximum potential impact, the maximum allowable overdepth volume is analyzed for the EIS/EIR. ***Table 4-1*** provides a comparison between the estimated volume to be dredged assuming the maximum volume, and the estimated volume to be dredged as reflected in the cost estimate.

Table 4-1. Estimated Maximum Volume of Sediment to be Dredged Compared to the Volume used in the Cost Estimate

	Volume (cy)[1]		
Sediment Source	**Dredging Option A (-32 feet MLLW)**	**Dredging Option B -34 feet MLLW**	**Dredging Option C -37 feet MLLW**
RWC Channel Bank Cut Volume	286,000	924,000	1,995,000
RWC Channel Overdepth (2 feet)	636,000	704,000	770,000
RWC Channel Berth Deepening	17,000	34,000	60,000
SBS Channel Bank Cut Volume	90,000	619,000	2,055,000
SBS Channel Overdepth (2 feet)	388,000	846,000	1,078,000
SBS Channel Lengthening	0	54,000	266,000
SBS Channel Lengthening Overdepth (2 feet)	54,000	120,000	205,000
TOTAL	1,471,000	3,301,000	6,429,000
Bulking (20%)	294,000	660,000	1,286,000
TOTAL Including Bulking	**1,765,000**	**3,961,000**	**7,715,000**
Volume Used in Cost Estimate	**936,990**	**2,497,619**	**5,476,588**
Non-Cover Material (included in total above)[2]	**46,000**	**81,000**	**138,000**

Notes:

[1] Volumes are rounded to the nearest 1,000 cy

[2] Contaminated material is only anticipated to occur in RWC Channel; the estimated volume is 5% of the remaining volume (including overdepth) in RWC Channel; the total shown includes bulking of 20%

Source: Matthew Young, pers. comm. 2015

In addition to channel deepening beyond the existing authorized depths, up to an estimated 366,000 cy of sediment would have to be dredged for the purposes of channel maintenance (referred to as maintenance dredging sediment). (366,000 cy is the average estimated sediment accumulation during a two-year period preceding the start of construction). The actual duration of construction would determine the amount of maintenance dredging sediment dredged from the channels during the construction phase. The duration of

construction would depend on the dredging depth, the placement site, and the dredging method.

Deepening of existing channels is separate from maintenance dredging, which is conducted to remove sediments that have shoaled into (accumulated in) the existing channel. Maintenance dredging is typically completed as part of the USACE's Bay-wide maintenance dredging program; however, it is more cost-effective to conduct the deepening and maintenance dredging in one pass. Following deepening of the channels, the channels would be maintained at their new, deeper depths. The deepening would result in a slight to moderate increase in the total volume of maintenance dredging, as further discussed below. Potential impacts associated with the maintenance dredging sediment that may be dredged in conjunction with the deepening are addressed through the USACE's maintenance dredging program environmental review.

To take advantage of the deeper channel, the Port would need to deepen its berths. Berths are typically dredged to a depth of four feet below the bottom of the channel to provide underkeel clearance for ships at low tide.

As described in ***Chapter 3***, the RWC Channel footprint would be modified slightly. The deepened portion of the channel adjacent to Port infrastructure would be tapered (narrowed) slightly (between 6 and 42 feet, depending on the channel depth selected) to avoid having to widen the top of the channel and still allow for stable channel side slopes. Further east, the channel footprint would be moved slightly (between 6 and 42 feet, depending on depth) to the south to avoid removal of mudflats adjacent to Bair Island near the entrance to Redwood Creek. The channel would be tapered as necessary to also avoid affecting mudflats at Greco Island. The channel modifications are shown in ***Figure 4-5 (a, b, and c)*****.**



Figure 4-5a. Proposed RWC Channel Realignment at -32 feet MLLW Depth



Figure 4-5b. Proposed RWC Channel Realignment at -34 feet MLLW Depth



Figure 4-5c. Proposed RWC Channel Realignment at -37 feet MLLW Depth

All temporary and permanent features constructed by the Project (such as channel side slopes and offloader facilities (***Figure 4-6***) including mooring dolphins and piles), would be constructed to appropriate seismic safety and geotechnical stability standards. Studies would be conducted during pre-construction engineering and design to establish the necessary parameters. The existing channel slopes would be analyzed and the future slopes designed, and constructed in accordance with EM 1110-2-1902 (USACE 2003).

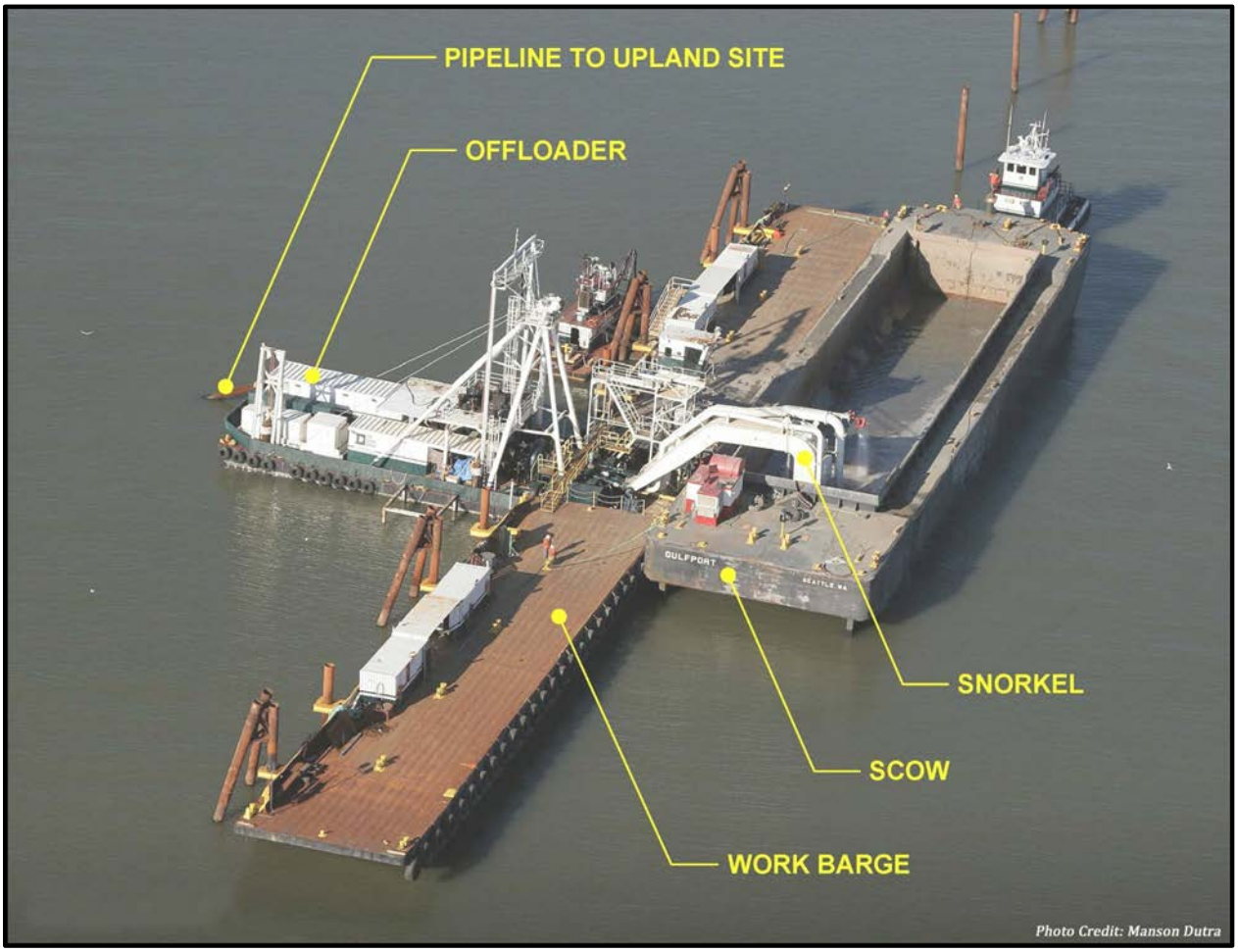


Figure 4-6. Typical Offloader Facilities

4.2.3 Construction Process

4.2.3.1 *Pre-Construction Investigations and Permitting*

Prior to the start of construction activities, USACE would require the construction contractor to develop various construction plans, as further described below (***Section 4.2.3.2***). Best Management Practices (BMPs) applicable to dredging, construction, hazardous materials handling and management, and habitat and species protection have been incorporated into the Project. The Project has been designed to avoid or minimize potential impacts to the environment where feasible.

Prior to implementing the dredging program, the Corps would conduct a comprehensive sampling and analysis program to characterize the chemical and physical characteristics of the sediment to be dredged. Sampling would be conducted to the maximum allowable overdepth plus 0.5 feet. The latter is also referred to as the Z-layer and characterizes the sediment that would be exposed following construction. Sampling would include sediment on the side slopes, as well as sediment in the berths.

Approval to use specific placement sites is required from the DMMO. The DMMO requires that the dredging project proponent prepare a sampling and analysis plan describing any sampling that would be conducted, as well as quality assurance procedures that would be implemented to ensure the collection of data of appropriate quality to support a decision regarding a suitable placement method. The sampling and analysis plan (SAP) and quality assurance project plan (QAPP) must be prepared in accordance with regional and federal guidance and approved by the DMMO. Following approval of the plan, USACE would sample the sediments in accordance with the approved SAP and QAPP, and submit a sampling and analysis report to the DMMO. Based on this report, the DMMO would determine the suitable placement method for the dredged sediments.

The RWC Project would comply with all applicable provisions in existing permits applicable to the placement sites and meet all applicable federal environmental compliance requirements (e.g., CWA Sections 401 and 404, ESA), including those federal requirements implemented by state agencies (e.g., CWA Section 401, Coastal Zone Management Act (CZMA)), as well as applicable state environmental compliance requirements. The Project would also complete Section 7 consultation with USFWS and NMFS, and Essential Fish Habitat consultation with NMFS.

4.2.3.2 ***Construction Best Management Practices***

To minimize potential environmental effects associated with the Project, detailed project plans would be developed prior to construction and an extensive set of BMPs, including environmental protection and safety practices, would be incorporated into the Project.

4.2.3.2.1 Project Plans

Prior to the start of construction activities, the USACE would require the construction contractor to develop the following plans:

- Fuel pipeline relocation and response plan
- Stormwater pollution prevention plan (SWPPP)
- Health and safety plan
- Spill prevention and response plan
- Oil transfer plan
- Waste management plan
- Traffic control plan (if needed)

- Air quality management plan
- Cultural resources protection plan

Relocation of the fuel pipelines, if not managed properly, could result in disruptions of the aviation fuel supply for San Francisco International Airport as well as hazards to workers and the environment. The fuel pipeline relocation and response plan would provide a detailed plan for managing fuel flow during relocation of the pipelines, including during unplanned disruptions, and would include a detailed plan for safely installing the new pipeline sections, uncovering and removing the old pipeline sections, connecting the existing and replacement pipeline sections at the tie-in locations. The health and safety plan would evaluate potential hazards associated with the dredging and placement operations, address site-specific work practices to ensure that workers and the environment are protected if contaminated sediment is dredged, and include provisions for communications and emergency response. The oil transfer plan would describe the process for refueling the dredge and any other equipment that is fueled over water (e.g., the booster pumps and equipment required to relocate the pipelines). The oil transfer plan would detail the responsibilities of the individual involved in the transfer, the transfer process, safety precautions, training requirements, and monitoring and communications protocols.

The spill prevention and response plan would address management and protective measures, emergency response measures, methods to capture fuel spills; and require a staging area designed to prevent leaks into the soil or water. The waste management plan would address handling and reuse/disposal of waste which may be generated during construction, including during relocation of the pipelines. The traffic control plan would address any special requirements for bringing oversize loads to any of the land-based staging areas, if needed (the majority of the equipment is expected to be mobilized to the dredging location by water). The air quality management plan is required to ensure that annual project emissions would remain below the federal General Conformity threshold. The contractor would be required to describe its planned equipment use (including engine horsepower, age, load factors, and projected operating hours for all major equipment) and associated air emissions, and to document its compliance with the planned equipment use. The cultural resources protection plan would be required only if the Eden Landing or Alviso placement sites are used. The plan would review the entire proposed alignment of any dredged sediment delivery pipelines (whether from an offloader or from a cutterhead dredge) for the presence of any known archeological or other submerged resources. The plan would define any required modifications to ensure that any known submerged cultural resources are avoided.

4.2.3.2.2 Best Management Practices

Appropriate implementation of BMPs would significantly reduce the potential for environmental impacts and safety concerns. The following BMPs have been incorporated into the Project.

- Air Quality/GHGs
    - Maintain equipment according to manufacturers' specifications.
    - Use diesel oxidation catalysts and catalyzed diesel particulate traps where feasible.
    - Restrict idling of construction equipment (excluding clamshell dredge) to a maximum of five minutes when not in use.
- Navigation safety:
    - Notification of near-by public landowners: Near-by owners of public lands would be notified of proposed dredging and placement activities in the vicinity of their properties to ensure that they are able to notify users of their property regarding the construction activities and the need to proceed with caution. Near-by public landowners would be encouraged to post signs informing the public about the construction activities. USACE would provide signage to the public landowners as requested.
    - Notification to nearby marinas: The contractor would be required to notify the nearby marinas of the proposed dredging and placement work, and provide them with the schedule to ensure that recreational vessel users are aware of the need for safe navigation around the dredge.
    - During dredging and disposal activities, navigational warning markers, lighting, and aids to navigation would continue to be used as needed to prevent navigational hazards from the dredging and offloading equipment, including any floating pipelines.
    - Notice(s) to mariners for dredging activities, pipelines and offloader construction and location: a notice to mariners would be issued requesting mariners to proceed with caution and/or to proceed at no wake speed as required to ensure the safety of both the dredging operation and the transiting vessel.
- Vessel Wake Management
    - Tugs and other vessels that could cause scour of the channel banks would be required to transit within the center of the channel when feasible, and to reduce vessel speeds when operating near sensitive habitat.
- Pile driving noise and vibration controls:
    - Pile driving windows would be used where sensitive wildlife is a concern so that work is done when listed species are least likely to be present. Pile driving windows would be the same as the dredging windows (June 1 through November 30); however, pile driving would only occur for a small number of days.
    - Pile driving would be completed using a vibratory hammer whenever feasible. If sediments are too dense for sole use of vibratory hammer, then an impact hammer may be used to proof the pile and pre-drill, if necessary, to approximately five feet above required pile tip elevation.

  - Bubble curtains would be used to reduce sound levels from the impact hammer, any time an impact hammer is used, to create an underwater wall of air around the pile to dissipate in-water sound waves.
  - Construction workers would employ the "soft start" technique, which allows fish and marine mammals to vacate the area before the pile driver reaches full power. For vibratory hammers, the contractor would initiate the driving at reduced energy for 15 seconds and then wait for one minute. This procedure shall be repeated two more times prior to starting the continuous driving. For impact driving, three initial strikes would be made by the hammer at 40 percent energy, followed by a one minute wait. Then, two subsequent three-strike sets would be completed before initiating continuous driving (URS Group, Inc. 2014b).
- Turbidity control:
  - While using a cutterhead dredge, undercutting would be prohibited to prevent sediment above the area being dredged from slumping in on the cutterhead thereby minimizing turbidity spikes.
- Protection of longfin smelt and Delta smelt:
  - All offloader water intakes would be equipped with fish screens achieving the appropriate approach velocity for the special status species that may be present in the vicinity of the offloader.
  - The USACE would implement a worker education program for listed fish species that could be adversely impacted by project activities. The program would include a presentation to all workers on biology, general behavior, distribution and habitat needs, sensitivity to human activities, legal protection status, and project-specific protective measures. Workers would also be provided with written materials containing this information.
- Construction staging:
  - The temporary construction staging area would be located on an impervious surface and located away from areas that could make it susceptible to damaging waves. The staging area would comply with the Port's storm water discharge permit and BMPs. Any liquids or other materials at the staging area that could spill or runoff during storm events would be located in a bermed area or an area equipped with other types of secondary containment. All materials brought to the Port and not immediately transferred to the dredge or other equipment must be stored within the staging area.
- Spill prevention and response for routine hazardous materials use and for fueling:
  - The contractor would be required to maintain adequate spill response materials at the dredge and/or work site, and train all workers in proper spill response.
  - Catch pans or drop cloths would be used under all equipment utilizing fluids
  - All fuel would be kept in double containment systems with positive shut-off values at the nozzles.
  - All fuel transfer hoses would be drained completely before being disconnected.

- All dredge engines would be equipped with fuel spill catching skirts; petroleum-fueled dredge engines that are not equipped with fuel spill catching skirts would not be allowed.
- Dredging would stop immediately following any fuel or hazardous waste leaks or spills, and cleanup actions would be implemented.
- All chemicals used in an aquatic environment would be approved for use in that environment.

4.2.3.2.3 Fuel Pipeline Relocation

The U.S. Department of Transportation's Pipelines and Hazardous Materials Safety Administration (PHMSA) regulates interstate and intrastate hazardous liquids transmission pipelines. PHMSA issues pipeline safety regulations addressing construction, operation, and maintenance, inspects pipeline operators, and enforces against violations of pipeline safety laws and regulations. The Fuel Pipeline Relocation and Response Plan would be prepared in accordance with PHMSA regulations as well as California' Office of the State Fire Marshall regulations. Due to the potentially hazardous nature of the work, special safety training is required for workers and contractors involved in the relocation. In addition, workers may need special security clearance and background checks in accordance with Homeland Security regulations. In general, work on existing fuel pipelines would require the section of the pipeline that may be worked on to first be locked out (i.e., isolated so that no fuel could enter that section of the pipeline) and tagged out (notifications are posted at the lockout locations to notify any worker that the pipeline is locked out). If the pipe is pressurized, it would then be depressurized, drained, and vented. If an explosive condition could occur in the pipeline, it would also be inserted, typically by filling it with nitrogen or another inert gas. These measures, any other required measures, and site-specific requirements would all be described in the Fuel Pipeline Relocation and Response Plan.

4.2.3.2.4 Coordination of Project Activities and Port Operations

Access to the Port's berths would be coordinated with the Port and San Francisco Bar Pilots to ensure that dredging operations do not cause undue interference with use of Port facilities. The dredge operator and all commercial vessels would be in communication with U.S. Coast Guard (USCG) Vessel Transfer Service (VTS) and monitor Channel 16 to ensure effective coordination of dredging operations and commercial vessel traffic. The San Francisco Bar Pilots, who board all commercial vessels before they enter the Harbor, would be aware of any notices to mariners and would coordinate with the dredge crew and VTS to ensure safe transit of the vessels under their control. To the degree feasible, dredging and fuel pipeline relocation activities would be scheduled to minimize delays to vessels transiting SBS or RWC Channels.

4.2.3.3 ***Channel Deepening and Maintenance during Channel Deepening***

The Project proposes to deepen RWC Channel from the current authorized depth of -30 feet MLLW to a depth of between -32 feet MLLW and -37 feet MLLW. SBS Channel would also be

deepened from its current authorized depth of -30 feet MLLW to between -32 and -37 feet MLLW, and would be lengthened as needed to reach naturally deep water (an estimated 3,300 feet to the north, and 2,200 to the south). Lengthening is required for all three dredging depths. This would allow vessels with drafts of 30 to 35 feet to use the channel without waiting for the tides, or reduce lightering requirements for deeper draft vessels. Squat, trim, and a minimum vessel underkeel clearance for maneuverability reduce the effective depth of a channel. The combined underkeel clearance required in the RWC Channel is two feet.

4.2.3.3.1 Dredging Duration and Schedule

The dredging and sediment reuse/disposal construction period is determined by a combination of factors including the volume of material dredged, air emission thresholds, dredge production rate, and how scows are loaded. The type of dredge used (clamshell or hydraulic cutterhead), and whether any of the dredging and offloading equipment is powered by electricity also affect the dredging duration.

For the proposed Project, the primary factors determining the duration of the dredging effort are the need to limit air emissions to remain below the general conformity threshold, and the assumption that overflow from scows would not be allowed. Coupled with the long transportation to the three permitted placement sites (Cullinan, Montezuma, and SF-DODS), this limits the volume of sediment that can be dredged and transported to a placement site each year to approximately 480,000 cy/year to SF-DODS, 600,000 cy/year to Montezuma, and 700,000 cy/year to Cullinan, based on the -32-foot MLLW (plus overdepth) dredging option. Due to efficiencies in dredging to deeper depths, dredging to -34 feet MLLW or -37 feet MLLW (plus overdepth) results in slightly higher production rates per unit air emissions; however, as a conservative measure, the production rate calculated for the -32-foot depth was used to estimate air emissions for all three depths.

Based on the estimated volume of sediment to be dredged, the minimum construction period evaluated in the EIS/EIR would be 11 months (2 dredging season) at – 32 feet MLLW (if all the sediment is placed at Cullinan), and 14 and 16 months, respectively, if Montezuma or SF-DODS are used as placement sites. These durations could change if changes are made to the project (i.e., if electrical power is used to power the dredge, or if overflow is allowed from the barges), but represent conservative assumptions (maximum durations) for the purposes of evaluating impacts. Durations to Eden Landing and Alviso were not estimated, because there is insufficient information to determine the maximum offloading rate for these sites.

4.2.3.3.2 Dredging Methods

The feasible dredging methods depend on the distance between the placement site and the dredging location. Eden Landing and Alviso ponds are sufficiently close to the RWC Channel dredging activities to allow use of a hydraulic cutterhead dredge (***Figure 4-7***) with direct delivery (pumping) of the sediment to the Eden Landing and Alviso ponds. A cutterhead dredge could also be used for SBS Channel if the Eden Landing ponds are the chosen placement site

(several booster pumps would be required); all other placement sites are too far from SBS Channel to permit use of a cutterhead dredge. The cutterhead dredge could be either diesel-powered or electric-powered, with no difference in performance characteristics. However, electric-powered dredges can be more expensive and difficult to operate than diesel dredges because of the movement logistics associated with the power cable. Due to the distance from shore to SBS Channel, a cutterhead dredge used at SBS Channel would be diesel-powered.

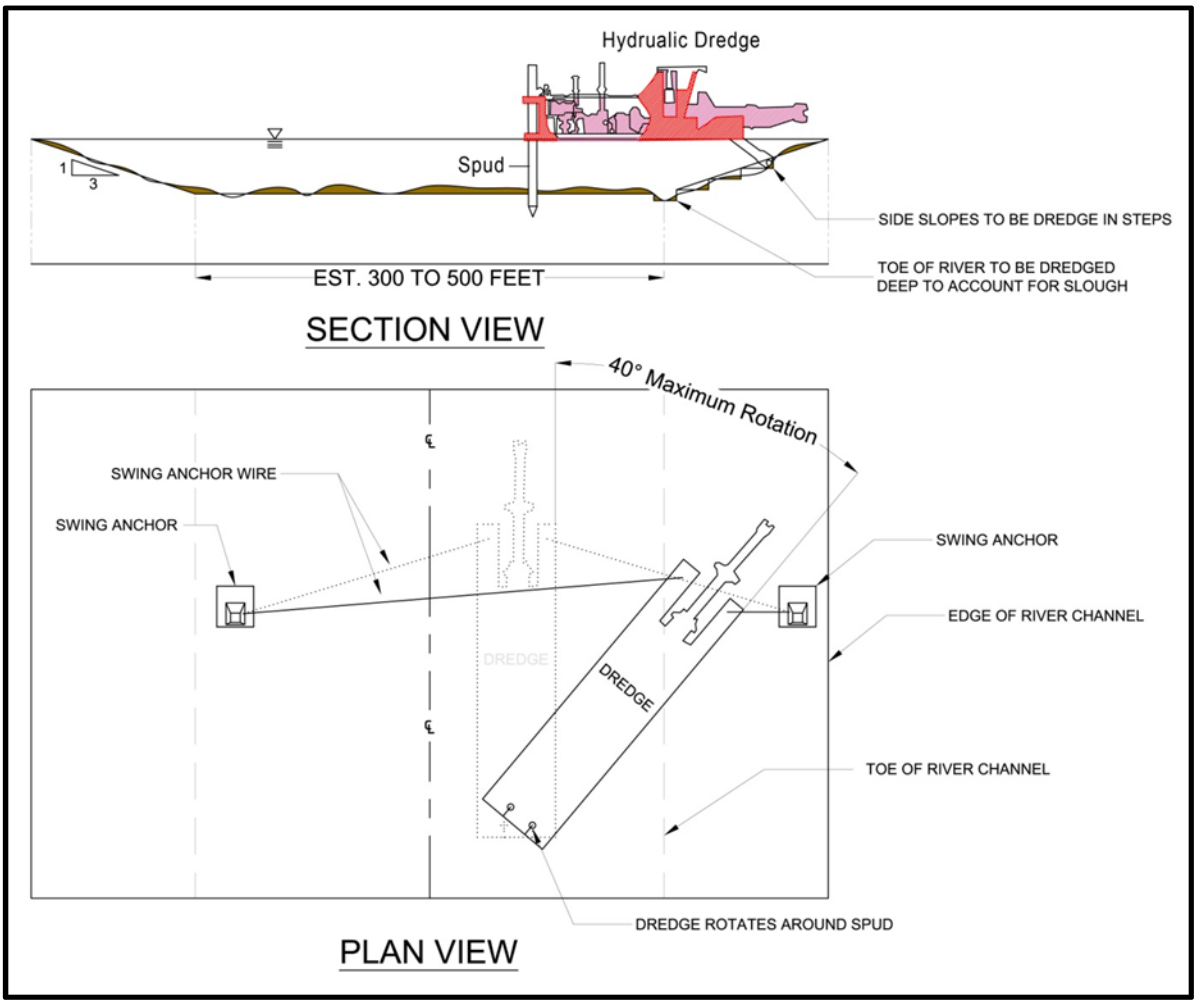


Figure 4-7. Hydraulic Cutterhead Dredge

For all other placement sites, dredging would be performed using a clamshell. Clamshells operating in RWC Channel could also be diesel-powered or electric-powered; SBS Channel is too remote to make electrically-powered dredges feasible. The determination whether to use a cutterhead or clamshell dredge when use of both is feasible would made based on cost, including cost of any required mitigation. If a dredge is electrically-powered, power would be supplied via the Port's substation located at Wharves 1 and 2, and a cable between the

substation and the dredge. A smaller substation would be located on the dredge to step down power to a voltage usable by the equipment on the dredge.

Dredged material in the RWC Channel is expected to consist primarily of Young Bay Mud, a predominantly fine-grained material. Dredged sediment at SBS Channel is expected to contain up to 30 percent sand. Dredging of the softer muds (fine grained sediments) would be done in such a way as to minimize sediment loss during the dredging cycle, including possibly slower cycling times and the use of environmental buckets.[9]

Sediment dredged with clamshells would be placed into scows. Scows bound for SF-DODS would be dump scows; the other sites could accept material contained in hopper scows which have fewer moving parts than dump scows. Dump scows have hulls that can be opened to dispose of the sediment.

Tugs would haul the scows to the designated placement site. The number of trips necessary to transport the sediment to the placement sites would depend on the size(s) of the scows, the quantity of sediment dredged, and whether overflow from the scows is allowed or not. At SF-DODS, material would be bottom-dumped from the scow. At the beneficial reuse sites, sediment would be offloaded from the scow with an offloader, and pumped into the site. To enable the offloader to pump the dredged material it would be slurried to 5 to 10 percent solids with water drawn from the Bay at the offloader location. The receiving beneficial reuse site(s) would be responsible for conducting environmental analysis of placement-related activities and sediment management. The environmental analysis for this Project assumes that sediment is delivered to a receiving location at an offloader (if provided by the placement site), or to the top of the Bay-front (outboard) embankment of the placement location when the Project would provide the offloading facilities (or if the material is pumped directly to the placement site from a cutterhead dredge).

4.2.3.3.3 Offloading Facilities

A hydraulic offloader consists of a transfer pump connected to the pipeline that runs from the offloader site to the receiving site. The hydraulic offloader pumps water into a scow compartment to create a slurry. An intake line feeds the transfer pump. The offloader would be equipped with fish screen to avoid entrainment of fish.

Typical infrastructure at the transfer (offloader) site is as follows (Moffatt & Nichol 2015):

- Mooring dolphins[10] with navigation lights
- The hydraulic offloader mounted on a barge
- A pipeline, which transports the material from the offloading site to the receiving site

[9] An environmental bucket is a special type of clamshell bucket that is fully enclosed and therefore retains most of the water and loose sediments generated during each cut.

[10] Mooring dolphins are small groups of piles that are tied together with cables or cap. Ships and scows are secured to the mooring dolphins with ropes or cables (i.e., moored).

- One or more booster pumps stationed along the pipeline to increase the pumping production rate, especially along pipeline routes longer than 3.5 miles, and
- Support equipment including scows, diesel generator, and site security

If the offloader and booster pumps have diesel engines then external power is not needed for these elements.

The sediment transfer pipeline would be approximately 24 to 36 inches in diameter. Positioning of the pipeline from the offloader to the dredged material placement site may require limited excavation of mud flats and tidal marsh, and/or shaping of the outboard embankment of the levee at the point of delivery to ensure that the pipeline has a sufficiently secure and level bed. Alternatively, at the point that the pipeline enters the outboard marsh, it may be laid on large wooden mats. The mats would also support any necessary ancillary equipment (e.g., booster pump) that is not placed on the levee itself, and would provide access to the pipeline for routine maintenance and inspection. The estimated work area covered by mats at the dredged sediment placement location would be no more than 2,000 square feet (40 feet by 50 feet). Any material that is excavated as part of the pipeline construction would be stockpiled on top of the outboard embankment near the dredging location and used to restore existing grade in the pipeline alignment once the sediment delivery process has been completed.

At the Eden Landing and Alviso placement sites, a booster pump would most likely be placed on the levee. The booster pumps would require regular fueling and maintenance. If access is available by land via the levees, the booster pumps would be serviced from land. Alternately, the booster pumps could be accessed from the water at high tide.

Dredging would occur 24 hours/day, 7 days a week during the 180-day dredging window. The dredging window was established by Bay Area regulatory and resource agencies to protect sensitive species that may be present at other times. The dredging window extends from June 1 through November 30. The estimated production rate for a clamshell dredge delivering to SF-DODS, Cullinan, and Montezuma is approximately 3,700, 5,300, and 4,300 cy/day, respectively. The Project's dredged sediment delivery rate to Eden and Alviso cannot be estimated at this time because the limitations on off-loading have not been defined. However, because the two sites are much closer to the dredging location, the daily production rate would likely be considerably higher than for the three currently-permitted sites. The theoretical production rate (if the dredging rate is not constrained by limited availability of scows or air emissions) is 10,000 cy/day, and delivery to both Eden Landing and Alviso may achieve this rate. A hydraulic cutterhead dredge could potentially yield a daily production rate of 12,000 – 15,000 cy/day, or more. The Alviso Ponds site may be able to accept sediment delivered at this rate; however, the Eden Landing ponds are likely to have some limitations on the ability to manage decant

water from dredging. Consequently, a daily production rate of 10,000 cy was assumed for both Eden Landing and Alviso.

If the dredge is diesel-fueled it would typically be fueled at the dock every 3 – 4 weeks; alternatively if the dredge is too far from the dock to make returning to the dock economical, a licensed contractor may be used to deliver fuel scow to the dredge. The same would be true for the equipment used to relocate the pipelines. Booster pumps and offloaders would most likely be fueled by fuel scow. All fueling operations would comply with USCG, State lands Commission and CDFW's Office of Spill Prevention and Response requirements, as applicable. Some of the offloading equipment could be electrically-powered.

Available scows in the Bay Area range in capacity from less than 1,000 cy to as much as 6,000 cy. Due to the limited availability of 6,000 cy scows the Project would plan on using 4,000 cy scows. These scows have a typical draft of 18 feet. Scows would be loaded to 90 percent capacity for destinations within San Francisco Bay, and to 80 percent capacity for travel to SF-DODS[11]. Estimated travel times for loaded and unloaded scows are discussed in ***Appendix A*****,** Air Quality and Greenhouse Gases.

Table 4-2 summarizes the placement site operations assumptions for each placement site. The dredging and placement sites are described in more detail in the following sections.

[11] A large percentage of the scow volume would be taken up by water, especially if no overflow is allowed. The cost estimate assumes that the scows would transport 1,600 cy (in place volume) per trip to SF-DODS, and 1,800 cy/trip to Cullinan or Montezuma.

Table 4-2. Placement Site Operations

Placement Site	Dredging Process	Delivery Process	Required Offloading Facilities to be Provided by Project	Offloading Facilities Provided by Placement Site
Cullinan	Clamshell	Barge to offloader; pump to site	Option 1: Offloader and approximately 4,300-4,500 feet of pipeline, depending on off-loader location. Booster pump not required.	Option 2: Cullinan site provides offloader and pipeline. (Cullinan would charge increased tipping fee.)
Montezuma	Clamshell	Barge to offloader, then pump to site	None	All
SF-DODS	Clamshell	Bottom dump	N/A	N/A
Eden Landing Ponds	Option 1: Clamshell Option 2: Cutterhead	Option 1: Barge to offloader, then pump to site Option 2: Direct pumping from cutterhead dredge	Option 1: Offloader and approximately 3.5 miles of pipeline. 1 or 2 booster pumps required. Option 2: Approximately 6 miles of pipeline from cutterhead in RWC Harbor to placement site. 2 booster pumps required. Up to 16 miles of pipelines from cutterhead in SBS Channel to placement site. Multiple booster pumps required.	None at Present (TBD)

Placement Site	Dredging Process	Delivery Process	Required Offloading Facilities to be Provided by Project	Offloading Facilities Provided by Placement Site
Alviso Ponds	Option 1: Clamshell; or Option 2: Cutterhead in RWC Channel and Clamshell for SBS Channel	Option 1: Barge to offloader, then pump to site Option 2: Direct pumping from cutterhead dredge in RWC Channel; barge SBS Channel sediment to offloader, then pump to site	Option 1A: Offloader and approximately 4 miles of pipeline to Pond A2W. 2 booster pumps required. Option 1B: Approximately 9 miles of pipeline from cutterhead in RWC Channel to placement site. Multiple booster pumps required. SBS Channel sediment would require use offloader and pipeline. Option 2A: Offloader and approximately 6 miles of pipeline to Pond A9. 3 booster pumps required. Option 2B: Approximately 11 miles of pipeline from cutterhead in RWC Channel to placement site. Multiple booster pumps required. SBS Channel sediment would require use offloader and pipeline.	None at present (TBD)

Staging for dredging activities would be within the Port of Redwood City. The staging area may include storage of equipment and materials, parking for workers, and other necessary support functions. Employees would be transferred to the dredge operations in a crew boat from within the Port or a near-by marina. Crews would contain 16 to 18 workers and would work 12 hour shifts.

Although any accumulated maintenance dredging material would be dredged as part of the deepening process, environmental impacts associated with dredging, transporting, and disposing of maintenance dredging sediment are addressed in the Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay Fiscal Years 2015–2024 Environmental Assessment (EA)/EIR prepared by USACE (USACE and RWQCB 2015). Maintenance "episodes" have separate authorizations from dredging projects that involve deepening, and all maintenance dredging is evaluated with respect to NEPA and CEQA. Consequently, this document does not evaluate the impacts associated with the current level of maintenance dredging. Post-construction maintenance dredging is discussed below.

4.2.3.4 *Fuel Pipeline Relocation*

The SBS Channel overlays three fuel pipelines (***Figure 2-1***). They consist of a 10-inch diameter inactive Shell petroleum line,[12] and 10-inch and 12-inch active Kinder-Morgan petroleum lines. There are three possible construction methods for relocating the three fuel pipelines crossing SBS Channel to a deeper depth. The alignment would not change, or would shift only as much as needed to ensure safe working conditions around the existing fuel pipelines. The three potential methods are:

- Trenching using a clamshell dredge
- Directional drilling, and
- Using a "jet sled" (also referred to as a "jet skid")

These three methods are described below, and all three methods are evaluated in this document. The preferred method would be chosen during the design phase, and would consider environmental effects, cost, and required equipment. USACE would coordinate with the Resource Agencies as well as Kinder-Morgan and Shell to ensure pipeline work is performed safely and in an environmentally sound manner.

In all cases, the pipelines would be lowered to a depth such that the top of the pipeline is a minimum of 6 feet below the maximum depth of the channel[13] as presently understood as appropriate to address safety requirements. For the two methods involving trenching, the pipeline would first be covered with three feet of sand, and then two feet of armor rock for

[12] This pipeline may be abandoned. If so, the work would be reduced to simply cutting and removing the section of the pipeline crossing the channel.

[13] The maximum depth would be the authorized depth (-32 feet MLLW, -34 feet MLLW, or -37 feet MLLW) plus two feet of overdepth.

protection. The remaining depth of the channel pipe trench, and the entire pipe trench outside of SBS Channel would be allowed to fill in naturally with sediment. For directional drilling, the pipeline would be lowered to a sufficient depth such that no sand armor rock protection would be required.

Up to 2,500 feet of each existing pipeline would be replaced and deepened (the 500 feet located below SBS Channel and up to 1,000 feet on either side). Several barges would be required to deliver and lay the pipe. Installation of the replacement pipeline sections would require working from derrick barges. Pipe would most likely be delivered in 100- to 250-foot lengths and welded together on the barge. The pipe would be lowered into the water using a roller system, and the barges would be moved ahead using anchors.

At the end of the replacement sections, the replacement sections would be tied into the existing pipelines. The old pipeline sections would be cut and removed. For the Kinder-Morgan pipelines, one pipeline would continue to operate while the other pipeline is being worked on. The Shell pipeline is inactive. A total of up to 7,500 feet of pipelines would be installed, and up to 7,500 feet of pipelines would be removed.

4.2.3.4.1 Pipeline Tie-In

The replacement pipeline segments could either be tied into the existing pipelines in situ, or above water. The existing pipelines, or a portion of the pipelines that could be isolated, would first be emptied and made inert by purging the empty pipelines of explosive gases, as needed. At the tie-in location, the existing pipelines would be cut, and the new pipeline segments would be welded to the existing pipelines. Once both ends of the replacement pipelines have been connected to the existing pipelines, the existing pipelines under the SBS Channel would be removed. The tie-in process would require approximately one month at each end and tie-ins at the two ends may be performed concurrently to expedite the return of the pipelines to active service. Staging of equipment and materials would occur either at the former Shell dock at San Francisco Airport or at the Brisbane Marina. Workers would be transferred from the staging area to the work area by boat. Tie-in activities would be contained either on a barge (above water tie-in process) or within a dewatered area (in situ tie-in process) to ensure that no petroleum products enter the Bay.

Pipeline Tie-In Above Water

If the tie-in is done above water, a sufficiently-long portion of the pipe would be exposed to allow the center of the pipeline to be lifted onto a barge, and cutting and welding operations would occur on the barge. The pipeline sections on both sides of the channel would be exposed by using high pressure water to “jet” the soil away from around the pipeline. This is a commonly used method because it is safer than using a clamshell bucket or an excavator to dig around the buried pipeline.

It is estimated that approximately 1,000 feet of buried pipeline on both sides of SBS Channel would need to be uncovered in order to safely lift the pipeline out of the water and onto a work barge without damaging or kinking the pipeline. Once the pipeline is secured on the work barge, the existing pipeline would be cut and connected to the new section of pipe that will be laid into the newly excavated trench. (The trench would be parallel to the existing pipeline). The cut would be made in an area with appropriate secondary containment and spill response equipment in case there is some residual petroleum product in the pipeline after it was emptied and inerted.

Once the connection is made, the pipeline would be lowered into the prepared trench. This process would be repeated at the other end of the trench where the other connection will be made. After the pipeline has been pressure tested for leaks and certified, it would be covered with sand and armor rock as described above.

Pipeline Tie-in in Situ

If the pipeline connection is made in situ, the work area would have to be dewatered. A temporary cofferdam, most likely constructed of steel sheet pile, would be installed at both ends of the pipeline to isolate the area within the work area. Each cofferdam would be located in the shallowest area away from SBS Channel on either side and within 1,000 feet of the channel. Based on current San Francisco Bay National Oceanic and Atmospheric Administration (NOAA) charts, these cofferdams would be in water that is approximately 25 to 29 feet deep. The cofferdam work area would be approximately 10 feet wide by 100 feet long. Once both of the cofferdams are in place and the work areas are fully isolated, each cofferdam would be dewatered. Excavation would then be conducted to expose the end of the replacement pipeline and the existing pipeline. Appropriate secondary containment would be provided in the ara where the cut is to be made, and spill response equipment would be on hand in case there is some residual petroleum product in the pipeline after it was emptied and inerted. Because the cut would be made within the dewatered area, any residual petroleum could readily be contained and prevented from entering the Bay.

The excavated material would be loaded into scows and hauled to the same placement site as the channel deepening material. Once the pipe connection is made, the pipeline would be pressure tested and certified.

4.2.3.4.2 Clamshell Trenching

Clamshell trenching construction would use a clamshell dredge to excavate a trench adjacent to the existing pipeline trench. Excavated sediment would be placed into barges, and disposed of at the same location as the sediment dredged from SBS Channel. The replacement pipelines would be laid into the trenches, covered with 3-feet of sand, and then a 2-foot thickness of armor rock would be placed over the sand, and the remaining foot of trench would naturally backfill over time with sediment. The estimated trench width would be 5 -feet for the Shell pipeline and 10-feet for the two Kinder-Morgan pipelines (both Kinder-Morgan pipelines would

be placed into the same trench). The bottom of the trench would be between -40 feet MLLW and -45 feet MLLW; the maximum depth of the trenches would be 6.5 feet below project depth in the SBS Channel and would be as shallow as 2 feet deep in the areas adjacent to SBS Channel. Existing permits for the pipelines require the pipelines to be located at or below depth of -42 feet MLLW below the bottom of SBS Channel, and the current elevation of the pipelines is out of compliance with the permits. The depths discussed in this document is based on establishing a safe distance between the maximum depth of the channel and the top of the pipelines.

The trenches would have estimated side slopes of 2:1 (Horizontal:Vertical). The estimated volume of sediment to be excavated for both of the trenches would range from 8,000 cy to 12,000 cy, depending on the depth of the existing pipeline outside of the SBS Channel. The trenches would range from 12-feet wide to 26-feet wide at the top of the Kinder-Morgan trench and 7-feet wide to 12-feet wide at the top of the Shell trench. The material excavated from the trench would be taken to the same location as the material excavated from SBS Channel.

Trench construction would require a total of 5 to 10 days, depending on the depth and length of the trenches. The Contractor would use the same dredge plant and scows that they would use for channel deepening dredging activities. It is assumed that the trenching would occur during the same time period as the deepening to avoid additional relocation construction costs and additional mobilization and demobilization of equipment. Backfilling the trench once the ends of the relocated segment have been tied into the existing pipeline would require another 5 to 10 days. The total construction period would therefore be 2 to 3 months per pipeline segment, depending on whether both ends of the pipeline are tied in at the same time.

4.2.3.4.3 Directional Drilling

Directional drilling is an alternative to in-water construction. Directional drilling would occur from a water-based staging area in San Francisco Bay (the shorelines are too far away to allow for directional drilling from the shoreline). Directional drilling would not require trenching, but would require exposing the existing pipeline at both ends of the replacement segment to tie-in the replacement segment. The pipeline could be installed to any desired depth, and may be installed more deeply than the minimum depth required by law. More desirable (denser and more consistent) materials may exist deeper below the channel, which may offset the possibility of requiring additional drilling operations should caving or flowing of sands be encountered while drilling at shallower depths. Directional drilling offshore usually consists of three steps: barge/platform preparation, borehole drilling, and pipeline pull back through the drilled hole to the pipeline re-attachment location

The borehole is drilled from the entry point to the exit point following a previously designed profile and alignment. During borehole drilling, a directional guidance system is used to navigate the hole along its pre-designed profile. In some cases the borehole is drilled as a pilot hole, and pilot hole enlarging, known as “pre-reaming,” would be necessary. Pre-reaming

would be implemented to provide a borehole diameter large enough so that the pipeline can be installed in the drilled crossing. Once the drilled hole is appropriate for size of pipe to be placed, the pipe is pulled back hydraulically through the hole with the drilling equipment to the reconnection location. The pipeline may be pre-assembled in a single string and placed on rollers prior to pullback. For pullback, a reamer is connected to the drill pipe. The drill pipe is then pulled back towards the entry point until the pipeline is fully installed (USFWS 2015).

4.2.3.4.4 Jet Sled Construction Process

The replacement pipeline sections could also be installed using the "jet sled" method of construction. A jet sled is a piece of equipment that is launched by crane from a barge, and travels along the bottom of the water body on skids. The pipeline is first laid on the Bay bottom, and the jet sled travels over the pipeline. The jet sled uses adjustable width water jets placed on either side of the pipe to slurry sediment in the pipeline alignment, and dredge pumps to suction the slurried sediment out of the pipeline alignment, thereby opening up a trench. The sediment is discharged to either side of the pipeline alignment, and the pipeline sinks into the open trench. Depending on the type of pump used to suction the slurried sediment, the slurried sediment could contain from 10 percent to as much as 40 percent solids.

The trench would have the same dimensions as that for the clamshell construction method. Trench construction would require 150 to 300 days per pipeline segment to cross SBS Channel, depending on the depth of the trench, for a combined total of 300 to 600 days to install just the portion of the pipelines underneath SBS Channel. If the entire 2,500-foot segment of pipeline is excavated using this method, the duration would range from 25 to 50 months per pipeline segment, or a total of 50 to 100 months for both pipelines.

4.2.3.5 *Berth Deepening and Wharf Strengthening*

As discussed above, to take advantage of the deeper channel, berths have to be deepened by a corresponding amount. The berth depths currently range from -23.2 feet MLLW to -29.0 feet MLLW. Maintenance dredging of Berths 1 through 4 is planned for late 2015 and 2016. The Port has recently upgraded Wharves 1 and 2, which are the wharves used with Berths 1 and 2. Berths 1 and 2 can safely be deepened to -40 feet MLLW, which would correspond to a channel depth of -36 feet MLLW.

The wharves at Berths 3 and 4 are currently being studied to determine whether additional strengthening of the wharves is required to allow the berths to be deepened. If required, wharf strengthening could include improving the existing fendering systems (which would require little or no in-water construction, and would transfer the potential load from vessels to the fenders rather than the wharves), driving additional piles, or installing a cutoff wall to reinforce the slope beneath the wharves. Berth 5 would not be deepened. No current or future maritime cargo related projects are under consideration for Wharf 5. Cargo statistics over the past 20 years show virtually no cargoes to Wharf 5. For the purposes of this document, it was

assumed that no wharf improvements are required to ensure that the wharves continue to meet existing geotechnical stability criteria.

The estimated volume for berth deepening for Berths 1 through 4 combined is 17,000 cy for deepening commensurate with a -32 foot MLLW channel depth, 34,000 cy for a channel depth of -34 feet MLLW, and 60,000 cy for a channel depth of -37 feet MLLW.

4.2.3.6 *Post-Construction Maintenance Dredging*

There would be increased maintenance dredging associated with the proposed deepening of the two channels. Estimated annual maintenance dredging for RWC Channel would increase by up to 93,000 cy for an estimated total annual maintenance dredging volume of up to 276,000 cy if the channel is deepened to -37 feet MLLW (***Table 4-3***).

Table 4-3. Estimated Annual Post-Construction Maintenance Dredging Sediment Volume

	Annual Volume (cy)[1]		
Sediment Source	**Dredging Option A** **-32 feet MLLW**	**Dredging Option B** **-34 feet MLLW**	**Dredging Option C** **-37 feet MLLW**
RWC Channel Existing Maintenance Dredging Volume	183,000	183,000	183,000
RWC Channel Post-Construction Increase in Maintenance Dredging	24,000	51,000	93,000
SBS Channel Existing Maintenance Dredging Volume	3,000	3,000	3,000
SBS Channel Post-Construction Increase in Maintenance Dredging	1,000	2,000	2,400
TOTAL Post-Construction Maintenance Dredging	211,000	239,000	281,000

The estimated increase in maintenance dredging at SBS Channel would be up to 24,000 cy every 10 years (SBS Channel is currently dredged on approximately a 10-year cycle). The combined volume would represent a 13 to 51 percent increase over the historical maintenance dredging volume for the federal channels.

The estimated annual maintenance dredging requirement for the RWC berths would be expected to increase by a similar percentage, i.e., by up to 7,500 cy annually. Thus the total annualized increase in maintenance dredging of channels plus berths would be up to an estimated 102,500 cy. The placement site for maintenance dredging sediment would be selected based on cost and proximity, and would most likely be SF-11 (Alcatraz). SF-DODS could also be used. Eden Landing (once permitted) and Alviso (once permitted) could also be used, as well as other sites as they become available over time.

As discussed above, maintenance dredging is an on-going program performed by the USACE, and subject to separate CEQA/NEPA analysis. Berth dredging, which is the responsibility of the Port, would typically occur separately from channel maintenance, and would be subject to CEQA review and permitting.

Redwood City Channel

RWC Channel would typically be dredged every 1-2 years. The sediment would be placed at SF 11 (Alcatraz), which is preferred for cost reasons, or any other cost-effective permitted placement site. The most likely dredging process would be a clamshell dredge (USACE and RWQCB 2015); however, the material could also be dredged with a cutterhead dredge if a permitted site with sufficient capacity is available close enough to RWC Channel (e.g., if the Eden Landing site becomes available) and the sediment meets the chemical quality criteria established for the site. The expected daily production rate would be 3,000 – 6,000 cy. Dredging would occur during the established work window (June 1 through November 30) only. The dredged sediment is expected to be consistent with current material (i.e., more than 80 percent fines).

San Bruno Shoal Channel

SBS Channel would typically be dredged every 10 years. As with RWC Channel, the sediment would be placed at SF-11 (Alcatraz), which is preferred for cost reasons, or any other cost-effective permitted placement site. SF-DODS is considered a possible placement location for maintenance sediment from SBS Channel. The most likely dredging process would be a clamshell dredge; however, the material could also be dredged with a hopper dredge, if available. The expected daily production rate would be 3,000 – 6,000 cy for a clamshell, and 7,000- 8,000 cy for a hopper dredge. Dredging would occur during the established work window (June 1 through November 30) only. The dredged sediment is expected to be consistent with current material (primarily fines with some sand).

While the project would result in an increase in the *volume* of maintenance dredging for the authorized project, the associated environmental *impact* would be insignificant because the deepened Project would be maintained under the LTMS policies, and maintenance dredging and disposal associated with the Project would be consistent with the LTMS program.

4.2.3.7 *Post Construction Operational Changes*

Following completion of the deepened channel and berths, vessels would be able to enter the Port without waiting as long for the proper tides, or be able to enter the Port more heavily loaded. The overall cargo volume is not expected to increase in response to the deepened channel; however, as described in ***Chapter 2***, cargo growth is expected to continue commensurate with overall economic growth in the area. However, because the deeper channel would allow more heavily-loaded vessels to enter the Port, relatively fewer vessel calls would be required to accommodate the growth than under the No Action/No Project condition.

Many factors affect harbor growth and competitiveness, such as land-side development and infrastructure, location of distribution centers for imports, source locations for exports, population and income growth and location, Port logistics and fees, business climate and taxes, carrier preferences, labor stability or volatility, and business relationships. Harbor depth is just one of the many factors involved. USACE analyses, which have included consideration of commodity forecasts, competing ports, port capacities, and land side costs to hinterland origins and destination, proved to a reasonable degree that deepening of a particular harbor would have little to no effect on the total amount of cargo shipped through that Port.

Annual cargo volume through the Port is highly variable and dependent on the status of the economy. USACE has determined that based on projected future growth in the region, annual growth would average 2.8 percent. Over the past 13 years, the total number of vessels calling at the Port has ranged from a low of 47 in Fiscal Year 2010 to a high of 156 in Fiscal Year 2005. In Fiscal Year 2014, 89 vessels called at the Port. A significant number of the vessel calls, ranging from 23 to 68 percent, are barges that are used to lighter ships before they come into the Port. In calendar year 2014, 40 percent of the vessel calls were barges. Barges are shallow draft vessels, and deepening the channel would not affect the economics of using barges; however, the number of barges required to deliver a specified volume of cargo to the Port would decrease with increasing channel depth (reduced lightering of cargo).

Approximately 2 barge calls per month are associated with lightering aggregate cargo; the remaining barges are used to deliver sand from in-Bay sand mining operations (one scow per month, on average), and deliver miscellaneous materials on a very infrequent basis (4 to 5 barges per year). With the deeper channel, less lightering would be required, and the total number of vessel calls and barge calls is projected to decrease initially, although the total tonnage shipped through the Port would be expected to continue to increase over time. A shift to larger vessels would also occur; this shift would be more pronounced with deeper channel depths.

Table 4-4 shows the post-construction deep draft vessel call projections for 2018 (estimated start of construction) and 2025. With the forecast growth rate of 2.8 percent, the Port would reach a forecast cargo throughput of 2.5 million tons/year in 2025. \. Increases in cargo throughput capacity would be due to infrastructure improvements, and are not affected by the proposed deepening of the channels. The environmental effects of the increased capacity provided by Phases 1 (complete) and 2 of the Wharves 1 and 2 Reconstruction Project were addressed in the EIR for that Project (Port of Redwood City 2010) and are not analyzed further in this document. With completion of Phase 2, the Port would have an estimated combined annual capacity of 2.5 million tons of sand and aggregate. The Port also has permitted, existing capacity for 850,000 tons of cement, 300,000 tons of gypsum, and is capable of exporting up to 450,000 tons of scrap metal per year. The Port is not currently contemplating any other projects to increase capacity beyond these capacity thresholds. The Port estimates that current

aggregate barge calls would be cut in half with deepening to -32 feet MLLW, and that the sand and miscellaneous barge calls would remain unaffected.

Table 4-4. Deep Draft Vessel Call Projections

Project Depth (MLLW)	Fiscal Year			
	2014 (Baseline)	2018	2025	2067*
-30 feet	64	82	104	104
-32 feet	N/A	76	93	93
-34 feet	N/A	70	88	88
-37 feet	N/A	62	79	79

Note: Vessel call projections do not include barge calls (see text)

* End of project life

Increased cargo throughput would lead to a corresponding increase in activity at the Port, including an increase in off-loading equipment use, and an increase in truck movements into and out of the Port. The Port currently operates 24 hours per day when a vessel is in Port, and no changes in operating hours or Port facilities (beyond the planned implementation of Phase 2 of the Wharves 1 and 2 Reconstruction Project) would be required to accommodate the projected growth. With the exception of air emissions, post-construction operational changes would therefore be the same for all alternatives, including the No Action/No Project Alternative. Changes in truck traffic, noise, and related effects associated with projected cargo growth from the Wharves 1 and 2 Reconstruction Project were addressed in that Project's EIR and mitigation was also provided (Port of Redwood City 2010).

4.2.4 Overall Physical, Environmental, and Social Setting of Study Area

4.2.4.1 *Dredging Sites*

4.2.4.1.1 Redwood City Harbor Channel

The Port of Redwood City is approximately 18 nautical miles south of San Francisco on the western side of South San Francisco Bay. It provides deep-draft access to the mid-Peninsula and San Jose metropolitan areas. The Port is situated within the confines of Redwood Creek. Redwood Creek is a year-round flowing stream located in the eastern part of Redwood City, and approximately 3.5 miles from downtown Redwood City, in San Mateo County, California. RWC Channel extends from deeper water in South San Francisco Bay into Redwood Creek and consists of the Harbor Entrance Channel, the Outer Turning Basin, Connecting Channel, the Inner Turning Basin, and Inner Channel. The Inner Channel primarily supports recreational craft, and is currently not maintained by the federal government (USACE and RWQCB 2015). Approximately 21,000 feet of the channel would be deepened as part of the RWC Project. The channel and turning basins range in width from 300 feet to 900 feet. Maintenance dredging of the Entrance Channel, Outer Turning Basin, Connecting Channel, and Inner Turning Basin is

typically performed every one to two years using clamshell-bucket equipment. These areas were partially dredged in 2014. Dredging to the full authorized depth of – 30 feet MLLW will be completed in 2015. Dredged material from Redwood City Harbor has typically been more than 80 percent fines, and been placed at the SF-11 (Alcatraz) in-Bay disposal site. RWC Channel was last deepened more than 50 years ago, in 1962 (USACE and RWQCB 2015).

Sensitive habitat is present at Bair Island and Greco Island west and east of RWC Channel. Bair Island is an approximately 2,600-acre complex of former tidal salt marsh which has been restored to tidal action. Greco Island is reported to be the largest remaining prehistoric tidal marsh in South San Francisco Bay, covering a total area of 817 acres.

4.2.4.1.2 San Bruno Shoal Channel

SBS Channel is a 30,000-foot channel located in open water in central South San Francisco Bay, in unincorporated San Mateo County. It is 500 feet wide, and is located approximately 2.5 miles east of the western shoreline of the Bay, and 6 miles west of the eastern shore of the Bay. The southern-most point of SBS Channel is approximately 4 miles north of the San Mateo Bridge. SBS Channel is dredged using a hopper dredge at 10-year intervals or greater, and was last dredged in 2005 (USACE 2014a).

The SBS Channel overlays three fuel pipelines (***Figure 2-1***), as described above. Subsurface utility locating information indicated that the inactive Shell petroleum line was located between 3.8 and 6.2 feet below the bottom of the channel; the channel in this area had a bottom elevation ranging from -30 feet MLLW to -33 feet MLLW.

The Kinder-Morgan petroleum lines were located in the horizontal plane; however, the subbottom profiling was unable to confidently determine the pipeline depths. A filled-in trench ranging from 20 to 30 feet in width was found, with the bottom of the trench at depths between 2.8 and 6.8 feet below the bottom of the channel. While it is assumed that the pipelines would have been laid into the bottom of the trench, no pipeline could be confidently located within the trench. Channel depths in this area ranged from -29 feet MLLW to approximately -33 feet MLLW. The eastern approximately 215 feet of pipeline in the channel could not be surveyed. The channel bottom materials changed, and sub-bottom profiling was unsuccessful. Divers confirmed that dense armor rock was present in this area at depths ranging from 1.8 to 3 feet below the bottom of the channel. In the center of the channel divers were able to probe through the armor rock and locate two pipelines approximately 5 feet below the bottom of the channel. The pipelines were separated about 5 feet. A secondary reflector of unknown source was consistently found at depths of approximately 15 feet below the channel bottom (Fugro and HDR 2014).

The permits for the fuel pipelines indicate that the pipeline owners were required to place the pipelines at depths of -42 feet MLLW or greater. The current pipeline elevations are therefore out of compliance with the permits. Because it has not been determined who will be

responsible for relocating the pipelines, the environmental effects of relocating the pipelines are evaluated in this document for completeness.

4.2.4.2 ***Placement Sites***

This section discusses the Cullinan, Montezuma, SF-DODS, Eden Landing ponds, and Alviso ponds placements sites.

4.2.4.2.1 Cullinan Ranch Tidal Restoration Project

The Cullinan Ranch Tidal Restoration Project is an approximately 1,575-acre wetland restoration site located in western-most Solano County between State Highway 37 on the south and Dutchman Slough on the north. The site is owned by the USFWS and is part of the San Pablo Bay National Wildlife Refuge. Cullinan was formerly used as ranch land. The site is being restored to tidal marsh, and is subsided up to 6 feet below tidal marsh elevation. The majority of the Cullinan site was breached to tidal action on January 6, 2015. The breached portion of Cullinan is expected to remain open water habitat for several decades, and complete tidal marsh development may require 60 to 100 years.

The site is bordered by managed ponds that are part of CDFW's Napa Sonoma Marshes State Wildlife Area to the west, and Guadalcanal Village Restoration Site, another tidal restoration site (currently owned by CalTrans), to the east. Immediately north of Dutchman Slough, a tidal slough that is approximately 250 feet wide, is Pond 3. Pond 3 is a tidal marsh restoration area (also part of CDFW's Napa Sonoma Marshes State Wildlife Area) that was breached in 2006. State Highway 37 borders the site to the south.

Dutchman Slough is fringed with very narrow bands of tidal marsh along its margins; wider bands are found near the mouth of Dutchman Slough along the east side of Pond 3. Guadalcanal Village was restored to tidal action by Caltrans as mitigation for their Highway 37 improvement project, and is intended to accrete to tidal marsh.

To accelerate habitat formation at the Cullinan site, the eastern-most 290-acre area was diked off and permits were obtained by USFWS to receive dredged material. This portion of site has a capacity of 3 mcy of dredged sediment and is expected to be available until approximately 2020 (R. Lowgren personal communication 2015a). Cullinan is currently in the process of extending its permit to allow it to receive up to 9 mcy of dredged sediment.

The site can accept both surface (wetland cover) and foundation (wetland non-cover) quality sediment. Wetland foundation material would have to be covered with three feet of wetland surface material (R. Lowgren personal communication 2015b). While the site itself is configured to receive dredged sediment, no offloading facilities have been constructed. Offloading facilities could be provided either by the Cullinan project, or the project delivering dredged sediment. The tipping fee for site use would vary depending on whether the dredging project or the Cullinan project provides offloading operations. Sediment transport to the site would require two 4,000-cy scows and two 1,800-hp hauling tugs. The estimated travel time to

the site is 6.1 hours. Scows would moor at the offloading facility while sediments are being unloaded.

The permits for the site allow for two offloader locations in the Napa River, north and south of the mouth of Dutchman Slough (see ***Figure 4-4***). The offloader locations are approximately 1 mile east of the receiving location for dredged sediment, and pipeline corridors for sediment delivery pipelines are also included in the permit. The offloader locations are located in deeper water to allow the use of large scows when delivering sediment to the site. Scows with a capacity of up to 6,000 cy/18-foot draft are acceptable, although navigation considerations may limit the practical size to 4,000 cy. The northern offloader location is less subject to currents than the southern location; the advantage of the southern location is that it is close to Mare Island, and electrical power could be provided from Mare Island to the southern offloader. If power is supplied to the southern offloader, the power line would most likely be installed on temporary power poles. A small substation would be located at the offloader to step down the power to a voltage usable by the offloading equipment.

The stationary offloader would be on a floating 6,000-square-foot platform held in position by two stake supports (18- to 24-inch diameter spuds). Additionally, up to three temporary mooring piles may be driven to accommodate scows and scows. These piles would be either pipe steel or wooden marine piles, typically used for this application. The permitted work area around the offloader is 200 feet by 400 feet. The sediment would be slurried and pumped to Cullinan Ranch through a High Density Polyethylene pipeline. The pipeline would float on the surface of the water along the edge of Dutchman Slough and would be anchored with small dead weight anchors to prevent wandering. If the pipeline crosses a navigable area, weights would be used to hold down and anchor the pipe to the bottom of the channel so boat traffic can proceed unimpeded. Appropriate signage and night-time lighting would be placed on the offloader, spuds and moorings in accordance with the requirements of the USCG (SLC 2012).

Impacts from *use* of this site would occur whether or not the site was used for RWC Project sediments, because it is being used by other projects as well. Therefore, impacts associated with transporting dredged material to this site and transferring it to the top of the levee at the designated sediment delivery location are attributable to the RWC Project, whereas impacts associated with dredged sediment placement, and management are not, since they have been evaluated under separate environmental reviews and would occur independently of the RWC Project. Impacts associated with construction of the offloader, and with offloading and delivery of sediment to the site would be associated with the RWC Project if the RWC constructs the offloader, and therefore are analyzed in this Integrated Document. The analysis assumes that the RWC Project would incorporate the provisions in the Cullinan permits for offloader construction and operation into its permits for use of the site. If the offloader and pipeline are constructed by the Cullinan project, then the RWC Project would only be responsible for impacts associated with transport of sediment to the off-loading location.

4.2.4.2.2 Montezuma Wetlands Restoration Project

The Montezuma Wetlands Restoration Project site is situated near Collinsville in Solano County (see ***Figure 4-4***). Montezuma is the only active wetland restoration site in the Bay Area that has site improvements and a dedicated hydraulic offloading system in place for receiving dredged material. The site can accept both surface (wetland cover) and foundation (wetland non-cover) quality sediment. It is also the only large privately-owned and operated beneficial reuse site. Restoration of wetlands at the site is being accomplished by engineered placement of approximately 17 mcy of dredged sediment to raise the subsided site to elevations appropriate for intertidal marsh. Upon completion the Montezuma project will restore approximately 1,880 acres of tidal and seasonal wetlands, and approximately 480 acres of upland buffer zone habitats at the site (ACTA 2014). Unlike most private wetland restorations, the MWRP is not being constructed as mitigation for any actions – the funding is entirely derived from tipping fees. The owner/operator is Montezuma Wetlands LLC.

The project began accepting material from the Oakland Harbor Deepening Project in December 2003. Through 2013, approximately 4.5 mcy had been successfully placed into Phase I of the MWRP. The Montezuma site has been partially restored and now provides habitat for some species of endangered plants and animals. Montezuma has a remaining capacity of approximately 12 mcy.

The site will be filled in four consecutive and hydrologically independent phases (Phases I through IV), each with its own tidal channel system and separated by phase boundary levees. The remaining capacity of Phase I is estimated to be approximately 1 mcy. Wetland foundation quality sediment, if placed into a dredged sediment cell, is placed into a subcell in the center of the sediment cell. At least three vertical feet of wetland surface quality sediment must be placed above any wetland foundation quality sediments and at least 200 lateral feet of wetland surface quality sediments must be placed between the foundation subcells and the interior cell levees to ensure that the wetland foundation quality sediments remain isolated from plants and animals.

The site has deep-water access, as well as a docking area and dredged material offloading equipment. The offloading equipment is designed for large (i.e., greater than 3,000 cy) scows. The offloading facility consists of the Liberty (an electric offloader specially designed for pumping from dredged material scows), two flat-deck mooring scows that help hold the dredge scows in place during offloading operations, and a small dock to access the Liberty. Water is mixed with sediment in the scows to form a slurry containing about 15 to 35 percent sediment. The slurried sediment is pumped by the Liberty through a 24-inch diameter pipeline to the sediment cells in the restoration area of the site. To allow use of Bay and river water for offloading (groundwater from a make-up water pond at the site is also used), the Liberty's hull intakes were equipped with fish screens when it was in use at the Hamilton Wetland Restoration Project in Marin County. The fish screens achieve an approach velocity of 0.2

ft/sec, as required for protection of Delta smelt. The two fish screens are attached directly to each side of the Liberty hull and are situated about 5 feet below the water surface at all times.

Transport to the site would require two 4,000-cy scows and two 1,800-hp hauling tugs. Scows would moor at the offloading facility while sediments are being unloaded, a process that would take about 3 hours. Travel time to the site is estimated to be 8.3 hours. The site is capable of an average rate of acceptance of 20,000 to 30,000 cy per day and peak of 60,000 cy per day (USACE and Port of Oakland 1998).

As for Cullinan, impacts from *use* of this site would occur whether or not the site was used for RWC Project sediments, because it is being used by other projects as well. Offloading impacts are addressed by the Montezuma project because the Montezuma project provides offloading services. Therefore, only impacts associated with transporting dredged material to this site are attributable to the RWC Project. Potential impacts associated with dredged sediment offloading, placement, and management have been evaluated under separate environmental reviews and would occur independently of the RWC Project.

4.2.4.2.3 SF-DODS

Located about 50 miles west of the Golden Gate Bridge (***Figure 3-4***), SF-DODS is the farthest offshore and deepest (8,000 to 10,000 feet) dredged material disposal site in the United States. It is fully permitted. The site is managed by USEPA and is monitored on a regular basis in accordance with the Site Management and Monitoring Plan (SMMP) for the site. SF-DODS was designated under Section 102 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) (USEPA 2014). MPRSA requires project sponsors to consider feasible, practicable, and environmentally superior alternatives to ocean disposal if they are available.

The disposal location is a 600-meter radius circle located at the center of the approximately 8.1 square mile area designated as SF-DODS. The site has characteristics of a continental slope deep benthic habitat. Sediment would be hauled to the site in large (4,000 cy) bottom dump scows with 3,000-hp ocean-going tugs (***Figure 4-8***). Sediments would be disposed of by opening the hulls of the scows to release the sediment. The estimated travel time to the site would be 9.1 hours.

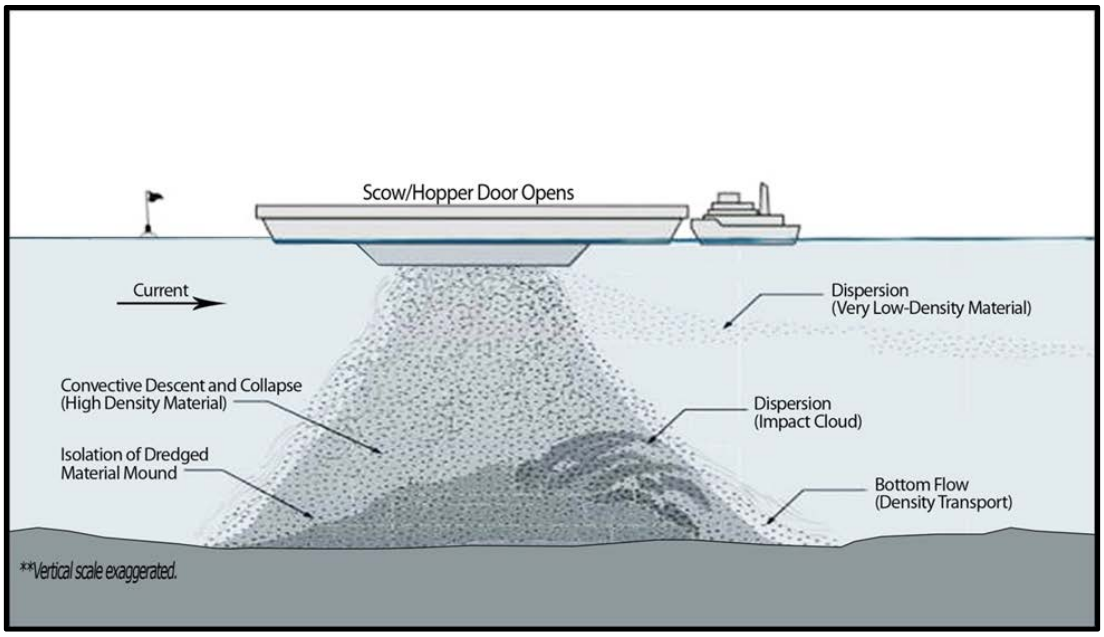


Figure 4-8. Typical Bottom Dump Scow

The open-water disposal that occurs at ocean placement sites is considered unconfined, meaning the dredged materials are in direct contact with the aquatic environment. Only dredged material determined suitable for unconfined aquatic disposal (SUAD) may be placed at these sites. SF-DODS is considered a nondispersive site (i.e., sediments disposed of at this location tend to remain in place) (USACE and RWQCB 2015). SF-DODS can accept a maximum of 4.8 mcy per year; therefore, this placement site could easily accept the maximum annual sediment production (approximately 1.8 mcy) from the RWC Project.

4.2.4.2.4 Eden Landing Ponds

The Eden Landing ponds are considered a potential placement site. Eden Landing is the closest to both the RWC Channel and SBS Channel. Delivery to this location would reduce environmental impacts and result in a higher daily production rate for dredging. The site owner, CDFW, is interested in receiving dredged sediment to accelerate restoration of the site to tidal marsh; however, neither permits nor the infrastructure required to accept dredged sediment currently exist.

While this site is not currently ready to accept dredged sediment, it has strong support from the California State Coastal Conservancy (CSCC 2015) as well as CDFW. The SBSP Restoration Project's commitment to beneficial reuse of sediment is reflected in the recent completion of the SBSP Restoration Project Beneficial Reuse Feasibility Study (Moffat & Nichol 2015). Delivery of dredged sediment to the Eden Landing ponds could also serve as a pilot project for future delivery of dredged sediment to the Alviso Ponds.

The Eden Landing ponds are part of the Eden Landing Ecological Reserve (ELER) and part of the SBSP Restoration Project Phase 2 restoration. Phase 1 restoration actions at ELER were focused on the northern half of Eden Landing north of Old Alameda Creek. The Phase 2 actions at Eden Landing are focused on the ponds in the southern half of the complex, in the area between the Old Alameda Creek channel and the federally-constructed Alameda Creek Flood Control Channel (ACFCC). The Eden Landing ponds are within the City of Hayward, and are bordered by the town of Union City to the east.

The southern portion of Eden Landing includes 11 ponds that were divided into three groups based on their locations and their proximity and similarity to each other. The three groups are as follows:

- The Bay Ponds: Ponds E1, E2, E4, and E7 are the four large ponds closest to San Francisco Bay, and the ponds most likely to receive dredged sediment from the RWC Project.
- The Inland Ponds: Ponds E5, E6, and E6C are somewhat smaller ponds in the northeast portion of the complex, near ponds E4 and E7.
- The Southern Ponds: Also called the C-Ponds, Ponds E1C, E2C, E4C, and E5C are in the southeastern portion of the complex. They are separated from the Inland Ponds and the Bay Ponds by an Alameda County–owned freshwater outflow channel and diked marsh areas known collectively as "the J-ponds" (URS 2014a).

RWC Project sediment would be delivered to the closest Bay-front levee at Eden Landing. Pond E2 is the only pond in the Phase 2 restoration area that has a Bay-front levee. Pond E1, while close to the Bay, is separated from the Bay by a small marsh. The primary challenge in delivering dredged material to Eden Landing is the shallow water in the South Bay. While a scow can transport dredged material to within a few miles of the site, the mudflats offshore of the site are too shallow for these vessels to navigate. A water depth of at least 20 feet MLLW is preferred to accommodate large scows. To move the material the last few miles, the scow would be offloaded at a deep water transfer site (offloader) and the dredged material would then be pumped to the site by pipeline. ***Figure 2-1*** shows the preferred deep water offloader location for the Eden Landing ponds, based on evaluations conducted as part of the SBSP Beneficial Reuse Feasibility Study (Moffatt & Nichol 2015). The recommended offloader location is approximately 3.8 miles from the closest point at Pond E2 (Moffatt & Nichol 2015), and approximately 2 miles from the mouth of RWC Channel.

From the offloader, a pipeline would be laid through the shallow portions of the Bay and outboard mudflats at Pond E2. Based on the available information, it is assumed that one booster pump would be adequate to transfer material from the offloader to the Pond E2 levee. Additional booster pumps may be required if higher than anticipated percentages of sand are included in the dredged material, because sand settles faster and requires greater pumping velocities compared to finer sediments (Moffatt & Nichol 2015).

Sediment could also be delivered to the Eden Landing ponds directly from a hydraulic cutterhead dredge. A pipeline would extend from the dredge to the sediment delivery location at Pond E2. The footprint of the pipeline in the vicinity of the Eden Landing site would be the same as for the offloader pipeline. For dredging in RWC Channel, the cutterhead pipeline would extend further west (across the channel and into the dredging area). For dredging at SBS Channel, the pipeline would extend generally north and would likely parallel the natural deep water channel. If a cutterhead dredge is used, a booster pump could be located on the dredge and/or on the Pond E2 levee. Due to the greater distance, multiple booster pumps would be required if a hydraulic cutterhead is used to dredge SBS Channel; these additional booster pumps could be stationed on the Pond E2 levee and in the Bay. The alignment of any sediment delivery pipeline would avoid the two eelgrass beds located offshore from the northern edge of Pond E2.

While the EIR for Phase 2 restoration of Eden Landing has not been completed, it is anticipated that Eden Landing would only be able to accept sediment that meets criteria for wetland surface use. The maximum estimated sediment capacity of the Eden Landing Phase 2 restoration is 7.2 mcy. The maximum capacity for Ponds E1 and E2 combined is 3.4 mcy; the maximum capacity for Ponds E1, E2, E4, and E7 combined is 4.7 mcy. Eden Landing thus has the potential flexibility to accept the majority of the wetland surface quality material from the RWC Project; the small amount of excess material and any sediment that does not meet wetland surface criteria would have to be taken to another site.

4.2.4.2.5 Alviso Ponds

The Alviso ponds are also considered a potential placement site. While slightly farther from RWC than the Eden Landing ponds, this site is much closer to both RWC Channel and SBS Channel than any of the permitted sites, and has a large capacity to accept sediment. The site owner, USFWS, is interested in receiving dredged sediment to accelerate restoration of the site to tidal marsh; however, as for Eden Landing, neither permits nor the infrastructure required to accept dredged sediment currently exist. Because some of the ponds are deeply subsided, less infrastructure may be required to manage decant water from sediment than at Eden Landing. Some of the ponds in the Alviso pond complex have elevated sediment mercury concentrations (a legacy of historic mercury mining operations upstream of the area). As for Eden Landing, the SBSP Restoration Project is committed to beneficial reuse of sediment at the site (CSCC 2015).

The Alviso Pond Complex consists of 25 ponds on the shores of the South Bay in Fremont, San Jose, Sunnyvale and Mountain View, within Santa Clara and Alameda counties. The pond complex is bordered on the west by the Palo Alto Baylands Park and Nature Preserve and the City of Mountain View's Charleston Slough; on the south by commercial and industrial land uses, Mountain View's Shoreline Park, the National Aeronautics and Space Administration (NASA) Ames Research Center, and Sunnyvale Baylands Park; and on the east by Coyote Creek in San Jose and Cushing Parkway in Fremont.

Three groups of ponds within the Alviso Pond complex could potentially receive dredged sediment. Two of these groups (Ponds A1 and A2W, and Ponds A5- A8S) are part of the Phase 2 restoration program for the South Bay Salt Ponds.

- Ponds A1 and A2W, referred to as the Mountain View Ponds, are on the western edge of the Alviso Pond Complex. The City of Mountain View lies immediately to the south, and Charleston Slough and the Palo Alto Flood Control Basin lie to the west. Ponds A1 and A2W are separated by Mountain View Slough (also known as Permanente Creek). Stevens Creek lies to the east of Ponds A2W. The ponds comprise approximately 625 acres, and have an estimated 8.2 mcy dredged sediment capacity. These ponds are the most likely to be restored in Phase 2, and are the closest to the RWC Project dredging locations.
- Ponds A5, A7, A8 and A8S are located in the southern central portion of the Alviso Pond Complex, and referred to as the A8 ponds. They are west of the town of Alviso, and north of Sunnyvale and State Route (SR) 237. They are located between Guadalupe Slough to the west and Alviso Slough to the east. Ponds A8 and A8S were also included in the SBSP Restoration Project Phase 1 work; they were made reversibly tidal through installation of a gate that opened in July 2010 (CSCC and USWFS 2015, in review). Although Ponds A8 and A8S were part of Phase 1 restoration, pursuant to the Adaptive Management Plan for the SBSP Restoration Project, they are also included in Phase 2.[14] Ponds A5 – A8S comprise approximately 1,440 acres, and have an estimated 17 mcy dredged sediment capacity.
- Ponds A9 – A15 are located in the east portion of the Alviso Pond Complex. Restoration of Ponds A9-15 is part of the TSP (and Locally-Preferred Plan) for the South San Francisco Bay Shoreline Study (USACE 2014a).[15] The ponds are located north and west of the town of Alviso, between Alviso Slough and Coyote Creek. The ponds comprise approximately 2,100 acres, and have an estimated 22.5 mcy dredged sediment capacity.

The recommended sediment delivery location for the Mountain View Ponds is on the west side of Pond A2W, near the entrance to Mountain View Slough. The recommended sediment delivery location for both the A8 Ponds and Ponds A9-A15 is on the west side of Pond A9 near the mouth of Alviso Slough (Moffatt & Nichol 2015). The site owner would transfer the sediment across Alviso Slough to the A8 ponds if those ponds are chosen to receive dredged sediment.

The Alviso Pond Complex is far from any maintained deep-water channel; however, the natural deep water channel in San Francisco Bay extends past (south of) the Dumbarton Bridge. A water depth of 35 feet extends to approximately 1.75 miles south of the Dumbarton Bridge and a water depth of 20 feet is available approximately 1 mile further south. The Sediment

[14] Pond A5 was restored to muted tidal action in Phase 1, and could be converted to tidal habitat. It has a capacity of approximately 2.3 mcy.

[15] Pursuant to current USACE policy, USACE cannot do restoration work on USFWS lands, and the restoration effort would have to be conducted by USFWS.

Beneficial Reuse Feasibility Study (Moffatt & Nichol 2015) recommended that the offloader be located between the Dumbarton Bridge and the railroad bridge located approximately 0.75 miles south of the Dumbarton Bridge. This would avoid vessels having to transit the railroad bridge, thereby minimizing scow transport delays while navigating in relatively shallow waters near the railroad bridge.

The distance from the recommended offloader location to the Pond A2W sediment delivery location is approximately 4 miles; the distance to the Pond A9 sediment delivery location is approximately 6 miles. A booster pump would be needed at the shoreline to allow the dredged material to reach the Mountain View Ponds. The Pond A9 sediment delivery location would require a booster pump at the shoreline and an intermediate booster pump between the offloader and the shoreline (Moffat & Nichol 2015). The pumping distance from the recommended offloader location to the Alviso ponds is greater than to Eden Landing. The pumping distance is considerably greater than the pumping distance at Cullinan; however, the travel distance to the Alviso offloader is much less than to Cullinan, and the combined capacity of the ponds is substantially more than any other beneficial reuse site.

Sediment could also be delivered from RWC Channel to the Alviso ponds directly from a hydraulic cutterhead dredge. A pipeline would extend from the dredge directly to either Alviso sediment delivery location. The footprint of the pipeline in the vicinity of the sediment delivery location would be the same as for the offloader pipeline; however, the pipeline would extend much further; it may be up to 5 miles longer when the cutterhead is dredging near the west end of RWC Channel. If a cutterhead dredge is used, one booster pump could be located on the dredge. SBS Channel is too far from the Alviso ponds to allow use of a hydraulic cutterhead.

While the EIS/EIR for Phase 2 restoration of the Alviso Pond Complex has not been completed, and the South San Francisco Bay Shoreline Study Integrated Document is also in the Draft stage, it is anticipated that Alviso ponds would only be able to accept sediment that meets wetland surface criteria. The Alviso site has the capacity to easily to accept all wetland surface quality material from the RWC Project; however, sediment that does not meet wetland surface criteria would have to be taken to another site.

4.3 Project Alternatives Analysis Considerations

Chapter 3 described the screening of preliminary Project components, including channel modifications, dredging depths, and placement sites, and provided the preliminary list of alternatives. A total of 17 Project alternatives were defined to maximize the flexibility of the Project to select the most cost effective and environmentally sound plan. To streamline the analysis of the large range of alternatives, impacts associated with the three dredging options and use of the various placement sites were evaluated separately (see ***Appendix A)***, and then combined into an alternative-by-alternative assessment and ranking of impacts (see ***Section 4.5). Table 4-5*** presents a summary of impacts and mitigation measures.

Table 4-5. Summary of Impacts and Mitigation Measures

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
AQ-1	Construction Air Emissions	SU			All Dredge Options; Cullinan, Montezuma, SF-DODS (Eden Landing and Alviso not analyzed)	SU
AQ-2	Long-term (Future) Operational Emissions	NI	NA		NA	NI
Biological Resources						
BIO-1	A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service	SU	BIO-M1	Minimize Species Entrainment	Dredge Options; Cullinan, Eden, Alviso	SU
			BIO-M2	Conduct Entrainment Monitoring		
			BIO-M3	Minimize Entrainment during SBS Channel Pipeline Replacement		
			BIO-M4	Avoid Construction that Could Affect Tidal Aquatic Habitats when Salmonid Species and Other Special Status Fish Species are known to Occur		
			BIO-M5	Limit Speeds for Construction Vessels		
			BIO-M6	Habitat Mitigation		
			BIO-M7	Construction Schedule and Sequencing		
			BIO-M8	Rail Surveys and Noise Windows		

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
			BIO-M9	Pre-Construction Special Status Wildlife Surveys		
			WQ-M1	Monitor Turbidity and Implement Minimization Measures		
BIO-2	A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service	S	N/A		Dredge Options	LTS
BIO-3	A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption-	NI	N/A		N/A	LTS
BIO-4	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.	LTS	N/A		N/A	LTS
BIO-5	Conflict with any local policies or ordinances protecting biological resources	S	BIO-M1	Minimize Species Entrainment	Cullinan, Eden, Alviso	LTS
			BIO-M2	Conduct Entrainment Monitoring		
			BIO-M3	Minimize Entrainment during SBS Channel Pipeline Replacement		
			BIO-M4	Avoid Construction that Could		

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
				Affect Tidal Aquatic Habitats when Salmonid Species are known to Occur		
			BIO-M5	Limit Speeds for Construction Vessels		
			BIO-M6	Habitat Mitigation		
Cultural Resources						
CUL-1	Cause a substantial adverse change in the significance of a historical resource.	NI	N/A		N/A	NI
CUL-2	Cause a substantial adverse change in the significance of an archaeological resource	S	CUL-M1	USS Thompson shipwreck shall be avoided by all pipeline construction and laying activities	Dredge Options; Cullinan, Eden, Alviso	LTS
			CUL-M2	The USACE shall attempt to avoid all known shipwrecks. The USACE shall make reasonable attempts to locate the shipwreck "Echo" and determine whether the dredging and widening activities in San Bruno Shoal Channel would affect the shipwreck.		
			CUL-M3	If the project is found to affect the Morgan Shell, Manana, or City of Glendale shipwrecks, the USACE shall not complete that part of the proposed action until the shipwrecks are evaluated for historical significance and		

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
				appropriate environmental review is completed.		
			CUL-M4	Mitigate for the potentially substantial adverse change in the significance of other archaeological resources. If an archaeological resource cannot be avoided by project activities, the archaeologist shall prepare an Archaeological Evaluation Plan (AEP) and submit this plan to USACE for approval. The AEP shall create a program to determine the potential of the expected resource to meet the NRHP and CRHR criteria.		

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
CUL-3	Directly or indirectly destroy a unique paleontological resource or site or unique geological feature	S	CUL-M5	If paleontological resources are encountered during Project construction activities, all work shall be temporarily halted or diverted and a qualified paleontologist shall be retained to ascertain the nature of the discovery, the significance of the find, and provide proper management recommendations.	Dredge Options; Cullinan, Eden, Alviso	LTS
CUL-4	Disturb any human remains, including those interred outside of formal cemeteries	S	CUL-M6	The USACE shall discuss with the descendants all reasonable options regarding the descendants' preferences for treatment and make all reasonable efforts to develop an agreement for the treatment of human remains and associated funerary objects.	Dredge Options; Cullinan, Eden, Alviso	LTS
Geology/Soils/Seismicity						
GEO-1	Expose People or Structures to Potential Substantial Seismic or Other Geologic Hazards that Cannot be Avoided or Reduced through the Use of Standard Engineering Design and Seismic Safety Techniques	LTS	N/A		N/A	LTS
GEO-2	Significant Soil Erosion Creating Risks to Life, Property, or Waterways, or Damage to Sensitive Habitat	S	GEO-M1	Conduct Supplemental Hydrodynamic Surveys and Monitor for Erosion	Dredge Options	LTS
			BIO-M5	Limit Speeds for Construction		

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
				Vessels-add		
Hazards and Hazardous Material						
HAZ-1	Increase in Navigation Incidents or Other Substantial Navigational Safety Risks	LTS	N/A		N/A	LTS
HAZ-2	Substantial Hazard to the Public or the Environment from Routine Use, Transport, or Disposal of Contaminated Sediment or Hazardous Materials	S	WQ-M1	Monitor Turbidity and Implement Minimization Measures	Dredge Options	LTS
HAZ-3	Substantial Hazard to the Public or the Environment through Reasonably Foreseeable Accident or Upset Conditions Involving Hazardous Materials	LTS	N/A		N/A	LTS
Land Use and Planning						
LU-1	Conflict with Applicable Land Use Plan, Policy, or Regulation of an Agency with Jurisdiction over the Project	LTS	N/A		N/A	LTS
LU-2	Introduction of Land Uses or Activities Incompatible with Existing or Adjacent Land Uses	LTS	N/A		N/A	LTS
LU-3	Physical Division of Existing Communities	NI	N/A		N/A	NI
LU-4	Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plan	NI	N/A		N/A	NI
Noise and Vibration						
N-1	Noise Level Increase of More than 5 dBA at Sensitive Receptor Locations	NI	N/A		N/A	NI

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
N-2	Exceedance of Applicable Noise Thresholds	LTS	N/A		N/A	LTS
Recreation						
REC-1	Restricted or Reduced Availability or Quality of Existing Recreation Opportunities	LTS	N/A		N/A	LTS
Socioeconomics/Population/Housing						
SE-1	Measurable and Prolonged Decrease in Local Job Supply or Decrease in Revenue from Leading Industries	BE	N/A		Dredge Options; Cullinan, Montezuma, Alviso, Eden, SF-DODS	BE
SE-2	Disproportionate Benefit to High-Income, White Communities and/or Disproportionate Harm to Low-Income Communities and/or Communities of Color	BE	N/A		Dredge Options; Cullinan, Montezuma, Alviso, Eden, SF-DODS	BE
Transportation/Navigation/Traffic						
NAV-1	Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade	LTS	N/A		N/A	LTS
NAV-2	Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area	LTS	N/A		N/A	LTS
Utilities/Service Systems						
UTIL-1	Potential Damage to Utilities or Service	LTS	N/A		N/A	LTS

Impact No.	Impact Name	LOS*	Mitigation Measure No.	Mitigation Measure Name	Dredge Options & Placement Sites for Which a Significant Impact Could Occur	LOS After Mitigation
	Systems					
UTIL-2	Interfere with Operations of or Cause Other Disruptions to Utilities or Service Systems	LTS	N/A		N/A	LTS
UTIL-3	Need to Relocate or Otherwise Protect or Replace Utilities or Service Systems	LTS	N/A		N/A	LTS
Water Quality and Hydrology						
WQ-1	Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standard (TSS levels)	SU	WQ-M1	Monitor Turbidity and Implement Minimization Measures	Dredge Options; Alviso, Eden	SU
WQ-2	Increased Erosion, Especially at Bair Island or Greco Island, due to Increased Vessel Wake Force	LTS	N/A		N/A	LTS
WQ-3	Acceleration of Sedimentation resulting in Significant Effects on Receiving Water Quality or Aquatic Habitat	LTS	N/A		N/A	LTS
WQ-4	Substantial Adverse Effect on State- or Federally-Protected Wetlands (RWC)	LTS	N/A		N/A	LTS
WQ-5	Substantial Increase in Salinity in Public or Private Wells from Salt Water Intrusion	LTS	N/A		N/A	LTS

Notes: N/U- Mitigation measure not used

* Dredging options or placement sites for which a significant impact could occur

BE = Beneficial Effect	NI = No Impact
LOS = Level of Significance	S = Significant
LTS = Less than Significant	SU = Significant and Unavoidable Impact

The approach taken for the resource analysis in ***Appendix A*** also allows for flexibility in Project execution, particularly with respect to the potential use of Eden Landing and/or Alviso as placement sites. Alternatives involving their use were evaluated to the degree feasible, but because neither site is currently permitted to receive dredged sediment, and neither site has the infrastructure in place to manage dredged sediment, alternatives including these sites cannot currently be selected as a Recommended Plan. Project costs and placement site availability could be reevaluated as the Project moves closer to implementation to determine if a less costly and more environmentally sustainable alternative has become feasible. Pursuant to USACE policy, the selected alternative (TSP) is determined based on an economic (benefit/cost) analysis, as described in ***Chapter 6***.

4.4 Overall Regulatory Setting

The Federal, state, regional, and local laws, regulations, policies, and plans that affect the Project are summarized in ***Appendix G***. ***Table G-1*** summarizes the relevant portions of potentially applicable Federal and state laws, regulations, and policies. For each resource area that has been evaluated in detail for the Project, the potentially applicable local plans and policies are summarized in ***Tables G-2 through G-13***.

4.5 Evaluation of Alternative Plans

This section summarizes and compares the potential environmental impacts of the No Action/No Project Alternative (a description of the No Action/No Project Alternative is provided below) and the 17 dredging/placement alternatives. As described in ***Section 3.5***, Project alternatives were constructed using each dredging option (to an authorized depth of -32 feet, -34 feet, and -37respectively, all including overdepth), and a variety of placement options, including 100 percent beneficial reuse at placement locations that are currently permitted, maximum beneficial reuse at the SBSP Restoration Project locations (assuming that one of these sites would become available by the time the Project is ready to be constructed), the most economical option, and several combinations of these options.

The Project alternatives are summarized in ***Table 3-5***; the table shows the maximum estimated sediment volume that would be delivered to each placement site under each alternative. The actual volume of sediment delivered to each placement site would be determined by the actual volumes dredged. The actual volumes dredged to deepen the channel could change based on the amount of overdepth actually dredged. Based on past experience, it is likely that instead of the full two feet of overdepth, dredging would capture approximately one foot of overdepth. Including bulking during dredging, this would reduce total dredged sediment volumes by between 647,000 cy to 1,232,000 cy depending on dredging depth. This lower volume was used to estimate construction costs, as described briefly in ***Section 4.2.3***. A reduction in the sediment volume would substantially reduce the duration of Project activities, and would therefore also substantially reduce air emissions from the Project.

Alternatives A-1 through A-5 incorporate Dredging Option A (-32 feet MLLW channel depth), Alternatives B-1 through B-6 include Dredging Option B (-34 feet MLLW channel depth), and Alternatives C-1 through C-6 would use Dredging Option C (-37 feet MLLW channel depth). The sediment volumes for each placement site shown in ***Table 3-5*** typically establish an upper bound on the amount of sediment that would go to each site for the purposes of the impact assessment. ***Table 4-6*** shows the differences in construction duration for alternatives at the three Project depths, and also shows the differences in duration between the cost estimate volume and the maximum dredging volume. The alternatives including Eden Landing and Alviso are not included in this table, because the dredging durations have not been quantified for these locations. However, assuming the maximum volume is dredged, dredging durations are estimated to last 3 - 4 dredging seasons for Dredging Option A, 7 - 9 dredging seasons for Dredging Option B and 13 - 16 dredging seasons for Dredging Option C. These durations are dictated by the need to remain below the conformity threshold for criteria air pollutants; the dredge could work faster than the durations shown (durations could be reduced by 1 to 5 dredging seasons if emissions could be reduced to remain below the conformity threshold).

Although the impact analysis included evaluation of sediment delivery to Alviso Pond A9, none of the action alternatives incorporate placement at Alviso Pond A9. Delivering dredged sediment to Pond A9 would be somewhat more costly than delivering dredged sediment to Pond A2W, because the increased pumping distance would require use of a third booster pump, which would have to be constructed in San Francisco Bay. Thus, from a cost and environmental resources perspective, delivery to Pond A2W would be preferable to delivery to Pond A9. Furthermore, it is currently anticipated that Pond A2W would be the first Phase II restoration pond to be available to receive dredged sediment. Nonetheless, should Pond A9 become available as a permitted dredged sediment placement location in advance of Pond A2W, it would likely be preferable to North Bay (San Pablo Bay) placement sites due to the reduced transport distance to Pond A9.

Table 4-6. Comparison of Dredging Volumes and Project Construction Durations

Dredging Option	Cost Estimate Sediment Volume[1]	Maximum Estimated Sediment Volume[2]	Dredging and Off-Loading Duration (months)						
			SF-DODS			Cullinan[3]			
			Alternative	Cost Estimate Volume	Maximum Volume	Alternative	Cost Estimate Volume	Maximum Volume	Alternati
A (-32 feet)	936,990	1,765,000	A-3	8.4	15.9	A-1	5.9	11.1	A-2
B (-34 feet)	2,497,619	3,961,000	B-2	21.9	34.9	B-3	14.6	20.2	B-4
C (-37' feet)	5,476,588	7,715,000	C-2	47.6	67.2	C-3	40.5	57.7	C-4
			Dredging and Off-Loading Duration (Dredging Seasons[4]) Based on Dr						
A (-32 feet)	936,990	1,765,000	A-3	2	3	A-1	2	2	A-2
B (-34 feet)	2,497,619	3,961,000	B-2	4	6	B-3	3	4	B-4
C (-37' feet)	5,476,588	7,715,000	C-2	8	12	C-3	7	10	C-4
			Dredging and Off-Loading Duration (Dredging Seasons[4]) to Meet Confor						
A (-32 feet)	936,990	1,765,000	A-3		4	A-1		3	A-2
B (-34 feet)	2,497,619	3,961,000	B-2		9	B-3		7	B-4
C (-37' feet)	5,476,588	7,715,000	C-2		16	C-3		15	C-4

Notes:

[1] Includes SBS Channel lengthening and berth deepening

[2] Adjusted volumes used for EIS/EIR analysis include maximum overdepth dredging (additional volume not included in cost estimate)

[3] Cullinan capacity is currently 3 mcy. Excess material would be transported to SF-DODS.

[4] One dredging season is one 6-month dredging window (i.e., June 1 - Nov 30 of one year)

[5] See discussion in Section 4.3.5.1.2

4.5.1 No Action/No Project Alternative

For this document, the No Action Alternative (NEPA) and No Project Alternative (CEQA) include the same assumptions, and are therefore evaluated together The No Action Alternative is the NEPA benchmark for assessing environmental effects, including the cumulative impacts, of the Proposed Project. The No Action/No Project Alternative represents the expected future condition if neither the Project nor one of the action alternatives are approved and there is no change from the current channel depth.

The future No Action/No Project Alternative includes reasonably foreseeable projects in the study area that are consistent with the continuation of existing management direction or level of management for plans, policies, and operations by the NEPA and the CEQA lead agencies occurring after 2014 through the end of the analysis period (2030).

Under the CEQA, the No Project Alternative is not the benchmark for assessing the significance of the impacts of the proposed Project and alternatives; the benchmark is the baseline year (2014). The CEQA Guidelines §15126.6 (e)(1) state that "The 'no project' alternative analysis is not the baseline for determining whether the proposed project's environmental impacts may

be significant, unless it is identical to the existing environmental setting analysis which does establish the baseline." The No Project Alternative, then, describes the circumstances that would occur if the project does not proceed [CEQA Guidelines §15126.6 (e)(3)(B)] and, like the No Action Alternative, assumes the continuation of existing Port plans, policies, and operations into the future. Additionally, impacts should be analyzed "projecting what would reasonably be expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services" [CEQA Guidelines §15126.6 (e)(3)(C)].

Similar to the No Action Alternative, although not identified as the baseline, the No Project Alternative allows decision-makers to compare the future condition without the Proposed Project to the future condition with the Proposed Project and use the results as one more tool for alternative selection.

Under the No Action/No Project Alternative dredging of RWC Channel and SBS Channel would not occur. All construction-related activities would be avoided; there would be no need to lower the pipelines below SBS Channel, or to deepen the berths at the Port. Maintenance dredging of RWC and SBS Channels would continue to occur at the same frequency and would generate the same volumes as under current conditions. Maintenance dredging would continue to be managed and environmental review of maintenance dredging would continue to be performed by the USACE. There would be no change in effects to resources from maintenance dredging.

Because there would be no sediment from channel deepening, there would be no need to transport any dredged sediment to any of the placement sites, and there would be no need to construct any offloading facilities. (Absent a supplemental source of dredged sediment, one or more of the placement sites would require longer to achieve the goal of tidal marsh restoration. The delay in habitat formation cannot be quantified because it would depend on the specific site plans and alternate approaches to achieving the target habitat.)

Cargo volume would continue to grow with economic demand, at an estimated average rate of 2.8 percent. The number of vessels calling at the Port would grow in response to increased demand, and vessels would continue to have to be light loaded, lighter into scows, or wait for the tides to enter the Port. It is possible that the number of scow calls at the Port would increase more rapidly than total vessel calls, as a greater percentage of cargo is likely to be lightered into scows, as has occurred during past years with high demand. There would be increases in the duration of offloading activities at the Port corresponding to the increased cargo moving through the Port.

The forecast cargo tonnage by 2025 is2.5 million tons. By 2025, the Port is expected to receive 104 deep draft vessel calls. This represents an increase of 62.5 percent, and would be due to the increased cargo tonnage. With implementation of Phase 2 of the Wharves 1 and 2 and Reconstruction Project, the Port's sand and aggregate throughput capacity would increase to

2.5 million tons per year. No other improvements that would affect the Port's existing throughput capacity are planned. Gypsum throughput would remain at a maximum of 300,000 tons/year (per the existing permit), and scrap metal exports would remain at or below 450,000 tons/year.

Increases in sand/aggregate throughput capacity were fully analyzed in the EIR for the Wharves 1 and 2 and Reconstruction Project (Port of Redwood City 2010), and mitigation was provided. As a result of increased cargo movement through the Port, there would be increases in noise in the vicinity of the Port, as offloading equipment is operated more frequently, an increase in the number of trucks leaving the Port area to accommodate the increased cargo volume, and increases in air emissions. The Port currently operates 24 hours per day when a vessel is in port. The closest residential receptors are houseboat residents at Docktown Marina; these residents are considerably closer to Highway 101 than to the southern-most portion of the Port, and are surrounded by other commercial and industrial uses.

Under the No Action/No Project Alternative, there would be no effects to air quality during construction (there would be no dredging to deepen the channel), cultural resources (there would no dredging or excavation of previously undisturbed areas); land use (there would be no change in land use); geology, soils, and seismicity (there would be no changes to existing conditions); and water quality and hydrology (there would be no new sources of potential releases). Effects to biology (from increased ballast water exchange); hazards and hazardous materials (from increased fuel and maintenance chemical use and increased vessel traffic); recreation (indirect effect from increased noise); and utilities (from increased use of existing utility lines) would be *de minimis* and would be controlled by compliance with applicable laws and regulations. The increased cargo volume would result in a slight increase in jobs, which would be a benefit to socioeconomics; however, cost of materials would continue to reflect the inefficiencies associated with the -30-foot channel depth. There would be no effects to resources at any of the placement sites because there would be no need for placement sites.

Under the No Action/No Project Alternative there would be an increase in vessel calls; however, this increase in vessel calls is not attributable to the proposed Project because the proposed Project would not cause any growth in cargo throughput. Consequently, increases in air emissions due to increased vessel calls are not an effect of the proposed Project. However, vessel calls would be reduced by between 11% and 24% percent by 2025, with a similar reduction in vessel emissions. The bulk of the transport emissions are due to the transit of a vessel; the increased draft of each vessel would increase drag, but would not have a large effect on fuel consumption.

4.5.2 Comparison of Impacts by Dredging Option and Placement Site

Table 4-7 provides a summary of the impacts and benefits that would occur at the placement sites, and for the three dredging options. Detailed information regarding the impacts analysis for each resource area is provided in ***Appendix A***. ***Table 4-7*** provides a numerical rating

characterizing the maximum level of impact for each resource area that would be expected to be associated with each dredging option and placement site. The level of adverse impact for a given resource is defined as: (0) negligible/no impact; (-1) less than significant; (-2) significant but mitigable; or (-3) significant and unavoidable. Beneficial effects are indicated in the table by a "B." The sections below for each resource area explain the impacts listed in ***Table 4-7***, and compare the advantages and disadvantages of the various dredging options and placement site.

Table 4-7. Comparison of Impacts by Dredging Option and Placement Site

Environmental Resource	Dredging Option A (-32 feet MLLW)	Dredging Option B (-34 feet MLLW)	Dredging Option C (-37 feet MLLW)	Cullinan	Montezuma	SF-DODS	Eden Landing	Alviso
Air Quality and GHGs	-3/B*	-3/B*	-3/B*	-3/B*B	-3/B*	-3/B*	N/A	N/A
Biological Resources	-2/-3**	-2/-3**	-2/-3**	-2	-1	-1	-2	-2
Cultural Resources	-2	-2	-2	-2	0	0	-2	-2
Geology/Soils/Seismicity	-1	-1	-1	0	0	0	0	0
Hazards and Hazardous Materials***	-1	-1	-1	-1/0	0	0	-1/0	-1/0
Land Use	-1	-1	-1	-1	-1	0	-1	-1
Noise	-2	-2	-2	-2	-1	-1	0	-2
Recreation	-1	-1	-1	-1	0	0	0	-1
Socioeconomics	B	B	B	0	0	0	0	0
Transportation and Navigation****	-1/B	-1/B	-1/B	-1	-1	-1	0	0
Utilities and Service Systems*	0/-1	0/-1	0/-1	0/-1	0	0	0	0
Water Quality and Hydrology	-2	-2	-2	-1	-1	-1	-1	-1

Impact Rating:
-3 = significant and unavoidable adverse impact
-2 = significant but mitigable adverse impact
-1 = adverse but not significant impact
0 = negligible or no impact
B = beneficial
N/A = Not available. Emissions with use of these placement locations could not be estimated, due to lack of specific information regarding offloading operations
* First rating is for construction effects, second rating is for operational effects.
** Second rating would apply if the jet sled method of construction is used for pipeline relocation.
*** Second rating would apply if dredges are electrically powered, or an electric offloader is used, or sediment is pumped directly to the site via an electrically-powered cutterhead dredge
**** First rating is for construction phase/second rating is for post-construction phase

4.5.2.1 *Air Quality and Greenhouse Gases*

Impacts due emissions of criteria air pollutants during construction are related to both the total volume dredged, and the rate of dredging. The greater the total volume of sediment dredged in a given year, the greater the total annual emissions. As stated in Section 4.2.3.2.2, the air quality management plan would ensure that annual emissions remain below the conformity threshold (the duration of the Project would be extended as needed to ensure that annual emissions remain below the conformity threshold). However, even with implementation of available mitigation, it would be impossible to reduce average daily construction-related criteria air pollutant emissions to below the BAAQMD thresholds, and use of any dredging options and placement sites would lead to significant and unavoidable impacts from dredging and transport of dredged material. Conversely, deepening of the channels would reduce the number of vessel calls required to deliver the same volume of sediment, thereby reducing operational air emissions (both of criteria air pollutants and GHGs) and creating a benefit for the Project alternatives relative to the No Action/No Project Alternative. Dredging Option C would lead to the greatest reduction in vessel calls and the lowest operational air emissions.

4.5.2.2 *Biological Resources*

Although there would be impacts to biological resources at RWC and SBS channels that would result from the dredging options, most impacts would be less than significant after mitigation. If the jet sled method of construction is used, the impacts from the pipeline relocation work at SBS Channel would be expected to have significant and unavoidable impacts due to the substantially higher turbidity and the impacts on aquatic species during the construction period. After construction is complete, no long term impacts are expected. At the placement sites, impacts on biological resources would be either be less than significant or no impact would occur. Deepening RWC and SBS Channels is consistent with their purpose to support deep-draft navigation, and deepening in RWC Channel has been designed to minimize impacts to aquatic species in the channels and to avoid the mudflats adjacent to Greco and Bair Islands. Of the three dredging options, Dredging Option A would have the least impact because it results in the shortest dredging duration.

LTMS policies support the beneficial reuse of dredged material from deepening and maintenance projects, and placement of dredged sediment at beneficial reuse site would have a long-term beneficial effect on biological resources. Because the placement sites are closer to the dredging location, and scows can be loaded more heavily in-Bay, use of beneficial reuse sites would also reduce the total dredging period. Compliance with applicable RWQCB permitting requirements; BCDC permitting requirements; LTMS policies; the USFWS and NMFS Section 7 consultations; California Endangered Species Act (CESA) requirements; and NMFS Essential Fish Habitat consultation; and implementation of BMPs and mitigation measures (***Section 4.2.2***) would minimize potential biological resources impacts.

4.5.2.3 ***Cultural Resources***

Potential cultural resources impacts associated with all dredging options are less than significant after mitigation. Impacts of pipeline relocation and dredging would be considered a potentially significant effect on shipwrecks and unknown submerged cultural resources, human remains, and paleontological resources. With the implementation of mitigations measures as described in ***Appendix A***, the impact is less than significant.

At the placement sites, all of the areas on the landward side of the levees where dredged material would be placed and associated areas of disturbance have been evaluated for environmental impacts already by previous CEQA/NEPA documents and are not part of the study area. Existing placement sites (Montezuma and Cullinan) were discussed in the Federal Navigation Channels EA/EIR which found that there are no known paleontological, archaeological, or historical resources within the existing placement sites.

There would be no effects on shipwrecks, archaeological resources, human remains, or paleontological resources due to the placement of dredged material at SF-DODS or Montezuma or from maintenance dredging. At Cullinan, Alviso and Eden Landing there is the potential for significant impacts from the placement of dredged material to unknown submerged cultural resources, archaeological resources, human remains, or paleontological resources. With the implementation of mitigations measures as described in ***Appendix A***, the impact is less than significant.

4.5.2.4 ***Geology, Soils, and Seismology***

No significant impacts to geology, soils, and seismicity are expected to result from any of the dredging options. Seismic-related ground-shaking cannot be prevented or predicted, but the likelihood of potential adverse effects related to seismic hazards during project construction is fairly low since strong seismic events are rare. Slope failure could occur at the dredging sites as a result of a large seismic event, however, channels would be properly designed in accordance with EM 1110-2-1902 to avoid significant impacts. For each dredging option, both RWC and SBS Channels would be dredged, which could result in minimal erosion of the channel side slopes. However, design dimensions of the channels are intended to preclude sloughing of the channel sides and therefore effects would be less than significant. Relocation of the fuel pipelines would require construction of a trench or directional drilling; if a trench is constructed it would be designed to sediment in naturally over the sand and armor rock protection, and any sloughing of material from the side slopes of the trench would contribute to cover over the pipes.

Delivery of dredged sediment to existing permitted placement sites would not be expected to result in onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse. Transport of dredged sediment would not disturb Bay bottom sediments, and therefore would not result in any significant soil erosion. Any offloaders and pipelines constructed as part of the Project would be designed to the appropriate seismic safety standards. Construction of the

offloader and installation of a pipeline from either a cutterhead dredge or an offloader to a dredged sediment delivery location may cause minor soil disturbance, however effects would be limited in extent and duration and are less than significant. Of the three dredging options, Dredging Option A would have the least impact because it would result in the least amount of sediment dredged. No impacts to geology, soils and seismicity impacts would be expected at SF-DODS or Montezuma because no construction would occur.

4.5.2.5 *Hazards and Hazardous Materials*

Potential impacts associated with hazards and hazardous materials are less than significant for all dredging options and all placement sites. The greatest hazard would be associated with the relocation of the fuel pipelines as well as with any over-water fueling of dredging, construction, or off-loading equipment. BMPs incorporated into the project and alternatives and preparation of the Fuel Pipeline Relocation and Response Plan would ensure that potential hazards associated with fuel pipelines and equipment fueling would remain less than significant. Potential hazards associated with over-water fueling would be reduced further if the dredges and/or offloading equipment are powered by electricity.

Other potential hazards include the presence of contaminated soil, and navigational hazards from dredging, construction, or off-loading equipment. Contaminated soil would be dredged and placed in accordance with requirements from DMMO and resource and permitting agencies, which would ensure that potential impacts associated with the contaminated soil would remain less than significant. Similarly, compliance with USCG regulations regarding aids to navigation, notices to mariners, lighting, and vessel traffic lanes would ensure that navigational hazards from dredging and transport of sediment remain less than significant.

4.5.2.6 *Land Use*

No significant land use impacts would result from any of the dredging options. At the placement sites, impacts on land use would be either less than significant or no impact would occur. Deepening RWC and SBS Channels is consistent with their purpose to support deep-draft navigation, and deepening in RWC Channel has been designed to avoid impacts to Greco and Bair Islands. All placement sites, including SF-DODS, have either been specifically permitted to accept dredged sediment, or would be specifically permitted to receive dredged sediment prior to use as a placement site. Less than significant impacts to land use could occur from the presence of dredging, construction, and/or off-loading equipment in areas used for commercial navigation and recreational boating. Of the three dredging options, Dredging Option A would have the least impact because it would result in the shortest dredging duration. No land use impacts would be expected at SF-DODS or Montezuma, because no construction would occur.

4.5.2.7 *Noise*

Potential noise impacts from all three dredging options are similar. All three dredging options may require pile driving to isolate the tie-in locations for the relocated fuel pipelines. With mitigation, no significant noise impacts would result from any of the dredging options.

Although dredging noise could result in harassment for marine mammals, these noise levels are comparable to noise produced by commercial shipping vessels already using the area. At RWC Channel, trail users at Bair and Greco Islands, as well as non-motorized boat users in the area, could potentially experience a less than significant noise impact from the Project due to the temporary construction noise associated with the dredging activities. Neither ambient noise levels nor legal thresholds would be exceeded.

At the placement sites, noise impacts would either be less than significant, adverse but mitigable, or no impact would occur (Eden Landing). In the case of Eden Landing, all sensitive receptors other than wildlife, which is addressed in the biology section, are far enough away that noise would not be a concern. The ambient noise at the Alviso offloader is relatively high due to its proximity to both the highway and the railroad bridge. While some wildlife receptors are potentially located within 0.3 miles of the offloader, with mitigation measures no impact is expected there and the remaining receptors are further away. SF-DODS would have no noise impacts, except for the short-duration transit noise on wildlife, which would be less than significant. At Montezuma, outdoor recreational users and wildlife would experience a less than significant noise impact (noise levels from the Project at the receptor locations would be below ambient noise levels) and there would be no impact to residential areas from noise. Cullinan is the only site where noise levels could temporarily exceed estimated ambient levels. Wildlife is the only identified sensitive receptor at Cullinan (the closest residential receptors are located approximately 0.35 miles away on the south side of Highway 37), and mitigation measures would be used to reduce noise impacts to less than significant levels.

4.5.2.8 ***Recreation***

Potential impacts to recreation from the dredging options would be less than significant. Impacts to recreation could occur from dredging, construction at the placement locations, or offloading equipment and activities interfering with use of existing recreational resources. During dredging and sediment delivery, the USACE would coordinate with the USFWS and other agencies as needed on signs and detours to safeguard recreationists during construction and maintain access to unaffected areas. Of the three dredging options, Dredging Option A would have the least impact because it would result in the shortest dredging duration. Construction of offloading facilities at the Cullinan and Alviso placement sites would require work in sloughs, where the presence of construction equipment could block more of the available boating access than on the open Bay. Direct impacts would be limited to immediate work areas, however, and continued access would be provided. Furthermore, the duration required for construction in the sloughs would be short. SF-DODS would result in the least impacts to recreation, because it has the least recreational use of any of the placement areas, and there would be no offloading facilities.

4.5.2.9 ***Socioeconomics***

There would be no significant adverse effects to socioeconomics, population, or housing from any of the dredging options or placement sites. The construction phase of the Project would

create a small, local increase in jobs, both at the dredging site (i.e., in the vicinity of the Port) and at the chosen placement site if a beneficial reuse site is chosen. The reduced transportation costs for building materials following construction would be a benefit to the local construction industry, and may result in the indirect creation of a few jobs. Neither during construction nor during operations would there be a sufficiently large increase in employment that additional housing or other public facilities would be required.

4.5.2.10 *Transportation and Navigation*

No significant impacts to transportation and navigation would result from this Project. While up to 1,000 scow round trips[16] would result during each construction season, this is only about 0.8 percent of the total number of vessel movements tracked by VTS in 2014. During the post-construction phase, there would be a benefit to navigation in the project area, as vessel delays and lightering (i.e., scow trips) are reduced, and fewer, larger vessels could use the Port. At Eden Landing and Alviso, the effects would be negligible or non-existent and the effects would be less than significant at the other placement sites.

4.5.2.11 *Utilities and Service Systems*

There would be no significant adverse effects to utilities and service systems for either the dredging options or the placement sites. Because there would only be a small number of workers working on the Project, there would be no impacts to service systems such as waste water or potable water treatment facilities. There could be a short-term reduction in fuel transport capacity as the fuel pipelines below SBS Channel are relocated; however, this effect would occur for all three dredging options, and would be limited to several months as the deeper pipeline segments are tied into the existing fuel lines, and provisions for addressing unanticipated interruptions in the fuel supply would be included in the Fuel Pipeline Relocation and Response Plan. Powering either the dredge and/or the Cullinan offloading facilities with electricity would not cause a significant adverse effect to the local electrical supply, however limited construction may be required to bring the power supply to the dredge or offloader.

4.5.2.12 *Water Quality and Hydrology*

Although there would be water quality impacts to the RWC and SBS Channels that would result from any of the dredging options, the impacts would be less than significant after mitigation. At the placement sites, impacts on water quality would be either less than significant or no impact would occur. Deepening RWC and SBS Channels is consistent with their purpose to support deep-draft navigation, and deepening in RWC Channel has been designed to avoid impacts to Greco and Bair Islands, including the outboard mudflats. Of the three dredging options, Dredging Option A would have the least impact because it would result in the shortest dredging duration. All placement sites, including SF-DODS, have either been specifically permitted to accept dredged sediment, or would be specifically permitted to receive dredged

[16] If Eden Landing and Alviso are used; if the more distant sites are used, the maximum annual number of scow trips would be around 400 trips.

sediment prior to use as a placement site. No hydrological impacts would be expected at any of the sites. Compliance with applicable water quality regulations, permits, the implementation of BMPs and mitigation measures WQ-M1 and GEO-1 (***Appendix A***) would ensure that potential water quality impacts would be less than significant for all placement sites.

4.5.3 Comparison of Project Alternatives

Table 4-8 shows the maximum level of impact that would be expected associated with each project alternative, including the No Action/No Project Alternative. The level of impact in the table for a given resource is noted as: (0) negligible/no impact; (-1) less than significant impact; (-2) significant but mitigable impact; or (-3) significant and unavoidable impact. Beneficial effects are indicated in the table by a "B." The level of impact assigned to each alternative in ***Table 4-8*** is based on the highest impact that could occur, even if that impact would occur at only one site in the alternative (for alternatives that contain more than one placement site). The impacts associated with each resource area for each placement site and for the three dredging options are described in detail in Appendix A and are summarized in ***Table 4-8***. The combined impacts for each alternative, therefore, consist of the combined impacts for the dredging option and the selected placement site(s). The sections below on each resource area briefly discuss the impact levels in ***Table 4-8***, and compare the advantages and disadvantages of the various alternatives relative to each resource area. For each resource area section, the impacts are summarized by alternative unless the impacts are essentially the same for several alternatives, in which case the alternatives with similar impacts are discussed as a group.

Table 4-8. Comparison of Impacts by Project Alternative

	ALTERNATIVE																
Environmental Resource	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**B-1**	**B-2**	**B-3**	**B-4**	**B-5**	**B-6**	**C-1**	**C-2**	**C-3**	**C-4**	**C-5**	**C-6**
Air Quality and Greenhouse Gases	-3/ B**	-3/ B**	-3/ B**	N/A	N/A	-3/ B**	-3/ B**	-3/ B**	-3/ B**	N/A	N/A	-3/ B**	-3/ B**	-3/ B**	-3/ B**	N/A	N/A
Biological Resources	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Cultural Resources	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Geology/Soils/Seismicity	0	0	0	0	0	0	-0	0	0	0	0	-1	-1	-1	-1	-1	-1
Hazards and Hazardous Materials*	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0	-1/0
Land Use	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Noise	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Recreation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Socioeconomics	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Transportation and Navigation**	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B	-1/B
Utilities and Service Systems*	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1	0/-1
Water Quality and Hydrology	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2

Impact Rating:
-3 = significant and unavoidable adverse impact
-2 = significant but mitigable adverse impact
-1 = adverse but not significant impact
0 = negligible or no impact
B = beneficial
N/A = Not available. Emissions with use of these alternatives could not be estimated, due to lack of specific information regarding offloading operations at the placement sites
* Second rating would apply if dredges are electrically powered, or an electric offloader is used, or sediment is pumped directly to the site via an electrically-powered cutterhead dredge
** First rating is for construction phase/second rating is for post-construction phase

4.5.3.1 ***Air Quality/GHGs***

The impacts of each project alternative are compared in ***Table 4-6***. Construction emissions would result in significant and unavoidable impacts associated with emissions of criteria air pollutants. As discussed in ***Section A.2.3 of Appendix A***, increases in operational emissions would be associated only with landside improvements and regional economic activity. Deepening of the channels would not contribute to an increase in cargo throughput. However, the proposed Project would result in reduced emissions of criteria air pollutants and GHGs for all depths relative to the same cargo volume entering the Port at the existing channel depth.

4.5.3.1.1 No Action /No Project Alternative

Under the No Action/No Project Alternative there would be no construction-related emissions. Total cargo tonnage processed through the Port would continue to increase commensurate with economic growth in the region. This would result either an increase in the number of deep draft vessel calls (and the percentages of vessels being light loaded would remain the same), or an increase in the amount of cargo carried by each vessel with increased lightering to allow the vessels to enter the Port. Lightering into barges would continue to increase with increased growth, but would increase more rapidly if the number of deep draft vessel calls remains similar to the baseline, because each vessel would require more lightering. Maintenance dredging would continue at the current level.

Project alternatives emissions associated with the *construction* phase are related to the volume of sediment dredged, and the location and process used to dispose of the sediment. In general, placement locations that are closer to the dredging location would result in lower emissions compared to locations that are farther away. For the purposes of this analysis, "unit emissions" were determined to allow for the most effective comparison. "Unit emissions" were calculated per 10,000 cy of dredged material taken to a specific placement site from a given dredging location. Unit emission factors were calculating for dredging 10,000 cy of sediment at RWC Channel and SBS Channel, as well as for transporting sediment from RWC Channel to Cullinan, Montezuma, and SF-DODS, and for transporting sediment from SBS Channel to these same locations. Due to a lack of data regarding the offloading process at Eden Landing and Alviso (***Appendix A***), air emission calculations could not be performed for these two locations, and therefore Alternatives A-4, A-5, B-5, B-6, C-5, and C-6 could not be evaluated with regard to air quality. ***Table 4-9*** provides the summary of maximum estimated construction emissions for each alternative. Total emissions are directly related to the volume dredged and transport distance; consequently, alternatives involving Dredging Option A (to -32 feet MLLW) result in reduced air emissions compared to the other alternatives, and Alternative A-1, which involves placement at Cullinan has the lowest overall emissions. Detailed calculations of dredging, transport, placement, and other construction emissions are provided in ***Tables A-4*** through ***A-7*** in ***Appendix A***.

Table 4-9. Construction Phase Air Pollutant Emissions Associated with Each Alternative

Alternative	Total Emissions (tons)							No. of Dredging Seasons Required
	NOx	ROG	PM_{10}	$PM_{2.5}$	SO_2	CO	CO_{2eq}	
A-1	255.96	25.91	12.67	12.28	0.15	131.68	14,230.83	3
A-2	299.91	30.32	14.37	13.94	0.18	160.79	17,822.87	3
A-3	366.85	37.12	16.99	16.48	0.24	204.96	23,225.45	4
B-1	603.33	61.05	29.55	28.65	0.36	314.66	34,299.53	7
B-2	814.26	82.39	37.72	36.59	0.53	454.75	51,521.02	9
B-3	634.80	64.25	30.79	29.85	0.39	335.41	36,834.08	7
B-4	673.06	68.04	32.25	31.28	0.40	360.84	39,997.95	7
C-1	1,241.22	125.54	60.12	58.30	0.74	656.65	72,207.21	13
C-2	1,598.31	161.72	74.06	71.84	1.04	892.45	101,098.46	16
C-3	1,415.06	143.20	66.92	64.90	0.90	771.35	86,232.57	15
C-4	1,319.43	133.39	63.22	61.33	0.79	707.38	78,410.53	14

From an operational standpoint, the deepest channel depth would provide the greatest reduction in the number of vessel calls relative to the No Action/No Project Alternative. Vessels could be loaded more heavily and less lightering would be required. For all dredging options, the total number of vessel calls would be less than under the No Action/No Project Alternative. Vessel offloading operations would be similar to the No Action/No Project Alternative, with potential minor reductions in air emissions as the more efficient large vessel offloading systems are used for a higher percentage of the cargo rather than the less efficient barge offloading process.

4.5.3.2 *Biological Resources*

4.5.3.2.1 No Action/No Project Alternative

There would be no changes, and biological resources at both the dredging sites and the placement sites would be unaffected. Therefore, no impacts are expected under the No Action/No Project Alternative.

4.5.3.2.2 Alternative A-1 (Channel deepening to -32 feet MLLW, placement at Cullinan)

Although there would be impacts to biological resources at RWC and SBS Channels that would result from the dredging, the impacts would be less than significant after mitigation. If the jet sled method of construction is use, the impacts from the pipeline relocation work at SBS Channel would be expected to have significant and unavoidable impacts due to the substantially higher turbidity and the impacts on aquatic species during the construction period. After construction is complete, no long-term impacts are expected. The construction of the offloader and pipeline at Cullinan would have localized and short term impacts that would be less than significant and the site would be expected to return to pre-project conditions after construction is complete.

4.5.3.2.3 Alternative A-2 (Channel deepening to -32 feet MLLW, placement at SF-Montezuma)

Impacts from dredging of RWC and SBS Channels and relocation of the pipeline at SBS Channel would be the same as for Alternative A-1. There could be a significant an unavoidable impact from relocation of the pipeline, due to the turbidity created during construction. The delivery of dredged sediments to Montezuma would have a less than significant impact on biological resources.

4.5.3.2.4 Alternative A-3 (Channel deepening to -32 feet MLLW, placement at SF-DODS)

Impacts from dredging of RWC and SBS Channels and relocation of the pipeline at SBS Channel would be the same as for all "A" alternatives. The delivery of dredged sediments to Montezuma would have a less than significant on biological resources. At SF-DODS however, there would be localized and short term impacts, which would return to pre-project conditions after the disposal is complete.

4.5.3.2.5 Alternatives A-4 and A-5 (Channel deepening to -32 feet MLLW, placement at Eden and Alviso, respectively)

Impacts from dredging of RWC and SBS Channels and relocation of the pipeline at SBS Channel would be the same as for all "A" alternatives. The delivery of dredged sediments at Montezuma would have a less than significant on biological resources. At the Eden Landing and Alviso placement sites, construction of the offloader and pipeline would have localized and short term impacts, which would return to pre-project conditions after the construction is complete.

4.5.3.2.6 Alternative B-1 (Channel deepening to -34 feet MLLW, placement at Cullinan & Montezuma)

For all the "B" alternatives, the larger sediment volume (3.96 mcy) dredged from the channels compared to the "A" alternatives would increase the duration of the disruption to biological resources in the area around the Project. Although there would be impacts to biological resources at RWC and SBS channels that would result from the dredging options, the impacts would be less than significant after mitigation. As for the "A" alternatives, the impacts from the pipeline relocation work at SBS Channel could have significant and unavoidable impacts due to

the substantially higher turbidity levels and the impacts on aquatic species during the construction period if the jet sled method of construction is used. After construction is complete, no long-term impacts are expected. There would be a less than significant impact to Montezuma from the delivery of the dredged sediment. The construction of the offloader and pipeline at Cullinan would have localized and short term impacts that would be less than significant and would be expected to return to pre-project conditions after construction is complete.

4.5.3.2.7 Alternative B-2 (Channel deepening to -34 feet MLLW, placement at SF-DODS)

Impacts from dredging of RWC and SBS Channels and relocation of the pipeline at SBS Channel would be the same for Alternative B-2 as for Alternative B-1. After construction is complete, no long term impacts are expected. The delivery of dredged sediments to Montezuma would have a less than significant impact on biological resources. At SF-DODS, there would be localized and short term impacts, which would return to pre-project conditions after the disposal is complete.

4.5.3.2.8 Alternatives B-3 (Channel deepening to -34 feet MLLW, placement at Cullinan)

Impacts from dredging of RWC and SBS Channels and relocation of the pipeline at SBS Channel would be the same as for all "B" alternatives. The construction of the offloader and pipeline at Cullinan would have localized impacts that would be less than significant and conditions at the site would be expected to return to pre-project conditions after construction is complete. At SF-DODS, there would be localized impacts, which would return to pre-project conditions after the disposal is complete.

4.5.3.2.9 Alternative B-4 (Channel deepening to -34 feet MLLW, placement at Montezuma)

Impacts from dredging of RWC and SBS Channels and relocation of the pipeline at SBS Channel would be the same as for all "B" alternatives. The delivery of dredged sediments to Montezuma would have a less than significant impact on biological resources.

4.5.3.2.10 Alternatives B-5 and B-6 (Channel deepening to -34 feet MLLW, placement at Eden and Alviso, respectively)

Impacts from dredging of RWC and SBS Channels and relocation of the pipeline at SBS Channel would be the same as for all "B" alternatives. The delivery of dredged sediments to Montezuma would have a less than significant impact on biological resources. At Eden Landing and Alviso Pond A2W, construction of the offloader and pipeline would have localized impacts, which would return to pre-project conditions after the construction is complete.

4.5.3.2.11 Alternatives C-1 through C-6 (Channel deepening to -37 feet MLLW, all placement sites)

For all the "C" alternatives, the larger sediment volume (7.7 mcy) dredged from the channels compared to the "A" and "B" alternatives would increase the duration of the biological resources impacts in the area around the dredging and pipeline relocation area. After construction is complete the sites are expected to return to pre-project conditions. All impacts to the placement sites are the same as for the "B" alternatives.

4.5.3.3 ***Cultural Resources***

The impacts of each Project alternative are compared in ***Table 4-8***. With the exception of the No Action/No Project Alternative, the impacts of pipeline placement and dredging would be considered a potentially significant effect on shipwrecks and unknown submerged cultural resources, human remains, and paleontological resources. With the implementation of mitigation measure as described in ***Appendix A*** the impact would be less than significant.

4.5.3.3.1 No Action/No Project Alternative

Under the No Action/No Project Alternative there would be no impacts to cultural resources. Maintenance dredging would continue, but no dredging that would deepen or widen the shipping channels would occur. No impacts to cultural resources would result as dredged material transport would not involve sediment disturbance, and would not be expected to result in a disturbance of archaeological or paleontological resources. The dredged material would be placed at existing placement sites on previously placed dredged material. Therefore, placement activities would not result in impacts to unique archaeological resources, because the underlying native deposits would not be disturbed. Environmental review would be required if the USACE used placement sites that have not been previously evaluated (USACE 2014b).

4.5.3.3.1 Project Alternatives

The impacts of all of the alternatives on cultural resources are expected to be similar. Alternatives involving Dredging Option A would entail less removal of sediment, and would therefore pose a somewhat lower risk of encountering unknown cultural resources, human remains, and paleontological resources. With implementation of mitigation as described in ***Appendix A***, all action alternatives would result in less than significant impacts to cultural resources.

4.5.3.4 ***Geology, Soils, and Seismology***

4.5.3.4.1 No Action/No Project Alternative

The No Action/No Project Alternative would avoid construction impacts associated with the dredging alternatives, including temporary impacts on soil erosion resulting from dredging, relocation of the pipelines, and construction of offloading facilities at Cullinan, Eden Landing, and Alviso.

Regular maintenance dredging of RWC and SBS Channels would continue. Because of the study area's proximity to the San Andreas and Hayward faults, the area could experience strong seismic ground shaking resulting in slope failure of the channel side slopes under the No Action/No Project Alternative. Proximity to the faults and soil conditions could result in liquefaction at the maintenance dredging and placement sites during seismic events. Strong ground shaking, liquefaction, ground settlement, subsidence, and lateral spreading could occur as part of the No Action/No Project Alternative. During maintenance dredging, workers would be exposed to these risks. However, because no new structures would be built, and

maintenance dredging volumes would remain the same, the No Action/No Project Alternative poses the lowest risk of seismic-related incidents.

4.5.3.4.2 Alternatives A-1 through A-5

Impacts related to geology, soils, and seismicity would be similar for these five alternatives. Although the alternatives may result in minimal erosion of the channel sides from sloughing after the channels are dredged (due to the disturbance of sediments), historic patterns of erosion and sediment accumulation would not be expected to change. Seismic hazards such as ground shaking and liquefaction, and the potential for slope failure of the channel banks would be similar to those for the No Action/No Project Alternative above. The potential for erosion impacts due to placement activities would be minimal and temporary at Cullinan, Eden Landing, and Alviso. Offloading facilities could also be subject to severe shaking. Workers at the Project site would be exposed to these risks; however, proper design of the offloading facilities would reduce potential seismic-related risk to less than significant levels. Because no offloading facilities would be constructed at Montezuma and SF-DODS, the alternatives using only these two placement sites would have slightly lower impacts to seismicity and soils than the alternatives involving Cullinan, Eden Landing, or Alviso.

4.5.3.4.3 Alternatives B-1 through B-6

Impacts related to geology, soils, and seismicity would be similar to Alternatives A-1 through A-5 except that twice as much sediment would be dredged from the channels and delivered to placement sites. The potential for slope failure would be slightly greater for these alternatives due to the deeper dredging at the channels, and the greater duration of construction activities would result in in a corresponding, very minor, increase in potential for seismic events affecting the offloading locations. As for Alternatives A-1 through A-5, because no offloading facilities would be constructed at Montezuma and SF-DODS, the alternatives using only these two placement sites would have slightly lower impacts to seismicity and soils than the alternatives involving Cullinan, Eden Landing, or Alviso.

4.5.3.4.4 Alternatives C-1 through C-6

Impacts related to geology, soils, and seismicity would be same as Alternatives B-1 through B-6 except nearly twice as much sediment would be dredged and delivered to placement sites. The potential for slope failure would be the greatest with these alternatives because these alternatives would result in the greatest channel depths. There would be a minor increase in potential for seismic events affecting the offloading locations due to the extended duration of project activities. The Montezuma and SF-DODS placement sites would not require construction of any offloading facilities, therefore the alternatives using only these two placement sites would have slightly lower impacts to seismicity and soils than the alternatives involving Cullinan, Eden Landing, or Alviso.

4.5.3.5 *Hazards and Hazardous Materials*

4.5.3.5.1 No Action/No Project Alternative

Use and management of hazardous materials would remain the same as they currently occur within the Port. Maintenance dredging, including dredging of any contaminated sediments would continue in accordance with the USACE's maintenance dredging program. Relocation of the existing fuel lines below SBS Channel would not be required.

4.5.3.5.2 Alternatives A-1 – A-5

All three dredging options would require relocating the fuel pipelines. Because Dredging Option A would require the least amount of dredging, it would have the lowest fuel use and shortest construction duration. Use of hazardous materials could be reduced further by using an electrically-powered dredge and operating the Cullinan offloader using electric power. There would be no offloader operations at SF-DODS, and impacts associated with offloader operations at Montezuma would be the responsibility of the site owner. Due to their remote locations, it is unlikely that the offloading facilities at Eden Landing and Alviso could be electrically-powered; however, it is possible that sediment could be delivered to these sites directly via cutterhead dredge, thus reducing potential risks due to fueling of offloading equipment. The shorter dredging and placement duration would also result in the least risk of a navigational incident.

The quantity of contaminated sediment in RWC Channel has not been fully defined, and therefore it is not possible to determine whether a greater volume of contaminated sediment would have to be dredged for Dredging Options B and C than for Dredging Option A.

4.5.3.5.3 Alternatives B-1 – B-6

Dredging Option B would require approximately twice as much dredging as Dredging Option A, and would therefore have greater fuel use and a slightly greater risk of an adverse event from a fuel spill or navigational incident. Similarly, the duration of use for the placement sites would be approximately double that compared to Alternatives A-1 through A-5. If offloading facilities are electrically-powered, there would be no difference in potential offloading-related hazards materials incidents between alternatives including Dredging Option A and alternatives including Dredging Option B.

The quantity of contaminated sediment in RWC Channel has not been fully defined, and therefore it is not possible to determine whether a greater volume of contaminated sediment would have to be dredged for Dredging Options B and C than for Dredging Option A.

4.5.3.5.4 Alternatives C-1 – C-6

Dredging Option C would require approximately four times as much dredging as Dredging Option A, and would therefore pose the greatest potential risk associated with hazardous materials and navigational incidents. As for Alternatives B-1 through B-6, if offloading facilities

are powered by electricity, the potential for hazardous materials incidents associated with offloading would the same regardless of the volume of material placed.

The quantity of contaminated sediment in RWC Channel has not been fully defined, and therefore it is not possible to determine whether a greater volume of contaminated sediment would have to be dredged for Dredging Options B and C than for Dredging Option A.

4.5.3.6 ***Land Use and Planning***

4.5.3.6.1 No Action/No Project Alternative

Land uses would remain the same as they currently exist at both the dredging site and the placement sites. Therefore, no impacts are expected under the No Action/No Project Alternative.

4.5.3.6.2 Project Alternatives

The impact from all dredging options would be the same and the construction of a temporary staging area to support the dredging activities would not be significant impact. All placement sites, including SF-DODS, have either been specifically permitted to accept dredged sediment, or would be specifically permitted to receive dredged sediment prior to use as a placement site. Less than significant impacts to land use could occur from the presence of dredging, construction, and/or off-loading equipment in areas used for commercial navigation and recreational boating.

4.5.3.7 ***Noise***

4.5.3.7.1 No Action/No Project Alternative

Under the No Action/No Project Alternative, there would be no use of the placement sites, and no change in the noise environment. Noise sources within the Port would remain the same; however, noise levels may increase slightly over time as cargo volume and therefore use of Port facilities increases over time. Noise at the Port has high legal thresholds, due to its industrial use. Existing land and water-based traffic and activities in the Project area contribute to the existing noise environment, sometimes incurring adverse impacts, which require mitigation by the parties involved.

4.5.3.7.2 Alternative A-1

Noise would occur from dredging activities, pile driving for fuel line relocation if the new fuel pipeline segments are tied in *in situ*, construction of the offloader (including limited pile driving) and offloader operations. The duration of dredging and offloading activities would be shorter for alternatives involving Option A than for the other dredging options. The most intense noise impacts in the project area would be from pile driving, and any pile driving would be short term, localized, and would not be significant after mitigation. Operation of tugboats and offloader pumps during dredged material delivery may temporarily increase noise levels at nearby wildlife receptors. However, the closest habitat is low quality and this impact is not considered significant. Tugboats towing scows to and from the offloader would be idling after

positioning the scow at the offloader. Noise from the tugboats would be intermittent and short, occurring roughly four to six times per day.

4.5.3.7.3 Alternative A-2, B-4, and C-4

The most intense noise impacts in the Project Area (pile driving at SBS Channel during pipeline relocation) would be short term, localized, and would not be significant after mitigation. Though Alternative B-4 would have longer dredging durations and would result in more scow trips to delivery sites, the overall noise impacts are comparable. The reuse of dredged sediments at Montezuma would have very low impact from a noise perspective, since only minimal noise from tugboats towing scows to the offloader would be produced. The noise from this activity would be less than ambient levels. There is potential for less than significant noise impacts to recreational boaters, but this would be short-lived and the affected area is easily avoided by boaters, especially since notices to mariners will be issued through the USCG.

4.5.3.7.4 Alternative A-3, B-2, and C-2

The most intense noise impacts in the Project Area (pile driving at SBS Channel during pipeline removal) would be short term, localized, and would not be significant after mitigation. Though Alternatives B-2 and C-2 would have longer dredging durations and would result in more scow trips to delivery sites, the overall noise impacts are comparable. Use of SF-DODS for sediment disposal has relatively low noise impacts. There would be less than significant noise impacts to wildlife from tugboats towing scows past wildlife areas en route to SF-DODS. The reuse of dredged sediments at Montezuma has very low impact from a noise perspective, as described above.

4.5.3.7.5 Alternatives A-4, B-5, and C-5

The most intense noise impacts in the project area (pile driving at SBS and during Eden Landing offloader construction) would be short term, localized, and would not be significant after mitigation. Though Alternatives B-5 and C-5 would have longer dredging durations and would result in more scow trips to the offloader sites or an increased duration of pumping from the cutterhead, the overall noise impacts are comparable. Maximum use of Eden Landing for dredged material placement would be the best option from a noise impact perspective, since there would be no adverse noise impacts, other than effects to wildlife from pile driving for the offloader, from use of Eden Landing. The reuse of the wetland foundation sediments at Montezuma has very low impact from a noise perspective, as described above.

4.5.3.7.6 Alternative A-5, B-6, and C-6

The most intense noise impacts in the project area (pile driving at SBS Channel and during offloader construction at Alviso) would be short term, localized, and would not be significant after mitigation. Though Alternatives B-6 and C-6 would have longer dredging durations and would result in more scow trips to the placement sites or an increased duration of pumping from the cutterhead, the overall noise impacts are comparable. The offloading of dredged sediments at the Alviso offloader would have relatively low impacts due to the high existing

noise environment from nearby highways and railroads and the attenuation of noise with distance. Noise impacts from the booster pump at the sediment delivery location would be similar to those anticipated at Cullinan. The reuse of the wetland foundation sediments at Montezuma has very low impact from a noise perspective, as described above.

4.5.3.7.7 Alternative B-1 and C-1

The most intense noise impacts in the project area (pile driving at SBS Channel and during offloader construction at Cullinan) would be short term, localized, and would not be significant after mitigation. Although Alternative C-1 would have longer dredging durations and would result in more scow trips to placement sites, the overall noise impacts are comparable. The reuse of the wetland foundation sediments at Montezuma has very low impact from a noise perspective, as described above. The reuse of dredged sediments at Cullinan would have localized and short term impacts on noise due to the construction of the offloader and during offloader operations. Operation of tugboats and offloader pumps during dredged material delivery may temporarily increase noise levels at wildlife receptors nearby. However, the closest habitat is low quality and this impact is not considered significant. Noise from the tugboats would be intermittent and short, occurring roughly four to six times per day.

4.5.3.7.8 Alternatives B-3 and C-3

The most intense noise impacts in the project area (pile driving at SBS Channel and during offloader construction at Cullinan) would be short term, localized, and would not be significant after mitigation. Though Alternative C-3 would have a longer dredging durations and would result in more scow trips to placement sites, the overall noise impacts are comparable. The reuse of dredged sediments at Cullinan would result in localized and short term noise impacts as described above. Use of SF-DODS for sediment disposal has relatively low noise impacts. There would be less than significant noise impact to wildlife from tugboats towing scows past wildlife areas near en route to SF-DODS.

4.5.3.8 ***Recreation***

4.5.3.8.1 No Action/No Project Alternative

Recreation features would continue to function as they do currently at both the dredging sites and the placement sites. The No Action/No Project Alternative would avoid any short-term impacts associated with dredging, pipeline relocation and offloading elements of the project alternatives. The existing recreational features would not be affected. Over time, increased cargo throughput through the Port could have *de minimis* effects on recreational boat use in RWC Channel, and through indirect (noise) effects on nearby recreational resources.

4.5.3.8.2 Alternatives A-1, A-5, B-1, B-3, and B-6

These alternatives would require construction of an offloader and pipeline for placement of dredged sediment. Work may be required in a slough and the presence of construction equipment could interfere with boating access. During construction, the USACE would coordinate with USFWS on signs to safeguard recreationists and maintain access to unaffected

areas. Continued access would be provided, and the duration required for construction in the sloughs would only be a matter of days. Therefore impacts to recreational activities would be short-term and considered less than significant. Alternatives B-1 and B-6 include use of the Montezuma placement site, and Alternative B-3 would include use of SF-DODS, both of which would have negligible impacts to recreational activities.

4.5.3.8.3 Alternatives A-2, A-3, B-2, and B-4

No construction is required for the Montezuma and SF-DODS placement sites. Barges would deliver sediment to the offloader already in place at Montezuma and sediment would be bottom-dumped at SF-DODS. SF-DODS is located in open waters where minimal recreational activities take place. Alternative B-4 would not require use of SF-DODS.

4.5.3.8.4 Alternatives A-4 and B-5

These alternatives would require construction of an offloader and pipeline for placement of dredged sediment. Work would occur in an open water area, therefore impacts to recreational activities would be short-term and less than significant. Both alternatives include use of the Montezuma placement site, which would have negligible impacts to recreational activities.

4.5.3.8.5 Alternatives C-1 through C-6

The recreational impacts of Alternatives C-1, C-2, C-3, C-4, C-5 and C-6 would be the very similar to B-1, B-2, B-3, B-4, B-5, and B-6, respectively. The amount of sediment delivered to each site would nearly be doubled. Impacts to recreation would have the greatest duration under these alternatives, however, impacts would still be considered less than significant.

Alternatives A-2 and A-3 are the most-preferred alternatives and C-1, C-3, and C-6 are the least-preferred alternatives with regard to impacts to recreation.

4.5.3.9 ***Socioeconomics***

4.5.3.9.1 No Action/No Project Alternative

There would be no use of the placement site under the No Action/No Project Alternative and consequently no effect on socioeconomics. Cargo throughput at the Port is forecast to grow at an average annual rate of 2.8 percent whether or not the proposed Project is implemented. Therefore regional job growth associated with increased Port operations would occur under this alternative; however, there would be no economic benefit to the construction industry in the region.

4.5.3.9.2 All Project Alternatives

All dredging options would have a slight beneficial effect due to increased efficiency in use of the Port for importing and exporting construction materials. A very minor short-term benefit would also accrue from the creation of up to 40 to 45 construction jobs lasting between 11 and 67 months. No adverse impacts are expected since positive impacts to the economy would not be disproportionately distributed. Similarly, adverse impacts would not be disproportionately distributed to low income communities and/or communities of color.

4.5.3.10 *Transportation/Navigation*

4.5.3.10.1 No Action/No Project Alternative

Transportation and navigation would remain the same as they currently exist at both the dredging sites and the placement sites. Since dredge sites are currently depth-limited and the proposed Project would reduce navigation constraints, the existing inefficiencies would continue under the No Action/No Project Alternative and likely worsen over time due to increasing demand for construction commodities in the South Bay and the tendency for ships to get bigger over time. However, as described previously, cargo growth is driven by regional demand, and is expected to continue at an average annual rate of 2.8 percent, resulting in reaching the 2.5 million ton forecast cargo tonnage in 2025.

4.5.3.10.2 All Project Alternatives

The post-construction effect on navigation would be beneficial, as the added depths would decrease delays, improve navigation efficiency, and decrease the overall number of scow trips in the project area. During construction, the impact from all dredging options would be the same and the construction of temporary staging areas to support the dredging activities would not be a significant impact. All placement sites scenarios would involve some additional vessel transits in the Project Area; however only two to three scows per day would be taken to the placement sites, and impacts from this limited number of scow trips would be less than significant. A notice to mariners would be posted so that both commercial and recreational users in the project area are aware of the location and schedule for construction. Contractors would be required to comply with all rules for vessel navigation.

Truck traffic from the Port would increase in response to cargo growth, as described above. This increase in truck traffic would occur whether or not the proposed Project is constructed.

4.5.3.11 *Utilities and Service Systems*

4.5.3.11.1 No Action/No Project Alternative

Under the No Action/No Project Alternative there would be no demand for electricity or other utilities to support dredging to deepen RWC channel or pump dredged sediment to the Eden Landing or Alviso placement sites. There would be no construction at and no use of any of the placement sites, and no need to supply electrical power to any of the site. Use of utilities at the Port would increase commensurate with growth in cargo throughput.

The existing fuel pipelines are at considerably shallower elevations than dictated by their permits. It is unknown whether the pipeline owners would be required to relocate the pipelines if the proposed Project is not constructed.

4.5.3.11.2 Project Alternatives

All action alternatives would require relocation of the fuel pipelines crossing under SBS Channel. Only minor use of non-electrical utilities, if any, would be required by the alternatives (i.e., to provide sanitary facilities to the small number of workers associated with the proposed

Project). If the Project decides to employ an electrically-powered dredge for work in RWC Channel, an existing substation would be used; however, power demand would increase substantially while the Project-related dredging is occurring.

4.5.3.11.3 Alternatives A-2, A-3, B-2, B-4, C-2, and C-4

These alternatives would use only Montezuma and/or SF-DODS as placement sites and would have no other utility requirements.

4.5.3.11.4 All Other Alternatives

All other alternatives could have minor utility use associated with the small crew operating the offloaders; however, with the exception of electrical power at Cullinan, no utility construction is anticipated for any of the alternatives.

4.5.3.12 ***Water Quality and Hydrology***

4.5.3.12.1 No Action/No Project Alternative

Water quality would remain the same as it currently is at both the dredging sites and the placement sites. Surface water quality would be controlled through the Port of Redwood City's existing stormwater management program and in compliance with the state of California's general permit for stormwater.

4.5.3.12.2 Alternative A-1

Water quality impacts on the water column from this alternative would localized and would not be significant after mitigation. The reuse of dredged sediments at Cullinan would have localized and short term impacts on the water column due to the construction of the offloader and pipeline, which would return to ambient conditions after construction is complete.

4.5.3.12.3 Alternative A-2

Water quality impacts on the water column from this alternative would be localized and would not be significant after mitigation. The reuse of dredged sediments at Montezuma would have no impact on water quality.

4.5.3.12.4 Alternative A-3

Water quality impacts on the water column from this alternative would localized and would not be significant after mitigation. The reuse of dredged sediments at Montezuma would have no impact on water quality. At SF-DODS, there would be localized and short term impacts on the water column, which would return to ambient conditions after the disposal is complete.

4.5.3.12.5 Alternatives A-4 and A-5

Water quality impacts on the water column from these alternatives would localized and would not be significant after mitigation. The reuse of dredged sediments at Montezuma would have no impact on water quality. At the Eden Landing and Alviso placement sites, construction of the offloader and pipeline would have localized and short term impacts on the water column, which would return to ambient conditions after the construction is complete.

4.5.3.12.6 Alternative B-1

For all the "B" alternatives, the larger sediment volume (3.96 mcy) dredged from the channels compared to the "A" alternatives would increase the duration of the water quality disruption in the water column in the area immediately around the dredge. The reuse of dredged sediments at Montezuma would have no impact to water quality. The reuse of dredged sediments at Cullinan would have localized and short term impacts on the water column due to the construction of the offloader and pipeline, which would return to ambient conditions after construction is complete.

4.5.3.12.7 Alternative B-2

For all the "B" alternatives, the larger sediment volume (3.96 mcy) dredged from the channels compared to the "A" alternatives would increase the duration of the water quality disruption in the water column in the area immediately around the dredge. The reuse of dredged sediments at Montezuma would have no impact on water quality. At SF-DODS, it would have localized and short term impacts on the water column, which would return to ambient conditions after the disposal is complete.

4.5.3.12.8 Alternatives B-3

For all the "B" alternatives, the larger sediment volume (3.96 mcy) dredged from the channels compared to the "A" alternatives would increase the duration of the water quality disruption in the water column in the area immediately around the dredge. The reuse of dredged sediments at Cullinan would have localized and short term impacts on the water column due to the construction of the offloader and pipeline, which would return to ambient conditions after construction is complete. At SF-DODS, it would have localized and short term impacts on the water column, which would return to ambient conditions after the disposal is complete.

4.5.3.12.9 Alternative B-4

For all the "B" alternatives, the larger sediment volume (3.96 mcy) dredged from the channels compared to the "A" alternatives would increase the duration of the water quality disruption in the water column in the area immediately around the dredge. The reuse of dredged sediments at Montezuma would have no impact on water quality.

4.5.3.12.10 Alternatives B-5 and B-6

For all the "B" alternatives, the larger sediment volume (3.96 mcy) dredged from the channels compared to the "A" alternatives would increase the duration of the water quality disruption in the water column in the area immediately around the dredge. The reuse of dredged sediments at Montezuma would have no impact on water quality. At Eden Landing and Alviso, construction of the offloader and pipeline would have localized and short term impacts on the water column, which would return to ambient conditions after the construction is complete.

4.5.3.12.11 Alternatives C-1 through C-6

For all the "C" alternatives, the larger sediment volume (7.7 mcy) dredged from the channels compared to the "A" and "B" alternatives would increase the duration of the water quality

disruption in the water column in the area immediately around the dredge. All impacts to the action alternatives are the same as the "B" alternatives.

5 NEPA/CEQA Considerations and Other Required Analyses

This chapter addresses other topics required by NEPA and CEQA in this Integrated Document. The following sections address environmental justice (NEPA, Executive Order 12898, 59 CFR 7629), provide a summary of cumulative impacts (NEPA and CEQA; details for each resource are presented in ***Chapter 4 and Appendix A***), growth-inducing impacts (CEQA), and other required analyses. The other required analyses include unavoidable adverse impacts (CEQA), irreversible and irretrievable commitments of resources (NEPA and CEQA), the relationship of short-term uses and long-term productivity (NEPA), energy resources (CEQA) and the identification of the environmentally superior alternative (CEQA).

5.1 Unavoidable Adverse Impacts/Unavoidable Significant Impacts

This EIS/EIR identified a number of potentially significant impacts. All of these impacts can be reduced to a less than significant level by application of the mitigation measures identified in this document, with the exception of potential impacts to air quality and turbidity effects to biota if the jet sled method of construction is used. The following impacts would still be considered potentially significant after application of available mitigation:

- Impact AQ-1: <u>Construction Air Emissions</u>

Although construction of the proposed Project would be scheduled so that emissions of criteria air pollutants remain below the conformity threshold, average daily emissions of NOx, ROG, and $PM_{2.5}$ would exceed the BAAQMD thresholds of significance for construction emissions. Specific measures, including use of an electric offloader at Cullinan, reducing the dredge horsepower, and limiting the horsepower of tugs used in-Bay, have already been incorporated into the proposed Project; nonetheless, BAAQMD thresholds of significance for construction emissions would be exceeded. Two other measures are currently under evaluation to determine their feasibility for the proposed Project: powering the dredge in RWC Channel using electrical power, and requiring use of Tier 3 engines for all transport tugs. Depending on the selected alternative and the specific constituent, emissions could be reduced from 13% to 56% if the additional measures are feasible.

- Impact Bio-1: <u>A substantial adverse effect through substantial population decline, 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 CDFWS or USFWS.</u>

Use of the jet sled method of construction could require between 50 and 100 months for pipeline replacement at SBS channel (depending on depth). Turbidity effects would occur primarily in SBS Channel, an area that currently experiences some disturbance from deep draft vessel traffic. Due to the long duration of the dredging activities in a localized area, effects from increased turbidity associated with jet sled would be considered significant. Use of a silt curtain or other barrier device would be infeasible due to the use of the channel by deep draft

vessels. Turbidity impacts to special status species and other fish species would be minimized though compliance with LTMS and permitting requirements and implementation of WQ-M1 (***Appendix A, Section A.15.4***); however, the residual impact would remain significant. Use of the jet sled method of construction would result in a significant and unavoidable impact from increased turbidity. After construction is complete the site would quickly be expected to return to near pre-project conditions and the impacts would be expected to be less than significant.

- Impact WQ-1: Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standard

There is little information regarding the turbidity impacts from a jet sled or pipeline jetting operation; however, total suspended solids (TSS) levels would be expected to be substantially higher in the lower water column than TSS from dredging operations. The plume would extend from the pipeline replacement site for a variable distance which would be influenced by tides and currents. The duration of the pipeline excavation would be substantially longer than the other two pipeline replacement methods. Although the TSS levels would be expected to be high during the jet sled construction period, after completion, the plume would be expected to settle quickly, particularly due to the expected higher sand content of the sediment in the SBS Channel area, and no long term turbidity effects are expected.

The dredging operations at SBS would be done in conjunction with the pipeline replacements to minimize mobilization of equipment which would extend the duration of elevated turbidity and TSS levels at the site. Dredging of the trench would add up to 3 weeks to the total dredging duration. If the clamshell or directional drilling pipeline replacement methods are used the impact would be expected to be less than significant impact with the implementation of Mitigation Measure WQ-M1 (***Appendix A, Section A.15.4***). If the jet sled pipeline excavation method is used, the impact would be expected to be significant and unavoidable due to the longer duration of high turbidity and TSS levels and the lack of feasible mitigation measure (i.e. use of a silt curtain or other barrier device).

5.2 Issues of Known Controversy

One issue of known controversy has been identified. As documented in USEPA's comment letter received during the scoping period, resource and regulatory agencies are targeting 100 percent beneficial reuse for deepening projects (the USEPA letter is provided in ***Appendix K***). USACE's policy for determining the NED Plan requires that national economic development benefits be maximized, which in turn requires use of the lowest cost placement site. For this project, the lowest cost placement option is disposal at SF-DODS. An NED Plan relying primarily on SF-DODS for dredged sediment placement would be controversial.

Should the Eden Landing or possibly Alviso ponds become available as a dredged sediment placement site by the time the proposed Project is ready to go to construction, they may be a less expensive location for dredged sediment placement than SF-DODS.

5.3 Relationship of Short-Term Uses and Maintenance/Enhancement of Long-Term Productivity

The Council on Environmental Quality (CEQ) Guidelines that implement the NEPA regulations (40 CFR 1500 et seq.) require that an EIS discuss issues related to environmental sustainability. The discussion relates to environmental consequences, including consideration of "the relationship between local short-term uses of [our] environment and the maintenance and enhancement of long-term productivity" [42 USC 4332(C)(iv)].

The proposed Project has USACE objectives and non-federal sponsor objectives. The USACE objective is to contribute to NED while remaining consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders, and other Federal planning requirements.

The non-federal sponsor's objectives are to enhance the economic and environmental sustainability at the Port of Redwood City by allowing use of the Port by more heavily-laden vessels, while ensuring protection of near-by sensitive habitats, and supporting the LTMS policies, including beneficial reuse of dredged material.

The Project would result in deepening of RWC and SBS Channels to a depth between -32 feet MLLW and -37 feet MLLW plus overdepth, and placement of the dredged sediment at one or more of five placement sites. None of the action alternatives are anticipated to generate growth in cargo throughput (***Section 5.5***).

As described in Chapter 3, deepening the channels would support the USACE's NED objective and the non-federal sponsor's economic sustainability objective by supporting economic development through an increase in transportation efficiency. All action alternatives would protect adjacent habitats through proper channel design, and most alternatives would contribute to enhancement of the environment through beneficial reuse of dredged sediment. As shown in Chapter 4, none of the action alternatives would result in long-term adverse effects on environmental sustainability. However, an environmental effects trade-off exists between the goal of minimizing turbidity at the dredge location by avoiding barge overflow, and the number of tug trips required to transport the dredged sediment to the placement sites. Eliminating barge overflow effectively reduces the sediment load of each scow by 33 percent, resulting in a 50 percent increase in the number of tug trips required to transport the dredged sediment to the placement site(s). There would be a substantial increase in fuel use, criteria air pollutant emissions, and GHG emissions if barge overflow is eliminated.

During operations, increasing transportation efficiency would reduce criteria air pollutant emissions and GHG emissions relative to the No Action/No Project condition (see Section 4.5.2) without inducing growth in cargo throughput.

5.4 Irreversible and Irretrievable Commitments of Resources

Section 15126(c) of the CEQA Guidelines requires an EIR to address any significant irreversible environmental changes and irretrievable commitment of resources that may occur as a result of implementation of the proposed Project or alternatives. Resources that are irreversibly or irretrievably committed to a project are those that are typically used on a long-term or permanent basis; however, some are considered short-term resources that cannot be recovered and are thus considered irretrievable. This includes use of nonrenewable resources (e.g., fuel, wood, or other natural or cultural resources), the commitment of future generations to similar uses, and irreversible damage, which can result from environmental accidents associated with the Project. Irreversible changes associated with all of the alternatives include the use of building materials, nonrenewable energy sources, and labor required to operate trucks, machinery, and other equipment. The unavoidable destruction of natural resources which limit the range of potential uses of that particular environment would also be considered an irreversible or irretrievable commitment of resources.

Implementation of any Project alternatives would result in both short- and long-term impacts. During dredging and placement of dredged sediment there would be an increase in air pollution emissions and noise in the immediate vicinity of the dredging and placement site(s) and there could be adversely affected special status fish and marine mammals. Noise effects and impacts to special status fish and marine mammals would be temporary and less than significant after mitigation. The air quality impacts during construction would be significant and unavoidable and would last for the duration of construction, up to 16 dredging seasons. If scow overflow is allowed, the total Project duration and tug trips would decrease by 33 percent. The transport and placement of the dredged material at one or more of the proposed placement sites would increase maritime traffic for the duration of the dredging period. Depending on the selected placement sites, there could be up to 400 scow trips per year if the existing permitted reuse sites are used, or a total of up to 4,800 scow trips during the dredging period. The SF-DODS disposal site would require the most trips. This level of additional traffic would have only minimal effects on shipping lanes in the San Francisco, San Pablo, and Suisun Bays relative to existing traffic, and any impacts would be short term. If Eden Landing or Alviso are used, there could be up to 1,000 tug trips per year, but the effect of up to 6 round trip tug trips per day would be also be less than significant, and the total number of tug trips to these placement sites would be 4,300 or less. All action alternatives could also result in the damage or destruction of unknown archeological and paleontological resources, and human remains.

The proposed Project would constitute an irreversible or irretrievable commitment of nonrenewable or depletable resources for the materials, time, money, and energy expended during activities implementing the proposed Project. Under all alternatives except the No Action/No Project Alternative, there would be irreversible and irretrievable commitments of resources. The following paragraphs summarize the irreversible and/or irretrievable impacts of the proposed Project.

- Project construction and long-term maintenance of the study area would require consumption of fossil fuels and energy. Fossil fuels (gasoline and diesel fuel) would be used to power dredging and offloading equipment, support vessels, worker and ancillary supply vehicles, and other support equipment. The energy consumed for project construction represents a permanent and nonrenewable commitment of these resources.
- All of the materials used for construction of the proposed offloading facilities would come from off-site sources. This would constitute a long-term, nonrenewable investment by the Federal and non-federal sponsors. Dredging and dredged sediment placement activities are considered a long-term nonrenewable investment of these resources.
- The capital and labor required for construction would be an irreversible and irretrievable commitment of financial resources.

These commitments of resources could have been applied to projects other than the proposed Project. No natural resources would be permanently destroyed, and acceleration of habitat restoration, if some or all of the dredged sediment is placed at a beneficial reuse site, would be considered beneficial to the region.

5.5 Growth-Inducing Impacts

CEQA requirements for evaluation of growth-inducing impacts are set forth in Section 15126.2 (d) of the CEQA Guidelines (California Code of Regulations, Title 14, Division 6, Chapter 3, Sections 15000-15387). CEQA requires that both direct and indirect impacts of all phases of a proposed project be considered. Growth-inducement is typically considered to be a direct or indirect effect of an action that either directly fosters growth or removes an obstacle to economic or population growth, or the construction of new housing. The CEQA Guidelines also require evaluation of new infrastructure and service facilities needed to serve growth induced by a project. The Guidelines note that "it must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment." Therefore, the nature of the effects of any induced growth also must be considered to determine if the impacts of that growth are potentially significant.

Some projects may be considered growth inducing while others may be growth accommodating (i.e. they are intended to accommodate planned growth, but do not induce that growth). The proposed Project would be growth accommodating. The distinction is primarily whether or not a project removes an obstacle to growth. The purpose of the proposed Project is to improve the efficiency of deep draft navigation at the Redwood City Harbor and San Bruno Shoal Channels (see ***Section 2.6***)

The proposed Project would not induce growth in cargo throughout through the Port; cargo growth is driven by regional economic growth, and would occur regardless of whether the channels are deepened. The Port's throughput capacity is determined by its land-side infrastructure. The Port has implemented Phase 1 of the Wharves 1 and 2 Reconstruction

Project, which upgraded the infrastructure at the Port to increase cargo throughput capacity. The Wharves 1 and 2 Reconstruction Project is proceeding, and Phase 2 would be implemented whether or not the channel is deepened.

Analyses of various harbors, which have included consideration of commodity forecasts, competing ports, Port capacities, and land side costs to hinterland origins and destinations proved to a reasonable degree that deepening of a particular harbor would have little to no effect on the total amount of cargo shipped through that port. Many factors affect harbor growth and competitiveness (***Section 2.2***). They include land side development and infrastructure, location of distribution centers for imports, source locations for exports, population and income growth and location, port logistics and fees, business climate and taxes, carrier preferences, labor stability or volatility, and business relationships. Harbor depth is just one of the many factors involved. Overall growth in cargo is limited by the throughput capacity of the Port, which is controlled by the land-side infrastructure. As described in ***Section 4***, the permitted maximum throughput capacity of the Port with Phase 2 of the Wharves 1 and 2 Reconstruction Project completed is 2.5 million tons of sand and aggregate, 300,000 tons of gypsum, 850,000 tons of cement, and export of up to 450,000 tons of scrap metal. There are no plans to increase the Port's throughput capacity beyond these levels, and the proposed Project would have no effect on the maximum throughput capacity at the Port.

The Project would be growth-accommodating, in that it would reduce the challenges that shippers face when using the Port. As stated in Section 1.1, Purpose and Need for Project, the purpose of the project is to provide for more efficient movement of commodities and provide for related economic benefits. In so doing, the Project would have a minor beneficial effect on regional air quality because the total number of vessel calls, delays entering the Port, and the need for lightering cargo into scows would all be reduced relative to the No Action/No Project Alternative.

5.6 Environmental Justice

5.6.1 Affected Environment

5.6.1.1 *Regulatory Setting and Study Methodology*

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, was issued on February 11, 1994. The order requires Federal agencies to identify and address disproportionately high and adverse human health and environmental effects of Federal programs, policies, and activities on minority and low-income populations. As the Federal sponsor of the proposed Project, USACE must consider how the project might affect these target populations.

Potential environmental justice populations were identified primarily using 2010 U.S. Census information. Because the Census Bureau's current population reports (Consumer Income Reports P60) do not provide detailed information about the study area, they were considered but not used for analysis.

Much of the study area, including all permitted and potential placement sites, is open, undeveloped land. The following sites that are part of the Project Area are far (1.5 miles or more) from the closest residential areas and therefore were not evaluated to determine whether the closest community would be classified as an environmental justice community:

- SBS Channel (1.5 miles or more from the closest residential area)
- The Eden Landing offloading location (2.3 miles from the closest residential area)
- Eden Landing sediment delivery location (3 miles from the closest residential area)
- Alviso offloading location (1.5 miles or more from the closest residential area)
- Alviso sediment delivery locations (both 2.9 miles from the closest residential areas to the two locations)
- Alviso intermediate booster pump location (2.9 miles from the closest residential locations)
- SF-DODS (50 miles offshore)

Both the Montezuma (Collinsville, Census Tract 2535, no block level information) and Cullinan (Vallejo, Census Tract 2517.02, Block 1101) placement sites are located in an open space area; however, there are residential areas within approximately 0.3 to 0.35 miles of both locations. For these areas, the census tract data applicable to those nearby residential areas were used as a basis for evaluation. Finally, there are two residential communities in the vicinity of RWC Channel: The houseboats at Docktown Marina, and mobile home parks along East Bayshore Road. The closest houseboat is about 0.7 miles from the southern-most dredging location; the closest mobile home is about 1.2 miles from the southernmost dredging location. These two communities are in the same Census tract (6103.02), but in separate Census blocks (1053 and 1037, respectively). The applicable Census block for the Cullinan site contains only 26 people; therefore the entire census tract was used as basis for comparison. No Census block-level data are available for Collinsville.

5.6.1.2 *Minority Populations*

According to the CEQ guidelines for environmental justice analyses (CEQ 1997):

> Minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the majority population percentage in the general population or other appropriate unit of geographic analysis. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

This study uses criterion (a) to identify minority communities. For the purpose of this study, a *minority* is a person who is Black, Asian, American Indian or Alaskan Native, or Native Hawaiian or other Pacific Islander or is of Hispanic or Latino origin. People of Hispanic or Latino origin may be of any race and of more than one race.

Table 5-1 summarizes the racial and ethnic population distribution of cities in the study area. Minority populations in the cities and counties in and around the study area range from 50.4 percent to 73.9 percent, compared to the 54.2 percent for the nine-County Bay Area as a whole, and 60.3 percent for the State as a whole. For the specific census tracts and blocks discussed above, the minority populations are as follows:

- Redwood City, Docktown Marina – Census tract 6103.02, Block 1053: 61.9 percent
- Redwood City, Mobile Home Park Area – Census tract 6103.02, Block 1037: 59.9 percent
- City of Vallejo, Lighthouse Drive Area – Census tract 2517.2, Block 1101: 57.7 percent
- Solano County, Collinsville/Rio Vista Area – Census tract 2535 (no block-level data): 30.0 percent

Table 5-1. Socioeconomic Data by Jurisdiction and Project Site, Redwood City Harbor Navigation Improvement Project

Site	Jurisdiction	Population 2013 estimates	Median household income (in 2013 dollars), 2009-2013	Persons in poverty (%)**	Bachelor's degree or higher, % of persons 25 years +, 2009-2013	White alone (%), 2013	Hispanic or Latino (%), 2013	Asian alone, (%), 2013	Black or African American alone (%), 2013	American Indian & Alaska Native alone (%), 2013	Total Minority Population (%), 2013
Redwood City Harbor Channel	Redwood City	80,872	$79,419	9.0	40.2	60.2 (2010)	38.8 (2010)	**10.7** (2010)	2.4 (2010)	0.7 (2010)	52.6 (2010)
	San Mateo County	747,373	$88,202	8.4	44.4	**63.3**	25.4	26.9	3	0.9	52.6
San Bruno Shoal	City of South S.F.	66,174	$76,785	**7.1**	29.8	37.3 (2010)	34 (2010)	**36.6** (2010)	2.6 (2010)	0.6 (2010)	73.8 (2010)
	City of Brisbane*	**4,443**	$73,630 (2012)	14.1 (2009)	48.0	46.4	25.6	23.3	**0.2**	**0.2**	52.6
Eden Landing Ecological Reserve	Alameda County	1,578,891	$72,112	13.1	41.8	52.0	22.7	28.2	12.4	1.2	64.5
	City of Hayward	151,574	$62,013	14.4	**24.2**	18.6 (2010)	**40.7** (2010)	21.6 (2010)	11.3 (2010)	0.3 (2010)	73.9 (2010)
Montezuma	Solano County	424,788	$67,177	14.2	24.3	60.7	25.2	15.4	**14.9**	1.3	52.6
Cullinan Ranch	Vallejo	118,837	**$53,046**	**17.5**	23.3	**32.8**	22.6	24.9	22.1	0.7	70.3
Alviso Pond Complex	Santa Clara County	**1,862,041**	$91,702	10.8	46.5	57.2	26.8	34.1	2.9	**1.4**	65.2
	City of Mountain View	77,846	**$97,338**	8.1	**62.6**	56 (2010)	**21.7** (2010)	26 (2010)	2.2 (2010)	0.5 (2010)	50.4 (2010)
	City of San Jose	998,537	$81,829	12.2	37.4	42.8 (2010)	33.2 (2010)	32 (2010)	3.2 (2010)	0.9 (2010)	69.3 (2010)
Compare With:	San Francisco	7,150,739 (2010)	$75,989 (2006-2010)	9.7 (2006-	41.5 (2006-2010)	52.5 (2010)	23.5 (2010)	23.3 (2010)	6.7 (2010)	0.7 (2010)	54.3 (2010)

Site	Jurisdiction	Population 2013 estimates	Median household income (in 2013 dollars), 2009-2013	Persons in poverty (%)**	Bachelor's degree or higher, % of persons 25 years +, 2009-2013	White alone (%), 2013	Hispanic or Latino (%), 2013	Asian alone, (%), 2013	Black or African American alone (%), 2013	American Indian & Alaska Native alone (%), 2013	Total Minority Population (%), 2013
	Bay Area***			2010)							
	State of California	38,802,500 (2014)	$61,094	16.8	30.7	73.5	38.4	14.1	6.6	1.7	60.8
	United States	316,128,839 (2014)	$53,046	14.5	28.8	77.7	17.1	5.3	13.2	1.2	36.8

All data is sourced from the United States Census Bureau, unless otherwise noted. Statistics of note (e.g., maxima or minima) are **bolded.**

*Brisbane is a small city, less than 5,000 people, and was not addressed separately in the national census. Census data for Brisbane is taken from city-data.com.

**No date was provided for this item, but data are likely from 2009-2013.

***San Francisco Bay Area data are taken from Bay Area Census (2010) and aggregates data from the following nine Counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

5.6.1.3 *Low Income Population*

To identify low-income populations, the CEQ's environmental justice guidance states the following (CEQ 1997):

> *Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.*

However, the Census Bureau's current P-60 population report provides only general information about income trends nationwide and does not provide detailed information about the study area (US Census Bureau 2014). Because of this, the 2010 Census data are used to obtain more detailed information on income and poverty in the Census tracts listed above.

For the purpose of this study, a low-income population is persons who have a median income below the poverty thresholds defined by the U.S. Department of Health and Human Services. To identify low-income populations in the study area, this study identifies areas having a substantially higher percentage of people and households in poverty than:

1) For cities: the counties in which they are located
2) For counties: the nine-county Bay Area average

Table 5-1 summarized the median income and poverty status of people living in cities and counties in the study area. Table 5.1 showed that, in general, people living in the Bay Area have a much higher median income than the residents of California as whole, and with the exception of Vallejo, all cities in the study area have higher incomes than the State average. To some degree, the higher incomes associated with each city reflect a higher cost of living in the Bay Area and are more meaningful when compared to the county incomes (and to each other) rather than to the State statistic. Poverty levels at the three locations of interest and the comparable rates at the city or county level are provided below.

- Redwood City, Docktown Marina and Mobil Home Park Area – Census tract 6103.02: 10.7 percent poverty rate; Redwood City Poverty Rate: 9.0 percent
- City of Vallejo, Lighthouse Drive Area – Census tract 2517.2: 45.1 percent poverty rate; City of Vallejo Poverty Rate: 17.5 percent
- Solano County, Collinsville/Rio Vista Area – Census tract 2535: 10.5 percent poverty rate; Solano County poverty rate: 14.2 percent

5.6.1.4 *Summary*

In summary, the 2010 Census information shows that the population of Redwood City near the Port of Redwood City and the City of Vallejo near the Cullinan Ranch site support a minority population. The census data also indicate that the same areas are lower income, although given the error range for the estimate of persons living in poverty, it is uncertain whether the poverty rate for the Redwood City tract is actually lower than that of Redwood City as a whole. The community of Collinsville meets neither the minority percentage nor the income disparity criteria for an environmental justice community. The discussion of potential effects on environmental justice populations assumes that Redwood City near the Port and Vallejo near the Cullinan site represent environmental justice populations in the study area.

5.6.2 Potential Effects on Environmental Justice Populations

5.6.2.1 *Methodology for Determining Effects*

Pursuant to Executive Order 12898, this section considers whether the project alternatives would:

- Cause disproportionately high adverse effects (such as noise, air quality, and access effects) on the identified population(s) during construction
- Cause disproportionately high adverse effects on the identified population(s) during operation and maintenance of the deepened channels

As defined in the 1997 CEQ guidance, the factors below are used to measure environmental justice effects.

5.6.2.1.1 Human Health Effects

For human health effects, agencies are to consider the following factors to the extent practicable:

- Whether the health effects, which may be measured in risks and rates, are significant (as the term is used by the NEPA), or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death;
- Whether the risk or rate of hazard exposure by a minority population, low-income population, or Indian tribe to an environmental hazard is significant (as the term is used by the NEPA) and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group; and
- Whether health effects occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

5.6.2.1.2 Environmental Effects

For environmental effects, agencies are to consider the following:

- Whether there is or will be an impact on the natural or physical environment that significantly (as the term is used by the NEPA) and adversely affects a minority population, low-income population, or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-

income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment;

- Whether environmental effects are significant (as the term is used by the NEPA) and are or may be having an adverse impact on minority populations, low-income populations, or Indian tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and
- Whether the environmental effects occur or would occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

The communities identified as environmental justice communities in the vicinity of the Port and the Cullinan project are located adjacent to major highways (Highway 101 and Highway 37, respectively). The Docktown Marina area is also located in the immediate vicinity of an industrial area that is located south of the dredging area and north of Highway 101. This analysis does not evaluate how the existing land uses have affected the community in the past. The following discussion focuses on how the RWC Project might affect these environmental justice communities.

5.6.2.2 *Evaluation of Project Components*

In general, the proposed Project is expected to have a negligible effect on regional economic conditions; cargo growth at the Port would be driven by local economic conditions. The Project may have a slight indirect regional effect on the construction industry through reduced cost of materials, which in turn could result in slight increases in construction employment. These minor positive effects would apply to all populations in the study area. The following paragraphs examine the potential environmental justice population effects associated with deepening RWC Channel, and delivering sediment to the Cullinan placement site. As discussed above, the remaining Project areas are sufficiently far from residential areas that no effects to residents would be expected.

5.6.2.2.1 Redwood City Harbor

Activities at this location would consist of dredging to deepen the channel and berths. While the maximum dredging duration for the entire RWC Channel could last up to approximately 48 months over eight dredging seasons, the dredge would be moving at a minimum estimated rate of 15 feet per day, so that after one dredging season the dredge would be a minimum of 1.2 miles from the closest residential area.

There would be no access or transportation effects on the nearby community as all deliveries would occur by water, and dredging crews would be small (estimated at 16 to 18 workers). Dredging activities could result in noise effects and air emissions. Due to the distance between the closest residential areas and the dredging area, noise effects were determined to be less than significant.

5.6.2.2.2 Cullinan Placement Site

Activities at this site would include construction of the offloader and sediment transfer pipeline, and offloading operations. Construction of the offloading facilities would require several months, and would require 1 to 2 days of pile driving. All work related to the offloading facilities would be north of Highway 37. Once the facilities are constructed, two to three scows per day would call at the offloader; offloading would be expected to take several hours per scow, during which time the tug would be idling. Offloading activities could occur for a total of up to 26 months over four to five dredging seasons. There would be no access or transportation effects on the nearby community as all deliveries would occur by water. Construction of the offloading facilities and use of the offloader could result in noise effects and air emissions. With the possible exception of the one to two days of pile driving, noise associated with delivering scows and pumping the dredged sediment would not be audible over the background noise from Highway 37.

5.7 Energy Resources

Per Public Resources Code Section 21100(b)(3), in order to ensure that energy implications are considered in project decisions, CEQA requires that an EIR include a discussion of the potential energy impacts of the proposed project, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy. Potentially significant energy implications of a project are to be considered in the EIR to the extent relevant and applicable to the project.

Appendix F of the State CEQA Guidelines outlines issues related to energy conservation and includes potential project description considerations, types of impacts applicable to energy use, and potential mitigation measures to reduce wasteful, inefficient, and unnecessary consumption of energy. Energy conservation is defined as wise and efficient use of energy that may be achieved by:

(1) decreasing overall per capita energy consumption,

(2) decreasing reliance on fossil fuels such as coal, natural gas and oil, and

(3) increasing reliance on renewable energy sources.

Energy used during project construction, operation, and maintenance would be expended in the form of electricity, gasoline, and diesel fuel, which would be used primarily by dredges, offloaders, booster pumps, and other construction equipment (i.e., for the pipeline relocation).

Appendix F of the CEQA Guidelines encourages reductions in energy expended in transportation. For the purposes of the proposed Project, transport of dredged sediment to placement sites in San Francisco Bay would be accomplished with lower horsepower tugs than transport to SF-DODS, and these sites would also be closer to the dredging locations. However, the in-Bay dredging sites would require either an offloader or direct pumping to the dredged

sediment location through a hydraulic cutterhead. Offloading facilities would not be required at SF-DODS. As discussed in ***Section 4.5.3.1.2***, total construction emissions are directly related to the volume dredged and transport distance. Alternatives involving Dredging Option A (to -32 feet MLLW) result in reduced air emissions compared to the other alternatives because less dredging would occur, and reducing the transport distance would reduce transport-related fuel consumption. Alternative A-1, which would use Cullinan as the placement site, would have the lowest fuel consumption of the action alternatives.

In addition to the selection of the placement site, there are several factors related to the construction process that have a substantial effect on the energy consumed to construct the Project. As discussed in ***Section 5.3***, if barge overflow is not allowed, there would be a substantial reduction in the net volume of sediment that would be transported by each scow. The total number of tug trips as well as the project duration would increase by 50 percent due to 33 percent reduction in effective scow capacity. Therefore, there would be an approximately 50 percent increase in fuel use and transport-related air emissions, as well as a substantial increase in dredging-related air emissions as some equipment on the dredge would be in continuous operation, even if the dredge is idle. A further important construction decision pertains to the size of the scows used. The current air emission estimate assumes that 4,000 cy scows would be used. If 5,000 cy scows are used, the volume of dredged sediment that could be hauled during each trip would increase by 25 percent, and the number of tug trips required would decrease by 20 percent.[17] This would also be expected to reduce the overall Project duration and associated dredge stand-by fuel use and other miscellaneous fuel use.

The energy intensiveness of the proposed Project could be reduced if the dredge and/or offloaders and booster pumps are electrically-powered and a portion or all of the electrical power used is from renewable sources. Currently, power provided by Pacific Gas and Electric (PG&E) contains an estimated 33 percent renewables content. In some locations, power can be purchased from other providers that provide up to 100 percent renewables content. The evaluation of energy conservation benefits of using electrically-powered equipment must consider ancillary energy costs (such as setting power poles and stringing line, and transmission losses), and compare these to the complete energy cost of fueling the construction equipment with conventional fuel (diesel). The latter energy costs would include the energy associated with delivering the fuel and transferring it to the equipment, any equipment and staff required for fueling operations, and stand-by time during fueling activities.

If the Eden Landing and/or Alviso placement sites become available in time for construction of the Project, and are chosen as the reuse sites, a more substantial portion of the dredging and

[17] This reduction may be partially offset by the use of larger horsepower tugs, if larger tugs are needed to haul the larger barges, or by a greater operating factor (harder working engine) on the same size tug. Nonetheless some reductions in fuel use and corresponding air emissions would be anticipated.

placement activities could be accomplished using electrical power because all sediment from RWC channel could be dredged and placed using a hydraulic cutterhead powered by electricity.

While the primary energy consumption during construction results from dredging, transport, and offloading of sediment and passenger vehicle use would be minimal, workers would nonetheless be encouraged to carpool or seek alternative forms of transportation. Following construction, the project would have a beneficial effect on energy resources as a result of transportation efficiencies. A deeper channel would allow vessels to enter with a deeper draft, thereby reducing the number of vessel and barge calls associated with a given volume of commodities. Depending on the amount of deepening conducted, total vessel calls from sand and aggregate deliveries could be reduced by between 7 percent and 24 percent relative to the No Action/No Project Alternative.

5.8 Cumulative Impacts

Cumulative impacts include the direct and indirect impacts of a project together with the impacts of all other anticipated past, present, and reasonably foreseeable future actions in the area, including those proposed or implemented by others. The analysis of cumulative impacts concentrates on whether the Project impacts would be cumulatively considerable.

5.8.1 Assessment Methodology and Thresholds

The cumulative impacts assessment reviews the effects of recent past, present, and reasonably foreseeable future actions along with the direct and indirect effects of the RWC Harbor Deepening Project. ***Table 5-2*** shows the potential cumulative projects. Cumulative impacts are discussed for those resources that could be affected by the project, even if such impacts are less than significant. The geographic area for the evaluation of cumulative effects varies by resource. For most resources, evaluation on a study area basis is appropriate; however, for certain resources, the natural environment provides a more appropriate analysis context. For example, air quality is addressed on an air basin basis.

The timeframe considered for the cumulative impacts analyses is 2014 through 2025. The timeframe selected allows for analysis considering the best available information regarding reasonably foreseeable cumulative effects to regional resources that may be affected by the Project. To consider the time period after about 2025 would be speculative given historical variability in cargo volumes.

It is also not necessary to consider the period before 2014. Both RWC and SBS Channels have been maintained at their current depths since 1962. Maintenance dredging at SBS Channel is infrequent (occurring typically every 10 years) and generates relatively low quantities of material (3,000 cy per year, or 30,000 cy per episode); maintenance dredging in RWC Channel was initiated in 2014, and is scheduled to be completed in 2015. Two of the placement sites, SF-DODS and Montezuma, have been in active use for more than 10 years and are expected to continue to be in active use for many more years. The Cullinan site was used in 2014 for a small quantity of dredged material placement (100,000 cy) using a different offloading process at the

proposed sediment delivery location; the offloader and pipeline that would be used for this Project have not been constructed. While Phase I activities for the SBSP Restoration Project are underway or completed, Phase II activities, which could include placement of dredged sediment at the Eden Landing and Alviso ponds as described in this document, are currently in the planning stage.

Table 5-2. Cumulative Impacts – Current and Reasonably Foreseeable Future Projects

Project Number	Project Name/ Location	Status/ Anticipated	Project Summary	Cumulative Resources	Source
1	Federal Maintenance Dredging in San Francisco Bay	Ongoing	The USACE conducts maintenance dredging at 11 locations in San Francisco Bay and its environs (Napa River Channel, Oakland Harbor, Petaluma River Channel, Redwood City Harbor, Richmond Harbor, San Francisco Harbor, San Leandro Marina, San Pablo Bay/Mare Island Strait, San Rafael Creek, Suisun Bay Channel, and Suisun Slough Channel). Maintenance dredging is expected to occur at all or portions of these locations during the project planning period. Up to 1.4 mcy are dredged annually during the maintenance dredging window extending from June 1 through November 30 of each year. Maintenance dredging sediment is typically disposed of at a combination of locations including SF-8, SF-9, SF-10, SF-11, SF-16, SF-17, SF-DODS, and other sites (including beneficial reuse sites) that are permitted and may be economically viable. SF-9, SF1-0, SF-11, and SF-16 are in-Bay placement sites; SF-DODS, SF-8, and SF-17 are ocean placement sites.	All resources except cultural resources	
2	Nonfederal Maintenance Dredging in San Francisco Bay	Ongoing	More than 100 marinas, ports, and berthing slips are maintenance dredged in the San Francisco Bay/Estuary. Most of the nonfederal maintenance projects are along the shorelines and in the tributaries of the Estuary.	All resources except cultural resources	
3	San Francisco Bay and Delta Sand Mining Project	10-year leases to continue mining sand (until 2022)	The California State Lands Commission action is a 10-year General Lease through December 31, 2022. Hanson Marine Operations proposed new 10-year mineral extraction leases to enable the continuation of dredge mining of construction-grade sand from certain delineated areas of Central San Francisco Bay, Suisun Bay, and the western Sacramento-San Joaquin River Delta area.	All	CSLC 2012, CEQAnet 2013, C. Boudreau pers. comm. 2015

Project Number	Project Name/ Location	Status/ Anticipated	Project Summary	Cumulative Resources	Source
4	South San Francisco Shoreline Study	Planning phase; construction could begin in 2017	Congressionally authorized study by USACE together with the Santa Clara Valley Water District and the CSCC to identify and recommend flood risk management and ecosystem restoration projects along South San Francisco Bay for federal funding.	Air Quality, Biology, Cultural Resources, Hazards/Hazardous Materials, Noise, Recreation, Transportation and Navigation, Water Quality and Hydrology	USACE 2013
5	South Bay Salt Pond Restoration, Phase II	Planning Phase	The CSCC, the California Department of Fish and Wildlife, and the United States Fish and Wildlife Service are the project sponsors for this tidal wetland restoration project that, when complete, will restore approximately 15,000 acres of industrial salt ponds to tidal wetlands, mudflats, and other wetland habitats.	Air Quality, Biology, Hazards/Hazardous Materials, Noise, Recreation, Transportation and Navigation, Water Quality and Hydrology	CSCC 2015
6	San Francisco Bay to Port of Stockton John F. Baldwin Ship Channel Phase III Navigation Improvement Project	Planning phase of first segment of John F. Baldwin Ship Channel	The San Francisco Bay to Stockton project is divided into two components, the Western Reach and the Eastern Reach, now entitled Project I and Project II. The dividing boundary of the two reaches is located at Avon (just east of the Carquinez Bridge). The Western Reach (also known as the John F. Baldwin Ship Channel) includes the West Richmond Channel, Pinole Shoal Channel, and the Bulls Head Reach portion of the Suisun Bay Channel. The Eastern Reach includes the remaining portions of the Suisun Bay Channel (i.e., Suisun Bay Channel east of Avon and New York Slough) and Stockton Deepwater Ship Channel. The proposed deepening of Project I is currently being evaluated while the Eastern Reach, Project II, is on hold pending completion of the Project I Director's GRR Report.	All	

Project Number	Project Name/ Location	Status/ Anticipated	Project Summary	Cumulative Resources	Source
7	Suisun Marsh Restoration Plan	Planning phase	The United States Department of the Interior is the project sponsor for tidal restoration targets of 5,000 to 7,000 acres and 44,000 to 46,000 acres of managed wetlands during the 30-year implementation period.	Air Quality, Biology, Hazards and Hazardous Materials, Noise, Recreation, Transportation and Navigation, Water Quality and Hydrology	U.S. Department of the Interior, USFWS, and CDFW, 2011
8	WETA Central Bay Operations and Maintenance Facility Project	Construction activities as early as 2016	The Central Bay Operations and Maintenance Facility project is being developed by WETA to provide a central San Francisco Bay base for WETA's ferry fleet. The project site is near Pier 3 of Alameda Point. The facility will also include a system of floating docks and gangways that would provide daytime and overnight berthing capacity for up to 11 vessels. CEQA review has been completed and permitting is in progress.	All	WETA 2015
9	Oyster Shell Mining, South San Francisco Bay	On-going, permits through 2017; beginning renewal process	A private entity holds a State Lands Commission permit to mine oyster shells in the eastern portion South Francisco Bay just north of the San Mateo Bridge. Mining operations are based on demand and typically mine on average 6,000 cy of shell per month for a yearly average of approximately 70,000 cy. Mining occurs only when demand exists.	All	C. Boudreau personal communication 2015
10	Coast Guard Island Berth Deepening	Design phase; construction planned for 2016	Deepen existing berths at Coast Guard Island (Alameda) to allow vessels with deeper draft to use the berths.	All	

Note: No planned or recent fuel pipeline relocation projects in the Bay were identified.

5.8.2 Summary of All Cumulative Impacts for Each Resource

This section summarizes the potential cumulative effects of the action alternatives.

5.8.2.1 *Air Quality and Greenhouse Gases*

The cumulative air quality impacts include a net increase of any criteria pollutant for which the Project region is in nonattainment under an applicable Federal or state ambient air quality standard. Based on BAAQMD guidance, if a Project exceeds the identified significance thresholds, its emissions are cumulatively considerable, resulting in significant adverse air quality impacts to the region's existing air quality conditions.

The reasonably foreseeable actions in ***Table 5-2*** include activities that would produce construction and/or operational emissions that could overlap with dredging activities and contribute to cumulative air quality impacts in the study area. Under any of the alternatives, emissions from dredging, transport, and placement activities would cause emission increases above the BAAQMD significance thresholds, and the proposed Project's contribution to cumulative air impacts would be cumulatively significant.

5.8.2.2 *Biological Resources*

Cumulative effects to biological resources would only occur if another project were located in close proximity to the RWC Project because the effects from the RWC Project to biological resources are localized. Cumulative effects to biological resources from turbidity, entrainment, habitat disturbance, habitat modification, noise, interference with the movement of marine mammals and fish, and suspension of contaminated sediment have the potential to occur if dredging at RWC Channel were to occur at the same time as the nonfederal maintenance dredging at the marina adjacent to the Port of Redwood City. Existing water quality regulations and the required permits would ensure that the cumulative impact on water quality from the Project in combination with marina maintenance dredging would remain less than significant. The additional impacts from maintenance dredging at the marinas is expected to be small and in conjunction with this Project impacts would not rise to the standard of being cumulatively significant.

Cumulative effects to biological resources from turbidity, entrainment, habitat disturbance, habitat modification, noise, interference with the movement of marine mammals and fish, and suspension of contaminated sediment have the potential to occur at SBS Channel if dredging and pipeline replacement were to occur at the same time as a nearby project. Pile driving could have an impact to wildlife species due to underwater noise. Due to the short duration of pile driving activities associated with SBS pipeline replacement, the distance from other projects in ***Table 5-2,*** and unlikely concurrent construction schedule, a cumulative biological noise impact is not expected***.*** The use of the jet sled method to trench for the pipeline replacement has the potential to be a significant and unavoidable impact. The impacts from these effects including turbidity from the jet sled are localized and there are no current or future projects within 0.25

miles of SBS Channel; therefore the Project impacts would be would not rise to the standard of being cumulatively significant.

Cumulative impacts at the placement sites would be specific to the time and location of the Project activities. No cumulative impacts are expected at SF-DODS, Cullinan and Montezuma. Oyster shell mining in South San Francisco Bay would have the potential to create a cumulative impact, if it were located in close proximity to the Eden Landing or Alviso offloader during the construction period and if the mining operations are continuous. However oyster shell mining operations occur only when demand exists, and are therefore episodic. Construction of the offloader would occur more than 3 miles from the areas designated for oyster shell mining, and would comply with all permits and regulations. The impacts associated with construction of the offloader and sediment transfer pipeline would be temporary and therefore there would not be a significant cumulative impact.

The South San Francisco Shoreline Study itself would not result in a cumulative impact. If it were determined that construction of the levees both at Eden Landing and Alviso were required for flood protection, that work could have a cumulative effect if it occurred at the same time as construction of the sediment transfer pipeline and in the vicinity of the pipeline location. However, it is highly unlikely that the levee work would occur in the same location and at the same time as the sediment delivery process, because the sediment delivery process would block a portion of the levee and would interfere with the levee construction. It is much more likely that either the sediment delivery or levee work would be completed first. Furthermore, the impact from the installation of the pipeline on the levee would be minor, short term, and temporary in comparison to reconstructing the levee for flood control. Therefore there would not be a significant cumulative impact. The cumulative impacts to biological resources from pile driving are described in the Noise analysis in ***Section 5.8.2.7***.

5.8.2.3 *Cultural Resources*

The proposed Project or alternatives would not result in any individual effects to historical resources and would, therefore, not contribute to cumulative impacts to historical resources. Dredging and pipeline placement could result in the inadvertent discovery of buried archaeological resources, submerged shipwrecks or other objects of historical significance, human remains, and paleontological resources. With implementation of mitigation as described in ***Appendix A***, the impact would be less than significant and would not result in a cumulatively significant effect on archaeological resources, submerged shipwrecks or other objects of historical significance, human remains, and paleontological resources.

5.8.2.4 *Geology Soils, and Seismicity*

No cumulative impacts are expected. Impacts associated with this resource area would be specific to the time and location of the Project activities, and none of the cumulative projects would occur at the same in the same footprint as the Project at the same time as the Project,

or, in the case of the Eden Landing and Alviso placement sites, would occur before or after Project activities have been completed.

5.8.2.5 *Hazards and Hazardous Materials*

The impacts from navigation hazards, potential spills, and/or use or management of hazardous materials at any specific site would be small, and potential impacts from the Project would not rise to the standard of being cumulatively significant. Existing laws, regulations, and programs pertaining to navigation, contaminated sediment, and use and management of hazardous substances would ensure that the cumulative impact on hazards and hazardous materials from the Project in combination with future dredging and placement of dredged sediment would remain less than significant.

5.8.2.6 *Land Use*

There would be no cumulative impact to Land Use. Land use at the dredging sites and placement sites would remain consistent with applicable plans and policies, and this would also be true of the reasonably foreseeable cumulative projects listed in ***Table 5-2***.

5.8.2.7 *Noise*

Cumulative impacts to noise could occur if several noise generating activities would have the potential to affect the same noise sensitive receptors. This would most commonly occur if activities are occurring in the same or nearby locations at the same time. All projects listed in ***Table 5-2*** would either occur at a different location or at a different time than the proposed Project. Therefore there would be no cumulative effects to land-based sensitive receptors. The Project's contribution to cumulative noise impacts would be less than significant.

5.8.2.8 *Recreation*

Cumulative impacts to recreation could occur if several projects were to be undertaken in the same area or would have the potential to affect the same recreational use over an extended area. This would occur if the project activities are occurring in the same or nearby locations at the same time. The projects listed in ***Table 5-2*** are either far away from the activities associated with the RWC Project, or would primarily occur before or after RWC Project activities. There would be no cumulative effects to recreation in and near RWC and SBS Channels. Although maintenance dredging of the RWC Channel could occur during the channel deepening if the channel deepening activities occur over more than 2 or 3 dredging seasons. The presence of an additional dredge in the channel area would not result in a cumulatively significant effect on recreation because ample space for boating would remain. Other projects in ***Table 5-2*** could cause localized effects on recreational boating; however, due to the large area available for recreational boating in San Francisco Bay, the contribution of the Project to effects on recreational boating would not be cumulatively significant.

5.8.2.9 *Socioeconomics*

There would be no cumulative impact to socioeconomics, population, and housing. While all projects listed in ***Table 5-2*** would provide for a minor increase in jobs, the effects of the

proposed Project to housing needs or other effects driven by increases in population growth in combination with all other reasonably foreseeable cumulative projects would remain less than significant. Socioeconomic benefits would be geographically distributed, and would not economically disadvantage any community.

5.8.2.10 *Transportation and Navigation*

During construction, the proposed Project could result in localized, less than significant impacts to navigation due to the presence of the dredging, construction, and offloading facilities. Following construction, the proposed Project would initially contribute to a small reduction in the number of vessel calls at the Port of Redwood City relative to the 2014 baseline, and a sustained reduction in the number of vessel calls relative to the No Action/No Project Alternative. This would be a benefit of the Project. By 2025, when cargo tonnage moving through the Port is expected to reach 2.5 million tons, deep draft vessel traffic could increase as much as 45 percent relative to the 2014, which would represent an increase of less than 1 deep draft vessel call per week. The need for lightering would be reduced relative to the No Action/No Project Alternative.

Cumulative effects could occur if construction equipment or vessel traffic could significantly increase the potential for navigation delays or incidents. Maintenance dredging in RWC Channel may be required if the dredging duration extends more than 2 to 3 years. Channel deepening and channel maintenance activities would be coordinated to minimize effects on Port operations. The other projects listed in ***Table 5-2*** are either located in areas that are far from the Project Area, or would occur before or after Project-related construction activities. There would be no cumulative effect to navigation.

Cumulative effects to land-based traffic during construction could occur if the projects in ***Table 5-2*** in combination with Project-related traffic would contribute to an adverse effect on freeway volume or capacity, or if the projects in ***Table 5-2*** would contribute traffic to the same intersections as the RWC Project. There would be no overlapping construction activities from the projects in ***Table 5-2*** affecting the same intersections as the RWC construction activities with the possible exception of maintenance dredging occurring during channel deepening. However, RWC Project's potential construction-related traffic is limited to a small number of worker vehicle trips, and the same would be true for maintenance dredging activities. Similarly, effects on local freeway would be minimal because the various projects in ***Table 5-2*** would either occur in a location affecting other portions of the Bay Area road network, or, in the case of maintenance dredging in RWC Channel, would occur before or after the Project construction activities. The Project would not contribute cargo growth (i.e., truck trips) during operation of the Project; cargo growth is driven by regional economic conditions and Port land-side infrastructure; the environmental documentation for the Port's most recent infrastructure improvements addressed traffic effects associated with improvements to Wharves 1 and 2, and provided mitigation for these resulting increases in truck trips (Port of Redwood City 2010). The

Project's effect on transportation would generate only a very small number of daily vehicle trips.

5.8.2.11 *Utilities and Service Systems*

The impacts on utilities and service systems associated with any specific Project would be small, and potential impacts from the Project would not rise to the standard of being cumulatively significant. The need for any increased utility service would be geographically distributed, and would not cause a large effect in any specific location. The cumulative impact on utilities and service systems from the Project in combination with the projects listed in ***Table 5-2*** would be less than significant.

5.8.2.12 *Water Quality and Hydrology*

Cumulative effects to water quality and hydrology would only occur if another project were located in close proximity to the RWC Project because the water quality effects from the RWC Project are localized. There are no impacts to hydrology from the Project. Cumulative effects to water quality from turbidity or suspension of contaminated sediment would occur if dredging at RWC Channel were to occur at the same time as the federal channel maintenance dredging in RWC Channel or non-federal maintenance dredging at the marina adjacent to the Port of Redwood City. The additional impacts from maintenance dredging at the marinas would be expected to be small and in conjunction with this Project impacts would be would not rise to the standard of being cumulatively significant. Channel maintenance dredging could occur in areas away from the channel deepening activities (more than 0.25 miles from the deepening area).

Cumulative effects could potentially occur due to jet sled construction suspension of contaminated sediment at SBS Channel, if dredging and pipeline replacement were to occur at the same time as a nearby project. The use of the jet sled to trench for the pipeline replacement has the potential to be a significant and unavoidable impact. The impacts from these effects including turbidity from the jet sled are localized and there are no current or future projects within 0.25 miles of SBS channel; therefore the Project impacts would be would not rise to the standard of being cumulatively significant.

No cumulative impacts to water quality at any of the placements sites are expected. Impacts at the placement sites would be specific to the time and location of the Project activities. Existing water quality regulations and the required permits would ensure that the cumulative impact on water quality from the Project in combination with marina maintenance dredging would remain less than significant.

5.8.3 Contextual Relationship between Alternatives and Cumulative Impacts

The potential extent of cumulative impacts is primarily affected by the dredging option selected. Increased deepening would require substantially greater dredging, which in turn would extend the construction duration by a corresponding amount. Greater deepening may also require a longer construction duration for the relocation of the fuel pipelines because the

pipelines would have to be relocated to a deeper depth (there would be little or no effect if directional drilling or clamshell trenching are the selected construction method). Both of these factors would result in greater impacts during construction.

For most resources, changes in duration of construction activities would not alter the level of impacts to that resource. For these resources, a change in construction duration and the resulting environmental effects would not lead to a change in the Project's contribution to cumulative effects. For resources with cumulatively significant effects (including air quality/greenhouse gases and cultural resources) alternatives requiring less dredging and placement would not reduce the potential impacts to a less than significant level, and the Project's effects on these resources would remain cumulatively significant.

Following construction, increased deepening would increase transportation efficiency by allowing more heavily loaded vessels to enter RWC Harbor. This in turn would reduce air emissions associated with cargo movement relative to the No Action/No Project Alternative, and is considered a beneficial effect of the proposed Project. The deeper the channels, the greater the increase in cargo per vessel, and the corresponding reduction in air emissions. In addition, providing dredged sediment is delivered to a beneficial reuse placement site, increased dredging would result in greater benefits to these sites by increasing the volume of sediment available to raise site elevations and accelerate habitat formation in advance of substantial sea level rise.

5.9 Environmentally Superior/Environmentally Preferable Alternative

NEPA requires that the ROD identify an environmentally preferable or alternative or alternatives. According to the CEQ, the environmentally preferable alternative is the alternative that

> …will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources.

The Council recognizes that the identification of the environmentally preferable alternative may involve difficult judgments, particularly when one environmental value must be balanced against another. The public and other agencies reviewing a Draft EIS can assist the lead agency in developing and determining environmentally preferable alternatives by providing their views in comments on the Draft EIS. Through the identification of the environmentally preferable alternative, the decision maker is clearly faced with a choice between that alternative and others, and must consider whether the decision accords with the Congressionally-declared policies of the Act.

CEQA requires identification of the environmentally superior alternative. CEQA Guidelines (Section 15126.6(a) and (e)(2)) require that an EIR's analysis of alternatives identify the

"environmentally superior alternative" among all of those considered. If the No Project Alternative is identified as environmentally superior, then the EIR also must identify the environmentally superior alternative among the project alternatives. CEQA's goal in identifying the environmentally superior alternative is to assist decision makers in the Project approval process. CEQA does not require an agency to select the environmentally superior alternative, nor to consider the feasibility of environmentally superior project alternative identified in the EIR, if mitigation measures included in the EIR would reduce environmental impacts of the approved project to less than significant levels (*Laurel Heights Improvement Association of San Francisco v. Regents of the University of California*, 47 Cal.3d 376, 400-3 (1988*); Laurel Hills Homeowners Association v. City Council* 83 Cal. App. 3d 515 (1978), CEQA Guidelines Sections 15042–15043). All applicable mitigation measures must be incorporated into the Project.

For the purposes of this Project, the environmentally superior/preferable alternative is the No Action/No Project Alternative. The No Action/No Project Alternative would not result in any impacts during construction, and would avoid the significant and unavoidable air quality impacts associated with dredging and placement of dredged material. It would result in somewhat higher air and greenhouse gas emissions during operations, as vessels continue to experience delays entering the Harbor, the vessel fleet calling at the Port continues to contain more smaller vessels, and more lightering would be needed (relative to Project alternatives) to bring the required volume of cargo into the Port.

The environmentally superior/environmentally preferable alternative Project alternative is Alternative A-1, which consists of deepening RWC and SBS Channels to -32 feet MLLW and reusing the dredged sediment at Cullinan Ranch. While this alternative has construction air emissions which are avoided by the No Action/No Project Alternative, Alternative A-1 would reduce air emissions following construction by allowing more heavily loaded vessels to enter the Port. In addition, the sediment dredged from deepening the channels would be reused beneficially to accelerate tidal marsh habitat formation at Cullinan. Relative to the No Action/No Project Alternative, post-construction Alternative A-1 would result in an 11% percent reduction in vessel calls. Accelerating tidal marsh formation in advance of sea level rise, particularly within the next 15 years, is a key goal of the Bay Area regulatory and resource agencies, and environmental community.

To further minimize potential impacts from Project construction, the jet sled method of pipeline relocation should be avoided. Either directional drilling or clamshell excavation would prevent significant and unavoidable impacts to biological resources and water quality, and are the environmentally-preferred construction process for pipeline relocation.

If either the Eden Landing or the Alviso placement sites are permitted by the time the proposed Project is ready to be constructed, it is anticipated that use of either of these sites would be considered environmentally preferable/superior to using Cullinan. Although there is currently insufficient information to quantify transportation emissions from these locations, the

transportation distance between the dredging locations and these placement sites is much shorter than to the Cullinan site. Because Eden Landing is approximately 4 miles closer to RWC Channel, and ten miles closer to SBS Channel than Alviso, it would likely be the preferred placement location. Either of these two South Bay placement sites would also provide the benefit of accelerating habitat restoration. Other potential environmental impacts, including biological resources and cultural resources impacts would be similar to Alternative A-1.

6 Identification of the Tentatively Selected Plan

6.1 Final Array of Alternative Plans

Seventeen preliminary action alternatives and the No-Action alternative were developed as documented in ***Chapter 3***, and summarized in ***Table 3-5***. The next steps in the study were to further refine the selection of the retained placement sites for the dredged materials and to identify the optimum channel depth. It was decided at this time that the alternatives array could be further reduced due to limited information and the uncertainties associated with the availability of the two sites that are still under study, Eden Landing and Alviso Pond Complex.

6.1.1 Final Evaluation of Placement Sites

A more rigorous and detailed analysis of the viability of the retained placement sites was conducted. The results of the analyses are detailed in ***Chapters 4 and 5***. The proposed beneficial reuse sites at the SBSP Restoration Project had uncertain time frames for when they would be permitted and available for use. Also, critical details were not available for development of cost estimates and identification of impacts of transporting dredged material to the sites. To address these uncertainties, a workshop was conducted in January 2015 with the Project Delivery Team (PDT) and site owners. The viability of using the two retained South Bay Salt Pond sites (Eden Landing and Alviso Pond Complex) was discussed and assumptions for probable construction methods were developed.

It is envisioned by the SBSP Restoration Project site owners that a third party (potentially a public/private partnership) would design, finance, construct, and operate facilities for deepwater offloading dredged material, piping the material to the site, and decanting the material at the site. A tipping fee would be charged for use of these facilities. Adequate information is not available for development of the estimated tipping fee that would be charged.

The evaluation of potential placement sites focused on site availability, capacity, and the permit status. Although highly desirable due to their proximity to the dredging sites, both Eden Landing and Alviso Pond Complex sites are still in the early development phase. The EIRs for the sites have not been completed. Even though the site owners indicate that the sites could be ready by 2018, it is not certain that permitting would be complete and the facilities for transporting the dredged material would be constructed and operational by that time. Additionally, there is no proponent that has come forward at this time to finance the operations required to offload and transport the dredged material to the sites. Therefore, both the Alviso Pond Complex and Eden Landing sites are not being considered further at this time. As a result, Alternatives A-4, A-5, B-5, B-6, C-5 and C-6 are not being carried forward for evaluation at this time. However, if either Alviso Pond Complex or Eden Landing sites were to be permitted and available by 2018 and found to be cost effective, then use of these sites would be reconsidered.

The two upland beneficial reuse sites, Cullinan Ranch Tidal Restoration Project and Montezuma Wetlands Restoration Project (***Figure 6-1***), are already available and permitted, as is the ocean disposal site SF-DODS, so these were retained for use in the final array of alternatives. However preliminary cost numbers on using the combination of Cullinan and Montezuma as placement sites was not cost effective. It is less expensive to use one or the other. As a result, Alternatives B-1 and C-1 were also not carried forward for further evaluation. Descriptions of the remaining nine alternatives are provided in ***Section 6.2***.



Figure 6-1. Sites Retained in the Final Alternatives

6.2 Descriptions of the Nine Final Alternative Plans

Alternative A-1: 32 foot Depth with Placement at Cullinan. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -32 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. One hundred percent of the wetland dredged material acceptable as wetland cover, will be placed at Cullinan Ranch Tidal Restoration Project. Cullinan does accept wetland non-cover material which is assumed to be about 5 percent of the total volume dredged from the RWC Channel.

Alternative A-2: 32 foot Depth with Placement at Montezuma. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -32 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. One hundred percent of the dredged material suitable for wetland cover will be placed at Montezuma Wetlands Restoration Project. Montezuma does accept wetland non-cover material which is assumed to be about 5 percent of the total volume of dredged material from RWC Channel.

Alternative A-3: 32 foot Depth with Placement at SF-DODS. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -32 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. All dredged material shall be transported in bottom dump scows to SF-DODS except for approximately 46,000 cy which is suitable for wetland non-cover material placement at Montezuma Wetlands Restoration Project.

Alternative B-2: 34 foot Depth with Placement at SF-DODS. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -34 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. All dredged material shall be transported in bottom dump barges to SF-DODS except for approximately 81,000 cy which is suitable for wetland non-cover material placement at Montezuma Wetlands Restoration Project.

Alternative B-3: 34 foot Depth with Maximum Placement at Cullinan. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -34 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. Dredged material shall be taken to Cullinan and the site's capacity will be maximized at approximately 3 mcy. Wetland

non-cover quality dredged material will be placed at Cullinan. The remaining 710,000 cy shall be transported in bottom dump barges to SF-DODS.

Alternative B-4: 34 foot Depth with Placement at Montezuma Only. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -34 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. All dredged material (wetland cover and non-cover quality) shall be placed at Montezuma Wetlands Restoration Project.

Alternative C-2: 37 foot Depth with Placement at SF-DODS. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -37 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. All dredged material shall be transported in bottom dump barges to SF-DODS except for approximately 138,000 cy which is wetland non-cover quality material to be placed at Montezuma Wetlands Restoration Project.

Alternative C-3: 37 foot Depth with Placement at Cullinan and Montezuma. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -37 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. One hundred percent of the dredged material placement is to be placed at a combination of Cullinan Ranch Tidal Restoration Project and Montezuma Wetlands. This placement combination assumes that dredged material is placed at Cullinan until it reaches its 3 mcy capacity and the remaining 4,080,000 cy is to be placed at Montezuma. This constitutes one hundred percent beneficial reuse for placement.

Alternative C-4: 37 foot Depth with Placement at SF-DODS. Deepen the channels at Redwood City Harbor and San Bruno Shoal to a depth of -37 feet MLLW, with a slight realignment at the channel entrance at Redwood City Harbor towards the east to avoid adverse impacts to Bair Island Restoration Project, bottom-cut the channel between Reaches 3-5 so that the existing side slopes and Port facilities will remain undisturbed. All dredged material shall be placed at Montezuma Wetlands Restoration Project.

No Action Alternative: The No Action Plan (or the future without-project condition) is described in ***Section 2.3***. It constitutes the benchmark against which plans are evaluated. Forecasts of future without-project conditions consider all other actions, plans and programs that would be implemented in the future to address the problems and opportunities in the study area in the absence of a USACE project.

6.3 Evaluation Criteria

In accordance with USACE guidance for planning documents (ER 1105-2-100), four accounts and four planning criteria were used to evaluate the focused array of alternative plans and determine the single TSP.

The four accounts are specified in the USACE Planning Guidance Notebook (ER 1105-2-100). They were established via the Flood Control Act of 1970. The accounts are used to facilitate evaluation and display of effects of alternative plans. The accounts address: the National Economic Development (NED), Environmental Quality (EQ), Other Social Effects (OSE), and Regional Economic Development (RED).

- ***National Economic Development (NED)***. The first account displays changes in the economic value of the national output of goods and services. ER 1105-2-100 requires identification of the plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective. This plan is to be identified as the NED plan. In accordance with the Federal objective, the NED plan will be recommended unless the non-federal sponsor proposes a locally preferred plan (LPP) that, if acceptable to the Federal government, may be recommended if the non-federal sponsor is willing to increase their monetary contribution if necessary to make up for the shortfall with the NED plan benefits.
- ***Environmental Quality (EQ).*** The EQ account addresses the anticipated environmental impacts associated with implementation of the alternative plans. The environmental impacts of the alternative plans are fully documented in ***Chapter 4*** in compliance with the requirements of NEPA and CEQA.
- ***Other Social Effects (OSE***). The OSE account relates to navigational and public safety. San Francisco Bar Pilots have confirmed that there is no safety concern related to navigating ships for the proposed alternatives.
- ***Regional Economic Development (RED).*** This account is based on regional jobs created as a result of project construction.

Additionally there are four planning criteria used by the USACE to compare plans. These are Completeness, Efficiency, Effectiveness and Acceptability. Descriptions of how these criteria were applied to this study are described below.

- ***Completeness:*** The extent to which the alternative plans provide and account for all necessary investments or actions by all involved parties to ensure the planning objectives are realized. In this study, alternatives that don't have viable placement sites were eliminated from consideration.
- ***Effectiveness:*** The extent to which the alternative plans contribute to meeting the planning objective. The objective of this project is to improve navigation efficiency. All of the final alternatives contributed to improved navigation efficiency.

- ***Efficiency:*** The extent to which the alternative plan is the most cost effective means of achieving the project goal and objectives. Efficiency is based on the net NED benefits of the alternative.
- ***Acceptability:*** The extent to which the alternative plans are acceptable in terms of applicable Federal and State laws, regulations and public policies.

6.3.1 NED Analysis

HarborSym is a discrete event Monte-Carlo simulation model developed by the Institute for Water Resources (IWR), a USACE laboratory. It is designed to facilitate economic analyses of proposed navigation improvement projects in coastal harbors. HarborSym was used to evaluate the benefits of deepening the channels to -32, -34, and -37 feet MLLW.

Cost estimates were prepared for the screened alternative plans to include the costs of dredging and hauling the material to placement sites, mobilization and demobilization, planning engineering and design, construction management, contingency, operations, maintenance repairs rehabilitation, and relocations.

The costs and benefits were analyzed together to determine annual project costs, annual NED benefits, annual net NED benefits, and benefit to cost ratios. ***Table 6-1*** provides the results of the economic evaluation of the focused array of alternative plans and provides the basis for identification of the NED plan, which is highlighted in green. Alternatives with positive annual net benefits (i.e., average annual NED benefits greater than average annual costs) were carried forward for more detailed comparisons.

The NED plan is identified as Alternative A-3: Channel Deepening to -32 feet MLLW with placement of dredged material at SF-DODS. This plan reasonably maximizes net national economic development benefits consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders, and other Federal planning requirements. It has the greatest net benefit and operations, which will realize greater efficiencies and transportation cost savings.

Table 6-1. Economic Analysis of Alternative Plans

Placement Site	Alternative	Depth (ft)	Total Project Cost ($1,000)	Annual Benefits ($)	Annual Project Costs ($)	Annual Net Benefits ($)	Benefit to Cost Ratio	Result
Montezuma	A-2	32	75,950	3,950,000	3,600,000	350,000	1.1	Retain
	B-4	34	161,680	7,540,000	7,653,000	-113,000	1.0 (rounded)	Not carried forward
	C-4	37	315,150	8,110,000	14,769,000	-6,659,000	0.5	Not carried forward
Cullinan	A-1	32	73,588	3,950,000	3,501,500	448,500	1.1	Retain
	B-3	34	148,070	7,540,000	7,085,500	454,500	1.1	Retain
	C-3	37	300,450	8,110,000	14,156,000	-6,046,000	0.6	Not carried forward
SF-DODS	**A-3**	**32**	**73,150**	**3,950,000**	**3,483,000**	**466,800**	**1.1** (1.134 rounded)	**Retain (NED Plan)**
	B-2	34	151,050	7,540,000	7,209,750	330,250	1.1 (1.0458 rounded)	Retain
	C-2	37	292,950	8,110,000	13,843,500	-5,733,500	0.6	Not carried forward

6.3.2 Four Accounts Evaluation

The four alternatives that had average annual benefits that were less than the average annual costs (B-4, C-4, C-3, and C-2) were not carried forward for additional evaluation (***Table 6-1***). The remaining five alternatives including the NED plan were further evaluated against the accounts of Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). The results are described below and are summarized in ***Table 6-2***.

- ✓ Environmental Quality (EQ) addresses the anticipated environmental impacts associated with implementation of the alternative plans. Placement of material at Cullinan Ranch or Montezuma Wetlands is considered beneficial reuse and would contribute to the goals of the LTMS. The results of detailed assessment of environmental impacts of the alternative plans is presented in ***Table 4-5***. In general, all the alternatives would have less than significant impacts or less than significant impacts with mitigation. However, if

the jet sled construction method is used to relocate the pipelines at SBS Channel, there could be significant and unavoidable impacts. Use of a clamshell dredge or directional drilling for pipeline relocation would result in a less than significant impact.

- ✓ Regional Economic Development (RED) is based on regional jobs created as a result of project construction. This is estimated to be the same across all alternatives.
- ✓ Other Social Effects (OSE) relates to navigational, public safety, and environmental justice issues. San Francisco Bar Pilots have stated that there is no safety concern related to navigating ships for the proposed alternatives. This will be confirmed during Preconstruction Engineering and Design (PED) when the ship simulation studies are conducted. Environmental justice impacts were evaluated in ***Section 5.6*** and found to be less than significant for all alternatives.

***Table 6-2*. Evaluation Results Using Four Planning Accounts**

Depth	Montezuma	Cullinan		SF-DODS	
	32 (A-2)	32 (A-1)	34 (B-3)	32 (A-3)	34 (B-2)
2. NED: Annual Net Benefits	$350.0k	$448.5k	$454.5	$466.8k	$330.3
2. EQ: Environmental Impacts	Low	Low	Low	Medium	Medium
3. RED: Regional Job Creation	Low	Low	Low	Low	Low
4. OSE: Navigational Safety/Environmental Justice (EJ)	Safe/No EJ impact	Safe/No EJ impact	Safe/No EJ impact	Safe/No EJ impact	Safe/No EJ impact

6.3.3 Planning Criteria Evaluation

Table 6-3 provides a final summary of the Completeness, Effectiveness, and Efficiency of the alternatives. Plans that are incomplete (i.e., those that don't have viable placement sites) and/or plans that are ineffective at reducing transportation costs, were already eliminated from the final array of alternatives. Therefore, all the remaining five alternatives evaluated are complete and effective. Efficiency was evaluated based on the net benefits of the plans. Plan A-3: Channel Deepening to 32 feet with dredged material placed at SF-DODS, maximized net Annual NED benefits at $1.5M.

Table 6-3. Planning Criteria Evaluation

Placement Sites	Montezuma	Cullinan		SF-DODS	
Channel Depths	**32 (A-2)**	**32 (A-1)**	**34 (B-3)**	**32 (A-3)**	**34 (B-2)**
Completeness: *Actions of others required*	Complete Available Capacity Permitted	Complete Available Capacity Permitted	Complete Available Capacity Permitted	Complete Available Capacity Permitted	Complete Available Capacity Permitted
Effectiveness: *Transportation Cost Savings*	Meets objective	Meets objective	Meets objective	Meets objective	Meets objective
Efficiency: *Net Benefits*	$350,000	$448,500	$454,500	$466,800	$330,250
Compliance with Fed Law	Meets objective	Meets objective	Meets objective	Meets objective	Meets objective
Result	**Drop**	**Drop**	**Drop**	**TSP**	**Drop**

6.4 Identification of the Tentatively Selected Plan (TSP)

Results of alternative plan evaluations are summarized based on the four accounts (***Table 6-2***) and the four planning criteria (***Table 6-3***). Based on this evaluation the TSP is the NED plan, highlighted in green in ***Table 6-3***. This plan calls for a deepening of the existing federal project to a depth of -32 feet MLLW with slight adjustments in alignment in order to avoid adverse environmental impacts to Bair and Greco Islands and Port infrastructure. Results of the evaluation as they pertain to the TSP and, where appropriate, the future without project are discussed below:

6.4.1 Four Accounts Evaluation of the TSP

- ✓ **NED**: The selected plan is the NED plan which maximizes net NED benefits. Implementation will provide annual net benefits of $1,502,066 to the nation.
- ✓ **EQ**: The selected plan generally results in less than significant impacts on the affected environment. The exception is that there is a potential for unavoidable significant impacts to cultural resources and significant but mitigatable impacts on noise. Placement of dredged material at a beneficial reuse site is not included in the recommended plan because currently available sites are not cost effective. However, if Eden Landing (or Alviso Pond Complex) is successfully permitted in time to receive RWC dredged material and the mechanisms for transporting dredged material to the sites are

in place, consideration will be given to placing the dredged material at the beneficial reuse site.

- ✓ **RED**: The selected plan will not significantly impact the regional economic conditions, although jobs will be created during the construction period.
- ✓ **OSE**: San Francisco Bar Pilots have stated that there is no safety concern related to navigating ships for the selected plan. This will be confirmed during PED when the ship simulation studies are conducted. Environmental justice impacts were evaluated in ***Section 5.6*** and found to be less than significant for all alternatives.

6.4.2 Planning Criteria Evaluation of the TSP

- ✓ Completeness: The selected plan is complete, the placement sites for the dredged material (SF-DODS and Montezuma) are currently permitted and have adequate capacity to accept all the dredged material.
- ✓ Effectiveness: The selected plan will meet the primary objective of reducing costs and inefficiencies associated with the current federal navigation project. The selected plan reduces the need for light loading, lightering, topping off, and awaiting favorable tide conditions, thereby significantly improving navigation efficiency.
- ✓ Efficiency: The selected plan is the most efficient of all the alternative plans proposed and this is reflected in having the highest amount of net annual benefits over costs.
- ✓ Acceptability: The selected plan is in conformity with all necessary state and federal laws and regulations. The plan and all supporting documentation will have been vetted with all appropriate stakeholders, resource agencies and general public. This document represents the draft EIS/EIR and is being subjected to a public and agency review. All comments will be addressed and the final report will be made available for a final public and agency review.

7 Public Involvement, Review, and Coordination

The goal of public involvement and coordination is to open and maintain channels of communication with the public in order to give full consideration to public views and information in the planning process. The objectives of public involvement are: 1) to provide information about project activities to the public; 2) to make the public's desires, needs, and concerns known to decision-makers; 3) to provide for consultation with the public before decisions are reached; and, 4) to consider the public's views in reaching decisions.

Public involvement and agency coordination activities required by USACE planning policies and procedures have been conducted in conjunction with the requirements of NEPA and CEQA. Public and agency correspondence related to this project is contained in ***Appendix K***. This appendix will be updated through the remaining coordination and review process.

7.1 Public Involvement

7.1.1 Scoping Meeting

On 10 December 2014, the San Francisco District, USACE and the Port of Redwood City conducted a scoping meeting in compliance with NEPA and CEQA. The purpose of the scoping meeting was to obtain public and agency input on the issues that should be considered in decision making for the Redwood City Harbor Navigation Feasibility Study and EIS/EIR study process. A summary of the meeting is provided in ***Appendix K***.

The meeting presentation described the purpose of the study, how the NEPA and CEQA processes were being integrated with the planning process, the initial alternatives, the evaluation criteria that will be used to compare the alternatives, opportunities for public input, and the schedule for completion of the study. Comments received during the meeting were generally supportive of channel deepening.

Two letters were received during the scoping process: one from the SLC and another from USEPA. The SLC letter identified resources that should be evaluated during the study process. The USEPA letter identified topics that should be addressed in the EIS/EIR. It also recommended that the Montezuma Wetland Restoration Project, the Cullinan Ranch Tidal Restoration Project, and the Dumbarton Bridge Passive Sediment Transport Sites be considered for placement of the dredged material for beneficial reuse. These sites were evaluated in this document.

7.2 Institutional Involvement

7.2.1 Interagency Meeting

An interagency meeting attended by federal and state resource agencies was conducted May 19, 2015. The purpose of the meeting was to describe the study, summarize the findings to date, and to obtain feedback regarding potential issues or areas of concern. The TSP was identified and a description was provided of the planning process and the rational for the

preliminary recommendation. Comments received during the meeting are addressed in this report.

7.3 Report Circulation

The draft integrated feasibility report and EIS/EIR will be circulated for concurrent public and agency review for a 45 day period. All comments will be addressed and the final integrated report will be circulated for a final 30-day public review.

7.4 Public Views and Responses

A public meeting will be conducted during the review period for the draft integrated report to provide an additional opportunity for public input. All written and oral comments received during this period will be addressed in the final report. An appendix will be included in the final report providing responses to each comment and the draft integrated report will be revised as appropriate.

8 List of Preparers

Table 8-1. List of Preparers

Name	Title/Organization	Yrs. Experience
Main Report		
Eric Jolliffe	Environmental Manager/USACE	20
Jaime O'Halloran	Water Resources Planner/USACE	7
Paula Gagnon	Natural Resources Specialist/HydroPlan LLC	13
Susa Gates	Senior Scientist/GAIA Consulting, Inc.	33
Martin Gonzalez	Senior Water Resources Planner/HydroPLan LLC	31
Lewis Hornung	Project Manager/HydroPlan LLC	37
Sage Jensen	Biologist/Sage Environmental Services, LLC/HydroPlan LLC	17
Daria Mazey	Senior Water Resources Planner/HydroPlan LLC	9
Melba Policicchio	Scientist III/GAIA Consulting, Inc.	15
Leann Taagepera	Cultural Resources Specialist/HydroPlan LLC	20
Susanne von Rosenberg	NEPA/CEQA Specialist/GAIA Consulting, Inc.	31
Appendix A: Affected Environment Resource Assessment		
Paula Gagnon	Natural Resources Specialist/HydroPlan LLC	13
Susa Gates	Senior Scientist/GAIA Consulting, Inc.	33
Daria Mazey	Senior Water Resources Planner/HydroPlan LLC	9
Melba Policicchio	Scientist III/GAIA Consulting, Inc.	15
Leann Taagepera	Cultural Resources Specialist/HydroPlan LLC	20
Susanne von Rosenberg	NEPA/CEQA Specialist/GAIA Consulting, Inc.	31
Appendix B: Civil Design		
Frank Sun	Civil Engineer/USACE	13
Dave Doak	Navigation Technical Manager/USACE	33
Appendix C: Cost Engineering		
Sherman Fong	Cost Engineer/USACE	31
Appendix D: Geotechnical Engineering		
Michael G. Stevens, P.G.	Geotechnical Engineer/USACE	33
Appendix E: Water Resources Engineering		
Patrick Sing	Hydraulic Engineer/USACE	7
Appendix E: Water Resources Engineering		
Bonievee Delepaz	Real Estate Specialist	
Appendix G: Regulatory Setting		
Paula Gagnon	Natural Resources Specialist/HydroPlan LLC	13
Susa Gates	Senior Scientist/GAIA Consulting, Inc.	33
Daria Mazey	Senior Water Resources Planner/HydroPlan LLC	9
Melba Policicchio	Scientist III/GAIA Consulting, Inc.	15
Leann Taagepera	Cultural Resources Specialist/HydroPlan LLC	20
Susanne von Rosenberg	NEPA/CEQA Specialist/GAIA Consulting, Inc.	31

Appendix H: Species of Concern		
Susa Gates	Senior Scientist/GAIA Consulting, Inc.	33
Melba Policicchio	Scientist III/GAIA Consulting, Inc.	15
Susanne von Rosenberg	NEPA/CEQA Specialist/GAIA Consulting, Inc.	31
Appendix I: Sediment Data		
Roxanne Grillo	Physical Scientist/USACE	5
Appendix J: Economics		
Arden Sansom	Economist/USACE	
Appendix K: NEPA/CEQA Scoping Meeting Summary		
Lewis Hornung	Project Manager/HPLLC	37

9 Compliance with Applicable Laws, Policies, and Plans

Implementation of the TSP requires compliance with applicable federal, state and local statutes and policies pertaining to dredging and dredged material placement activities, and protection of aquatic and terrestrial resources. Some of these laws require the USACE to obtain permits, certifications, or approvals from other agencies before taking action. The following section describes the key federal and state laws applicable to the TSP and for which permits or certifications are required. This section also discusses the status of coordination with the issuing agencies and progress made toward compliance with the relevant laws and regulations. Other laws pertaining to the protection of environmental resources are presented by applicable resource areas in ***Appendix G***, Regulatory Setting.

9.1 Federal Laws

9.1.1 National Environmental Policy Act (NEPA)

Under NEPA, federal agencies must consider the environmental consequences of proposed major federal actions. The spirit and intent of NEPA is to protect and enhance the environment through well-informed federal decisions, based on sound science. NEPA is premised on the assumption that providing timely information to the decision maker and the public about the potential environmental consequences of proposed actions would improve the quality of federal decisions. Thus, the NEPA process includes the systematic evaluation of potential environmental consequences expected to result from implementing a proposed action. The CEQ sets forth regulations implementing NEPA.

Status: This document is intended to fulfill the requirements of NEPA, the CEQ regulations (40 C.F.R. pt. 1500-1508), and USACE Procedures for Implementing NEPA (Engineer Regulation 200-2-2). Full compliance with NEPA will be achieved when the final EIS/EIR and Record of Decision are filed with the USEPA.

9.1.2 Clean Water Act (CWA), Section 401 Water Quality Certification

The Clean Water Act (CWA) is the primary Federal law governing water pollution. It established the basic structure for regulating discharges of pollutants into waters of the U.S. and gives the USEPA the authority to implement pollution control programs, such as setting wastewater standards for industries. In some states, such as California, the USEPA has delegated authority to regulate the CWA to state agencies. The Porter-Cologne Water Quality Control Act of 1969 (Porter-Cologne Act), and associated regulations found in California Code of Regulations Title 23, establish a comprehensive program for the protection of water quality and the beneficial uses of waters of the state. It addresses both point and nonpoint source discharges, to both surface and ground waters and provides for the adoption of water quality control plans to designate beneficial uses of water, set water quality objectives to protect beneficial uses, and provide for a program to achieve those objectives. The San Francisco Bay RWQCB administers Section 401 of the CWA, and either issues or denies Water Quality Certifications (WQCs) based on an assessment of whether the proposed action would comply with Federal water quality

standards and the Basin Plan, and the RWQCB's master water quality control planning document. WQCs typically include project-specific requirements established by the RWQCB to ensure attainment of water quality standards.

Status: The USACE will request a 401 WQC pertaining to the proposed action concurrent with the Draft EIS/EIR. With issuance of a WQC from the RWQCB, the USACE would be in full compliance with this Act.

9.1.3 Clean Water Act (CWA), Section 404

The goal of Section 404(b)(1) Guidelines of the CWA (Guidelines) is "to restore and maintain, the chemical, physical, and biological integrity of waters of the United States (waters of the US) through the control of discharges of dredged or fill material." The regulations set forth in 40 CFR Section 230 are the substantive criteria issued by the USEPA, used in evaluating discharges of dredged of fill material in to waters of the US. The 404(b)(1) guidelines provide regulations outlining measures to avoid, minimize and compensate for impacts. They also specify that "no discharge of dredged or fill material shall be permitted if there is a practical alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (40 C.F.R. § 230.10[a]).

Section 404 of the CWA requires that a permit be obtained from the USACE when an action will result in the discharge of dredged or fill material into wetlands and waters of the U.S. Under Section 404, the USACE regulates such discharges and issues individual and/or general permits for these activities. Before the USACE can issue a permit under Section 404, it must determine that the project is in compliance with the CWA Section 404(b)(1) guidelines.

Status: When conducting its own civil works projects, the USACE does not issue permits to itself. Rather, the USACE complies with the guidelines and substantive requirements of the CWA, including Section 404. The RWC Project would require discharge of fill material into waters of the U.S., therefore a Section 404(b)(1) analysis will be conducted on the TSP, and will be appended to this document. The USEPA will review the analysis along with the Draft EIS/EIR to ensure that discharge of fill material would comply with the 404(b)(1) guidelines.

9.1.4 Endangered Species Act

Under the federal ESA (16 U.S.C. §§ 1531-1544), all federal agencies shall, in consultation with the Secretary of the Interior or Secretary of Commerce, use their authorities to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of habitat determined under the ESA to be critical.

The ESA provides a program for conserving threatened and endangered plants and animals, and the habitats in which they are found. It is designed to protect critically imperiled species from extinction. The ESA is administered by USFWS and NMFS. In general, NMFS is responsible for

protection of ESA-listed marine species and anadromous fishes, while other species are under USFWS jurisdiction.

Section 7 of the ESA prohibits Federal agencies from authorizing, funding, or carrying out activities that are likely to jeopardize the continued existence of a listed species or destroy or adversely modify its critical habitat. By consulting with USFWS and NMFS before initiating projects, agencies review their actions to determine if those actions could adversely affect listed species or their habitat. Through consultation, USFWS and NMFS work with Federal agencies to help design their programs and projects to conserve listed and proposed species. The agencies then prepare a Biological Opinion, which often includes conditions, reasonable and prudent alternatives, and protection/mitigation measures that must be completed if the project is implemented.

Status: The USACE has been coordinating with USFWS and NMFS through informal meetings and discussions. An ESA Section 7 Biological Assessment will be prepared and appended to this integrated feasibility report and EIS/EIR. The biological assessment will include the USACE's determination of the listed species that may be adversely affected by the proposed project. Formal Section 7 Consultation will be initiated following the release of the Draft EIS/EIR. The USFWS is expected to complete a Biological Opinion in regard to the TSP to complete the consultation requirements. With issuance of a Biological Opinion from the USFWS, the USACE would be in full compliance with this Act.

9.1.5 Fish and Wildlife Coordination Act (FWCA)

The FWCA ensures that fish and wildlife receive consideration equal to that of other project features from projects that are constructed, licensed, or permitted by Federal agencies. The FWCA requires federal agencies that construct water resource development projects to consult with USFWS, NMFS, and the applicable state fish and wildlife agency (CDFW) regarding the project's impacts on fish and wildlife and measures to mitigate those impacts.

Status: The USFWS and CDFW have participated in evaluating the proposed project and USACE is considering all recommendations proposed by the agencies. A Coordination Act Report (CAR) will be requested. When complete, it will be appended to this integrated feasibility report and EIS/EIR. With issuance of a final CAR from USFWS and CDFW, the USACE would be in full compliance with this Act.

9.1.6 Magnusun-Stevens Fishery Conservation and Management Act

Sections 305(b)(1)(D) and 305(b)(2-4) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources. This legislation mandates the identification, conservation, and enhancement of Essential Fish Habitat (EFH), which is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity," for all managed species. Federal agencies consult with NMFS on proposed actions that may adversely

affect EFH. The main purpose of the EFH provisions of the Act is to avoid loss of fisheries due to disturbance and degradation of the fisheries habitat.

Status: An EFH Assessment will be prepared and appended to this integrated feasibility report and EIS/EIR. The NMFS is expected to issue EFH Conservation Recommendations to avoid, minimize, mitigate, or otherwise offset any identified adverse effects of the project prior to the issuance of the ROD. The RWC project will be in full compliance with this Act once a response is provided to the EFH conservation recommendations.

9.1.7 Coastal Zone Management Act (CZMA)

The CZMA, established in 1972 and administered by the NOAA's Office of Ocean and Coastal Resource Management, provides for management of the nation's coastal resources through a state and federal partnership. Under the federal consistency provisions of the CZMA, federal projects need to be consistent with the state's coastal zone management program and policies to the maximum extent practicable (16 U.S.C. § 1456); this determination is made by the lead federal agency, and concurrence is requested from the state or local agency responsible for implementing the CZMA.

Pursuant to the McAteer-Petris Act, the San Francisco Bay Conservation and Development Commission (BCDC) is the state's coastal zone management agency responsible for issuing consistency determinations under the CZMA for San Francisco Bay. The San Francisco Bay Plan is BCDC's policy document specifying goals, objectives, and policies for BCDC jurisdictional areas.

Status: The USACE will prepare a draft CZMA federal consistency determination and submit documentation of compliance with applicable chapters of the CZMA to BCDC after release of the draft EIS/EIR. The USACE will be in full compliance with the CZMA when the BCDC issues a consistency determination.

9.1.8 Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act (33 U.S.C. 401 *et seq.*) requires authorization from the USACE for the construction of any structure in, or over any navigable water of the U.S., including the excavation/dredging or deposition of material in these water or any obstruction or alteration in a "navigable water."

Status: The USACE does not issue itself Section 10 permits, however, it may issue a Section 10 permit to the non-federal sponsor, if required. The USACE will ensure compliance with Section 10 before completion of the NEPA process.

9.1.9 Clean Air Act (CAA)

The USEPA, in conjunction with the U.S. Department of Transportation (DOT), established the General Conformity Rule on 30 November 1993. The rule implements the Clean Air Act (CAA) conformity provision, which requires federal agencies to identify, analyze, and quantify

emission impacts of an action and mandates that the federal government not engage, support, or provide financial assistance for licensing or permitting, or approve any activity not conforming to an approved CAA implementation plan.

Status: A General Conformity Applicability Analysis pertaining to the proposed action is included in this document (***Section 4.4.2***). This consists of calculation of the foreseeable indirect emissions for each alternative. Foreseeable indirect emissions include operational emissions as well as the incremental increase in emissions from recurring O&M dredging. The direct emissions for each alternative plus the indirect emissions are compared to the Federal deminimis levels. If the emissions from the project (including mitigation measures) fall below Federal de minimis levels then no Conformity Determination will be needed. If emissions exceed deminimis levels, a General Conformity Analysis will be prepared. When the EPA issues a Conformity Determination the USACE will be in compliance with the CAA.

9.2 State Laws

9.2.1 California Environmental Policy Act (CEQA)

The CEQA was closely modeled on NEPA and requires public agencies to consider and disclose to the public the environmental implications of proposed actions. CEQA applies to all discretionary activities that are proposed or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. Unlike NEPA, CEQA imposes an obligation to implement measures or project alternatives to avoid or mitigate significant adverse environmental effects, when feasible. When avoiding or mitigating significant environmental impacts of a proposed project is not feasible, CEQA requires that agencies either disapprove of the project, or prepare a written statement of the overriding considerations with approval of such project. Under the direction of CEQA, the California Natural Resources Agency has adopted regulations, known as the Guidelines for Implementation of the CEQA (CEQA Guidelines, California Code of Regulations Title 14, Section 15000 et seq.), which provide detailed procedures that agencies must follow to implement the law.

Status: This EIS is intended to fulfill the requirements of CEQA and the CEQA Guidelines, although as a federal agency, the USACE is not required to comply with CEQA.

9.2.2 California Endangered Species Act (CESA)

The CESA (California Fish and Game Code 2050-2116) operates in a similar fashion to the federal ESA, but is administered by CDFW. Certain species that are federally listed may not be listed on the CESA or vice-versa, or may have a different listing status. Similar to the federal ESA, CESA and the Native Plant Protection Act authorize CDFW to designate, protect, and regulate the taking of protected species in the State of California. Section 2080 of the California Fish and Game Code prohibits the taking of state listed plants and animals. CEQA lead agencies considering the approval of proposed projects that may adversely impact state-listed threatened or endangered species must consult with CDFW as a trustee agency. There has

been no clear and explicit waiver of federal sovereignty with respect to CESA. Accordingly, as a federal agency, USACE does not seek incidental take authorization or other authorization under CESA. In issuing a WQC, however, the RWQCB must comply with CESA. The RWQCB's environmental review must give consideration to rare and endangered species, as protected by the Basin Plan in the beneficial uses protecting Preservation of Rare and Endangered Species, and Fish Migration. Similarly, in the NEPA significance criteria, USACE must consider special-status species and whether the action threatens violation of federal, state, or local law or requirements imposed for the protection of the environment (40 C.F.R. § 1508.27[b][9-10]).

Status: This document analyzes impacts to species listed under CESA to facilitate issuance of a WQC.

10 Recommended Plan

This chapter discusses the details of the recommended plan, which was determined by plan formulation process described in ***Chapters 3 and 6***. Impacts of the plan are detailed in ***Chapters 4 and 5.*** The details of the recommended plan discussed in this chapter include material quantities and classifications, O&M, dredged material placement, costs and benefits, and risk and uncertainty. A locally preferred plan (LPP) has not been identified. Therefore, the recommended plan is the NED Plan, identified generally as the **32 foot depth deepening at both Redwood City Harbor and SBS Channels with a slight realignment at Redwood City Harbor only to avoid sensitive environmental features of Bair Island and Greco Island including the peripheral mudflats.**

10.1 Plan Components

- Both channels will be deepened from -30 feet to -32 feet MLLW. The side slopes of both channels will be maintained at 3H:1V. An additional one foot of paid overdepth will be allowed; an additional one foot of overdepth will be allowed but not paid.
- The channel at Redwood City Harbor would range from 350 feet wide near the entrance to 288 feet throughout the rest of the channel. The channel alignment at the turn into Redwood City Harbor will retain the existing width but will be slightly modified. The intent of these modification is to avoid impacts to not only Bair and Greco Island but also Port facilities as well:
    - From Station 80+00 to Station 122+ 00 the channel will be realigned 6 feet to the east away from Bair Island
    - From Station 127+00 to Station 140+00 the channel will be realigned 6 feet towards the west to avoid impacts to adjacent Greco Island mudflats
    - From Station 140+00 to Station 155+00 the channel will be shifted 6 feet away from Bair Island.
    - From Station 155+00 to Station 162+00 the channel will be reduced in width by 12 feet so as to avoid impacts to the RWC port facilities
    - From Station 162+00 to the end of the turning basin, the channel width was reduced by six feet on the Bair Island side only so as to avoid adverse impact to Bair Island.
- The SBS Channel will remain approximately 500 feet wide and 29,850 feet (5.65 miles) long and will not be realigned. Some extension may be required to ensure a smooth transition to the existing channel bottom.
- At approximately Station 38+00 on SBS Channel, 10 inch and 12 inch petroleum pipelines that will be adversely impacted due to their location relative to the new

deepened channel will be lowered (relocated) to accommodate the increased channel depth. These two pipelines are owned by Kinder Morgan.

- At approximately station 148+70 on the SBS Channel, a ten inch petroleum pipeline owned by the Shell Oil Company that will also be impacted by the deepened channel will be lowered (relocated) to accommodate the increased channel depth.

Details pertaining to both the recommended plan, and placement of the dredged material are presented in the following sections.

10.2 Dredging Considerations

10.2.1 Dredging Volumes

The recommended plan would dredge a total of approximately 1,400,000 cy of in-place material. Adding a 20 percent bulking factor and a two-foot overdepth (***Table 4-1***) means that a placement capacity for 1,680,000 cy will be required. The material from RWC Channel will consist of greater than 80 percent fines and will be mostly young bay mud. Between 60 percent and 70 percent of the material dredged from SBS Channel will be fines and the remainder mostly sands. All of the material meets the requirements for ocean disposal at SF-DODS.

The allowed 2 feet overdepth accounts for the inherent variability and inaccuracy of dredging equipment (normally ± two feet). Also, the dredge operator may practice overcutting. An "overcut" along the sides of the channel) where substrates are unconsolidated materials, like sand and silts) may be employed in anticipation of movement of material down the sides of the channel. Overcut throughout the channel bottom may be the result of furrowing or pitting by the dredging equipment (such as the hopper dredge's drag arms, or the clamshell dredge's bucket). ***Figures 10-1 and 10-2*** illustrate these concepts.

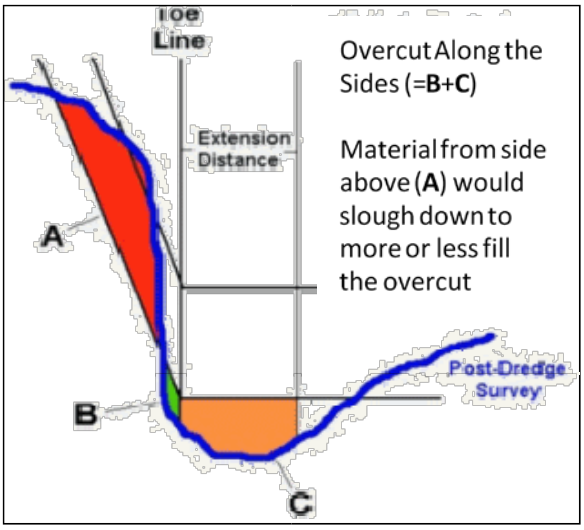


Figure 10-1. Conceptual Depiction of Overcut Dredging

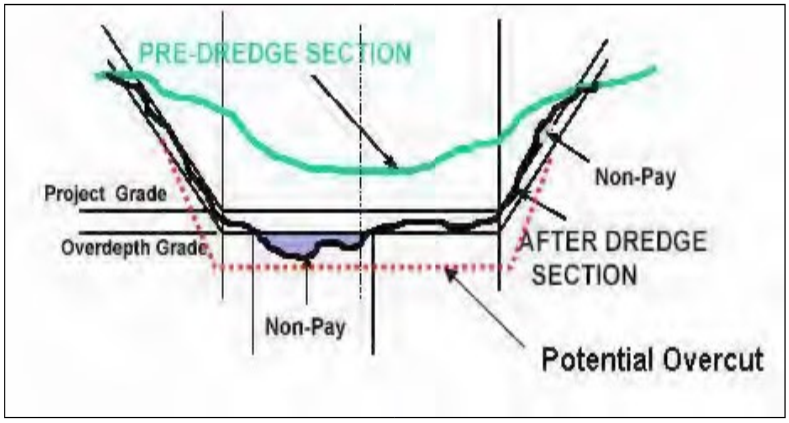


Figure 10-2. Conceptual Depiction of Overdepth Grade Dredging

10.2.2 Disposal of Dredged Material at SF-DODS

All the dredged material is to be disposed of at SF-DODS which is located in the Pacific Ocean west of San Francisco approximately 75 nautical miles from the SBS dredging site and 85 nautical miles from the RWC dredging site. It is the farthest and deepest of the dredged material disposal sites and:

- Is approximately eight square miles of open ocean area with a 600 meter circular center disposal location,
- Is considered non-dispersive (sediments tend to stay in place) and is unconfined,
- Is fully permitted and managed by the EPA, and
- Can accommodate a maximum of 4.8 mcy of dredged material annually.

10.3 Equipment and Construction Considerations

In general, the USACE does not specify types of equipment and construction methods within its specifications due to the requirements of Federal acquisition regulations compliance with the Competition in Contracting Act. The act requires Federal agencies to limit how specifications are written to prevent limiting competition among contractors. The contractor selected by USACE will determine the most efficient construction methodology of the project, in their professional opinion, and submit that as part of a proposal to USACE. USACE can, and does, specify the intended results of construction, safety measures, environmental compliance requirements, etc. through detailed plans and specifications. Generic information regarding common construction techniques is discussed below.

10.3.1 Equipment

10.3.1.1 *RWC Channel*

Since this channel is somewhat confined, it will be dredged mechanically likely using a clamshell dredge with a bucket suitable for use with mud. A clamshell dredge is able to work in more confined areas and is less sensitive to wave conditions. However, they do have low capacity and are unable to dig into very firm or consolidated material such as rock. The RWC channel is

bordered by either the environmentally sensitive mudflats of both Bair and Greco Islands or very expensive Port infrastructure. The clamshell dredging operation cycle is to lower the mud bucket in open position to the bottom surface, then close the bucket, thereby penetrating the bottom surface material due to its significant weight. A 21 cy clamshell dredge is assumed to be used. Dredging depth is controlled by length of wire used to drop the bucket. Production rate will vary depending on the size of the bucket used, the type of material being dredged, and the distance barges must be towed to the disposal site. Tugboats will be needed to move the dredge to its various locations.

Potential environmental impacts from clamshell dredging in the unconsolidated sediments of RWC Channel include possible re-suspension of sediments when the bucket hits the bottom and as material washes from the bucket as it rises through the water column. These impacts can be mitigated by controlling the speed of the bucket as it drops and rises, as well as the use of a closed bucket system. Environmental effects are further discussed in ***Chapter 4***.

10.3.1.2 *SBS Channel*

This channel is in open water within the approximate center of San Francisco Bay. While a Hopper Dredge or a Cutterhead Dredge could be used, it is assumed that a 21 cy clamshell dredge similar to that used in the RWC channel and with similar bottom dump barges will be used for transport to SF-DODS.

10.3.1.3 *Finishing Techniques*

Since dredging equipment does not typically result in a perfectly smooth and even channel bottom, a drag bar, chain or other item may be drug along the channel bottom to smooth down high spots and fill in low spots. This finishing technique also reduces the need for additional dredging to remove any high spots that may have been missed by the dredging equipment. It may be more cost-effective to use a drag bar or other leveling device than to conduct additional dredging.

10.3.1.4 *Transport to SF-DODS*

Barges used to transport the dredged material to SF-DODS will likely be “bottom dump” type with a 5,000 cy capacity. These barges typically have an 18 foot draft and are filled to a maximum of 80 percent of their capacity when used for travel to open ocean disposal sites such as SF-DODS. A bottom dump barge has doors on the bottom of the hopper which open at the disposal site to allow the dredged material to fall to the bottom of the ocean. This type of barge has slower disposal than the split hull type dump barges. As a result the dropped material disperses over a greater area. The split hull type barges have two hulls connected with hinges at the front and back which allow them to swing apart. This results in a faster descent through the water column reducing the re-suspension of sediments. Either type is acceptable for use at SF-DODS.

10.3.1.5 *Navigation Aids*

The USCG is typically responsible for providing and maintaining navigation aids. While the realignment being recommended is slight (six feet), a small cost will be added to the project for miscellaneous administrative coordination with the USCG during and post construction. Typically, the necessary relocation of aids for this small of a realignment is considered minor and incidental by the USCG and there is no charge for the actual physical relocation. The Bar Pilots shall be consulted and their recommendations incorporated as to placement of all navigation aids.

10.3.2 Construction Considerations

10.3.2.1 *Dredging Window*

Dredging would occur only during the established window established by the California Bay Area regulatory and resource agencies to protect sensitive species that may be present at other times. The dredging window extends from June 1 through November 30. Dredging work will occur 24 hours a day and 7 days a week during this dredging window. Typically crews are expected to work 12 hour shifts.

Over the last few years, the LTMS agencies have worked closely with the National Marine Fisheries Service (NMFS) to develop a proposed update to the LTMS programmatic biological opinion (BO). That process is near completion.

The proposed update summarizes the accomplishments of the LTMS program over the years in reducing impacts to salmonids and green sturgeon, as well as other fish species, and outlines a proposed simplification of the existing environmental work windows for salmonids. In this proposal, no additional work windows would be created for green sturgeon. In addition, the proposal includes the opportunity for certain projects to work outside the salmonid work window without further consultation with NMFS, so long as the dredged material is beneficially reused to benefit fish habitat (such as at a tidal wetland restoration site) (Bay Planning Coalition 2015).

10.3.2.2 *Construction Phasing*

Construction phasing is based on USACE estimates for dredging durations and element costs and provides the plan for contract phases per fiscal year. The number of contracts required to complete this project is a function of the funding stream, the contractor's proposal, construction methods, equipment availability, compliance with air quality requirements, and construction window compliance. These factors may require multiple contracts and since most of this data is currently unavailable, the precise number and timing of contracts cannot be predicted at this time. A single continuing contract is assumed for this construction project. This will allow the contractor to group like items, meet the Port implementation schedules, have some flexibility with component construction due to weather or environmental conditions, and reduce mobilization and demobilization costs.

10.4 Real Estate Requirements

The non-federal sponsor will acquire the minimum interests in real estate required to support the construction and subsequent operation and maintenance of the Project. At this time, all project construction activities will occur within the channel where Navigational Servitude applies. Should any mudflats be negatively impacted resulting in a Real Estate "taking" then appropriate mitigation measures will be taken. Transport and disposal of dredged material will also occur in submerged lands where Navigational Servitude applies. Navigational Servitude may be exercised under statutory rights and powers without obligation for compensation to the riparian landowners.

Staging and work areas will be within the lands below the designated MHW line or on Port of Redwood City property. These lands will be certified by the non-federal sponsor.

Although there are no real estate acquisition requirements for disposal of dredged material, the project has the opportunity to support the LTMS by evaluating the feasibility of placing dredged material from the Redwood City Navigation Improvement Project at beneficial reuse sites. The goal of LTMS is to manage dredging and disposal activities in the Bay Area to maximize beneficial reuse of dredged material and minimize disposal in the Bay and at SF-DODS.

Use of the Eden Landing Ecological Reserve or the Alviso Pond Complex for beneficial reuse of dredged material from the RWC Project has been carefully considered in this study. Use of either of these placement sites potentially offer cost savings and environmental benefits. However, due to uncertainty in when the sites will be permitted and available and the methods that would be used to transport dredged material to the sites, they were considered to be potentially not implementable. Evaluations of the environmental impacts of using Eden Landing and Alviso Pond placement sites are documented in ***Chapter 4*** of this document. If either of these sites become available in time for Project construction and they are found to be cost effective, the Project implementation plan can be modified accordingly.

While there are no Public Law 91-646 Relocations required in connection with the project there are pipelines that have been identified and need to be relocated. They are owned by Kinder Morgan and Shell. The former Shell dock at San Francisco Airport is a convenient staging area for the relocations. All costs associated with the relocations are borne by the non-federal sponsor.

There are no real estate costs for this construction project other than the administrative costs during preconstruction, engineering and design (PED), which are required for coordination purposes. These costs are administrative and are not for lands and damages. Per USACE regulations, they are included in the cost sharing analysis.

10.5 Pipeline Relocations

There are two pipelines owned by Kinder Morgan and one owned by Shell (currently inactive) that will need to be relocated as they cross the SBS Channel (***Figure 2-1***). The pipeline

relocation was estimated at $15 million for three jet-fuel pipelines located underneath the channel at San Bruno Shoal. All three pipelines will need to be lowered in order to accommodate the deepened SBS channel. Each pipeline will have a section of 2,500 linear feet removed and replaced at lower elevations that will allow for a 6 foot cover. Trenches will be dug and each pipeline replacement will have armoring over the 500 foot length that traverses SBS. Details for the equipment needed and construction to be performed can be found in ***Section 4.2.3***.

10.6 Local Betterments

In order to take advantage of the deeper channel and thereby realize the projected benefits, the five existing berths at the Port have to be deepened by a corresponding amount of two feet. Typically, berths should be a minimum of 4 feet deeper than the channel depth. Currently all five berths are at -34 feet MLLW; since the new deepened channel will be at -32 feet MLLW, the berths will be deepened to -36 feet MLLW.

The non-federal sponsor will be responsible for both funding and constructing these improvements. In order to deepen the berths, the attached wharves must remain structurally sound with the greater berth depths. The Port has recently completed upgrades to Wharves 1 and 2 that will maintain structural integrity of the wharves at a berthing depth as low as -40 feet MLLW. The Port is currently evaluating wharves 3 through 4 to determine whether any improvements would be required. Wharf 5 is not of concern. It is not currently being dredged and all cargo tonnage over the past 20 years has gone to Wharves 1 thru 4. Although not anticipated, if strengthening of the wharves were to be necessary, one of the following measures could be taken by the Port:

- Improve the existing fender systems
- Drive additional piling
- Install a cutoff wall to reinforce the slope beneath the wharves

Because wharves 3 through 5 will require no additional structural modifications to support the two foot deepening, it has been assumed that no wharf improvements will be required to meet geotechnical stability criteria. The Port will be responsible for deepening the berths. It is estimated that 17,000 cy of material will need to be removed.

10.7 Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R)

Maintenance dredging is an ongoing program currently performed by the USACE at the existing RWC and SBS Channels. The current scheduled maintenance at RWC Channel is once every one to two years as long as funding is available. The current scheduled maintenance at SBS Channel is once every 10 years. There will be an increase in the overall volume to be dredged post project completion (approximately 13 percent) but also an increase in the rate of sediment deposition due to the increased depths. Despite this, both channels are expected to retain their current dredging maintenance schedule. Disposal will continue to be at the historic in-Bay

disposal site (SF-11) unless other more cost effective and/or environmentally beneficial sites come on line. Use of a clamshell dredge is the most likely method of future maintenance dredging. There should be no change in the anticipated material characteristics for both the RWC and SBS channels.

10.8 Cost Apportionment

Federal and non-federal cost apportionment for project implementation is described in ***Table 10-1***. The pipeline removal/relocation financial costs are incurred by the pipeline owners per navigational servitude, which is a non-Federal implementation cost item. It's treated as an associated economic cost and included in the economic analysis, but is not considered a project financial cost that is cost shared between USACE and the Port.

Table 10-1. Redwood City Navigation Improvement Project Cost Apportionment

TSP (NED Plan) Project First Cost	Project Implementation Cost	Federal Cost	Non-Federal Cost
General Navigation Features (GNF) (75% Federal / 25% Non-Federal)[1]	$52,982,000	$39,737,000	$13,246,000
Environmental Mitigation (75% Federal / 25% Non-Federal)	$200,000	$150,000	$50,000
LERRs (100% Non-Federal)	$218,000	$0	$218,000
Subtotal Project First Cost	**$53,400,000**	**$39,887,000**	**$13,514,000**
Additional Project Implementation Requirements and Cost Adjustments			
10% Cash (GNF minus LERR - Paid Over Period NTE 30 years		($5,122,000)	$5,122,000
Local Service Facilities (100% Non-Federal)	$505,000	$0	$505,000
Aids to Navigation (100% Federal-US Coast Guard)	$100,000	$100,000	$0
Pipeline Relocation - Navigation Servitude (100% Pipeline Owner)	$18,750,000	$0	$18,750,000
Subtotal Additional Project Implementation Requirements and Cost Adjustments	**$19,355,000**	**($5,022,000)**	**$24,377,000**
TOTAL	**$72,755,000**	**$34,865,000**	**$37,891,000**
Incremental Increase in Annual O&M (100% Federal)	**$435,000**	**$435,000**	**$0**

[1]Includes Mob/Demob, PED, & S&A.

11 Recommendations

I concur with the findings presented in this report. The recommended plan developed is technically sound, economically justified, and socially and environmentally acceptable.

The work proposed is within the existing authority. I recommend that the plan selected herein, deepening the existing Federal channels at Redwood City and San Bruno Shoal an additional two feet to a depth of -32 feet MLLW with only a slight realignment of six feet and some minor narrowing of the RWC Channel near the Port facilities, be authorized by Congress for implementation. These minor adjustments to the existing Federal channel were necessary to reduce the possibility of any "taking" of mudflats at either Bair Island or Greco Island. Should these adverse environmental impacts to existing resources be noted during PED, then appropriate mitigation will be taken. Costly impacts to Port facilities are being avoided. As such, at this time no mitigation compensation for environmental resources are anticipated. Relocation, establishment, and disestablishment of aids to navigation are to be funded by the United States Coast Guard.

- The total estimated cost of the project is $73,150,000, with a Federal share of $34,865,000 and a non-federal share of $37,891,000.
- The average annual costs were determined to be $3,483,000 and average annual benefits were $466,800, with a benefit to cost ratio of 1.1 to 1. Average annual net benefits are $1,512,486.

The recommended plan conforms to the essential elements of the U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and complies with other Administration and legislative policies and guidelines on project development. If the project were to receive funds for Federal implementation, it would be implemented subject to the cost sharing, financing, and other applicable requirements of Federal law and policy for navigation projects including WRDA 1986, as amended; and would be implemented with such modifications, as the Chief of Engineers deems advisable within his discretionary authority. Aids to navigation are to be funded by the U.S. Coast Guard. Federal implementation is contingent upon the non-federal sponsor agreeing to comply with applicable Federal laws and policies. Prior to implementation, the non-federal sponsor shall agree to:

a. Provide, during the periods of design and construction, funds necessary to make its total contribution for commercial navigation equal to:
   - 25 percent of the cost of design and construction of the General Navigation Features (GNFs).
b. Provide all lands, easement, and rights-of-way (LERR), including those necessary for the borrowing of material and placement of dredged or excavated material, and perform or assure performance of all relocations, including utility relocations, all as determined by

the government to be necessary for the construction or operation and maintenance of the GNFs;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the GNFs an additional amount equal to 10 percent of the total cost of construction of GNFs less the amount of credit afforded by the Government for the value of the LER and relocations, including utility relocations, provided by the non-Federal sponsor for the GNFs. If the amount of credit afforded by the Government for the value of LER, and relocations, including utility relocations, provided by the non-federal sponsor equals or exceeds 10 percent of the total cost of construction of the GNFs, the non-federal sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to an refund for the value of LER and relocations, including utility relocations in excess of 10 percent of the total costs of construction of the GNFs;
d. Provide, operate, and maintain, at no cost to the Government, the local service facilities in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Government;
e. In the case of project features greater than 32 foot depth, provide 50 percent of the excess cost of operation and maintenance of the project over that cost which the Government determines would be incurred for operation and maintenance if the project had a depth of 32 feet;
f. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating and maintaining the GNFs;
g. Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;
h. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20;
i. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601– 9675, that may exist in, on, or under LER that the Federal Government determines to be necessary for the construction

or operation and maintenance of the GNFs. However, for lands, easements, or rights-of-way that the Federal Government determines to be subject to the Navigation Servitude, only the Federal Government shall perform such investigation unless the Federal Government provides the non-federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

j. Assume complete financial responsibility, as between the Federal Government and the non-Federal sponsor, for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under LER that the Federal Government determines to be necessary for the construction or operation and maintenance of the project;

k. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA;

l. Comply with Section 221 of PL 91-611, Flood Control Act of 1970, as amended, (42 U.S.C. 1962d-5b) and Section 101(e) of the WRDA 86, Public Law 99-662, as amended, (33 U.S.C. 2211(e)) which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

m. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, (42 U.S.C. 4601-4655) and the Uniform Regulations contained in 49 CFR 24, in acquiring lands, easements, and rights-of-way, necessary for construction, operation and maintenance of the project including those necessary for relocations, the borrowing of material, or the placement of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

n. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, PL 88-352 (42 USC 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive changes the provision of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c);

o. Provide the non-federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of 1 percent of the total amount authorized to be appropriated for the project; and

p. Not use funds from other Federal programs, including any non-federal contribution required as a matching share therefore, to meet any of the non-federal sponsor's obligations for the project costs unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the project.
q. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government.
r. Mitigation monitoring during construction and post construction shall be cost shared between the Federal government and non-federal sponsor, 75 percent and 25 percent, respectively.

The information contained herein reflects the information available at this time and current departmental policies concerning formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works program or the perspective of higher review levels within the executive branch. Consequently the recommendations may be modified before it is submitted to the Congress as a proposal for authorization and implementation funding. However, prior to submittal to the Congress, the State of California, the Port of Redwood City (the non-federal sponsor), interested Federal agencies and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

_____ _____

Date

John C. Morrow

Lieutenant Colonel, U.S. Army

District Commander

12 References

ACTA Environmental Inc. 2014. Report on Sediment and Water Quality Monitorint-2012Montezuma Wetland Project, Solano County, California. September.

Ahlborn, 1990. California Wildlife Habitat Relationships System, California Department of Fish and Game. G. Ahlborn, reviewed by M. White, edited by M., California Interagency Wildlife Task Group. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=2357, Accessed 10 February 2015.

Alameda County. 1973. Alameda County General Plan Safety Element. May 30. http://acgov.org/cda/planning/generalplans/index.htm. Last Accessed March 2, 2015.

Alameda County. 1994. Alameda County General Plan Countywide Elements Conservation Element. May 5. http://acgov.org/cda/planning/generalplans/index.htm. Accessed April 1, 2015.

Alameda County, Community Development Agency, Planning Department, March 2012, Castro Valley General Plan. Chapter 7: Biological Resources. Last Accessed on 6 January 2015. Available at: http://acgov.org/cda/planning/generalplans/documents/Chapter-7-Biological-Resources.pdf

Alameda County Flood Control and Water Conservation District (ACFCWCD). 2015. Eden Landing Salt Ponds. http://acfloodcontrol.org/projects-and-programs/environmental-restoration/eden-landing-salt-ponds. Accessed February 22, 2015.

Alameda Social Services, 2014. *Alameda County Industry Clusters, New Trends in the Workforce.* April 9, 2014. Available at: http://alamedasocialservices.org/acwib/info-research/documents/display.cfm?folder=documents&filename=Alameda_County_-_New_Trends_in_the_Workforce.pdf. Accessed on 18 March 2015.

Allen, Thomas B. 1974. *Vanishing Wildlife of North America*. Washington, D.C.: National Geographic Society.

Anchor Environmental C.A. L.P. (Anchor). 2003. Literature review of effects of resuspended sediments due to dredging operations. Prepared for Los Angeles Contaminated Sediments Task Force, Los Angeles, CA, June.

Anderson, S. 2002. "Lasiurus cinereus" (On-line), Animal Diversity Web. Accessed February 10, 2015 at http://www.biokids.umich.edu/accounts/Lasiurus_cinereus/

Association of Bay Area Governments, 2013. Plan Bay Area Environmental Impact Report, Appendix H: Biological Resources Special-Status. Association of Bay Area Governments and the Metropolitan Transportation Commission. Accessed on 10 February 2015. Available at: http://planbayarea.org/pdf/Draft_EIR_Chapters/Appendix_H_Biology.pdf

Association of Bay Area Governments (ABAG). 2015. Earthquake and Hazards Program-Liquefaction Susceptibility. http://gis.abag.ca.gov/website/Hazards/?hlyr=liqSusceptibility. Accessed March 15.

Bay Planning Coalition. 2015. LTMS NFMS Consultation. April 8. http://bayplanningcoalition.org/2014/04/ltms-nmfs-consultation/ Accessed 6-15-15.

Barnard, W.D., 1978. Prediction and Control of Dredged Material Dispersion around Dredging and Open-Water Pipeline Disposal Operations, Technical Report DS -78- 13, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Benfield, M. C. AND T. J. Minello. 1996. Relative effects of turbidity and light intensity on reactive distance and feeding of an estuarine fish. *Environmental Biology of Fishes* 46:211–216.

BioKIDS is sponsored in part by the Interagency Education Research Initiative. It is a partnership of the University of Michigan School of Education, University of Michigan Museum of Zoology, and the Detroit Public Schools. This material is based upon work supported by the National Science Foundation under Grant DRL-0628151.

Bay Area Census, 2010. San Francisco Bay Area Census Data. Sources: Census 2000 SF1, SF3, DP1-DP4, Census 2010 DP-1, American Community Survey (ACS) 2006-2010. MTC-ABAG Library, 101 Eighth Street, Oakland CA 94607. Available at: http://www.bayareacensus.ca.gov/bayarea.htm. Accessed on 18 March 2015.

Bay Conservation and Development Commission, USACE, RWQCB, State Water Resources Control Board (BCDC et al). 2012. *Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region, 12-Year Review Process*. June.

Bay Conservation and Development Commission, USACE, RWQCB, State Water Resources Control Board (BCDC et al). 1998. *Long Term Management Strategy for Bay Area Dredged Material Final Environmental Impact Statement/Environmental Impact Report*. August.

British Columbia Ministry of Environment, 2014. Accessed on 10 February 2015. Available at: http://www.env.gov.bc.ca/wld/fishhabitats/sturgeon/

Butterfly Conservation Initiative (BFCI), 2015. Myrtle's silverspot butterfly. Accessed on 9 February 2015. Available at: http://butterflyrecovery.org/species_profiles/myrtles-silverspot-butterfly/

California Department of Fish and Game (CDFW). 2009. Species Fact Sheets.. Available at: http://www.dfg.ca.gov/delta/data/longfinsmelt/documents/LongfinsmeltFactSheet_July09.pdf. Last Accessed March 25, 2015.

California Department of Fish and Game (CDFW). 2015a. Bair Island Ecological Reserve-San Mateo County. http://www.dfg.ca.gov/lands/er/region3/bair.html. Accessed February 4, 2015.

California Department of Fish and Wildlife (CDFW). 2015b. Threatened and endangered animal list, Threatened, Endangered and Rare Plant List, and Fully Protected Animal List. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed 3/3/2015.

California Department of Fish and Wildlife (CDFW). 2015c. STATE AND FEDERALLY LISTED ENDANGERED, THREATENED, AND RARE PLANTS OF CALIFORNIA. Janaury. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed March 1, 2015.

California Department of Fish and Wildlife (CDFW). 2015d. STATE & FEDERALLY LISTED ENDANGERED & THREATENED ANIMALS OF CALIFORNIA. January. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed March 1, 2015.

California Department of Fish and Wildlife, Natural Diversity Database. January 2015. Special Animals List. Periodic publication. 50 pp.

California Environmental Protection Agency. 2015. http://www.waterboards.ca.gov/sanfranciscobay/basin_planning.shtml#basinplan. Accessed June 29, 2015.

California Freshwater Shrimp, Last Accessed on 5 February 2015, Available at: http://www.epa.gov/espp/factsheets/ca-fw-shrimp.pdf

California Native Plant Society, Rare Plant Program (CNPS). 2015. Inventory of Rare and Endangered Plants (online edition, v8-02). http://www.rareplants.cnps.org Accessed 10 February 2015.

California State Coastal Conservancy (SCC). 2010. San Francisco Bay Area Draft Water Trail Plan Draft Revised EIR. August. http://scc.ca.gov/2010/07/30/san-francisco-bay-area-water-trail/. Accessed March 24, 2015.

California State Coastal Conservancy (CCSC). 2015. Letter of Intent to Coordinate with the U.S. Army Corps of Engineers, San Francisco District for the Delivery of Dredged Material to the South Bay Salt Ponds Restoration Project, dated March 3, 2015, signed by John Bourgeois, Executive Project Manager

California State Coastal Conservancy and U.S. Fish and Wildlife Service (CSCC & USFWS). 2015. SBSP Phase 2 Restoration Administrative Draft Environmental Impact Statement/Environmental Impact Report. May.

California State Lands Commission (SLC). 2012. Addendum to the Final Environmental Impact Report for the Cullinan Ranch Restoration Project, Solano and Napa Counties.

California State Lands Commission (SLC). 2014. Mitigated Negative Declaration, Hercules LLC/Prologis Pipeline Removal Project, March 2014. Lead Agency: California State Lands Commission, Applicant: Hercules LLC/Prologis. Accessed 21 April 2015. Available at: http://www.slc.ca.gov/division_pages/DEPM/Reports/Hercules/Hercules.html

California State Lands Commission (SLC). 2015. SLC Shipwreck Database. (http://shipwrecks.slc.ca.gov/ShipwrecksDatabase/Shipwrecks_Database.asp). Accessed February 11, 2015.

City-data.com, 2015. Website. Available at: www.city-data.com. Last accessed on 18 March 2015.

City of Alameda, 1991, *City of Alameda General Plan*. (http://www.cityofalamedaca.gov/City-Hall/General-Plan) accessed January 14, 2013

City of Alameda, 2012, *Alameda Municipal Code.* (http://library.municode.com/index.aspx?clientId=16753&stateId=5&stateName=California) accessed January 14, 2013

City of Brisbane, 1994, *General Plan*, Chapter IX: Conservation; Chapter X: Community Health and Safety. Last accessed on March 5, 2015. Available at: http://www.ci.brisbane.ca.us/general-plan

City of Brisbane. 1994. City of Brisbane General Plan Chapter V Land Use. June 21. http://www.ci.brisbane.ca.us/general-plan. Accessed January 8, 2015.

City of Fremont, 2011, *A Vision for Fremont's Future: General Plan 2030*, Chapter 7 Conservation Element—Biological Resources, Chapter 2—Land Use. Last accessed on 8 January 2015. Available at: https://www.fremont.gov/398/General-Plan

City of Fremont, 2011, *City of Fremont General Plan*. December 2011.

City of Fremont, 2013, *Fremont Municipal Code*. (http://www.codepublishing.com/ca/fremont/) accessed January 29, 2013

City of Hayward, 2011a, *Hayward Municipal Code*. (http://www.hayward-ca.gov/CITY-GOVERNMENT/DEPARTMENTS/CITY-CLERK/) accessed January 14, 2013

City of Hayward, 2011b, *City of Hayward General Plan*. Amended May 2011.

City of Hayward, July 2014, *Hayward General Plan—Looking Forward 2040*, Policy Document Part 3: Natural Resources Element; Part 3.6: Hazards; Policy Document: Part 3 Economic Development Element. Last accessed April 9, 2015. Available at: http://www.hayward-ca.gov/generalplan/

City of Inglewood, 2014. Appendix B Sensitive Species Potentially Occurring within the City of Inglewood. Last accessed on 7 January 2015. Available at: http://www.cityofinglewood.org/generalplan/AppB_SensitiveSpecies_web.pdf

City of Menlo Park, 2013, *City of Menlo Park General Plan*, May 2013, "Open Space/Conservation, Noise and Safety Elements." Last accessed on 7 January 2015. Available at: http://www.menlopark.org/DocumentCenter/View/234

City of Mountain View, 2012. Chapter 7: Noise, Mountain View 2030 General Plan, prepared by City of Mountain View Community Development Department, 500 Castro Street, Mountain View, CA 94041, July 10, 2012. Available at: http://www.mountainview.gov/depts/comdev/planning/regulations/general.asp. Last Accessed on April 9, 2015.

City of Mountain View. 2012. City of Mountain View General Plan. July 10. http://www.ci.mtnview.ca.us/civicax/filebank/blobdload.aspx?blobid=10702. Last Accessed March 2015.

City of Redwood City. 2008. "Redwood City General Plan Update, Geology, Soils and Seismicity Background Report."

City of Redwood City, 2009. Public Information Summary for Community Meeting Held on October 11, 2009. Redwood Shores Lagoon Improvement - Dredging. Accessed 21 April 2015. Available: http://www.redwoodcity.org/bit/infrastructure/shores_dredge_2009/shores_dredge.html

City of Redwood City, 2010a, Redwood City General Plan, Chapter 1 The Built Environment Element, Chapter 5 Natural Resources Element, and Appendix E: Potential Plant and Animal Species Occurring in Plan Area. http://www.redwoodcity.org/phed/planning/generalplan/FinalGP_Docs.html. October 11. Last Accessed March 15, 2015.

City of Redwood City. 2010b. Redwood City New General Plan, DEIR. May.

City of San Francisco Planning Department, *San Francisco General Plan,* Environmental Protection Element. Last Accessed on 6 January 2015. Available at: http://www.sf-planning.org/ftp/general_plan/I6_Environmental_Protection.htm#ENV_GEN_1

City of San Jose. 2007. City of San Jose Envision San Jose 2040 General Plan. August. http://www.sanjoseca.gov/index.aspx?nid=1737. Last Accessed April 9, 2015.

City of San Jose. 2011, *Envision San José 2040 General Plan*, Chapter 3 Environmental Leadership, Community Forest (p 23), Natural Communities and Wildlife Habitat (p 26-32), Wildlife Movement (p 32-33). Last accessed on 8 January 2015. Available at:

http://www.sanjoseca.gov/DocumentCenter/Home/View/474 (ADD IN NOISE SECTION REFERENCE)

City of San Jose. 2012. Municipal Code, Section 20.100.450. *Hours of construction within 500 feet of a residential unit.*

City of San Mateo, 2009. General Plan Update Appendix E of ADEIR. April 2009. Last accessed on 8 January 2015. Available at: http://www.cityofsanmateo.org/DocumentCenter/Home/View/5230

City of South San Francisco. City of South San Francisco General Plan – Chapter 7 Open Space and Conservation Element; Chapter 8 Health and Safety Element; Chapter 9 "Noise". http://www.ssf.net/360/Read-the-Plan. Last Accessed April 9, 2015.

City of Sunnyvale, 2011, *General Plan* (pp 3-39; 7-26). Last Accessed on 8 January 2015. Available at: http://sunnyvale.ca.gov/CodesandPolicies/GeneralPlan.aspx

Clarke, D. G., and Wilber, D. H. (2000). "Assessment of potential impacts of dredging operations due to sediment resuspension," DOER Technical Notes Collection (ERDC TN-DOER-E9), U. S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/dots/doer

CNT Group. 2015. Bay Area Sea Accident Timeline. http://mapreport.com/na/west/ba/news/subtopics/d/n.html. Accessed 4/18/2015.

Congressional Record. 1930. 71st Cong., 2d sess., vol. 72 pt. 10.

Cook, et al, 2010. *Distribution and Ecology of the Russian River Tule Perch*, David Cook, Shawn Chase, and David Manning, Sonoma County Water Agency, Environmental Resources, 2010. Accessed on 5 February 2015. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47316

Coosa-Alabama River Improvement Association. www.caria.org/barges_tugboats.html Accessed 4-20-2015.

Cornell Lab of Ornithology website. All About Birds. Accessed on 5 February 2015. Available at: http://www.allaboutbirds.org/guide/chipping_sparrow/lifehistory

Council on Environmental Quality (CEQ). 1997. Environmental Justice: Guidance under the National Environmental Policy Act. December. http://www.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_ceq1297.pdf Accessed May 15, 2015.

County of San Mateo, 1986. *General Plan*. Environmental Services Agency, Planning and Building Division. San Mateo County, California. Available at: http://planning.smcgov.org/sites/planning.smcgov.org/files/SMC-GP%201986.pdf. Last Accessed on 16 March 2015.

County of San Mateo, 2004. *County of San Mateo Profile*. Available at: http://www.co.sanmateo.ca.us/bos.dir/budget/recommend2004/CountyProfile.pdf. Accessed on 18 March 2015.

County of San Mateo. 1986. General Plan-Vegetation, Water, Fish and Wildlife Resources Chapter. November 8. http://planning.smcgov.org/documents/general-plan-policies. Accessed April 1, 2015.

County of Santa Clara, Planning Office, December 1994, Santa Clara County General Plan: Charting a Course for Santa Clara County's Future: 1995-2010. Last accessed on 6 January 2015. Available at: http://www.sccgov.org/sites/planning/PlansPrograms/GeneralPlan/Pages/GP.aspx

CSU Stanislaus, 2006. Endangered Species Recovery Program, Department of Biologicial Science. San Joaquin Dune Beetle. Accessed on 9 February 2015. Available at: http://esrp.csustan.edu/speciesprofiles/profile.php?sp=cogr

Delta Modeling Associates. 2014. *South San Francisco Bay Sediment Transport Modeling*, Final Report, Prepared for U.S. Army Corps of Engineers, San Francisco District, June 2014.

Delta Modeling Associates. 2015. *Sediment Transport Modeling for Navigation Channel Deepening of Redwood City Harbor, Redwood City Harbor Navigation Improvement Feasibility Study*, prepared for the U.S. Army Corps of Engineers, San Francisco District, December 2014.

Dickerson, C., K.J. Reine, and D.G. Clarke, 2001. "Characterization of underwater sounds produced by bucket dredging operations," DOER Technical Notes Collection (ERDC TN-DOER-E14), U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi. Available at: www.wes.army.mil/el/dots/doer.

Ducks Unlimited. 2015. Cullinan Ranch Tidal Restoration Project. http://restorecullinan.info/history.htm. Accessed February 8, 2015.

East Contra Costa County, 2006. Species Accounts, Plants. Accessed on 9 February 2015. Available at: http://www.co.contra-costa.ca.us/depart/cd/water/HCP/archive/final-hcp-rev/pdfs/apps/AppD/19a_brittlescale_9-28-06_profile.pdf

EDAW, et al (SBSPRP), 2007, South Bay Salt Pond Restoration Project, Final Environmental Impact Statement/Report, Volume 1, December 2007, Prepared by EDAW, Philip Williams and Associates, Ltd., H.T. Harvey and Associates, Brown and Caldwell,

Geomatrix. Chapter 3.6 Biological Resources. Last Accessed on 5 February 2015. Available at: http://www.southbayrestoration.org/EIR/downloads.html

Environmental Services Agency (ESA). Planning and Building Division, San Mateo County, California, November 1986, General Plan, VEGETATIVE, WATER, FISH AND WILDLIFE RESOURCES POLICIES. Last accessed on 6 January 2015. Available at: http://planning.smcgov.org/sites/planning.smcgov.org/files/documents/files/GP%20Ch%2001-VegWaterFish%26Wildlife%20Policies.pdf

Environmental Services Agency (ESA). 2010, Port of Redwood City Wharves 1 and 2 Redevelopment Project Draft EIR, Prepared for Port of Redwood City, March 2010.

Eslinger, Bonnie, 2013. "Redwood City gets $1 million fireboat bought with homeland security funds," San Jose Mercury News. Accessed on 15 April 2015. Available at: http://www.mercurynews.com/ci_23564994/redwood-city-gets-1-million-fireboat-bought-homeland

Field, E.H., and 2014 Working Group on California Earthquake Probabilities. 2015. UCERF3: A New Earthquake Forecast for California's Complex Fault aystem: USGS 2015–3009, 6 p., http://dx.doi.org/10.3133/fs20153009.

Fugro Consultants, Inc. 2012. *Geotechnical Data Report Redwood City Deep Water Ship Channel, Redwood City, CA.* December.

Fugro Pelagos, Inc. and HDR Engineering Inc. (Fugro and HDR) 2014. San Bruno Shoal Navigation Channel Pipeline Location and Depth of Burial Survey, San Francisco, California Marine Survey Report; Survey Period: June 4 – 8, 2014.

Germano & Associates, Inc. 2010. "Review/Synthesis of Historical Environmental Monitoring Data Collected at the San Francisco Deep Ocean Disposal Site (SF-DODS) in Support of EPA Regulatory Decision to Revise the Site's Management and Monitoring Plan." June.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, Calif./S.F. Bay Regional Water Quality Control Board, Oakland, Calif. http://www.sfei.org/node/2123. Accessed March 27, 2015.

Golden Gate National Parks Conservancy, 2015. Mission Blue Butterfly. Accessed on 9 February 2015. Available at: http://www.parksconservancy.org/conservation/plants-animals/endangered-species/mission-blue-butterfly.html

Harvey, H.T. 2005. South Bay Salt Pond Restoration Project Biology and Habitats Existing Condition Report. March. http://www.southbayrestoration.org/documents/technical/. Accessed March 10, 2015.

Harbor Safety Committee of the San Francisco Bay Region (HSC). 2014. San Francisco, San Pablo, and Suisun Bays Harbor Safety Plan. June 12.

Harris Miller Miller & Hanson Inc. (HMMH), 2014 Feb. Figure 1: Noise Impact Boundary 12-Month CNEL Contours for January 2013-December 2013 for Oakland International Airport. Oakland, California. Annual 2013 Noise Contours, February 7, 2014. Source: Port of Oakland ANOMS. Published in HMMH Report No. 302551.002.003-4.

Hayes DF, Engler RM (1986) Environmental Effects of dredging. Technical notes. US Army Engineer Waterways Experiment Station, Vicksburg

HDR Engineering (HDR) 2014. Draft Interim Feasibility Report and Environmental Impact Statement / Report South San Francisco Bay Shoreline Phase I Study. December.

Helley, Edward J. et al. 1979. Flatland Deposits – Their Geology and Engineering Properties and Their Importance to Comprehensive Planning. USGS Professional Paper 943.

Herbich, J.B., Brahme, S.B., 1991. Literature Review and Technical Evaluation of Sediment Resuspension During Dredging, Contract Report HL-91-1, Prepared for the Department of the Army, Washington, D.C: U.S. Army Corps of Engineers.

HT Harvey & Associates (Harvey, et al), 2007, South San Francisco Bay Shoreline Study Existing Biological Conditions Report (Appendix Q to the 2014 Shoreline Study Report).

ICF Jones & Stokes, 2009, Sears Point Wetland and Watershed Restoration Project Draft Environmental Impact Report/Environmental Impact Statement, DES-08-32, August 2009, Prepared for California Department of Fish and Game and the U.S. Fish and Wildlife Service.

Illingworth & Rodkin, Inc. 2004. *City of Oakland Noise Element Update, Environmental Noise Background Report*. December 2004.

Illingworth & Rodkin, Inc. 2010. *Envision San Jose 2040 General Plan Comprehensive Update Environmental Noise Assessment, San Jose, California*. December 2010.

iNaturalist.org, 2015. Accessed on 10 February 2015. Available at: http://www.inaturalist.org/taxa/68424-Ranunculus-lobbii

Jepsen, 2011. Prepared by Sarina Jepsen, The Xerces Society for Invertebrate Conservation, December 2009. Edited by Sarah Foltz Jordan, December 2009. Final edits by Rob Huff, Conservation Planning coordinator, FS/BLM, March 2011. Accessed on 10 February 2015. Available at: http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/sfs-iibi-gonidea-angulata-2011-03.doc

Johnson, B. H., and Parchure, T. M. (1999). Estimating dredging sediment resuspension sources, *DOER Technical Notes Collection* (TN DOER-E6), U.S. Army Engineer Research and Development Center, Vicksburg, MS. *www.wes.army.mil/el/dots/doer*

Jones and Stokes. 2003. Napa River Salt Marsh Restoration Project DEIR/DEIS. April.

Jones and Stokes. 2004. Final Napa River Salt March Restoration Project Environmental Impact Report. April. http://napa-sonoma-marsh.org/documents/FEIR/feir.html. Accessed April 13, 2015.

LTMS. 2014. LTMS Update Draft Programmatic ESA Consultation with NOAA: Proposed Windows Modification and Additional Measures for Salmonids and Green Sturgeon. April 7.

MarineBio, 2015. "Sea Otters, Enhydra lutris ~ MarineBio.org." MarineBio Conservation Society. Web. Last update: 1/14/2013 Accessed Tuesday, February 10, 2015. Available at: http://marinebio.org/species.asp?id=157

Marshall, Don B. 1978. *California Shipwrecks, Footsteps in the Sea.* Seattle. Superior Publishing Company.

Moffat and Nichol. 2015. SBSP Restoration Project Beneficial Reuse Feasibility Study. January 2015.

Moratto, Michael J. 1984. California Archaeology. San Diego: Academic Press, Inc.

Morey, et al, 2000. *California Wildlife Habitat Relationships System,* California Department of Fish and Game. Written by S. Morey, reviewed by T. Papenfuss, edited by R. Duke, D. Alley, updated by CWHR Program Staff, March 2000. California Interagency Wildlife Task Group. Accessed 10 February 2015. Available at: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentVersionID=17641

Napa River Salt Marsh Restoration Project Draft Environmental Impact Report/Environmental Impact Statement, April 2003. Chapters 5: Biological Resources, 6: Wildlife, and 7: Aquatic Resources.

National Oceanic and Atmospheric Administration (NOAA). 2010. Essential Fish Habitat Consultation for Operations and Maintenance Dredging in the San Francisco Bay Area and Associated Dredged Material Placement. July 13.

National Oceanic and Atmospheric Administration (NOAA). 2012. Sei Whale *(Balaenoptera borealis),* Updated November 23, 2013. Accessed on 5 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/seiwhale.htm

National Oceanic and Atmospheric Administration (NOAA). 2013. Fin Whale (*Balaenoptera physalus)*, Updated September 4, 2013. Accessed on 5 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm and Black

Abalone, Updated 27 February 2013. Accessed on 9 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/invertebrates/blackabalone.htm

National Oceanic and Atmospheric Administration (NOAA). 2014a. White abalone, Updated November 25, 2014. Accessed on 10 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/invertebrates/whiteabalone.htm

National Oceanic and Atmospheric Administration (NOAA). 2014b. Guadalupe fur seal, Updated November 4, 2014. Accessed on 10 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/mammals/pinnipeds/guadalupefurseal.htm

National Oceanic and Atmospheric Administration (NOAA). 2014c. Leatherback Turtle, Updated June 23, 2014. Accessed on 10 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm

National Oceanic and Atmospheric Administration (NOAA). 2014d. Loggerhead Turtle, Updated December 15, 2014. Accessed on 10 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm

National Oceanic and Atmospheric Administration (NOAA). 2014e. Olive Ridley Turtle, Updated October 30, 2014. Accessed on 10 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/turtles/oliveridley.htm

National Oceanic and Atmospheric Administration (NOAA). 2014f. Coho salmon. Updated May 15, 2014. Accessed on 10 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/fish/cohosalmon.htm

National Oceanic and Atmospheric Administration (NOAA). 2015. North Atlantic Right Whales (*Eubalaena glacialis)*. Updated January 15, 2015. Accessed on 5 February 2015. Available at: http://www.nmfs.noaa.gov/pr/species/mammals/whales/north-atlantic-right-whale.html

National Oceanic and Atmospheric Administration (NOAA). Navigation Chart 18651. 2013. http://www.charts.noaa.gov/OnLineViewer/18651.shtml. December. Accessed April 13, 2015.

National Wildlife Federation (NWF), 2015. Accessed 10 February 2015. Available at: http://www.nwf.org/wildlife/wildlife-library/amphibians-reptiles-and-fish/sea-turtles/green-sea-turtle.aspx

NatureServe, 2013. Hysterocarpus traskii. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Downloaded on 11 February 2015.

NatureServe, 2014. Accessed 10 February 2015. Available at: http://explorer.natureserve.org/servlet/NatureServe?searchName=Cryptantha+hooveri

Navsource Naval History. 2015. http://www.navsource.org/archives/05/305.htm. Accessed March 5, 2015.

Nightingale, B., and C. Simenstad. 2001. *Overwater structures: Marine issues.* Aquatic Habitat Guidelines: An integrated approach to marine, freshwater, and riparian habitat protection and restoration. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington State Department of Transportation by University of Washington, Seattle, Washington.

Office of Coast Survey. 2010. Automated Wreck and Obstruction Information System. http://www.nauticalcharts.noaa.gov/hsd/awois.html. Accessed February 26th, 2015.

Oregon Department of Fish and Wildlife (Oregon DFW), 2015. Accessed on 5 February 2015. Available at: http://www.dfw.state.or.us/resources/fishing/warm_water_fishing/Sac_perch.asp

Pacific Biology, 2014, Pinole Creek at Interstate 80 Fish Passage Improvement Project--Biological Habitat Evaluation, September 2014.

Pacific EcoRisk. 2008. DATA REPORT Characterization of Port of Redwood City Sediments: Results of Dredge Materials Sampling and Analysis. March. http://www.dmmosfbay.org/site/alias__8931/170540/default.aspx. Accessed April 24, 2015.

Pacific EcoRisk. 2010. Sediment Characterization Sampling and Analysis Results (SAR) for the Port of Redwood City Berths 1-4: 2010 Re-Sampling and Analyses Dredge Maintenance Program. September. http://www.dmmosfbay.org/site/alias__8931/170540/default.aspx. Accessed April 24, 2015.

Paddison, Joshua. 2015. 1821-1847: Missions, Ranchos, and the Mexican War for Independence. University of California, Calisphere, http://www.calisphere.universityofcalifornia.edu/calcultures/eras/era3.html. Accessed January 28th, 2015.

Peddicord, R. K., and McFarland, V. A. (1978). "Effects of suspended dredged material on aquatic animals," Technical Report D-78-29, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS., NTIS No. AD A058 489. http://el.erdc.usace.army.mil/elpubs/pdf/trd78-29.pdf

Pennekamp, J G S and Quaak, M P (1990). Impact on the environment of turbidity caused by dredging. *Terra etAqua,* Vol. 42: 10-20.

Port of Redwood City. 2010. Port of Redwood City Wharves 1 and 2 Redevelopment Project Draft EIR. March.

Port of Redwood City. 2014. Board of Port Commissioners Terminal Tariff No. 8; Effective July 1, 2014.

Reine, K.J., D.G. Clarke, C. and Dickerson, 2002. "Acoustic characterization of suspended sediment plumes resulting from barge overflow," DOER Technical Notes Collection (ERDC TN-DOER-E15), U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Reine, K.J., and C. Dickerson, 2014. "Characterization of Underwater Sounds Produced by a Hydraulic Cutterhead Dredge during Maintenance Dredging in the Stockton Deepwater Shipping Channel, California," DOER-E38, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Reeves, et al, 1998. RECOVERY PLAN FOR THE BLUE WHALE. Prepared by Randall R. Reeves, Phillip J. Clapham, Robert L. Brownell, Jr., and Gregory K. Silber for the Office of Protected Resources National Marine Fisheries Service National Oceanic and Atmospheric Administration Silver Spring, Maryland. July 1998. Accessed on 5 February 2015. Available at: http://www.nmfs.noaa.gov/pr/pdfs/recovery/whale_blue.pdf

Robinson A, Greenfield BK. 2011. LTMS Longfin Smelt Literature Review and Study Plan. SFEI Contribution XXX. San Francisco Estuary Institute, Oakland, CA. 40 pp.

San Francisco Bay Conservation and Development Commission (BCDC). 2013. Application Summary for Consistency Determination No. C2004.005.03, for the proposed construction and use of a new 16,000-square-foot offloading facility at Cullinan Ranch. October 25.

San Francisco Bay Regional Water Quality Control Board (RWQCB). Draft Staff Report - Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines. May.

San Francisco Bay Regional Water Quality Control Board (RWQCB). 2011. Basin Plan. San Francisco Bay Basin (Region 2).

San Francisco Bay Regional Water Quality Control Board (RWQCB). 2015. San Francisco Bay (Region 2) Water Quality Control Plan. March 20. http://www.waterboards.ca.gov/sanfranciscobay/basin_planning.shtml. ASccessed April 25, 2015.

San Francisco Estuary Institute (SFEI). 2015. Montezuma Wetlands Project Description. http://www.californiawetlands.net/upfiles/273/Project%20Description-Oct20.pdf. Last Accessed April 19, 2015.

San Francisco Estuary Project. 2007. Comprehensive Conservation and Management Plan. http://www.sfestuary.org/about-us/strategic-plan/. Accessed March 29, 2015.

San Francisco International Airport (SFO), 2015. Website. *Fly Quiet Program.* Available at: http://www.flysfo.com/community-environment/noise-abatement/fly-quiet. Accessed on 16 March 2015.

San Joaquin kit fox, Last accessed on 10 February 2015. Availble at: http://www.epa.gov/espp/factsheets/san-joaquin-kitfox.pdf

Santa Clara County. 1994. Santa Clara County General Plan Book A and Book B. December 12. http://www.sccgov.org/sites/planning/PlansPrograms/GeneralPlan/Pages/GP.aspx. Accessed December 10, 2014.

Santa Clara County, 2003. Code of Ordinances, Title B Regulations, Division B11-Environmental Health, Chapter VII. Control of Noise and Vibration.

Santa Clara Valley Water District, 2000, Safe Clean Water Report and Clean, Safe Creeks and Natural Flood Protection Plan. Last accessed on 8 January 2015. Available at: http://www.valleywater.org/SafeCleanWater.aspx

Santa Clara Valley Water District (SCVWD). 2009. DEIR Alviso Slough Restoration Project. May. http://www.valleywater.org/services/alvisoslough.aspx. Accessed March 1 2015.

Save the Bay. 2015. The Story of Cullinan Ranch. http://blog.savesfbay.org/2015/01/the-story-of-cullinan-ranch/. Accessed February 9, 2015.

SBSP Restoration Project (SBSP Project). 2014. SBSP Restoration Project Phase 2 Draft EIS/EIR. December.

SCVWD. 2009. DEIR Alviso Slough Restoration Project. May. http://www.valleywater.org/services/alvisoslough.aspx. Accessed march 1 2015.

Seattle Audobon Society, 2015. Bird Web. Last accessed on 8 January 2015. Available at: http://birdweb.org/birdweb/bird/brewers_sparrow

SeaVision. 2011. *Survey Report: Sub-Bottom Profiler Survey (Final Report), Combined Bathymetry/ Sub-Bottom Survey, Redwood City and San Bruno Shoal Deepwater Ship Channels.* May 20.

Shakal, Anthony, et al. 2014. "*Proceedings of SMIP14 Seminar on Strong-Motion Data from the M6.0 South Napa Earthquake of August 24, 2014.* California Strong-Motion Instrumentation Program, California Geological Survey.

Shuford, W. D., and Gardali, T., editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

Solano County. 2008. Solano County General Plan. Chapter 2-Land Use; Chapter 4 Resources; Chapter 5- Public Health and Safety. August 5. http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp. Last Accessed February 22, 2015.

Solano County and Solano Economic Development Corporation, 2015. *Solano County 2014 Index of Economic and Community Progress*, March 2015. Available at: http://www.solanocounty.com/civicax/filebank/blobdload.aspx?BlobID=19863. Accessed on 18 March 2015.

Solano County Water District. 2012. Solano Habitat Conservation Plan. October. http://scwa2.com/water-supply/habitat/solano-multispecies-habitat-conservation-plan. Accessed March 19, 2015.

Sonoma.edu, 2015. California Coastal Prairie, Animals. Last accessed on 8 January 2015. Available at: http://www.sonoma.edu/preserves/prairie/prairie_desc/animals.shtml

Sonoma State University, Anthropological Studies Center. 2015. Shipwrecks. http://www.sonoma.edu/asc/publications/vestiges/Shipwrecks.html. Accessed February 4, 2015.

"Sperm Whales, Physeter macrocephalus ~ MarineBio.org." MarineBio Conservation Society. Web. Accessed Tuesday, February 10, 2015. <http://marinebio.org/species.asp?id=190>. Last update: 1/14/2013 2:22:00 PM

Starratt, Wes, PE, 2006. "Two Fireboats Save the Waterfront," San Francisco Bay Crossings, Accessed 15 April 2015. Available at: http://www.baycrossings.com/dispnews.php?id=1515

Stern, E.M., W.B. Stickle. 1978. Effects if Turbidity and Suspended Material in Aquatic Environments; Literature Review. Technical Report D-78-21, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, MS.

Sturtevant, William C. (gen. ed.). 1978. *Handbook of North American Indians*. 20 vols. Smithsonian Institution, Washington, D.C. https://books.google.com/books?id=I6b6EEE1YIIC&pg=PA299&lpg=PA299&dq=malaria+epidemic+california+1822&source=bl&ots=EVWoKYVPu7&sig=GmAk2nVhNfMCB3AOz4E5SYuh0Lw&hl=en&sa=X&ei=CYDBVNaHAYGlNqrPgLgK&ved=0CB4Q6AEwAA#v=onepage&q=malaria%20epidemic%20california%201822&f=false).

Tessler, et al, 2007. Black Oystercatcher (*Haematopus bachmani)* Conservation Action Plan, 1 April 2007, Prepared by David Tessler, James Johnson, Brad Andres, Sue Thomas, and Richard Lanctot for the Alaska Department of Fish and Game, the U.S. FWS, Manomet Center for Conservation Science, and WHSRN (Western Hemisphere Shorebird Reserve

Network). Accessed on 5 February 2015. Available at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/FocalSpecies/Plans/BLOY.pdf.

Tetra Tech Inc. 2005. Guadalupe River Watershed Mercury TMDL Report. Final Conceptual Model Report.

Tetra Tech Inc. 2006. Conceptual Model of Mercury in San Francisco Bay.

Thackston, E.L., Palermo, M.R. (a), 2000. Improved Methods for Correlating Turbidity and Suspended Solids for M onitoring, DOER Technical Notes Collection, ERDC TN-DOER-E8, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Treadwell and Rollo. 2011. *Geotechnical Progress Report Redwood City, California Preliminary Conclusions and Recommendations Port of Redwood City, Wharves 1 and 2.* September 23.

United States Army Corps of Engineers (USACE). 1989. Dredging Guidance Letter No. 89-01, USACE. March.

United States Army Corps of Engineers (USACE). 1998a. Oakland Harbor Deep Draft Navigation (50 foot) Improvement Project Draft Final Environmental Impact Report/Environmental Impact Statement. March

United States Army Corps of Engineers (USACE). 1998b. Oakland Harbor Deep Draft Navigation (50 foot) Improvement Project Draft Final Feasibility Report with Revisions. April

United States Army Corps of Engineers (USACE). 2003. "EM 1110-2-1902, Engineering and Design, Slope Stability."

United States Army Corps of Engineers (USACE). 2005. Mare Island Dredged Material Disposal Ponds, Final EIS/EIR. October. http://mareisland.org/EIS_EIR/Final%20EIS-EIR/Volume%20I%20Environmental%20Analysis/_%20Cover%20Volume%20I,%20Title,%20Contents.pdf.

United States Army Corps of Engineers (USACE). 2009, *Port of Los Angeles Channel Deepening Project, Volume I, Final Supplemental Environmental Impact Statement/Supplemental Environmental Impact Report*. April 2009.

United States Army Corps of Engineers (USACE). 2012. Environmental Assessment for Suisun Bay Channel and New York Slough Maintenance Dredging for Calendar Year 2012. September.

United States Army Corps of Engineers (USACE). 2013, Sutter Basin Pilot Feasibility Final Report--Final Environmental Impact Report / Supplemental Environmental Impact Statement, Prepared by the U.S. Army Corps of Engineers Sacramento District,

Central Valley Flood Protection Board, and Sutter Butte Flood Control Agency, Available at http://www.spk.usace.army.mil/Portals/12/documents/civil_works/Sutter/Final_Report/SutterPilotFeasibilityReport_FEIR-SEIS.pdf, Last accessed on 26 December 2014

United States Army Corps of Engineers (USACE). 2014a. Environmental Assessment of Redwood City Harbor Federal Channels, Maintenance Dredging, San Francisco, California, Calendar Year 2014 and 2015, draft document. August.

United States Army Corps of Engineers (USACE). 2014b. Redwood City Harbor 2014 O&M Dredging Sampling and Analysis Results.

United States Army Corps of Engineers (USACE). 2015a. South San Francisco Bay Shoreline Phase I Study, Integrated Document Environmental Impact Statement/Report. December.

United States Army Corps of Engineers. 2015b. Supplemental Report Redwood City Harbor 2014 O&M Dredging Composite Area 07 High Resolution Sampling and Analysis Results USACE Contract No. W912:7-D-0001 Kinetic Laboratories, Inc. and Atkens North America, January.

United States Army Corps of Engineers and Port of Oakland (USACE and Port of Oakland). 1998. Oakland Harbor Deep Draft Navigation (-50-foot) Improvement Project Draft Final Environmental Impact Report/Environmental Impact Statement. 1998a. March.

United States Army Corps of Engineers and Port of Sacramento. 2011. Draft Supplemental EIS/Subsequent EIR Sacramento River Deep Water Ship Channel. February. http://www.spn.usace.army.mil/Missions/ProjectsandPrograms/ProjectsAZ/SacramentoRiverDeepWaterShipChannel%28C%29/Main/Documents.aspx . Accessed 4/1/2015.

United States Army Corps of Engineers and Regional Water Quality Control Board for San Francisco Bay (USACE and RWQCB). 2014. Draft Environmental Assessment/Environmental Impact Report, Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay, Fiscal Years 2015-2024. December.

United States Army Corps of Engineers and Regional Water Quality Control Board for San Francisco Bay (USACE and RWQCB). 2015. Final Environmental Assessment/Environmental Impact Report, Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay, Fiscal Years 2015-2024. April.

United States Army Corps of Engineers and Santa Clara Valley Water District (SACE and SCVWD). 2014. Draft South San Francisco Bay Shoreline Phase I Study EIS/EIR. December. http://www.valleywater.org/SSFBS-DEIR.aspx)

United States Army Corps of Engineers and US Environmental Protection Agency (USACE & USEPA). 1998. Evaluation of Dredged Material Proposed for Disposal in Waters of the US – Testing Manual for Discharge in Inland and Near Coastal Water.

United States Army Corps of Engineers and US Environmental Protection Agency (USACE & USEPA). 2011. Letter to Mr. Robert S. Hoffman, Assistant Regional Administrator for Habitat Conservation, National Marine Fisheries Service, entitled: *Agreement on Programmatic EFH Conservation Measures for Maintenance Dredging Conducted under the LTMS Program (Tracking Number 2009/06769).* June 9.

United States Army Corps of Engineers and Weston. 2005. Characterization of suspended sediment plumes associated with Knockdown Operations at Redwood City Harbor, California. October 12.

United States Census Bureau. , 2010-2014. Quickfacts. Available at: http://quickfacts.census.gov/qfd/states/06000.html. Accessed on 18 March 2015.

United States Census Bureau (US Census Bureau). 2014. Income and Poverty in the United States: 2013 Current Population Reports. September. https://www.census.gov/content/dam/Census/library/publications/2014/demo/p60-249.pdf Accessed on 18 March 2015.

United States Department of the Navy. 2015. Naval History and Heritage Command official website. http://www.history.navy.mil/research/underwater-archaeology/sunken-military-craft-act/smca.html

United States Department of Transportation Federal Highway Administration (USDOT Federal Highway Administration), 2003, Public Roads, Volume 67. No. 1. "Living With Noise" by Chris Corbisier, July/August 2003, Available at: https://www.fhwa.dot.gov/publications/publicroads/03jul/06.cfm. accessed 25 March 2015.

United States Environmental Protection Agency (USEPA), 2010, Endangered Species Protection Program, Endangered Species Fact Sheet.

United States Environmental Protection Agency (USEPA). 2012, Noise Pollution website. (http://www.epa.gov/air/noise.html) accessed January 14, 2013.

United States Environmental Protection Agency (USEPA). 2014. Dredging and Sediment Management, San Francisco Deep Ocean Disposal Site. Last updated October 12, 2014. http://www.epa.gov/region9/water/dredging/sfdods/ accessed May 19, 2015.

United States Fish and Wildlife Service. 2008. Draft Environmental Impact Statement/Environmental Impact Report Cullinan Ranch Restoration Project Solano and Napa Counties. April. http://www.fws.gov/cno/refuges/cullinan/. Accessed 3.15.15.

United States Fish and Wildlife Service (USFWS). 1998. Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area. Accessed on 9 February 2015. Available at: http://ecos.fws.gov/docs/recovery_plans/1998/980930c.pdf

United States Fish and Wildlife Service (USFWS). 2008a. Oregon Fish and Wildlife Office, Species Fact Sheet: Short-tailed albatross, Last updated April 17, 2008. Accessed on 5 February 2015. Available at: http://www.fws.gov/oregonfwo/Species/Data/ShortTailedAlbatross/

United States Fish and Wildlife Service (USFWS). 2008b. Draft EIS/EIR Cullinan Ranch Restoration Project, Solano and Napa Counties, California. April. http://www.fws.gov/cno/refuges/cullinan/

United States Fish and Wildlife Service (USFWS). 2013. Oregon Fish and Wildlife Office, Species Fact Sheet: Pacific lamprey, Last updated February 25, 2013. Accessed on 5 February 2015. Available at: http://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/

United States Fish and Wildlife Service (USFWS). 2014a. Species Assessment and Listing Priority Assignment Form--*Hypomesus transpacificus* Delta smelt, May 2, 2014. Accessed on 5 February 2015. Available at: https://ecos.fws.gov/docs/species/uplisting/doc4452.pdf

United States Fish and Wildlife Service (USFWS). 2014b. Oregon Fish and Wildlife Office, Species Fact Sheet: Vernal pool fairy shrimp, Last updated April 28, 2014. Accessed on 5 February 2015. Available at: http://www.fws.gov/oregonfwo/Species/Data/VernalPoolFairyShrimp/

United States Fish and Wildlife Service (USFWS). 2014c. Oregon Fish and Wildlife Office, Species Fact Sheet: Northern spotted owl, Last updated May 27, 2014. Accessed on 5 February 2015. Available at: http://www.fws.gov/oregonfwo/species/data/northernspottedowl/

United States Fish and Wildlife Service (USFWS). 2014d. Oregon Fish and Wildlife Office, Vernal Pools, Last updated September 30, 2014. Accessed on 5 February 2015. Available at: http://www.fws.gov/oregonfwo/FieldOffices/Roseburg/VernalPools/

United States Fish and Wildlife Service and California Department of Fish and Game (USFWS and CDFW). 2007. South Bay Salt Pond Restoration Project Final EIS/EIR, December. http://www.southbayrestoration.org/EIR/downloads.html.

United States Geological Survey. 2008. Bay Area Earthquake Probabilities. http://earthquake.usgs.gov/regional/nca/ucerf/ Accessed March 15, 2015.

United States National Parks Service (NPS). 1992. National Register Bulletin 20. Nominating Historic Vessels and Shipwrecks to the National Register of Historic Places. http://www.cr.nps.gov/nr/publications/bulletins/nrb20/vs1.htm

United States National Parks Service (NPS). 1997. National Register Bulletin 15. How to Apply the National Register Criteria for Evaluation.

United States National Parks Service (NPS). 2015. Abandoned Shipwreck Act Guidelines. http://www.nps.gov/archeology/submerged/NRShips.htm. Accessed February 11, 2015.

United States National Parks Service (NPS). 2015. Nature & Science section. Accessed 10 February 2015. Available at: www.nps.gov

University of California, Berkeley, UC Museum of Paleontology. 2015a. http://ucmpdb.berkeley.edu/loc.html, Accessed February 25, 2015.Woodward-Lundgren & Associates. 1971. Soil and Geologic Data Collection, Bay Lands Flood Control Planning Study.

University of California, Davis (UCD), Center for Watershed Sciences, 2011. *Mylopharodon Conocephalus.* Accessed on 5 February 2015. Available at: http://pisces.ucdavis.edu/content/mylopharodon-conocephalus

University California, Davis (UCD), 2015. California Fish Website. Accessed on 5 February 2015. Available at: http://calfish.ucdavis.edu/species/?uid=38&ds=241

University of Rhode Island and USEPA. 2015. Estuarine Science - San Francisco Bay. http://omp.gso.uri.edu/ompweb/doee/science/descript/baysfran.htm; accessed 4/24/15.

URS Group, Inc (URS). 2014a. South Bay Salt Pond Restoration Project Eden Landing Preliminary Alternatives Analysis Report. June.

URS Group, Inc., 2014b. Final Environmental Assessment for Waterfront Repairs at United States Coast Guard Station Monterey. Monterey, California. Prepared for U.S. Coast Guard, January 2014. Accessed: 21 April 2015. Available at: http://www.nmfs.noaa.gov/pr/pdfs/permits/uscg_monterey_ea.pdfWalker, B. 2004. Effects of management practices on grassland birds: Brewer's Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. Northern Prairie Wildlife Research Center Online. Accessed on 9 February 2015. Available at: http://www.npwrc.usgs.gov/resource/literatr/grasbird/brsp/brsp.htm (Version 12AUG2004).

Wikipedia. 2015. http://en.wikipedia.org/wiki/USS_Thompson_(DD-305). Accessed April, 2015.

WILDLIFE PROGRAM REPORT NO2010-10. Accessed on 11 February 2015. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0CCwQFjAC&url=https%3A%2F%2Fnrm.dfg.ca.gov%2FFileHandler.ashx%3FDocumentID%3D24503&ei=BQXZVMLND8SnggSN0IGwCQ&usg=AFQjCNG28ku_fMH8u2B0YtB4qyTOoeA_DA&bvm=bv.85464276,d.eXY

Williams, 2013. Transcontinental Gas Pipe Line Company, LLC. Request for an Incidental Harassment Authorization Under the Marine Mammal Protection Act. Rockaway Delivery Lateral Offshore Pipeline Route. October 2013. Submitted to NMFS.

Wise, Charles L. President. 1921. Shipping, Volume 13, No. 1 "Marine Mishaps." New York: Shipping Publishing Company. January 10. https://books.google.com/books?id=HTQfAQAAMAAJ&pg=RA6-PA66&lpg=RA6-PA66&dq=%22city+of+glendale%22+and+schooner+and+Redwood&source=bl&ots=s_iP0u4pU5&sig=RdNJpHMaARZiiejczwOdCg8ZZnY&hl=en&sa=X&ei=CLjrVPaVB5CvoQT_loLADw&ved=0CB4Q6AEwAA#v=onepage&q=%22city%20of%20glendale%22%20and%20schooner%20and%20Redwood&f=false

Zembal, et al. 2010. *A SURVEY OF THE BELDING'S SAVANNAH SPARROW*. State of California The Resources Agency Department of Fish and Game Wildlife Branch. Richard Zembal and Susan M. Hoffman, Clapper Rail Recovery Fund, Huntington Beach Wetlands Conservancy P.O. Box 5903 Huntington Beach, CA 92615, September 2010. NONGAME Index

Personal Communications

Christine Boudreau. 2015. Personal Communication with Susa Gates.

R. Lowgren. 2015a. Personal Communication with Susanne von Rosenberg.

R. Lowgren. 2015b. Personal Communication with Susanne von Rosenberg.

13 Index

Beneficial reuse 3-24
Berth 4-6, 4-29, 4-31, 5-21
California Endangered Species Act ..... 23, iv, 4-63, 9-7
California Environmental Quality Act 1, 1-1
City
  Brisbane 1, 2-1, 4-26, 5-9, 5-11, 12-4
  Hayward 4-1, 4-40, 4-77, 5-9, 12-5
  Mountain View 3-19, 4-42, 4-43, 5-10, 12-5
  San Jose 2-7, 4-34, 4-42, 5-10, 12-6, 12-8, 12-10
  South San Francisco ... 1, 1-3, 1-4, 2-1, 2-6, 2-8, 2-15, 2-16, 2-17, 3-4, 3-9, 3-11, 3-19, 3-20, 4-2, 4-34, 4-43, 4-44, 5-20, 5-21, 5-23, 12-6, 12-7, 12-9, 12-10, 12-18
Clean Air Act ..... 23, iv, 9-7
Clean Water Act ..... iii, 1-3, 4-46, 9-3, 9-4
Coastal Zone Management Act ..... 23, iv, 4-12, 9-6
Constraints ..... 8, 9, i, 2-16
Construction Equipment
  Bubble curtain 4-15
  Clamshell Dredge ..... vi, 2-12, 4-22, 4-24, 4-27
  Cutterhead ..... vi, 4-18, 4-23, 4-24, 10-4, 12-13
  Scow ..... vi, 4-39
County
  Alameda 3-11, 3-20, 4-40, 4-42, 5-9, 5-11, 5-21, 12-1, 12-4
  San Mateo 1, 2-1, 4-34, 5-9, 12-3, 12-7, 12-8
  Santa Clara 1-4, 1-5, 5-10, 12-7, 12-14
  Solano 3-21, 4-35, 4-37, 5-8, 5-9, 5-12, 12-1, 12-15, 12-16
Directional drilling 4-25, 4-28
Dredging Option
  Option A 3-25, 4-6, 4-30, 4-56, 4-62, 4-63, 4-65, 4-66, 4-68, 4-72, 4-76, 4-78, 4-79, 5-16
Endangered Species Act ..... 22, iii, 3-4, 9-4
Environmental Justice ..... 16, ii, 5-6, 5-13, 6-9, 12-7
Erosion 4-50, 4-53
Fish and Wildlife Coordination Act ..... 22, iv, 9-5
Four Accounts
  Environmental Quality 16, 5-3, 6-6, 6-8, 12-7
  National Economic Development 1, 16, 2-15, 6-6, 6-8, 6-9
  Other Social Effects 16, 6-6, 6-8, 6-9
Fuel pipeline 4-12
Goals 9, 2-14, 12-9
Greco Island 1, 2, 4, 20, 21, v, 2-1, 2-3, 2-17, 3-7, 3-16, 4-7, 4-34, 4-53, 4-66, 6-11, 10-1, 10-4, 11-1
Green Sturgeon 12-10

Longfin Smelt 12-14
Magnuson-Stevens Act 9-5
Maintenance dredging.....2-16, 3-2, 4-7, 4-29, 4-34, 4-58, 4-71, 4-76, 4-78, 5-17, 5-19, 5-25, 10-7
National Environmental Policy Act ..... 1, 22, iii, 1-1, 9-3, 12-7
New work 2-14
No Action Alternative..... 4-58, 6-6
Noise . 19, 20, 4-46, 4-51, 4-62, 4-66, 4-69, 4-79, 4-80, 4-81, 5-4, 5-20, 5-21, 5-23, 5-24, 12-5, 12-6, 12-9, 12-10, 12-14, 12-19
Objectives..... i, v, 1-6, 2-1, 2-15, 3-3
Opportunities ..... i, 2-14, 4-51
Pile driving..... 4-14, 5-22
Placement Site
- Alviso Ponds 4-21, 4-24, 4-40, 4-42
- Cullinan .. 2, 9, 10, 11, 12, 13, 14, 15, 16, 17, vi, 2-1, 3-15, 3-21, 3-22, 3-24, 3-25, 3-26, 3-27, 3-28, 4-2, 4-5, 4-17, 4-20, 4-21, 4-22, 4-35, 4-36, 4-37, 4-38, 4-43, 4-45, 4-47, 4-49, 4-50, 4-52, 4-52, 4-57, 4-62, 4-64, 4-66, 4-67, 4-71, 4-73, 4-74, 4-75, 4-76, 4-77, 4-78, 4-81, 4-84, 4-85, 4-86, 5-1, 5-7, 5-10, 5-13, 5-14, 5-15, 5-16, 5-18, 5-23, 5-28, 5-29, 6-2, 6-4, 6-5, 6-8, 6-9, 6-10, 7-1, 12-4, 12-8, 12-14, 12-15, 12-19, 12-20
- Eden Landing. 2, 9, 10, 11, 12, 13, 22, v, vi, 1-4, 2-1, 2-14, 3-15, 3-16, 3-17, 3-19, 3-20, 3-24, 3-26, 3-27, 3-28, 4-2, 4-3, 4-13, 4-17, 4-18, 4-20, 4-21, 4-22, 4-31, 4-35, 4-40, 4-41, 4-42, 4-43, 4-45, 4-55, 4-56, 4-62, 4-64, 4-66, 4-67, 4-72, 4-74, 4-75, 4-76, 4-77, 4-78, 4-81, 4-84, 4-85, 4-86, 5-2, 5-4, 5-7, 5-9, 5-17, 5-18, 5-23, 5-24, 5-29, 6-1, 6-11, 10-6, 12-1, 12-21
- Montezuma 2, 9, 10, 11, 12, 13, 14, 15, 16, 17, vi, 2-1, 3-15, 3-21, 3-22, 3-24, 3-25, 3-26, 3-27, 3-28, 4-2, 4-5, 4-17, 4-20, 4-21, 4-22, 4-35, 4-37, 4-38, 4-45, 4-52, 4-52, 4-57, 4-62, 4-64, 4-65, 4-66, 4-72, 4-74, 4-75, 4-77, 4-78, 4-80, 4-81, 4-82, 4-84, 4-85, 4-86, 5-7, 5-9, 5-18, 5-23, 6-2, 6-4, 6-5, 6-8, 6-9, 6-10, 6-11, 7-1, 12-14
- SF-DODS .9, 10, 12, 13, 14, 15, 16, 17, 21, 22, iv, vi, 2-1, 2-14, 3-3, 3-11, 3-13, 3-14, 3-15, 3-16, 3-22, 3-23, 3-24, 3-25, 3-26, 3-28, 4-1, 4-2, 4-17, 4-19, 4-20, 4-21, 4-22, 4-31, 4-35, 4-38, 4-39, 4-45, 4-52, 4-52, 4-57, 4-62, 4-64, 4-65, 4-66, 4-67, 4-68, 4-72, 4-74, 4-75, 4-77, 4-78, 4-79, 4-80, 4-82, 4-84, 4-85, 4-86, 5-2, 5-3, 5-4, 5-7, 5-15, 5-18, 5-19, 5-23, 6-2, 6-4, 6-5, 6-7, 6-8, 6-9, 6-10, 6-11, 10-2, 10-3, 10-4, 10-6, 12-9
- South Bay Salt Pond ....i, v, vi, 1-3, 1-4, 2-14, 3-16, 3-17, 3-18, 3-19, 4-42, 5-20, 6-1, 12-4, 12-8, 12-9, 12-20, 12-21

Porter-Cologne Water Quality Control Act..... 9-3
Problems ..... i, 2-12
Rivers and Harbors Act..... 23, iv, 9-6
Salmonids 12-10
Section 401..... iii, 1-3, 2-14, 4-12, 9-3
Section 404(b)(1)..... 9-4
Section 7 Biological Assessment 22, 9-5
Special Status species 2-16
Tentatively Selected Plan..... 17, 22, iii, 1-5, 1-7, 6-1, 6-10
Traffic ..... 5, 6, 20, i, v, 2-5, 2-6, 3-3, 3-7, 3-13, 4-12, 4-52

Turbidity 4-15, 4-46, 4-50, 4-53, 5-1, 12-16
Vessel call 4-33
Vibration 20, 4-51, 12-14
Water Quality Certification ..... 22, iii, 9-3, 9-4

Draft Integrated Feasibility Report and Environmental Impact Statement/Environmental Impact Report

Redwood City Harbor Navigation Improvement
Feasibility Study and Integrated EIS/EIR

Affected Environment Resource Assessment

Appendix A



US Army Corps of Engineers®

San Francisco District
U.S. Army Corps of Engineers
1455 Market
San Francisco, California 94103-1398

July 2015

This page was intentionally left blank.

Contents

A. Affected Environment Resource Assessment 1
A.1 Resource Areas Not Evaluated in Detail 1
A.1.1 Aesthetics 1
A.1.2 Mineral Resources 2
A.1.3 Public Services 2
A.2 Air Quality and Green House Gases 3
A.2.1 Affected Environment 4
A.2.2 Significance Thresholds 11
A.2.3 Environmental Consequences 13
A.2.2 Mitigation Measures 26
A.3 Biological Resources Overview 26
A.3.1 Affected Environment 27
A.3.2 Significance Thresholds 39
A.3.3 Habitat Conservation Plan, Natural Community Conservation Plan, or other Approved Local, Regional, or State Habitat Conservation Plans 41
A.3.4 Special Status Species 41
A.4 Biological Resources – Fish and Aquatic Resources 42
A.4.1 Environmental Consequences 42
A.4.2 Mitigation Measures 71
A.5 Biological Resources – Terrestrial Resources 72
A.5.1 Environmental Consequences 72
A.5.2 Mitigation Measures 85
A.6 Cultural Resources 86
A.6.1 Affected Environment 86
A.6.2 Significance Thresholds 95
A.6.3 Environmental Consequences 97
A.6.4 Mitigation Measures 104
A.7 Geology/Soils/Seismicity 106
A.7.1 Affected Environment 106
A.7.2 Significance Thresholds 117

A.7.3 Environmental Consequences 117
A.7.4 Mitigation Measures 121
A.8 Hazards and Hazardous Material 122
A.8.1 Affected Environment 122
A.8.2 Significance Thresholds 130
A.8.3 Environmental Consequences 130
A.8.4 Mitigation Measures 137
A.9 Land Use and Planning 137
A.9.1 Affected Environment 137
A.9.2 Significance Thresholds 140
A.9.3 Environmental Consequences 140
A.9.4 Mitigation Measures 146
A.10 Noise and Vibration 146
A.10.1 Affected Environment 148
A.10.2 Significance Thresholds 153
A.10.3 Environmental Consequences 154
A.10.4 Mitigation Measures 171
A.11 Recreation 172
A.11.1 Affected Environment 172
A.11.2 Significance Thresholds 179
A.11.3 Environmental Consequences 179
A.11.4 Mitigation Measures 183
A.12 Socioeconomics/Population/Housing 183
A.12.1 Affected Environment 184
A.12.2 Significance Thresholds 188
A.12.3 Environmental Consequences and Mitigation 189
A.12.4 Mitigation Measures 190
A.13 Transportation/Navigation/Traffic 190
A.13.1 Affected Environment 190
A.13.2 Regulatory Setting 199
A.13.3 Significance Thresholds 200

A.13.4 Environmental Consequences 201
A.13.5 Mitigation Measures 206
A.14 Utilities/Service Systems 206
A.14.1 Affected Environment 206
A.14.2 Significance Thresholds 208
A.14.3 Environmental Consequences 208
A.14.4 Mitigation Measures 211
A.15 Water Quality and Hydrology 211
A.15.1 Affected Environment 211
A.15.2 Significance Thresholds 222
A.15.3 Environmental Consequences 222
A.15.4 Mitigation Measures 237
A.16 References 238

Tables

Table A-1. National and California Ambient Air Standards, Bay Area Attainment Status 7
Table A-2. CEQA BAAQMD Threshold Values for Construction and Operation Emissions 12
Table A-3. General Conformity de Minimis Thresholds for Construction Emissions 13
Table A-4. Calculated Dredging and Transportation Emissions Based on CEDEP Estimate 18
Table A-5. Dredging Options – Estimated Dredging and Transport Emissions 21
Table A-6. CEQA BAAQMD Threshold Comparison for Construction Emissions 22
Table A-7. General Conformity Threshold Comparison for Construction Emissions 24
Table A-8. Current and Forecast Vessel Calls at Port of Redwood City 26
Table A-9. Response of Marine Species to Certain Concentration Levels of Total Suspended Sediments (Anchor 2003) 49
Table A-10. Shipwreck Data 94
Table A-11. Sound Levels and Relative Loudness of Typical Noises in Indoor and Outdoor Environments 147
Table A-12. Estimated Equipment Noise Levels at Dredging Sites 155
Table A-13. Estimated Noise Levels at Dredging Sites Compared to Ambient Conditions 156
Table A-14. Estimated Equipment Noise Levels by Placement Site 161
Table A-15. Predicted Noise Levels at Placement Sites Compared to Ambient Levels 163
Table A-16. Socioeconomic Data by Jurisdiction and Project Site, Redwood City Harbor Navigation Improvement Project 186
Table A-17. Main Industries in Project Area for RWC Navigation Improvement Project 187
Table A-18. Commercial Traffic and Commodity Volumes, Port of Redwood City 194

Figures

Figure A-1. Montezuma Wetland Restoration and Cullinan Ranch Restoration Sites 4
Figure A-2. Map of BAAQMD Air Quality Monitoring Sites (Source: BAAQMD 2015b) 10
Figure A-3. South Bay Salt Pond Restoration Project 37
Figure A-4. Alviso Pond Complex 63
Figure A-5. Eden Landing Ponds 68
Figure A-6. Alquist-Priolo Earthquake Fault Zones 109
Figure A-7. Earthquake Liquefaction Susceptibility 112
Figure A-8. Study Area including SF-DODS 139
Figure A-9. Existing and Planned Ferry Routes in San Francisco Bay 193
Figure A-10. Transit Route to and from SF-DODS 196
Figure A-11. Sub-bays of San Francisco Bay 212

A. Affected Environment Resource Assessment

This appendix supplements ***Chapter 4***, *Affected Environment, Environmental Consequences, and Mitigation Measures* of the *Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR*. In this document, each individual resource area is assessed to establish the baseline conditions, potential impacts that would result from the alternatives being considered are evaluated, and when appropriate, mitigation measures are identified.

This document refers to the *Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR* (without appendices) as the Main Integrated Report.

A.1 Resource Areas Not Evaluated in Detail

For some resource areas, it was not necessary to perform detailed analyses to determine that there would be no significant impacts caused by the Project Alternatives. These rational for concluding there would be no significant impacts to these resource areas are provided in the following sub-sections.

Aesthetics

Although aesthetic evaluations are inherently subjective, certain views are widely held to be scenic. Such vistas typically comprise or partially encompass natural landscapes and notable landmarks of the built environment. In the Project area, the important natural scenic resources and scenic features of the built environment include the Redwood City Harbor and Bair Island areas; San Francisco Bay and skyline near San Bruno Shoals and Alcatraz; South San Francisco Bay shoreline (including Eden Landing, Alviso and Ravenswood South Bay Salt Pond restoration sites and Dumbarton restoration area); and open ocean areas west of San Francisco.

To some observers, aesthetic resources may be considered slightly degraded during dredging and placement activities from the presence of dredge equipment, floating pipelines and turbidity produced during dredging and placement activities. These impacts would be temporary and would occur in locations where dredging and placement activities have occurred regularly in the past. Also, the temporary impacts (3-6 moths) to the visual landscape would be offset by the long-term aesthetic improvements provided by the restoration project. In addition, the waters of San Francisco Bay already include similar uses and equipment, such as ferry terminals, ports, scows, and industrial and commercial shipping operations that are part of the existing visual landscape. In this context, impacts to aesthetics and visual resources from the project alternatives would be negligible. The USACE would not use the placement sites until appropriate environmental review is completed, including evaluation of impacts on visual resources and aesthetics.

Therefore, the project alternatives would not adversely impact aesthetics and visual resources, and this resource is not evaluated further in this EIS/EIR.

Mineral Resources

The proposed Project would not require quarrying, mining, dredging, or extraction of locally important mineral resources within the Project Area, nor would it deplete any nonrenewable natural resource. Sand is mined from the San Francisco Bay for industrial and agricultural uses. Geographically, mining activity occurs in three areas: the Central Bay west of Angel Island; at Middle Ground Shoal just east of Port Chicago; and in the eastern portion of Suisun Channel (USACE 2012). No sand mining areas are located in the vicinity of the dredging sites, or the Eden Landing or Alviso ponds.

To reach the SF-DODS, Cullinan, and Montezuma placement sites Project-related vessel traffic may transit near some of the sand mining locations; however, Project-related vessel traffic would be a small fraction of the more than 130,000 annual vessel movements in San Francisco Bay. Dredging of the RWC and SBS Channels, and placement of dredged materials at any of the placement sites under the proposed alternatives would not adversely impact sand mining. The Project would not occur near and would not affect any land-based mineral resources. The proposed Project would not result in adverse impacts on mineral resources and therefore does not warrant further discussion in this EIR.

Public Services

Evaluating impacts to public services requires determining whether the proposed Project would affect the level of service and the need for expansion of fire protection, police, schools, public parks and libraries, and/or if the Project would impair emergency response capability. Workers for the project would be sourced from the existing labor pool and this Project is not expected to increase the service population for the Project Area. No new public facilities would need to be built or expanded as a result of the Project, since it is not projected to affect population, nor demand for services.

Emergency response capability could be reduced if the Project caused reduced access to locations requiring emergency response. The vast majority of the activities associated with this Project would occur on the water. All dredging would occur in-Bay at RWC Channel and SBS Channel and all of the placement sites would be accessed by water. Any upland activities to place and manage sediment delivered by the RWC Project are analyzed separately through each site's permitting process.

Offloaders and pipelines constructed by the Project would be placed so as to not obstruct navigation, and would be appropriately marked to avoid potential vessel incidents. Transport of sediment would require up to 75 round-trip scow trips per month for 6 months per year;[1] this is a small fraction of the total vessel traffic in San Francisco Bay. Vessels would be in contact with the US Coast Guard's Vessel Traffic Service, San Francisco (VTS). There would be

[1] Tug trips to Eden Landing and Alviso could be considerably higher because these sites are much closer; up to 175 tug trips per month could occur.

neither a need for additional emergency response nor a requirement for new or expanded public facilities as a result of Project construction.

The RWC Channel is approximately 21,000 feet (roughly four miles) in length and currently experiences low frequency large vessel traffic. In 2014 the Port had a total of 107 vessel calls. If averaged out per month, this equates nine vessel calls per month to the Port. The proposed Project would not cause cargo growth, and due to the efficiencies of the deeper channel (vessels can be loaded more heavily), the total number of vessel calls would be reduced compared to the No Project/No Action alternative. Thus, following deepening, emergency access would be the same or better for RWC and SBS Channels. Dredging RWC Channel and transporting dredged material from the dredge site to placement sites would not adversely affect the over-water public service activities performed by police, fire and any other emergency service in the South Bay due to the existing low traffic conditions and adequate width of the channel.

SBS channel experiences higher marine traffic than RWC channel, however there is ample maneuvering width for most vessels to either side of the channel. The deepening and subsequent maintenance of SBS channel would improve the safe navigability of the channel, again providing a beneficial impact to on-water public services.

Implementation of the Project would have no adverse impacts on public services and this resource is not evaluated further in this EIS/EIR.

A.2 Air Quality and Green House Gases

This section (***A.2***) discusses the relevance of both air quality and greenhouse gas (GHG) emissions to the study areas and Project activities. For this Project, air emissions result from engines of the vessels and equipment used for dredging, transport of the dredged material, and placement of the material. The Project is composed of a construction phase and an operational phase. For purposes of the air quality/GHG analysis:

- The construction phase would involve dredging up to 7,715,000 cy of sediment combined from RWC and SBS Channels and Berths 1 through 4 at the Port of Redwood City. As explained further in the Methodology Section (***Section A.2.2***), construction emission estimates were developed based on equipment estimates. The equipment estimates were taken from preliminary cost estimates prepared assuming 904,700 cy of material are dredged and placed into one of three placement sites: SF-DODS; Montezuma, or Cullinan (***Figure A- 1***). The air quality/GHG impacts of sediment delivery to the Eden Landing and Alviso Ponds are not evaluated because there is insufficient information regarding the likely operating parameters for sediment delivery to these sites.

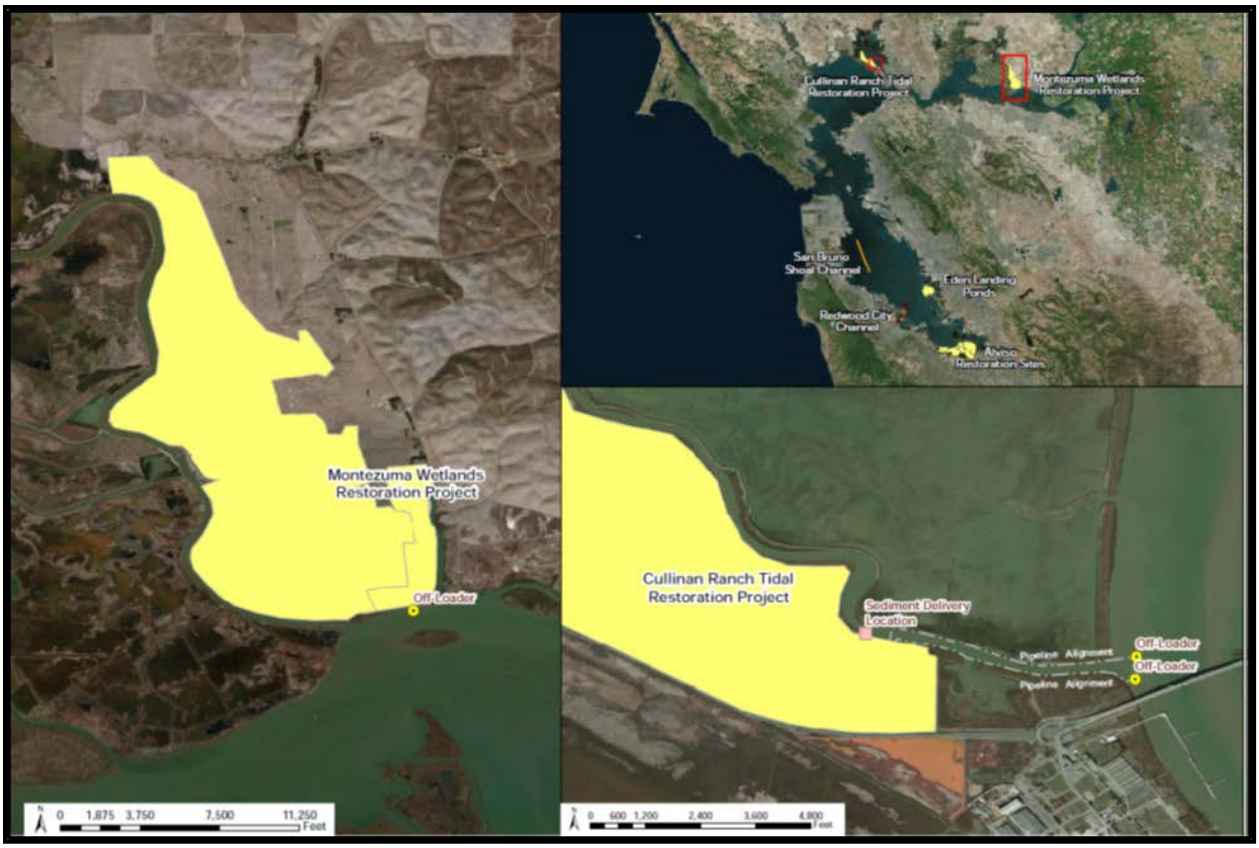


Figure A-1. Montezuma Wetland Restoration and Cullinan Ranch Restoration Sites

- The operational phase involves only the two channel locations, and how the deeper channels would affect vessel traffic patterns and the resulting air emissions over the short- and long-term.

Existing air quality and GHG emissions in the study areas, the proposed Project's significance thresholds, and the short-term and long-term environmental consequences of deepening the RWC and SBS Channels and Port berths, compared to the No Action Alternative (no deepening) are discussed within this sub-section. The applicable regulations related to air quality and GHG emissions that construction and operational activities must consider are described in more detail in ***Appendix G***, Regulatory Setting. Calculations used to develop final emission estimates are found in ***Attachment 1*** to this appendix, Air Quality and Greenhouse Gas Emission Calculations.

A.2.1 Affected Environment

The Project site is located in the San Francisco Bay Area Air Basin (Basin). The Basin includes nine-county regions including all of Alameda, Contra Costa, Santa Clara, San Francisco, San Mateo, Marin and Napa counties, and the southern portions of Solano and Sonoma counties. The Bay Area consists of mountains, valleys, and bays, which result in specific wind flow patterns. Wind patterns vary from season to season. Wind tends to move from areas of high-

pressure to low-pressure. In warm months, air currents move on-shore from the ocean to inland areas. Pacific Ocean air receives emissions from numerous anthropogenic and biogenic sources as it comes onshore. During the summer northwest winds enter the Bay Area through the Golden Gate Bridge and the lower portions of the Peninsula. This jet flow sweeps eastward, through the Golden Gate Bridge, creating southwest winds at Berkeley and northwest winds at San Jose. During the winter, the Pacific high pressure cell weakens and shifts southward. During winter rainy periods, inversions are weak or nonexistent, winds can be moderate to strong and air pollution potential decreases. Winter dry periods that can last over a week increase the potential for carbon monoxide (CO) and particulate pollution occurrences.

A.2.1.1 Air Quality

Air quality can be quantified by the concentration of various pollutants in the atmosphere. Air quality is affected by the rate, amount and location of air pollutants, and by the environmental conditions of the area that influence pollutant dispersal. Units of concentration are in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The importance of a pollutant is determined by comparing its concentration to an appropriate Federal, state, and/or regional ambient air quality standard. These threshold values represent allowable maximum concentrations into the air to maintain an appropriate and safe air quality. Specific pollutants are described below and Federal, state and regional thresholds are described in ***Section A.2.2***.

The Federal Clean Air Act (CAA) requires USEPA to set National Ambient Air Quality Standards (NAAQS) (40 Code of Federal Regulations [CFR] Part 50) for six pollutants considered harmful to public health and the environment. These standards are the maximum allowable atmospheric concentrations that may occur while protecting public health and welfare with a reasonable margin of safety. They include short-term (1-, 3-, 8-, and 24-hour periods) and long-term standards (quarterly and annual averages). USEPA has defined "primary" and "secondary" ambient thresholds for each of six criteria pollutants. Primary thresholds protect human health, particularly sensitive receptors such as children, the elderly, and sick. Secondary standards protect the natural environment.

USEPA calls these pollutants criteria air pollutants because it regulates them by developing science-based guidelines and permissible levels. The six criteria air pollutants are:

- **Ozone.** Ozone (O_3) is found in two regions of the Earth's atmosphere – at ground level and within the upper atmosphere regions. Ground-level ozone, or smog, is an air pollutant. Ozone is formed by chemical reactions between nitrogen oxides (NO_X) and volatile organic compounds (VOCs). Ozone is likely to reach unhealthy levels on hot sunny days in urban environments and can be transported long distances by wind. Emissions from industrial facilities and electric utilities, engine exhaust, gasoline vapors, and chemical solvents are some of the major sources of NO_X and VOCs.
- **Particulate matter (PM).** PM refers to a range of particles in the atmosphere including dust, aerosols and metallic oxides, and organic chemicals (USEPA 2015). Some PMs,

such as pollen, are naturally occurring. Whether natural or anthropogenic, PMs can cause health problems, reduced visibility (or haze), and adverse environmental impacts (acidification of waterbodies). The size of particles is directly linked to their potential for causing health and environmental problems. The USEPA is concerned about particles that are 10 micrometers in diameter or smaller because these particles can pass through the throat and nose and enter the lungs or travel long distances in the wind. Two categories of PM have been defined: PM_{10} and $PM_{2.5}$, particles less than 10 and 2.5 micrometers in diameter, respectively.

PM may also be classified as primary or secondary depending on the compounds and processes involved during its formation. Primary particles are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks, or fires. Secondary particles form in complicated reactions in the atmosphere of chemicals such as sulfur dioxides and NOx that are emitted from power plants, industries, and automobiles. Secondary particles make up most of the fine particle pollution in the country.

- **Carbon monoxide (CO).** CO is a colorless, odorless gas emitted from combustion processes, largely originating from mobile sources. Exposure to CO can reduce the oxygen-carrying capacity of the blood.

- **Nitrogen Dioxide (NO_2).** NO_2, a reactive oxide of nitrogen, is one component of NOx. Other nitrogen oxides include nitrous acid and nitric acid. While USEPA's NAAQS covers the entire group of NO_X, NO_2 is of greatest interest and the indicator for the larger group of nitrogen oxides. NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO_2 is linked with a number of adverse effects on the respiratory system.

- **Sulfur dioxide (SO_2).** SO_2 is an oxide of sulfur. The largest sources of SO_2 emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%) (USEPA 2015). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO_2 is linked with a number of adverse effects on the respiratory system.

- **Lead.** In the past, sources of lead emissions have been from fuels from motor vehicles and industry. Regulations have decreased emissions from transportation sources, and today the major sources of lead emissions are ore and metals processing and piston-engine aircraft operating on leaded aviation gasoline (USEPA 2015). Lead can affect the nervous system, kidney function, immune system, reproductive and developmental systems, and the cardiovascular system.

USEPA has classified air basins as "attainment" or "nonattainment" for each criteria pollutant, based on whether or not the national standards have been achieved (40 CFR Part 81, Subpart C, Section 107). The CAA requires each state to develop a State Implementation Plan (SIP) that is its primary mechanism for ensuring that the NAAQS are achieved and maintained within that state. The California Clean Air Act (CCAA), patterned after the Federal CAA, also designates areas as "attainment" or "nonattainment".

Individual states may also establish their own air quality standards. The California Health and Safety Code, Section 39606, authorizes the California Air Resources Board (CARB) to set ambient air pollution standards for public health, safety, and welfare. CARB makes area designations for 10 pollutants: O_3, suspended particulate matter (PM_{10} and $PM_{2.5}$), CO, NO_2, SO_2, sulfates, lead, hydrogen sulfide (H_2S), and visibility reducing particles.

- Regional air districts also develop local air quality/pollutant regulations and prepare air quality plans that set goals and measures for achieving attainment with NAAQS and CAAQS. The districts develop emission inventories, collect air monitoring data, and perform and perform analyses.

Table A-1 shows the NAAQS and CAAQS and the Bay Area's attainment status for each standard.

Table A-1. National and California Ambient Air Standards, Bay Area Attainment Status

		California Standards		National Standards	
Pollutant	**Averaging Time**	**Concentration**	**Attainment Status**	**Concentration**	**Attainment Status**
Ozone	8 Hour	0.070 ppm (137 µg/m^3)	Nonattainment	0.075 ppm	Nonattainment
	1 Hour	0.09 ppm (180 µg/m^3)	Nonattainment		
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m^3)	Attainment	9 ppm (10 mg/m^3)	Attainment
	1 Hour	20 ppm (23 mg/m^3)	Attainment	35 ppm (40 mg/m^3)	Attainment
Nitrogen Dioxide	1 Hour	0.18 ppm (339 µg/m^3)	Attainment	0.100 ppm	Unclassified
	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)		0.053 ppm (100 µg/m^3)	Attainment
Sulfur Dioxide	24 Hour	0.04 ppm (105 µg/m^3)	Attainment	0.14 ppm (365 µg/m^3)	Attainment
	1 Hour	0.25 ppm (655 µg/m^3)	Attainment	0.075 ppm (196 µg/m^3)	Attainment
	Annual Arithmetic Mean			0.030 ppm (80 µg/m^3)	Attainment
Particulate Matter	Annual Arithmetic Mean	20 µg/m^3	Nonattainment		

Pollutant	Averaging Time	California Standards		National Standards	
		Concentration	Attainment Status	Concentration	Attainment Status
(PM_{10})	24 Hour	50 µg/m^3	Nonattainment	150 µg/m^3	Unclassified
Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	Nonattainment	15 µg/m^3	Attainment
	24 Hour			35 µg/m^3	Nonattainment
Sulfates	24 Hour	25 µg/m^3	Attainment		
Lead	30 Day Average	1.5 µg/m^3			Attainment
	Calendar Quarter	-		1.5 µg/m^3	Attainment
	Rolling 3 Month Average	-		0.15µg/m^3	
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Unclassified	No Federal Standards	
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm (26 µg/m^3)	No information available		
Visibility Reducing Particles	8 Hour (10:00 to 18:00)		Unclassified		

mg/m^3 = milligrams per cubic meter
ppm = parts per million
µg/m^3 = micrograms per cubic meter
Source: (BAAQMD 2015a)

A.2.1.1.1 **Toxic Air Contaminants (TACs)**

The California Health and Safety Code defines TACs (also known as hazardous air pollutants or HAPs) as air pollutants that may cause/contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. TACs are less pervasive in the urban atmosphere than criteria air pollutants, but are linked to acute or chronic and/or carcinogenic adverse health effects (USEPA 2015). USEPA is working with state, local, and tribal governments to reduce air toxics releases of 187 pollutants to the environment. Examples of toxic air pollutants include benzene, found in gasoline; perchloroethylene, emitted from some dry cleaning facilities; and methylene chloride, used as a solvent and paint stripper. Most air toxics originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Some air toxics are also released from natural sources such as volcanic eruptions and forest fires. Diesel particulate matter (DPM) has also been identified as a TAC by CARB (CARB 1998). DPM is not a single substance, but rather a mixture of many substances. Research by the Bay Area Air Quality Management District (BAAQMD) indicates that DPM emitted by diesel engines, accounts for more than 85 percent of

the total inventoried cancer risk from TACs in the Bay Area, and is one of the TACs of greatest concern statewide (BAAQMD 2014).

A.2.1.1.2 **Sensitive Receptors**

Sensitive receptors are those segments of the population most susceptible to poor air quality: children, the elderly, and those with pre-existing serious health problems affected by air quality (e.g. people at residences, schools and school yards, parks and playgrounds, daycare centers, nursing homes, and medical facilities). Most USACE Federal navigation channels and existing placement sites are not located near sensitive receptors.

A.2.1.1.3 **Air Quality in the Project Area**

BAAQMD maintains a database of air quality data collected at ambient air monitoring locations throughout the region (***Figure A-2***). Monitored pollutants include O_3, NOx, CO, SO_2, H_2S, PM_{10} and $PM_{2.5}$, hydrocarbons, elemental and organic carbon, and various hazardous air pollutant compounds. Not all constituents at monitored at each location. The Bay Area is currently classified as non-attainment for the:

- National and California eight-hour ozone standard;
- California PM_{10} standard;
- California $PM_{2.5}$ annual arithmetic mean standard; and,
- The National $PM_{2.5}$ 24 hour standard (BAAQMD 2015a).

Over the past three years (2011 through 2013), the following specific exceedances were observed at monitoring stations located near RWC and SBS Channels (BAAQMD 2015b):

- Redwood City (closest monitoring station to RWC Channel):
    - No exceedances of the national 8-hour ozone standard, NO_2 or CO.
    - Three exceedances of the national 24-hour $PM_{2.5}$ standard.
- San Francisco (closest monitoring stations to SBS Channel)
    - No exceedances of the national standards for O_3, PM_{10}, or CO.
    - Three exceedances of the national 24-hour $PM_{2.5}$ standard.
    - One exceedance of the national 1-hour NO_2 standard.

Similarly for the proposed placement sites, the following exceedences were observed at nearby monitoring stations over the past three years (BAAQMD 2015b):

- Vallejo (monitoring station closest to the Cullinan Ranch Tidal Restoration Project):
    - No exceedances of the national standards for O_3, NO_2, SO_2, or CO

- Eight exceedances of the national 24-hour $PM_{2.5}$ standard.

- Martinez (monitoring station to the Montezuma Wetlands Restoration Project)
  - SO_2 concentrations did not exceed the national 1-hour 75-ppb standard.

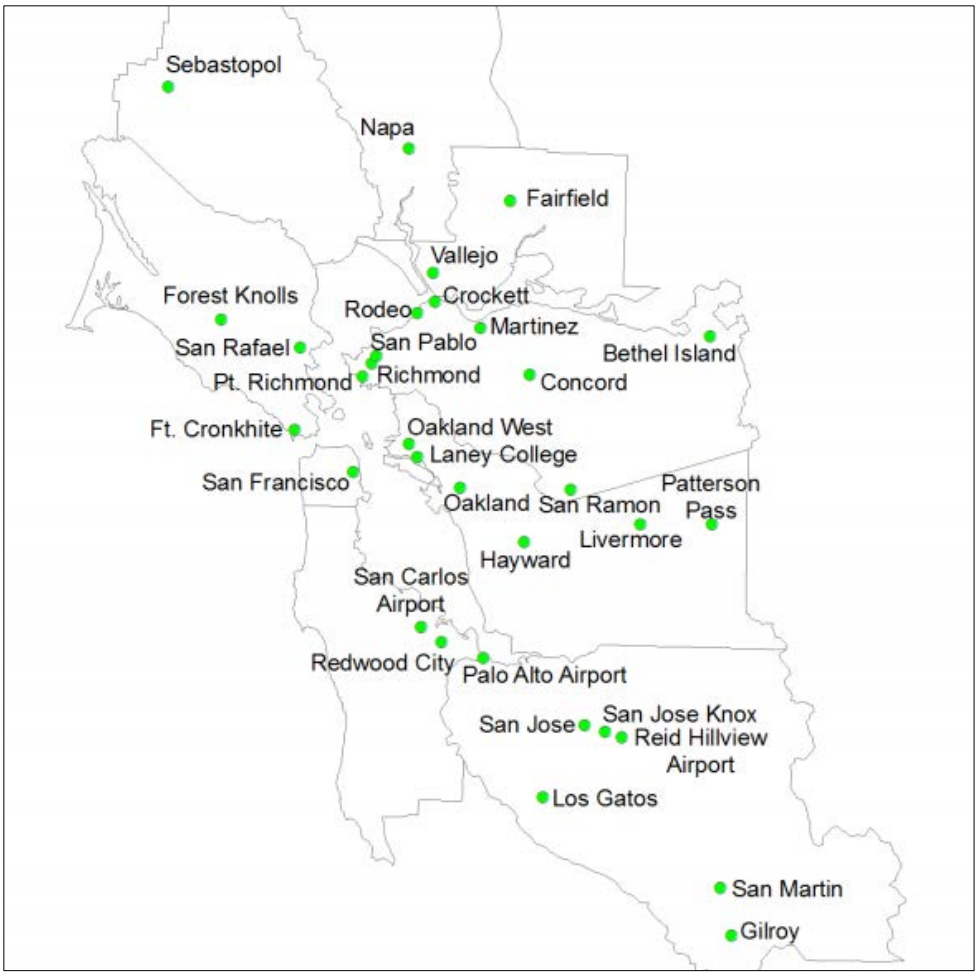


Figure A-2. Map of BAAQMD Air Quality Monitoring Sites (Source: BAAQMD 2015b)

A.2.1.2 A.2.2 Greenhouse Gases and Climate Change

Climate is governed by incoming solar radiation and the greenhouse effect. The "greenhouse effect" is the result of certain naturally occurring, atmospheric gases absorbing long-wave radiation emitted from the Earth. Absorption of this long-wave radiation in the atmosphere, as opposed to being transmitted into space, warms the Earth. Gases that trap heat in the atmosphere are called greenhouse gases (GHGs). GHGs emissions adversely affect the environment by contributing to global climate change. In order of importance to the greenhouse effect, GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and O_3. While some gases, such as CH_4 nitrous oxide (N_2O), are more effective at trapping heat than others, such as CO_2 and water vapor, the latter are present in much greater

quantities in the atmosphere, and thus have a much higher contribution to the greenhouse effect.

Natural factors, which include solar variation and volcanic activity, contribute to climate change. However, strong scientific evidence suggests that these factors alone do not fully explain the observed accelerated global warming of the past few decades. Human (anthropogenic) activities such as the burning of fossil fuels (adding more GHGs to the atmosphere) and clearing of forests (removing a natural sink for carbon dioxide), have intensified the natural greenhouse effect. Carbon dioxide emissions from the burning of fossil fuels are the most substantial source of anthropogenic GHG emissions. The primary human activity affecting the amount and rate of climate change is GHG emissions from the burning of fossil fuels. The most important GHGs directly emitted by human activities include CO_2, CH_4, N_2O, and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. In 2013, CO_2 accounted for 82% of all US greenhouse gases according to the USEPA (2015).

The USEPA issued a "Mandatory Reporting of Greenhouse Gases Rule" on October 30, 2009. The rule, referred to as 40 CFR Part 98 or Part 98, is referred to as the Greenhouse Gas Reporting Program. GHGs covered under the Greenhouse Gas Reporting Program are CO_2, methane, N_2O, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers. Each GHG is assigned a global warming potential (GWP), which is then standardized to CO_2 (with CO_2 having a value of 1). The GWP is a measure of the ability of a gas or aerosol to trap heat in the atmosphere. GHG emissions in ***Section A.2.3*** are shown as CO_2 equivalents or CO_{2eq}. Emissions of CO_2, CH_4, and N_2O are typically converted into CO_{2eq} by multiplying their emissions by their respective GWP.

The state government has declared that California is particularly vulnerable to the impacts of climate change. Specifically, increased temperatures are believed to have potential to greatly reduce the Sierra snowpack, an important source of water for the state. In addition, rising temperatures are believed to threaten the state's air quality problems and adversely impact human health. Rising sea levels also threaten the state's coastal real estate and natural habitats. The California Global Warming Solutions Act of 2006 directs the State to reduce GHG emissions to 1990 levels by the year 2020.

A.2.2 Significance Thresholds

The Project area is subject to air quality regulations developed and implemented at the Federal, state, and regional levels. At the Federal level, the USEPA is responsible for implementation of the CAA. Some portions of the CAA (e.g., certain mobile-source and other requirements) are implemented directly by USEPA. Other portions of the CAA (e.g., stationary-source requirements) are implemented by state and local agencies. Responsibility for attaining and

maintaining air quality in California is divided between CARB and the regional air quality districts.

BAAQMD prepares plans to attain ambient air quality standards in the San Francisco Bay Area Air Basin as required by the CAA and the CCAA (BAAQMD 2012). BAAQMD also developed project-level thresholds and guidance for use during the CEQA evaluation process. These threshold values for a Project's individual air emissions, if exceeded, would result in significant adverse air quality impacts to the region's existing air quality conditions. This includes ozone precursors, VOCs or NO_X, the $PM_{2.5}$ precursor SO_2, $PM_{2.5}$, or CO. ***Table A-2***[2] summarizes the air quality thresholds applied to this Project for both construction-related activities and long-term operations-related activities. BAAQMD's *CEQA Air Quality Guidelines* (May 2012) specify that a project generating more than 54 pounds per day of ROG, NOx or $PM_{2.5}$, or more than 82 pounds per day of PM_{10}, will have a significant impact on the Bay Area's regional air quality. BAAQMD does not provide significance thresholds for GHGs for construction activities.

Table A-2. CEQA BAAQMD Threshold Values for Construction and Operation Emissions

Pollutant	Construction Related Emissions	Operational-Related Emissions	
Criteria Air Pollutants and Precursors (Regional)	**Average Daily Emissions (lb./day)**	**Average Daily Emissions (lb./day)**	**Maximum Annual Emissions (ton/year)**
ROG	54	54	10
NO_X	54	54	10
PM_{10} (exhaust)	82	82	15
$PM_{2.5}$ (exhaust)	54	54	10
Local CO	None	9.0 ppm (8-hour average) 20.0 ppm (1-hour average)	
CO_{2eq}	N/A		1,210[1]

[1] 1,100MT = 1,210 short tons
Lbs. = pound
Source: (BAAQMD 2012)

The USEPA enacted the Federal General Conformity regulation (40 CFR Parts 5, 51, and 93) in 1993. General Conformity prohibits any Federal action that does not conform to the applicable air quality attainment plan, or SIP, and applies to areas designated as nonattainment or maintenance for NAAQS. This is meant to ensure Federal activities do not interfere with the emission budgets in the SIP. A Project is exempt from the conformity rule if the total net project-related emissions (construction and operation) are less than the *de minimis* thresholds

[2] Analysis of air quality impacts relies on CEQA Thresholds of Significance from BAAQMD's May 2011 Guidelines. While the Alameda Superior Court ordered BAAQMD to set aside these Thresholds until a CEQA review is conducted, the Court did not rule that the Thresholds lacked substantial evidence to support them or that they were flawed or scientifically unsound. The Court held that BAAQMD is required to conduct further environmental review of the Thresholds before it can readopt them.

established by the conformity rule. A project that produces any of the 10 emissions that exceed conformity thresholds shown in ***Table A-3*** is required to mitigate or offset these impacts.

Table A-3. General Conformity de Minimis Thresholds for Construction Emissions

Pollutant	*De Minimis* Thresholds (tons/year)	Notes
O_3 (ROG, VOC or NO_X)	100	Included because BAAQMD is an O_3 maintenance area.
NO_2	100	Included as a potential precursor for $PM_{2.5}$ formation.
SO_2	100	Included as a potential precursor for $PM_{2.5}$ formation.
$PM_{2.5}$	100	Included because BAAQMD is a $PM_{2.5}$ maintenance area.
PM_{10}	100	Included because BAAQMD is a PM_{10} maintenance area.

Source: (40 CFR 93.153)

In December of 2014, CEQ released final guidance on the ways Federal agencies can improve their consideration of the effects of GHG emissions under NEPA. 79 FR 77802 states that if a proposed action would cause direct emissions of greater than 25,000 tons of CO_{2eq} GHG emissions on an annual basis, agencies should consider this an indication that a quantitative and qualitative assessment may be meaningful to decision makers and the public. For long-term actions that have annual direct emissions of less than 25,000 metric tons of CO_{2eq}, the CEQ encourages Federal agencies to consider whether the action's long-term emissions should receive similar analysis.

Based on the identified thresholds, impacts would be significant if the Project would:

- Violate any air quality standard or plan;
- Generate a cumulative net increase of a criteria pollutant for which the project region is in nonattainment under an applicable Federal or state standard;
- Generate GHG emissions that may have a significant impact on the environment.

A.2.3 Environmental Consequences

The following subsections first describe the methodology used to calculate both construction and operational air emissions and GHGs and then discuss the results and incorporated mitigation measures.

A.2.3.1 Construction Emissions Methodology

This section summarizes the methodologies used to assess air quality impacts, including GHGs, under CEQA and NEPA. The NAAQS criteria air pollutant emissions, including GHG emissions (comprised of CO_2, N_2O, and CH_4), were estimated for construction and operation of the proposed Project dredging options and placement sites. To determine their significance, the

proposed Project emissions were compared to the significance thresholds for construction and operational-related emissions discussed in ***Section A.2.2***.

The emission estimates presented in this document were calculated using the latest available data, assumptions, and emission factors at the time this document was prepared. Project construction activities would involve the use of in-water equipment such as clamshell dredges, tow boats, scows, derrick barges, work tugs, crew boats, and Offloader. The information needed to calculate emissions, including dredging quantities, equipment utilization, engine sizes, travel speeds and times, and other construction-related information, was provided by USACE and Port of Redwood City staff. Proposed dredging options and placement sites are combined into a focused array of alternatives in ***Section 3.6 of the Main Integrated Report***, and are analyzed in ***Section 4.5 of the Main Integrated Report***.

Construction activities associated with channel deepening and sediment placement would occur for a period of about 6 months per year, during the in-water regulatory work window for the San Francisco Bay Area of June 1 through November 30. The main sources of construction-related emissions are combustion products from dredging and dredged material placement equipment. One clamshell dredge would be used for excavation during dredging activities. Dredged material would then be placed into one of three scows and transported to the placement site with the assistance of two tug boats (one tug boat per scow). All major motorized dredging equipment would be diesel-powered.

Dredged sediment quantities used in the emissions calculations were calculated by the USACE based on a recent hydrographic survey. USACE Dredge Estimating Program (CEDEP) output data provided by the San Francisco District was used to estimate emissions from dredging and sediment transport activities. These data included equipment types and quantities, engine specifications (including assumed model year), as well as operating times, and travel distances.

Emissions calculated for construction followed the methods described in the CARB Emissions Methodology for Commercial Harbor Craft Operating in California, Appendix B (CARB 2007a) and Appendix C (CARB 2010). Tugboat main and auxiliary engine sizes and age were determined from tugboat owner data. Load factors, fuel correction factors, and emissions factors were derived based on data tables provided in the CARB Harbor Craft document (CARB 2011a), not including those for GHGs or SO_2/SO_X. GHG emission factors and deterioration factors used were obtained from the Port of Los Angeles' "Inventory of Air Emissions – 2013" (Starcrest 2014). Emission factors for SO_2 were calculated according to CARB methodology using the brake specific fuel consumption (BSFC) rate and assuming 15 ppm ultra-low sulfur diesel (ULSD). For the purposes of these calculations, work tugs and crew boats were considered "work boats" as defined in Appendix B (CARB 2007a) while derrick barges were considered "cranes" and scows were considered "pumps" as defined in Appendix C (CARB 2010). The clamshell dredge was considered a "dredger." The emissions factors for the derrick

barge, scows, and clamshell dredge were derived based on the CARB California Barge and Dredge Emissions Inventory Database (CARB 2011b).

The fuel sulfur content used for calculating emissions for all harbor craft and other construction equipment was 15 ppm in accordance with the September 1, 2006 CARB diesel fuel regulation for harbor craft.

For each of the dredging options and the three placement sites, physical boundaries were established for purposes of the emissions calculations. Two of the three placement sites, Cullinan and Montezuma, lie entirely within the jurisdictional boundaries of the BAAQMD air basin. Therefore, emission calculations for those two sites include emissions due to transit along the entirety of the Redwood City-to-Cullinan route and the Redwood City-to-Montezuma route, respectively. For the SF-DODS placement site, however, due to the fact that SF-DODS is roughly 50 miles west of the Golden Gate emissions calculations only include emissions due to transit to the outer ring of sea buoys roughly 17 miles west of the Golden Gate. This boundary is consistent with the water side boundary for all of the Bay Area seaport emission inventories and lies outside the jurisdictional boundaries of the air basin.

Based on the CEDEP estimates, deepening RWC Channel to -32 feet MLLW would require dredging 603,700 cy of material while the deepening the SBS Channel to the same depth would require dredging 284,000 cy of material. These quantities were used as the basis for estimating construction emissions for dredging and transport. The emission calculations also include emissions due to deepening the Redwood City vessel berths to a depth of -36 feet MLLW as well as the emissions due to relocating three petroleum pipelines beneath SBS Channel to a minimum of 6 feet below the bottom of the channel. The emissions for the Cullinan alternative also include operation of an electric offloader at the Cullinan placement site and associated supporting diesel equipment. The Cullinan and Montezuma placement site emission estimates do not include any landside equipment used in placing the dredge material. All landside equipment emissions at these two sites were included in their respective EIS/EIRs and would occur whether or not the RWC Project delivers sediment to these sites.

The CEDEP-based emission estimates were then used to calculate estimated unit emissions per 10,000 cy of sediment dredged and transported to a specific location. The estimated emissions associated with the CEDEP estimate for deepening to -32 feet MLLW, and for each dredging option were calculated, along with the equipment operating hours for construction and emissions for dredging and transporting the corresponding amount of sediment to one of the three placement sites. The emission calculation tables are provided in ***Attachment 1*** to this appendix, Air Quality and Greenhouse Gas Emission Calculations.

A.2.3.2 Operational Emissions Methodology

Operational emissions sources include bulk carriers and tugboats. Since these sources use diesel fuel they would generate emissions of diesel exhaust. Future year emission estimates were calculated for the years 2018 and 2025, respectively, to determine how the project may

impact future air quality and GHG emissions. The methodology for calculating baseline and future operational emissions is discussed below. Information regarding vessel activity and operating characteristics was provided by Port of Redwood City staff.

Existing, or baseline, Port of Redwood City maritime operations in San Francisco Bay and landward of the outer ring of sea buoys were estimated to understand the implications of the proposed Project on operations over the long-term. In 2014 emissions due to operations at the Port of Redwood City were calculated in accordance with California Air Resources Board Appendix D, Emissions Estimation Methodology for Ocean-Going Vessels.

Similar to construction emission calculations, load factors, fuel correction factors, and emissions factors were derived based on data tables provided in the CARB Ocean-Going Vessels document, not including those for greenhouse gases. Greenhouse gas emission factors and deterioration factors used were obtained from the Port of Los Angeles' "Inventory of Air Emissions – 2013."

Vessel call information used in the baseline emissions calculations for 2014 was extracted from VTS data for the San Francisco Bay Area provided by the U.S. Coast Guard (USCG 2015). The VTS data contained vessel arrival and departure date and times, arrival and departure ports (including anchorage), as well as the name of each vessel. Vessel engine power, auxiliary engine power, vessel and engine age, and design speed for each ship were obtained from Clarkson's World Fleet Register (Clarkson's 2015).

Vessel and barge call information for the Port of Redwood City for 2014 was provided by the Port of Redwood City. This information included vessel names, arrival date and time, departure date and time; whether vessel was loaded or discharged, and commodity of load or discharge and tonnage. These data were cross-referenced with the VTS data to determine vessel travel routes after entering the Bay.

For purposes of the proposed Project the transit times and distances to and from Redwood City were broken down into segments at different speeds. It was assumed that vessels would travel at 14.5 knots (cruise speed) from the outer ring of sea buoys west of the Golden Gate to the pilot boarding station. Vessels would then slow to 8 knots for roughly 12 minutes to allow the pilot to board or disembark the vessel. Within San Francisco Bay, vessel speed would be 12 knots except within SBS Channel and approaching the RWC Channel where vessel speed is assumed to be 7 knots. Within RWC Channel, vessel speed would be 5 knots. The travel durations for each segment of the vessel route were calculated by dividing the length of each segment, measured on NOAA nautical charts, by the assumed speed. Maneuvering time, both inbound and outbound, was assumed to 30 minutes (Don Snaman, pers. comm.).

For all vessel calls at the Port of Redwood City, the average hoteling time is about 62 hours (CARB 2011a). When vessels stop at an anchorage prior to or after leaving the Port of Redwood City, the average anchorage time is about 25 hours (CARB 2011a). In cases when vessels are at

anchorage at any time on the way to or from the Port of Redwood City, emissions from transit north of the anchorage location are included if appropriate based on the overall route of the vessel. For inbound trips to Redwood City, if a vessel originated from the pilot board station prior to stopping at anchorage, the emissions due to the PBS-to-anchorage segment are included. However, if a vessel originated from another Bay Area port prior to stopping at anchorage, the emissions due to transit from the other port to anchorage were not included. The same concept applied to outbound trips from the Port of Redwood City.

Vessel fuel was assumed to be in compliance with CARB Emissions Estimation Methodology for Ocean-Going Vessels, Appendix D (CARB 2011a). Vessels manufactured prior to 2000 are assumed to burn a 0.5% sulfur diesel fuel. Vessels manufactured after 2000 are assumed to burn a 0.1% sulfur diesel fuel in compliance with the North American Emissions Control Area (ECA) designated in 2010. Ships in ECAs must operate in accordance with the most stringent tier of emission standards contained in the amended International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI. This most stringent requires that by 2015 sulfur content for vessel fuel must not exceed 1000 ppm or 0.1%.

Tugs and towboats, or harbor craft, included in the baseline and future emissions estimates are those used to assist larger vessels entering and leaving the Port of Redwood City as well as those used to push barges to and from the Port. The barges arriving and departing generally contain bulk cement, scrap metal, rock and sand, and dry bulk cargo (Port of Redwood City 2015). For each ocean-going vessel call it is assumed, per communication with Redwood City staff, that there are two assist tugs for both inbound and outbound trips. Assist tugs are utilized by ocean-going vessels roughly between the Port of San Francisco's Pier 94 and the Port of Redwood City, an approximately 22-mile transit length. The emissions methodology for tugs, towboats and harbor craft used in Port operations is identical to that used for emissions calculations for tugs used in construction.

A.2.3.3 Impact AQ – 1: Construction Air Emissions

Estimated construction emissions are summarized in ***Tables A-4 through A-7***. ***Table A-4*** provides the estimated emissions for each dredging option and placement site based on the dredging volumes used on the CEDEP estimates. These estimates were then converted to unit emissions as described in ***Section A.2.3.1***, and applied to the maximum potential volume for each dredging option (see ***Table 4-1 of the Main Integrated Report***); the maximum estimated emissions are shown in ***Table A-5***.

The emission estimates for dredging include emissions due to relocation of the three petroleum pipelines beneath SBS Channel, channel deepening, and berth deepening. The estimated emissions reflect the measures taken to minimize potential construction air emissions, including use of an electric offloader at Cullinan, reducing the horsepower of the dredge, and limiting the horsepower of the tugs used for transport of sediment to in-Bay placement sites. Two other potential measures are currently being evaluated to determine their institutional

and financial feasibility. It may be possible to require transport tugs to be equipped with Tier 3 engines (several tugs in the Bay area have recently been equipped with these engines, and/or to electrify the dredge working in RWC Channel. Electrifying the dredge working in SBS Channel would not be feasible due to the distance from shore and the length of the channel. Electrifying the dredge working in RWC Channel, if feasible, would also reduce GHG emissions. The tables show estimated emissions with and without the potentially available additional measures.

As shown in ***Table A-6***, the Project would meet BAAQMD thresholds for PM_{10} daily emissions, but would exceed BAAQMD thresholds for NOx, ROG, and $PM_{2.5}$. Even if the additional air emission reduction measures are feasible and implemented, emissions of NOx and ROG would continue to exceed BAAQMD thresholds. Therefore, this impact is significant and unavoidable.

Table A-7 shows the total tons of select construction emissions for the Project compared to general conformity thresholds. With the exception of NO_X, emissions of criteria air pollutants would meet general conformity thresholds. The estimated emissions would occur over 2 to 12 dredging seasons if the expected dredging rate reflected in the CEDEP is attained. As can been seen from the tables, the combined dredging and transport emissions for any combination of dredging option and placement site at any depth would exceed the Federal General Conformity Thresholds for NO_X if dredging is conducted at the rate assumed by the CEDEP.

Annual construction emissions would be controlled to remain below the conformity thresholds, as specified in the air quality management plan (see ***Section 4.2.3.2.1 of the Main Integrated Document***). This would be a requirement of the construction contract. Annual emissions would be controlled by reducing the amount of dredging and associated transport each year. This would extend the total construction duration to between 3 and 16 dredging seasons, depending on the combination of dredging option and placement sites.

Table A-4. Calculated Dredging and Transportation Emissions Based on CEDEP Estimate

SF-DODS	**Emissions (tons) Based on CEDEP Estimate**						
Dredging Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\,eq}$**
RWC Channel	55.3748	3.1400	3.0458	5.4912	22.0418	0.0192	1997.6410
SBS Channel	38.1656	2.2031	2.1370	3.8343	15.2311	0.0130	1350.7421
Berth Deepening	1.7698	0.1004	0.0974	0.1755	0.7045	0.0006	63.8377
Pipeline Relocation d	0.8030	0.0445	0.0431	0.0783	0.3186	0.0003	29.6874
RWC Channel – With Potential Measures	1.6223	0.0968	0.0938	0.1956	0.6588	0.0006	58.0878
SBS Channel -- With Potential Measures	38.1656	2.2031	2.1370	3.8343	15.2311	0.0130	1350.7421
Berth Deepening -- With Potential Measures	0.0517	0.0031	0.0030	0.0062	0.0210	0.0000	1.8512
Pipeline Relocation -- With Potential Measures	0.8030	0.0445	0.0431	0.0783	0.3186	0.0003	29.6874
Total Dredging -- Project	**96.1132**	**5.4880**	**5.3233**	**9.5794**	**38.2959**	**0.0331**	**3441.9082**

Total Dredging -- With Potential Measures	**40.6426**	**2.3474**	**2.2770**	**4.1144**	**16.2295**	**0.0139**	**1440.3684**

Transport Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\ eq}$**
SF-DODS -- Project	93.4042	3.2895	3.1908	9.5941	67.5713	0.0911	8554.4929
SF-DODS -- With Potential Measures	93.4042	3.2895	3.1908	9.5941	67.5713	0.0911	8554.4929
TOTAL EMISSIONS							
Project	**189.5174**	**8.7774**	**8.5141**	**19.1734**	**105.8673**	**0.1242**	**11996.40**
Project With Potential Measures	**134.0468**	**5.6369**	**5.4678**	**13.7084**	**83.8008**	**0.1050**	**9994.86**

MONTEZUMA	**Emissions (tons) Based on CEDEP Estimate**						
Dredging Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\ eq}$**
RWC Channel	51.4856	2.9287	2.8409	5.1176	20.5031	0.0178	1851.1491
SBS Channel	36.0025	2.0835	2.0210	3.6238	14.3732	0.0122	1270.7248
Berth Deepening	1.5323	0.0872	0.0846	0.1523	0.6102	0.0005	55.0937
Pipeline Relocation	0.8030	0.0445	0.0431	0.0783	0.3186	0.0003	29.6874
RWC Channel -- With Potential Measures	1.6121	0.0961	0.0933	0.1943	0.6547	0.0006	57.7230
SBS Channel -- With Potential Measures	36.0025	2.0835	2.0210	3.6238	14.3732	0.0122	1270.7248
Berth Deepening -- With Potential Measures	0.0480	0.0029	0.0028	0.0058	0.0195	0.0000	1.7179
Pipeline Relocation -- With Potential Measures	0.8030	0.0445	0.0431	0.0783	0.3186	0.0003	29.6874
Total Dredging -- Project	**89.8235**	**5.1438**	**4.9895**	**8.9720**	**35.8051**	**0.0308**	**3206.6550**
Total Dredging -- With Potential Measures	**38.4657**	**2.2269**	**2.1601**	**3.9022**	**15.3659**	**0.0131**	**1359.8531**
Transport Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\ eq}$**
Montezuma	65.3829	2.2883	2.2197	6.7182	47.4212	0.0642	6020.5051
Montezuma -- With Potential Measures	65.3829	2.2883	2.2197	6.7182	47.4212	0.0642	6020.5051
TOTAL PROJECT EMISSIONS							
Project	**155.2064**	**7.4321**	**7.2092**	**15.6902**	**83.2263**	**0.0950**	**9227.16**
With Potential Measures	**103.8486**	**4.5152**	**4.3798**	**10.6204**	**62.7871**	**0.0773**	**7380.36**

Table A-4. Calculated Dredging and Transportation Emissions Based on CEDEP Estimate (continued)

CULLINAN	**Emissions (tons) Based on CEDEP Estimate**						
Dredging Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\ eq}$**
RWC Channel	45.9941	2.6319	2.5529	4.5915	18.3320	0.0158	1643.3131
SBS Channel	35.7937	2.0728	2.0106	3.6046	14.2912	0.0121	1262.4288
Berth Deepening	1.3689	0.0783	0.0760	0.1367	0.5456	0.0005	48.9081
Pipeline Relocation	0.8030	0.0445	0.0431	0.0783	0.3186	0.0003	29.6874
RWC Channel -- With Potential Measures	1.5979	0.0953	0.0924	0.1926	0.6489	0.0006	57.2152
SBS Channel -- With Potential Measures	35.7937	2.0728	2.0106	3.6046	14.2912	0.0121	1262.4288
Berth Deepening -- With Potential Measures	0.0476	0.0028	0.0028	0.0057	0.0193	0.0000	1.7028
Pipeline Relocation -- With Potential Measures	0.8030	0.0445	0.0431	0.0783	0.3186	0.0003	29.6874
Total Dredging -- Unmitigated	**83.9597**	**4.8274**	**4.6826**	**8.4110**	**33.4873**	**0.0287**	**2984.3375**
Total Dredging -- With Potential Measures	**38.2422**	**2.2154**	**2.1489**	**3.8812**	**15.2780**	**0.0130**	**1351.0343**
Transport Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\ eq}$**
Cullinan	47.2478	1.6527	1.6031	4.8578	34.2743	0.0464	4351.6869
Cullinan -- With Potential Measures	47.2478	1.6527	1.6031	4.8578	34.2743	0.0464	4351.6869
	Emissions (tons) Based on CEDEP Estimate						
Offloader Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\ eq}$**
Cullinan	1.4202	0.0801	0.0777	0.1605	0.5453	0.0005	49.9333
Cullinan -- With Potential Measures	1.4202	0.0801	0.0777	0.1605	0.5453	0.0005	49.9333
TOTAL PROJECT EMISSIONS							
Project	**132.6277**	**6.5603**	**6.3635**	**13.4293**	**68.3069**	**0.0756**	**7385.9576**
With Potential Measures	**86.9102**	**3.9482**	**3.8298**	**8.8995**	**50.0975**	**0.0599**	**5752.6544**

Table A-5. Dredging Options – Estimated Dredging and Transport Emissions

Dredging Option A (-32 feet MLLW) Estimated Dredging and Transport Emissions (tons) Based on EIS/EIR Volume							
Total Dredging Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\,eq}$**
Cullinan Ranch	162.23	9.33	9.05	16.26	64.71	0.06	5764.29
Montezuma	173.67	9.95	9.65	17.35	69.23	0.06	6198.02
SF-DODS	185.94	10.62	10.30	18.54	74.09	0.06	6656.98
Cullinan Ranch -- With Potential Measures	73.04	4.24	4.11	7.42	29.18	0.02	2577.85
Montezuma -- With Potential Measures	73.48	4.26	4.13	7.46	29.36	0.03	2595.05
SF-DODS -- With Potential Measures	77.72	4.49	4.36	7.87	31.04	0.03	2752.13
Total Transport Emissions							
Cullinan Ranch	90.86	3.18	3.08	9.34	65.91	0.09	8369.12
Montezuma	126.24	4.42	4.29	12.97	91.56	0.12	11624.85
SF-DODS	180.91	6.37	6.18	18.58	130.87	0.18	16568.47
Cullinan Ranch -- With Potential Measures	68.82	1.46	1.42	9.34	65.91	0.09	8369.12
Montezuma -- With Potential Measures	95.54	2.03	1.97	12.97	91.56	0.12	11624.85
SF-DODS -- With Potential Measures	136.79	2.94	2.85	18.58	130.87	0.18	16568.47
Total Offloading Emissions							
Cullinan Ranch	2.77	0.16	0.15	0.31	1.06	0.00	97.42
Cullinan Ranch -- With Potential Measures	2.77	0.16	0.15	0.31	1.06	0.00	97.42
Dredging Option B (-34 feet MLLW) Estimated Dredging and Transport Emissions (tons) Based on EIS/EIR Volume							
Total Dredging Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\,eq}$**
Cullinan Ranch	364.08	20.94	20.31	36.48	145.22	0.12	12936.19
Montezuma	389.75	22.33	21.66	38.94	155.37	0.13	13909.55
SF-DODS	417.29	23.83	23.12	41.60	166.27	0.14	14939.55
Cullinan Ranch -- With Potential Measures	163.92	9.50	9.22	16.65	65.50	0.06	5785.18
Montezuma -- With Potential Measures	164.90	9.56	9.27	16.74	65.88	0.06	5823.79
SF-DODS -- With Potential Measures	174.43	10.08	9.78	17.67	69.66	0.06	6176.31
Total Transport Emissions							
Cullinan Ranch	203.90	7.13	6.92	20.96	147.92	0.20	18781.91
Montezuma	283.30	9.91	9.62	29.11	205.48	0.28	26088.41
SF-DODS	405.99	14.30	13.87	41.70	293.70	0.40	37182.84
Cullinan Ranch -- With Potential Measures	154.45	3.29	3.19	20.96	147.92	0.20	18781.91
Montezuma -- With Potential Measures	214.40	4.55	4.42	29.11	205.48	0.28	26088.41
SF-DODS -- With Potential Measures	306..99	6.59	6.39	41.70	293.70	0.40	37182.84

Total Offloading Emissions							
Cullinan Ranch	6.22	0.35	0.34	0.70	2.39	0.00	218.62
Cullinan Ranch -- With Potential Measures	6.22	0.35	0.34	0.70	2.39	0.00	218.62
Dredging Option C (-37 feet MLLW) Estimated Dredging and Transport Emissions (tons) Based on EIS/EIR Volume							
Total Dredging Emissions	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**ROG**	**CO**	**SOx**	**$CO_{2\ eq}$**
Cullinan Ranch	709.13	40.79	39.56	71.06	282.85	0.24	25196.34
Montezuma	759.14	43.49	42.18	75.84	302.62	0.26	27092.19
SF-DODS	812.78	46.42	45.03	81.02	323.86	0.28	29098.36
Cullinan Ranch -- With Potential Measures	319.27	18.51	17.96	32.43	127.57	0.11	11268.03
Montezuma -- With Potential Measures	321.18	18.61	18.05	32.61	128.32	0.11	11343.24
SF-DODS -- With Potential Measures	339.74	19.64	19.05	34.42	135.68	0.12	12029.85
Total Transport Emissions							
Cullinan Ranch	397.15	13.89	13.47	40.83	288.11	0.39	36582.29
Montezuma	551.80	19.31	18.73	56.70	400.23	0.54	50813.46
SF-DODS	790.76	27.85	27.01	81.22	572.06	0.77	72422.52
Cullinan Ranch -- With Potential Measures	300.83	6.40	6.21	40.83	288.11	0.39	36582.29
Montezuma -- With Potential Measures	417.60	8.87	8.60	56.70	400.23	0.54	50813.46
SF-DODS -- With Potential Measures	597.94	12.84	12.45	81.22	572.06	0.77	72422.52
Total Offloading Emissions							
Cullinan Ranch	12.11	0.68	0.66	1.37	4.65	0.00	425.82
Cullinan Ranch -- With Potential Measures	12.11	0.68	0.66	1.37	4.65	0.00	425.82

Table A-6. CEQA BAAQMD Threshold Comparison for Construction Emissions

Dredging Option A (-32 feet MLLW) Pollutant	**BAAQMD Threshold**	**SF-DODS**	**Montezuma**	**Cullinan**
Regional Criteria Air Pollutants and Precursors	**Unmitigated Average Daily Emissions (lbs./day)**			
ROG	54	***154***	***145***	***151***
NO_X	54	***1,523***	***1,430***	***1,488***
PM_{10} (exhaust)	82	71	68	74
$PM_{2.5}$ (exhaust)	54	***68***	***66***	***71***
Local CO	None	-	-	-
Regional Criteria Air Pollutants and Precursors	**Mitigated Average Daily Emissions (lbs./day)**			
ROG	54	***110***	***97***	***99***
NO_X	54	***1,074***	***952***	***969***
PM_{10} (exhaust)	82	45	41	44
$PM_{2.5}$ (exhaust)	54	44	40	43
Local CO	None	-	-	-

Table A-6. CEQA BAAQMD Threshold Comparison for Construction Emissions (continued)

Dredging Option B (-34 feet MLLW) Pollutant	BAAQMD Threshold	SF-DODS	Montezuma	Cullinan
Regional Criteria Air Pollutants and Precursors	**Unmitigated Average Daily Emissions (lbs./day)**			
ROG	54	***158***	***148***	***163***
NO_X	54	***1557***	***1462***	***1610***
PM_{10} (exhaust)	82	72	70	80
$PM_{2.5}$ (exhaust)	54	***70***	***68***	***77***
Local CO	None	-	-	-
Regional Criteria Air Pollutants and Precursors	**Mitigated Average Daily Emissions (lbs./day)**			
ROG	54	**112**	**100**	**107**
NO_X	54	**1098**	**973**	***1048***
PM_{10} (exhaust)	82	46	42	48
$PM_{2.5}$ (exhaust)	54	45	41	46
Local CO	None	-	-	-

Dredging Option C (-37 feet MLLW) Pollutant	BAAQMD Threshold	SF-DODS	Montezuma	Cullinan
Regional Criteria Air Pollutants and Precursors	**Unmitigated Average Daily Emissions (lbs./day)**			
ROG	54	***159***	***149***	***132***
NO_X	54	***1574***	***1478***	***1299***
PM_{10} (exhaust)	82	73	71	64
$PM_{2.5}$ (exhaust)	54	***71***	***69***	***62***
Local CO	None	-	-	-
Regional Criteria Air Pollutants and Precursors	**Mitigated Average Daily Emissions (lbs./day)**			
ROG	54	***113***	***101***	***87***
NO_X	54	***1110***	***985***	***846***
PM_{10} (exhaust)	82	47	43	38
$PM_{2.5}$ (exhaust)	54	45	41	37
Local CO	None	-	-	-

Daily dredging emissions are included in the average daily emissions.

Table A-7. General Conformity Threshold Comparison for Construction Emissions

Pollutant	Conformity Threshold	SF-DODS	Montezuma	Cullinan
Dredging Option A (-32 feet MLLW)	**Emissions (tons/year)**	**Unmitigated Emissions (tons/year)**		
O_3 (ROG)	100	9.28	10.11	8.64
NO_x	100	91.71	99.97	85.29
SO_2	100	0.06	0.06	0.05
$PM_{2.5}$	100	4.12	4.65	4.10
PM_{10}	100	4.25	4.79	4.22
		Mitigated Emissions (tons/year)		
O_3 (ROG)	100	8.82	10.22	8.54
NO_x	100	86.21	99.86	83.33
SO_2	100	0.07	0.07	0.06
$PM_{2.5}$	100	3.51	4.21	3.67
PM_{10}	100	3.62	4.34	3.78
Pollutant	**Conformity Threshold**	**SF-DODS**	**Montezuma**	**Cullinan**
Dredging Option B (-34 feet MLLW)	**Emissions (tons/year)**	**Unmitigated Emissions (tons/year)**		
O_3 (ROG)	100	9.26	9.72	9.69
NO_x	100	91.48	96.15	95.70
SO_2	100	0.06	0.06	0.05
$PM_{2.5}$	100	4.11	4.47	4.60
PM_{10}	100	4.24	4.61	4.74
		Mitigated Emissions (tons/year)		
O_3 (ROG)	100	9.90	9.17	9.58
NO_x	100	96.74	89.64	93.51
SO_2	100	0.08	0.07	0.06
$PM_{2.5}$	100	3.94	3.78	4.12
PM_{10}	100	4.06	3.89	4.25
Pollutant	**Conformity Threshold**	**SF-DODS**	**Montezuma**	**Cullinan**
Dredging Option C (-37 feet MLLW)	**Emissions (tons/year)**	**Unmitigated Emissions (tons/year)**		
O_3 (ROG)	100	9.54	9.47	9.44
NO_x	100	94.33	93.64	93.20
SO_2	100	0.06	0.06	0.05
$PM_{2.5}$	100	4.24	4.35	4.48
PM_{10}	100	4.37	4.49	4.61
		Mitigated Emissions (tons/year)		
O_3 (ROG)	100	9.64	9.92	9.33
NO_x	100	94.21	97.00	91.07
SO_2	100	0.07	0.07	0.06
$PM_{2.5}$	100	3.84	4.09	4.01
PM_{10}	100	3.96	4.21	4.14

In summary, the proposed Project would meet Federal general conformity thresholds by extending the construction duration to 2 to 3 dredging seasons for Dredging Option A (-32-foot MLLW), 5 to 8 dredging seasons for Dredging Option B (-34-foot MLLW), and 12 to 17 dredging seasons for Dredging Option C (-37-foot MLLW). If dredged sediment quantities are consistent with the estimates used in the CEDEP (i.e., only approximately 1 foot total of overdepth would be dredged), the dredging durations could be reduced to 1 to 2 dredging seasons for Dredging Option A, 3 to 4 dredging seasons for Dredging Option B, and to 5 to 8 dredging seasons with Dredging Option C.

While Federal general conformity thresholds would be met, there would be a significant and unavoidable impact due to the exceedance of BAAQMD's average daily thresholds of ROG and NOx.

A.2.3.4 Impact AQ – 2: Long-term (Future) Operational Emissions

Operational air emissions consist of transport emissions and offloading emissions. Changes in future operational air emissions are primarily associated with growth in cargo throughput, and are not attributable to the proposed Project. As discussed in Chapter 4 of the Main Integrated Report, growth in cargo throughput at the Port is driven by local economic conditions rather than harbor depth. Potential emission increases associated with increased throughput capacity were analyzed as part of the Wharves 1 and 2 Reconstruction Project (Port of Redwood City 2010).

The only potential effect on future operations from the proposed Project is beneficial. Emissions associated with off-loading would be very similar for all potential channel depths, because they would be determined largely by the cargo throughput at the Port. Minor reductions in offloading emissions may result from the reduced need to lighter into barges with the deeper channels. Offloading from barges is less efficient than offloading from a large vessel.

Operational transport emissions would be reduced with the proposed Project because the number of vessel calls would decrease. While a more heavily loaded vessel would have a deeper draft, the total increase in fuel use would be small compared to the fuel required to bring a vessel into Port. By the Year 2025, total vessel calls with the proposed Project would be reduced between 11% (Dredging Option A, -32 feet MLLW) and 24% (Dredging Option C, -37 feet MLLW) compared to the no dredging scenario. Operational transport emissions would be expected to decrease by a similar percentage relative to the no dredging scenario. The forecasted vessel calls (for the Port of Redwood City are shown in ***Table A-8***. Beyond the year 2025, USACE indicated that vessel call numbers are expected to remain constant. As discussed in the Main Integrated Report, and as shown in ***Table A-8***, the total number of vessel calls for future years is highest at the existing channel depth of – 30 feet MLLW, and decreases with increasing channel depth.

Table A-8. Current and Forecast Vessel Calls at Port of Redwood City

Vessel Calls: -30-foot MLLW (Baseline)		
Year	**Ocean-Going Vessels**	**Tugs/Towboats for Barges Only**
2014	**66**	**46**
2018	**82**	**46**
2025	**104**	**46**

Vessel Calls: -32-foot		
Year	**Ocean-Going Vessels**	**Tugs/Towboats for Barges Only**
2014	**66**	**46**
2018	**76**	**46**
2025	**93**	**46**

Vessel Calls: -34-foot		
Year	**Ocean-Going Vessels**	**Tugs/Towboats for Barges Only**
2014	**66**	**46**
2018	**70**	**46**
2025	**88**	**46**

Vessel Calls: -37-foot		
Year	**Ocean-Going Vessels**	**Tugs/Towboats for Barges Only**
2014	**66**	**46**
2018	**62**	**46**
2025	**79**	**46**

Mitigation Measures

All feasible emissions reduction measures have been incorporated into the proposed Project.

A.3 Biological Resources Overview

This section addresses potential effects of the Project on biological resources. This overview presents information on the regional habitat types, the more specific dredge and placement site environmental settings, regulations pertaining to biological resources, and significance thresholds that are applicable to all or most biological resources topics. Existing Project Area characteristics, such as habitat types and plant and animal species present, are described based on site-specific information developed for the Project and published relevant information,

especially environmental impact reports prepared for other San Francisco Bay Area waterfront projects, and technical articles and agency reports as indicated in source citations.

Due to the large number of potentially affected special status species and diversity of potentially affected habitats in the dredged sites and placement sites, the discussion of the impacts to biological resources has been divided into two subsections following this overview. The two subsections are: Biological Resources - Fish and Aquatic Resources (***Section A.4***) and Terrestrial Resources (***Section A.5***). Aquatic biological resources as defined in this document include habitats and species that are primarily dependent on aquatic resources for survival such as fish, marine mammals, and some invertebrates. Terrestrial biological species as defined in this document include birds, mammals, plants and other species that may use aquatic resources but that spend significant time on dry land. All birds are grouped with the terrestrial species.

Affected Environment

The San Francisco Bay-Delta is the second largest estuary in the United States and supports numerous aquatic habitats and biological communities. It encompasses 479 square miles, including shallow mudflats. San Francisco Bay is divided into four main basins: South Bay, Central Bay, San Pablo or North Bay, and Suisun Bay.

More than 250 species of birds, 120 species of fish, 81 species of mammals, 30 species of reptiles, and 14 species of amphibians regularly occur in the San Francisco Estuary (USFWS and CDFW 2007). A number of endemic, endangered, threatened, and rare wildlife species or subspecies reside within the San Francisco Bay Area. Special Status species within the Project Area are listed in ***Appendix H***. Aquatic special status species with a potential to occur at dredging sites and at placement sites are identified in ***Tables H-1a and H-1b***, respectively.[3] Terrestrial special status species with a potential to occur at the dredging sites and placement sites are identified in ***Tables H-2a and H-2b***, respectively. The Project Area does not include all the habitat types that occur in San Francisco Bay. The primary habitats within the Project Area include: open water; tidal flats; tidal salt marsh; diked, non-tidal salt marsh; and associated levees that fringe the Bay. SF-DODS is located in open ocean habitat approximately 50 miles outside the Bay. All of San Francisco Bay and SF-DODS are essential fish habitat (EFH). These habitat types are described below.

a. Habitat Types Within the Study Area

There are seven habitat types within the Project Area: open water, tidal salt marshes, tidal brackish marsh, non-tidal salt marsh, tidal flat (mud flat), upland levee, and ocean water habitat.

Open Water Habitat

San Francisco Bay (Bay) has both deep open water habitat (deeper than -18 feet MLLW) and shallow open water habitat (shallower than -18 feet MLLW) (Goals Project 1999). Open water

[3] Due to a greater similarity of species and habitat considerations, SF-DODS was grouped with the dredging sites.

includes a variety of habitat types including subtidal Bay waters, tidal sloughs, shipping channels, and areas of standing ponded water. Deep open water habitat exhibits depths between -18 and -100 feet MLLW - this includes the deepest portions of San Francisco Bay and the largest tidal channels. The shallow open water (also referred to as shallow Bay) habitats include the vast majority of San Francisco Bay (USACE and RWQCB 2014). San Francisco Bay currently contains almost 172,000 acres of shallow Bay/channel habitat, and more than 82,000 acres of deep Bay/channel habitat (Goals Project 1999).

RWC and SBS Channel are located in deep water habitat within the Bay. The proposed alignment of RWC Channel would require dredging into portions of adjacent subtidal habitat. All dredging and pipeline relocation work at SBS would occur in deep open water habitat. The RWC Project work at Cullinan within Dutchman Slough, Napa River, and on the southern levee of Dutchman Slough would occur in shallow and deep water habitat. The Montezuma site is located in at the far eastern edge of Suisun Bay, in the immediate vicinity of the confluence of the Sacramento and San Joaquin Rivers, a combination of shallow and deep water habitat. The offloaders for Eden Landing ponds and Alviso ponds would be located in deep water, whereas pipelines from the offloaders to the dredged sediment delivery location would traverse primarily shallow water and mudflat habitat. If a cutterhead dredge is used to delivery sediment directly to the Eden Landing or Alviso ponds, it would traverse deep water habitat, shallow water habitat, and mudflat. Booster pumps for Eden Landing and Alviso would be located on the levee at the dredged sediment delivery location, and an intermediate booster pump that would be required to deliver dredged sediment to Alviso Pond A9 would be located in shallow open water.

Some of the species that use deep water habitat include the following:

- Fish such as brown rockfish (*Sebastes auriculatus*), halibut (*Paralichthys californicus*), sturgeon (*Asipenser* sp.), Delta smelt *(Hypomesus transpacificus)* in the North Bay, and longfin smelt throughout the entire Bay area.
- Waterbirds, such as surf scoter (*Melanitta perspicillata*), scaups (*Aythya* spp.), brown pelican, and terns (*Sterna* spp.),
- Marine mammals, such as Pacific harbor seal (*Phoca vitulina richardsi*), harbor porpoises *(Phoeocna phoeocna*) and California sea lion (*Zalophus californianus*).

Anadromous fish, such as Chinook salmon and steelhead, use deep water migratory pathways to and from upstream spawning areas (USACE and RWQCB 2014).

Shallow water habitat serves as feeding and foraging habitat for a variety of fish and birds species, including:

- A feeding area for the Pacific herring, northern anchovy (*Engraulis mordax*), and jacksmelt (*Atherinopsis californiensis*), as well as many other aquatic species.

- A nursery area for juvenile halibut and sanddabs (*Citharichthys stigmaeus*), shiner perch (*Cymatogaster aggregata*), herring, and other fishes.
- Migratory pathways for anadromous fish use to and from upstream spawning areas.
- Important avian foraging habitat for diving birds
- Foraging areas for marine mammals such as Pacific harbor seals (USACE and RWQCB 2014).

Shallow Bay habitat can also include eelgrass (*Zostera marina*) beds in various areas of the Bay; eel grass is San Francisco Bay's only rooted seagrass. Eelgrass is an Essential Fish Habitat area of particular concern (USACE and RWQCB 2014) and is habitat to a wide range of fish and invertebrates (USACE and RWQCB 2014). Pacific herring spawn on hard substrates (including anthropogenic structures such as pilings) and eelgrass (*Zostrea marina*) along the shallow margins of the Central Bay and can extend into portions of the South Bay. Two small eelgrass beds are found near the Eden Landing ponds.

Tidal Salt Marshes

Tidal salt marshes are interspersed along portions of the Bay edge and have historically been much more extensive. Current tidal marshes throughout the Bay comprise less than 25% of their former extent but they still support a high density and diversity of wildlife species. The loss of habitat has resulted in decreases in many species associated with tidal marshes, and endangered species listing of two species dependent on tidal marshes: salt marsh harvest mouse and Ridgway's rail.

In general, plant species diversity in tidal marshes is lower in South San Francisco Bay than in North San Francisco Bay (USFWS and CDFW 2007). The vegetative cover in tidal salt marshes is largely controlled by the salinity of both the water and substrate. Tidal marshes provide a variety of habitat for birds and other terrestrial wildlife, including resting, nesting, escape cover during high tides, and foraging habitat. In addition to other habitat types, tidal marshes are important for migratory birds, providing foraging habitat and roosting sites. Within the Project Area, tidal salt marshes are found at Bair Island and Greco Island adjacent to RWC Channel, and in small bands at the outboard sides of the Cullinan, Eden Landing, and Alviso levees at the potential dredged sediment delivery locations.[4]

Most salt marshes in the Bay are generally dominated by relatively few native plant species, such as pickleweed (*Salicornia pacifica*), native cordgrass (*Spartina foliosa*), saltgrass (*Distichlis spicata*), spearscale (*Atriplex triangularis*), fleshy jaumea (*Jaumea carnosa*), alkali heath (*Frankenia salina*),and sometimes large summer "blooms" of parasitic salt marsh dodder mats (*Cuscuta salina*). Marsh gumplant (*Grindelia hirsutula*; syn. *G. stricta* var. *angustifolia*, *G.* x *paludosa*) vegetation is widespread along marsh banks of tidal sloughs. Non-native plant species, many of which are highly invasive, have become established in salt marsh vegetation,

[4] The dredged sediment delivery locations were chosen in part to minimize the amount of tidal salt marsh that would be disturbed by sediment pipeline construction and operation.

including hybrid cordgrass (*Spartina alterniflora* x *foliosa*), perennial pepperweed *(Lepidium latifolium)*, and Mediterranean saltwort (*Salsola soda*). Marshes in San Pablo and Suisun Bays have remained relatively free of hybrid cordgrass (CSCC 2010).

Special-status birds and mammals that use tidal marshes include the State- and federally-listed Ridgway's rail (formerly California clapper rail (*Rallus obsoletus obsoletus*)), State-listed black rail (*Laterallus jamaicensis*), and State- and federally-listed salt marsh harvest mouse (*Reithrodontomys raviventris)* (USACE and RWQCB 2014), and salt marsh wandering shrew (*Sorex vagrans haliocoetes*), only occur within this habitat type.

Songbirds that forage and nest in the tidal marshes include song sparrow (*Melospiza melodia*), red-winged blackbird (*Agelaius phaeniceus*), and salt marsh common yellowthroat (*Geothlypis trichas sinuosa*), among others. Raptors that forage and breed in tidal marshes include Peregrine falcon (*Falco peregrinus*) and northern harrier (*Circus cyaneus*) (City of Redwood City 2010a). There are also a wide variety of shorebirds and waterfowl such as ruddy duck, northern pintail (*Anas acuta*), red knot (*Calidris canutus*), western sandpiper, American avocet, black-necked stilt, long-billed dowitcher, and marbled godwit that use tidal marshes.

Aquatic species that utilize tidal marsh for breeding and/or foraging include a large number of invertebrates and fish such as chinook salmon, three-spine stickleback, longjaw mudsucker (*Gillichthys mirabilis*), rock crab, opossum shrimp, and California bay shrimp (*Crangon franciscorum*) (City of Redwood City 2010a). The composition of the invertebrate community is primarily influenced by salinity, the frequency and duration of tidal inundation, and the type and density of emergent vegetation.

Tidal Brackish Marsh

In San Francisco Bay the brackish marsh occurs predominantly where freshwater inflows from the Delta mix with the tidal waters from the ocean near Suisun Bay. In Suisun Bay, tidal brackish marsh maybe characterized by tule and cattails. Brackish tidal marsh also occurs at the mouths of several South Bay streams where bulrushes, spearscale, and cordgrass are present (Goals Project 1999). Within the Project Area, some tidal brackish marsh occurs in a narrow band along levees at Cullinan and Alviso. Salinities in brackish marsh may significantly vary by season and from year to year depending on rainfall. This mixing zone where the fresh and salt water meet can be several miles wide in Suisun Bay and is one of the Bay's most productive zones. Delta smelt, young striped bass, Pacific herring and salmon feed in this area (Goals Project 1999).

Tidal Flat Habitat

Tidal flat habitat includes mudflats, sandflats, and shell flats. This habitat occurs from below MLLW to Mean Tide Level (MTL) and supports less than 10 percent cover of vascular vegetation, with the exception of eel grass. The vegetative cover typically includes areas of colonization by cordgrass and annual pickleweed but the vegetative cover is too sparse to be

distinct salt marsh habitat (USFWS and CDFW 2007). Mudflats often occur along the edges of the tidal sloughs and channels, and on the outboard side of some levees. Mudflats comprise the largest area of tidal flat habitat in the Bay and occur adjacent to RWC Channel (outboard of Greco and Bair Islands), Cullinan, Alviso ponds, and Eden Landing ponds. More than one-half of the San Francisco Bay's tidal flat habitat is in the southern half of the San Francisco Bay (City of Redwood City 2010a). In the Lower South Bay, south of Dumbarton Bridge, the average water depth is only 3 feet and 75% of the Bay's surface area consists of mudflats.

Mudflats are a key reason for the importance of the San Francisco Bay Area to West Coast shorebird populations, with an average of 67 percent of all the shorebirds on the West Coast using San Francisco Bay wetlands (USFWS and CDFW 2007). Although the largest numbers of shorebirds forage on the broad flats along the edge of the Bay at low tide, some shorebirds, gulls, Ridgway's rail, and large waders (e.g., herons and egrets) feed on the exposed flats along sloughs and channels, and the smaller channels in the brackish and salt marshes (USFWS and CDFW 2007). Mudflats can be dynamic depositional features, changing in extent and location depending on the nature of erosion and deposition of sediments (USFWS and CDFW 2007).

Tidal flats provide aquatic habitat for invertebrate organisms and fish. The mudflats support an extensive community of aquatic organisms including diatoms, worms, and shellfish, as well as algal flora. Crustaceans, polychaete worms, gastropod and bivalve mollusks, and other invertebrates live on or just below the surface of the mud. Inundated mudflats provide foraging and/or breeding habitat for many species of fishes such as Pacific staghorn sculpin (*Leptocottus armatus armatus*), Pacific herring (*Clupea pallasi*) and starry flounder (*Platichthys stellatus*) among others (City of Redwood City 2010a). During the daily high tides, fish move over the mudflats to feed on these invertebrates. As the tide recedes and exposes the mudflats, the fish retreat to subtidal areas.

The mudflats support a large number of birds and other terrestrial species. Birds, primarily shorebirds, leave their high-tide roosts and feed on the mudflats. Shorebirds, gulls, terns, American white pelicans, and ducks often use exposed mudflats as roosting or loafing areas when available. The mudflats provide foraging habitat for a variety of migratory shorebirds such as long-billed curlew (*Numenius americanus*), western sandpiper (*Calidris mauri*), American avocet (*Recurvirostra americana*), black-necked stilt (*Himantopus mexicanus*), marbled godwit (*Limosa fidoa*), and long-billed dowitcher (*Limnodromus scolopaceus*).

When the tides rise, most of these birds return to roosting areas in salt marshes, salt ponds and associated levees, or other alternate habitats. Pacific harbor seals (*Phoca vitulina richardsi*) haul out on tidal flats and the seals move to open waters when the tides rise. Because benthic invertebrates recede deeper into the mud as the tidal elevation drops, especially large concentrations of foraging birds usually occur along the edge of the receding or rising tide line (USFWS and CDFW 2007).

Non-Tidal Salt Marsh

Diked, non-tidal salt marshes adjacent to tidal waters (separated by dikes) are generally jurisdictional (State- and federally regulated) wetlands. Diked non-tidal salt marshes ordinarily support simple vegetation with low plant species diversity. They are usually dominated by pickleweed, or simple mixtures of pickleweed and saltgrass. Such diked non-tidal salt marshes often decline in salinity over time, and admit various non-native weeds such as broadleaf pepperweed (CSCC 2010). Within the Project Area, non-tidal salt marsh is located on the inboard side of some of the levees at Eden Landing ponds and Alviso ponds.

Levee-Upland Habitat

Levees are earthen structures that separate open water tidal areas from salt ponds, marsh or upland areas in the Project Area. The levees in the South Bay salt pond complexes (Eden Landing and Alviso ponds) as well as the Cullinan levees were typically constructed from soils excavated from borrow ditches in former salt marshes (USFWS and CDFW 2007; USFWS 2010). In the South Bay the levee substrate is typically silty-clay in texture and saline; levees at Cullinan are constructed from Bay Mud. Some levees may be reinforced with riprap or concrete debris.

The levees in the South Bay salt pond complexes support peripheral halophytes (plants adapted to living in a saline environment) along the banks and tops of levees separating tidal areas from salt ponds (USFWS and CDFW 2007). Peripheral halophytes in the South Bay typically include nonnative, ruderal (disturbance loving, weedy) species such as iceplant (*Mesembryanthemum nodiflorum*), New Zealand spinach (*Tetragonia tetragonioides*), Russian thistle (*Salsola soda)*, and Australian saltbush (*Atriplex semibaccata*) (USFWS and CDFW 2007).

South Bay levees are used by nesting by birds such as California gulls, black-necked stilts, and American avocets. Large numbers of shorebirds use salt pond levees for roosting, particularly when intertidal foraging habitats, including mudflats and tidal salt marsh, are inundated during high tide. Some species, particularly western snowy plovers, black-necked stilts, and least sandpipers, also forage frequently along the margins of levees. Gulls, Forster's and Caspian terns, cormorants, pelicans, and other waterbirds also frequently roost on levees. The California least tern uses levees in the South Bay as post-breeding roosting sites. Mammals use levees for dispersal and to obtain access to foraging areas. Levees with rip-rap or concrete debris provide some cover for other small mammals such as the Norway rat (*Rattus norvegicus*), roof rat (*Rattus rattus*), and feral cat (*Felis catus*), while peripheral halophytes along the lower edges of the levee provide high-tide refugia for species such as the salt marsh harvest mouse, Ridgway's rail, and California black rail (USFWS and CDFW 2007).

The inboard levee slopes and the tops of the levees at Cullinan support upland habitat. The outboard side of the levee is characterized by remnant tidal salt marsh species transitioning to ruderal upland habitat consisting predominantly of nonnative vegetation. The native scrub plant coyote brush also occurs in the ruderal upland habitat. These levees provide habitat for raptors, owls, sparrows, and mammals including raccoons, rabbits, ground squirrels, mice, and

rats. The levee tops adjacent to tidal marshes provide important refuge for marsh species during extreme high tide events.

Ocean Water Habitat

SF-DODS is located in the open ocean on the lower continental slope, approximately 50 miles west of San Francisco. It is the only part of the Project Area that is located in ocean water habitat. Water depths at the site range between approximately 2,500 meters and 3,000 meters (USACE and RWQCB 2014). Biological resources at SF-DODS can be separated into three basic communities: the shallow pelagic community, the deep water pelagic community, and the continental slope benthic community. The shallow pelagic community includes various sea birds, marine mammals, migratory fish, and pelagic invertebrates. Seventeen species of cetaceans (whales, dolphins, and porpoises) are frequently observed near SF-DODS (USACE and RWQCB 2014). Of these, Dall's porpoise (*Phocoenoides dalli*), harbor porpoise *(Phoeocna phoeocna*), and Pacific white-sided dolphin are considered common resident species. The deep water pelagic community includes fish and invertebrates such as squid that are adapted to deep water conditions and marine mammals that dive to great depths while foraging. The continental slope benthic community is sparsely populated by fish and invertebrates that are adapted to the harsh conditions of the deep sea (USACE and RWQCB 2014).

b. Dredge and Placement Site Description

Redwood City Harbor

The RWC Channel consists of a deep open water habitat and shallow open water habitat on portions of the channel side slopes. The Project includes the proposed alignment of the dredged channel, and deepening of Berths 1 through 4. The current -30-foot MLLW deep open water habitat is regularly disturbed by maintenance dredging to remove up to 6 to 8 feet of sediment along the channel bottom. On either side of the existing channel are the shallow water habitat and tidal mudflats surrounding the tidal marshes at Bair and Greco Islands. These islands are preserved for their natural resources and are managed by the USFWS as part of the Don Edwards San Francisco Bay National Wildlife Refuge. Areas frequently used by harbor seals are near Greco and Bair Islands. Both Bair Island and Greco Island are known habitat for Ridgway's rail and double breasted cormorant as well as other avian species. Although not in the Project Area, in addition to the mudflats other habitat that occurs adjacent to the RWC Channel at both Greco Island and Bair Island includes tidal salt marsh and shallow open water habitat (HT Harvey 2005).

The proposed RWC Channel would slope from the maximum -39 feet MLLW bottom of the proposed channel to shallow water (i.e., from a maximum of -37 feet MLLW and 2 feet of overdepth). Tidal mudflats would be avoided by ensuring that the channel daylights[5] in shallow open water habitat. Up to 14.3 acres of shallow water habitat would be converted to deep

[5] Intersects the natural Bay bottom

water habitat as a result of widening the top width of the channel by up to 42 feet. The majority of the subtidal habitat would be removed along the southern side of the channel adjacent to Greco Island.

The deep water habitat in the channel is likely to support a variety of fish and marine mammals, which would use the area for foraging and migration between habitats.

Benthic invertebrates which live in the bottom substrate have been periodically disturbed by the maintenance dredging. This Project would not increase the frequency of the maintenance dredging events but would increase the volume of sediment to be dredged by an estimated 13% - 51% per episode, depending on the extent of channel deepening. This would increase the duration of the maintenance dredging but not the extent of the disturbance, as maintenance dredging would continue to occur within the footprint of the RWC channel.

San Bruno Shoal Channel

SBS Channel is located approximately 2.5 miles east of the western shoreline of the Bay, and 6 miles west of the eastern shore of the Bay. The channel and the immediate vicinity, including possible widening and lengthening areas, and pipeline relocation areas, are entirely deep water habitat (minimum depth of approximately -26 feet MLLW) with no nearby intertidal or wetland habitat. Further east of the channel and associated widening area is the main San Bruno Shoal, with water depths ranging from -2 feet MLLW to -10 feet MLLW (NOAA 2013b). Similar to RWC Channel, SBS Channel is periodically disturbed by maintenance dredging which would affect benthic organisms. However, SBS Channel is dredged at a much lower frequency (approximately every 10 years) than RWC Channel. The site likely provides foraging habitat and migration areas for a variety of fish, marine mammals, and invertebrates.

Cullinan Ranch Tidal Restoration Project

Shallow salt/brackish water habitat occurs in Napa River near the proposed offloader locations and in Dutchman Slough along the pipeline location. Shallow-water habitat provides foraging and roosting habitat for numerous species of wildlife, including mallard, cinnamon teal, great blue heron, snowy egret, and American coot. Steelhead, striped bass, green sturgeon, yellowfin goby, Delta smelt, longfin smelt and other fish occupy the Napa River and possibly Dutchman Slough (Jones and Stokes 2004).

Shallow water habitat and mudflats occur along the tidally-influenced Dutchman Slough. Benthic organisms such as worms and clams typically occur in the soft muddy bottom of subtidal habitats. Fish species, waterfowl and diving ducks are also typical users of subtidal aquatic habitat for foraging. Mudflats adjacent to the levees provide important foraging and roosting areas for resident and migrant shorebirds, wading birds, and gulls. The outboard side of the levee adjacent to Dutchman Slough supports remnant tidal marsh vegetation, characterized by pickleweed and gumplant vegetation. Spartina foliosa (native cordgrass) would be expected in the vicinity of the site.

The tops of the levees and the inboard levee slopes at Cullinan provide upland habitat. Vegetation is characterized by nonnative species including mustard, wild fennel, poison hemlock and annual grasses. The native scrub plant coyote brush also occurs on the levees (USFWS 2008b). In general, the tops of the levees and the inboard levee slopes provide habitat for raptors, owls, sparrows, and mammals including raccoons, rabbits, ground squirrels, mice, and rats. The upland habitat may also provide foraging, roosting and nesting habitat for short eared owls, northern harriers, and white-tailed kites. In addition, levee tops and high vegetation on levee slopes adjacent to the tidal marshes can provide refuge for marsh species during extreme high tide events.

Montezuma Wetlands Restoration Project

Montezuma is located at the eastern margin of Suisun Marsh, near the confluence of Suisun Bay and the Sacramento-San Joaquin River Delta. The facility has a permitted offloader; the pump for the offloader is permitted to operate only between August 1 and December 15 to protect larval stage Delta and longfin smelt and would use groundwater from June 1 through July 31. The offloader site is located in brackish open water habitat and as such would support split tail, Chinook salmon, and the endangered delta smelt and longfin smelt. Critical habitat for Delta smelt, green sturgeon, Central Valley steelhead, Central Valley Spring-run Chinook, and Central Valley Winter-run Chinook is located in the Sacramento River at Montezuma. Longfin smelt spawn at Montezuma. The Montezuma site is used by a variety of waterfowl and foraging shorebirds. The area potentially affected by RWC Project activities does not include any mudflat, upland or wetland habitat.

SF-DODS

SF-DODS is located 50 miles west of the Golden Gate Bridge and is approximately 2.5 nautical miles wide by 4.5 nautical miles long (6.5 square nautical miles). The water depth at the site is 2,500 to 3,000 meters. To reach SF-DODS scows must be towed through the protected Gulf of Farrallones National Marine Sanctuary. To avoid environmental impacts due to the potentially rough ocean conditions scows transporting material to SF-DODS are monitored and there are limitations on transit routes, allowable weather and wave conditions, maximum scow load and scow performance (no spill or leakage) (USEPA 2014). This ocean water habitat supports pelagic communities of seabirds such as gulls, albatross and Northern Fulmars, marine mammals, and fish and benthic communities. The site is fully permitted as a bottom dumping disposal site. Monitoring of SF-DODS has concluded that benthic organisms rapidly recolonize the site after dumping of dredge sediments (USEPA 2010b).

Alviso Pond Complex

The portion of the Alviso Pond complex within the Project Area includes open water, brackish marsh, tidal salt marsh and adjacent levee habitats. For the RWC Project, the sediment would be taken by scow to an offloader from where it would then be pumped through a floating and

submerged pipeline to a sediment delivery location either on the top of the levee adjacent to Pond A2W or Pond A9. The offloader would be located in deep water habit to allow fully loaded scows to transit during low tide. Floating and/or submerged pipelines would cross through deep to shallow water habitat, mudflats and small areas of tidal marsh to the pond levees. Sediment dredged from RWC Channel could also be pumped directly to the sediment delivery locations; multiple booster pumps would be required to pump the required distance (up to 13 miles to the dredged sediment delivery location at Pond A9). The pipeline from the cutterhead would be longer, but would cross the same habitat types as the pipeline from the offloader.

Pond A2W is bordered on the north by the Bay and on the south by Mountain View Park. Pond A2W is bordered on the west by Mountain View Slough and then Pond A1 and on the east by Stevens Creek (***Figure A-3)*.** The outboard areas of the pond levee and the lower reaches of the surrounding sloughs are characterized by upland and tidal salt marsh. The levee tops support salt tolerant plants including peripheral halophytes. Open water habitat exists along the Mountain View Slough and Stevens Creek (HT Harvey 2005).

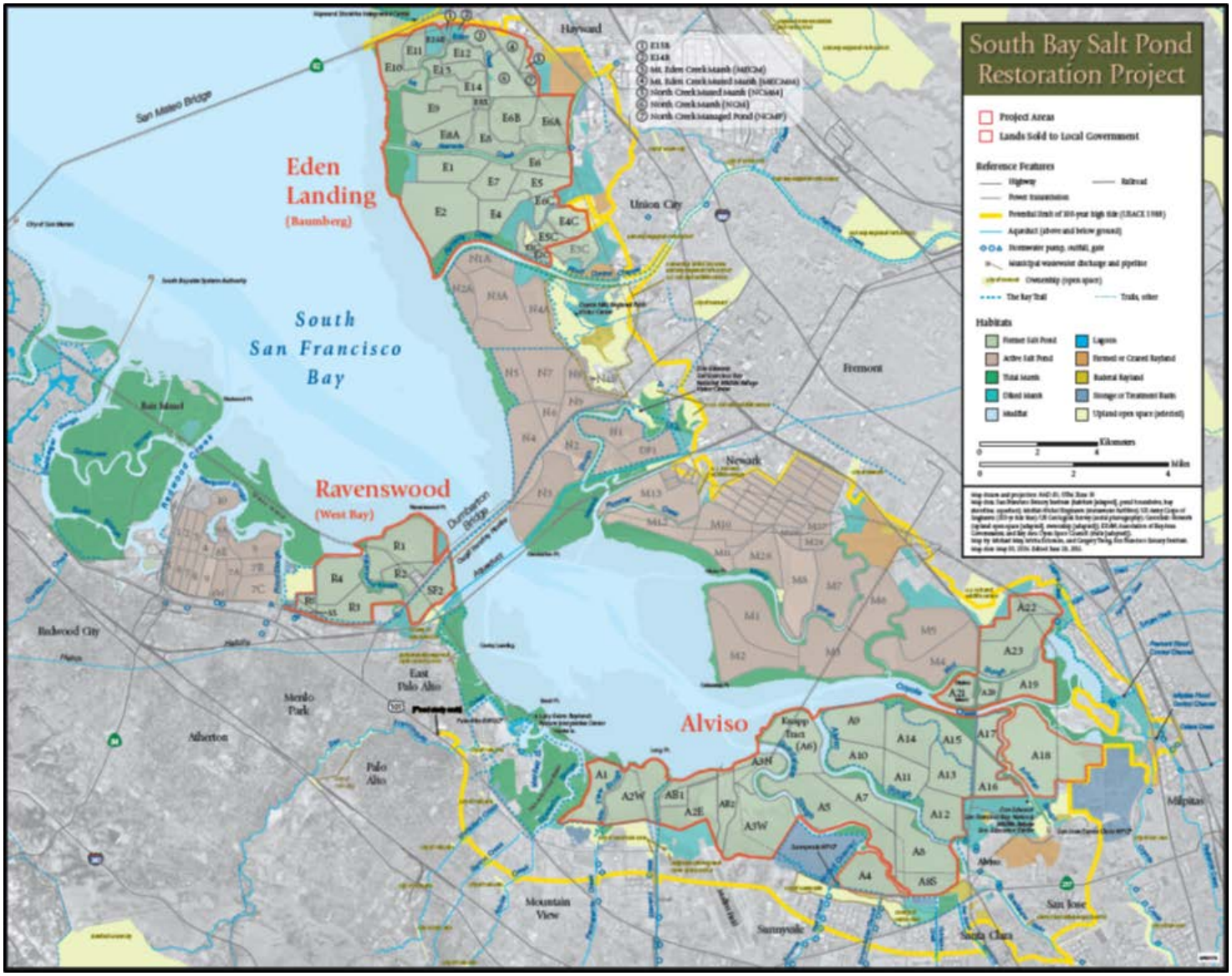


Figure A-3. South Bay Salt Pond Restoration Project

Pond A9 (365 acres) is bordered by Coyote Creek to the north and on the South by ponds A10 and A11. It is bordered on the west by Alviso Creek and to the east by Pond A14 (***Figure A-3***). The sediment would be delivered to the top of the Pond A9 pond levee along its northern edge adjacent to Alviso Slough. The habitat on the outboard side of the levee along Alviso Slough consists primarily of mudflat and open water habitat, and also includes small areas of tidal salt marsh habitat intermixed with brackish marsh. A large mudflat island is located at the mouth of Alviso Creek adjacent to Pond A9 (USACE 2014a).

Fish that may occur in the open water habitat of the South Bay include the northern anchovy, shiner perch, longfin smelt, white croaker, Pacific staghorn sculpin, bay goby midshipman, English sole, cheekspot goby, American shad, Pacific staghorn sculpin, three-spined stickleback and Pacific herring (USACE 2014a). Mudflats provide important habitat for resident and migratory bird populations in the South Bay as well as foraging habitat for estuarine fishes and invertebrates. A variety of shorebirds, gulls, terns, American white pelicans, and ducks use the mudflats.

Salt marsh habitat occurs on the outboard levees along the western and eastern extent of the Alviso complex. Salt marsh dominated by cordgrass occurs on the lower elevations of the marsh that border mudflat areas. Pickleweed-dominated salt marsh occurs at higher elevations, just above the cordgrass-dominated fringes of the salt marshes. The pickleweed salt marsh communities extend upstream into Mountain View Slough, Stevens Creek and Alviso Slough. Cordgrass borders occur along Mountain View Slough and Alviso Slough (HT Harvey 2005). Tidal marsh is also present along the north side of the mouth of Coyote Creek. Upstream in these sloughs, the brackish marsh initially contains patches of pickleweed salt marsh and cordgrass as it transitions from salt marsh to brackish marsh.

Levees separate many of the individual ponds in the Alviso complex and the ponds from San Francisco Bay. Along the outboard side of the levees, the pickleweed and cordgrass salt marsh habitats are separated by elevation. Cordgrass typically occurs below the MHW mark and pickleweed occurs above this mark and often extends up the levee banks. The fill soils associated with levees provide an artificial ecotone habitat that is marginally suitable for special status plants of relatively dry, alkaline areas. Peripheral halophytes occur along the banks and tops of levees separating tidal areas from salt ponds, and occasionally along levees separating salt ponds from each other. The extent of peripheral halophytic vegetation is primarily determined by the salinity of the levee soils, and how recently the levee soils were excavated from borrow pits in adjacent salt ponds. Peripheral halophytes typically include non-native, ruderal species such as iceplant (*Mesembryanthemum nodiflorum*), New Zealand spinach (*Tetragonia tetragonioides*), Russian thistle (*Salsola soda*), and Australian saltbush (*Atriplex semibaccata*). Native high marsh species also occasionally form peripheral halophytic habitat along levee banks. These species include marsh gumplant, alkali heath, spearscale, and saltgrass. In addition, pickleweed may also occur on levee banks along with these species.

Peripheral halophytic vegetation provides important refugial habitat to salt marsh wildlife species during high tides (HT Harvey 2005).

Eden Landing Ponds

The Eden Landing ponds within the Project Area includes open water, mudflats, tidal salt marsh, and levee-upland habitat. Two eelgrass beds are located nearby. For the RWC Project the sediment would be taken by scow to an offloader from which it would then be pumped through a floating and/or submerged pipeline to a sediment delivery location at the top of the Pond E2 Bay-front levee (***Figure A-5***). The offloader would be located in deep water habit to allow fully loaded scows reach the offloader during low tide. The floating and/or submerged pipeline would cross through the deep to shallow water habitats, mudflats and tidal marsh to the pond levee.

Alternatively, sediment could be delivered directly via a pipeline from a hydraulic cutterhead dredge. No offloader would be required; the pipeline would terminate in the same location as a pipeline from an offloader. The location of the cutterhead pipeline in San Francisco Bay would vary depending upon the location of the dredge. The cutterhead pipe would cross the same types of habitats as the pipeline from the offloader, but could be as long as 16 miles to reach the north end of SBS Channel.

The Eden Landing ponds include salt marsh, brackish marsh, freshwater marsh and peripheral halophyte marsh habitat (HT Harvey 2005). Large areas of pickleweed salt marsh lie to the west of the Eden Landing complex at the mouths of Old Alameda Creek (i.e., the Flood Control Channel) adjacent to Pond E1 (north of Pond E2). Pickleweed salt marsh dominates the lower reach of the Alameda Creek Flood Control Channel adjacent to Pond E2, however tidal marsh habitat is largely absent in the vicinity of the proposed dredged sediment delivery location. Large expanses of mudflat extend to the west of the Eden Landing complex. Open water habitat exists in the Bay west of the mudflats and in Old Alameda Creek (HT Harvey 2005). In addition, a small oystershell beach ridge is located on the north end of the outboard marsh of Pond E2 Two patches of eelgrass are located a short distance north of the proposed dredged sediment delivery location. The smaller patch is located approximately 4,500 feet northwest of the proposed dredged sediment delivery location, approximately 4,000 feet offshore. The larger patch is located approximately 1,200 feet off-shore, and is approximately 4,400 feet north-northwest of the proposed dredged sediment delivery location. The levees support peripheral halophytes with similar vegetation that is represented at the Alviso ponds.

Significance Thresholds

Establishing thresholds of significance, determining the significance of impacts, and establishing mitigation for biological resources require consideration of several inherent external and dynamic factors which would affect biological conditions even if the Project were not constructed. In particular, for many potential species it is difficult to identify a quantitative threshold of significance. Many plant and animal populations may vary considerably from one

year to the next (interannual variability). For example shorebird numbers require many years of bird surveys to establish a quantitative baseline, and available data on many birds may not accurately describe existing conditions for NEPA/CEQA baseline purposes. For example, the interannual variability in shorebird numbers in the South Bay could result in numbers that, in some years, would drop below a given threshold, even without the Project (USFWS and CDFW 2007). Furthermore, quantitative data are lacking for many, if not most, species at most locations that comprise the Project Area. In addition, many factors affecting species viability are out of the control of the RWC Project. These include factors such as climate change and habitat modification in other parts of the world (for migratory species). Many species are mobile, and variations in the number of individuals present at any given location in any given year reflects factors such as prey availability, presence of predators, weather, and availability of other habitat that may be more desirable. Consequently, significance criteria for biological resources focus on qualitative assessment of potential effects.

The effects of the proposed Project or alternative on biology are considered to be significant if the proposed Project or alternatives would result in any of the following:

- A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.
- A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service. This would include causing:
    - the loss or substantial reduction in area or distribution of a unique or rare plant community;
    - A major increase in the distribution, rate of spread, abundance, or impact of an invasive non-native species; or
    - A major, long-term reduction in diversity of native species and communities (that are not special status species).
- A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.
- Substantial interference 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.
- A conflict with any local policies or ordinances protecting biological resources.
- A conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

The term "substantial adverse effect on habitat or natural communities" and "substantial interference with movement or wildlife migration corridors" has not been quantitatively defined in CEQA. What is considered "substantial" varies with each species and with the particular circumstances pertinent to a particular geographic area.

Habitat Conservation Plan, Natural Community Conservation Plan, or other Approved Local, Regional, or State Habitat Conservation Plans

This CEQA significance threshold was included for completeness but none of the cities or counties in the Project Area have adopted habitat conservation plans or natural community plans that are applicable to the Project Area except Solano County. Solano County has an adopted habitat conservation plan (HCP) that is applicable to the Project Area. The reuse of the sediments to enhance marsh habit at Cullinan is consistent with that HCP (Solano County Water Agency 2012). As part of the Dredge Material Management Office (DMMO) sediment evaluation and permitting process, the Project would be permitted in compliance with the SFRWQCB Basin Plan and permitting requirements; BCDC Bay Plan and permitting requirements; LTMS policies; and other local and regional agency plans and regulatory requirements. The Project would also comply with the requirements of the USFWS Section 7 consultation, CESA requirements, and the NMFS Section 7 and Essential Fish Habitat consultation. The LTMS policies support the beneficial reuse of dredged material from deepening and maintenance projects. The Project would not conflict with adopted conservation plans and therefore there would be no impact related to this significance criterion at any of the dredging or placement sites.

Special Status Species

In evaluating impacts to special status plant and wildlife species within the Project Area, the analysis was based on relevant literature. Special status species tables were developed from special-status plant and wildlife species listed on the USGS 7.5 minute Quadrangles that encompass the various locations that comprise the Project Area and then the list was refined to include only those species for which there is appropriate habitat within the Project Area. Species lists generated from the USFWS quadrangle search and CNDDB quadrangle search were combined.

Special status aquatic and terrestrial species are listed in ***Appendix H*** on ***Tables H-1a through H-2b*** and include those species listed as endangered, threatened, proposed for listing as threatened or endangered, or species of concern, or are designated as Fully Protected species under one or more of the following regulatory statues: Federal Endangered Species Act, as amended; Marine Mammal Protection Act of 1972, as amended; California Endangered Species Act; California Fish and Game Code; and California Native Plant Protection Act of 1977. Special status species also include locally rare species defined by the California Environmental Quality Act (CEQA) guidelines 15125(c) and 15380, which may include species that are designated as sensitive, declining, rare, locally endemic or as having limited or restricted distribution by

various federal, state and local agencies, organizations and watch lists. Their status is based on their rarity and endangerment throughout all or portions of their range.

Impacts to aquatic species that occur in the Project Area are described below in ***Section A.4.*** Aquatic biological resources are wildlife that the majority of their life is dependent on aquatic habitat e.g. fish. Impacts to terrestrial species that occur in the Project Area are described in ***Section A.5*****.**

A.4 Biological Resources – Fish and Aquatic Resources

Environmental Consequences

- **Dredging Options**

The three dredging options consist of deepening RWC and SBS Channels to -32 feet MLLW, -34 feet MLLW, or -37 feet MLLW. All three options include relocating the fuel pipelines crossing SBS Channel to a minimum of 6 feet below the maximum depth of the channel (i.e., including overdepth). Potential effects of all three dredging options to biological resources are very similar; consequently the three dredging options are analyzed together. ***Table H-1a (Appendix H)*** shows the special status aquatic species that could occur at the dredge sites. Special status aquatic species that may be present at the dredge sites include Chinook salmon, steelhead, green sturgeon, and longfin smelt. No eelgrass or special status invertebrates occur at the dredge sites. The proposed Project would widen the existing dredged channels by up to 12 feet for the -32-foot depth, 24 feet for the -34-foot depth and 42 feet for the -37-foot depth.

RWC Channel is and would continue to be located immediately adjacent to the mudflats at Bair Island and Greco Island. Removal of any mudflats outboard of Bair Island and Greco Island would be avoided through channel design. The channel side slopes would be constructed with a 3:1 slope to minimize the potential for sloughing. As discussed in the Geotechnical Engineering Appendix (***Appendix D***), the final design of RWC Channel, including the exact RWC Channel alignment and the channel side slopes, may be affected by several factors such as the underlying sediment type, bar pilot navigational requirements, and further engineering analysis to be performed during the design phase.

Deepening and widening of SBS Channel is less constrained. The current 500-foot bottom width would be retained along the entire channel, regardless of the amount of deepening. All channel side slopes would remain at a 3:1 slope. Relocating the three fuel pipelines crossing SBS Channel would be accomplished using one of the three methods described in ***Section 4.2.3.4 of the Main Integrated Report***. Up to 2,500 feet of each of the three existing pipeline would be removed and replaced at greater depth. The habitat that would be disturbed at SBS Channel is deep water habitat. No disturbance of shallow water habitat is expected.

<u>Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a</u>

candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

For the aquatic biological environment it is not expected that there would be a significant population decline of aquatic species including special status aquatic species except potentially through entrainment of listed species. The dredging would occur within all relevant work windows, which are June 1 through November 30, follow BMPs, Programmatic EFH conservation measures, and permit requirements. Under certain circumstances work windows could be modified through additional consultation process with the appropriate agencies. A summary of the key potential impacts follows.

Entrainment

Dredging could occur with a clamshell or a hydraulic cutterhead. The Project would comply with LTMS work windows where applicable and other permitting measures to minimize entrainment and its effects on species. During t the biological consultation for the Project, the Corps would consult with USFWS and NMFS regarding entrainment. The avoidance and minimization measures identified as part of that consultation would be implemented as needed.

Entrainment associated with clamshell dredging would be minimal. If a hydraulic cutterhead is used, special status species, non-listed fish species and other organisms could be incidentally entrained in significant numbers during the dredging operation as the dredge suctions water and material from the channels into the pipe. There is a higher potential for entrainment for fish that live and feed on and near the bottom of the water column. Although some of these non-listed fish species (e.g. Pacific staghorn sculpin, Pacific sanddabs) may be entrained, this would not have significant effect on their population numbers or species survival. Entrainment would be of particular concern for longfin smelt due to the significant long term population decline (more than 25 years) in San Francisco Bay. (Due to the salinity of the water at the dredging locations, Delta smelt would not be present.) Population decline is attributed principally to reductions in freshwater inflows and introductions of exotic invasive clam species (USERDC 2014).

Entrainment is also of concern for green sturgeon which are benthic feeders, and may be present year round in the Project area. Due to their year round occurrence there is no work window for the species that would avoid entrainment although further research into a work window is proposed. San Francisco Bay is designated critical habitat for green sturgeon. Adult and sub-adult sturgeon are found in both deep and shallow water (Stanford et al 2009). Entrainment impacts would be greater with cutterhead dredging but would also occur at a low level from clamshell dredging. Based on current knowledge the entrainment rates for Green Sturgeon appear to be generally low (Stanford et al 2009).

Salmonids may also be present in the dredging area. Salmonids may pass through the proposed dredging area en route to spawning habitat further south. Redwood Creek does not have a salmon run (Port of Redwood City 2010), but salmon may stray into RWC Channel. After hatching, young-of-the-year (i.e., first-year juvenile) green sturgeon move into the Delta and San Francisco Bay where they may remain for 2 to 3 years before migrating to the ocean (USACE and RWQCB 2014). Sub-adult and nonspawning adult green sturgeon use both ocean and estuarine environments for rearing, foraging, and feeding on benthic invertebrates, crustaceans, and fish (Moyle 2002). Although juvenile and adult green sturgeon have the potential to be present in the Project area during dredging, it is generally believed they would be motile enough to avoid entrainment.

In addition there is the potential for fish species to be entrained in vessel propeller wash or struck by vessel propellers. Fish species may be struck by propellers or entrained in propeller wash (propwash) from tugs and other vessels during dredging operations. In a study of entrainment in propwash and propeller strikes on the Mississippi River, large-body species such as sturgeon showed a higher probability of being struck by a vessel propeller. Sturgeon are known to experience direct injury and mortality due to propeller strikes and entrainment in propwash. In a study by the Engineer Research and Development Center (ERDC) on the Mississippi River to assess impacts of propeller strikes on Atlantic sturgeon (Acipenser oxyrinchus), 2% of all fish entrained behind a large tugboat were found to have been injured by propeller strikes. The study also noted that entrainment of sturgeon in propwash of deep draft vessels produced mortality rates substantially exceeding those associated with dredging entrainment (USACE and Port of Sacramento 2011).

Following construction, the potential for green sturgeon to be struck by vessel propellers or entrained in vessel propwash would increase with additional vessels call at the Port of Redwood City. As discussed in Section 4.2, there could be up to a 45% increase in vessel calls, although the total number of vessel calls would be less than under the No Action/No Project condition. The impacts to green sturgeon from vessel strikes and entrainment in vessel propwash would be less than significant.

Longfin smelt may occur throughout San Francisco Bay at all times of year. They are not powerful swimmers and sometimes occur near the bottom of the water column where entrainment by the draghead of a hydraulic dredge can occur. There is no specified work window for longfin smelt. Modeling has indicated that smelt may continue to decline over the next 30 years due to a small degree from Bay-wide maintenance and deepening dredging, but largely due to significant other factors which contribute to their decline. The LTMS Draft Programmatic Work Window Consultation (BCDC et al. 2014) for conservation measures for salmonids, green sturgeon and smelt and have been incorporated into the Project. In addition, the following measures determined through coordination with CDFW may be implemented as required to protect longfin smelt (these measures generally benefit other fish species as well):

1. Dredging may proceed anywhere when water temperature exceeds 22.0 degrees Celsius.
2. The USACE would implement a worker education program for longfin smelt, and other listed terrestrial and aquatic species.
3. Draghead pumps would only be turned on when the dragheads are on the seafloor or within 3 feet of the seafloor when priming pumps.
4. USACE will coordinate with the dragtender to monitor the dragheads so that they maintain positive contact with the seafloor during suction dredging.
5. If the Project undertakes work requiring only a partial dredging window to complete (i.e., following work during a full dredging window of operations in the prior year), USACE would dredge later (October-November) during the dredging window, if feasible, to reduce entrainment risk.

Little is known regarding entrainment of species associated with use of the jet sled trenching process that may be used for pipeline replacement at SBS Channel. It is assumed that there would be some level of entrainment from the pipeline that takes in water to pump into the sediment to move the sediment off the pipe and create the trench for pipeline replacement. Entrainment is not expected to occur with the clam shell trenching method or directional drilling.

Entrainment impacts to special status species and other fish species would be minimized though compliance with LTMS programmatic measures, and permitting requirements and implementation of BIO-M1, BIO-M2, and BIO-M3 (***Section A.4.2***).

Noise

All dredging activities would take place in the federal navigation channels, which receive regular boat traffic, and therefore have high background levels of underwater noise. Large shipping vessels have continuous noise in the range of 180 to 189 dB (USACE and RWQCB 2015). Mechanical and hydraulic dredges both produce repetitive sounds that may be intense enough to cause adverse effects on fish and marine mammals. Clamshell dredges can have a repetitive sequence of sounds generated by the winches, bucket impact with the substrate, closing and opening the bucket, and sounds associated with dumping the dredged material into the scow. The highest sound impacts are produced during the bucket's impact with the substrate, which can result in peak sound pressure levels (SPL) of 124 decibels (dB) measured 150 meters from the bucket strike location (USACE and RWQCB 2014). Underwater noise is generated by hydraulic dredging equipment, including rotating cutterheads, pumps, propellers, suction pipes, and the cutterhead contact with the substrate. The noise from a hydraulic cutterhead dredge will vary by size and sediment, it can produce continuous noise in the range of 150 to 170 dB when measured 10 meters from the cutterhead, with noise levels varying with dredge size and sediment type (USACE and RWQCB 2014). All three dredging options may require short term pile driving to isolate the tie-in locations for the relocated fuel pipelines at the SBS Channel.

Currently, there are approximately two to four weekly deep draft vessel that transits through SBS Channel and RWC Channel, as well as an unknown amount of other commercial vessel traffic. Maintenance dredging occurs on average every 19 months; i.e., approximately 2 out of every 3 years. Maintenance dredging occurs during the six-month dredging window (i.e., between June 1 and November 30), and the typical duration is 2 to 4 months. The deepening dredging noise would also occur during the 6-month dredging window, and would be nearly continuous over this period up to 6 months; however, it would occur annually over multiple years ranging from 2 up to 12 years.

Marine mammals are occasionally found within the proposed dredging areas. Levels of harassment for marine mammals are defined by the MMPA. Level A harassment is defined as "[A]ny act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as "[A]ny act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering." Any activities that may result in harassment of marine mammals under these guidelines would require an Incidental Harassment Authorization (IHA) from the NMFS. For impact pile-driving, NMFS defines noise level exposure above 190 dB RMS (root mean squared) as Level A harassment for seals and sea lions (which could occur in the area) and indicates that noise levels above 180 dB RMS (can cause injury to cetaceans (whales, dolphins, and porpoises). Level B harassment for impact pile-driving is defined as sound levels between 160 dB and 190 dB. For continuous noise, such as vibratory pile-driving the Level B criterion is 120 dB (SLC 2012; USACE and RWQCB 2014). The dredging and pile driving could produce underwater noise that qualifies as harassment for marine mammals and is comparable to the noise produced by commercial shipping vessels currently occurring in the project area, as well as dredging activities during maintenance dredging. Level A harassment is unlikely to occur; however, Level B harassment could occur in the immediate vicinity of the dredge. At these levels behavioral effects could include changes in feeding behavior, fleeing, and startle response. More serious injury, such as rupture of swim bladder from peak noise, is not expected to occur.

For fish the effects of dredge-generated noise and sound waves are still largely unknown, with the amount of scientific knowledge varying by species. Effects may include behavioral changes, neurological stress, and temporary shifts in hearing thresholds (USACE and RWQCB 2015). Generally noise-related studies have been on the effects of pile driving and the Fisheries Hydroacoustic Working Group (FHWG), whose members include California departments of transportation, CDFW, and other agencies determined that noise at or above peak noise levels greater than 206 dB are considered to be injurious (SLC 2012, USACE and RWQCB 2015). Accumulated SPLs of 187 dB for fishes that are greater than 2 grams, and 183 dB for larval fishes below that weight, are considered to cause temporary shifts in hearing, resulting in temporarily decreased fitness and detrimental behavioral changes (USACE and RWQCB 2015).

Periodic maintenance dredging in the channels has not produced injuries to fish and deepening would also not be expected to injure fish. Effects to fish behavior (avoidance, fleeing, changes in feeding behavior, etc.) may occur at lower dB ranges. NMFS uses 150 dB as the threshold for adverse fish behavioral effects (USACE and RWQCB 2014). Injury to fish from peak noise (e.g., rupture of swim bladder) is not expected to occur. The noise levels from Project dredging activities would be expected to cause special status as well as non-listed species fish and marine mammals to temporarily avoid the area where the dredge operates and/or temporarily affect behavior such as feeding; however, these adverse impacts would be expected to be short term. Fish species are expected to return after dredging stops; therefore no long term impacts are expected.

At SBS, several methods are proposed to remove the pipelines and construct the trench. Jet sled use is not expected to produce noise levels that could affect fish or marine mammal populations (Williams 2013). The noise levels from using a clamshell dredge to construct the trench would be similar to noise from dredging operation. Noise from directional drilling is expected to be minimal and short term. Relocation of the pipeline would also require installation of cofferdams, which would be constructed of sheetpiles. Pile driving would be conducted adjacent to SBS Channel as part of the pipeline removal process. A sound assessment of underwater noise from pile driving was completed in 2012 (Illingworth and Rodkin 2012). This assessment determined that underwater sound would exceed levels that have the potential to disturb or temporarily decrease fitness of fish with a prolonged exposure to the underwater sound. Such effects could potentially impact fish over areas of up to 328 feet from pile driving (USACE and RWQCB 2015). However, the assessment also determined that the use of bubble curtains reduced noise impacts to levels that would not cause injury to fish. As described in ***Section 4.2.3.2.2 of the Main Integrated Report***, pile driving for this Project would use vibratory pile drivers, wherever possible. If substrates are too dense for vibratory hammers, an impact hammer would be used and noise would be attenuated with a bubble curtain. A "soft start" technique would also be employed for both types of hammers to give wildlife time to exit the area during pile driving.

Marine mammals are highly mobile and likely to avoid areas of noise while dredging operations are underway (USACE and RWQCB 2014). Impacts may therefore include temporary displacement of marine species; however, the affected area would be limited to the immediate dredging area and would not substantially limit habitat or movement of wildlife and therefore the impact is expected to be less than significant. Pile driving activities would produce underwater sound that has the potential to harass marine mammals (Level B harassment, which includes non-injury behavioral effects). Vibratory driving would produce lower levels of sound than impact pile driving, but would still exceed Level B harassment thresholds. Level A harassment, which includes potential injury, is not expected to occur as a result of the project activities (USACE and RWQCB 2014).

Noise impacts to special status species, including marine mammals, and other fish species would be minimized though the compliance with permitting requirements and implementation of BIO-M4 (***Section A.4.2***).

Turbidity, Total Suspended Solids, and Contaminants

Increased Turbidity

Proposed dredging and pipeline relocation activities would introduce suspended sediments into the water column which would result in an increase in turbidity in the vicinity of the dredge. Hydraulic dredging would minimize turbidity at the site whereas clamshell dredging would result in a higher level of turbidity. Although dredging would be continuous, increases in turbidity would be expected to be localized, with the most concentrated portion of the turbidity plume located along the bottom of the water column and decreasing in concentration toward the surface (USACE and Port of Oakland 1998). The plume would extend downcurrent of the dredging site for a variable distance which would be influenced by tides and creek flows. After completion of dredging activities, the plume would be expected to settle quickly with no long term effects. The dredge would move 23 to more than 100 feet per day. Turbidity plumes would dissipate as the dredge moves. Studies have indicated that turbidity can naturally range as high as 1000 mg/l. Total suspended solids (TSS) levels in the Bay vary greatly, ranging from 10 mg/l to over 100 mg/l depending on season, tidal stage, and depth (USACE and RWQCB 2014).

The removal of the SBS Channel pipeline would substantially increase turbidity if the jet sled method of construction is chosen. There is little information on the impacts from a jet sled operation; however, the TSS levels would be expected to be higher in the lower portion of the water column than for trenching operations and for a long duration. The plume would extend downcurrent of the jetting site for a variable distance which would be influenced by tides and currents. Although the TSS levels would be expected to be high locally during the jetting activity, after completion, the plume would be expected to settle quickly particularly due to the expected higher sand content of the sediment in the area, and with no long term effects are anticipated. If pipelines are tied in above water, the pipelines on both sides of the channel would be jetted out of the sediment, and similar effects to using the jet sled method of construction would occur. Turbidity from use of a clamshell dredge to construct the trench would be similar to dredging the channel and duration would be less than 20 days per pipeline segment. Turbidity from directional drilling is expected to be minimal and short term.

Increased turbidity levels associated with the dredging and pipeline relocation activities could result in biological impacts to organisms. Higher turbidity levels during a dredging event can result in a slight reduction in light penetration (measured as transmissivity) in the water column immediately adjacent to the dredging operations. Transmissivity is important to phytoplankton because phytoplankton require sufficient light to photosynthesize. The increased turbidity would not be expected to significantly affect phytoplankton productivity because phytoplankton production typically occurs in the upper portion of the water column where the decrease in transmissivity is expected to be minimal. Filter feeding organisms (e.g., mussels)

both in the bottom substrate and those organisms attached to the pilings along the berths could be affected by increased turbidity due to clogged gills and feeding apparatus.

High levels of turbidity may affect fish by disrupting normal feeding behavior, reducing growth rates, increasing stress levels, and reducing respiratory functions (Anchor 2003). Review of the literature regarding the effects of turbidity associated with construction in the aquatic environment on anadromous salmonids indicates turbidity may interfere with visual foraging, increase susceptibility to predation, and interfere with migratory behavior. Turbidity also reduces the avoidance response of juvenile chinook salmon to bird and fish predator models (Anchor 2003) and induces a surfacing response in juvenile coho salmon, which potentially increases their vulnerability to predation (Anchor 2003).

There is little direct information available to assess the effects of turbidity in San Francisco Bay on juvenile or adult green sturgeon. The green sturgeon forages in bottom sediments and thus is well adapted to living in estuaries with fine sediment substrate and is tolerant of elevated levels of turbidity. Listed species in San Francisco Bay commonly encounter areas of increased turbidity due to storm flow runoff events, wind and wave action, and benthic foraging activities of other aquatic organisms. Fish generally react by avoiding areas of high turbidity and return when concentrations of suspended solids are lower.

Many laboratory studies have attempted to determine the levels of suspended sediments that cause impacts on the physiology of marine organisms. A study found that most of the fish and invertebrates studied could withstand levels of resuspended sediments of up to 250 to 400 mg/l for a period of about 9 to 10 days without effect (Anchor 2003). ***Table A-9*** presents total suspended sediments (TSS) concentrations at which effects are noted from typical studies (Anchor 2003).

Table A-9. Response of Marine Species to Certain Concentration Levels of Total Suspended Sediments (Anchor 2003)

Species	Concentration (mg/l)	Response
Rainbow Smelt *Osmerus Mordax*	10	Increased swimming behavior
Most fish and invertebrate	250-400	No effect
American Shad larvae	500	32% mortality after 4 days of exposure
White Perch	650	Elevated hematocrit levels after 5 days of exposure.
Striped Bass	1,500	Elevated hematocrit levels after 14 days of exposure
Fish	4,000	Exhibits of erosion at gill filament tips
Shiner Perch	6,000	50% mortality
Chinook Salmon smolts	11,000	50% mortality after 96 hours of exposure

Observed biological impacts from the studied TSS concentrations ranged from no effect to lethal impacts. Marine organisms' response to resuspended sediments is a function of the resuspended sediment concentration, the duration of exposure, and the type and level of development of organisms. Study results indicate that significant adverse impacts likely do not occur during typical dredging projects, though biological effects can occur at higher resuspended sediment concentrations. Typical concentrations of suspended sediments generated by dredge projects are less than the sub-lethal and lethal levels observed in the laboratory studies (C. Boudreau per comm. 2015). Further, elevated resuspended sediment concentrations in typical dredging projects are generally confined to the immediate vicinity of the dredge or discharge point and dissipate rapidly at the completion of the operation. Resuspended sediment concentrations caused by natural phenomenon such as floods, storms, large tides and winds are often higher and of longer duration than those caused by dredging.

Marine organisms in the Bay are adapted to the fluctuating turbidity levels. Fish are expected to avoid areas of higher than normal turbidity and filter feeders would recover in a short time. The effects of dredging on turbidity would be short term and localized during dredging with implementation of mitigation measures WQ-M1 this impact would be less than significant.

During pipeline relocation, turbidity in the lower portions of the water column could be relatively high if the jet sled method of construction is used or the pipeline is jetted out of the sediment as part of the tie-in process. Use of the jet sled method of construction could require approximately between 50 and 100 months for pipeline replacement at SBS channel (depending on depth). Turbidity effects would occur primarily in SBS Channel, an area that currently experiences some disturbance from deep draft vessel traffic. Due to the long duration of the dredging activities in a localized area, effects from increased turbidity associated with jet sled would be considered significant. Use of a silt curtain or other barrier device would be infeasible due to the use of the channel by deep draft vessels. Mitigation measure WQ-M1 would be implemented; however, the residual impact would remain significant. Use of the jet sled method of construction would result in a significant and unavoidable impact from increased turbidity. After construction is complete the site would quickly be expected to return to near pre-project conditions and the impacts would be expected to be less than significant. Turbidity impacts to special status species and other fish species would be minimized though compliance with LTMS and permitting requirements and implementation of WQ-M1 (***Section A.15.4***); however, the impact if jet sled construction were used for the SBS pipeline relocation would be significant and unavoidable.

Increased Suspension of Toxics and Organics

The sediments from the deepening of the channels would primarily be made up of find grained sediment including some contaminated sediment at RWC Channel and a combination of 30% sands and 70% fine grained sediment at SBS Channel. Available sediment sampling data from

recent maintenance dredging episodes indicates that most of the sediment to be dredged, with the exception of the Inner Turning Basin in RWC Channel, is likely to be suitable for unconfined aquatic disposal. Past maintenance dredging characterizations for the Port of Redwood City indicated that generally sediment chemical concentrations were similar to ambient levels in the Bay. Testing in 2008 and 2010 indicated a lack of toxicity in elutriate and solid phase biological tests which would support the conclusion that contaminant concentrations are not available in the water fraction (Pacific EcoRisk 2008 and 2010).

A small percentage of sediment could be unsuitable for unconfined aquatic disposal, and may have to be placed at a reuse site capable of accept wetland foundation dredged sediment. The spatial extent of contaminated sediments that could be resuspended would be limited in extent and suspended sediments would quickly settle out of the water column. Organic compounds are generally less soluble than metals. Consequently, direct toxicity via organic compounds dissolved in the water column is often less likely. However, organic compounds tend to bioaccumulate in organisms. This can occur both through dissolved phase exposure through the water column and from organic compounds adsorbed to particulate matter.

Organic compounds such as PCBs are usually sequestered on particulate matter and can be released to surrounding water when sediments are dredged resulting in suspending the particles. The exposure from this sediment is expected to be short term in the area of the Inner Turning Basin, and toxicity testing of the sediments has shown that toxicity associated with these sediments is generally comparable to the reference sediment from SF-DODS and SF-11 (Kinnetic and Atkins 2015). Due to the relatively short exposure duration, the limited concentration, and minimal solubility of contaminants at the site, toxic effects are expected to be insignificant. The impact would be less than significant.

Beneficial Impacts from Resuspended Sediments

While resuspended sediments are typically associated with negative impacts, an increase in the amount of resuspended sediments can also have beneficial impacts to the aquatic environment. For example, a study indicated that suspended bottom material serves as an additional food source for the blue mussel *Mytilus edulis*, and that this organism depended on suspended bottom material to exploit fully its feeding potential, and to reach the maximum growth rates observed in nature (Anchor 2003). Other studies also suggested that suspended sediments could cause the release of nutrients to marine plants that can stimulate algal growth (Anchor 2003). It also has been found that several species actively prefer turbid over clear water conditions to facilitate feeding and avoidance behaviors (Anchor 2003). Turbid conditions may also enhance the visual contrast of prey items and thus increase overall feeding rates, as was demonstrated for larval pacific herring *Clupea pallasi* (Anchor 2003). Alternatively, increased turbidity may reduce the risk of predation while foraging and result in increased foraging rates, as was observed for juvenile chinook salmon (Anchor 2003).

Habitat Disturbance

Potential dredging pipeline replacement impacts to the existing benthic community in the channels would occur due to removal of the existing benthic communities in the deeper subtidal areas. No special status benthic species are likely to occur within RWC and SBS channels. The existing benthic deeper subtidal habitat in the Port's RWC channel is frequently disturbed, both by maintenance dredging that occurs every one to two years, and by propwash associated with ship movements. SBS Channel experiences a much lower maintenance dredging frequency; however, it would also be subject to disturbance of bottom sediments due to frequent vessel transits. The location where the pipeline would be removed and replaced (1000 feet on either side of SBS channel) has not been disturbed for many years. Although the Project would cause benthic productivity to be reduced temporarily in the dredged channels and pipeline trench, it would be expected that recolonization of the dredged areas and pipeline replacement area with species similar to the existing benthic community would start soon after dredging/replacement is complete especially in areas with silty sediments (USACE and Port of Oakland 1998). Because the existing benthic community at RWC channel is frequently disturbed, and recolonization would occur within a relatively short time, dredging impacts in the channel are considered to be less than significant. The area of SBS Channel dredged under Dredging Options B and C would be substantially larger than under Option A, which would disturb more bottom substrate and benthic habitat. Dredging and pipeline replacement at SBS Channel is less frequent and the bottom substrate is expected to contain higher sand content which could lengthen the period that it would be required for benthic species to recolonize; however, it would be expected that benthic organisms would recolonize over time and wildlife species would utilize the extensive nearby deepwater habitat for foraging during the construction period; and therefore the impacts would be less than significant.

Habitat Modification

Deepening of RWC Channel would include conversion of some shallow open water habitat to deep open water habitat. All of the dredging locations are EFH (USACE and RWQCB 2015). An estimated5.6 to 14.3 acres of shallow water habitat would be removed, depending on the channel depth. No habitat conversion would occur at SBS Channel; all proposed work areas are at depths below –18 feet MLLW. Extensive shallow water habitat is present near RWC Channel in the open waters of the Bay. Nonetheless, the shallow water habitat is considered essential fish habitat and is managed under federal management plans (FMPs)for Pacific groundfish and Pacific coast salmon, and conversion of the habitat would therefore be considered a significant impact. With implementation of Mitigation Measure BIO-M6, this impact would be less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

Potential impacts associated with habitat alteration would consist of the physical removal of soft bottom substrates in the subtidal deep water habitat and shallow water habitat in the existing channels and berths during dredging. Marine organisms immediately adjacent to the dredge operations may also be lost due to smothering of existing habitats during resettlement of suspended sediment. The species would be expected to recolonize the area relatively quickly. No special status benthic epifauna or infauna species would occur in these areas (USACE and RWQCB 2015). The shallow water soft bottom habitat is EFH for Pacific groundfish and Pacific salmon and as described above conversion would be a significant impact.

The widening of the channels would create more deep water habitat in the RWC and SBS Channels vicinity. The reduction in shallow water habitat would be expected to have a minimal effect on species that inhabit shallow water habitat except EFH species that use shallow water habitat. The Project is engineered to avoid dredging the mudflats. The Project would be in compliance with any measures required in the Section 7 consultation, CESA requirements, EFH consultation, and the permits. The proposed dredging is not expected to have substantial adverse effect on sensitive natural communities and no special status specie area located in the affected habitat. The loss of shallow water habitat would be mitigated with implementation of Mitigation Measure BIO-M6, this impact would be less than significant.

The dredging operations would not be expected to spread invasive species beyond the SBS and RWC Channels into adjacent habitat and therefore the impact is less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption.

The dredging of RWC and SBS channels would not adversely affect protected wetlands because the Project is located in existing channels and adjacent subtidal deep and shallow water habitat. The dredging would deepen the existing channel alignment and would remove subtidal habitat to stabilize the channel slope but would not remove, fill, or cause a hydrological interruption of wetlands. There would be no impact.

Impact BIO-4: 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.

Fish and marine mammal movement and migration could be affected by the Project due to the species' avoidance of the dredging area when the dredge is operating. Physical disturbances such as underwater noise and increased turbidity may cause fish and marine mammals to temporarily avoid areas with high levels of turbidity or noise. These impacts would be expected to be localized and the fish and/or marine mammals would return following the completion of dredging. All work would occur during the work window. The Project would be in compliance with any measures required in the Section 7 consultation, CESA requirements, EFH

consultation, and the permits including the BMPs described in ***Section 4.2 of the Main Integrated Report***. This is a short term impact that is considered to be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

The project would have short term temporary impacts to biological communities but would not be expected to have long term impacts consistent with the cities of Redwood City and Brisbane's policies (***Appendix G***). The City of Redwood City has policy to protect tidal flats. The Project is engineered to avoid dredging the mudflats. Therefore the impact is less than significant.

Placement Sites

Cullinan Ranch Tidal Restoration Project

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

Cullinan has SLC and BCDC permits to construct an offloader and piping to discharge slurried sediment to the diked upland portion of the site. This portion of the site is being restored to intertidal elevation for rapid vegetation to tidal marsh. It is expected that the RWC Project, if it constructs the offloader and pipeline, would obtain similar permits for the site that would also allow one or both of the two offloader locations and pipeline alignments included in the Cullinan permits. The impacts from the construction of the offloader and related pipeline were previously evaluated in the *Addendum to the Final Environmental Impact Report for the Cullinan Ranch Restoration Project Solano and Napa Counties* (SLC 2012).

Activities associated with use of this placement site would be the transport of dredged material to this site by scow, construction and operation of the dredged sediment offloader and pipeline, and delivery of dredged sediment to the top of the levee where it would be discharged into the inboard side of the levee (***Figure A-1***). The offloader locations are proposed to be in the Napa River in deep water, approximately 1 mile east of the levee where the sediment would be delivered. The offloader and work area around the offloader would be approximately 200 feet by 400 feet. The offloader platform would be held in place by two spuds. The sediment would be slurried by pumping water from the Napa River through a fish screen in compliance with NOAA Fisheries Service (NOAA Fisheries), USFWS and California Department Fish and Wildlife (CDFW) guidance. The sediment would be pumped to Cullinan Ranch through a sediment placement pipeline which would float on the surface of the water along the edge of Dutchman Slough and be anchored with small dead weight anchors. If the sediment placement pipeline crosses a navigable area, weights would be used to hold down and anchor the pipeline to the bottom of the channel. Management of the sediment once it reaches the top of the

levee would be part of the Cullinan Ranch Tidal Restoration Project and has been evaluated under separate environmental reviews.

Shading

The offloader once constructed may be in place for up to ten years. The platform for the offloader is expected to be approximately 6,000 square feet and would cast shade over the water which can impact phytoplankton production, affect invertebrate and vertebrate communities, affect fish foraging, alter fish species composition and alter normal predator prey relationships when compared to open water conditions. No eelgrass or bottom growing algae occur in the area of the offloader construction. Marine species in the Napa River are adapted to relatively high TSS levels as sediment constantly resuspended due to daily tidal currents, waves and water flow. The daily tidal currents and water flow would also limit the duration that species would be subject to shading. While fish species composition could be somewhat different beneath structures than in open-water conditions, the change due to the Project related to overwater structures is not substantial and the potential effect of shading on sensitive species is not expected to constitute an adverse effect.

The reduction in light resulting from overwater structures can affect behavior, and has the potential to deflect or delay fish migration, reduce prey resource production and availability, and alter predator-prey relationships. Many predatory fish, such as striped bass, are associated with structures and could occur near the offloader. This could result in a slight increase in predation on larval and young fish in the local Project Area. Larger predatory fish may move into shallow water to feed during high tide. However, larval or young fish would most likely avoid areas that are shaded by the floating platform (SLC 2012) and it is unlikely that significant increases in predation would occur. The potential impact from Project due to shading is expected to be less than significant.

Noise

The impacts from pile driving are similar to the pile driving at the SBS pipeline replacement. FHWG determined that noise at or above peak noise levels greater than 206 dB can cause barotrauma to auditory tissues, the swim bladder, or other sensitive organs in fish. Accumulated sound energy levels (SEL) above 187 dB for large fish and 183 dB for larval fish (less than 2 grams body weight) have been determined to be potentially detrimental to fish (SLC 2012). Pile driving would occur over a very short period and in accordance with the best management practices outlined in ***Section 4.2 of the Main Integrated Report***. This would include use of vibratory pile driving were feasible, soft starts for pile driving, and bubble curtains if needed to attenuate pile driving noise (if vibratory pile driving is not feasible). Peak sound pressures of 206 dB are not anticipated to occur with the vibratory hammer installation of the mooring piles. It is estimated that every pile would be driven approximately 10 minutes (600 seconds). There would be about 1,800 seconds of operation if all three piles were driven in one day. A conservative assessment assumes all piles strikes are at the same distance to the

receiver (i.e., a fish) and all pile strikes produce the maximum SEL. The distance over which the 187 dB accumulated SEL level would be exceeded is about 105 feet for a hollow steel pile. If wooden piles are installed, the 187 dB accumulated SEL level would not be exceeded (SLC 2012).

For marine mammals, if impact pile driving is used it would not be expected to produce sound levels above the Level A Harassment threshold (190 dB) defined by NMFS. The Level B harassment for impact pile driving would be 260dB and 190dB and could be exceeded over a distance of up to one mile for steel piles. If wooden piles are installed, the threshold could be exceeded over a distance of 600 feet (SLC 2012).

As discussed previously, pile driving activities produce would produce underwater sound that has the potential to harass marine mammals, producing Level B non-injury behavioral effects. Vibratory driving would produce lower levels of sound than impact pile driving, but could still exceed Level B harassment thresholds (USACE and RWQCB 2014). However, background underwater sound levels in the lower Napa River are expected to be greater than 120 dB due to regular boat traffic, which may produce sound levels of 150 dB or more. Given the short duration of pile-driving (1,800 seconds total) and the distribution of marine mammals (no haul outs or other regular use areas are located on the Napa River) it is unlikely that any marine mammals would experience harassment (SLC 2012). Avoidance of the area by marine mammals and fish would be temporary and is expected to occur only while the hammers are in use.

The noise levels could cause temporary hearing loss or behavioral changes to special status and other species of fish. As described in ***Section 4.2.3.2.2 of the Main Integrated Report***, pile driving for this Project would use vibratory pile drivers, wherever possible. If substrates are too dense for vibratory hammers, an impact hammer would be used and noise would be attenuated with a bubble curtain. A "soft start" technique would also be employed for both types of hammers to give wildlife time to exit the area during pile driving. With the implementation of the Mitigation Measure BIO-M4 to ensure that pile driving occurs when special status fish species are not present the impact would be less than significant.

<u>Smothering</u>

There is potential for smothering of benthic organisms in the immediate area of the pile driving and the placement of the sediment conveyance pipeline. When driving the piles and/or placing the spuds, benthic organisms, primarily clams, worms and other invertebrates, would likely be killed at the pile or spud location. In addition, there is potential for non-mobile organisms to be smothered by the pipeline in Dutchman Slough, if the pipeline is laid on the bottom or moves up and down with the tides. The impacts to marine organisms would be temporary and these relatively small areas would be expected to recover quickly once the offloader, piles and pipeline are removed; therefore the impact is less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The Cullinan offloader would be located in the deep water habitat and the pipeline would traverse mudflats, a small fringe of salt marsh, and upland habitat on the levee. There would be minimal temporary physical removal of habitat during construction and operation of the offloader which would be expected to return to the previous habitat after the offloader and piping are removed. These small habitat areas would not be permanently modified and no substantial adverse effect on sensitive natural communities would be expected; therefore the impact is less than significant. Greatly accelerated creation of tidal wetland habitat from the reuse of the dredged sediment is expected to have a beneficial impact on sensitive natural communities.

Construction equipment would comply with permits and regulations intended to minimize the spread of invasive nonnative species by vessels. The placement site operator would be responsible for managing the placement of dredged materials at the placement sites in accordance with conditions of their permits and other regulatory approval, which include measures to minimize the spread of invasive nonnative species. Therefore, project activities would not be expected to substantially increase the spread of invasive nonnative species. Potential impacts from Project due to the spread of invasive species are expected to be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

The Project would construct the offloader with minimal disturbance to underlying subtidal habitat. Construction of the offloading pipeline could lead to removal or damage to a very small area of fringe tidal marsh outboard of the sediment delivery location; an area of up to 1,000 square feet may be affected. This area is expected to revegetate rapidly once the pipeline is removed, or could serve as a breach location once the Cullinan site is filled to intertidal elevation. The main portion of the pipeline would be located away from any tidal marsh vegetation. The impact to wetlands would be less than significant.

Impact BIO-4: 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.

As discussed above shading from the offloader and pile driving from the construction of the offloader could potentially affect fish and other marine organism behavior including migratory behavior. The offloader and/or piping would not be expected to affect the movement or migratory corridor for special status fish or non-listed fish species in Napa River and Dutchman

Slough. The platform would be approximately 6,000 square feet, which is a relatively small area when compared to the extensive open water habitat in the vicinity of the Project. Potential impacts from the Project due on fish and marine organism migration or migratory corridors is expected to be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

The Project would be consistent with Solano County's policies (***Appendix G***). Solano County has policy to protect the County's natural habitats and diverse plant and animal communities, particularly occurrences of special-status species, wetlands, sensitive natural communities, and habitat connections. The Project would have short term impacts during construction as described in Impact BIO-1 that would be mitigated by mitigation measures BIO-M4 as well as BIO-M5. Long term impacts from operation of the offloader are expected to be minimal. The accelerated creation or enhancement of marsh habitat by the beneficial reuse of the sediment is a beneficial impact from the Project. The Project is not expected to conflict with local policies or ordinances and therefore the impact is less than significant.

Montezuma Wetland Restoration Project

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

For the RWC Project, only the impacts associated with transporting dredged material by scow to this offloading facility are attributable to the RWC Project. Dredged sediment offloading, management of the offloading facility, sediment placement, and Montezuma site management are services provided by the Montezuma project and have been evaluated under separate environmental reviews and would occur independently of the RWC Project. Potential noise exposures to wildlife would be limited to underwater noise from tug engines. Potential underwater noise associated with tugs would be below the thresholds set by NMFS as causing adverse impacts to fish and marine mammals. This impact is less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The Project would tie up to the Montezuma offloader that is located in the deep water habitat of the Sacramento River. No substantial adverse effect on sensitive natural communities would be expected; therefore the impact is less than significant. Creation of tidal wetland habitat from the reuse of the dredged sediment is expected to have a beneficial impact on sensitive natural communities.

Construction equipment, including tugs and scows, would comply with permits and regulations intended to minimize the spread of invasive nonnative species by vessels. The placement site operator would be responsible for managing the placement of dredged materials at the placement sites in accordance with conditions of their permits and other regulatory approvals, which would include measures to minimize the spread of invasive nonnative species. Therefore, Project activities would not be expected to substantially increase the spread of invasive nonnative species. The potential impact from the Project due to the spread of invasive species is expected to be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

The Project would deliver sediment to the offloader with minimal disturbance to underlying subtidal habitat and would not remove, fill, or cause a hydrological interruption of wetlands and therefore there would be no impact.

Impact BIO-4: 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.

The effect of the Project would be due to tying up the scows at the offloader. No impacts would be expected to fish and marine organism migration or migratory corridors

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

The Project would not be expected to have any long term adverse impacts. Solano County has policy to protect the County's natural habitats and diverse plant and animal communities, particularly occurrences of special-status species, wetlands, sensitive natural communities, and habitat connections (***Appendix G*****).** The Project is not expected to conflict with local policies or ordinances and therefore there is no impact.

SF-DODS

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The disposal of dredged material in ocean waters is regulated under the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA). The MPRSA prohibits disposal activities that would unreasonably degrade or endanger human health or the marine environment. Under the Act, the USEPA and the USACE have joint authority for regulating ocean disposal of dredged material and for managing ocean disposal sites. Permits for the transportation and disposal of

dredged material into ocean waters are authorized under MPRSA §103(e) after USEPA concurs that environmental criteria and conditions established by USEPA are applied. Management of SF-DODS consists of:

- regulating the quantities, types of material, times, rates, and methods of disposing of dredged material at an SF-DODS through a Site Management and Monitoring Plan (SMMP);
- developing and maintaining an effective monitoring program for the site; and
- enforcing permit conditions for approved dredging projects.

The location of SF-DODS was selected to avoid important fishery areas and geographically unique or otherwise sensitive habitats and it is one of the most intensively monitored sites in the nation. To date, 15 years of monitoring data have been collected for the SF-DODS and the data has been reviewed to determine the impacts of dredge disposal at SF-DODS (USEPA 2010b). The USEPA study concluded that:

- Measured chemical concentrations in the sediment have generally not exceeded those background values found either at the site prior to disposal or at the SF-DODS reference area; the few chemical compounds whose concentrations have exceeded background values have still been well below any value to cause any potential concern for biological effects.
- No suspended sediment plumes have resulted in substantial or increased uptake of contaminants by water column organisms outside the SF-DODS boundary or within the Gulf of Farallones National Marine Sanctuary.
- There have been no adverse impacts to marine birds, marine mammals or pelagic fish from disposal activities; the only effect observed was small and limited to the immediate vicinity of the disposal zone in the heaviest disposal years.
- Detailed analysis of 120 benthic samples revealed that stations within the SF-DODS boundary that are affected by large volumes of dredged material have recolonized rapidly and by the same taxa that are normally found in the adjacent ambient sediments.
- The distribution, abundance, and physiological condition of krill, fish larvae, and juvenile fishes do not appear to be negatively affected by any of the dredged material disposal activities at SF-DODS.

The only noise source associated with placement of sediment at SF-DODS would be tugs towing the scows. Tugs would follow the designated lanes across the Gulf of the Farallones Marine Sanctuary. Tugs would be in transit, and would only be in the area for a short period of time. Wildlife has ample opportunity to avoid the noise source.

The RWC Project would be required to obtain permits for and meet all regulatory requirements for acceptable sediment for disposal at SF-DODS. Monitoring has concluded that the special

status marine mammals that occur in the area have had no adverse effect. Monitoring of SF-DODS has concluded that the disposal of permitted dredge material has been temporary disturbance and that the site returns to pre-disposal conditions within a short period. The impacts from the Project would be less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

As described under Impact BIO-1, long term monitoring of the disposal of sediment at the site have concluded that there are no significant adverse effects from use of the site for sediment disposal. The sediments from the Project would be tested and permitted prior to disposal and would comply with all regulatory requirements. The impact from the Project would be less than significant.

Barges and equipment would comply with permits and regulations intended to minimize the spread of invasive nonnative species by vessels. The Project would be in compliance with conditions of the permits and other regulatory approvals. Therefore, project activities would not be expected to substantially increase the spread of invasive nonnative species. Potential impacts from Project due to the spread of invasive species are expected to be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

The SF-DODS site does not include wetland habitat and therefore there would be no impact to wetlands.

Impact BIO-4: 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.

Marine birds, marine mammals and many species of pelagic fish are far-ranging in seasonal migration patterns and/or occur over large areas within the region. The effects on these species, including their movement, was studied at the site and took into account regional influences. These factors included regional climate variations, natural variations in regional ocean circulation patterns, variations of biological populations, and human-induced effects such as adverse impacts of fishing gear, point and non-point sources of pollution, and marine debris. The study concluded that there was no relationship between marine mammal or bird density and distance from SF-DODS, nor between mammal density and disposal activities, indicating that variation in marine mammal densities were not related to disposal site activities at SF-DODS. There were also no data to indicate any adverse effect of disposal at SF-DODS on

abundance of juvenile fish or plankton. The impact from the Project would be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

There are no local policies or ordinances relevant to SF-DODS and therefore there are no impacts from the Project.

Alviso Ponds

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

Activities associated with use of this placement site would be the transport of dredged material to this site by scow, construction and operation of the dredged sediment offloader, pipeline, and booster pump(s), and delivery of dredged sediment to the top of the levee where it would be discharged into the inboard side of the levee (***Figure A-4***). The offloader location is proposed to be in the South Bay in deep water, approximately 4 miles to 6 miles north of the levees where the sediment would be delivered. The offloader and work area around the offloader would be approximately 200 feet by 400 feet. The offloader platform would be held in place by piles, and mooring dolphins would be provided for the scows. Delivery of sediment to the Pond A9 dredged sediment delivery location would require another booster pump between the offloader and the levee. The platform for the booster pump would be considerably smaller than the offloader platform, and would be constructed in the same manner as the offloader platform.

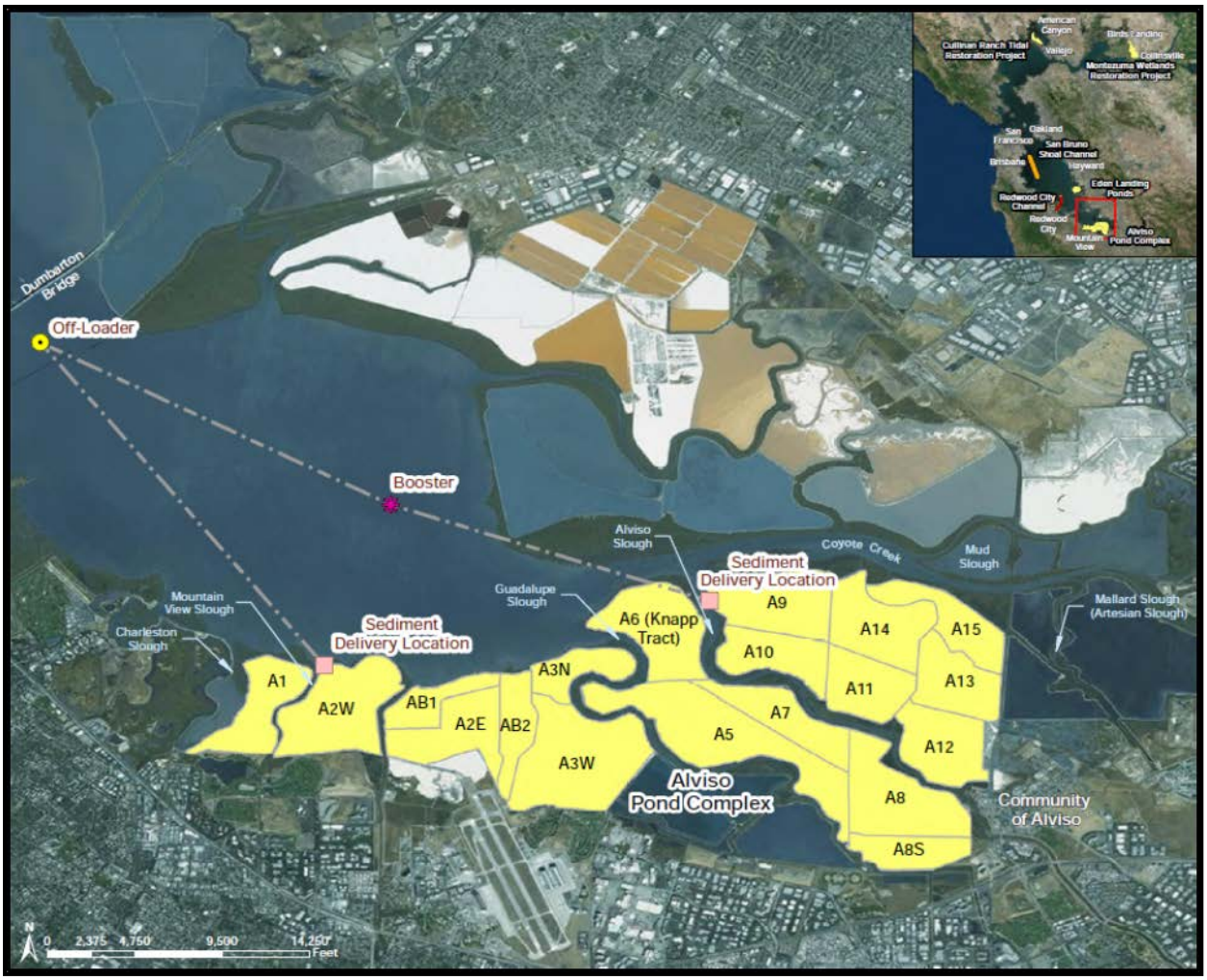


Figure A-4. Alviso Pond Complex

The sediment would be slurried by adding water pumped to the offloader through a fish screen in compliance with NOAA Fisheries, USFWS and CDFW guidance. The slurried sediment would be pumped to the Alviso Ponds through a sediment placement pipeline which would float on the surface of the water or lay on the Bay bottom and be anchored with small dead weight anchors. If the sediment placement pipeline crosses a navigable area, weights would be used to hold down and anchor the pipeline to the bottom of the channel. The pipeline would be laid through deep water, shallow water, and mudflat habitat, and may be laid through a narrow band of fringe marsh outboard of the levee. Management of the sediment once it reaches the top of the levee would be part of the Alviso Pond Project and evaluated under separate environmental reviews.

Sediment from RWC Channel could also be pumped directly from a cutterhead dredge. If a cutterhead dredge is used, the pipeline would most likely be laid into the natural deep water channel and then cross shallow water and mudflat habitat, and may be laid through a narrow band of fringe marsh outboard of the levee.

Shading

The offloader and possible booster pump station once constructed could be in place for up to four years. The platform for the offloader is expected to be approximately 6,000 square feet and would cast shade over the water which can impact phytoplankton production, affect invertebrate and vertebrate communities and affect fish foraging, alter fish species composition and normal predator prey relationships when compared to open water conditions. No eelgrass or bottom growing algae occur in the area of the offloader or booster pump construction. The platform for the booster pump has been conservatively estimated to require 3,000 square feet, and shading from the booster pump platform would have the same effects as shading from the offloader. Daily tidal currents and wave and water flow would limit the duration that species would be subject to shading. While fish species composition could be somewhat different beneath structures than in open-water conditions, the change due to the Project in overwater structures in the area is not substantial and the potential effect of shading on sensitive species is not expected to constitute a significant adverse effect.

The reduction in light resulting from overwater structures can affect behavior and has the potential to deflect or delay fish migration, reduce prey resource production and availability, and alter predator-prey relationships. Many predatory fish, such as striped bass, are associated with structures and could occur near the offloader. This could result in a slight increase in predation on larval and young fish in the local Project Area. Larger predatory fish may move into shallow water to feed during high tide. However, larval or young fish would most likely avoid areas that are shaded by the floating platform (SLC 2012) and it is unlikely that significant increases in predation would occur. The potential impact from Project due to shading is expected to be less than significant.

Noise

The only noise level generated at the Alviso placement site that has the potential to impact sensitive aquatic wildlife receptors is from the pile driving activities during construction of the offloader and/or intermediate booster pump location if sediment is delivered to Pond A9. The pile driving activities would be expected to be very similar to those described for Cullinan. Up to 3 mooring dolphins could be installed over a span of several days at both locations. FHWG determined that noise at or above peak noise levels greater than 206 dB can cause barotrauma to auditory tissues, the swim bladder, or other sensitive organs in fish. Accumulated sound energy levels (SEL) above 187 dB for large fish and 183 dB for larval fish (less than 2 grams body weight) have been determined to be potentially detrimental to fish (SLC 2012). Pile driving would occur over a very short period and in accordance with the best management practices outlined in ***Section 4.2 of the Main Integrated Report***. This would include use of vibratory pile driving were feasible, soft starts for pile driving, and bubble curtains if needed to attenuate pile driving noise (if vibratory pile driving is not feasible). Peak sound pressures of 206 dB are not anticipated to occur with the vibratory hammer installation of the piles. It is estimated that the

duration of pile driving would be short. A conservative assessment assumes all piles strikes are at the same distance to the receiver (i.e., a fish) and all pile strikes produce the maximum SEL. The distance over which the 187 dB accumulated SEL level would be exceeded is about 105 feet for a hollow steel pile. If wooden piles are installed, the 187 dB accumulated SEL level would not be exceeded (SLC 2012).

For marine mammals, if impact pile driving is used it would not be expected to produce sound levels above the Level A Harassment threshold (190 dB) defined by NMFS. The Level B harassment for impact pile driving would be 260dB and 190dB and could be exceeded over a distance of up to one mile for steel piles. If wooden piles are installed, the threshold could be exceeded over a distance of 600 feet (SLC 2012).

As discussed previously, pile driving activities produce would produce underwater sound that has the potential to harass marine mammals, producing Level B non-injury behavioral effects. Vibratory driving would produce lower levels of sound than impact pile driving, but could still exceed Level B harassment thresholds (USACE and RWQCB 2014). The background underwater noise level at the offloader and intermediate booster pump locations is unknown; however, recreational boat traffic is present in the area and would result in some underwater noise. Given the short duration of pile-driving (up to 90 minutes total over several days) and the distribution of marine mammals (no haul outs would occur in the deep water habitat) it is unlikely that any marine mammals would experience harassment. Avoidance of the area by marine mammals and fish would be temporary and is expected to occur only while the hammers are in use (USACE and RWQCB 2014).

Best management practices as discussed in ***Section 4.2 of the Main Integrated Report***, including pile driving windows, would be utilized to minimize the risk of conducting this activity when sensitive wildlife is present, and vibratory hammers would be used when feasible. A "soft start" would also be performed to give marine life the chance to leave the area before the full and sustained noise of pile driving commences. Underwater sound levels from pile driving could also exceed levels that have the potential to disturb or temporarily decrease fitness of fish with a prolonged exposure to the underwater sound. If necessary, as described in the BMPs, a bubble curtain would be implemented to minimize effects to nearby aquatic wildlife. Vibratory impact pile driving would increase noise levels over background; however, the noise levels would be temporary and of short duration (approximately 90 minutes total over several days) and would not be expected to result in noise levels that would be injurious to fish or marine mammals. With the implementation of the mitigation measure BIO-M4 to ensure that pile driving occurs when special status fish species are not present the impact would be less than significant.

Because the pipeline (whether from the offloader or the cutterhead dredge) would be laid on the bottom of the Bay, non-mobile benthic organisms located immediately beneath the footprint of the pipe could be smothered. However, the footprint of the pipe would be small

(the maximum pipeline diameter would be no more than 36 inches and is likely to be between 18 and 24 inches), there are not special status species in the benthic community, and the benthic community is expected to reestablish rapidly once the pipeline is removed, this impact would be less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The Alviso offloader and possible booster pump station would be located in the deep water habitat and the pipeline would traverse deep water, shallow water, and mudflat habitats. It may also across a small fringe of tidal marsh outboard of the upland habitat on the pond levees. There could be minimal physical removal of habitat during construction and operation of the offloader which would be expected to return to the previous habitat after the offloader and piping is removed. These small habitat areas would not be permanently modified and no substantial adverse effect on sensitive natural communities would be expected; therefore the impact is less than significant. Creation of tidal wetland habitat from the reuse of the dredged sediment is expected to have a beneficial impact on sensitive natural communities.

Construction equipment would comply with permits and regulations intended to minimize the spread of invasive nonnative species by vessels. The placement site operator would be responsible for managing the placement of dredged materials at the placement sites in accordance with conditions of their permits and other regulatory approvals, which would include measures to minimize the spread of invasive nonnative species. Therefore, project activities would not be expected to substantially increase the spread of invasive nonnative species. Potential impacts from Project due to the spread of invasive species are expected to be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

The Project would construct the offloader and possible booster pump station with minimal disturbance to underlying subtidal habitat and construction of these facilities would not remove, fill, or cause hydrological interruption of wetlands. Construction of the pipeline may require removal of a small area (up to 1,000 square feet) of outboard fringe marsh; alternatively the pipeline could be laid on wooden mats placed onto the vegetation. The vegetation would be expected to reestablish rapidly once the pipeline is removed. The impact to wetlands would be less than significant.

Impact BIO-4: 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.

As discussed above, shading from the offloader and possible booster pump station, and pile driving from the construction of the offloader could potentially affect fish and other marine organism behavior including migratory behavior. The offloader and/or piping would not be expected to affect the movement or migratory corridor for special status fish or non-listed fish species in the vicinity of the offloader. The offloader platform would be approximately 6,000 square feet which is a relatively small area when compared to the open water habitat in the vicinity of the Project, and the booster pump platform would be smaller. Potential impacts from the Project to fish and marine organism migration or migratory corridors are expected to be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

The Project would have temporary impacts to biological communities but would not be expected to have long term impacts upon Project completion and is consistent with Santa Clara County's, the City of Mountain View's and the City of San Jose's policies (***Appendix G***). The Project would have short term impacts during construction as described in Impact BIO-1 that would be mitigated by mitigation measures BIO-M4 as well as BIO-M5. The Project is not expected to conflict with local policies or ordinances and therefore the impact is less than significant.

Eden Landing Ponds

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

Activities associated with use of this placement site would be the transport of dredged material to this site by scow, construction and operation of the dredged sediment offloader and pipeline, and delivery of dredged sediment to the top of the levee where it would be discharged into the inboard side of the levee (***Figure A-5***). Sediment could also be pumped directly from a cutterhead dredge. The cutterhead pipeline location would change as the dredge moves, but would generally follow the same route across the mudflats as the pipeline from the offloader. In other areas, the pipeline from the cutterhead dredge would be located in shallow or deep open water.



Figure A-5. Eden Landing Ponds

The offloader location is proposed to be in the South Bay in deep water, approximately 3.5 miles west of the levee where the sediment would be delivered. The offloader would be constructed and operated in the same way as the Alviso offloader. The pipeline would be laid through deep water, shallow water, and mudflat habitat, and may be laid through a narrow band of fringe marsh outboard of the levee. If the sediment placement pipeline crosses a navigable area, weights would be used to hold down and anchor the pipeline to the bottom of the channel. If sediment is pumped directly from a cutterhead, the pipeline could extend up to 16 miles from the north end of SBS Channel to the sediment delivery location at Pond E2. Management of the sediment once it reaches the top of the levee would be part of the Eden Landing project and evaluated under separate environmental reviews.

<u>Shading</u>

The offloader once constructed could be in place for up to four years. The configuration of the offloader and the shading effects from the offloader would be the same as described for the Alviso site.

Noise

The noise levels associated with offloader construction and operation would be the same as for the Alviso site. The only noise that has the potential to impact sensitive fish and mammal receptors is from the pile driving activities. Marine mammals and fish maybe impacted by the temporary pile driving activities associated with construction of the offloader. With implementation of the best management practices included in ***Section 4.2 of the Main Integrated Report***, potential noise effects from pile driving would not be expected to be injurious to fish or marine mammals. The noise levels could cause temporary hearing loss to special status and other species of fish. With the implementation of the mitigation measure BIO-M4 to ensure that pile driving occurs when special status fish species are not present the impact would be less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The Eden Landing offloader would be located in the deep water habitat and the pipeline would traverse deep water, shallow water, mudflats and possibly pass in the vicinity of nearby eelgrass beds before reaching the fringe of tidal marsh and upland habitat on the Pond levees. There would be minimal temporary physical removal of habitat during construction and operation of the offloader and piping. This habitat, including any removal of mudflat and fringe tidal marsh, would be expected to return to the previous habitat after the offloader and piping are removed. With the exception of adjacent eelgrass beds, these small habitat areas would not be permanently modified and no substantial adverse effect on sensitive natural communities would be expected. Eelgrass beds is an EFH and could be affected be the suspension of sediment during construction of the pipeline and possibly the offloader depending on the proximity of the offloader to the eelgrass beds. Distribution of eelgrass in San Francisco Bay is limited by sediment in the water (turbidity) and the depth to which light can penetrate at levels high enough to sustain eelgrass growth. In San Francisco Bay, eelgrass is limited to depths of about 10 feet or less depending on localized turbidity conditions. Sediment would not be expected to resuspend during operation of the offloader. Pre-dredge surveys of the eelgrass beds would be required; however, the limited quantity of resuspended sediment from the laying the pipeline and potentially offloader construction in compliance with regulatory permits is not likely to have a significant impact to eelgrass beds. Accelerating tidal marsh habitat creation through the reuse of the dredged sediment is expected to have a beneficial impact on sensitive natural communities.

Construction equipment would comply with permits and regulations intended to minimize the spread of invasive nonnative species by vessels. The placement site operator would be responsible for managing the placement of dredged materials at the placement sites in accordance with conditions of their permits and other regulatory approval, which include measures to minimize the spread of invasive nonnative species. Therefore, project activities would not be expected to substantially increase the spread of invasive nonnative species. Potential impacts from Project due to the spread of invasive species are expected to be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption.

The Project would construct the offloader with minimal disturbance to underlying subtidal habitat and construction of these facilities would not remove, fill, or cause hydrological interruption of wetlands. Construction of the pipeline may require removal of a small area (up to 1,000 square feet) of outboard fringe marsh; alternatively the pipeline could be laid on wooden mats placed onto the vegetation. The vegetation would be expected to reestablish rapidly once the pipeline is removed. The impact to wetlands would be less than significant.

Impact BIO-4: 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.

As discussed above for the Alviso ponds, shading from the offloader and pile driving from the construction of the offloader could potentially affect fish and other marine organism behavior including migratory behavior. The offloader and/or piping would not be expected to affect the movement or migratory corridors for special status fish or non-listed fish species in the vicinity of the offloader. The platform would be approximately 6,000 square feet which is a small area when compared to the open water habitat in the vicinity of the offloader. Potential impacts from the Project to fish and marine organism migration or migratory corridors are expected to be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

The Project would have short term impacts to biological communities but would not be expected to have long term impacts upon project completion consistent with the Alameda County's and the City of Hayward's policies (***Appendix G***). The Project would have short term impacts during construction as described in Impact BIO-1 that would be mitigated by mitigation measures M4 as well as BIO-M5. Long term impacts from operation of the offloader are expected to be minimal. The Project is not expected to conflict with local policies or ordinances and therefore the impact is less than significant.

Post-Construction Operation

Under existing ballast water regulation, ships exchange ballast water in the ocean before entering San Francisco Bay . This requirement ensures that future ships entering the Bay for calls at the Port would have deballasted and reballasted prior to entering the Bay and thereby minimized the potential spread of invasive species. It is expected that there would be less deballasting/reballasting on the transit to the RWC Channel with the deeper channels. The reduced need for deballasting and reballasting in South San Francisco Bay to safely transit under the San Mateo Bridge would be reduced following channel deepening. This would slightly reduce the potential for spread of invasive species following deepening of the channel.

Mitigation Measures

The following mitigation measures were identified to minimize Project effects on aquatic wildlife. With implementation of these measures as described above, potential impacts to aquatic biological resources from the proposed Project would be less than significant for all components except the potential for extended duration elevated TSS resulting from fuel pipeline relocation using the jet sled method.

Mitigation Measure BIO-M1: Minimize Species Entrainment

In addition to the LTMS measures described in ***Section 1.6.1 of the Main Integrated Report***, dredging activities shall be scheduled to take into account seasonal longfin smelt migrations that are affected by hydrologic conditions.

Mitigation Measure BIO-M2: Conduct Entrainment Monitoring

If hydraulic dredging is used, conduct entrainment monitoring on a percentage of sediment dredged from the channels. Adaptively manage construction such that hydraulic dredging ceases should entrainment of listed species reach the number of individuals set in any incidental take statement/permit. The percentage of dredged material that must be monitored and the amount of take allowed shall be determined during the formal state and federal ESA consultation processes.

Mitigation Measure BIO-M3: Minimize Entrainment during SBS Channel Pipeline Replacement

A fish screen or other agency approved method would be required on the water intake(s) for the jet sled unless it is determined that entrainment of listed species would not reach the number of individuals set in any incidental take statement/permit. The amount of take allowed shall be determined during the formal state and federal ESA consultation processes.

Mitigation Measure BIO-M4: Avoid Construction that Could Affect Tidal Aquatic Habitats when Salmonid Species and Other Special Status Fish Species are known to Occur.

Construction activities that could affect special status species would occur during the applicable species windows. If construction activities must occur during periods when special status

species could be present, USWFS, in consultation with NMFS and CDFW, shall determine what, if any, additional mitigation measures may be required. In the event that the Project is undertaking exceptionally noisy construction activities such as driving piles during periods when endangered species are present and the best management practices described in ***Section 4.2 of the Main Integrated Report*** are inadequate to control pile driving noise, additional sound attenuation techniques shall be implemented as required in the applicable permits and other regulatory approvals.

Mitigation Measure BIO-M5: Limit Speeds for Construction Vessels

Limit speeds for construction vessels (i.e., dredges, tugs, and scow/tug combinations, and other large vessels) to 2 knots or less when approaching or operating in the dredging locations. Smaller support vessels carrying personnel and/or supplies to the dredging location would be limited to 5 knots or less. Limiting vessel speeds in the dredging location would minimize the likelihood of propeller strikes and other vessel collisions, as well as propwash entrainment of fish that may be in the study area.

Mitigation Measure BIO-M6: Habitat Mitigation

Shallow water habitat loss from channel deepening shall be compensated for through the creation of new shallow water habitat (e.g., construction of channels in wetland restoration projects), or through purchasing mitigation credits from an approved mitigation bank. The mitigation ratio and specific mitigation opportunities shall be determined during the EFH consultation for the Project.

A.5 Biological Resources – Terrestrial Resources

Environmental Consequences

The impacts to terrestrial species (defined as those species for whom the majority of their life is spent on land), are described in this section. Special-status wildlife and plants species that occur in or near the Project Area are listed ***Appendix H*** in ***Tables H-3 and H-4.*** Species that were listed on the applicable quads, but for whom no suitable habitat is present in the Project Area are not included in the tables.

Terrestrial habitat in the Project area is limited, and consists primarily of levee habitat and tidal marsh. All potential effects to bird species are evaluated in this section, and therefore effects to aquatic areas used for foraging and roosting are also evaluated.

Dredging Options

Potential effects of all three dredging options are very similar; consequently the three dredging options are analyzed together. ***Table H-3 in Appendix H*** shows the special status terrestrial species that could occur at the dredging sites. Both RWC and SBS Channel are entirely aquatic sites and there is no upland habitat. The only terrestrial species potentially associated with the

two dredge sites would be bird species that use the channel for feeding or forage on the mudflats. The open water of the channels provides roosting and "loafing" habitat for birds such as surf scoter (*Melanitta perspicillata*), lesser scaup (*Aythya affinis*), Northern shoveler (*Anas clypeata*), and brown pelican. During low tide, mud flats provide crucial foraging and roosting areas shorebirds including western sandpiper (*Calidris mauri*), least sandpiper (*Calidris minutilla*), dunlin (*Calidris alpina*), long- and short-billed dowitcher (*Limnodromus griseus*, and *L. scolopaceus*, respectively), long-billed curlews (*Numenius americanus*), whimbrels (*Numenius phaeopus*), and American avocet (*Recurvirostra americana*).

The Project would be located immediately adjacent to the mudflats at Bair Island and Greco Island and would avoid dredging in the mudflats. To avoid impacts to the mudflats, the Project located the channel alignments as far as possible from the mudflats and adjusted the bottom width of the channel where needed to maintain the required 3:1 slope of the channel banks. The exact location of the channel and the slope would be determined during design, and may be affected by several factors including the sediment type, bar pilot navigational requirements, and final slope stability analysis (USACE 2015).

Potential impacts to birds in the Project Area could result primarily from loss of foraging opportunities due to increased turbidity and disturbance from operation of the dredging equipment (primarily noise and light effects) and loss of prey. Through the DMMO process and consultation provided by resource agencies, all proposed dredging, transport, and placement of dredged material would be reviewed. This review includes a review of sediment testing results. Sediments with elevated concentrations of chemical contaminants could have adverse effects to the food chain if released.

The Project would implement BMPs and comply with RWQCB permit conditions, the BCDC consistency determination, CESA requirements, and measures specified in the Section 7 and NMFS EFH consultations. The USACE would also implement sediment bioaccumulation testing in accordance with the LTMS Programmatic EFH agreement. Adherence to these measures and BMPs would minimize the potential for impacts from dredging disturbance, including disturbance due to increased turbidity, noise, night lighting, habitat disturbance and bioaccumulation of contaminants in the food chain.

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The presence of tugs, scows, dredges, and tender vessels could result in disturbances to birds due to elevated noise levels and night-time lights. The lights from dredging at night may create a disturbance that could result in birds avoiding the immediate vicinity of the dredging vessels. Special status birds that are likely to use the dredge site for foraging or be present in the mudflats and tidal marshes adjacent to the Project Area are: Peregrine falcon, American white

pelican, black skimmer, Western Snowy plover, least tern, Forster's tern, and Ridgway's rail. All of these species potentially forage in the vicinity of the channels but are not expected to nest in the main channel area. The California least tern and Western Snowy plover have been known to historically nest at Bair Island but no recent occurrences are known in the past several decades.

Noise and Night Lighting

Birds are likely to avoid the immediately vicinity of dredging operations due to noise and night lighting. Birds located in or near the channels are likely to be accustomed to ongoing ship traffic and human activity such as recreational boating use associated with the marinas. Bird species have also been exposed to similar noise and night light disturbances during maintenance dredging. Ambient noise levels in the natural areas near the Port where the wildlife sensitive receptors are located are assumed to be 55 dBA. During the dredging period, the dredging operations may disturb foraging and resting behaviors, decrease time available for foraging, and increase energetic costs as a result of increased flight times and startling responses. The maximum predicted noise levels of 54.6 dB in the marsh bordering the dredging areas do not exceed ambient noise in the wildlife area as described in Table A-14 in Section ***A.10 Noise and Vibration.*** Birds in this area are likely to temporarily flee to avoid the dredging operations but are expected to return after dredging is completed and therefore the impact is less than significant.

Certain special status bird species such as Ridgway's rail and California black rail may be sensitive to loud noise during the nesting season if the noise intensity is unusually high. For this reason, the USFWS Biological Opinion for the LTMS Program specifies that dredging shall not occur within 250 feet of potential habitat for this species from February 1 through August 31. The USFWS considers all potential habitat to actually be occupied by this species unless surveys that year document its absence. The marsh habitat adjacent to the RWC channel has the potential to be occupied by Ridgway's rail and California black rail. Noise impacts from both construction and dredging operations to these species during the nesting season are potentially significant. With the implementation of Mitigation Measure BIO-M7 through BIO-M9 the impact to noise sensitive species and other special status species would be less than significant.

Turbidity and Contaminants

Turbidity

An increase in turbidity in the dredging areas could reduce visibility in the immediate vicinity of dredging operations, thereby reducing foraging success due to the decrease in the visibility of the prey. However, because it is anticipated that fish would also avoid the dredge area, bird avoidance of the immediate area would not result in a significant decrease in foraging success. Due to their mobility, the birds would likely follow the fish and forage in the readily available nearby areas. Bird species have been exposed to similar disturbances during maintenance

dredging. The area that would be avoided is limited to the immediate vicinity of the dredge site, which is a small fraction of the total foraging area for the birds. Once dredging in a specific area is complete, fish and birds would return to the area. Impacts on food availability and foraging success as a result of increased turbidity in the water column would be short term and localized and are expected to result in a minimal reduction in short-term food availability for birds. The impact is less than significant.

Contaminants

Any toxic metals and organics, pathogens, and viruses, absorbed or adsorbed to fine-grained particulates in the sediment may become biologically available to organisms as a result of sediment resuspension during dredging -- either in the water column or through food chain processes. Most available studies suggest that there is no significant transfer of metal concentrations into the dissolved phase during dredging, even though release of total metals associated with the suspended matter may be large (USACE and RWQCB 2014). Organic contaminants such as pesticides, polychlorinated biphenyls (PCBs), and polyaromatic hydrocarbons (PAHs) are generally not very soluble in water, and direct toxicity by exposure to dissolved concentrations in the water column is not very likely (USACE and RWQCB 2014). Sediments testing results would be reviewed by DMMO, and DMMO review would include an evaluation of the potential for impact to aquatic organisms that would potentially be a food source for bird species. The Project would also undertake sediment bioaccumulation testing in compliance with the *Agreement on Programmatic EFH Conservation Measures for Maintenance Dredging Conducted under the LTMS Program* (USACE and USEPA, 2011). These studies would assess the potential for dredging to increase contaminant concentrations in the environment above baseline conditions; however, based on exiting studies significant bioaccumulation above background in bird species is not expected and therefore the impact is less than significant.

Vessel Wakes

Wake wash is generally of concern where wetlands, other sensitive habitats, and marinas are close to vessel routes. In general, if vessel wake-generated waves have significantly greater wave heights or energy at the shoreline than natural wind waves, wake wash can lead to resuspension of shoreline sediments and hence shoreline erosion or damage. Higher waves could also lead to periodic swamping of marsh vegetation.

In 2004, the Port of Redwood City conducted a study to evaluate vessel wake effects in RWC Channel (URS 2004). At RWC Channel, waves in the entrance channel area and within Redwood Creek are generated by daily winds in the Central and South Bay. Westerly to west by northwesterly winds typically build during the day. The strongest winds occur in the late afternoon. Because the entrance to Redwood Creek is located towards the southern end of the Bay it experiences waves that result from wind acting over a long fetch. Large waves can be experienced in the Bay offshore of the channel entrance during afternoons with strong winds. The inner portion of the channel in redwood Creek is relatively protected. Measured and

calculated wave heights in the channel near Westpoint and Corkscrew Sloughs showed that this inner channel quiescent compared to the outer channel.

The 2004 study addressed "barges"; because barges are towed by tugs, the information contained in the 2004 study is relevant to tug/scow combinations that would be used to haul dredged sediment. Provided the tugs move slowly in RWC Channel as barges do, and as required by the BMPs, wakes are expected to be similar to the barge wakes in the study, which were evaluated extensively. The wake height from barges has been observed to be small as barges tend to travel at slow speeds. Barges were found to have low wake energy, with approximately 1,200 J/m in a 10-wave wake train measured at 100 feet from the vessel. Maximum wave heights are between 0.08 and 0.12 m (0.26 and 0.4 feet). The study noted that during times when wind waves were present, it was not possible to distinguish between wind waves and barge wake.

The study also evaluated the energy in the largest wave in the barge wake compared to the energy in ferry wakes, as ferry wakes are known to be of potential concern. The study concluded that the energy in the energy in the largest wave in the wake from existing high-speed ferries measured 100 feet from the vessel would be about 117,000 J/m, or over 90 times as great as the barge wakes. The wave records indicate that barges produce small, low energy, wakes.

The study calculated the energy from two barge calls per month (assuming the wake energy from an empty barge would be the same as for a loaded barge) and compared it to the monthly wind average wind wave energy (excluding storm events). The study determined that it is equivalent to 19,200 J/m per month, or 0.2 percent of the monthly average wind wave energy (excluding storm events). During construction up to five single tug trips per day could occur in RWC Channel (i.e., two complete round trips and a partial trip). This would increase the vessel wake energy by a factor of approximately 40 compared to the energy generated by the barge calls, to approximately 8% of the average wind wave energy. This level of wave energy is not expected to cause adverse effects to mudflat or swamping of habitat. This impact is less than significant.

Other Habitat Disturbance

Another potential impact of concern would be the loss of prey species and altered benthic habitat due to the dredging of the deep and shallow water habitat. This would reduce the abundance of prey species and invertebrates for diving ducks (e.g. scaups and scoter) and grebes of various species. Although the dredging would represent a permanent loss of shallow water habitat, due to the abundance of foraging habitat within the vicinity of the Project Area, the impact is less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

No terrestrial habitat is located in the dredge channels. The Project would not affect any unique plant communities or substantially affect the diversity of non-listed species. The Project would not affect any terrestrial habitat, and therefore the Project would not spread any terrestrial invasive species. There is no impact.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

The dredging of RWC and SBS Channels would not adversely affect protected wetlands because the Project is located in existing channels and is not located in wetlands. As discussed above, vessel wakes would be low energy and are not expected to affect wetland habitat. There is no impact from the Project.

Impact BIO-4: Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.

No terrestrial habitat is located in the dredge channels and vessel wakes are not expected to cause adverse effects to tidal marsh. Therefore there is no impact from the Project. Effects to aquatic species have been discussed in ***Section A.4.1***.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

No terrestrial habitat is located in the dredge channels and therefore there is no impact from the Project. Effects to aquatic species have been discussed in ***Section A.4.1***.

Placement Sites

Cullinan Ranch Tidal Restoration Project

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

At Cullinan, Project activities would include the construction and operation of the offloader and sediment transfer pipeline within Napa River and Dutchman Slough. The sediment transfer pipeline would have a short section that may cross a band of salt marsh and then ruderal upland levee habitat before it reaches the discharge point. The size of the pipeline is small, approximately 24 to 36 inches in diameter. Construction of the pipeline may require a work

area up to 1,000 square feet. Once construction is complete, tidal marsh habitat would be expected to reestablish rapidly, or the location would serve as the site of a levee breach to bring tidal action into the dredged sediment placement area.

Noise sensitive species, including Ridgway's rail and California black rail may be present in the marsh habitat near the offloader locations. Noise impacts from both construction of the offloader to these species during the nesting season are potentially significant. While estimated noise levels from offloader operations (see ***Table 4-15 in the Main Integrated Report***) at these sensitive receptor locations exceed the typical noise levels in open space areas, they are below the ambient levels due to the presence of Highway 37 immediately south of the southern offloader location, and are therefore considered to be less than significant. With the implementation of mitigation measures BIO-M7 through BIO-M9 the impact to noise sensitive species and other special status species would be less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

A very short section of the sediment transfer pipeline would be placed on upland levee habitat. This short section of pipeline would not be expected to have a significant effect on any unique plant communities or substantially affect the diversity of native plant or wildlife species. Construction equipment would comply with regulations intended to minimize the spread of invasive nonnative species and the placement of the short section of pipeline on the levee would not be expected to spread terrestrial invasive species. Any invasive species within the construction work area would be removed from the site. The impact would be expected to be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

A short section of the 24- to 36-inch pipeline would cross a small band of salt marsh and ruderal upland levee habitat to the discharge point at the top of the levee. The band of salt marsh habitat can be intermittent in the area and the Project would be designed to avoid or minimize the construction in salt marsh habitat. If the pipeline cannot avoid a marsh area, it is expected that vegetation at that location would readily recolonize after the pipeline and any wooden mats are removed, and there would be no long term impacts. The potential impact from the pipeline alignment in the narrow band of salt marsh habitat is small when compared to the extensive nearby marsh habitat in the vicinity of the Project. The impact would be expected to be less than significant.

Impact BIO-4: 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.

The Project would block movement of some terrestrial wildlife along the levee; however, the individual animals could use other parts of the site to maneuver around the pipe, if necessary. The construction period would be short, and therefore the impact is expected to be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

Solano County has a policy to protect the County's natural habitats and diverse plant and animal communities, particularly occurrences of special-status species, wetlands, sensitive natural communities, and habitat connections (***Appendix G***). The Project would accelerate habitat restoration at the Cullinan site and is therefore not expected to conflict with local policies or ordinances. There is no impact from the Project.

Montezuma Wetland Restoration Project

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

For the RWC Project, only impacts associated with transporting dredged material by scow to this offloading facility are attributable to the RWC Project. Dredged sediment offloading, management of the offloading facility, sediment placement, and Montezuma site management are services provided by the Montezuma project and have been evaluated under separate environmental reviews and would occur independently of the RWC Project. There is no terrestrial wildlife habitat at the Montezuma offloader and therefore there would be no adverse impact to special status species from the Project.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The Project would tie up to the Montezuma offloader that is located in the deep water habitat of the Sacramento River. No terrestrial habitat is associated with the offloader within the Project Area. The Project would not affect the distribution of invasive species. No substantial adverse effect on sensitive natural terrestrial communities would be expected; therefore there is no impact from the Project. Creation of tidal wetland habitat from the reuse of the dredged sediment is expected to have a beneficial impact on sensitive natural communities.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

There is no wetland habitat at the Montezuma offloader and therefore there would be no impact from the Project.

Impact BIO-4: 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.

There is no terrestrial habitat at the Montezuma offloader associated with the Project and therefore there would be no adverse impact to special status species from the Project.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

Solano County has a policy to protect the County's natural habitats and diverse plant and animal communities, particularly occurrences of special-status species, wetlands, sensitive natural communities, and habitat connections (***Appendix G***). The Project would promote formation of tidal marsh habitat, and is not expected to conflict with local policies or ordinances; therefore there is no impact from the Project.

SF-DODS

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

Birds use the area for foraging habitat and are likely to avoid the site during sediment disposal operations and move to nearby extensive ocean habitat to forage. However, it would be expected that the birds would return to the area after the completion of the sediment disposal. Each scow would require only 10 to 15 minutes to complete disposal of the sediment in the scow, and there would be 2 to 3 scows per day. The disposal at SF-DODS would not have a substantial adverse effect on special status or other bird species and therefore there is no impact from the Project.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

There is no terrestrial habitat at SF-DODS and therefore there would be no impact from the Project.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption or other means.

There is no wetland habitat at SF-DODS and therefore there would be no impact from the Project.

Impact BIO-4: 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.

There are no terrestrial species at SF-DODS that would use the site in any of the ways identified and therefore there would be no impact from the Project.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

The Project is consistent with the permitted use of the site, and is not expected to conflict with local policies or ordinances; therefore there is no impact from the Project.

Alviso Ponds

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The Project activities associated with this placement site would consist of the construction and operation of the offloader and sediment transfer pipeline within South San Francisco Bay, including a section of the pipeline that would cross mudflats, a narrow band of tidal marsh and then upland habitat on the levee before it reaches the discharge point at the top of the levee. A booster pump would most likely be located at the top of the levee. If the Pond A9 sediment delivery location is selected, another booster pump would be required mid-way between the offloader and the levee. This booster pump would most likely be located in shallow water habitat. Construction of the entire pipeline may require several months, and operations would occur for period of up to 24 months spread over 4 dredging windows.

The construction of the offloader and pipeline could temporarily disturb special status and other bird species using the mudflats and tidal marsh for foraging and upland habitat as refuge. However the effects during construction would be short term and the construction areas are adjacent to extensive mudflat, tidal marsh and upland refuge habitat that is available to wildlife during this period. The extent of the pipeline alignment and work area at the levee is small relative to the extent of mudflat and tidal marsh habitat in the vicinity. After construction is complete, the bird species are expected to return to the most of the area, although some noise sensitive species may avoid the immediate vicinity of the offloader, booster pump(s) and

sediment delivery location while sediment delivery is in progress. The pipeline would be removed after the Project is complete.

Wildlife in Pond SF-2 located west of the offloader location and in the SFBNWR to the east of the offloader location is also located between Highway 84 and the railroad, and therefore is exposed to high ambient noise levels. Predicted noise levels at Pond SF-2 from pile driving for the Alviso offloader would be 62 dBA without controls, and 56 dBA with controls, compared to the estimated ambient noise level of 70 to 74 dBA (refer to ***Table A-16*** i***)***. Predicted noise levels from pile driving at the SFBNWR lands to the east of the offloader construction would range from 63 to 69 dBA, compared to the estimated ambient level of 70 to 74 dBA (refer to ***Table A-16)***. Noise sensitive species, including Ridgway's rail and California black rail may be present in these two habitat areas near the offloader location. If these species are present in these areas, they would be expected to be accustomed to high levels of ambient noise.

Noise sensitive species may also be present in the SFBNWR south of the railroad. The ambient noise in this area is expected to be considerably lower, although still higher than in open space areas that are further away from transportation corridors. The maximum pile driving noise with controls at these receptors would be 63 dBA, compared to estimated ambient levels of 64 to 68 dBA (see ***Table A-15***). This noise level would occur for only a short duration, and actual construction activities would be more than 2,000 feet from this area. Noise impacts from both construction and operation of the offloader equipment to these species during the nesting season are potentially significant. With the implementation of Mitigation Measure BIO-M7 through BIO-M9 the impact to noise sensitive species and other special status species would be less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

Parts of the sediment transfer pipeline would be placed on mudflats, tidal marsh and upland levee habitat. The pipeline would have a short term impact to these habitats as described in Impact BIO-1 but would not be expected to have a significant effect on any unique plant communities or substantially affect the diversity of any native species. Construction equipment would comply with regulations intended to minimize the spread of invasive nonnative species and the placement of the pipeline on the levee would not be expected to spread terrestrial invasive species. The impact would be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption, or introduction or substantial spread of invasive nonnative plants or wildlife, or other means.

The Project activities at this placement site would consist of the construction of the offloader, booster pumps, and sediment transfer pipeline crossing South San Francisco Bay. The approximately 24- to 36-inch pipeline would cross mudflat, tidal marsh and subsequently upland levee habitat to the discharge point at the top of the levee. Construction of the pipeline may require a work area up to 1,000 square feet. The Project would be designed to avoid or minimize placement of the pipeline in tidal marsh habitat. If the pipeline cannot avoid the marsh area, it is expected that the vegetation in the area would readily recolonize after the pipeline is removed and there would be no long term impacts. The potential impact from the pipeline alignment in the tidal marsh habitat is small when compared to the nearby habitat in the vicinity of the Alviso sediment delivery locations. The temporary disturbance to the tidal marsh habitat is expected to be minimal.

Impact BIO-4: 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.

The Project would block movement of some terrestrial wildlife along the levee; however, the individual animals could use other parts of the site to maneuver around the pipe, if necessary. In addition, the construction period would be short. Therefore the impact is expected to be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

Santa Clara County, the City of Mountain View and the City of San Jose have policies to protect natural habitats and plant and wildlife communities (***Appendix G***). The Project is not expected to conflict with local policies or ordinances and therefore there is no impact from the Project.

Eden Landing Ponds

Impact BIO-1: A substantial adverse effect through substantial population decline, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The Project activities associated with this placement site would consist of the construction and operation of the offloader and sediment transfer pipeline within South San Francisco Bay, including a section of the pipeline that would cross mudflats, a narrow band of tidal marsh and then upland habitat on the levee before it reaches the discharge point. Alternatively, a pipeline could be laid from the cutterhead dredge directly to the top of the levee. In both cases, a booster pump would most likely be located at the top of the levee. If the cutterhead dredge is used for SBS Channel as well, intermediate booster pump locations would most likely be required, similar to what would be constructed for the Alviso Pond A9 delivery location. Estimated noise levels at the closest sensitive receptors are shown in ***Table A-15***.

Construction of the offloader or cutterhead pipeline may require several months. The construction of the pipeline could temporarily disturb special status and other bird species using the mudflats and tidal marsh for foraging and upland habitat as refuge. However the effects during construction would be short term and the site is adjacent to extensive mudflat, tidal marsh and upland refuge habitat. The footprint of the the pipeline alignment and associated construction work area is small relative to the mudflat and tidal marsh habitat in the vicinity. After construction is complete the bird species are expected to return to the area in the vicinity of the pipeline, booster pump, and offloader. All offloading facilities would be removed after the Project is complete. Pile driving for the offloader would occur over several days; as discussed previously, the total pile driving time is estimated to comprise 30 minutes or less over this period.

At Eden Landing, noise sensitive species, including Ridgway's rail and California black rail may be present in the marsh outboard of Pond E1. These potential sensitive receptors are far enough away that noise levels due to pile driving at the offloader location would attenuate to less than 55 dBA. The potential intermediate booster pump locations would be further from sensitive habitat areas, and noise effects from pile driving would therefore be less than significant.

The offloader and booster pumps would operate for up to 24 months over 4 years (i.e., during 4 dredging windows). Potential noise levels at the closest sensitive wildlife receptors would be less than 45 dBA. This impact would be less than significant.

Impact BIO-2: A substantial adverse effect on any sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service.

The sediment transfer pipeline would be placed on mudlflats, tidal marsh and upland levee habitat. The pipeline would have a short term impact to this habitat as described in Impact BIO-1 but would not be expected to have a significant effect on any unique plant communities or substantially affect the diversity of a native species. Construction equipment would comply with regulations intended to minimize the spread of invasive nonnative species and the placement of the pipeline on the levee would not be expected to spread terrestrial invasive species. The impact would be less than significant.

Impact BIO-3: A substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act through direct removal, filling, hydrological interruption, or introduction or substantial spread of invasive nonnative plants or wildlife, or other means.

The Project activities at this placement site would consist of the construction of the offloader, booster pumps, and sediment transfer pipeline crossing South San Francisco Bay. The approximately 24- to 36-inch pipeline would cross mudflat, tidal marsh and subsequently

upland levee habitat to the discharge point at the top of the levee. Construction of the pipeline may require a work area up to 1,000 square feet. The Project would be designed to avoid or minimize placement of the pipeline in tidal marsh habitat. If the pipeline cannot avoid the marsh area, it is expected that the vegetation in the area would readily recolonize after the pipeline is removed and there would be no long term impacts. The potential impact from the pipeline alignment in the tidal marsh habitat is small when compared to the nearby habitat in the vicinity of the Eden Landing sediment delivery location. The temporary disturbance to the tidal marsh habitat is expected to be minimal.

Impact BIO-4: 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.

The Project would block movement of some terrestrial wildlife along the levee; however, the individual animals could use other parts of the site to maneuver around the pipe, if necessary. In addition, the construction period would be short. Therefore the impact is expected to be less than significant.

Impact BIO-5: Conflict with any local policies or ordinances protecting biological resources.

Alameda County and the City of Hayward have policies to protect natural habitats and plant and wildlife communities (***Appendix G***). The Project is not expected to conflict with local policies or ordinances and therefore there is no impact from the Project.

Mitigation Measures

Mitigation Measure BIO-M7: Construction Schedule and Sequencing

To the extent possible schedule and sequence construction so that construction of offloading facilities occurs outside the breeding season for bird species that may occur within the Project area and that are protected by the ESA or MBTA. If construction activities are scheduled to occur during the breeding season, within 14 days prior to construction, a qualified, USFWS-approved biologist shall complete a survey of all potential nesting habitat within 500 feet of the proposed dredged sediment pipeline alignment, and any other portion of the placement site(s) required for dredged sediment delivery.

The same nesting survey requirements shall apply when dredging is scheduled to occur within 500 feet of potential nesting habitat for these sensitive bird species. If active nests are found during pre-construction surveys, consultation with USFWS shall occur to determine potential project impacts (including noise impacts) and the appropriate course of action. This could potentially include establishing buffer zones, relocating individuals and nests, temporal restrictions (i.e., rescheduling construction activities), and/or restrictions on placement of the dredged sediment delivery pipeline.

Mitigation Measure BI0-M8: Rail Surveys and Noise Windows

If noise levels from construction or operations at any of the placement sites and/or dredging could exceed ambient levels at tidal marsh habitat in the vicinity of the placement sites, a qualified biologist shall determine if the habitat is known or suitable Ridgway's rail or California black rail habitat. If the habitat is known Ridgway's rail or black rail habitat, no noise generating activities that could exceed ambient levels ("excess noise") shall occur during the breeding season (February 15 through August 31) for these species.

If suitable habitat is present, but it is unknown whether these species are present, either excess noise shall be avoided during the breeding season, or protocol level surveys shall be conducted during the appropriate period prior to the scheduled construction or sediment delivery effort. If the surveys determine that no rails are present, then work may proceed without restrictions. If rails are determined to be present, the habitat is then considered known rail habitat.

Excess noise may be avoided through scheduling work outside of the breeding season, or implementing noise controls as determined by the regulatory agencies such as shielding the pumps, installing mufflers, and enclosing pumps.

Mitigation Measure BIO-M9: Pre-Construction Special Status Wildlife Surveys

Special status wildlife surveys shall be completed by a qualified, USFWS-approved biologist within 14 days prior to construction of both dredged material offloading and delivery facilities. The survey areas shall include all portions of the placement sites within 500 feet of any construction areas. The survey shall include a survey for all special status species (e.g., salt marsh wandering shrew, salt marsh harvest mouse), nests and other breeding habitats (e.g., rodent burrows) as well as unique habitat features required by special status species potentially occurring within the construction areas. If special status species, nests, or unique habitat features are encountered, avoidance and/or relocation measures shall be established and implemented; the measures shall be defined through consultation with USFWS. Measures may include establishing exclusion and buffer zones within the construction area, trapping and relocating individuals, or temporal restrictions (i.e., avoiding construction during the breeding season).

Alternatively, special status species may be assumed to be present, and avoidance measures implemented to avoid take of special status species. This may include hand-clearing areas of pickleweed marsh, installation of exclusion fencing, and/or other measures as appropriate.

A.6 Cultural Resources

Affected Environment

This section identifies and evaluates issues related to cultural and paleontological resources. The "Affected Environment" discussion below describes the current setting of the action area. The purpose of this information is to establish the existing environmental context, or background, against which the reader can understand the environmental changes caused by

the action. The environmental setting information is intended to be directly or indirectly relevant to the subsequent discussion of impacts. For example, the setting summarizes the pre-history and history of the Bay's shoreline and in-water areas because the action could affect cultural and historical resources in those areas.

The proposed Project would not affect any existing structures either directly or through new elements (such as new construction) that could affect the setting of the built environment. Therefore, only the potential effects of the proposed Project to archaeological and paleontological resources are evaluated. The proposed Project is proposing the deepening of the berthing areas - not widening.

The Project boundary for the analysis in this document is from the dredging location at the Redwood City Harbor and San Bruno Shoal Channels to the top of the levees at the placement sites. No offshore areas would be affected by the Project, with the exception of specific areas of disturbance at the dredging and placement sites as described below. The study area includes the San Francisco Deep Ocean Disposal Site (SF-DODS), as well as the waters that would be used by vessels traveling to the disposal sites and pipelines that could be used to transport dredged materials to the Eden Landing or Alviso disposal sites. All of the areas on the land where dredged material would be placed and associated areas of disturbance are not part of the study area and have been evaluated for environmental impacts already by previous CEQA/NEPA documents (USFWS & CDFW 2007, USACE & SCVWD 2014). Existing placement sites (Montezuma and Cullinan) were discussed in the Federal Navigation Channels EA/EIR which found that there are no known paleontological, archaeological, or historical resources within the existing placement sites (USACE & RWQCB 2014).

Areas of Disturbance at Placement Sites

1. Montezuma Wetlands Restoration Site: No analysis regarding cultural resources is required for this existing placement site. A CEQA/NEPA document was already prepared for this site (USACE & RWQCB 2014).

2. Cullinan Ranch Tidal Restoration Site: No cultural resources analysis is required for this site on the land where dredged material would be placed, as it is not part of the study area and was already analyzed in previous CEQA/NEPA documents (USFWS 2009, SLC 2012, USACE and RWQCB 2014). The Project may install the off-loader and pipeline leading from the off-loader to the disposal location. Potential disturbance areas would, therefore, include the off-loader locations (there are two options) and pipeline alignments (also two options). The Project may be required to electrify the southern off-loader.

3. Eden Landing: No analysis regarding cultural resources is required for this site on the land where dredged material would be placed, as it is not part of the study area and was analyzed in previous environmental documents (USFWS and CDFW 2007, USACE 2014a). The Project would use one of two options for dredged sediment delivery:

a. Option 1: The Project would construct an off-loader, which would be located in approximately eighteen feet of water, including a scow tie up location, and a pipeline from the off-loader to the levee. The work would require limited pile driving and possibly limited excavation to lay pipe through outboard mudflats/marsh. It is not known if the pipeline would be submerged or floating, or a combination of the two. In addition, booster pumps would also be required and could be located at the off-loader or on-shore (on the levee); or.

b. Option 2: The Project would use a hydraulic dredge and pump material directly from RWC and/or SBS Channels to Eden Landing, through a (most likely) submerged pipeline. Booster pumps would also be required and be located at the dredge location and on the levee. If material is pumped from SBS Channel, intermediate booster pumps would also be required.

4. Alviso: No analysis regarding cultural resources is required for this site on the land where dredged material would be placed, as it is not part of the study area and was analyzed in previous environmental documents (USFWS and CDFW 2007, USACE 2014a). The two options described above for Eden Landing would also apply to this location, although the Alviso site is too far from SBS Channel to allow direct pumping from that dredging site. There would be two locations where sediment delivery could occur: at Ponds A1/A2W, and at Pond A9.

The Eden Landing and Alviso disposal sites were previously analyzed for impacts to cultural resources caused by the South Bay Salt Pond Restoration Project in that Project's EIS/EIR and in earlier analyses described in that report (USFWS and CDFW 2007). In addition, the Alviso disposal site was analyzed for impacts to cultural resources in the Draft Interim Feasibility Report and EIS/EIR for the South San Francisco Bay Shoreline Phase I Study (USACE 2014a).

Terminology

The following definitions are common terms used to discuss the regulatory requirements and treatment of cultural resources:

Cultural resources is the term used to describe several different types of properties: prehistoric and historical archaeological sites; architectural properties such as buildings, bridges, and infrastructure; and resources of importance to Native Americans or other groups of people.

Historic properties is a term defined by the National Historic Preservation Act (NHPA) as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places (NRHP), including artifacts, records, and material remains related to such a property.

Historical resources as described in the California Environmental Quality Act (CEQA) include buildings, sites, structures, objects, or districts, each of which may have historical, prehistoric, architectural, archaeological, cultural, or scientific importance, and is eligible for listing or is

listed in the California Register of Historical Resources (CRHR) or a local register of historical resources. The CRHR includes resources listed in or formally determined eligible for listing in the NRHP, as well as some California State Landmarks and Points of Historical Interest.

Paleontological resources are defined as including fossilized remains of vertebrate and invertebrate organisms, fossil tracks and trackways, and plant fossils. A unique paleontological site would include a known area of fossil-bearing rock strata.

Physical Setting

This section summarizes the ethnographic and historic settings of the general area and discusses in more detail the prehistoric and historic resources relevant to the Project area. Due to the long-term history of navigation on San Francisco Bay, and the navigational challenges posed by San Francisco Bay, there are numerous shipwrecks in the Bay. This section analyzes effects to archaeological sites and sunken vessels.

The analysis for this Project consisted of reviews of historical research and archaeological surveys conducted by the USACE and USFWS in recent years and reviews of information on shipwrecks produced by the California State Lands Commission (SLC), National Parks Service (NPS), and the National Oceanic and Atmosphere Administration (NOAA). The environmental documents reviewed include the following:

- Draft South San Francisco Bay Shoreline Phase I Study EIS/EIR, (USACE 2014a)
- South Bay Salt Pond Restoration Project Final EIS/EIR, (USFWS and CDFW 2007b)
- Draft EA/EIR, Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay, Fiscal Years 2015-2024 (USACE and RWQCB 2014)

As stated in USACE & RWQCB 2014:

> *The USACE has established policy and procedures for conducting underwater surveys for maintenance dredging and disposal activities (USACE 1989). The USACE is directed to make a reasonable and good faith effort to identify submerged cultural resources that may be affected by project implementation. Typically, the review of project documents and research of historical records and other sources is sufficient to determine what the potential is for submerged sites to be present and whether there would be an effect. The policy states that underwater surveys to identify archaeological sites are not required within the boundaries of previously dredged channels or previously used disposal areas unless USACE determines that there is a good reason to believe that such resources exist, and that they would be altered or destroyed as a result of project implementation.*

Prehistoric Setting

San Francisco Bay San Pablo Bay, and surrounding marshlands and uplands were used extensively by humans during prehistoric and historic times. Before circa A.D. 1770, at the time

of the first major European contact, the San Francisco Bay region was occupied by Coast Miwok, Patwin, Bay Miwok, and Costanoan/Ohlone Native American people. The Costanoan/Ohlone population in 1770 has been estimated at 7,000. Archaeological remains related to the prehistoric occupation of the area are evidenced by hundreds of shellmounds and occupation sites that lined the shores of the San Francisco, San Pablo, and Suisun Bays. Native people were known to produce and use the naturally-occurring salt that exists along the bay. The locations of these shellmounds approximately follow the current shoreline, but also line major tributaries feeding into the Bay (Moratto 1984).

During the last major ice age, the Bay was well above sea level and was the site of converging river valleys that drained through the Golden Gate and towards the continental shelf. The most recent filling of San Francisco Bay occurred during the past 10,000 years. Glacial melt began approximately 15,000 years ago and the Bay began filling around 10,000 to 11,000 years before present (B.P.). By 8,000 years ago, marine waters had begun to enter San Francisco Bay. Sea levels rose rapidly until approximately 6,000 B.P. and have continued to rise more slowly since then. Rising Bay levels may account for submerged archaeological sites (Moratto 1984).

Shellmounds are mounds or deposits containing shells, animal bones, and potentially human remains and other evidence of pre-historic settlement of an area. Many of the shellmounds known to be located around the Bay have been found in close relationship with marshy areas. A number of known shellmounds stand partially below current sea level, indicating that their accumulations began during lower water level occurrences in the past. Given the long duration both of the Bay water rise and human occupation of the shore zone, it is likely that earlier use and occupation sites, such as shellmounds, are present below current sea levels (Moratto 1984).

The configuration of the Bay shoreline has also changed in the last one hundred and fifty years or so due to the deposition of gold mining sediments flowing downstream from hydraulic mining locations, agriculture, the narrowing of river channels through levee construction, construction of salt ponds, development of "man-made land," and more modern construction and fill near the shore. It is estimated that 875 million cubic meters of sediment were deposited in the Bay from 1850 to 1914, as a result of mining in the Sierra Nevada foothills (Moratto 1984).

Historic Setting

Spanish Time Period

Spanish explorers are said to have first visited the entrance to the Bay in 1769. Travel from the sea into the Bay first occurred in 1775. Spanish exploration in the late 1700s and in the 1800s led to the establishment of permanent settlements along the coast of California, mostly in the form of missions. No buildings or structures directly related to the Spanish explorers remain in the Redwood City area, however. Spanish explorers came into increasing contact with Native Americans in the first half of the 1770s as expeditions were led through the region. In 1776, construction of the San Francisco Presidio and the mission of Our Seraphic Father San Francisco de Asís were begun in Yalamu territory near the northern end of the San Francisco peninsula. Later that year, the mission of Our Seraphic Mother Santa Clara began construction in Tamien

territory to the south, and a small civilian settlement was begun near Mission Santa Clara, which was established in 1777 (USFWS 2008b, City of Redwood City 2010b, USACE 2014e).

Mexican Time Period

Mexico gained independence from Spain in 1821 and California changed from Spanish to Mexican control. Due to the relaxation of trade restrictions, merchant ships, occasional whalers, and warships from the United States and from Europe began freely entering the Bay. The change to Mexican independence brought new laws, administrators and a shift of power from missionaries to secular governors and ranching families. The decline of the missions allowed for the rise of extensive ranching along the California coast as well as the Sacramento Valley area. What was Native American land became more than 500 land grants (Ranchos) distributed to prominent California families. Then followed a time period of skirmishes and battles between the Mexican army and Native Americans. This and parceling of the land into Ranchos, along with epidemics of small pox and malaria that spread through Native populations resulted in the further decimation of the Native population and culture (Paddison 2015, Sturtevant 1978, USACE 2014e).

American Time Period

California became a part of the United States as a result of the Mexican-American war that ended in 1848. During the Gold Rush (lasting from 1849 to approximately 1855), there was a large population increase of immigrants and gold seekers to California. Redwood City developed into an important shipping point during this time. Lumbermen and merchants realized that the "Redwood Embarcadero," as it was then known, would be a good shipping point for their goods. Industrial growth continued along the tidelands, along with residential and commercial building. Redwood City was incorporated in 1868 and a modern deep water port was ultimately created in 1937. The Gold Rush resulted in a large increase in ships traveling into the Bay and San Francisco became a major city and port. Commercial fishing began with whaling and salmon fishing in the 1850s with the fishing and shrimping growing into major industries. Ferries became popular ways to travel throughout the Bay Area until the construction of train and car bridges, which caused people to switch modes of travel (City of Redwood City 2010a, USACE 2014e).

<u>Placement Sites</u>

The wetland areas in the Bay were originally open marshes used by Native people and wildlife. The tidelands around San Francisco and San Pablo Bays remained undeveloped until the 1850s-1860s, but were transformed in the 1870s with the reclamation of much of the tideland under the 1868 Green Act. By the early 20th century, levees enclosed nearly all of the marshes around the Bay. New land uses included salt production, ranching and farming, duck hunting, and urban infrastructure including roads. Many former agricultural and salt pond areas around the Bay and associated waterways are now being converted back to tidal marshes and wetlands using dredged material from other projects in the Bay Area (USACE 2005, San Francisco Estuary Institute 2015, Save the Bay 2015, Ducks Unlimited 2015.)

Shipwrecks in San Francisco Bay

Since its exploration by Spanish navigators in 1769, the Bay has been the site of numerous shipwrecks. SLC has created a database of more than 1,500 shipwrecks off the coast of California and within bays and waterways. The sailing conditions off of the Golden Gate are known to be difficult and for many ships, the waters of the Bay became a final resting place. Many ships were lost due to explosions, collisions, and sabotage. Others lost in the Bay were grounded or sunk intentionally (Office of Coast Survey 2015, SLC 2015, Sonoma State University 2015.) The ship wrecks in the SLC database occurred between 1540 and about 1990; the database includes the approximate latitude and longitude and other available information for each one. In addition, the NOAA Automated Wreck and Obstruction Information Center includes over 13,000 listed shipwrecks and obstructions. Also, the National Park Service maintains a list of shipwrecks that are on the NRHP.

Paleontological Setting

Paleontological resources provide indirect evidence of the form and activity of ancient organisms. Such locations and specimens are important nonrenewable resources. A search of the University of California Museum of Paleontology paleontological database did not identify any previously identified paleontological resources in the study area. Within San Mateo County the search revealed 905 identified paleontological localities. Specimens could be buried in Bay sediments as the Bay region contains a diverse record of geologic history. There may be a potential for the inadvertent discovery of unique paleontological resources during dredging activities (University of California Berkeley 2015, USACE 2014e).

Previous Studies

A draft Environmental Assessment (EA) prepared by the USACE in August 2014 analyzed the routine maintenance of dredging in the Redwood City Harbor federal channels. That Project entailed dredging to previously-dredged depths and concluded that routine maintenance dredging was not expected to affect cultural resources. No known cultural resources were identified in the channels or the maneuvering areas. That study stated “should dredging activity reveal any artifact of archeological or historical interest, work in the vicinity of the archeological or historical interest will cease. A qualified USACE archaeologist will evaluate the significance of the find and carry out the appropriate actions in accordance with federal laws and Regulations. Work in the area in question will not be allowed until the archeologist has given clearance to proceed” (USACE 2014b).

A draft EA/EIR was prepared by the USACE and the and the RWQCB in December 2014, which analyzed maintenance dredging of the federal navigation channels in and around the Bay, for fiscal years 2015-2024. That Project also proposed dredging at previously-dredged depths and found that because “no known paleontological, archaeological, or historical resources within

the federal navigation channels or existing placement sites, no impacts are expected to result from the project alternatives" (USACE and RWQCB 2014).

Results of Shipwreck Search

There are three primary sources of information on shipwrecks – the SLC database, the NOAA Information Center, and NPS's list of shipwrecks on the NRHP. The SLC database contains more than 1,500 records and provides a list of shipwrecks by county. It is based primarily on historical accounts of the ships, such as name of ship, year sunk, reason for sinking, and approximate locations. The data describe potential resource locations, as exact locations may not be known (SLC 2015). NOAA's Automated Wreck and Obstruction Information Center includes over 13,000 listed shipwrecks and obstructions.

All three databases were searched for any known shipwrecks located in the areas that would be affected by the RWC Project. No shipwrecks on the NPS NRHP list are located in the area that would be affected by the Project; the NOAA database identified two locations. SLC staff searched the database and their records for shipwrecks. Three locations were identified in the SLC database. Some shipwrecks have been salvaged through time and the SLC database does not indicate if such salvaging took place. It is possible that shipwrecks identified were salvaged or even demolished to reduce risks to ship traffic. Dredging has taken place in the federal shipping channels and this dredging could have removed evidence of shipwrecks in that area (Office of Coast Survey 2010, NPS 2015). Two shipwrecks were located as existing at the eastern Alviso sediment delivery area, on the eastern shore of Alviso Slough, north of the area where a sediment delivery pipeline would terminate (Office of Coast Survey 2010.) The Project would be constructed south of this area; however, thereby avoiding the two shipwrecks. The pipeline route from the cutterhead dredge to either the Alviso or Eden Landing placement sites has not been defined. However, the pipeline would be routed to avoid any shipwrecks through implementation of the cultural resources protection plan (see ***Section 4.2.3.2.1 of the Main Integrated Report***).

The five shipwrecks that could potentially be affected by the Project as shown in ***Table A-10.***

Table A-10. Shipwreck Data

Channel/Placement/ Pipeline Site	Ship Name/Reason for Sinking	Year Sunk	County	Latitude	Longitude	Source
Redwood City Harbor/Docks	City of Glendale (Fishing Schooner) – Possible Arson	1921 [1]	San Mateo	37deg 31'00"N (DecLat = 37.5167)	122deg 12'20"W (DecLong = -122.206)	SLC database
Redwood City Harbor where it meets the Bay/San Francisco Bay	Morgan Shell (Tugboat) – Burned[2]	1951	San Mateo	37deg 31'53"N (DecLat = 37.5314)	122deg 11'29"W (DecLong = -122.191)	SLC database (likely taken from NOAA database)
Redwood City Harbor where it meets the Bay/San Francisco Bay	Manana – Exploded[3]	1969	San Mateo	37deg 32'00"N	122deg 11'27"W	NOAA database
San Bruno Shoal Area/Between Redwood City and San Francisco	Echo (Sloop or Schooner) – Foundered[4]	1879	San Mateo	37deg 37'30"N (DecLat = 37.625	122deg 17'30"W (DecLong= -122.292)	SLC database
South of the San Mateo Bridge/San Francisco Bay (Potential Pipe Location for Alviso Disposal Site)	USS Thompson (DD 305) – Sunk as Target[5]	1944	San Mateo	37deg 33' 10"N (DecLat=37.55299	122deg 9'27.882"W (DecLong=-122.157745	NOAA database

[1]The ship may not have sunk, as a 1921 magazine account of the incident stated that it had "slight damage." (Wise 1921) Also described as having been "Burned at dockside at Redwood City, a victim of arson." (Marshall 1978)

[2]SLC Database notes that "Wreck salvaged except for engine block. Vessel reported silting up, and that engine would be below mudline by 1995" (California State Lands Commission 2015).

[3]NOAA Database notes that "vessel exploded and sank in 1969…no portion of the hull or cabin are intact…wreck should be appropriately charted as wreckage" (Office of Coast Survey 2010).

[4]The ship is said to have "Foundered and sank between Redwood City and San Francisco" (Marshall 1978). SLC database location radius for the shipwreck site is 8,000 square feet, a large and imprecise location.

[5]The ship was a Clemson-class destroyer of the U.S. Navy named in honor of Richard W. Thompson. It was sunk for military target practice and is now known as the "South Bay Wreck" (Wikipedia 2015, Navsource Naval History, 2015).

Significance Thresholds

The NRHP is the nation's master inventory of historic places deemed worthy of preservation. The NRHP is administered by the NPS and includes listings of buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or cultural significance at the national, state, or local level. Structures, sites, buildings, districts, and objects over 50 years of age can be listed in the NRHP as significant historic resources. However, properties under 50 years of age that are of exceptional importance or are contributors to a district can also be included in the NRHP.

National Register criteria applied to evaluate the significance of cultural resources are defined in 36 Code of Federal Regulations (CFR) 60.4 as follows:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
>
> 1. that are associated with events that have made a significant contribution to the broad patterns of history;
> 2. that are associated with the lives of persons significant in our past;
> 3. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> 4. that have yielded or may likely yield information important in prehistory or history.

Integrity refers to a property's ability to convey its historical significance. There are seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. The importance and applicability of these qualities depend on the historical significance of the resource and the nature of its character-defining features (NPS 1997).

Under federal regulations (36 CFR 800.5), an adverse effect occurs when a project alters directly or indirectly, any of the characteristics of a historic property that qualifies that project for inclusion on the NRHP in a way that diminishes the integrity of the property. Adverse effects on historic properties include, but are not limited to, the following (36 CFR 800.5):

- physical destruction of all or part of the property;
- alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, and hazardous material remediation, that is not consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties;
- removal of the property from its historic location;
- change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; or

- introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features.

Significance Thresholds under CEQA

State historic preservation regulations affecting this Project include the statutes and guidelines contained in CEQA, under PRC Sections 20183.2 and 21084.1 and Section 15064.5 of the CEQA Guidelines. Per CEQA, public agencies must consider the effects of their actions on both "historical resources" and "unique archaeological resources." Pursuant to PRC Section 21084.1, a "project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment."

"Historical resource" is a term with a defined statutory meaning (PRC, Section 21084.1; determining significant impacts to historical and archaeological resources is described in the State CEQA Guidelines, Section 15064.5 [a], [b]). Under State CEQA Guidelines Section 15064.5(a), historical resources include the following:

1) A resource listed in, or determined to be eligible by the State Historical Resources Commission, for listing in the CRHR (PRC, Section 5024.1).
2) A resource included in a local register of historical resources, as defined in Section 5020.1(k) of the PRC or identified as significant in a historical resource survey meeting the requirements of Section 5024.1(g) of the PRC, will be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.
3) Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be a historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record. Generally, a resource will be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing in the CRHR (PRC, Section 5024.1), including the following:
    a. is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
    b. is associated with the lives of persons important in our past; or
    c. embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or may be likely to yield, information important in prehistory or history.
4) The fact that a resource is not listed in, or determined to be eligible for listing in the CRHR, not included in a local register of historical resources (pursuant to Section 5020.1(k) of the PRC), or identified in a historical resources survey (meeting the criteria

in Section 5024.1(g) of the PRC) does not preclude a lead agency from determining that the resource may be an historical resource as defined in PRC Section 5020.1(j) or 5024.1.

As noted above, CEQA also requires lead agencies to consider whether projects will impact "unique archaeological resources." Public Resources Code Section 21083.2, subdivision (g), states that " 'unique archaeological resource' means an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

1) contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information;
2) has a special and particular quality such as being the oldest of its type or the best available example of its type; or
3) is directly associated with a scientifically recognized important prehistoric or historic event or person."

Following Public Resource Code Sections 21083.2 and 21084.1, and Section 15064.5 and Appendix G of the State CEQA Guidelines, cultural resource impacts are considered to be significant if implementation of the project considered would result in any of the following:

1) Cause a substantial adverse change in the significance of a historical resource as defined in PRC section 21084.1 and CEQA Guidelines section 15064.5, respectively;
2) Cause a substantial adverse change in the significance of an archaeological resource as defined in Public Resources Code section 21083.2, 21084.1, and CEQA Guidelines section 15064.5, respectively;
3) Directly or indirectly destroy a unique paleontological resource or site or unique geological feature; or
4) Disturb any human remains, including those interred outside of formal cemeteries.

For purposes of CEQA (and NEPA), to determine whether cultural resources could be significantly affected, the historical significance of the resource itself must first be determined. Section 15065 of the CEQA Guidelines mandates a finding of significance if a project would eliminate important examples of major periods of California history or prehistory. CEQA Guidelines Section 15064(b), defines a significant impact to historical and cultural resources as the following: "[S]ubstantial adverse change in the significance of a historical resource means physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of the resource would be materially impaired."

Environmental Consequences

This section identifies environmental effects associated with deepening the channels and use of each of the placement sites, describes how they would occur, and prescribes mitigation measures to reduce significant impacts.

Methods and Assumptions for the Effect Analysis

The study area was reviewed for the existence of cultural resources through the review of CEQA/NEPA documents that already evaluated impacts to cultural resources, including the following:

- Draft South San Francisco Bay Shoreline Phase I Study EIS/EIR (USACE 2014a) http://www.valleywater.org/SSFBS-DEIR.aspx
- South Bay Salt Pond Restoration Project Final EIS/EIR (USFWS and CDFW 2007) http://www.southbayrestoration.org/EIR/downloads.html)
- Draft EA/EIR, Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay, Fiscal Years 2015-2024 (USACE and RWQCB 2014) http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/dredging/Fed%20Nav%20Channels_DEAEIR_Dec2014.pdf)

In addition, the three shipwreck databases were searched for any known shipwrecks located in the areas that would be affected by the Project. Since the Project's actions do not propose demolition of existing structures or the introduction of features that would be incompatible with the historic setting of the built environment, and the effects on the land-ward side of levees is not part of the study area and, only the effects of the Project on submerged archaeological and paleontological resources were evaluated. The significance of effects was determined based on the historical significance of the resource affected and the type of potential impact.

Dredging Options

The proposed dredging options would result in deepening of the RWC and SBS Channels. Impacts to cultural resources would be similar under all three dredging alternatives, and all three dredging options are therefore addressed as a group.

Impact CUL-1: Cause a substantial adverse change in the significance of a historical resource.

The proposed dredging options would not result in the demolition of existing structures or the introduction of features that would be incompatible with the historic setting of the built environment. Therefore, no effects to historical resources would occur.

Impact CUL-2: Cause a substantial adverse change in the significance of an archaeological resource

Shipwrecks

Dredging Guidance Letter No. 89-01, USACE, March 13, 1989, established policy and procedures for conducting underwater surveys for maintenance dredging and disposal activities. The Letter indicates that the USACE is to make a reasonable and good faith effort to identify submerged cultural resources that may be affected by a USACE project. The policy states that underwater surveys to identify archaeological sites are not required within the boundaries of previously dredged channels or previously used disposal areas unless the USACE finds that there is a good

reason to believe that such resources exist, and that they would be altered or destroyed as a result of project implementation (USACE 2104b). The proposed action evaluated in this document entails deepening and widening in some areas, as well as pipeline construction (relocation) outside of the existing channel footprint at SBS Channel in addition to dredging within the existing footprint of the channel.

No known shipwrecks are located within the federal navigation channels (USACE 2104b). However, five shipwrecks were identified as potentially existing near or within the dredging and pipeline construction areas: the City of Glendale, Morgan Shell, Manana, Echo, and USS Thompson (DD 305).

The City of Glendale was a fishing schooner, said to have been sunk in 1921. However, research indicates that it may have survived the arson incident and may not have sunk (Wise 1921). This ship was said to have been located at dockside (Marshall 1978) and its GPS coordinates place it along the south side of the channel at the land's edge. The proposed action would be located entirely in the water area of the RWC channel; therefore, it does not appear that the proposed Project would affect the ship, if it still exists in that location.

The Morgan Shell is a tugboat that that burned and sunk in 1951. It is located east of Bair Island in the Bay near to the mouth of RWC Channel. The SLC database notes that "wreck salvaged except for engine block. Vessel reported silting up, and that engine would be below mudline by 1995" (SLC 2015). The Manana exploded and sunk in 1969 and is located near the Morgan Shell. The NOAA database notes that "vessel exploded and sank in 1969…no portion of the hull or cabin are intact…wreck should be appropriately charted as wreckage." It also states that "Wood and metal debris protruding 1ft out of the mud uncovers 2 ft at [mean lower low water] within a 5m radius of the surveyed position of lat 37-32-09. 9n, long 122-11-17.9w." Due to the poor condition of the two shipwrecks and that either or both were salvaged, they would appear to not qualify as historic under the NRHP or CEQA, due to a lack of integrity of materials. In addition, even if the ships were more intact, they do not appear to be eligible for the NRHP or the CRHR on any of the four criteria. However, more detailed analyses would need to be completed to evaluate the historical significance of the two shipwrecks, and potentially further environmental review, if it is determined that they would be affected by the proposed Project.

The Echo is known as either a sloop or schooner in SLC records. It foundered and sank in 1879 between Redwood City and San Francisco in the San Bruno Shoals area. The SLC database location radius for the shipwreck site is very large, at 8,000 square feet, indicating an imprecise location. Research in historical newspapers has failed to reveal other information regarding the shipwreck or a more precise location. However, from reviewing the location as described in SLC records, it would appear to exist east of the proposed Project area in and near the San Bruno Shoals. Due to the lack of information about this shipwreck, a determination of historical significance is not possible without further research. If it is determined that the proposed

Project would affect this shipwreck, an evaluation of historical significance would be required to be completed, and potentially further environmental review.

The USS Thompson (DD-305) is a U.S. Navy Clemson-class destroyer named in honor of Richard W. Thompson. The keel of the USS *Thompson* was laid down on 25 September 1918, at San Francisco, by the Bethlehem Steel Corporation. The ship was launched on 15 January 1919, was commissioned at the Mare Island Naval Shipyard in Vallejo on 16 August 1920. It was decommissioned in April, 1930 and sold for scrap in June of the same year. The ship was bought by a private party and turned into a floating restaurant in lower San Francisco Bay during the 1930s. In 1944, the Navy purchased the ship from the new owner, is said to have salvaged features of it, and intentionally sunk it in a mudflat in the Bay, where Army and Navy aircraft used it for practice bombing runs with dummy bombs. The ship is now commonly known as the "South Bay Wreck." It is located within San Mateo County south of the San Mateo Bridge and is a popular location for recreational kayakers to visit. The shipwreck is potentially within the location where a pipeline could be placed to transport the dredged material to the Alviso disposal site. (Wikipedia 2015, Navsource Naval History 2015)

The USS Thompson may be considered to be eligible for the NRHP as a shipwreck, although it is not intact, presumably due to salvaging activities and use for military bombing practice. Its shape and form are still discernable, however. The term "shipwreck" is defined by the NPS in National Register Bulletin 20 as "A submerged or buried vessel that has foundered, stranded, or wrecked. This includes vessels that exist as intact or scattered components on or in the sea bed, lake bed, or river bed, mud flats, beaches, or other shorelines, excepting hulks." A "hulk" is defined as a "substantially intact vessel that [is] not afloat…"

The USS Thompson shipwreck may be considered eligible for the NRHP under criterion A - it is associated with "events that have made a significant contribution to the broad patterns of our history." Under Criterion A, a shipwreck may qualify for listing in the NRHP through her association with the historic theme of the military and naval warships (United States National Parks Service 1992). In addition, it may be considered to be a "submerged historic resource," per PRC 6313. More research would need to be completed to determine if the shipwreck would be considered historically significant under federal and/or state guidelines; however, the shipwreck appears to be eligible for the NRHP, and therefore, the CRHR. In addition, the effects on the USS Thompson are further regulated by the SMCA, which states that the Navy's sunken military craft remain property of the U.S. regardless of their location or the passage of time and may not be disturbed without permission from the U.S. Navy.

Impacts of pipeline relocation adjacent to SBS Channel would be considered a potentially significant effect on the shipwrecks. Mitigation measures CUL-M1, CUL-M2, and CUL-M3 listed at the end of this section under ***A.6.4 Mitigation Measures*** would mitigate for the potentially substantial adverse change in the significance of archaeological resources and the impacts would be less than significant.

Other Archaeological Sites

The proposed action evaluated in this document entails deepening and widening in some areas, in addition to dredging and the potential relocation of fuel pipelines within the Bay. The exact location of the areas of disturbance is not fully known at this time. Previously dredged areas, such as shipping lanes and maneuvering areas have already altered the Bay floor, so that any submerged cultural resources in those areas would have been severely damaged or destroyed. In sediments not previously disturbed, it is possible that archaeological resources would be disturbed by the proposed Project.

The inadvertent discovery of archaeological materials would be considered a potential significant impact. However, the following measures are incorporated to mitigate any potential impacts to Native American and historical archaeological resources (including shipwrecks), in the event that unanticipated archaeological remains were encountered during construction and dredging activities.

Mitigation Measure CUL-M4 is listed at the end of this section under A.6.4 Mitigation Measures and would mitigate for the potentially substantial adverse change in the significance of other archaeological resources. Under all dredging options, the inadvertent discovery of archaeological materials during Project activities represents a potential impact; however, implementation of Mitigation Measures CUL-1through CUL-4 would reduce the potential to result in impacts to archaeological resources to a less-than-significant level.

Impact CUL-3: Directly or indirectly destroy a unique paleontological resource or site or unique geological feature

The likelihood of the proposed Project affecting any significant paleontological resources is minimal due to the nature of the sediment to be dredged. The sediment would be Bay Mud, which would have accumulated in the past 6,000-7,000 years. However, the disturbance of paleontological resources would be considered a potentially significant impact. Therefore, a mitigation measure has been added to reduce the level of impact, in the event that paleontological resources were encountered during the construction of the proposed Project.

Under all dredging options, the inadvertent discovery of paleontological resources during Project activities represents a potential impact; however, implementation of Mitigation Measure CUL-M5 (see ***Section A.6.4***) would reduce the potential to result in impacts to paleontological resources to a less than significant level.

Impact CUL-4: Disturb any human remains, including those interred outside of formal cemeteries

No evidence of human remains is known to exist for the study area. However, it is possible that human remains could be inadvertently uncovered with proposed Project implementation. Such disturbance of unidentified human remains would be a significant adverse impact.

If human remains of Native American origin are discovered during dredging or pipeline construction, it would be necessary to comply with state laws relating to the disposition of Native American burials, which fall under the jurisdiction of the Native American Heritage Commission (NAHC) (PRC Section 5097). In addition, pursuant to State law (CEQA Guidelines Section 15064.5, PRC 5097.87, and the Health and Safety Code Section 7050.5) Mitigation Measure CUL-M6, be implemented if any human remains are discovered (see ***Section A.6.4***).

Under all dredging options, the inadvertent disturbance of human remains during project activities represents a potential impact; however, implementation of Mitigation Measure CUL-6 would reduce the potential to result in impacts to human remains to a less than significant level.

A.6.1.1 Placement Sites

As stated above for the placement sites, all of the areas on land where dredged material would be placed and associated areas of disturbance are not part of the study area and have been evaluated for environmental impacts already by previous CEQA/NEPA documents (USFWS and CDFW 2007, USACE & SCVWD 2014). Existing placement sites (Montezuma and Cullinan) were also discussed in the Federal Navigation Channels EA/EIR which found that there are no known paleontological, archaeological, or historical resources within the existing placement sites (USACE & RWQCB 2014). No impact from the proposed Project is expected at the Montezuma site because the proposed Project would only deliver material to the offloader; there would be no disturbance of the Bay bottom or shore. Similarly, there would be no disturbance of any structures or intrusion into the seafloor at SF-DODS, and no impacts would be expected at SF-DODS.

Cullinan Ranch Restoration Project

As part of the previous CEQA evaluation, *Addendum to the Final EIR for the Cullinan Ranch Restoration Project* (SLC 2012), for the offloader and related piping at Cullinan the following mitigation measure was required:

> MM CR-3.1. Stop work if subsurface cultural deposits are encountered during Construction Activities. If previously unknown subsurface historic or archaeological artifacts are encountered during deep earth-moving construction activities, work shall halt and the San Pablo Bay National Wildlife Refuge manager shall be immediately notified. A regional archaeologist or similarly qualified individual (under the approval of the USFWS) shall assess the deposits before work resumes in the discovery area.

The proposed Project also proposes the construction of an offloader(s) and related piping with the potential to affect subsurface unknown historic, paleontological and archaeological resources.

<u>Impact CUL-1: Cause a substantial adverse change in the significance of a historical resource</u>

The proposed Project would not result in the demolition of existing structures or the introduction of features that would be incompatible with the historic setting of the built environment. Therefore, no effects to historical resources would occur.

Impact CUL-2: Cause a substantial adverse change in the significance of an archaeological resource

The proposed Project also proposes the construction of an offloader and related piping with the potential to affect archaeological resources. With the implementation of mitigation measures CUL-M4 the impact would be less than significant.

Impact CUL-3: Directly or indirectly destroy a unique paleontological resource or site or unique geological feature

The proposed Project also proposes the construction of an offloader and related piping with the potential to affect unique paleontological resource or site or unique geological feature. With the implementation of Mitigation Measures CUL-M5 the impact would be less than significant.

Impact CUL-4: Disturb any human remains, including those interred outside of formal cemeteries

The proposed Project also proposes the construction of an offloader and related piping with the potential to affect undiscovered human remains. With the implementation of Mitigation Measures CUL-M6 the impact would be less than significant.

Alviso Pond Complex and Eden Landing Ponds

Impact CUL-1: Cause a substantial adverse change in the significance of a historical resource.

The proposed Project would not result in the demolition of existing structures or the introduction of features that would be incompatible with the historic setting of the built environment. Therefore, no effects to historical resources would occur.

Impact CUL-2: Cause a substantial adverse change in the significance of an archaeological resource

For Alviso and Eden Landing, the Project also proposes the construction of an offloader and related pumps and piping, or use of a pipeline from the cutterhead dredge to deliver sediment directly to these placement sites. Both delivery options have the potential to affect unknown archeological resources. No archaeological resources have been identified in the vicinity of the proposed offloader locations. Potential pipeline alignments would be evaluated in the cultural resources protection plan (see ***Section 4.2.3.2.1 of the Main Integrated Report***) to ensure that they avoid any known archaeological resources. Nonetheless, there could be an inadvertent discovery of archeological resources during construction of the offloader and/or pipeline. The inadvertent discovery of archaeological materials during project activities represents a potentially significant impact; however, implementation of Mitigation Measure CUL-4 (see

Section A.6.4) would reduce the potential impacts to archaeological resources to a less than significant level.

Impact CUL-3: Directly or indirectly destroy a unique paleontological resource or site or unique geological feature

For Alviso and Eden Landing, the inadvertent discovery of paleontological resources during Project activities represents a potential impact; however, implementation of the cultural resources protection plan (see ***Section 4.2.3.2.1 of the Main Integrated Report***) and Mitigation Measure CUL-M5 (see ***Section A.6.4***) would reduce the potential to result in impacts to paleontological resources to a less than significant level.

Impact CUL-4: Disturb any human remains, including those interred outside of formal cemeteries

Mitigation Measures

For Alviso and Eden Landing, the inadvertent disturbance of human remains during project activities represents a potential impact; however implementation of Mitigation Measure CUL-M6 (see ***Section A.6.4***) would reduce the potential to result in impacts to human remains to a less than significant level. Mitigation Measures

The following mitigation measures were identified to minimize the proposed Project's effects on cultural resources. With implementation of these measures as described above, potential impacts to cultural resources from the proposed Project would be less than significant.

Mitigation Measure CUL-M1:

To avoid effects of the potential pipeline that could be utilized to transport material to the Alviso site, the site of the USS Thompson shall be avoided by all pipeline construction and laying activities and no part of the site shall be disturbed. The pipeline activities and pipeline location itself shall take place outside of all remains of the shipwreck.

Mitigation Measure CUL-2:

The USACE shall attempt to avoid all known shipwrecks that could be affected by all activities of the implementation of the project, including dredging and pipeline placement. The USACE shall make reasonable attempts to locate the shipwreck "Echo" and determine whether the dredging and widening activities in San Bruno Shoal Channel would affect the shipwreck. If the activities are proposed to take place in an area that would affect the shipwreck, the USACE shall not complete that part of the proposed action until the shipwreck is evaluated for historical significance and appropriate environmental review is completed.

Mitigation Measure CUL-3:

After the location of the dredging and widening activities is further defined, if the project is found to affect the Morgan Shell, Manana, or City of Glendale shipwrecks, the USACE shall not complete that part of the proposed action until the shipwrecks are evaluated for historical significance and appropriate environmental review is completed. If the shipwrecks are to be affected by the project and are not found to be historically significant, that conclusion shall be documented using State of California Department of Recreation 523 forms.

Mitigation Measure CUL-4*:*

The USACE or designated person shall inform all personnel connected with construction of the Project of the possibility of finding archaeological resources. These potential cultural and historic resources include fragments of bone, stone tools, structural remains, ship remnants, or historic refuse. If such resources are encountered during project activities, the USACE shall immediately halt all soil-disturbing activities within the area of the find, as appropriate. (If hydraulic dredging and pipeline transportation of dredged materials is utilized, it is recognized that it would be possible for construction personnel to not notice the inadvertent discovery of archaeological remains until the materials arrived at a disposal site.) The USACE archaeologist or other qualified archaeologist who shall then ascertain the nature of the discovery, the significance of the find, and provide proper management recommendations.

Project personnel shall not collect cultural resources found at any time. Prehistoric cultural material includes, but is not limited to, chert or obsidian flakes, projectile points, mortars, and pestles, dark friable soil containing shell and bone dietary debris, heat-affected rock, human burials, shell midden deposits, hearth remains, and stone and/or shell artifacts. Historic material, including but not limited to, ship remains, maritime-related structures and remains with square nails, whole or fragmentary ceramic, glass or metal objects, wood, nails, brick, anchors, barge remnants, dumpsites, or other materials may occur within the project area. Any identified cultural resources shall be recorded on DPR 523 historic resource recordation forms by a qualified archaeologist.

If an archaeological resource cannot be avoided by project activities, the Project archaeologist shall prepare an Archaeological Evaluation Plan (AEP) and submit this plan to USACE for approval. The AEP shall create a program to determine the potential of the expected resource to meet the NRHP and CRHR criteria. The archaeologist shall then conduct an evaluation consistent with the USACE-approved AEP. The methods and findings of the evaluation shall be present in an Archaeological Evaluation and Effects Report, which shall be submitted to USACE for review upon completion.

Mitigation Measure CUL-5:

If paleontological resources are encountered during Project construction activities, all work shall be temporarily halted or diverted and a qualified paleontologist shall be retained to ascertain the nature of the discovery, the significance of the find, and provide proper

management recommendations. Project personnel shall not collect paleontological resources found. The paleontologist shall consult USACE to determine the procedure that would be followed before work is allowed to resume at the location of the find. If USACE determines that avoidance is not feasible, the paleontologist shall prepare a salvage plan in accordance with the Society of Vertebrate Paleontologist's guidance documents and CEQA Guidelines. The plan shall be submitted to the USACE for review and approval prior to implementation.

Mitigation Measure CUL-6

If human remains are found during project construction activities, the activities shall cease and USACE's project representative shall immediately contact the Coroner of the County in which the remains were found to evaluate the remains, and follow the procedures set forth in CEQA Guidelines Section 15064.5(e)(1). (As discussed earlier, due to the nature of the project, it may not be possible for project personnel to notice the inadvertent discovery of human remains.) If the Coroner determines that the finds are of Native American origin, and therefore not subject to his/her authority, s/he shall notify the NAHC within 24 hours. The NAHC shall identify the most liked descended (MLD) person or a person who may make a recommendation for the means of treating the human remains and any associated grave goods. Per PRC 5097.98, the USACE shall ensure that, according to generally accepted cultural or archaeological standards or practices, the immediate vicinity of where the Native American human remains are located, is not damaged or disturbed by further activity until the USACE has discussed and conferred, with the most likely descendants regarding their recommendations, if applicable, taking into account the possibility of multiple human remains. The USACE shall discuss with the descendants all reasonable options regarding the descendants' preferences for treatment and make all reasonable efforts to develop an agreement for the treatment of human remains and associated funerary objects.

A.7 Geology/Soils/Seismicity

Affected Environment

This section describes the environmental setting for geology, soil, and seismicity for the Project. It also includes a brief description of the physical characteristics of sediment in the Project Area. Chemical characteristics of the sediment are discussed in Section 4.4.9, Hazards/Hazardous, Toxic, and Radioactive Waste.

A.7.1.1 Regional Geological Setting

The San Francisco Bay Area is located in the Coast Ranges geomorphic province which is characterized by northwest-southeast trending valleys and ridges. These are controlled bed folds and faults that resulted from collision of the Pacific and North American plates and subsequent strike-slip faulting along the San Andreas fault zone. The Bay Area experienced uplift and faulting in several episodes during late Tertiary time (about 25 to 2 million years ago) that produced a series of northwest-trending valleys and mountain ranges, including the Berkeley Hills, the San Francisco Peninsula, and intervening San Francisco Bay. The Coast

Ranges can be further divided into the northern and southern ranges, which are separated by the San Francisco Bay.

San Francisco Bay lies within a broad depression created from an east-west expansion between the San Andreas and the Hayward Fault systems. The Bay Area is underlain largely by sedimentary rocks of the Franciscan Assemblage (50 to 200 million years old) and Great Valley Sequence (65 to 150 million years old). Much younger rocks and alluvium (less than about 15 million years old) typically overlie these rocks. The thickness of the various historic sediment formations varies throughout San Francisco Bay, but they can be several hundred feet thick overall.

About 10,000 to 11,000 years ago, the rising sea re-entered the bay, and the sediments accumulated rapidly in the emerging San Francisco Bay and the surrounding floodplains. The sediments that now cover the bottom of the bay or blanket the adjacent flatlands are, for the most part, less than 5,000 years old. The upper several feet of the sediment profile in most locations consists of more recently deposited marine and riverine sediments. Being geologically very young, the surface deposits tend to be weaker and more compressible than deeper more well-consolidated alluvium that predates the last sea level rise.

Sediments in the Bay fall into three broad categories: sandy bottoms in the channels; shell debris over a wide expanse of the South Bay (derived from remnants of oyster beds); and soft deposits (known as Bay Mud) underlying the vast expanses of shallow water (USACE & RWQCB 2014). Some of the former tidal flats are covered with artificial fill.[6] Regions of the bay where currents are strong, including the deep channels of the bay and the central channels of the major rivers in the Delta, generally have coarser sediments (i.e., fine sand, sand, or gravel). Areas where current velocities are lower, such as the shallow fringes of each sub-region of San Francisco Bay (Suisun Bay, San Pablo Bay, Central San Francisco Bay, and South San Francisco Bay), are covered with Bay Mud (BCDC et al. 1998). The shallow subsurface sediments (Bay Mud) of San Francisco Bay (shallower than -100 feet NAVD88) can be divided into three units, Young Bay Mud, Bay Deposits, and Old Bay Mud.

Young Bay Mud

Young Bay Mud generally consists of gray to grayish-green fine sand, silts, and silty-clays. These are more recent marine sediments that are exposed at the mudline throughout the Project Area in the RWC Channel and the SBS Channel. Thicknesses can range up to 120 feet under the Bay, thinning to less than 1 foot around the original margins of the bay. Shell fragments are sometimes found in the Young Bay Mud. With increasing depth, there is some consolidation in the Young Bay Mud clay, although it is typically not as stiff as the Old Bay Mud.

Bay Deposits

[6] United States Geological Survey (USGS), 1983, Geologic Map of San Mateo County, California, Map I-1257-A.

Between the Young Bay Mud and the Old Bay Mud there appears to be a horizontally variable sand unit that consists of fine sand. This sand unit varies in composition between silty sand and sandy clay. The unit does not consistently appear throughout the Bay Area, but it has been observed in the San Bruno Shoal area.

Old Bay Mud

Underlying the Young Bay Mud is a firm, stiff, dark greenish-gray silty clay that is typically a very stiff, over consolidated clay. It is markedly different from overlying Young Bay Mud. It has a greater compressive strength, includes thin sand and gravel lenses, and lacks shell fragments in the clay. The Old Bay Mud is thicker than 50 feet beneath the central part of the Bay, with a maximum thickness of more than 100 feet just east of Yerba Buena Island.

A.7.1.2 Dredging Efficiency of Existing Sedimentary Units

The three recognized sedimentary units in the southwestern San Francisco Bay area are important with regard to dredging projects. Typically, "mud-bucket" clamshells are sufficient to dredge the clay, silt, and sands of the Young Bay Mud and Bay Deposits. However, such dredges are inefficient when they encounter the previously undisturbed, much stiffer Old Bay Mud, which would instead require more powerful scow-mounted heavy excavators or heavy clamshell buckets, in order to deepen the existing channel bottom below the existing project depth.

A.7.1.3 Seismicity of the Region

The San Francisco Bay Area lies along an active system of right-lateral strike-slip faults forming the tectonic boundary between the North American and Pacific Plates. Tectonic disturbances create seismic waves which travel through the Earth generating ground shaking or earthquakes. The size of an earthquake can be described by its magnitude or intensity. Earthquakes in the Bay Area have their origin in the release of strain energy by the sudden movement of a fault. Strain energy is constantly accumulating in the crustal rocks of the region because of the relative movement of the Pacific Plate relative to the North American Plate. Locally, the tectonic plate boundary is referred to as the San Andreas Fault Zone (SAFZ), which includes the San Andreas Fault, and numerous other active faults.

Regional Faults

The SAFZ includes faults found by the California Geological Survey under the Alquist-Priolo Earthquake Fault Zoning Act (APEFZA) to be "active" (i.e., to have evidence of fault rupture in the past 11,000 years). Some of the major regional active faults within the SAFZ include the San Andreas, Hayward-Rodgers Creek, San Gregorio-Seal Cove, West Napa, Concord-Green Valley, Marsh Creek-Greenville, and Calaveras faults. The most significant to the Project include the San Andreas, Hayward-Rodgers Creek, and Calaveras faults. These faults have caused severe ground shaking in the past and have the potential to do so in the future. Regional active faults are shown on ***Figure A-6***.



Figure A-6. Alquist-Priolo Earthquake Fault Zones

According to the most recent fault activity map (Jennings et al 2010), the State Mining and Geology Board defines an "active fault" as one which has "had surface displacement within Holocene time" (about the last 11,000 years). A "potentially active fault" is considered to be any fault that "showed evidence of surface displacement during Quaternary time" (last 1.6 million years). Because of the large number of potentially active faults in California, the State Geologist adopted additional definitions and criteria in an effort to limit zoning to only those faults with a relatively "high" potential for surface rupture. Thus, the term "sufficiently active" was defined as a fault for which there was evidence of Holocene surface displacement. This term was used in conjunction with the term "well-defined," which relates to the ability to locate a Holocene fault as a surface or near-surface feature (Bryant and Hart 2007).

The Project Area could be subject to damage from movement on any one of the active San Francisco Bay Area earthquake faults. According to the UCERF3[7], the latest earthquake probability model, the probability of one or more earthquakes of magnitude 6.7 or higher occurring in the San Francisco Bay Area within the next 30 years (starting in 2014) is 72% (Field et al. 2015). The likelihood of a magnitude 6.7 or greater earthquake occurring along individual faults is 14.3 percent for the Hayward-Rodgers Creek Fault, 6.4 percent for the Northern San Andreas Fault, and 7.4 percent for the Calaveras Fault.

Faults are less likely to rupture (less ready) when and where there has been a recent earthquake, and are more likely to rupture (more ready) where tectonic forces have built up during many years without an earthquake. The comparably low value for the Northern San Andreas fault (6.4%) is partly because of the relatively recent 1906 earthquake on that fault. Probabilities on two other Bay Area faults, the Hayward–Rodgers Creek and the Calaveras, currently exceed those on the Northern San Andreas, in part because they are both relatively ready (Field 2015). The last damaging earthquake on the Hayward Fault was in 1868.

The Alquist-Priolo Special Studies Zones Act of 1972, administered by the California Division of Mines and Geology, is designed to mitigate the hazard of fault rupture by prohibiting the location of most structures for human occupancy across the traces of active faults. Development projects are regulated if they fall into one of these zones. Neither the RWC and the SBS Channels nor the dredge placement sites lie within or near an Alquist-Priolo Earthquake zone and no active faults are mapped at any of these locations.

A.7.1.4 Subsidence

Young Bay Mud is a very soft, highly compressible material that can cause settlement and ground subsidence. Bay Mud is encountered at the dredging sites as well as the placement

[7] Scientists have developed a new earthquake forecast model for California, referred to as the third Uniform California Earthquake Rupture Forecast, or "UCERF3." The new model provides authoritative estimates of the magnitude, location, and likelihood of earthquake fault rupture throughout the state. UCERF3 represents the latest model from the Working Group on California Earthquake Probabilities (WGCEP) (WGCEP 2014), which also released forecasts in 1988, 1990, 1995, 2003, and 2007.

sites. The potential for settlement is correlated to thickness of the Bay Mud that underlies a given location. Therefore, a new earthen or structural load constructed in an area that contains a significant thickness of Bay Mud can cause consolidation of Bay Mud, which would cause ground settlement resulting in lower ground surface elevations. The RWC Project is not proposing to construct substantial new structures and would not impose any substantial earthen loads on any portion of the Project Area.

A.7.1.5 Earthquake-Related Effects

Surface Fault Rupture

Seismically-induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude and nature of fault rupture can vary for different faults or even along different strands of the same fault. Ground rupture is considered more likely along active faults. Neither the dredging sites nor the placement sites are within an Alquist-Priolo Fault Rupture Hazard Zone, and no mapped active faults traverse the immediate Project Area. Because there are no faults on the project site or on adjacent properties, there is no known risk of surface rupture during an earthquake.

Ground Shaking

Ground shaking is a general term referring to all aspects of motion of the earth's surface resulting from an earthquake, and is normally the major cause of damage in seismic events. The extent of ground shaking is controlled by the magnitude and intensity of the earthquake, distance from the epicenter, and local geologic conditions. Ground shaking intensity during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and type of geologic material. Intensity is a subjective measure of the perceptible effects of seismic energy at a given point and varies with distance from the epicenter and local geologic conditions. Areas underlain by bedrock tend to experience less ground shaking than those underlain by unconsolidated sediments such as artificial fill.

The San Andreas Fault is considered capable of generating a magnitude 7.9 (M_W) earthquake, similar to the 1906 San Francisco earthquake. A 7.2 (M_W) magnitude event on the Peninsula portion of the San Andreas Fault or a 7.9 (M_W) event on the entire San Andreas Fault could be capable of generating very strong (MMI VIII) to violent (MMI IX) seismic shaking in the project area. To the east, the Hayward fault could produce a 6.5 (M_W) event that could result in moderate to strong (MMI VI-VIII) seismic shaking in the project area.

Liquefaction and Lateral Spreading

Liquefaction is the sudden temporary loss of shear strength in saturated, loose to medium-density granular sediments subjected to ground shaking. When this occurs, it can cause foundation failure of buildings and other facilities, such as levees. The potential for liquefaction depends on a number of factors including the duration and intensity of earthquake shaking, particle size distribution of the soil, density of the soil, and elevation of the groundwater. In general, more compressible soils, such as plastic silts or clays, do not generate excess pore

pressure as quickly or to as great an extent as less compressible soils, such as sands. Soils with large amounts of clay such as Bay Muds, therefore, tend to be less susceptible than sandy soils to liquefaction-type behavior. According to the ABAG Liquefaction Susceptibility Map, the land-based portions of the Project have a moderate risk of liquefaction with a very high risk along the Port of Redwood City and portions of Bair Island (***Figure A-7***).

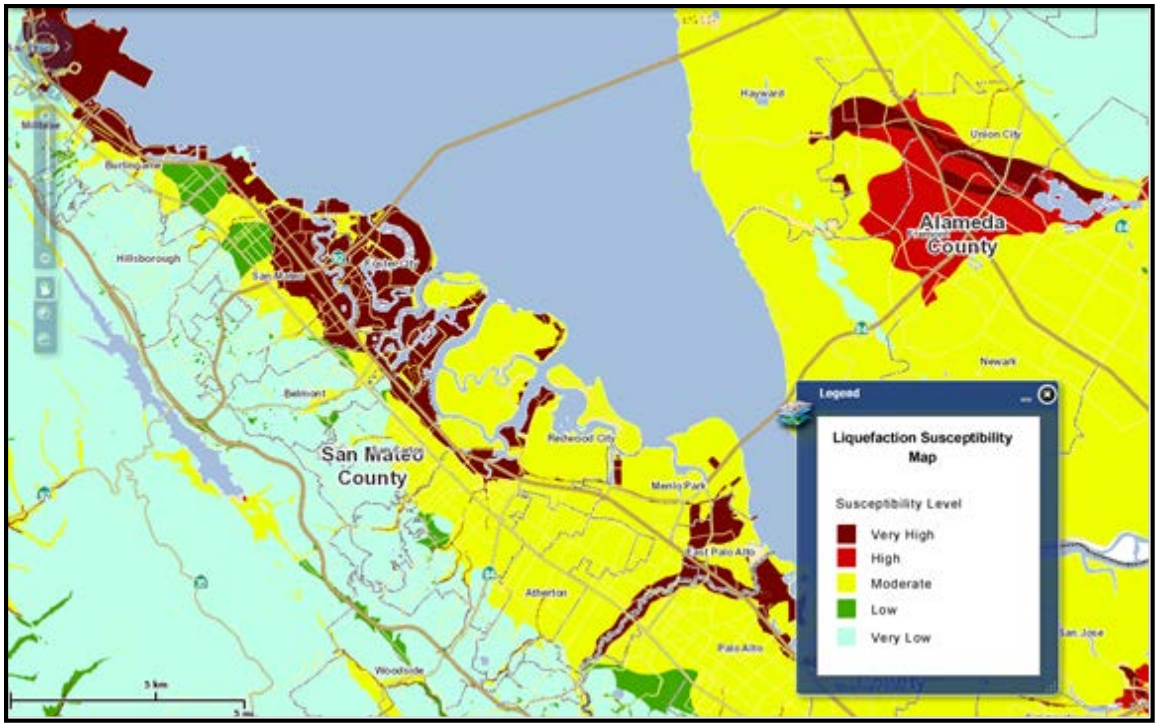


Figure A-7. Earthquake Liquefaction Susceptibility [8]

Lateral spreading is a form of horizontal displacement of soil toward an open channel or other "free" face, such as an excavation boundary. Lateral spreading can result from either the slump of low cohesion and unconsolidated material or more commonly by liquefaction of either the soil layer or a subsurface layer underlying soil material on a slope, resulting in gravitationally-driven movement. Earthquake shaking leading to liquefaction of saturated soil can result in lateral spreading where the soil undergoes a temporary loss of strength. Portions of the Project area are highly susceptible to liquefaction hazards, indicating that lateral movement to an open face, i.e., somewhere along one of the channel banks, is possible.

Tsunamis and Seiches

Large earthquakes can generate seismic sea waves, or tsunamis, which can cause damage along the coastline. Due to the narrowness of the Golden Gate, tsunamis pose relatively little risk

[8] Source: ABAG, "Earthquake and Hazards Information, Earthquake Liquefaction Susceptibility," developed based on USGS open file report 00-444 and 2006-1037. http://gis.abag.ca.gov/website/liquefactionsusceptibility/. Accessed 15 March 2015.

inside the Bay. Redwood City is located about 10 miles east of the Pacific Ocean shoreline, and is not within the County of San Mateo Tsunami Evacuation Planning area. Therefore tsunamis are not considered further in this document.

In addition to tsunamis, earthquakes also have the potential to generate a seiche. A seiche is a standing wave oscillation in an enclosed waterbody (such as a bay) that continues after the cessation of the originating force. Seiches may also be triggered by atmospheric conditions. Although the Bay Area is located in the seismically active region of California, historically, it has not been adversely affected by seiches. Therefore seiches are not considered further in this document.

Slope Stability

Slope instability can be manifested as landslides—including mudflows ("mudslides") or by more subtle processes such as soil creep. Slope instability is a complex phenomenon that can occur at many scales and for many reasons. Examples of triggering mechanisms include earthquakes, grading/excavation, and erosion.

A.7.1.6 Dredging Sites

RWC Channel

RWC Channel is located in Redwood Creek, and extends from the mouth of Redwood Creek to deep water in the San Francisco Bay. RWC Channel is approximately 5 miles east of the San Andreas fault. The channel is surrounded by extensive areas of marshlands and associated Bay Mud deposits. The entire channel is underlain by Holocene Bay Mud (Helley and LaJoie 1979). Soils in the current and former tidal flat areas are classified as the Novato and Reyes Series soils. They consist of very deep, nearly level poorly drained and somewhat poorly drained soils on tidal flats[9].

Sediment chemical quality is discussed in detail in ***Section A.8***, Hazards and Hazardous Materials. This section addresses sediment physical characteristics. The sediment quality of RWC Channel has been characterized several times in recent years in conjunction with maintenance dredging. The most recent data are included in ***Appendix I of the Main Integrated Report*** and are summarized in ***Section A.8***, Hazards and Hazardous Materials.

Sediment in RWC Channel is predominantly silt and clay, with 2 percent or less sand and gravel (USACE and RWQCB. 2014). The channel maintenance dredging sediment data collected between 2008 and 2014 indicate that the fines (silts and clays) in the samples typically exceed 96% with silt ranging from 29 to 65 percent and clay ranging from 35 to 69 percent.

According to test borings and Cone Penetration Tests (CPTs) that were drilled in 2012 along the shoreline of the Port's Wharves 1 and 2 and below the wharf area, compressible Bay Mud is present below on-shore fill and below the mudline off-shore. The thickness of the Bay Mud

[9] USDA, 1991, *Soil Survey of San Mateo County, Eastern Part, and San Francisco County, California*,

ranged from 3 to 10 feet off-shore and 24 to 35 feet on-shore. A layer of medium dense to very dense granular material was encountered beneath the on-shore Bay Mud. This material consisted of silty/clayey sand and gravel with varying amounts of silt and clay. However, this granular layer was not encountered in any of the off-shore borings or CPTs. Granular material may have the potential to liquefy during an earthquake. In general, the majority of the potentially liquefiable layers are relatively thin and appear to be discontinuous (Treadwell and Rollo 2011).

Sediment samples were collected in RWC Channel in 2001, 2005, 2008, 2011 and 2014 prior to maintenance dredging. With the exception of the berth areas at Wharves 1 and 2 and the Inner Turning Basin, maintenance dredging sediment samples have not been collected below -32.5 feet MLLW. In addition, there are no sediment data for the channel side slopes. For the purposes of this project, it is assumed that the sediment physical characteristics are the same for the material between -32.5 feet MLLW and -39 feet MLLW (i.e., -37 +2 feet MLLW) as well as the sediment on the side slopes of the channel.

Geotechnical field exploration was performed in RWC Channel in 2012 by Fugro West. Eleven overwater borings were drilled to approximately -49 to -55 feet MLLW. All but two borings encountered a layer of Young Bay Mud. Where encountered, Young Bay Mud extended to depths of about -24 to -54 feet MLLW. The bottom of the Young Bay Mud was generally deeper toward the north, in the Bay (to approximately -54 feet MLLW) and shallower toward the south within the inner shipping channel (to approximately -24 feet MLLW) (Fugro 2012). The soil encountered below the Young Bay Mud generally consisted of soft to stiff gray to olive brown to light brown lean clay (CL) with varying amounts of sand, with lesser amounts of fat clay with sand, sand, and clayey sand, and extended to the maximum depths explored. This soil can be characterized as alluvial deposits and generally has a lower water content and lower plasticity than the Young Bay Mud (Fugro 2012).

In 2010, a marine geophysical sub-bottom profiler survey of RWC and SBS Channels was performed by SeaVision. Eleven vibacore samples were collected from RWC Channel at depths ranging from -32 and -53 feet NAVD 1988, with the majority of the depths between -33 and -36 feet NAVD 1988. In general, these cores indicated the presence of a gray, very soft clayey silt layer overlying a gray to greenish-gray soft to medium silty clay that exhibited increasing stiffness with depth. The survey effort indicated that Old Bay Mud is well below the -35 foot NAVD 88 elevation in RWC Channel.

San Bruno Shoal Channel

Only limited data are available regarding the geological conditions at SBS Channel. In 2010, twenty-four vibracore samples were collected from SBS Channel with bottom-of-hole elevations ranging between -30 and -43 feet NAVD 1988. These cores were generally similar to the samples collected in the RWC Channel in that they indicated the presence of a gray, very soft clayey silt layer overlying a gray to greenish-gray soft to medium silty clay that exhibited

increasing stiffness with depth. A well-sorted fine brown silty sand was encountered at several locations. This sand is consistent with descriptions of the sandy Bay Deposits described in the work of Goldman (1969) as the sand unit that overlies the Old Bay Mud in San Francisco Bay. Based on the sub-bottom profiling survey Old Bay Mud may occur above -35 feet NAVD 1988 in SBS Channel (Seavision 2011). Material dredged in the San Bruno Shoal is assumed to be 70% mud and silt and 30% loose sand (USACE 2014d). A review of test data back to and including 1993 indicated that no data have been collected at SBS Channel during the past 22 years.

As described in ***Section 4.2 of the Main Integrated Report***, three fuel pipelines are located underneath the SBS and will have to be relocated for this Project. The pipelines would be lowered to a depth of between -40 and -45 feet MLLW to provide a minimum 6-foot separation between the top of the pipeline and the bottom of the channel, while allowing for overdepth of up to 2 feet. The replacement pipeline sections would be covered with three feet of sand and two feet of armor rock, and the remainder of the trench would be allowed to silt in naturally over the rock.

A.7.1.7 Placement Sites

Cullinan Ranch

Cullinan Ranch is underlain by varying thicknesses of Bay Mud. Holocene age intertidal deposits (Qi) underlie the Cullinan Ranch site. These deposits are composed of soft mud and peat deposits in marshes, swamps, and adjacent waterways (California Division of Mines and Geology 1982). The Cullinan Ranch site has moderate liquefaction susceptibility (ABAG 2015d)

Cullinan Ranch soils are all of the Reyes series. These soils are silty clays deposited primarily by sediment-laden bay waters, but also by tributary freshwater streams. Slopes in the area range from 0 to 2%, but most are less than 1%. The erosion hazard of these soils is considered to be low.

The closest active fault to the Cullinan Ranch site is the West Napa Fault, located approximately 3 miles northwest of the site. The Concord-Green Valley fault is located approximately 5 miles east of the site, and the Hayward-Rodgers Creek fault is located roughly 5 miles southwest of the site. The possibly active Franklin Fault (Quaternary fault) runs along the Napa River, west of Cullinan Ranch. No active faults traverse the site. In 2014, the South Napa magnitude 6 earthquake caused the strongest shaking in the San Francisco Bay area since the 1989 Loma Prieta earthquake. According to the USGS, the earthquake occurred near the West Napa Fault and the Carneros-Franklin Faults. Although there are several faults in the region, only the West Napa Fault is known to have displaced Holocene-age sediments, which is positive evidence of surface fault rupture in the last 11,000 years (Shakal 2014).

Montezuma Wetlands Restoration

The Montezuma Wetlands site is located in recent alluvium and Bay Muds in the floodplain of the Sacramento River and the Montezuma Hills. The site is located 12.5 miles east of the active

Concord-Green Valley fault (***Figure A-6***). The Vaca/Kirby Hill fault runs north-south along the west side of the Montezuma Slough. This Quaternary fault is considered a potentially active fault (showing evidence of surface displacement sometime during the last 1.6 million years). There are no known active faults within the site.

SF-DODS

The continental shelf offshore of the Golden Gate is a broad, relatively flat plain, with water depths up to 180 m (500 feet). SF-DODS is located beyond the continental shelf, on the continental slope, in water depths of 2,500 to 3,000 meters. This relatively narrow (about 35 km wide) segment of the continental slope has rugged topographic relief and an average slope of six degrees or more (BCDC et al. 1998). The location of SF-DODS was specifically selected to avoid geographically unique or otherwise sensitive habitats (Germano & Associates 2010).

SF-DODS is close to the foot of the continental slope in an area characterized by slow deposition and by very little mass movement of sediment. The site is in an area that is atypically sandy relative to other continental slopes (Karl 2001). The mean grain size decreases with increasing depth on the slope, from dominance by silty and clayey sands in Pioneer Canyon (approximately 35km outside the site boundary), to primarily silt and clay closer to the disposal site itself (Karl 2001).

Sediment samples have been collected from SF-DODS and the surrounding areas and analyzed for sediment chemistry each year to monitor the effects of dredged material disposal on the chemical and physical characteristics of bottom sediments within and adjacent to the SF-DODS.

The San Andreas Fault runs offshore approximately 50 mile east of the SF-DODS site.

Alviso Ponds

In general, the Alviso area is mapped as Bay Mud. The Bay Mud is relatively thin (< 5 feet) along the existing urban/salt pond boundary and becomes deeper (35 to 40 feet thick) along the outer pond levees adjacent to the Bay. Bay Mud is underlain by alluvial flood plain deposits that range in grain size from coarse to fine and are generally medium dense to dense/stiff in consistency. The Alviso Pond complex has moderate liquefaction susceptibility (HDR 2014). The existing outboard levees are most likely constructed of Bay Mud borrow excavated from adjacent ponds and sloughs (HDR 2014).

Soils in the Alviso pond complex are generally not categorized, but labeled as tidal marsh or salt concentration ponds. Some soils are categorized Alviso Clays and Mocho fine sandy loam over basin clays (EDAW 2007), which are generally poorly drained.

Alviso Pond A9 is approximately five miles east of the Hayward Fault and 12 miles west of the San Andreas Fault. Pond A2W is roughly 8.5 miles west of the Hayward Fault and 8 miles east from the San Andreas fault. The San Jose Fault, a concealed potentially active Quaternary

fault[10], traverses the southwest portion of Pond A2W continuing northwest through Pond A1 and Charleston Slough to the Dumbarton Bridge. No active faults cross the Alviso Pond complex. The 1989 Loma Prieta Earthquake, which was a 7.1M, strong shaking effects in San Jose.

Eden Landing Ponds

Within the Eden Landing pond complex the thickness of Bay Mud varies from about 0 to 28 feet (USFWS AND CDFW 2007). An outcropping of the Franciscan Unit rock type exists within the pond complex. Eden Landing is approximately 3 miles west of the trace of the Hayward Fault and 12 miles east of the San Andreas Fault. Potential for settlement within the pond complex is strongly correlated to Bay Mud thickness. The ponds along the Bay side of the Eden Landing pond complex have a moderate liquefaction susceptibility.

Soils in the Eden Landing pond complex are primarily Reyes-Urban Land soils (USFWS AND CDFW 2007). These soils consist of very poorly drained clays located on tidal flats or urban land, and are also known as Bay Muds.

Significance Thresholds

The effects of a project or alternative on geology and soils are considered to be significant if the proposed Project or alternatives would:

- Expose people or structures to potential substantial seismic or other geologic hazards that cannot be avoided or reduced through the use of standard engineering design and seismic safety techniques, or
- Result in substantial soil erosion at the dredging and/or placement sites, creating substantial risks to life, property, waterways, or resulting in damage to sensitive habitat

Environmental Consequences

This section evaluates the potential impacts on geology, seismicity and soils that would result from implementation of the Project. While none of the dredging or placement sites are located in an Alquist-Priolo earthquake hazard zone, the proposed Project could potentially be affected by large earthquakes that could occur anywhere in the greater Bay Area and/or tsunamis resulting from a large offshore earthquake. Other geology- and soil-related impacts that could occur to the Project site, such as erosion, subsidence or slope failure, would be more site-specific and confined to the immediate vicinity of the dredging sites.

Geological impacts were evaluated in two ways: (1) impacts of the Project on the local geologic environment; and (2) impacts of geohazards on Project components that may result in substantial damage to structures or infrastructure or expose people to substantial risk of injury.

[10] Showing evidence of displacement sometime during the past 1.8 million years.

Impacts are considered significant if the Project meets either of the significance criteria identified above.

Dredging Options

The proposed dredging would result in deepening of the RWC and SBS Channels. Impacts to geology, soil and seismicity would be similar under all three dredging alternatives, and all three dredging options are therefore addressed as a group.

Impact GEO-1: Expose People or Structures to Potential Substantial Seismic or Other Geologic Hazards that Cannot be Avoided or Reduced through the Use of Standard Engineering Design and Seismic Safety Techniques

As discussed previously, the San Francisco Bay Area is considered to be seismically-active region. The dredging sites are have the potential to be subject to significant ground shaking resulting from an earthquake along any of the active faults located in the region including the San Andreas, the closest active fault to the dredging sites. No active faults or faults that fall under the Alquist-Priolo Special Studies Zone Act of 1972 have been mapped at either dredging site, and there would not be any construction of new structures.

During and immediately after a strong seismic event, saturated loose granular soils may lose strength (liquefy), and may experience relatively rapid volumetric change, resulting in subsidence or lateral spreading at the dredging sites. Generally thicker deposits will accumulate more volumetric change than thinner deposits. The dredge sites are underlain by Bay Mud, and portions of the channels and the RWC berths are underlain by a thin layer of sand; however, the sand layer is not consistent throughout the Project Area. Sandy soils are potentially liquefiable, and liquification of the sandy soils could result in related ground failures including lateral spreading, subsidence or slope failure. Deepening of the channels and berths could increase the risk of slope failures of the channel banks if the constructed slopes are inadequate. The channel banks could become unstable under seismic or static conditions depending on the nature of the underlying soil and geometry (height and steepness) of the slopes.

Because there are no structures in or adjacent to SBS Channel, collapse of a portion of the channel banks as a result of an earthquake would not result in any damage to structures and would not expose people to potential harm. Deepening of RWC Channel and berths could increase the risk of slope failures of the channel banks if the constructed slopes are inadequate. The channel and berth banks could become unstable under seismic or static conditions depending on the nature of the underlying soil and geometry (height and steepness) of the slopes. Collapse of the channel and/or berth banks in RWC Channel could also lead to failure of adjacent structures (wharves).

Additional data on sediment properties would be collected as needed during the design phase. The existing slopes would be analyzed and the future slopes designed, and constructed in

accordance with EM 1110-2-1902 (USACE 2003). Adherence to applicable design specifications and standards would ensure that the risk of slope failure would be reduced to an acceptable level. To address potential concerns with RWC Channel deepening adjacent to existing structures, the current footprint of the channel would not be widened near existing structures. This impact is less than significant.

Impact GEO-2: Significant Soil Erosion Creating Risks to Life, Property, or Waterways, or Damage to Sensitive Habitat

Erosion of the channel banks and habitat adjacent to the channel banks could occur as a result of sediment sloughing from the channel banks and/or vessel wakes and propeller wash. The proposed RWC Channel footprint has been designed to minimize impacts to existing sensitive habitat (mudflat) adjacent to the channel. The design of the channels is intended to minimize sloughing of the channel sides and thus sloughing-related erosion effects to mudflats adjacent to RWC Channel.

There would be no expected impact to Bair Island, as the channel daylight would be the same as for the current channel. The channel daylight would move between 6 and 42 feet closer to Greco Island, and could potentially contribute to erosion of the mudflats adjacent to Greco Island. This impact is potentially significant. With implementation of Mitigation Measure GEO-M1, this impact would be reduced to less than significant.

Vessel wakes and prop wash during dredging and post-construction could contribute to erosion of the mudflats. As described in ***Section A.5.1***, passing vessels, including tugs and deep draft vessels, could generate vessel wakes that exceed the naturally-occurring sustained wind-wave heights in RWC Channel. The increased vessel traffic during and following construction could therefore lead to an increase in erosion of mudflats adjacent to the channel. Annual deep draft vessel calls could increase from 64 up to 93 during the life of the project; this would result in approximately 1 to 2 additional vessel transits per week. Potential impacts due to increases in erosion from increased deep draft vessel transits would be less than significant.

During construction, there would be increased tug traffic of up to five to six one-way tug trips per day. In addition, there would be several crew and tender boat trips per day. Crew and tender boats are small vessels, and their vessel wakes would be similar to those of the recreational boats currently using RWC Channel. The potential effects on mudflat erosion due to crew and tender boats would be less than significant.

Tugs have powerful engines and increased use of tugs could potentially contribute to increased erosion of adjacent mudflats. With implementation of Mitigation Measure BIO-M10, this impact would be less than significant.

Placement Sites
Cullinan

Impact GEO-1: Expose People or Structures to Potential Substantial Seismic or Other Geologic Hazards that Cannot be Avoided or Reduced through the Use of Standard Engineering Design and Seismic Safety Techniques

The offloader and pipeline would be designed to the appropriate seismic safety standards. The design of the pipeline would consider appropriate slopes and support on the outboard embankment to avoid damage to the embankment. Additional data would be collected as needed during the design phase. This impact is less than significant.

As discussed above for the dredging options, the risk of tsunamis and seiches in San Francisco Bay is low. The risk is further reduced by the location of Cullinan north of Mare Island Strait; Mare Island Strait is narrow and would further attenuate the effects of any tsunami. Potential impacts of tsunamis and seiches on delivery of sediment, including construction of the offloader and pipeline, would be less than significant.

Impact GEO-2: Significant Soil Erosion Creating Risks to Life, Property, or Waterways, or Damage to Sensitive Habitat

Offloader construction would be designed to minimize effects on near-by habitat. Minor disturbance of marsh, mudflat and/or subtidal habitat could occur as a result of pipeline installation. However, the effect would be limited in extent and duration, and would be designed to avoid causing significant erosion. The potential for increases in erosion of nearby mudflats and marsh habitat due to vessel wake from tugs would be low because tugs would be moving slowly as they are delivering scows to the offloader, and because there would only be a small number of tugs trips each day. This impact is less than significant.

Montezuma

Potential impacts to geological resources and seismic effects associated with placement of sediment at the Montezuma site are all addressed by the Montezuma site. Delivering sediment to be off-loaded would have no impacts on geological resources or seismic effects.

SF-DODS

Impact GEO-1: Expose People or Structures to Potential Substantial Seismic or Other Geologic Hazards that Cannot be Avoided or Reduced through the Use of Standard Engineering Design and Seismic Safety Techniques

Seismic-induced settling of sediments disposed of at SF-DODS would consolidate the material, and is not expected to cause movement of the material outside of the SF-DODS boundaries (USACE and Port of Oakland 1998). Therefore, there would be no impact related to seismic hazards associated with use of the SF-DODS.

Impact GEO-2: Significant Soil Erosion Creating Risks to Life, Property, or Waterways, or Damage to Sensitive Habitat

This offshore placement site is considered non-dispersive, meaning that sediment stays within the placement boundaries (BCDC et al. 1998). Nonetheless, some migration of the sediment outside the disposal area is known to occur, and migration is generally consistent with modeling (Germano & Associates 2010). According to the USEPA (2010b) monitoring report, the apparent accumulated thickness of dredged material outside the site boundary is less than 10 cm. Freshly deposited particles are constantly being reworked into the underlying sediments by infaunal burrowing and feeding activity. Therefore, impacts related to soil erosion would be insignificant for this site.

Alviso and Eden Landing Ponds

Impact GEO-1: Expose People or Structures to Potential Substantial Seismic or Other Geologic Hazards that Cannot be Avoided or Reduced through the Use of Standard Engineering Design and Seismic Safety Techniques

The offloader, booster pump(s) and pipeline at these two placement sites would be designed to the appropriate seismic safety standards. The design of the pipeline would consider appropriate slopes and support on the outboard embankment to avoid damage to the embankment. Pipeline design and effects of seismic events on the pipelines would be similar for a pipeline from the offloader to the dredged sediment delivery location and for a pipeline from a cutterhead dredge to the dredged sediment delivery location. Additional data would be collected as needed during the design phase. This impact is less than significant.

As discussed above for the dredging options, the risk of tsunamis and seiches in San Francisco Bay is low. Furthermore, the facilities to be constructed to enable use of these two placement sites would be resistant to the effects of tsunamis and seiches because they are placed in the Bay. Potential impacts of tsunamis and seiches on delivery of sediment, including construction and use of an offloader and pipelines, would be less than significant.

Impact GEO-2: Significant Soil Erosion Creating Risks to Life, Property, or Waterways, or Damage to Sensitive Habitat

If offloaders are constructed to support sediment delivery to these two sites, the offloaders would be placed in deep water, and construction would be designed to minimize effects on the Bay and any near-by habitat. Minor disturbance of marsh, mudflat and/or subtidal habitat could occur as a result of pipeline installation, whether the pipeline is originating at a cutterhead dredge or an offloader. However, the effect would be limited in extent and duration, and would be designed to avoid causing significant erosion. This impact is less than significant.

Mitigation Measures

Mitigation Measure GEO-M1: Conduct Supplemental Hydrodynamic Surveys and Monitor for Erosion

There is insufficient information to determine whether and to what degree the channel daylight for the RWC Channel could intersect mudflats adjacent to Greco Island. To avoid inadvertent loss of mudflat and/or an increase in erosion of mudflat, the Corps shall conduct supplemental hydrodynamic surveys of the east side of Redwood Creek in the vicinity of Greco Island. If the channel daylight line may intersect with the outboard mudflats at Greco Island, the Corps shall evaluate the potential for alternative alignments in this area, including potentially tapering the channel sides (narrowing the footprint of the channel) and/or steepening the channel side slopes (if feasible without adversely affecting the stability of the channel banks). In addition, wherever the new channel daylight line comes into close proximity with the mudflats, the Corps shall conduct erosion monitoring (e.g., through use of erosion pins) to establish whether loss of mudflat is occurring, and shall mitigate for loss of habitat through purchase of mitigation credits or other means as approved through biological consultation.

A.8 Hazards and Hazardous Material

Affected Environment

This section address potential hazards posed by the proposed Project, including hazards to navigation, hazardous materials, and contaminated sediment. The proposed Project would not affect potential flood hazards. Deepening RWC Channel and SBS Channel would not affect the likelihood of flooding in the vicinity of the channels. Similarly, construction of offloading facilities at some of the potential placement sites would not cause a substantial obstruction to flood flows and would not affect flooding. Potential effects to flooding from placing sediment into the placement sites has been, or would be, addressed by the separate environmental documents prepared by the placement site owners.

A.8.1.1 Hazards to Navigation

Hazards to navigation can be divided into five categories: (1) shoals and islands, (2) bridges and other structures, (3) fog and inclement weather, (4) vessel traffic, and (5) tides and currents. Hazards to navigation may result in collisions, groundings, and allisions.[11]

Islands and the shallow areas around such islands as Alcatraz, Angel Island, Treasure Island, and Yerba Buena Island as well as shallow areas such as San Bruno Shoal are hazards to navigation and, when combined with other elements including fog, traffic, or malfunctioning radar equipment, can present an extreme hazard. Bridges and other structures pose a similar hazard that is frequently coupled with restricted maneuvering room. These hazards are identified on navigation charts and by lighting and other aids to navigation.

Summer fog and winter storms contribute to navigation difficulties in the Bay. Some types of commercial vessels, including tankers carrying hazardous materials such as fuel oil, have been restricted from transiting the Bay during periods of low visibility.

[11] An allision is defined as a vessel striking a fixed object as, for example, when the Cosco Busan struck the Bay Bridge.

The greatest hazard to vessel navigation is other vessel traffic. Large commercial and naval vessels are required by US Coast Guard (USCG) regulations to use designated traffic lanes when traveling in inland waterways. Smaller commercial vessels (i.e., tugboats, ferryboats, and private vessels) often do not navigate within specific traffic lanes, but rather travel the most direct route. Private (recreational) vessel users also travel freely across the Bay. Recreational boaters may be unaware of navigation rules, and/or underestimate the danger posed by large vessels. These private vessels can pose hazards to navigation, particularly if other circumstances such as fog are present. Private vessel traffic is heaviest during weekend days. Commercial vessels are required to coordinate with the USCG's Vessel Traffic Service San Francisco, which monitors and guides vessel traffic in San Francisco Bay in the same way that air traffic control monitors and guides local air traffic.

Grounding is a collision between a vessel and the seafloor or edge of a channel. Groundings can result in damage to vessels as well as serious environmental consequences. A ship aground in a channel can block the transit of other vessels or create new shoaling, and may cause serious delays to commerce. Maneuvering deep-draft ships in narrow channels with minimal underkeel clearance poses high navigational risks, given the complexities of tides, currents, and weather conditions in the Bay (HSC 2014).

Tidal action causes extremely strong currents throughout the Bay during periods of maximum ebb and maximum flood tides. Strong currents (above 2 knots) are potentially hazardous if not properly "corrected for" during slow speed maneuvering. The greatest currents occur at the Golden Gate with the average maximum flood current being 3.3 knots[12] and the maximum ebb current being 4.5 knots. Even as far south as Hunter's Point, there are currents of 2.2 knots at maximum ebb (USACE and Port of Oakland 1998).

The VTS collects detailed reports of every vessel incident in the Bay. The categories of incidents include collisions, near-misses, vessel grounding, noncompliance (not listening to the VTS or acting contrary to their instructions), non-participation (turning the vessel radio off), hindering navigation (e.g., a sail boat passing in front of a commercial vessel confined to narrow channels or fairways), and loose scows (the tow line between the tug and the scow breaks and the scow is set adrift, or the tugboat loses power). There have only been a few incidents involving commercial vessels in the past 5 years. These include a ferry colliding with Pier 41, a party boat colliding with underwater rocks near Alcatraz, a small speedboat striking a ferry, and a tanker side-swiping Bay Bridge Tower E (CNT Group 2015).

A.8.1.2 Hazardous Material

Hazardous materials are present in the Project area in the fuel pipelines crossing under SBS Channel (jet fuel), and fuel in vessels transiting the channels. Some vessels may carry cargoes that are considered hazardous materials. Transport of hazardous materials on water is governed by 46 CFR 15 Part 146 *et seq.* (Dangerous Cargo). The Port Tariff (Port of Redwood

[12] One knot is equal to 1 nautical mile per hour, or 1.15 statute miles/hour.

City 2014) includes various requirements applicable to dangerous cargoes, as well as requirements pertaining to the proper management of oily wastes and fuels.

A.8.1.3 Contaminated Sediments

Sediments in San Francisco Bay have been impacted by wastes originating from industrial and commercial activities around the Bay. These activities have released inorganic and organic chemical constituents to San Francisco Bay. The constituents present and their concentrations vary around the Bay depending on the types of sources upstream of the sediment being tested and the proximity of these sources to the sediment.

The San Francisco Estuary Institute (SFEI) conducts the Regional Monitoring Program (RMP) that tracks contaminant distribution and trends throughout the Bay. In some locations some chemical constituent concentrations exceed or approach thresholds set to protect human health and/or the environment. In general, chemical concentrations in San Francisco Bay have been declining over the past 20 years, reflecting improved waste management practices. However, some new chemicals (e.g., certain types of flame retardants) have been introduced (SFEI 2015).

Because sediment is San Francisco Bay frequently contains legacy anthropogenic chemicals, testing is required prior to channel deepening and maintenance dredging. Sediment chemical data are reviewed by the Dredged Material Management Office (DMMO), and compared to ambient and reference concentrations to determine the suitability of the dredged sediment for various types of placement sites.

Dredged Material Management Office

The DMMO was created in 1996 to establish a comprehensive and consolidated approach to permitting placement of dredged material to eliminate redundancy and delays in the dredged material placement permitting process. The DMMO reviews and approves sampling and analysis plans (SAPs), reviews the resulting sampling and analysis reports (SARs), and approves sediment chemical classifications proposed in the SARs. The sediment classifications in turn determine the allowable dredged placement locations. The DMMO determines the suitability for placement of dredged material at a given location, based on sediment testing results and LTMS program goals. The DMMO is a joint program composed of USACE, USEPA, BCDC, RWQCB, and the State Lands Commission. Participating agencies include CDFW, NMFS, and USFWS.

Regional Monitoring Program

The RMP compiles sediment, water, and tissue samples from a variety of monitoring stations around the Bay. Not all stations are analyzed for all constituents of interest. Although there is considerable variation among locations, a review of the data shows that in general, sediments are less contaminated in San Pablo and Suisun Bays than in Central and South San Francisco

Bays (SFEI 2015). Data from the RMP are frequently used as reference data for evaluating contamination levels in dredged sediment.

Testing Requirements for Placement and Beneficial Reuse of Dredged Material

Material proposed to be dredged and placed at ocean, inland aquatic, or upland/beneficial reuse sites requires sediment characterization to predict the environmental impacts associated with dredging and dredged material placement activities. The objective of the sediment testing requirements is to determine whether placement of dredged material at designated sites can occur without causing unacceptable effects to the surrounding environment.

Generally, sediments are tested for physical and chemical attributes and/or the potential for biological toxicity. The extent of sediment characterization necessary to ensure compliance with applicable environmental laws and regulations is site-specific. The type and extent of testing depends on the physical characteristics of the sediment, as well as the characteristics of the dredged material placement site.

The entire potential dredge prism, which includes 2 feet of overdepth, is characterized. Recently, testing of the so-called "Z-layer" has also been required to document the sediment quality of the sediment that would be exposed at the new post-dredging surface following the dredging episode.

For ocean disposal to take place, the material must be acceptable for deep-ocean placement, as regulated by the MPRSA. The standards under CWA and MPRSA for determining the need for testing differ. The requirement for testing under the CWA is based on reason to believe that contaminants are present in the proposed discharge and have the potential to result in unacceptable adverse impact (40 CFR § 230.60).

Testing under the MPRSA is required when the material does not meet the exclusionary criteria in 40 CFR § 227.13(b). Once it is determined that testing is required, the physical, chemical, and biological tests relied on for evaluating the material are similar for in-Bay and ocean placement sites.

For placement of dredged material in inland waters, including San Francisco Bay, Section 404 of the CWA, including the Section 404 (b)(1) Guidelines, and the regulations at 40 CFR Part 230 define the testing requirements. Current guidance for implementing inland aquatic disposal is provided in Evaluation of Dredged Material Proposed for Disposal in Waters of the US – Testing Manual for Discharge in Inland and Near Coastal Water (USACE and USEPA 1998), referred to as the Inland Testing Manual. The regulations allow some temporary effects to the environment, and these effects are based on water quality criteria and Limiting Permissible Concentrations (LPCs). Concentrations of chemicals of concern present in dredged material must be lower than concentrations that cause significant impacts to certain species.

In late 1997, NMFS published regulations requiring consultation for projects or programs that may adversely affect Essential Fish Habitat (EFH). Consequently, in 2004, the LTMS agencies and NMFS began preparing a programmatic EFH consultation for the LTMS program. The programmatic EFH agreement was completed in 2011 (USACE and USEPA 2011), and updated in 2012 to address mercury contamination considerations (USACE and USEPA 2012). The EFH agreement includes a number of Conservation Measures that enhance the environmental protectiveness of the LTMS program. The conservation measures in the Programmatic EFH also tie the sediment testing program to San Francisco Bay's existing Total Maximum Daily Loads (TMDLs) for mercury and polychlorinated biphenyls (PCBs), as well as to the RMP. This ensures that dredging and dredged material placement will be managed in a manner that directly complements other key pollution-reduction programs for San Francisco Bay. A proposed update to the programmatic EFH was issued by the LTMS agencies in October 2014, and is currently in review by NMFS. The update addresses protection of salmonids and green sturgeon, and is based on the results of the LTMS 12-Year Review, and proposed measures were incorporated into this EIS/R.

In the San Francisco Bay Area, placement of dredged material at upland sites or for beneficial reuse is regulated under the Porter-Cologne Act and the McAteer-Petris Act. Screening guidance is provided in the RWQCB's May 2000 staff draft summary report, *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* (RWQCB 2000). There are two levels of screening guidelines for beneficial reuse of sediments for wetland restoration: guidelines for wetland surface material (also referred to as wetland cover material) and for wetland foundation material (also referred to as wetland non-cover material).

Surface (also referred to as "cover") material is a class of material that is not expected to pose a threat to water quality or the aquatic environment, even in places where the material is in direct contact with surface waters or aquatic organisms and is suitable for unconfined aquatic disposal. Wetland foundation (also referred to as "non-cover") material is not of a quality that constitutes a hazardous or listed waste but has a potential for biological effects if directly exposed to organisms. Wetland foundation material is not expected to be a threat to water quality when an adequate amount of cover material is used to reduce the risk of foundation material coming into contact with the aquatic environment. The amount of cover material needed to adequately reduce this risk depends on site-specific characteristics.

A.8.1.4 Dredging Sites

Redwood City Harbor

Navigation Hazards

In calendar year 2014, the Port received 107 vessel calls, consisting of 64 ships and 43 barges. Panamax vessels, the largest vessels calling on the Port are 110 feet in width; the channel has a width ranging from 300 to 900 feet. Approximately 60% of the ship calls were Panamax vessels. Standard scows used to transport aggregate to the Port are 76 feet wide. Navigation in RWC

Channel is constrained by the deep draft channel and the widths of the turning basins. Private and public marinas are located south and east of the channel, contributing recreational boat traffic to the channel. There have been no incidents pertaining to large vessels in RWC Channel in the past five years.

Hazardous Materials

The presence of hazardous materials in RWC Channel is primarily associated with vessels in transit. No fixed locations containing hazardous materials are located within the proposed dredging area. None of the sediment to be dredged would be classified as a hazardous material.

Contaminated Sediment

Sediment testing has been conducted in RWC Channel in support of maintenance dredging. The most recent sediment data collected were collected in 2014. Sediment chemistry data for 2008 through 2014 are provided in ***Appendix I***. Sediment was collected to a maximum depth of -32.5 feet MLLW. In general, sediment samples collected from RWC Channel have met the criteria for open water disposal (SUAD) and wetland surface material. The most recent testing, however, indicated that total PCB congener concentrations in some sediment cores in the Inner Turning Basin exceeded the wetland foundation criteria of 180 µg/kg. Biological testing conducted indicated that species effects for most test species were statistically similar to reference sediments from SF-DODS (Kinnetic and Atkins 2015). Additional testing is in progress to characterize depths below -32.5 feet MLLW.

San Bruno Shoal Channel

Navigation Hazards

Navigation in SBS Channel is slightly constrained by the deep draft channel; however, many vessels other than deep draft vessels would be able to transit the area without using the channel. Other vessel traffic in the area consists of recreational vessel use and minor commercial traffic. There have been no incidents pertaining to large vessels in SBS Channel in the past five years.

Hazardous Materials

The presence of hazardous materials in SBS Channel is primarily associated with vessels in transit. The three fuel pipelines underlying the channel also contain hazardous materials. None of the sediment to be dredged would be classified as a hazardous material.

Contaminated Sediment

There are no available data regarding contaminated sediment in SBS Channel. SBS Channel is not near any point source locations, and sediment chemical concentrations are expected to be representative of ambient conditions. Because sediment in SBS Channel is sandier than at RWC

Channel, chemical concentrations in SBS Channel are also likely to be lower than at RWC Channel.

A.8.1.5 Placement Sites

None of the placement sites, including proposed offloader, pipeline, and booster pump locations are known to contain hazardous materials. Similarly, all offloading locations would be in deep water at the edge of existing channels or natural deep water areas. No larger vessel incidents (i.e., involving tugs and scows) have been recorded in the vicinity of any of the proposed off-loading locations in the past five years.

Cullinan Ranch Restoration Project

There is extensive recreational boat traffic on the Napa River and periodic recreational boat traffic on Dutchman Slough. The proposed offloader locations are situated on the western edge of the deep water channel in Napa Rover and the proposed pipeline alignments are located in shallow water adjacent to the levees along Dutchman Slough. No contaminated sediment is known to be present at the proposed offloader locations at Cullinan, or within the proposed pipeline alignments. There are no regional monitoring program sites near the Cullinan site. The closest sites are near the south side of Mare Island Strait (SFEI 2015) and likely reflect influences from industrial and military activities along Mare Island Strait. These data are not considered relevant to the Cullinan site. The site is permitted to receive wetland foundation sediment.

Montezuma Wetlands Project

There is recreational boat traffic in the vicinity of the offloading location, however, there are no nearby marinas or other sources of recreational vessel traffic. The offloading location is very close to the northern shore, north of Chain Island. No construction is proposed at this placement site.

SF-DODS

There may be occasional recreational or larger vessel traffic in the vicinity of the offloading location, however, there are no nearby sources of recreational vessel traffic. This site is located in deep water in the open ocean, and no disturbance of the existing bottom sediment is expected. Existing bottom sediments collected in the vicinity of the site provide reference concentrations for allowable chemical and biological characteristics in sediment to be disposed of at this site.

Eden Landing Restoration Project

The proposed offloader location is on the eastern edge of the natural deep water channel in San Francisco Bay. The proposed pipeline alignment is located in deep to shallow water and would cross shallow water and mudflats prior to terminating at the top of the levee at Pond E2.

Recreational boating occurs in the South Bay, and the pipeline alignment is designed to avoid interfering with recreational vessel traffic.

One sediment sampling station included in the RMP is located near the proposed offloader location; no sediment sampling stations are located in the vicinity of the sediment delivery location. The designated sampling station generally has relatively low concentrations of contaminants; with the exception of dioxins and methyl mercury, most concentrations at this station are below the mean for San Francisco Bay (SFEI 2015).

Alviso Ponds Restoration Area

The proposed offloader location is on the eastern edge of the natural deep water channel in San Francisco Bay, between the Dumbarton Bridge and the railroad bridge. Although the natural deep water channel extends south of the railroad bridge, the offloader location was selected to avoid potential congestion associated with the need to pass the railroad bridge. The proposed pipeline alignments are located in deep to shallow water and would cross shallow water and mudflats prior to terminating at the top of the levees at either Pond A2W or A9. Booster pumps would be located on top of the levee at the sediment delivery location. Recreational boating occurs in the far South Bay and the pipeline alignments are designed to avoid interfering with recreational vessel traffic. The additional booster pump required to deliver sediment to the Pond A9 located would be in relatively shallow water east of the natural deep water channel.

The geography and history of the San Francisco Bay affects the distribution of mercury-contaminated sediments within and surrounding the South Bay Salt Ponds area. South San Francisco Bay has been subjected to discharges of mercury contaminated sediments originating from the historic New Almaden mining district. The mining activities causing these discharges date back to the late 1800s and early 1900s; the discharges persist as a legacy source in the Guadalupe River watershed. The land area around the New Almaden mines has been cleaned up and restored to beneficial use, and downstream remediation and stewardship is underway in the watershed.

However, a legacy of mercury contamination persists in the form of a north-south mercury concentration gradient in sediments. The average concentration of mercury in Bay sediments is 0.4 ppm, and the median concentration of mercury in suspended sediments is 0.3 ppm. This gradually increases to 0.5 - 0.8 ppm in the South Bay, and then sharply increases to 1 – 2 ppm in Alviso Slough, especially just after high-flow events (Tetra Tech Inc. 2005, 2006). Other contaminant concentrations also tend to be elevated relative to the San Francisco Bay mean, with most sample locations in the Lower South Bay exhibiting contaminant concentration in the 3rd or 4th quartiles (SFEI 2015).

Significance Thresholds

Hazards and hazardous materials impacts would be considered significant if the dredging, pipeline relocation, and/or sediment transport activities would cause or create:

- An increase in navigation incidents or other substantial navigational safety risks, including risks to recreational boats;
- A substantial hazard to the public or the environment through dredging or routine transport, use, or disposal of contaminated sediment or hazardous materials or wastes; or
- A substantial hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.

Environmental Consequences

Potential hazards to navigation were assessed by evaluating the available navigation area, intensity of vessel use, and ability to divert around potential obstacles. Potential hazards associated with hazardous materials present in the Project area and/or used as part of the Project were evaluated by assessing the likelihood of releases or other incidents associated with these hazardous materials. There would be the storage of small amounts of hazardous material in staging areas at RWC and possibly at the former Shell dock for the pipeline work at SBS. Because there would be little or no use or storage of hazardous materials on land, the analysis focused on potential hazardous materials incidents on the water. The potential for spreading contaminated sediment through spills and/or dredging practices was evaluated by considering the degree of contamination in the sediments and the measures in place to minimize or avoid spills. Potential risks to biota from contaminated sediment are addressed in ***Sections A.4 and A.5***.

A.8.1.6 Dredging Options

Potential hazards associated with the three dredging options are very similar. The primary difference is the duration of the dredging effort and therefore the duration for which the hazard could exist.

Impact HAZ-1: Increase in Navigation Incidents or Other Substantial Navigational Safety Risks

All equipment used to conduct the dredging and relocate the fuel pipelines would be highly visible and well-marked in accordance with USCG regulations. Any floating or submerged dredged material pipelines would also be marked, and any portions of submerged pipelines located in the channel would be laid in the bottom of the channel.

Navigation in RWC Channel is constrained by the deep draft channel. Dredging equipment and any associated pipelines would be present for a period of 6 months per year for up to 2 years. Although the equipment may restrict certain portions of the channel, it would be highly visible and well-marked. Best management practices for safe navigation would be implemented as

described in ***Section A-14***. These include notices to mariners, coordinating work with the Port and San Francisco Bar Pilots, and having the dredge operator remain in communication with VTS and monitor Channel 16.

The San Francisco Bar Pilots, who board all commercial vessels before they enter San Francisco Bay and would guide the vessel through SBS Channel and into RWC Harbor, would be aware of any notices to mariners and would coordinate with the dredge crew and VTS to ensure safe transit of the vessels under their control. Notification of the nearby marinas regarding the proposed work and schedule would ensure that recreational vessel users are also aware of the need for safe navigation around the dredge.

SBS Channel is less constrained. Many vessels other than commercial deep draft could safely navigate outside the channel to avoid the dredge, if necessary. Passages of vessels near the dredge would be coordinated and the dredge would be moved if necessary. The same would be true for equipment used to relocate the fuel pipelines.

Following construction, portions of the RWC Channel would be slightly narrower at the bottom than currently. The channel alignment and configuration would be verified through a ship simulation study performed during the design phase, and the changes to the channel are also being reviewed with the bar pilots. Operating guidelines for the channel would take into consideration any measures required to continue to operate safely in RWC Channel. Navigational safety in SBS Channel would not be affected, as the bottom of the channel would remain at its current width of 500 feet.

The pipeline relocation activities in SBS Channel could temporarily block a portion of the channel. The directional drilling process could be conducted entirely from outside the channel boundaries, and therefore would not pose any hazards to navigation within the channel. The dredged trench construction process would require up to three weeks of work in the channel; however, dredge movements would be coordinated with vessel transits as they would be for all of the dredging activities. The jetsled method of construction would require at a minimum 50-100 months to complete the work in the channel. However, work would occur only 10 hours per day, and the ship used to deploy the jetsled could relocate when the jetsled is not in service. Also, because the channel is 500 feet wide, vessels would be able to transit past the jetsled equipment when it is operating near the margins of the channel. This impact is less than significant.

Impact HAZ-2: Substantial Hazard to the Public or the Environment from Routine Use, Transport, or Disposal of Contaminated Sediment or Hazardous Materials

Small quantities of hazardous materials may be stored at the staging area, and may be used on the dredge for routine maintenance. As discussed in ***Section 4.2 of the Main Integrated Report***, dredges, tugs, scows and all other vessel would be operated in compliance with all applicable regulations related to the prevention of water pollution by fuel, harmful substances,

and garbage, as well as from accidental discharges. Therefore, the potential for the release of hazardous substances from vessel operations during dredging would be minimal.

The primary routine use of hazardous materials for the proposed project would be related to equipment fueling during construction. Diesel fuel would be used to fuel all or part of the construction equipment. As described in ***Section 4.2 of the Main Integrated Report***, all fueling operations would be subject to USCG, OSPR, and SLC requirements. If dredges are diesel-fueled they would typically be fueled at the dock; dredges are capable of holding up to 3 – 4 weeks of fuel. Alternatively if the dredge is too far from the dock to make returning to the dock economical, a licensed contractor may be used to deliver fuel to the dredge using a fuel scow. Pipeline construction equipment could also be fueled at the dock or via a fuel scow, subject to the same best management practices. All smaller vessels, including tugs and work boats would be fueled at the dock. An Oil Transfer Plan would be developed to address potential concerns with fueling operations and ensure that appropriate preventative measures and practices are in place. This would include clear assignment of roles and responsibilities during fuel transfer, as well as communication protocols during the fueling process.

Although some of the sediment is contaminated with anthropogenic compounds, and some of these compounds exceed the median San Francisco Bay concentrations of these constituents, none of the sediment to be dredged would be classified as a hazardous material, and current data suggest that the majority of the sediment would be suitable for unconfined aquatic disposal. The small portion of sediment that is potentially not suitable for unconfined aquatic disposal would be reused at an appropriate beneficial reuse site. After construction is completed, vessels would continue to transit SBS Channel and use the Port subject to the same restrictions and requirements as vessels currently engaged in transporting cargo to the Port. If necessary based on more refined testing to be completed during the design phase, implementation of WQ-M1, including an environmental bucket and/or silt curtains, would be used to minimize the spread of any sediment containing elevated levels of anthropogenic chemical constituents. No overflow would be allowed from any scow at the dredge site, and scows would be filled only to the acceptable capacity. The Project would be consistent with BMPs as discussed in ***Section 4.2 of the Main Integrated Report*** and DMMO permit requirements. With implementation of WQ-M1, this impact is less than significant.

Impact HAZ-3: Substantial Hazard to the Public or the Environment through Reasonably Foreseeable Accident or Upset Conditions Involving Hazardous Materials

As stated above, all vessels would be operated in compliance with all applicable regulations related to fueling and management of hazardous substances. During transport, the dredged material would be secured, with precautions in place to minimize any risk of spills. If dredges are diesel-fueled, best management practices would require development of a safety plan and a spill prevention and response plan. None of the sediment to be dredged would be classified as a hazardous material.

Relocation of the fuel pipelines would involve cutting into existing fuel pipelines. As described in ***Section 4.2 of the Main Integrated Report***, the pipelines would first be emptied and inerted (purged of explosive gases), if necessary. All work directly involving the existing fuel pipelines would be conducted with workers who have specialized safety and response training, and are familiar with the specialized requirements for working around fuel pipelines. Because the Shell pipeline is inactive or abandoned, it poses minimal risk of a hazardous materials release. Work on the Kinder-Morgan pipelines would be more challenging because the two pipelines are located only 5 feet apart, and at least one of the pipes would continue to be in active service while the other pipeline is being worked on. Incidents could occur if the active pipeline is accidentally damaged by the excavation and/or tie-in process.

The Fuel Pipeline Relocation and Response Plan to be developed for the construction phase would address specific training requirements, safety requirements, emergency response requirements, and any other specific requirements imposed by the pipeline owners to ensure that work around the pipes occurs in a safe manner and the environment is protected. There would be little risk of a hazardous materials incident if the directional drilling method is chosen as the preferred option for relocating the pipelines. The borehole would be at a sufficient depth to avoid any risks to the pipelines, and both Kinder-Morgan pipelines would remain in active service until the new pipeline segments are ready to be tied into the existing pipeline. The jet sled method of pipeline trench construction would pose less potential risk to nearby pipelines than the clamshell dredged trench construction process because only a water jet is used to remove soil, so there is little risk of damaging an existing pipeline. The dredged trench method would result in a greater potential hazard, as there is little room for error when working near the pipelines, and dredge buckets are relatively large and precise control of the dredge bucket's movement through the water can be challenging. Proper excavation techniques and specific safety requirements for trench excavation would be incorporated into the Fuel Pipeline Relocation and Response Plan, if necessary. The three pipeline relocation methods would be evaluated in more detail during the design phase, and the preferred method would be selected in part based on the potential hazards associated with that method.

The other activity that has the potential to result in an accidental hazardous materials release is tying in the new pipeline segments into the existing pipeline. This step would require cutting the existing pipeline, and if the existing pipelines have not be properly emptied and inerted, an accident could result. However, because the tie would occur either on a barge (above water) or within a dewatered area protected by a cofferdam, any potential spills could be readily contained and cleaned up and would not enter the aquatic environment. Implementation of the Fuel Pipeline Relocation and Response Plan would ensure that pipelines are properly prepared prior to cutting. This impact is less than significant.

A.8.1.7 Placement Sites

Cullinan Ranch Restoration Project

Impact HAZ-1: Increase in Navigation Incidents or Other Substantial Navigational Safety Risks

Use of the Cullinan site may require construction of an offloader and dredged sediment delivery pipeline. Construction of the offloading facilities, the presence of the offloading facilities, and the mooring of scows at the offloader could pose minor hazards to navigation in the vicinity of the construction activities and offloading facilities. The offloading facilities would be would be present for no more than ten years. Actual offloading activities would only occur for a total of approximately 58 months during the work window. As described in ***Section 4.2 of the Main Integrated Report***, a notice to mariners would be issued to make other boaters in the vicinity aware of the proposed work and location of the temporary pipeline and offloader. Any Project-related vessels or equipment would be equipped with the necessary lights. This impact is less than significant.

Impact HAZ-2: Substantial Hazard to the Public or the Environment from Routine Use, Transport, or Disposal of Contaminated Sediment or Hazardous Materials

Small quantities of hazardous materials may be used on the equipment used to construct the offloader and pipeline. These materials may also be used as part of routine maintenance during operation of the offloader. Any material used in an aquatic setting would be approved for use in that setting. Fueling of tugs would occur at a permitted location, and fuel for a diesel-powered offloader would be delivered by fuel scow, following the same requirements as fueling dredges over water. As discussed in ***Section 4.2 of the Main Integrated Report***, all hazardous materials used by the Project would be managed and transported in accordance with all applicable regulations, and fueling would occur in accordance with applicable laws and regulations. None of the sediment to be delivered to Cullinan would be classified as a hazardous material. This impact is less than significant.

Impact HAZ-3: Substantial Hazard to the Public or the Environment through Reasonably Foreseeable Accident or Upset Conditions Involving Hazardous Materials

Small spills of hazardous materials, as well as spills of diesel during fueling could occur if the materials are improperly handled or transferred. As described in ***Section 4.2 of the Main Integrated Report***, the contractor would be required to comply with all applicable laws and regulations regarding over-water fuel transfers and management of hazardous substances. This would include preparing a spill prevention and response plan, maintaining adequate spill response materials at the dredge and/or work site, and training all workers in proper spill response. This impact is less than significant.

Montezuma Wetlands Project

Impact HAZ-1: Increase in Navigation Incidents or Other Substantial Navigational Safety Risks

Mooring of scows at the offloader could pose a very minor hazard to navigation in the vicinity of the offloader. However, there is adequate room near the offloader for smaller vessels to pass any scows and tugs. This impact is less than significant.

Impact HAZ-2: Substantial Hazard to the Public or the Environment from Routine Use, Transport, or Disposal of Contaminated Sediment or Hazardous Materials

Small quantities of hazardous materials may be used on the tug and scows used to haul sediment to Montezuma. Any material used in an aquatic setting would be approved for use in that setting. As discussed in ***Section 4.2 of the Main Integrated Report***, all hazardous materials used by the Project would be managed and transported in accordance with all applicable regulations. None of the sediment to be delivered to Montezuma would be classified as a hazardous material. This impact is less than significant.

Impact HAZ-3: Substantial Hazard to the Public or the Environment through Reasonably Foreseeable Accident or Upset Conditions Involving Hazardous Materials

Small spills of hazardous materials could occur if the materials are improperly handled on the tug or scow delivering sediment to Montezuma. As described in ***Section 4.2 of the Main Integrated Report***, the contractor would be required to comply with all applicable laws and regulations regarding management of hazardous substances. This would include preparing a spill prevention and response plan, maintaining adequate spill response materials at the dredge and/or work site, and training all workers in proper spill response. This impact is less than significant.

SF-DODS

Impact HAZ-1: Increase in Navigation Incidents or Other Substantial Navigational Safety Risks

The presence of scows at, or in transit to SF-DODS would not pose a new or unusual hazard to navigation. The tugs would use established navigation lanes and be in contact with VTS, and would observe weather-related travel restrictions. There would be no impact.

Impact HAZ-2: Substantial Hazard to the Public or the Environment from Routine Use, Transport, or Disposal of Contaminated Sediment or Hazardous Materials

Small quantities of hazardous materials may be used on tugs and scows used to haul sediment to SF-DODS. All hazardous materials used by the Project would be managed and transported in accordance with all applicable regulations. None of the sediment to be delivered to SF-DODS would be classified as a hazardous material. This impact is less than significant.

Impact HAZ-3: Substantial Hazard to the Public or the Environment through Reasonably Foreseeable Accident or Upset Conditions Involving Hazardous Materials

Small spills of hazardous materials could occur if hazardous materials on the tug or scow are improperly handled. As described in ***Section 4.2 of the Main Integrated Report***, the contractor would be required to comply with all applicable laws and regulations regarding management of hazardous substances. This would include preparing a spill prevention and response plan,

maintaining adequate spill response materials at the dredge and/or work site, and training all workers in proper spill response. This impact is less than significant.

Eden Landing Restoration Project and Alviso Pond Complex

Impact HAZ-1: Increase in Navigation Incidents or Other Substantial Navigational Safety Risks

Use of the Eden Landing and Alviso sites may require construction of an offloader, and a dredged sediment delivery pipeline from the offloader or a cutterhead dredge to the sediment delivery location. Construction of the offloading facilities, the presence of the offloading facilities, and the mooring of scows at the offloader could pose minor hazards to navigation in the vicinity of the construction activities and offloading facilities. The offloading facilities would be temporary. As described in ***Section 4.2 of the Main Integrated Report***, a notice to mariners would be issued to make other boaters in the vicinity aware of the proposed work and location of the temporary pipeline and/or offloader. Any Project-related vessels or equipment would be equipped with the necessary lights. This impact is less than significant.

Impact HAZ-2: Substantial Hazard to the Public or the Environment from Routine Use, Transport, or Disposal of Contaminated Sediment or Hazardous Materials

Small quantities of hazardous materials may be used on the equipment used to construct the offloader and pipeline. These materials may also be used as part of routine maintenance during operation of the offloader. Any material used in an aquatic setting would be approved for use in that setting. Fuel for a diesel-powered offloader would be delivered by fuel scow, following the same requirements as fueling dredges over water. As discussed in ***Section 4.2 of the Main Integrated Report***, all hazardous materials used by the Project would be managed and transported in accordance with all applicable regulations, and fueling would occur in accordance with applicable laws and regulations. None of the sediment to be delivered to these placement sites would be classified as a hazardous material.

Construction of the pipeline to Alviso and Eden Landing my require small amounts of excavation near the levee, where the pipeline passes through mudflats and possibly thin bands of tidal marsh outboard of the levee. At Alviso, the local sediment may contain levels of mercury and other constituents at concentrations exceeding San Francisco Bay average ambient levels. Although these concentrations are elevated, they are well below the threshold for a hazardous waste (20 mg/kg mercury). This impact is less than significant.

Impact HAZ-3: Substantial Hazard to the Public or the Environment through Reasonably Foreseeable Accident or Upset Conditions Involving Hazardous Materials

Small spills of hazardous materials, as well as spills of diesel during fueling could occur if the materials are improperly handled or transferred. As described in ***Section 4.2 of the Main Integrated Report***, the contractor would be required to comply with all applicable laws and regulations regarding over-water fuel transfers and management of hazardous substances. This would include preparing a spill prevention and response plan, maintaining adequate spill

response materials at the dredge and/or work site, and training all workers in proper spill response. This impact is less than significant.

Mitigation Measures

There are no significant impacts from the Project associated with hazards and hazardous materials; no mitigation is required.

A.9 Land Use and Planning

Affected Environment

A.9.1.1 Redwood City Harbor Land Uses

Redwood City Harbor (RWC) Channel is located in the eastern part of Redwood City in San Mateo County, California. The adjoining land use in this region consists of primarily urban areas comprised of industrial, commercial, residential, recreational, open space, salt ponds, restored wetland, and Port-related areas. Almost half of Redwood City's jurisdictional (land) area is under water, in San Francisco Bay (City of Redwood City 2010a). RWC Channel is approximately 21,000 feet in length. Land uses immediately adjacent to the channel area include open space, marinas, commercial, industrial, wetlands and the Port. These areas are described below.

Land Use North and Northwest of RWC Channel

Bair Island is located to the north and northwest of the channel. It is composed of three islands totaling approximately 3,000 acres that were a complex of former salt ponds. Large portions of Bair Island have been restored to tidal salt marshes. Approximately 1,985 acres are part of the Bair Island Ecological Reserve owned by CDFW and the remainder of the island is part of the USFWS Don Edwards NWR (CDFW 2015a). The part of Bair Island that borders the RWC Channel is within the USFWS Don Edwards National Wildlife Refuge and runs parallel to RWC Channel along the north and northwest.

South and Southwest End of Channel

The land uses located at the south and southwest end of RWC Channel are primarily industrial and commercial. The facilities in the area include the Port, offices, commercial space, heavy industrial facilities, marinas, UP railroad tracks, Seaport Boulevard, parking lots, public access, and vacant lots. The Port of Redwood City is approximately 108 acres. The Port area includes five wharves, two marinas, offices and other commercial space, the Seaport Conference Center, restaurants, and industrial/recycling (i.e. Cemex Cement, Cemex Aggregates, PABCO Gypsum, Sims Metal Management, etc.) facilities. East and south of the Port is the Redwood City Saltworks complex owned by Cargill, Inc., an approximately 1,400-acre salt pond area still considered to be in active use.

Southeast End of Redwood Channel

The southeast portion of RWC Channel is adjacent Greco Island, part of the Don Edwards San Francisco Bay NWR. Greco Island is an approximately 817-acre restored island marsh.

San Bruno Shoal Channel

San Bruno Shoal (SBS) Channel is located in San Francisco Bay, approximately 0.75 mile east of the City of San Bruno shoreline in San Mateo County and approximately 2 miles south of the City of San Francisco. The SBS Channel is approximately 30,000 feet in length and is part of and surrounded by San Francisco Bay. There are no land uses within the Project Area for SBS Channel.

Placement Sites

The dredged material placement sites consist of four beneficial reuse sites and SF-DODS. The Placement sites include Cullinan Ranch Tidal Restoration Project, Montezuma Wetlands Restoration Project, Alviso ponds (Ponds A1 and A2W; A5, A7, A8, and A8S; and Ponds A9 through A15), and Eden Landing ponds (Ponds E1 and E2, E4 and E7; Ponds E5, E6, and E6C; and Ponds E1C, E2C, E4C, and E5C). The land uses for each of these sites are described below.

Cullinan Ranch Tidal Restoration Project

Cullinan is located in Solano County and is an approximately 1,575-acre wetland restoration project. Approximately 290 acres of Cullinan were diked off to receive dredged sediment to create an elevation suitable for mid-marsh establishment. The area affected by the RWC Project only includes the two potential offloader sites, the pipeline alignments along Dutchman Slough leading from the offloader sites to the delivery point, and a small portion of the levee where the sediment delivery pipeline would enter the site and delivery of sediment from the pipeline would occur (***Figure 1-1***). The only land uses immediately adjacent to the offloader and the levee are restored wetlands, open water, and tidal channels.

Montezuma Wetlands Restoration Project

Montezuma is located in Solano County and is an approximately 2,000-acre wetland restoration project. The area affected by the RWC Project only consists of the offloader location (***Figure A-8***). The only land uses adjacent to the offloader are restored wetland, outboard marsh, and open water.



Figure A-8. Study Area including SF-DODS

SF-DODS

SF-DODS is approximately 50 miles west of the Golden Gate and is managed by USEPA Region IX. There are no adjacent land uses except open ocean water.

Alviso Pond Complex

The Alviso Pond Complex consists of multiple historic salt and other ponds in the South Bay Area within Santa Clara County. The Alviso Pond Complex is part of the SBSP Restoration Project. The RWC dredged sediment could be delivered to the Bay side of levees bordering the Alviso Pond Complex at several potential locations and distributed by the SBSP Restoration Project for further delivery of the sediments into the appropriate pond(s). These levee locations border the following ponds:

- Ponds A2W for delivery to Ponds A1 and A2W (Mountain View Ponds); and
- Pond A9 for delivery to Ponds A5, A7, A8 and A8S; and Ponds A9 through A15.

The surrounding land uses for all the ponds are salt ponds or wetland, tidal channels, and open water.

Eden Landing Ecological Reserve

Eden Landing Ecological Reserve is an approximately 5,500-acre area in the South Bay Area in the City of Hayward (ACFCWCD 2015). This area is part of the SBSP Restoration Project. The RWC dredged sediment would be delivered to a levee located on the Bay side of Eden Landing near Pond E2 and distributed by the SBSP Restoration Project into the appropriate pond(s). The surrounding land uses are wetland, tidal channels, and open water.

Significance Thresholds

The effects of the Project or alternative on land uses are considered to be significant if the proposed Project or alternatives would result in any of the following land use impacts (Impact LU) that would:

1. Result in a conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project (including, but not limited to a general plan, specific plan, local coastal program, or zoning ordinance);
2. Introduce land uses or activities incompatible with existing or adjacent land uses;
3. Physically divide existing communities; or
4. Conflict with any applicable habitat conservation plan or natural community conservation plan.

Environmental Consequences

Impacts to land use were assessed by determining whether the project activities would 1) alter an existing land use, 2) comparing any changes in land use with allowable land uses at the site, and with adjacent land uses, and 3) evaluating whether construction activities would be incompatible with adjacent land uses.

Dredging Options

Potential land use impacts associated with all three dredging options are similar; therefore the three dredging options are discussed together.

Impact LU-1: Conflict with Applicable Land Use Plan, Policy, or Regulation of an Agency with Jurisdiction over the Project

Dredging in RWC Channel would be consistent with local land use plans. Dredging in RWC and SBS Channels and pipeline installation activities at SBS Channel are not expected to have any significant long-term impacts to land uses. Temporary staging areas to support the dredging activities during construction would be within existing Port industrial areas or other industrial areas (e.g., near San Francisco Airport, if needed for the pipeline work). This impact is less than significant.

Impact LU-2: Introduction of Land Uses or Activities Incompatible with Existing or Adjacent Land Uses

As stated above, staging areas to support the dredging activities would be temporary and within existing Port or other industrial areas. There would be no other construction on land adjacent to the RWC Channel, or associated with dredging work or pipeline installation at SBS Channel. This impact is less than significant.

Impact LU-3: Physical Division of Existing Communities

Staging areas to support the dredging during the project would be temporary and within existing Port or other industrial areas. The project would not divide existing communities. There is no impact from the Project.

Impact LU-4: Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plan

There is no habitat conservation plan or natural community conservation plan for the City of Redwood City. The City of Brisbane does not have a habitat conservation plan or natural community conservation plan for this area. There is no impact from the project.

Placement Sites

Cullinan Ranch Tidal Restoration Project

Impact LU-1: Conflict with Applicable Land Use Plan, Policy, or Regulation of an Agency with Jurisdiction over the Project

Potential activities associated with use of the Cullinan site include construction of an offloader and up to 1 mile of floating pipeline, and offloading of scows at the offloader. Off-loading at

the Cullinan site could occur for up to a total of 19 months if the entire 3 MCY capacity of the site is used by the RWC Project. Construction of the offloader and pipeline could require up to up to three months. The Project is consistent with the local land use plans to protect and restore wetlands at Cullinan Ranch. Regulatory agencies permits and a lease from the State Lands Commission (SLC) have been obtained for a past sediment reuse project in 2014. These documents specify the requirements for construction and operation of the offloader and the RWC Project would have similar permits and would comply with all permit requirements. This impact is less than significant.

Impact LU-2: Introduction of Land Uses or Activities Incompatible with Existing or Adjacent Land Uses

The construction activity adjacent to and on the Cullinan site would be temporary. Construction and operation of the offloader and related piping would be in and adjacent to Dutchman Slough and piping would also be constructed on the outboard levee at Cullinan or Napa Sonoma Marsh Wildlife Area Pond 3. The adjacent land uses are wetlands and are designated as Marsh in the Land Use Element of the Solano County General Plan. The Project would not conflict with adjacent land uses and over the long term would support the restoration of the Cullinan to tidal marsh. This impact is less than significant.

Impact LU-3: Physical Division of Existing Communities

The construction and operation of the offloader would occur adjacent to Dutchman Slough, and pipeline would be in Dutchman Slough. There is no impact from the Project.

Impact LU-4: Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plan

There is a Solano Habitat Conservation Plan (HCP) for parts of Solano and Yolo counties. This plan covers the portion of Cullinan Ranch Tidal Restoration Project within Solano County. The site is owned and managed by USFWS and therefore the habitat is protected. The placement of dredged material within Cullinan is a beneficial reuse of the dredged sediment to restore the wetlands. This work is consistent with the HCP. There is no impact from the Project.

Montezuma Wetland Restoration Project

Impact LU-1: Conflict with Applicable Land Use Plan, Policy, or Regulation of an Agency with Jurisdiction over the Project

Potential activities associated with use of the Montezuma site consist of offloading sediment from the scows at the dedicated offloader (all potential impacts associated with operation of the offloader and placement and management of the sediment are addressed by the Montezuma project). Off-loading at the Montezuma placement site could occur for up to a total of approximately 58 months (spread over 10 dredging windows) if 7.7 MCY of

Montezuma's capacity is used by the RWC Project. The Project is consistent with the local land use plans and the Marsh land use designation with a Resource Conservation Overlay in the Solano County General Plan. The impact is less than significant.

Impact LU-2: Introduction of Land Uses or Activities Incompatible with Existing or Adjacent Land Uses

The RWC Project would not introduce activities incompatible with existing or adjacent land uses. The adjacent land uses are wetlands and are designated as Marsh or Water body and courses in the Land Use Element of the General Plan. The offloading of dredge sediment from this project would comply with all existing permits. The Project would not conflict with adjacent land uses and over the long term would support the restoration of the Montezuma project. There is no impact from the Project.

Impact LU-3: Physical Division of Existing Communities

The delivery of the sediment to the offloader would be in eastern Suisun Bay. There is no impact from the Project.

Impact LU-4: Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plan

The Solano County HCP includes Montezuma. The placement of dredged material at the Montezuma site is a beneficial reuse of the dredged sediment to restore the wetland. This work is consistent with the HCP. There is no impact from the Project.

SF-DODS

Impact LU-1: Conflict with Applicable Land Use Plan, Policy, or Regulation of an Agency with Jurisdiction over the Project

The potential activity associated with the use of the SF-DODS is bottom dumping of dredged material at the site. The site is located approximately 50 miles west of the Golden Gate Bridge. Use of this site for dredge material placement is consistent with all permits and plans. There is no impact from the Project.

Impact LU-2: Introduction of Land Uses or Activities Incompatible with Existing or Adjacent Land Uses

The site is located approximately 50 miles offshore and there are no activities incompatible with existing or adjacent land uses. There is no impact from the Project.

Impact LU-3: Physical Division of Existing Communities

There are no communities near SF-DODS and therefore there is no impact from the Project.

Impact LU-4: Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plan

There is no applicable habitat conservation plan or natural community conservation plan for SF-DODS and therefore there is no impact from the Project.

Alviso Ponds

Impact LU-1: Conflict with Applicable Land Use Plan, Policy, or Regulation of an Agency with Jurisdiction over the Project

Potential activities associated with use of the Alviso placement site would include construction of an offloader and 4 - 6 miles of floating or submerged pipeline, and offloading of scows at the offloader. Dredged sediment delivery to Alviso could occur for up to a total of 24 months (spread over 4 years) if all sediment generated under Dredge Option C is delivered to this placement site. Sediment delivery to the Pond A9 levee would require a floating or submerged pipeline in Alviso Slough.

Both Santa Clara County's and the City of San Jose's land use policies promote the protection and restoration of the wetlands. The construction and operation of the offloader and pipeline would be consistent with these land use policies. The Alviso restoration work would be analyzed as part of the South Bay Restoration Project and the enhancement of the habitat through beneficial reuse of dredge sediment is consistent with the SBSP Restoration plans. The construction of the offloader would require permits and approvals from regulatory agencies and SLC as described for the Eden Landing ponds and the RWC Project would comply with all requirements contained in these approvals and permits. This is impact is less than significant.

Impact LU-2: Introduction of Land Uses or Activities Incompatible with Existing or Adjacent Land Uses

The Project would not introduce activities incompatible with existing or adjacent land uses. The site is surrounded by salt ponds and marsh owned by USFWS. The offloading of dredge sediment from this Project would comply with all existing permits. The Project would not conflict with adjacent land uses and over the long term would support the restoration of the Alviso wetlands. There is no impact from the Project.

Impact LU-3: Physical Division of Existing Communities

The offloader and pipelines would be located in San Francisco Bay. There is no impact from the Project.

Impact LU-4: Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plan

Although Santa Clara County has a Habitat Conservation Plan, it does not apply to the baylands including the Alviso site. There is no impact from the Project.

Eden Landing Ponds

Impact LU-1: Conflict with Applicable Land Use Plan, Policy, or Regulation of an Agency with Jurisdiction over the Project

Potential activities associated with use of the Eden Landing placement site would include three options for transport of the dredged sediment to this placement site. One option would require the construction of an offloader and approximately 3.5 miles of floating or submerged pipeline, and offloading of scows at the offloader. Offloading at Eden Landing could occur for up to a total of up to 24 months (spread over 4 years) if all sediment generated under Dredge Option C is delivered to this placement site. Construction of the offloader and pipeline would require approximately three months.

The second option would involve the use of a cutterhead dredge at RWC and SBS Channels that would pump sediment directly from the dredging location to the sediment delivery location at the top of the levee on Pond E2.

The third option would be a combination of Options 1 and 2. The contractor may determine that it is most cost-effective to mobilize a clamshell for portions of the work, and a cutterhead for the other portion.

Both the County's and the City's land use policies promote the protection and restoration of the wetlands. The construction and operation of the offloader and pipeline or pipeline from the hydraulic cutterhead dredge would be consistent with these land use policies. The Eden Landing Ponds restoration work would be analyzed as part of the South Bay Restoration Project and the enhancement of the habitat through beneficial reuse of dredge sediment is consistent with the SBSP Restoration plans. The construction of the offloader and pipelines would require permits and approvals from regulatory agencies (including BCDC, RWQCB, CDFW, USFWS, and NOAA-Fisheries) and approval from the SLC and the RWC Project would comply with all requirements contained in the permits and approvals. This is impact is less than significant.

Impact LU-2: Introduction of Land Uses or Activities Incompatible with Existing or Adjacent Land Uses

The Project would not introduce activities incompatible with existing or adjacent land uses. The site is surrounded by salt ponds and marsh owned by CDFW. The offloading of dredged sediment from this Project would comply with all applicable permits and approvals. The Project would not conflict with adjacent land uses and over the long term would support the restoration of the Eden Landing wetlands. There is no impact from the Project.

Impact LU-3: Physical Division of Existing Communities

The offloader and pipelines would be located in San Francisco Bay. There is no impact from the Project.

Impact LU-4: Conflict with Applicable Habitat Conservation Plan or Natural Community Conservation Plan

There is no applicable habitat conservation plan or natural community conservation plan for the Eden Landing ponds. There is no impact from the Project.

Mitigation Measures

There are no significant impacts to land uses due to the dredging or placement options; no mitigation is required.

A.10 Noise and Vibration

This chapter discusses noise and its relevance to the study areas. It describes existing noise conditions and noise regulations applicable to the study areas, and evaluates potential effects on noise-sensitive uses. Noise sensitive uses (noise sensitive receptors) include uses such as residential areas, hospitals, schools, and child-care centers. Effects of noise on nearby wildlife populations are addressed in Biological Resource ***Sections A.4 and A.5*** on Fish and Aquatic Resources and Terrestrial Resources, respectively; however, the calculations supporting the impact assessment for noise effects on wildlife are presented in this section.

The traditional definition of noise is "unwanted or disturbing sound." Sound becomes unwanted when it either interferes with normal activities such as sleeping and conversation, or disrupts or diminishes one's quality of life. Persistent and escalating sources of sound also have the potential to affect one's health. Problems related to noise include stress-related illnesses, high blood pressure, speech interference, hearing loss, sleep disruption, and lost productivity (USEPA 2012).

The decibel (dB) is a unit used to express the intensity of a sound wave, and is used to measure noise levels and set noise regulations. The unit of measurement is generally adjusted to the A scale (dBA) to better approximate the human ear's range of sensitivity to sounds of different frequencies (USACE 2009). A noise level of 0 dBA is considered the threshold of human hearing, and a noise level of 140 dBA is considered the threshold of pain. ***Table A-11*** shows noise levels for a range of activities.

Table A-11. Sound Levels and Relative Loudness of Typical Noises in Indoor and Outdoor Environments

Activity (Distance from Noise Source)	Sound Level (dBA)	Subjective Impression	Relative Loudness
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-hp siren (100 feet)	130		32 times as loud
Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Riveting machine	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)	90		2 times as loud
Garbage disposal or food blender (50 feet)	80	Moderately loud	Reference loudness
Vacuum cleaner (10 feet) or passenger car at 65 mph (25 feet)	70		1/2 as loud
Large store air-conditioning unit (20 feet)	60		1/4 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Bedroom/living room or bird calls	40		1/16 as loud
Library, soft whisper (15 feet)	30	Very quiet	
Broadcasting studio	20		
	10	Just audible	
	0	Threshold of hearing	

There are several methods by which noise levels are expressed. One method, called the Equivalent Sound Level (Leq), is the average acoustic energy content of a noise over a given period of time. The Leq of a time period with varying noise levels and that of a steady noise are the same if they deliver the same acoustic energy to the ear during the period of exposure. Another noise measurement is the "Day-Night Average Sound Level" (Ldn). Ldn is the time average of noise levels for a 24-hour period with 10 dB added to noises occurring between 10:00 p.m. and 7:00 am (night-time "penalty"). This adjustment accounts for the increased sensitivity of people to nighttime noise. The "Community Noise Equivalent Level" (CNEL) is similar to the Ldn, except the CNEL also adds 5 dB to evening noise levels (7:00 p.m. to 10:00 p.m.). Ldn and CNEL noise measurement values are generally similar (USACE 2009).

Vibration

Vibration is another potential noise-related impact and is defined as the following.

> "Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal. The PPV is most frequently used to describe vibration impacts to buildings. The root mean square (RMS) amplitude is most frequently used to describe the effect of vibration on the human body. The RMS amplitude is defined as the average of the squared amplitude of the signal. Decibel notation (VdB) is commonly used to measure RMS. The decibel notation acts to compress the range of numbers required to describe vibration (Port of Redwood City 2010)."

Groundborne vibrations can be caused by natural phenomena—such as earthquakes, landslides, and sea waves—or by humans, in the case of machinery, traffic, explosions, trains, and construction equipment. Construction vibrations can be transient, random, or continuous. Transient construction vibrations are generated by blasting, pile-driving, and wrecking balls. Continuous vibrations result from vibratory pile-drivers, large pumps, horizontal directional drilling, and compressors (USFWS AND CDFW 2007).

Although pile driving, directional drilling, and use of large pumps are all activities associated with this Project, they will primarily occur in-Bay and are not expected to cause on-land vibration impacts. Booster pumps potentially located on levees are far from most land-based receptors are not expected to cause vibration impacts. Impacts to sensitive wildlife receptors from underwater noise generated by pile driving are of special concern. Underwater noise impacts from pile driving are assessed using noise thresholds set by resource agencies. Potential vibration impacts are inherent in this particular assessment. Vibration effects to structures and human receptors are not a concern for this Project and are not analyzed further.

Affected Environment

The following sections discuss existing noise conditions at locations within and adjacent to the study areas. The noise environment for the dredging and placement sites varies considerably, with the placement sites generally being located in quieter, more noise-sensitive natural areas. Noise regulations and standards promulgated by all applicable jurisdictions have been reviewed. These include Alameda County, San Mateo County, Santa Clara County, and Solano County, as well as the Cities of Brisbane, Hayward, Redwood City, San Jose, South San Francisco, and Mountain View. The Project is composed of a construction phase involving the two channel locations and the five placement sites, and an operational phase that would primarily affect the two channel locations. The regulatory setting information provided in the following section focuses on construction activities, and allowable operational noise levels at the two channel locations.

A.10.1.1 Dredging Sites

Redwood City Harbor Channel

RWC Channel is an industrial area. It is bounded to the southeast by the Port of Redwood City's and related industrial facilities, as well as Greco Island. While the industrial areas are not considered to be noise sensitive, Greco Island is a sensitive natural (wetland) area. To the northwest is Bair Island, which is also a sensitive wetland area. Recreational, residential, and industrial uses are present to the southwest of the proposed dredging area within and around the marinas. Some data are available regarding the background noise levels at the Port of Redwood City and nearby marinas west of the Port and are described below. The Redwood City General Plan provides ambient noise data from the "undeveloped lands" surrounding the Redwood Creek area, which this analysis assumes to be equivalent or comparable to Bair and Greco Islands.

The main contributors to the noise environment surrounding the RWC Channel are existing Port activities and vehicles traveling on Seaport Boulevard, the main street used to access the Port and nearby facilities. Seaport Boulevard lies less than half a mile inland from the channel's edge. Long-term noise measurements were taken for the Redwood City General Plan Noise and Vibration Background Report at the parking lot of the Seaport Center on July 16, 2008 through July 18, 2008. According to these measurements, the CNEL at this location was approximately 62 dBA. The primary noise source identified at the Seaport Center was noise from Seaport Boulevard (City of Redwood City 2008). Since noise travels over water, the reported noise level is assumed to be representative of the ambient noise level along the RWC Channel adjacent to the Seaport Center.

An Existing Noise Contours map contained in the 2010 Redwood City General Plan (ESA 2010) shows an average noise level of less than 55 dBA on the undeveloped land surrounding the RWC Channel study area. Intermittent noise would also be expected from ship traffic and aircraft en route to nearby San Francisco International Airport, which is located approximately 17 miles northwest of the Port along the shoreline. San Francisco Airport's Fly Quiet Program seeks to reduce noise impacts to nearby communities by preferring incoming and outgoing flights to approach and depart over water, when possible (SFO 2015).

The nearest residential receptors include residents that inhabit houseboats in the marinas at Redwood Landing and Docktown. The nearest of these receptors would be residents at Redwood Landing, approximately 0.5 miles south of the project site. Additionally, there is a mobile home community located approximately 1.5 miles southeast of the Port. Other residential areas near the project site include the downtown (about 2.2 miles southwest of the Port), and nearby neighborhoods of Middlefield, Ampex, and Friendly Acres (Port of Redwood City 2010). Kaiser Permanente Redwood City Medical Center is located approximately 2 miles southeast of the Port and the surrounding industrial areas. The highly trafficked Highway 101

lies between the proposed dredging location and the medical center and residential areas of downtown, Middlefield, Ampex and Friendly Acres.

San Bruno Shoal Channel

SBS Channel is located in deep water in South San Francisco Bay, within several miles of San Francisco International Airport to the west, and Metropolitan Oakland International Airport to the east. Other noise sources in the area consist of the full array of vessel traffic commonly found in San Francisco Bay.

Potential receptors include recreational users on the Bay and perhaps at the Tony Lema Golf Course, Oyster Bay Regional Shoreline, Marina Park, and the Hayward Regional Shoreline, several miles away along the East Bay shoreline. These recreation sites are all south of Oakland Airport and several miles east of the proposed dredging areas. Part of the Tony Lema Golf Course lies within the 65 dB noise contour for Oakland Airport (HMMH 2014). Some recreational use also exists on the western shoreline; the closest are Coyote Point Recreation Area and Poplar Creek Golf Course, both of which lie adjacent to and between Highway 101 and the Bay. Proposed dredging would occur several miles (roughly 3 miles at nearest point) east of these recreation areas.

SBS Channel lies within the jurisdiction of the City of South San Francisco, among others. The South San Francisco General Plan establishes average noise levels and projects how those would change by 2010. Due to the proximity to San Francisco International Airport (SFO), much of the noise discussion focuses on aircraft noise. With no change in SFO's runway configuration, aircraft noise contours were projected to shift gradually eastward by 2010. As a result, areas east of the current flight path were expected to experience an increase in average noise levels. At the same time, the 70 dB CNEL contour was expected to shrink, no longer impacting South San Francisco (City of South San Francisco 2015). However, the Fly Quiet Program at SFO has since sought to maximize over-water approaches and takeoffs in order to minimize noise to nearby communities. No noise contours for over bay areas were located, but this approach has likely shifted some of the higher noise levels in excess of 65 dB to the vicinity of the SBS area.

A.10.1.2 Placement Sites

Cullinan Ranch Tidal Restoration Site

The Cullinan Ranch Tidal Restoration Site is located immediately adjacent to State Highway 37. The southern offloader location is within 200 feet of the Highway 37 Mare Island Bridge over the Napa River; the northern offloader location is approximately 750 feet north of the Mare Island Bridge. The northern offloader is located approximately 500 feet east of the outboard marsh at the NSMWA's Pond 3 (restored to tidal action in 2006). The dredged sediment delivery location on the north Cullinan levee is within 2,000 feet of Highway 37, and approximately 300 feet south of Pond 3. Dutchman Slough and Pond 3 would be considered

noise sensitive locations. The southern offloader is less than 100 feet from low quality habitat that was formerly used as an informal construction and storage site. This habitat is the same distance from Highway 37 as the southern offloader and can be expected to have the same ambient noise levels as the southern offloader site. Although no noise monitoring data are available for Cullinan, noise from Highway 37 carries across the open expanse between the highway and the north side of Cullinan including the area around the sediment delivery location. Highway traffic noise levels typically range from 70 to 80 dBA at a distance of 50 ft. from the highway (USDOT 2003).

Montezuma Wetlands Restoration Project

The Project would deliver sediment to the Montezuma offloader; the Montezuma Wetlands Restoration Site is responsible for all environmental impacts associated with off-loading, placing, and managing the dredged sediment. The offloader is located approximately 100 feet off-shore of the southeastern levee of the Montezuma site, approximately 0.5 mile east of the mouth of Montezuma Slough and 0.2 mile north of Chain Island. The hamlet of Collinsville, which contains several residences, is located approximately 1,900 feet east of the offloader location. Recreational boaters are likely to pass by this site, and the DWR Collinsville Day-Use area is about 2 miles northwest of the offloader location.

SF-DODS

SF-DODS is located in the Pacific Ocean just west of the continental shelf. Some ship traffic is likely in the area; however, the predominant sounds are of natural origin.

Alviso Pond Complex

The Alviso ponds are located on the south shore of San Francisco Bay, bayward of the Cities of Fremont, San Jose, Sunnyvale, and unincorporated Santa Clara County. The two potential dredged sediment delivery locations are adjacent to other ponds within the Alviso Pond Complex. Pond A9 is surrounded by open water and other ponds. The most likely delivery location at Pond A9 is approximately 3 miles north of the closest residential area and 2.5 miles north of the closest industrial area. Recreational uses, including a golf-course, trails, and local parks are adjacent to Ponds A1 and A2W, and a trail runs around the perimeter of Pond A9.Intermittent noises can be heard in the vicinity of recreational facilities.

The primary local noise sources in the area include transportation systems and airports. US 101 and State Route 237 are to the south of the pond complex, and generate vehicular traffic noise. According to the City of Mountain View General Plan, 1990 noise levels on US 101 and SR 237 ranged from 72 to 76 dB (Ldn) and 65 to 74 dB (Ldn), respectively. These noise levels were expected to be similar in 2015 (City of Mountain View 2012).

Airport operations, including flights to and from the Palo Alto Municipal Airport (less than 1.5 miles west of the pond complex) and the Moffett Federal Airfield (immediately south of Pond

AB2) also contribute to local noise levels at the pond complex (USFWS and CDFW 2007). A 2010 Environmental Noise Assessment report (Illingworth & Rodkin, Inc. 2010) produced for the Envision San Jose 2040 General Plan found that in the area of the city closest to the study area (named Alviso Planning Area in the report), the main sources of noise include State Route 237 and Interstate 880, train operations along the Union Pacific Railroad, and aircraft.

A noise measurement conducted along State Route 237 determined the Day-Night Average noise level to be 74 dBA DNL, which is consistent with the noise levels reported by the City of Mountain View. Other significant noise-generating roadways include North First Street, Gold Street, Los Esteros Road, and Zanker Road. Currently, there are no major noise sources within the pond complex, with the exception of the railroad that crosses the pond complex east of A12, A13, and A15 (USFWS and CDFW 2007). The rail line is approximately 2.5 miles east of the proposed sediment delivery location.

The only sensitive receptor within the Alviso pond complex are trail users at Pond A9, and wildlife that may be present in the strip marshes in the vicinity of the dredged sediment delivery locations at Ponds A2W and A9. Most of the Alviso ponds are surrounded by commercial and industrial uses, the Bay, and active Cargill, Inc. (Cargill) ponds. The nearest residential receptors are to the west of Highway 101 (more than 1.5 miles from the proposed sediment delivery location at Pond A2W), and in the community of Alviso, 3 miles southeast of the proposed sediment delivery location at Pond A9. Most of the residents of Alviso are separated from the Alviso pond complex by railroad tracks near the western edge of the town.

For the purposes of the RWC Project, the Alviso pond complex placement site also includes the offloader location serving the Alviso ponds, and the intermediate booster pump location required if sediment is delivered to Pond A9. The offloader would be located between Highway 84 and the railroad to the south of the highway; this is a high-noise location. The closest sensitive receptors to the offloader location are habitat areas (wildlife receptors) approximately 0.3 – 0.5 miles to the east and southeast in the SFBNWR, and approximately 0.6 miles to west-southwest at Pond SF-2. Pond SF-2 is immediately adjacent to Highway 84, and the SFBNWR areas to the southeast are located between Highway 84 and the railroad, and immediately south of the railroad. The closest residential receptors are in East Palo Alto, approximately 1.7 miles to the southwest, and the closest recreational receptors would be at the Bay Trail location 1.5 miles to the southwest of the offloader location. The potential intermediate booster pump location for the Pond A9 dredged sediment delivery location is farther away from all sensitive receptors than the offloader and Pond A9 sediment delivery location, and therefore the impact assessment does not address this location separately.

Eden Landing Ponds

The Eden Landing ponds are located along the east shore of South San Francisco Bay, between Alameda Creek (Alameda Flood Control Channel) and Old Alameda Creek. The Eden Landing pond complex is in the City of Hayward, in Alameda County. The City of Union City is to the east

and the City of Fremont abuts the pond complex to the south. The ponds are surrounded by other wetlands, including managed ponds and tidal marsh to the north, east, and south. Residential areas are located approximately 3 miles east of the Pond E2 exterior embankment (i.e., the sediment off-loading location). The offloader that may be installed to pump sediment into this site is anticipated to be located approximately 3.5 miles west (off-shore) from the Pond E2 levee (in deeper water).

Recreational use (Bay Trail spur) occurs to the south of Pond E2 on the trails along the ACFCC, and hunting is permitted off-shore in navigable waters in season. With the exception of the trails along the ACFCC, the southern portion of Eden Landing ponds are closed to the public. Other recreational uses occur in the northern portion of the ELER, which would not receive sediment from of the Project. Intermittent noises can be heard in the vicinity of the recreational areas (USFWS and CDFW, et al. 2007).

Noise levels in this area are primarily influenced by vehicular traffic on SR 92 (approximately 3 miles north of the proposed sediment delivery location), and I-880, approximately 3 miles to the east of the E2 outboard levee. The Hayward General Plan identifies noise contours for major roadways within its jurisdiction. Noise levels within 50 feet (15 meters [m]) of SR 92 range from 75 to 79 Ldn (USFWS and CDFW 2007). Other local noise sources are associated with passing trains and airplanes flying overhead. The Union Pacific Railroad is located about 3.5 miles east of the sediment delivery location. The Hayward Executive Airport is located approximately 6 miles to the north of the proposed sediment delivery location. Currently, no major noise sources occur within the Eden Landing pond complex since salt production operations ceased when CDFW acquired the property.

According to the South Bay Salt Pond Restoration Project environmental analysis, open space and commercial and industrial uses surround the pond complex to the north, east and south, and San Francisco Bay is to the west. The nearest sensitive receptors are residences within the Eden Shores development (off Eden Shores Drive in the City of Hayward) approximately 300 feet north of Pond E6A, and 3 miles east of the proposed sediment delivery location. Residences are also located approximately 1,000 feet east of Pond E4C (off Carmel Way in Union City) (USFWS and CDFW 2007); these residences are located approximately 3.2 miles east of the proposed sediment delivery location.

Residential areas are also located approximately 2.5 miles to the west of the offloader locations. Sensitive wildlife may be present in the marsh areas located approximately 0.5 miles to the north and 0.6 miles to the south of the proposed dredged sediment delivery location.

Significance Thresholds

The effects of a project or alternative on noise are considered to be significant if the proposed Project or alternatives would:

1. Increase existing noise levels at sensitive receptor locations by more than 5 dBA, or

2. Expose sensitive receptors or other identified land uses to noise levels in excess of regulatory thresholds

Environmental Consequences

This section addresses potential effects to sensitive human receptors. Potential noise effects to wildlife species are primarily addressed in Biological Resources ***Sections A.4 and A.5***, Biological Resources. Calculations of the predicted noise levels for wildlife receptors are included in tables A-13, A-14, A-15, and A-16 below for completeness. Potential noise effects were evaluated by comparing calculated noise levels at the receptor location with existing (ambient) and permissible noise levels.

Dredging Options

Impact N-1: Noise Level Increase of More than 5 dBA at Sensitive Receptor Locations

Construction Phase Noise for Dredging

Potential noise effects from the three dredging options would be similar for all three options; the primary difference would be the duration of the construction activities. Consequently, all three dredging options are addressed as a group. Dredging could potentially occur a maximum of 24 hours a day, 7 days a week during the 180-day dredging window (June 1 through November 30). While noise can be generated from a variety of equipment used for dredging, the primary sources of equipment noise would include the dredge (with its associated pumps and generators) and tugboats, which would be used to position the dredges and scows. Other equipment, such as the work skiffs (crew boat) and tender tug, would be used for the dredge at the dredge site and would not contribute substantially to the noise associated with dredging activities.

Assuming dredging occurs using a clamshell, up to four pieces of equipment could be active simultaneously: the dredge, a tug boat attending a scow, a work skiff (crew boat), and a tender tug for the clamshell. The expected noise level at 50 feet if these four pieces of equipment are working simultaneously is captured in the clamshell dredge noise estimate that is presented in ***Table A-12***. The data presented show the expected noise levels at the nearest sensitive receptor location when dredging activities are closest to the sensitive receptor location. If a hydraulic cutterhead dredge is used, supporting equipment would include a booster pump(s) located at the dredge, a derrick barge, a work skiff, and two tender tugs. The noise expected from these pieces of equipment are combined into one noise measurement for the cutterhead dredge, also shown in ***Table A-12***. ***Table A-13*** provides a comparison of the predicted noise levels compared to ambient levels. As shown in Table A-13, the highest predicted noise level at the closest sensitive receptor is below 55dBA (cutterhead dredge plant), which is below the ambient levels at the nearest residential and sensitive habitat areas. Motorized boat users are not considered sensitive receptors. Non-motorized boat users may temporarily avoid the area

where dredging is occurring; however, the dredging location is relatively far from shore, in or immediately adjacent to the active ship channel, and limited to the small area of active dredging. Also, non-motorized boat users have ample opportunities for recreational activities in areas away from the dredging location. Potential noise impacts from dredging work in RWC and SBS Channels are less than significant.

Table A-12. Estimated Equipment Noise Levels at Dredging Sites

Project Site	Noise Source(s)	Reference Noise Levels (dBA)	Location of Noise Source	Distance to Closest Sensitive Receptor from Noise Location	Predicted Noise Levels (dBA) at Closest Receptor[1]
RWC Channel	Clamshell Dredge	67 @ 250 ft.	Dredging Channel	0.5 miles (residents - houseboats)	46.5
	Cutterhead Dredge	79 @ 160 ft. (L_{eq})			54.6
	Tugboat	82 @ 50 ft. (L_{eq})			47.5
SBS Channel	Clamshell Dredge	67 @ 250 ft.	Dredging Channel	3.0 miles (residents-Brisbane)	31
	Cutterhead Dredge	79 @ 160 ft. (L_{eq})			39
	Tugboat	82 @ 50 ft. (L_{eq})			32
	Pile driver (pipeline removal)	101 w/o controls; 95 w/ controls @ 50 ft. (L_{max})			50.9 w/o controls; 45 with controls
	Derrick scow (pipeline removal)	88 @ 50 ft.			38

Table A-13. Estimated Noise Levels at Dredging Sites Compared to Ambient Conditions

Project Site	Noise Source(s)	Location of Noise Source	Distance to Closest Sensitive Receptor from Noise Location	Ambient Noise at Sensitive Receptor Location	Predicted Noise Levels (dBA)[1]
RWC Channel	Clamshell Dredge	Dredging Channel	0.5 miles (residents - houseboats)	62; 55 in open areas	46.5
	Cutterhead Dredge				54.6
	Tugboat Tugboat				47.56 47.5
SBS Channel	Clamshell Dredge	Dredging Channel	3.0 miles (residents-Brisbane)	60-65	31
	Cutterhead Dredge				39
	Tugboat				32
	Pile driver (pipeline removal)				50.9 w/o controls; 45 with controls
	Derrick scow (pipeline removal)				38

[1] Predicted noise levels have been adjusted for distance to the receptor.

Pipeline Relocation

Pipeline relocation could be performed using three methods: trenching using clamshell, directional drilling, or a jet sled. Maximum noise effects from all three methods were considered. Trench construction using clamshell construction would be completed in one to two weeks per trench; jet sled construction options would require 50-100 months, depending on the depth of the trench. Once the trench is constructed, clamshell dredge would be used to place 3 feet of sand over the pipe, and two feet of armor rock over the sand.

The directional drilling method would not require trenching, but would involve drilling of a pilot hole, possibly widening the pilot hole (pre-reaming), and pipeline drawback. Given the size of the pipelines, it may be possible to drill the borehole in one pass.

Equipment required to install the replacement pipe would depend on the process chosen. All methods would include one or more work barges and one or more barges to deliver the pipe. Clamshell excavation would use the same equipment described above for dredging. Directional drilling may require one or more barges to serve as working platform for the drill rig, a derrick barge to place the pipe, and support equipment (tender tug, crew boat, etc.).

The jet sled is a piece of equipment that is launched by crane from a barge and travels along the bottom of the water body on skids. The pipeline is first laid on the Bay bottom, and the jet sled travels over the pipeline (it is towed by the pipeline laying barge). The jet sled uses adjustable width water jets placed on either side of the pipe to slurry sediment in the pipeline alignment, and dredge pumps to suction the slurried sediment out of the pipeline alignment, thereby opening up a trench. The sediment is discharged to either side of the pipeline alignment, and the pipeline sinks into the open trench.

As discussed in ***Section 4.2.3.4 of the Main Text***, the new pipeline segments could be tied into the existing pipelines in situ or above the water. For in situ tie-in, cofferdams (mostly likely steel sheetpile) would be driven to isolate the work area at the tie-in locations. The work area on each end of the pipeline segment would be approximately 10 feet wide by 100 feet long. A clamshell would then be used to excavate the area around the existing pipe. Alternatively, a portion of the existing pipeline could jetted out of the sediment on either side of the channel, and lifted onto a barge. Up to 1,000 feet of pipeline may have be to be jetted out of the sediment to allow a small portion of it be lifted onto a barge.

The noisiest equipment that would be used for this work are pile drivers to drive the sheet piles for the cofferdams. The pile driving would be short term work (up to four piles can be driven per day). The second noisiest piece of equipment is the derrick barge. Sound is not a concern in use of the jet sled since the sled would be pulled along the bottom by the barge already in place, which itself is held on a precise heading (Williams 2013).

The closest sensitive receptors to the SBS area, where this work would take place, are residents in the City of Brisbane (near the Shell pipeline) and recreational boaters and land-based recreational users (near the Kinder-Morgan pipeline), both roughly three miles from the construction activities. The residential areas in San Bruno are west of Highway 101, and Coyote Point Recreation Area is in the immediate vicinity of SFO. Surrounding areas have relatively high ambient noise levels, due to their proximity to SFO and Metropolitan Oakland International Airport, and their associated flyover traffic, as well as the the presence of Highway 101. Motorized boat users are not considered noise-sensitive receptors.

Noise from pipeline relocation activities would not be audible to land-based sensitive receptors. With noise attenuating at 6 dBA per doubling distance, the noise levels from even the loudest

of these activities would be no more than 51 dBA at the sensitive receptor locations, which is below the ambient noise at the land-based receptors. The maximum noise from the second loudest activity, use of the derrick barge would be at least no more than 38 dBA at the nearest land-based sensitive receptors. Predicted noise levels are presented in ***Table A-15*.**

The area comprises deep water habitat, however the work area where pile driving would occur is small enough such that marine mammals and other sensitive receptors could avoid the area during the temporary and periodic noise from pile driving and other pipeline removal activities. Potential noise impacts from pipeline removal work in SBS Channel are less than significant.

Berth Deepening at Port

Berth deepening work would be performed at the Port in conjunction with channel deepening. This work would be temporary. The Redwood City General Plan defines the normally acceptable noise threshold for the Port as less than 75 dBA, and the conditionally acceptable threshold as greater than 75 dBA. No threshold is given for an unacceptable noise level. The Redwood City Municipal Code allows construction noise of up to 110 dBA in residential areas and does not provide a threshold for industrial areas. No construction noise that permeates into residential is allowed during evening hours. Though no data are currently available regarding construction equipment and durations (i.e., a quantitative analysis cannot be performed), ambient noise and allowable noise levels at the Port are both high, such that no noise impact would be expected.

Impact N-2: Exceedance of Applicable Noise Thresholds

As discussed above, the Redwood City General Plan defines the normally acceptable noise threshold for the Port as less than 75 dBA, and the conditionally acceptable threshold as greater than 75 dBA. No threshold is given for an unacceptable noise level. The Redwood City Municipal Code allows construction noise of up to 110 dBA in residential areas and does not provide a threshold for industrial areas. No construction noise that exceeds local ambient noise is permitted to permeate into residential areas between 8 p.m. and 7 a.m.

There are high levels of background noise in and east of RWC Channel, due to the industrial activities within the Port. Noise levels would vary throughout the day and the week as vessels are unloaded or loaded, and industrial operations vary in their level of activity. The typical general ambient noise (as measured from Seaport Center parking lot about 0.9 miles, or 4,750 feet, from the Port of Redwood City) is about 62 dBA. The noise level at the actual Port is most likely higher than 62 dBA. Noise levels would typically be lower at night due to reduced industrial activity.

Dredging operations could occur as close as half a mile from the closest sensitive receptors (houseboats docked at Docktown Marina). Noise from construction equipment generally attenuates (decreases) at a rate of 6.0 to 7.5 dBA per doubling of distance (Port of Redwood City 2010). Using the more conservative value of 6 dBA per doubling of distance, the maximum attenuated noise levels at the closest residential receptors (level of noise once it reaches the sensitive receptors half a mile away) would be 54.65 dBA, well below both ambient and legal thresholds. Furthermore, the channel dredging would progress at 23 feet or more per day, and the distance between the closest residential receptors and the dredge would be 1.5 miles or more after one dredging season.

Trail users at Bair Island on the west side of RWC Channel and non-motorized boat users at Bair Island and Greco Island would also be considered sensitive receptors. Dredging activities could occur close to trail users and non-motorized boat users. There are no construction noise thresholds set by the City for open areas. The noise levels would not violate construction noise level restrictions for residential area set forth by the City—no noise above 110 dB at 25 feet and no noise above ambient at night. Elevated noise levels would be temporary in nature. Impacts would be less than significant.

The maximum predicted noise from Project activities in the SBS Channel area at the nearest land-based sensitive receptor is 50.9 dBA from pile driving activities during pipeline relocation. After that, dredging noise would be very low (imperceptible) at the nearest land-based sensitive receptor locations—39 dBA. This is well below ambient noise levels. Neither San Mateo County, nor the City of Brisbane, nor the City of South San Francisco set specific noise thresholds.

SBS Channel is very wide and non-motorized recreational boaters can avoid the dredging noise by taking a wider path around it. If boaters stay at least one fifth of a mile (roughly 750 feet) away from the loudest potential dredge (cutterhead), then the noise produced by the dredge would remain within the ambient range.

Placement Sites

There are three primary sources of noise associated with use of the placement sites: 1) tug boats towing scows to the placement site; 2) construction of pipelines and offloaders at placement sites, and 3) operation of the offloader and booster pump(s) during sediment offloading and transfer (pumping) of sediment to the sediment delivery location. Estimated noise levels associated with the equipment used to construct offloading facilities and to off-load and deliver sediment are provided below for each of the placement site (see ***Table A-14***). The noisiest activity associated with construction of an offloading facility would be pile driving for the mooring dolphins and any piles required to anchor the offloader barge. Estimated

pump noise from the offloading and/or booster pump operating closest to sensitive receptors for each site is also provided in ***Table A-14***.

Mooring piles may be driven to accommodate sediment-delivery scows at the offloader sites for Eden Landing, Alviso Ponds, and possibly Cullinan Ranch. Up to 26 steel pipe piles would need to be installed for the offloader mooring dolphins at each site. Typically crews can drive up to four piles per day (approximately two hours per pile installation). Use of the pile driving hammer is not constant during installation, since the two-hour estimate includes the time it takes to pile the rig, loft the pile, set it in place, align the pile for driving and set the leads and hammer in position. Thus actual pile driving would likely last between 1.25 and 1.5 hours per pile, with four piles being driven in a day for a duration of 6.5 days per site. Another 3.5 days per site would be needed to secure the mooring barges and offloader. This would not require more pile driving, but would generate noise from other equipment, such as the tugboat and work skiff.

While pile driving noise would be short term, noise from the offloader and booster pumps could potentially be generated for up to 24 months under a -37 foot MLLW channel deepening option when all the material is taken to Eden Landing or Alviso ponds. The Cullinan site has a smaller capacity but a slower dredge sediment placement rate, and would be filled up within approximately 19 months.

Table A-14. Estimated Equipment Noise Levels by Placement Site

Project Site	Noise Source(s)	Reference Noise Levels (dBA)	Location of Noise Source	Distance to Closest Sensitive Receptor from Noise Location	Predicted Noise Levels (dBA)[1]
Cullinan	Tugboat	82 @ 50 ft. (L_{eq}	Offloader (north)	300 ft (sensitive wildlife)	66.4
			Offloader (south)	100 ft (low quality habitat)	75.9
	Pile driver for offloader	101 w/o controls; 95 w/ controls @ 50 ft. (Lmax)	Offloader (north)	300 ft (sensitive wildlife)	81 w/o controls; 75 with controls
			Offloader (south)	100 ft (low quality habitat)	94.9 w/o controls; 88.9 with controls
	Offloader pump	76 dBA @ 50 ft	Offloader (north)	300 ft (sensitive wildlife)	60.4
			Offloader (south)	100 ft (low quality habitat)	69.9
Montezuma	Tugboat	82 @ 50 ft. (L_{eq})	Offloader	1,900 ft (residents)	50.4
Alviso	Tugboat	82 @ 50 ft. (L_{eq})	Offloader	1.5 miles (residents - East Palo Alto)	38
				0.375 miles (sensitive wildlife)	50
				1.0 mile (recreation - trail/open space)	41.5
	Pile driver for offloader	101 w/o controls; 95 w/ controls @ 50 ft. (Lmax)	Offloader	1.5 miles (residents - East Palo Alto)	57 w/o controls; 51 w/ controls
				0.375 miles (sensitive wildlife)	69 w/o controls; 63 w controls
				1.0 mile (recreation - trail/open space)	60.5 w/o controls; 54.5 w/ controls
	Offloader pump	76 dBA @ 50 ft	Offloader	1.5 miles (residents - East Palo Alto)	32

Project Site	Noise Source(s)	Reference Noise Levels (dBA)	Location of Noise Source	Distance to Closest Sensitive Receptor from Noise Location	Predicted Noise Levels (dBA)[1]
				0.375 miles (sensitive wildlife)	44
				1.0 miles (recreation-trail user)	35.5
	Booster pump at Pond A2W	80 – 85 dB @ 20 ft	Pond A2W levee	2 miles (residents)	30.5
				0.15 miles (sensitive wildlife)	53
				0.9 mile (recreation-trail user)	37.5
	Booster pump at Pond A9	80 – 85 dB @ 20 ft	Pond A9 levee	3 miles (residents)	27.5
				0.15 mile (sensitive wildlife)	53
				400 ft (recreation-trail user)	59
Eden Landing	Tugboat	82 @ 50 ft. (L_{eq})	Proposed Offloader	2.5 miles (residents)	33.5
	Pile driver for offloader	101 w/o controls; 95 w/ controls @ 50 ft. (L_{max})		2.5 miles (residents)	52.5 w/o controls; 46.5 with controls
	Offloader pump	76 dBA @ 50 ft		2.5 miles (residents)	27.5
	Booster Pump	80 – 85 dB @ 20 ft	Pond E2	3.0 miles (residents)	27.5
				3,100 ft (recreation - trail user)	41.1
				2,600 ft (sensitive wildlife [outboard marsh at Pond E1])	42.7

[1] Predicted noise levels have been adjusted for distance to the receptor.

Predicted noise levels at sensitive receptor locations were compared to the ambient noise levels at those locations in order to assess noise increases and the potential for objectionable levels of noise. The comparison is presented in ***Table A-15.***

Table A-15. Predicted Noise Levels at Placement Sites Compared to Ambient Levels

Project Site	Noise Source(s)	Location of Noise Source	Distance to Closest Sensitive Receptor from Noise Location	Ambient Noise at Sensitive Receptor location (dBA	Predicted Noise Levels (dBA)[1]
Cullinan	Tugboat	Offloader (north)	300 ft (sensitive wildlife)	46.5 - 56.5	66.4
		Offloader (south)	100 ft (low quality habitat)	58-68	75.9
	Pile driver for offloader	Offloader (north)	300 ft (sensitive wildlife)	46.5 - 56.5	81 w/o controls; 75 with controls
		Offloader (south)	100 ft (low quality habitat)	58-68	94.9 w/o controls; 88.9 with controls
	Offloader pump	Offloader (north)	300 ft (sensitive wildlife)	46.5 - 56.5	60.4
		Offloader (south)	100 ft (low quality habitat)	58-68	69.9
Montezuma	Tugboat	Offloader	1,900 ft (residents)	No data, assume 55	50.4
Alviso	Tugboat	Offloader	1.5 miles (residents - East Palo Alto)	70-74	38
			0.375 miles (sensitive wildlife)		50
			1.0 mile (recreation - trail/open space)		41.5
	Pile driver for offloader	Offloader	1.5 miles (residents- East Palo Alto)	70-74 at Pond SF-2; 64 – 68 at eastern sensitive wildlife location; ___ in East Palo Alto; 55 at trail (no data)	57 w/o controls; 51 w/ controls
			0.375 miles (sensitive wildlife)		69 w/o, 63 w controls
			1.0 mile (recreation - trail/open space)		60.5 w/o controls; 54.5 w/ controls

	Offloader pump	Offloader	1.5 miles (residents- East Palo Alto)	70-74 at Pond SF-2; 64 – 68 at eastern sensitive wildlife location; ___ in East Palo Alto; 55 at trail (no data)	32
			0.375 miles (sensitive wildlife)		44
			1.0 mile (recreation - trail/open space)		35.5
	Booster pump at Pond A2W	Pond A2W levee	2 miles (residents)	No data, assume 55	30.5
			0.15 miles (sensitive wildlife)	No data, assume 55	53
			0.9 mile (recreation-trail user)	No data, assume 55	37.5
	Booster pump at Pond A9	Pond A9 levee	3 miles (residents)	No data, assume 55	27.5
			0.15 mile (sensitive wildlife)	No data, assume 55	53
			400 ft (recreation-trail)	No data, assume 55	59
Eden Landing	Tugboat	Proposed Offloader	2.5 miles (residents)	No data, assume 55	33.5
	Pile driver for offloader		2.5 miles (residents)	No data, assume 55	52.5 w/o controls; 46.5 with controls
	Offloader pump		2.5 miles (residents)	No data, assume 55	27.5
	Booster Pump	Pond E2	3.0 miles (residents)	No data, assume 55	27.5
			3,100 ft (recreation- trail)	No data, assume 55	42.9
			2,600 ft (sensitive wildlife [outboard marsh at Pond E1])	No data, assume 55	43.9

[1] Predicted noise levels have been adjusted for distance to the receptor.

Cullinan

Impact N-1: Noise Increase of 5 dBA or More at Sensitive Receptor Locations

Cullinan is the only site at which a noise increase of 5 dBA or more over ambient may occur at sensitive receptor locations. At Cullinan, ambient noise levels are roughly 58 to 68 dBA at the southern offloader location and between 46.5 and 56.5 dBA at the northern offloader location. Ambient noise was estimated by calculating the attenuated noise from the State Highway 37, which is 750 feet away from the northern offloader and 200 feet away from the southern offloader. The levee delivery location is approximately 2,000 feet from the Highway and has an estimated ambient noise level of roughly 48 dBA.

Pile driving activities at Cullinan Ranch would increase ambient noise more than 5 dB with or without use of noise controls. At the proposed southern offloader location, noise levels would increase from 58 to 68 dB to somewhere between 76 (for tugboat peak noise) and 95 dBA (maximum possible pile driving noise). However, this increase would be temporary, lasting only 6.5 days for the pile driving and would only occur in short spurts for the tugboat while it is delivering and positioning a full scow. The pile driving would last for 1.25 to 1.5 hours, up to four times per day during the 6.5 day period; it would not be constant.

During offloading activities, a tug would pull up, the scow would tie up, and the tug would either leave or go on idle, significantly decreasing noise from the tugboat. Cullinan could accept up to 5,300 cy of material per day, which would mean between two and three deliveries per day. Since tug operators try to use as little fuel as possible, they are likely to idle once they have arrived thereby reducing noise levels. Though the predicted noise from tugboat is given at 100% of its motor operation, it is likely that the tugboat would generally operate at 80% or less when loaded, and less than 50% when empty, and at around five percent when idling. This would significantly decrease the noise effects from the tugboats operating at the offloader locations. Tugboat noise when operating at 100% is expected to range from 62 and 76 dBA at sensitive receptor locations. The maximum possible noise from tugs, although 8 to 14 dB louder than the ambient noise at the various possible delivery sites, would last for just enough time for the tug to pull up and position the scow to be tied up (approximately 5-20 minutes) up to three times per day. The noise impact from tugs delivering scows is considered less than significant.

Pile driving noise at sensitive receptor locations would range from 75 dBA with controls to 95 dBA without controls. This ranges from moderately loud to very loud. Wildlife comprises the main sensitive receptor group near Cullinan Ranch, and is discussed in ***Sections 4.3 through 4.5***. There is the possibility of recreational boaters in this area, however boaters would likely choose to avoid this site during construction. Since there are alternative recreational boating locations nearby and noise impacts are not expected to exceed 10 days during offloader construction and

would be minimal (periodic tugboat traffic while towing scows to offloader), the impact to potential recreational users is less than significant.

Noise from the offloader pump at the southern site would increase noise levels by approximately 2 dB over ambient; this is not considered a significant increase. At the southern offloader site, the pump would generate noise at roughly 60 dB at the sensitive receptor location. For the upper ranges of the estimated ambient noise, this is not a significant increase (3.9 dB), but for the quieter part of the range, it represents an increase of 13.9 dB. Under the worst case scenario (material from the proposed Project filling up Cullinan), the offloader would be operating for up to 19 months over a 4 year dredging window period (June 1 through November 30).

Since wildlife is the main sensitive receptor group in this area, the impact of the noise from the offloader, tugboats, and pile driving is further discussed in the Biology Resources – Wildlife, ***Section 4.4.6***. The closest residences are located south of Highway 37, and approximately 0.5 miles southeast of the southern offloader, and noise level from the offloader pump would be less than 55 dBA. Motorized boat users are not considered sensitive receptors. Non-motorized boat users may temporarily avoid the area where the offloader is operating. Non-motorized boat users have ample opportunities for recreational activities in areas away from the offloading location. Impacts to other sensitive receptors would less than significant.

Impact N-2: Exceedance of Applicable Noise Thresholds

As discussed for Impact N-1, noise effects from the Project at Cullinan are the only location expected to (temporarily) increase ambient noise at sensitive receptor locations by more than 5 dBA. Cullinan is in Solano County, which has thresholds for unacceptable noise ranging from 65 to 80 dBA, depending on the receptors. Solano County, however, does not set legal noise thresholds for wildlife receptors or open space. For outdoor activity areas, which is the closest applicable land use type that the County discusses, the County recommends "practical use of best-available noise reduction measures." Solano County requires use of sound mitigation measures if construction noise will be louder than the thresholds set for various land uses. Where noise could potentially impact wildlife receptors, mitigation measures are used. Noise thresholds set by resource agencies by which to judge impacts to wildlife are discussed in ***Sections A.4 and A.5***, Biological Resources. Noise levels from offloading operations at the closest residences would be less than 55 dBA, and would not be perceptible over the noise from Highway 37. Pile driving noise at the nearest residential receptor would range from 57 to 63 dBA, which is within in the acceptable range. This level of noise would only be generated for a very short period of time, as discussed above. The potential for exceedances of applicable noise thresholds set by Solano County is less than significant.

Montezuma

Impact N-1: Noise Increase of 5 dBA or More at Sensitive Receptor Locations

For the Montezuma placement site, the only potential noise source associated with the RWC Project would be tugs delivering scows of sediment. All other potential impacts associated with use of this site are the responsibility of the site owner. Since no noise measurements were found for Montezuma, the ambient noise level was assumed to be on par with other natural areas nearby, such as Bair Island, which is 55 dBA. The maximum predicted noise at the nearest sensitive receptor location to Montezuma is 50.4 dBA. There would be no impact.

Impact N-2: Exceedance of Applicable Noise Thresholds

Montezuma is also part of Solano County; for this site there are residential receptors located approximately 1,900 feet from the placement site. Solano County sets the following thresholds for residential low density, single family, duplex or mobile homes— less than 60 dB is normally acceptable, 55 to 70 dB is conditionally acceptable, 70 to 75 is normally unacceptable, and greater than 75 dB is clearly unacceptable. The maximum predicted noise at the nearest sensitive receptor location to Montezuma is 50.4 dBA, which is well below the threshold for normally acceptable levels for residential use. There would be no impact to residential uses.

Boating and related recreational uses may occur in the vicinity of the Montezuma offloader location. Solano County noise standards indicate that where it is not possible to reduce noise levels in outdoor activity areas to 60 dB or less using practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB may be allowed, provided that all available exterior noise level reduction measures have been implemented. While the noise level in the immediate vicinity of the tug (within approximately 400 feet) may periodically exceed the applicable noise threshold, the presence of tugs at the offloader would be episodic, as described for the Cullinan placement site above, and of limited duration. In addition, there is extensive availability of alternative recreation locations. The impact to outdoor uses is less than significant.

SF-DODS

Impact N-1: Noise Increase of 5 dBA or More at Sensitive Receptor Locations

Although wildlife may be present at SF-DODS, there would be no human receptors. There would be no impact.

Impact N-2: Exceedance of Applicable Noise Thresholds

SF-DODS is located in the deep Pacific Ocean and no legal noise thresholds are identified there. There would be no impact.

Alviso

Impact N-1: Noise Increase of 5 dBA or More at Sensitive Receptor Locations

For the Alviso ponds, the offloader location is between 4 and 6 miles north of the two possible sediment delivery locations. Consequently, the primary offloader construction noise effects (i.e., pile driving) would occur far from the sediment delivery locations. However, both the offloader and the sediment delivery locations would experience effects from pumps used to transport the sediment from the offloader to the delivery location. In addition to the pump at the offloader, each sediment delivery location would have a booster pump. The Pond A9 dredged sediment delivery location would require a second booster pump equidistant between the offloader and the sediment delivery location. As discussed earlier, the intermediate booster pump location is further away from sensitive receptor locations than other equipment that would be used, and is therefore not evaluated separately.[13] Noise effects were evaluated for the booster pumps at Ponds A9 and A2W and the offloader construction and offloader pumps. The information is presented in ***Table A-14 and Table A-15*****.**

Offloader and Intermediate Booster Pump Construction Noise

Residential areas in East Palo Alto are located approximately 1.5 miles southwest of the proposed Alviso offloader location. Industrial users are located 2.5 miles away. A portion of the Bay Trail and the Ravenswood Open Space Preserve are located within 1 mile southwest. Pond SF-2, which is a closely monitored restoration site, is within 0.6 miles (3,168 feet) to the west, and a portion the SFBNWR containing tidal marsh and open water ponds is located approximately 0.3 to 0.4 miles to the east. The closest residential receptors to the east are located approximately 3.8 miles away.

Ambient noise in the vicinity of the proposed offloader location would be relatively high (70 – 74 dB) because it is located between State Highway 84 and a railroad bridge. The final location of the Alviso offloader has not been determined, however, it is likely that it would be within 0.5 miles of Highway 84. The highest predicted noise level at the residential sensitive receptor

[13] The closest residential receptors to the proposed intermediate booster pump location that would be required for delivery to Pond A9 are approximately three miles to the west, on the west side of Palo Alto's municipal airport. Residential receptors are also located approximately 3.7 miles to the northeast. The closest recreational area is San Francisquito Creek Trail approximately 1.9 miles to the west.

location resulting from offloader construction is 57 dB from the use of the pile driver. The highest predicted noise level at the trail would also be due to the pile driver would be 54.5 dB with controls, and 60 dB without controls. The noise levels would be within 5dBA of ambient conditions.

Pile driving noise associated with the installation of the intermediate booster pump, if needed, would be lower at all sensitive receptor locations than noise from the offloader construction, because all sensitive receptors are farther from the potential pile driving activities. However, ambient noise levels at the recreational locations would be lower than for the sensitive receptors closest to the offloader location. Ambient noise levels at the closest recreational receptor locations are estimated to be 55 dBA (open space). Pile driving noise with controls would not exceed 60 dBA at any of these locations, and would be of short duration. This impact is less than significant.

Offloader Operations/Dredged Sediment Delivery

The same receptors that would be exposed to pile driving noise from the construction of the offloader would be exposed to operating noise (i.e., pump noise) while the offloaderis in operation. Pump noise would be considerably lower, but much more sustained, than pile driving. If the maximum amount of RWC sediment is placed at the Alviso ponds, the offloader would be expected to operate for 24 months total, comprised of four six-month dredging window periods. The noise from continual offloader operationwould be well below the existing ambient noise levels at the closest residential and recreational receptor locations.

Residential receptors closest to Ponds A2W and A9 would be exposed to maximum noise levels of 27.5 to 30.5 dBA, which much less than the ambient level of 55 dBA. Recreational receptors on the south side of Pond A2W could be exposed to noise levels of up to 37.5 dBA from the dredged sediment delivery pump, compared to expected ambient noise levels of 55 dBA in this area. The loudest predicted noise levels resulting from sediment delivery would come from the booster pump at Ponds A2W and A9 being approximately 0.15 miles from potential wildlife receptors. Even here, noise would only be 53 dBA, which is below ambient levels. Potential recreation receptors (Alviso Slough Trail) may come within 400 feet of the booster pump at Pond A9 (the area around the pump would be secured to ensure the safety of the public and construction operations). The predicted noise level associated with the booster pump would be 59dBA at 400 feet. Although the predicted level would be above ambient, it less than an increase of 5dBA. The potential impact would be less than significant.

<u>Impact N-2: Exceedance of Applicable Noise Thresholds</u>

Alviso Ponds are part of three different jurisdictions, Santa Clara County, City of San José, and the City of Mountain View. In Santa Clara County, permissible noise levels range from 45 to 75 dBA for residential uses during the night (10 pm to 7 am) to heavy industrial uses anytime during the day, respectively. Residential public space is limited to 55 dBA during the daytime hours (7 am to 10 pm). Higher noise levels are permitted for construction and demolition activities. The maximum noise levels for repetitively scheduled and relatively long-term operation stationary equipment ranges from 60 to 70 dBA between the hours of 7 am to 7 pm, depending on the land use. Noise levels for nonscheduled, intermittent short-term operation increases by 15 dBA above the stationary source. Variances to noise provisions may be authorized by the Director, assuming that permitted conditions included by the Director are protective.

The maximum noise effect of the project is from pile driving, which would measure at 57 dBA at the nearest residential receptor location without use of noise controls. With the exception of pile driving, no other noise source would exceed 45 dBA at the closest residential receptor. Since pile driving activities would be limited to day time hours and are a short term construction activity, the noise from this activity does not exceed legal thresholds. No other equipment would exceed 55 dBA at the closest residential receptor, and

The Envision San José 2040 General Plan (City of San Jose 2011) states that the city's acceptable noise level objective is 60 dBA DNL or less for residential and most institutional land uses. Section 20.100.450 of the San Jose Municipal Code (City of San Jose 2012) prohibits construction activity on a site located within 500 feet of a residential unit before 7:00 a.m. or after 7:00 p.m. Monday through Friday, or at any time on weekends. None of the proposed project activities would exceed these legal thresholds.

Mountain View sets noise standards for new single and multi-family developments at 65 dBA Ldn for exterior noise in private outdoor active use areas, as well as community outdoor recreation use areas. Noise standards do not apply to private decks and balconies in multi-family residential developments. None of the proposed activities would exceed these legal thresholds. This impact is less than significant.

Eden Landing

Impact N-1: Noise Increase of 5 dBA or More at Sensitive Receptor Locations

The closest sensitive residential receptors at Eden Landing are residents located 2.5 miles east of the offloader location in the community of Redwood Shores and three miles east of the Pond E2 Bayfront levee potential booster pump location. Some recreational users may be present along the Bay Trail approximately 0.6 miles to the south of Pond E2.

Offloader Construction Noise

The pile driving activities at Eden Landing are far enough away from the nearest sensitive receptors that they would attenuate to a maximum of 52.5 dBA at the nearest sensitive receptor location; this is below the assumed ambient noise level of 55 dBA. Furthermore, the pile driving activities would be temporary, only lasting 6.5 days and would not occur at night. There is no impact.

Offloader Operations/Dredged Sediment Delivery

Noise levels associated with offloader operations and sediment delivery activities at Eden Landing would be well below expected ambient levels. There is no impact.

Impact N-2: Exceedance of Applicable Noise Thresholds

There are no data for ambient noise, but it can reasonably be assumed that ambient noise at the Eden Landing ponds is comparable to other natural Bay-front areas nearby; thus a value of 55 dBA was chosen as the baseline. All noise sources would result in noise levels below at the closest sensitive receptor. These are below ambient noise levels. As discussed above, these noise levels would be below applicable legal thresholds for the City of Redwood City.

Eden Landing is located in the City of Hayward in Alameda County. The City of Hayward defines unacceptable noise levels between 65 to 80 dBA, depending on type of land use nearby. Chapter 4, Article 1, Section 4-1.03.4 of Hayward's Municipal Code allows construction activities to operate an individual device or piece of equipment with noise levels up to 83 dBA at a distance of 25 feet from the source and activities that do not produce a noise level exceeding 86 dBA at any point outside of the property plane. The Countywide Noise Element of the Alameda General Plan established interior and exterior noise average noise levels (Ldn) of 45 dBA and 55 dBA respectively for residential land uses based on Federal noise level standards. The Noise Element also references noise compatibility standards developed by the Association of Bay Area Governments, which identified an exterior noise level of 65 dBA CNEL or less as a basis for finding little noise impact on residential land uses, 65 to 70 dBA as a moderate impact, and any level above 70 dBA as a significant impact. There is a 5 dBA evening "penalty" from 10 PM to 7 AM. None of the Project activities would exceed these thresholds. No impact from exceeding noise thresholds would occur at Eden Landing. There would be no impact.

Mitigation Measures

There are no significant impacts from noise due to the dredging or placement options; no mitigation is required.

A.11 Recreation

This section summarizes the existing recreational conditions within the Project area; describes the recreational resource regulations applicable to the proposed Project; identifies the significance thresholds; and discusses the potential impacts that the Project and alternatives may have on recreational resources.

Affected Environment

The southern portion of the San Francisco Bay region is an urbanized area primarily comprised of residential communities and industrial and commercial areas, with recreational resources such as trails, parks, open space (land based), and marinas comprising the remaining areas. South San Francisco Bay itself is fronted by extensive wetland areas in various stages of restoration.

RWC and the SBS Channels are located in San Mateo County. The dredged sediment placement sites are located in Alameda, Santa Clara, and Solano Counties. Recreational resources, including trails, parks, land-based open space, and marinas, in the vicinity of the dredging location and placement sites offer a wide variety of recreational opportunities such as motorized and non-motorized boating, fishing, hunting, bird watching, walking, hiking, bicycling and photography. By law, all navigable waters are open to hunting during the appropriate seasons. The following sections describe recreation areas in or near the Project Area, as well as the dredging and placement sites.

A.11.1.1 San Francisco Bay Trail

The San Francisco Bay Trail (Bay Trail) is a shoreline trail and recreational corridor that, when complete, will encircle San Francisco and San Pablo Bays with a continuous 500-mile network of bicycling and hiking trails. It will link all nine Bay area counties and 47 cities (ABAG 2015c). Currently, approximately 338 miles of the planned alignment have been completed. The Bay Trail offers access to points of historic, natural and cultural interest; recreational areas such as beaches, recreational marinas, fishing piers, boat launches, and over 130 parks and wildlife preserves totaling 57,000 acres of open space; residential areas; and commercial and industrial areas.

It passes through highly urbanized areas like downtown San Francisco as well as remote natural areas like the Don Edwards San Francisco Bay National Wildlife Refuge. The Bay Trail's policies specifically seek to protect sensitive natural habitats. Bay Trail segments may consist of paved multi-use paths, dirt trails, bike lanes, sidewalks or city streets signed as bike routes. The Bay Trail also connects to trails that lead inland and with the Ridge Trail, another regional trail network (located primarily along the ridges of the Bay Area's hills).

A.11.1.2 Don Edwards San Francisco Bay National Wildlife Refuge

Don Edwards San Francisco Bay National Wildlife Refuge (SFBNWR) is located in San Mateo, Alameda and Santa Clara counties in San Francisco Bay. It is the first urban National Wildlife Refuge established in the United States, and provides opportunities for wildlife-oriented

recreation and nature study for the surrounding communities (USFWS 2012). USFWS currently maintains approximately 30,000 acres of the SFBNWR and intends to acquire an additional 13,000 acres in the vicinity of the SFBNWR (USFWS 2012). SFBNWR includes trails and other public facilities such as an educational center. Bair Island and Greco Island are part of the SFBNWR.

A.11.1.3 San Pablo Bay National Wildlife Refuge

San Pablo Bay National Wildlife Refuge (SPBNWR) is located in Solano and Sonoma Counties. SPBNWR includes open bay/tidal marsh, mud flats, and seasonal and managed wetland habitats. SPBNWR provides numerous recreation opportunities that include wildlife viewing, wildlife photography, hiking, boating, and hunting.

A.11.1.4 Eden Landing Ecological Reserve

Eden Landing Ecological Reserve (ELER) comprises approximately 6,400 acres of restored salt ponds, adjacent diked marshes, and transitional areas to uplands that are managed for resident and migratory waterbirds and tidal marsh habitats and species. The reserve, located in Alameda County, is owned and managed by CDFW and provides recreational opportunities that include wildlife viewing, photography, hiking, and waterfowl hunting. The 835-acre portion of ELER north of Old Alameda Creek (former Ponds 1B–6B, 7C, and 8B–17B) was restored as part of the Phase 1 South Bay Salt Pond Restoration Project. In this document, the southern portion of ELER is referred to as the Eden Landing ponds. The Eden Landing ponds serve as potential placement site for the RWC Project.

A.11.1.5 Napa Sonoma Marshes Wildlife Area

The Napa-Sonoma Marshes Wildlife Area (NSMWA) is an area of baylands, tidal sloughs and wetland habitat that provide habitat for sensitive species as well as extensive recreation opportunities. The NSMWA is managed by CDFW and is regularly used by hunters and fisherman, as well as bird watchers, photographers, bicyclists, and hikers. NSMWA lands are located north and west of Cullinan.

A.11.1.6 Dredging Sites

Redwood City Harbor Channel

RWC Channel is bordered by Bair Island to the west and north, and commercial and industrial properties to the south and east. Further north along the channel, Greco Island lies to the east, and San Francisco Bay lies to the north and east of the channel.

Trails

There are three trails near RWC Channel. They consist of the Bay Trail (portions are located to the east and west of the channel), and trails on Bair Island. The portion of Bay Trail that is adjacent to RWC Channel is located along the eastern side of the Port (ABAG 2015b). This segment of the Bay Trail is a landscaped, wide concrete sidewalk that begins at the intersection of Blomquist and Seaport Boulevard and runs north along Seaport Boulevard to the Pacific Shores Center (PSC) business park (Horii 2007). The Bay Trail then runs around the perimeter of

PSC and leads to a park along Westpoint Slough. A segment of the trail off Seaport Boulevard (approximately 0.7 miles from the start of the trail) leads to a small waterfront park and to the Redwood City (Municipal) Recreational marina.

Another portion of the Bay Trail near the RWC Channel runs along the western edge of Inner Bair Island. This trail is located approximately 0.7 miles southwest of the southernmost portion of the RWC Channel to be dredged. A pedestrian bridge was constructed in April 2013. The accessible trail is a 1-mile loop trail around the southeastern portion of Inner Bair Island (USFWS 2015b). The remaining portion of the Inner Bair Island trail located north of Area D is currently closed until restoration construction is complete (USFWS 2015c).

Parks and Open Space

According to the EIR in support of Redwood City's New General Plan, there are approximately 226 acres of active developed parkland in the City (City of Redwood City 2010b). None of Redwood City's active parklands are in or adjacent to RWC Channel. The closest neighborhood park is located off of Whipple Avenue south of Highway 101, approximately 1.5 miles southwest of the southern portion of RWC Channel.

One land-based recreational facility is located near the RWC Channel: a 4.6-acre sports field complex that is part of the PSC development located at the end of Seaport Boulevard, approximately 1,000 feet east of RWC Channel. The sports fields and courts were originally constructed for tenants of PSC, and are available to Redwood City for city-sponsored sports activities on a limited basis.

In addition to the developed parkland discussed above, Redwood City has approximately 700 acres of designated open space that can be used for passive recreation (walking, boating, exploring, etc.) (City of Redwood City 2010). The majority of Redwood City's open space is on bayfront lands including Bair, Bird, and Greco Islands; Redwood Shores Lagoon; the San Francisco Water Department Right of Way; and Edgewood County Park.

Recreational activities that currently take place at Bair Island include fishing, jogging, wildlife viewing, hiking/walking, bicycling, boating and hunting, (hunting is only allowed by boat at portions of Middle and Outer Bair Islands). Greco Island is the largest contiguous tidal marsh on the western side of the Bay and is relatively protected from human disturbance. Greco Island is only accessible by water, primarily through the use of non-motorized boats, and is available for passive recreation such as fishing and wildlife viewing. Hunting is allowed in season (USFWS 2015c).

Marinas

The Redwood City Marina (a public marina) and four private marinas are adjacent to the RWC Channel and use the federal channel for recreational boat access in and out of San Francisco Bay (USACE and RWQCB. 2014). These marinas provide a total of approximately 1,100 berths

for recreational boats. Channel deepening would occur north of all the marinas. Fishing in Redwood Creek and surrounding area provides a variety of fish including largemouth bass, bluegill and smallmouth bass.

The Port operates a 190-berth municipal recreational marina known as the Redwood City Marina (Port of Redwood City 2015) located south of RWC Channel and at the southern end of the Port Sequoia Yacht Club, which offers sailing and navigational classes, has its headquarters, clubhouse, and recreational boating club at the Marina.

The Redwood City Marina provides a launch ramp, electricity and water to all boats, and restrooms, showers, and laundry facilities for all recreational marina users. It has the only public boat launching facility with access to San Francisco Bay south of Coyote Point. Motorized as well as non-motorized watercraft such as kayaks and canoes use this public boat launch ramp. Crew boat races, Hawaiian Outrigger canoe races, and sailing regattas are regularly held on the Port's waterfront. Fishing is allowed from the public fishing pier.

Private marinas located adjacent to the federal channel include Redwood Landing Marina, Westpoint Harbor Marina, and Docktown Marina. Redwood Landing Marina, located south of Redwood Creek Channel at the southern end of the Port of Redwood City, is a small private recreational marina of over 40 boat slips. Westpoint Harbor Marina is boat accessible through Westpoint Slough, and is located east of the Port of Redwood City. It has over 270 slips.

No commercial fishing marinas/harbors are located in, or adjacent to RWC Channel.

San Bruno Shoal Channel

SBS Channel is located in the middle of San Francisco Bay. There are no land-based recreational facilities near SBS Channel. The only land-based activities associated with SBS CHannel may be the use of a staging area (e.g., at the old Shell Oil dock) to support pipeline relocation construction).

Aquatic recreational activities in the vicinity of SBS Channel and the pipeline installation areas could include motorized and non-motorized boat use, hunting in season, and fishing. A variety of fish including sturgeon, striped bass, and channel catfish have been caught in the vicinity of SBS Channel.

A.11.1.7 Dredged Material Placement Sites

Cullinan Ranch Restoration Project

Cullinan Ranch Tidal Restoration Project is part of SPBNWR and managed by USFWS. Cullinan is being restored to tidal marsh. A goal of the restoration project is to provide a key public access point for the SPBNWR. The majority of the site was restored to tidal action in January 2015. Adjacent to Cullinan is Guadalcanal Village, which was restored to tidal action by Caltrans as mitigation for their Highway 37 improvement project. Guadalcanal Village is in the process of being transferred to USFWS.

Trails

A levee-top walking trail, approximately 1.5 miles long, runs from the southwest corner of Cullinan to the northwest corner along the western levee. Visitors can park in a parking lot at the foot of the trail off Highway 37 (CDFW 2015b). The nearest Bay Trail segment is located east of Cullinan (across the Napa River Bridge) in Vallejo along Sacramento Street and Wilson Street (ABAG 2015a). No trails are located on the eastern portion of Cullinan Ranch that is slated to receive dredged sediment. Once the transfer of Guadalcanal Village to USFWS is complete, USFWS will install a new trail along the perimeter of Guadalcanal Village.

Parks and Open Space

The Cullinan site is primarily an open water area that is expected to accrete to intertidal (marsh) elevation within 60 to 100 years. NSMWA Pond 1 is located on the western boundary of the Cullinan Ranch Site and Dutchman and South Sloughs border Cullinan Ranch on its northern edge. Guadalcanal Village is located directly adjacent to the eastern boundary of Cullinan. Ponds 2, 2A, and 3 are located further north of Cullinan across Dutchman Slough.

An accessible kayak launch and a fishing pier are located in the southwestern portion of the Cullinan site, near the parking lot. Cullinan is currently closed to all hunting (Cullinan 2015). Hunting is allowed on SPBNWR lands south of Highway 37 and in the NSMWA Area at Ponds 1 and 3. Waterfowl hunting is only allowed by boat on open bay and navigable sloughs. Boating and fishing occurs in the tidal sloughs adjacent to Cullinan, as well as within Cullinan. The closest motorized boat launch ramps are in Vallejo at Brinkman's Marina, on Hudeman Slough in Sonoma County, on Skaggs Island, and on Cuttings Wharf Road in Napa County.

Marinas

There are no marinas within the Cullinan. Vallejo Municipal Marina is approximately 2 miles south of the proposed sediment delivery location, and 1 mile south of the proposed off-loader locations.

Montezuma Wetlands Restoration Project

Montezuma is located on the eastern edge of Suisun Marsh in Solano County east of Montezuma Slough. The site is bounded by the San Joaquin River-Sacramento River and Delta to the south. The offloader location is more than 2 miles east of Montezuma Slough in open water.

Parks and Open Space

The Department of Water Resources (DWR) Collinsville Day-Use Area is on the eastern shore of Montezuma Slough with access off of Collinsville Road and within the Montezuma site. The day use area is located more than 8,000 feet northwest of the offloader location.

Approximately 2 miles to the east, the Suisun Marsh's large open space areas provide extensive wildlife viewing, hiking, canoeing, hunting, and fishing opportunities. Duck hunting is the major recreational activity in the marsh occurring from late October until January. Approximately 150 private duck clubs are located in the marsh (DWR 2015). Fishing accounts for nearly as much recreational use in the marsh as duck hunting (Solano County 2008). At various times of the year several species of game fish may be caught in Suisun Marsh. They include striped bass, brown bullhead, white catfish, white sturgeon, black crappie and the occasional largemouth bass, Chinook salmon and steelhead (CDFW 2015b).

Boating and fishing occur on the open waters of the Delta and Sacramento and San Joaquin Rivers in the vicinity of Montezuma, as well as in Suisun Marsh. The open water areas in the vicinity of the Montezuma site provide a variety of recreational opportunities including fishing, hunting, boating, and viewing nature.

Marinas

There are no marinas near or at the Montezuma site.

SF-DODS

The SF-DODS placement site is located approximately 50 miles east of San Francisco in the Pacific Ocean. There are no trails, parks, land-based open space, recreational or commercial fishing marinas at this location. Deep-sea fishing and whale watching may occur from both private and commercial boats.

Alviso Ponds

A dredged sediment pipeline may deliver material to either the top of the levee at Pond A2W or Pond A9. The discussion below therefore focuses on recreational resources in the vicinity of the outboard levees at these ponds. Uses of open water areas near the proposed offloader location would be similar to those described for SBS Channel.

Trails

Segments of the Bay Trail in and around the Alviso ponds include:

Alviso Slough Trail (along the levees of Ponds A9 - A15),
A trail south of Alviso Ponds A1 and A2W, and
Stevens Creek Trail, located between Ponds A2W, A2E and AB1

An unimproved, on-street portion of the Bay Trail (no bike lanes or sidewalks) leads from the Alviso Marina and Historic District (adjacent to Alviso Ponds A8 and A12) south toward San Jose and Highway 237. In 2014, a smartphone audio tour of a 4.5-mile Alviso section of the Bay Trail launched.

The SFBNWR trails adjacent to the Alviso Ponds are the New Chicago Marsh Trail, Mallard Slough Trail, Butterfly Garden Trail, and the Marsh View Trail. All are located north of the town of Alviso within the Refuge's Alviso Unit Trails Unit.

Parks and Open Space

Several parks are located within 2 to 3 miles of Ponds A1/A2W. These include Palo Alto Baylands Park, Shoreline at Mountain View, and Stevens Creek Shoreline Nature Study Area. The closest public park to Pond A9 is Alviso Marina County Park, located approximately 3 miles south of the proposed sediment delivery location at Pond A9.

Various ponds within the Alviso Pond Complex are open to waterfowl hunting. At Ponds A5 and A7 and the northern portion of Pond A8N, waterfowl hunting is available from existing blinds. Ponds are accessed using electric or non-motorized boats. Generally, the waterfowl hunting season extends from approximately mid-October to mid-January.

Fishing is not allowed on any ponds within the Alviso Ponds Complex (including salt evaporation ponds or marshes). Visitors are allowed to fish from boats in the Bay and sloughs. Mallard Slough (east of Pond A17, also known as Artesian Slough) is closed to boats from March 1 through August 31 to protect sensitive wildlife species (USFWS and CDFW 2007).

Marinas

Alviso Marina County Park, south of Pond A12, has a launch ramp for boat access that provides one of the few clear routes in the San Jose area through the South Bay Salt Ponds out to the open waters of the San Francisco Bay (County of Santa Clara 2015). Shark and striped bass commonly occur at this recreational fishing site. A small commercial fishing vessel (the Dorothy Anne) works out of Alviso (USACE and RWQCB. 2014).

Eden Landing Ponds

The Eden Landing ponds, including the area that includes the potential sediment delivery location at Pond E2, are currently closed to the public; however, controlled access is permitted on specific hunt dates for hunters selected by a public lottery. A dredged sediment pipeline may deliver sediment to the top of the outboard levee at Pond E2. The discussion below therefore focuses on recreational resources in the vicinity of the Pond E2 outboard. Uses of open water areas near the proposed offloader location for this site would be similar to those described for SBS Channel.

Trails

Segments of the Bay Trail in Alameda County are located south of the Eden Landing ponds. The trail, known as the Alameda Creek Regional Trail runs along the north and south sides of the Alameda Creek Flood Control Channel (ACFCC, also known as Alameda Creek and Coyote Hills

Slough). This portion of the trail is considered a spur trail, and the closest point is located approximately 0.75 miles south of the proposed sediment delivery location at Pond E2.

As part of the restoration, CDFW, in partnership with EBRPD, completed construction on a new 3.8-mile segment of the Bay Trail Spine, north of Old Alameda Creek (SBSP 2015). The closest portion of this trail is more than 2.5 miles north of the proposed offloader location at Pond E2.

Parks and Open Space

Waterfowl hunting in the Eden Landing ponds occurs on lands deemed appropriate by CDFW; areas typically open to waterfowl hunting include marsh areas and ponds with sufficient water. Access for waterfowl hunting typically occurs on approximately six dates comprised of Saturdays and selected weekdays during the hunting season (late October through January) (CDFW 2015b).

Hayward Regional Shoreline Park, a 1,682-acre park owned and managed by EBRPD, is adjacent to the north side of ELER and stretches from San Lorenzo Creek to Highway 92. This park is approximately 2 miles north of the Eden Landing ponds.

Marinas

There are no marinas located in or adjacent to the Eden Landing ponds.

Significance Thresholds

The effects of the Project or alternatives on recreation and recreational facilities are considered to be significant if the proposed Project or alternatives would:

- Substantial reduce or restrict the availability or quality of existing recreation opportunities in the Project vicinity.

Environmental Consequences

Environmental effects to recreational resources were assessed by evaluating the potential for direct interference (e.g., blocking access to a marina entrance) with recreational activities, reduced access to recreational facilities and areas (e.g., through the presence of new equipment in waterways), and noise effects on sensitive recreational uses (e.g., trails in natural areas).

Dredging Options

Dredging Options

All three dredging options would have similar effects on recreation. The only difference is the duration during which these effects would occur. Therefore, all three dredging options are evaluated jointly.

Impact REC-1: Restricted or Reduced Availability or Quality of Existing Recreation Opportunities

Dredging in RWC Channel would last between a total of 11 months and 30 months, depending on the depth of the channel over two to five years (dredging windows). Dredging activities in RWC Channel may occasionally delay or temporarily impede recreational boating activities. These impacts would be temporary and considered a minor diminishment of quality of recreational resources. Notes to mariners and navigational warning markers would be used as needed to prevent navigational hazards. While the southernmost portion of RWC Channel is being dredged, the entrance of the Redwood City Municipal Marina may temporarily be obstructed by scows in the turning basin. Scows would generally be located so as to minimize obstructions. Any such obstruction would be of short durations (days). During construction, signs would be posted informing the public of any temporary marina closures. Dredging in SBS Channel would require between and 4 and 39 months over one to 7 years and installation of the replacement fuel pipelines would require between 50-100 months of jet sled operation; other methods would require 3 months or less. Relocation of the fuel pipelines would be performed before channel deepening SBS Channel. Dredging of SBS Channel and installation of the replacement pipelines may limit boating access in the immediate vicinity of the dredge or construction equipment; however, there would be sufficient room for recreational vessels to maneuver around dredge equipment and there would be ample other areas for boating in the vicinity.

Dredging and fuel pipeline installation activities are not expected to have any impacts to land-based activities. Staging areas to support the construction activities would not be located on or block existing recreational facility, and pipeline termination points would be within existing industrial areas. Noise impacts to recreational receptors are addressed in Section 4.5.10. This impact is less than significant.

Placement Sites

Cullinan

Impact REC-1: Restricted or Reduced Availability or Quality of Existing Recreation Opportunities

Potential activities associated with use of the Cullinan site include construction of an offloader and up to 1 mile of floating pipeline, and offloading of scows at the offloader. Off-loading at the Cullinan placement site could occur for up to a maximum of 58 months between June 1 and November 30 (10 dredging periods) if the entire 3 MCY capacity of the site is used by the RWC Project. Construction of the offloader and pipeline could require up to 2 months. During construction of the offloader and pipeline, access to Dutchman Slough may be impeded occasionally and access to the immediate construction area would be prohibited for safety reasons; however, recreational boaters could easily navigate around the construction equipment under most circumstances. Access to the offloader and the sediment delivery location would also be prohibited throughout the offloading period. Offloading activities would

not create an obstacle to recreational boating, as the Napa River is wide enough to provide ample space for recreational boat users to pass the offloader and any scows and tugs tied up at the offloader. Fishing, hunting, and wildlife viewing opportunities would also be largely unaffected; if any obstructions in Dutchman Slough occur, there are many alternative locations in the immediate vicinity of this placement site. This impact is less than significant.

Montezuma

Impact REC-1: Restricted or Reduced Availability or Quality of Existing Recreation Opportunities

Potential activities associated with use of the Montezuma site consist solely of offloading of scows at the existing offloader (all potential impacts associated with operation of the offloader and placement and management of the sediment are addressed by the Montezuma project). Because the RWC Project would only use the off-loader, and the site owner is responsible for all environmental impacts associated with delivery of sediment from the off-loader to the site and placement and management of sediment within the site, this analysis focuses on potential impacts that could occur as a result of transport to, and tying up at the off-loader at Montezuma. Land-based recreation is not evaluated.

Offloading at Montezuma could occur for up to 58 months over a period of 10 years if all sediment generated under Dredge Option C is delivered to this placement site. Offloading activities would not create an obstacle to recreational boating, as the waterway in the vicinity of the site north of Chain Island is more than 800 feet wide and provide ample space for recreational boat users to pass the offloader and any scows and tugs tied up at the offloader. Vessels could also pass south of Chain Island and avoid the offloading facilities completely. Fishing and hunting opportunities would also be largely unaffected. This is impact is less than significant.

SF-DODS

Impact REC-1: Restricted or Reduced Availability or Quality of Existing Recreation Opportunities

Potential activities associated with use of the SF-DODS placement site consist solely of offloading of scows by bottom dumping. Barges would require an estimated 15 minutes per load to dump their cargo. Dumping could occur anywhere within the 600-meter-radius circle (0.44 square miles area) at the center of SF-DODS. Recreational boating, commercial boating charters, and limited recreational fishing may occur in the vicinity of SF-DODS. Due to the large expanse of open water available for recreational activities at and around the site, the potential impact is less than significant.

Alviso

Impact REC-1: Restricted or Reduced Availability or Quality of Existing Recreation Opportunities

Potential activities associated with use of the Alviso placement site would include construction of an offloader and approximately 5 miles of floating or submerged pipeline, and offloading of scows at the offloader. Alternatively, activities associated with Alviso would require construction of a pipeline from the hydraulic offloader to the site. Offloading and dredged sediment delivery activities at Alviso could occur for up to a total of 24 months (spread over 4 years) if all sediment generated under Dredge Option C is delivered to this placement location. Construction of the offloader and pipeline would require up to 4months. During construction of the offloader and pipeline, access to the immediate construction area would be prohibited for safety reasons; however, recreational boaters would easily be able to navigate around the construction equipment. Access to the off-loader and the sediment delivery location would also be prohibited throughout the offloading period.

The pipeline would be submerged as needed to prevent obstacles to boating. Offloading activities would not create an obstacle to recreational boating, as there is ample space in the Bay for recreational boat users to pass the offloader and any scows and tugs tied up at the offloader. Fishing, hunting, and wildlife viewing opportunities would also be largely unaffected. Only the immediate area around the offloader would be blocked.

Alviso County Park, located near the south end Alviso Slough, is the only boat launching facility in the San Jose area that provides clear access to the San Francisco Bay. Sediment delivery to the Pond A9 embankment would require a floating or submerged pipeline in Alviso Slough. The pipeline would be located so as to minimize obstruction of the slough. A short term blockage of the slough may occur during construction of the pipeline. Signage would be posted in the vicinity to inform all boaters of any short term obstructions. This impact is less than significant.

Use of the Alviso placement site may also involve use of a cutterhead dredge that would pump material directly from the RWC Channel dredging location to the sediment delivery location at the top of the levee. This dredged sediment delivery mechanism could be used for sediment dredged from RWC Channel only. The cutterhead would deliver a maximum of 3.3 MCY, over a period of 8 - 9 months. The pipe from the cutterhead would be submerged to allow continued vessel traffic in RWC Channel. Thus offloading activities would not affect recreational boating, or other water-dependent recreation. This is impact is less than significant.

A segment of the Alviso Slough Trail at Pond A9 would have to be blocked off during the sediment delivery period. The Alviso Slough Trail, a 9 mile loop trail, runs along the perimeter of Ponds A9 through A15. The loop follows Alviso Slough to its junction with Coyote Creek and the Bay. A portion of this trail also runs along the perimeter of Pond A15 for a 3.6 mile loop. The Mallard Slough Trail, a 3.3 mile loop trail and the 0.5 mile in-and-out New Chicago Marsh Trail are located east of the Alviso Slough Trail. Of these three trails, the Alviso Slough Trail sees the least amount of usage (HDR 2014). Since recreational users would continue to have access to the remaining sections of the Alviso Slough Trail (as well as the Mallard Slough Trail and the New Chicago Marsh Trail and this impact is less than significant.

Eden Landing

Impact REC-1: Restricted or Reduced Availability or Quality of Existing Recreation Opportunities

Potential activities associated with use of the Eden Landing placement site would include construction of an offloader and approximately 3.5 miles of floating or submerged pipeline, and offloading of scows at the offloader. Alternatively, activities associated with Eden Landing would require construction of a pipeline from the hydraulic offloader to the site. The construction process would be the same as for the Alviso placement site; the construction duration would be slightly less because the pipeline would be shorter. Offloading activities would not create an obstacle to recreational boating, as there is ample space in the Bay for recreational boat users to pass the offloader and any scows and tugs tied up at the offloader. Fishing, hunting, and wildlife viewing opportunities would also be largely unaffected. Only the immediate area around the off-loader would be blocked, and there are many alternative locations in the immediate vicinity of this placement site.

Use of the Eden Landing placement site may also involve use of a cutterhead dredge that would pump material directly from the dredging location to the sediment delivery location at the top of the levee on Pond E2. This dredged sediment delivery mechanism could be used for sediment dredged from both RWC and SBS Channel. The cutterhead would deliver a maximum of 7.7 MCY, over a maximum of 17-21 months. The pipeline from the cutterhead would be submerged to allow continued vessel traffic in RWC Channel. Thus offloading activities would not affect recreational boating, or other water-dependent recreation. This is impact is less than significant.

Operational Effects

Impact REC-1: Restricted or Reduced Availability or Quality of Existing Recreation Opportunities

Following deepening, the total number of vessel calls would initially decrease as less lightering of cargo into scows would be required. Long-term, vessel calls may increase at an average of approximately 3 calls per year until 2025, when the maximum cargo throughput capacity at the Port is expected to be reached. This increase is de minimis and would not have a measurable effect on recreational opportunities in RWC Channel or in SBS Channel. This impact is less than significant.

Mitigation Measures

The potential impacts to recreation associated with the dredging and placement options, and post-construction operations are all less than significant; no mitigation is required.

A.12 Socioeconomics/Population/Housing

This section addresses the socioeconomics of the Project Area, identifying the main industries and how they may be affected by the proposed Project. The information presented includes statistics on the income and racial make-ups of the communities in the Project Area, as well as

information about the labor force and jobs. Contrasts with the larger surrounding areas were described where feasible.

Affected Environment

There are four counties and six cities with jurisdiction over portions of the Project Area. For the purposes of this section, socioeconomic information is presented for each of these jurisdictions, except SF-DODS, which is 50 miles offshore from the Golden Gate. Since labor for various industries in the Project Area could potentially be sourced from anywhere within a commutable distance, this evaluation assumes that some effects on the economy could extend beyond the particular jurisdiction being discussed.

Table A-16 presents socioeconomic data for the Project Area, indicating which dredging and placement sites are located in which jurisdictions. Often, two jurisdictions apply to a specific site, and county jurisdictions may apply to multiple sites. For example, RWC Channel is located in Redwood City and San Mateo County. SBS Channel is also located in San Mateo County, but one part of the channel is also located in the City of South San Francisco, while the other part is located in the City of Brisbane. Population data for each jurisdiction are provided to give a sense of size. The following economic factors are shown in ***Table A-16***: median household income, the percent of persons in poverty, and racial distribution data. The percentage of persons 25 years or older with a bachelor's degree or higher is also provided, since this usually correlates with socioeconomic prosperity. To establish a context for the local data, national, state, and Bay Area averages are also provided. The "white alone" category also includes white Hispanics, which is why percentages add up to more than 100%.

All data in ***Table A-16*** are sourced from the United States Census Bureau, unless otherwise noted. Statistics of note (maxima or minima, etc.) are bolded. It should be noted that Brisbane is a small city of less than 5,000 people and is not in the national census. Census data for Brisbane were taken from city-data.com. The San Francisco Bay Area data are taken from the Bay Area Census (2010) and aggregated from the following nine Counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

A.12.1.1 Dredging Sites

Redwood City Harbor Channel

RWC Channel is located in the eastern part of Redwood City in San Mateo County, California. It is an affluent area, with median income above both the local Bay Area average, as well as state and national averages. Poverty rates range from 8.4% countywide to 9% within Redwood City, both well below the national average of 14.5% and state poverty rate of 16.8%. These rates are also lower than the 9.7% poverty rate for the San Francisco Bay Area.

The Redwood City Harbor area is more white in racial composition than the greater Bay Area, though it is more diverse than the state and national averages. The second largest racial group after "white alone" (60.2%) is Hispanic or Latino, which comprises 38.8% of the residents. The

Hispanic/Latino percentage is similar to the State as a whole, well above the national average, and slightly above the overall Bay Area percentage. The next largest racial group is Asian (10.7%), which is less than both the Bay Area and State averages, but higher than the national average. Statistical data on socioeconomics is provided by location in ***Table A-16*** and the main industries for the Redwood City Harbor Channel area are presented in ***Table A-17****.*

San Bruno Shoal Channel

SBS Channel is located in San Francisco Bay, approximately 0.75 mile east of the City of San Bruno shoreline in San Mateo County and approximately 2 miles south of the City of San Francisco. Parts of the channel lie within the City of Brisbane as well. The area around SBS is relatively affluent, with median incomes on par with or higher than the Bay Area average, which are already higher than both the state and national averages for median income. The City of Brisbane, however, has a relatively high poverty rate of 14.1%, which is considerably higher than the Bay Area rate of 9.7%, although still lower than state and national poverty rates.

The racial compositions of communities around SBS vary quite a bit from each other and also from the regional, state, and national levels. The City of South San Francisco has the highest percentage of Asian residents of any jurisdiction within the Project Area, at 36.6%. This is more than double the state levels and well above the Bay Area levels as well.

A.12.1.2 Placement Sites

Cullinan Ranch and Montezuma

Cullinan and Montezuma are both located in Solano County. The socioeconomics for Solano County are presented in ***Table A-17*** and the main industries are presented in ***Table A-17***. Solano County is one of the poorest jurisdictions in the Project Area. Its poverty rate exceeds the Bay Area average, although its rate is still lower than the state and national averages. Residents of Solano County are about 50% less likely to have a bachelor's degree or higher than the average Bay Area resident. Median income for Solano County is higher than the state and national averages, though it falls well short of the Bay Area average. Solano County has the highest proportion of both white and black residents of any jurisdiction in the project area.

SF-DODS

SF-DODS is approximately 50 miles west of San Francisco and is managed by USEPA Region IX. It has no adjacent land uses except open ocean water and thus is not analyzed for socioeconomics.

Table A-16. Socioeconomic Data by Jurisdiction and Project Site, Redwood City Harbor Navigation Improvement Project

Site	Jurisdiction	Population, 2013 estimates	Median household income (in 2013 dollars), 2009-2013	Persons in poverty (%)	Bachelor's degree or higher, % of persons 25 years +, 2009-2013	White alone (%), 2013	Hispanic or Latino (%), 2013	Asian alone, (%), 2013	Black or African American alone (%), 2013	American Indian & Alaska Native alone (%), 2013
Redwood City Harbor Channel	Redwood City	80,872	$79,419	9.0	**40.2**	60.2 (2010)	38.8 (2010)	10.7 (2010)	2.4 (2010)	0.7 (2010)
	San Mateo County	747,373	**$88,202**	8.4	**44.4**	63.3	25.4	26.9	3	0.9
San Bruno Shoal	City of South S.F.	66,174	$76,785	7.1	29.8	37.3 (2010)	34 (2010)	**36.6 (2010)**	2.6 (2010)	0.6 (2010)
	City of Brisbane*	4,443	$73,630 (2012 $)	**14.1** (2009)	**48.0**	46.4	25.6	23.3	0.2	0.2
Eden Landing Ecological Reserve	Alameda County	1,578,891	$72,112	13.1	**41.8**	52.0	22.7	28.2	12.4	1.2
	City of Hayward	151,574	$62,013	**14.4**	24.2	18.6 (2010)	**40.7 (2010)**	21.6 (2010)	11.3 (2010)	0.3 (2010)
Cullinan Ranch	Solano County	424,788	$67,177	**14.2**	24.3	**60.7**	25.2	15.4	**14.9**	1.3
Montezuma										
Alviso Pond Complex	Santa Clara County	**1,862,041**	**$91,702**	10.8	**46.5**	57.2	26.8	34.1	2.9	**1.4**
	City of Mountain View	77,846	**$97,338**	8.1	**62.6**	56 (2010)	21.7 (2010)	26 (2010)	2.2 (2010)	0.5 (2010)
	City of San Jose	998,537	**$81,829**	12.2	**37.4**	42.8 (2010)	33.2 (2010)	32 (2010)	3.2 (2010)	0.9 (2010)
Compare With:	San Francisco Bay Area***	7,150,739 (2010)	$75,989 (2006-2010)	9.7 (2006-2010)	41.5 (2006-2010)	52.5 (2010)	23.5 (2010)	23.3 (2010)	6.7 (2010)	0.7 (2010)
	State of California	38,802,500 (2014)	$61,094	16.8	30.7	73.5	38.4	14.1	6.6	1.7
	United States	316,128,839 (2014)	$53,046	14.5	28.8	77.7	17.1	5.3	13.2	1.2

Table A-17. Main Industries in Project Area for RWC Navigation Improvement Project

Site	Jurisdictions	Main Industries
Redwood City Harbor Channel	Redwood City	Information Technology, Professional, Scientific, and Technical Services, Healthcare, Retail Trade, Construction (City of Redwood City 2010a))
	San Mateo County	Agriculture, Government, Services, Retail Trade, Mining and construction, Manufacturing, Transportation and public utilities, Wholesale trade, and Finance, insurance and real estate (County of San Mateo 2004)
San Bruno Shoal	City of South S.F.	Limited data. Industries generally described as agriculture and retail, with large employers HQ'd in S. S.F. for food wholesale, biotech and research and development, and some manufacturing (Wikipedia 2015)
	City of Brisbane	Construction, Professional, scientific, and technical services, Transportation and warehousing, Health care and social assistance, Manufacturing, Retail trade, Educational services, Public administration; Wholesale trade (City-data.com 2015)
Eden Landing Ecological Reserve	Alameda County	Advanced manufacturing, Bio science, Construction, Energy, Engineering, Healthcare, Information Communication Technology, and Transportation logistics (Alameda Social Services 2014)
	City of Hayward	Manufacturing, warehousing and distribution, technology and biotechnology, and food manufacturing (City of Hayward 2014)
Cullinan Ranch Tidal Restoration Project	Solano County	Government, education and health services, retail trade, leisure and hospitality, professional and business services, construction, agriculture, and wholesale trade (Solano County and Solano Economic Development Corporation 2015)
Montezuma Wetlands		
Alviso Pond Complex	Santa Clara County	Professional, scientific, management, administrative, and waste management services, Educational, health and social services, and Manufacturing (City-data.com 2015)
	City of Mountain View	Professional, scientific, and technical services, Computer and electronic products, Educational services, Accommodation and food services, Construction (City-data.com 2015)
	City of San Jose	Computer and electronic products, Professional, scientific, and technical services, Construction, Administrative and support and waste management services, Accommodation and food services; Healthcare, Educational services, Social assistance (City-data.com 2015)

Alviso

The Alviso Pond Complex is located in Santa Clara County and the Cities of San Jose, and Mountain View. All have jurisdiction over a portion of the ponds. The area around Alviso Pond Complex contains the first, second, and fourth most affluent jurisdictions in the Project Area, based on median income. The most affluent city, Mountain View, also has the highest percentage of individuals with Bachelor degrees or higher, an impressive 62.6%. The percentages of people in poverty for San Jose and Santa Clara County are lower than state and national averages, but are slightly higher than the regional average in the Bay Area. Santa Clara County has the second highest proportion of Asian (34.1%) residents—well above the regional, state, and national percentages—and the highest proportion of American Indians (1.4%) in the project area, though this number is still lower than the national average. There are comparatively very few African Americans in this area. The proportion of white only residents ranges from roughly 43% to 57% of the population for the jurisdictions around the Alviso ponds.

Eden Landing

The Eden Landing ponds are located in southern Alameda County. Though the median income for Alameda County is relatively high ($72,112) and well over the state and national median incomes, it is still below the Bay Area average ($75,989). Poverty is higher in Hayward than in any other jurisdiction in the Project Area; Hayward has 14.4% of the population living in poverty. This is just barely below the U.S. average, over two points below the State average and almost 50% higher than the average Bay Area poverty rate. Alameda County's poverty rate is also higher than the Bay Area average poverty rate.

The racial compositions of communities around Eden Landing vary greatly—white only percentages range from 18.6% in Hayward to 52% in Alameda County as whole. There are more Hispanics in Hayward (40.7%) than any other jurisdiction in the Project Area and Hispanics represent the racial majority in this city, with the second biggest racial group being Asians (21.6%) and the third being whites (18.6%).

Significance Thresholds

NEPA does not provide specific thresholds of significance for socioeconomic impact assessment. Significance is understood to vary depending on the setting of the proposed action (40 CFR 1508.27[a]). Similarly, CEQA Guidelines do not discuss significance criteria for economic impacts since they are not considered effects on the environment under CEQA.

For the purposes of the RWC Project, the effects of the Project or alternative on socioeconomics are considered to be significant if the proposed Project or alternatives would result in any of the following socioeconomic impacts:

1. Result in a measurable and prolonged decrease in local job supply or decrease in revenue from leading industries.
2. Disproportionately benefit high-income, white communities and/or disproportionately harm low-income communities and/or communities of color.

Environmental Consequences and Mitigation

The Project itself is not expected to yield any increase in Port cargo throughput. As discussed in Chapter 2, throughput is driven by local economic conditions. The Project and alternatives are intended to result in more efficient Port operations. Because the socioeconomic effects would be similar for all dredging and placement options, the analysis was conducted for all sites collectively.

Impact SE-1: Measurable and Prolonged Decrease in Local Job Supply or Decrease in Revenue from Leading Industries

The potential socioeconomic effects of the project are associated with short term job creation during construction. A small number of temporary jobs would be created during construction of the project; the duration of these temporary jobs would be no more than 12 years (the maximum duration of the project) for approximately 6 months per year. The majority of these jobs would be associated with the dredging and pipeline replacement activities; a few temporary jobs would also be created at the sediment delivery location if a beneficial reuse site is used.

The Project may result in some beneficial effects. Because the Port of Redwood City imports bulk construction and building materials, there may be a beneficial effect from this project on the regional construction industry, including the construction activities in some of the jurisdictions that would be affected by the Project. Beneficial effects could include minor reductions in cost and increased supply reliability. The proposed Project is not expected to generate any increases in construction activity, as construction activity is driven by local economic conditions.

Industries that are expanding rapidly and therefore constructing new facilities may experience indirect benefits from the proposed Project. Expanding industries in this region include information technology, professional, scientific and technical services, retail trade, biotech and research and development, computer and electronic products, and construction, among others (Alameda Social Services 2014; City of Hayward 2014).

The cargo handling facilities at the Port of Redwood City are not equipped to process other types of commodities, such as food and technology exports that would make it possible for the project to positively impact industries other than construction. There are no current plans to expand the Port's facilities (adding cranes or other equipment) to accommodate commodities other than construction materials; therefore the Project is not expected to impact any other

industries directly. The Project would have a slight beneficial effect; no adverse impacts are expected.

No mitigation is required because there would be no Project-related adverse impacts to socioeconomics.

Impact SE-2: Disproportionate Benefit to High-Income, White Communities and/or Disproportionate Harm to Low-Income Communities and/or Communities of Color.

Redwood City, San Mateo County, Brisbane, Alameda County, the City of Mountain View, City of South San Francisco, City of Hayward and San Jose may see local economic benefits to the construction industry. The communities that would benefit span a range of poverty levels and racial percentages. Therefore, from an economic standpoint, neither positive nor adverse effects are disproportionately distributed.

The two communities that have the lowest proportion of white residents, the City of Hayward (18.6%) and City of South San Francisco (37.3%) are not communities where construction is a leading industry. However, they are close enough to communities that have a strong construction industry so that labor could be reasonably sourced from them. Therefore, positive impacts to the economy through a beneficial on regional construction and growing Bay Area industries are not expected to be disproportionately distributed. There would be no impact.

Mitigation Measures

No mitigation is required because there would be no Project-related adverse impacts to socioeconomics.

A.13 Transportation/Navigation/Traffic

This section describes the water-based transportation and navigation setting for the Project, detailing the regulated navigation areas and "rules of the road" for vessels navigating the waters in and around the project locations. Regulations pertaining to navigation are also discussed. Land based traffic is briefly discussed, but since all the vast majority ofProject-related work would take place on-water, the analysis focuses on water-based transportation.

Affected Environment

A.13.1.1 Vessel Traffic in the Study Area

Vessel traffic in San Francisco Bay and outside the Golden Gate includes tugs, government vessels, passenger ferry ships, commercial shipping vessels, motorized and non-motorized recreational boats including large sail boats, commercial and sport fishing boats, and personal watercraft (jet skis).

The Vessel Traffic Service (VTS) San Francisco area extends from the Ports of Sacramento, Stockton and Redwood City to the offshore ocean approaches within a 38 nautical mile radius of Mount Tamalpais (Boone pers. comm. 2015) (more discussion of VTS and its role is provided in Section 4.5.13.2, below. Large vessels entering and maneuvering in San Francisco Bay are

required to be on contact with VTS and use designated traffic lanes set by VTS for inbound and outbound vessel traffic, and follow rules governing vessels entering and leaving ports. San Francisco Bay is a tricky complicated waterway from mariner's perspective.

Piloting in and out of the Bay and adjacent waterways is compulsory for all vessels of foreign registry and U.S. vessels under enrollment not having a federally licensed pilot on board. San Francisco Bar Pilots provide these services for vessel movements to and from all terminals in the Bay and tributaries to the Bay, including the Carquinez Strait.

Ship traffic density in San Francisco Bay has increased from approximately 124,987 movements in 2009 to an estimated 131,391 in 2014, with intermittent dips and increases in between (Boone pers. comm. 2015). This includes all types of commercial vessels including ferries, tugs and scows, container vessels, cruise ships, tour boats, etc.

Approach into San Francisco Bay

Approach lanes to the entrance of San Francisco Bay have been established from the north, west, and south. The approach lanes begin in Gulf of the Farallones. The northern and western approach lanes are composed of a 1 mile wide inbound traffic lane and a 1 mile wide outbound traffic lane with a 1 mile wide separation zone between the traffic lanes. The southern approach lane is composed of a 1 mile wide inbound traffic lane and a 1 mile wide outbound traffic lane with a 2 mile wide separation zone between the traffic lanes. Outside these lanes, the US Navy has designated areas for submarine operations within which scow operations are precluded.

The approach lanes lead to an offshore light station with a rotating beacon that marks the beginning of the main channel to the Golden Gate Bridge. The beacon, which is located 10 miles west of Point Bonita, is in the center of a precautionary area where all ships leaving and entering port converge and is called Light Buoy “SF” or referred to as the “San Francisco Sea Buoy.” This is the area where many ships take on or discharge San Francisco Bar Pilots.

Navigation to Port of Redwood City

Ships bound for the Port of Redwood City proceed in an easterly direction toward the Golden Gate Bridge through a narrow channel, which consists of inbound and outbound traffic lanes with a separation zone between them. These traffic lanes are 600 yards wide with a separation zone of approximately 150 yards. The water is usually more than 90 feet deep throughout this area, with the exception of shoal areas. A navigation channel through the shoal is maintained at a depth of 55 feet. Shoal waters less than 30 feet deep exist on either side of this narrow channel. Standard aids to navigation such as horns, bells, and lights are provided at appropriate locations near submerged rocks and points of land. Ships then proceed inbound either through the East Bound Traffic Lane (south of Alcatraz Island) or through the Deep Water Traffic Lane north of Harding Rock Buoy. They will typically transit under the Bay Bridge through the A-B Span or the D-E span. The B-C and C-D spans are options but the width between the bridge

towers is much narrower than the D-E and A-B spans. Once the vessels are clear of the Bay Bridge, they will transit south through SBS Channel and through the fixed navigation span of the San Mateo Bridge. The entrance to the RWC Channel is approximately 3.7 miles south of the San Mateo Bridge.

Vessels in transit through Central and South San Francisco Bay typically maintain speeds between 10 and 12 knots. Dead slow speed for vessels entering RWC Channel is approximately 7 knots; typical speeds within RWC Channel are approximately 9 knots. Vessels entering RWC are escorted by one or more tugs.

As noted in Chapter 3, approximately 70% of vessels entering the Port have drafts that exceed the allowable draft under current conditions. Three options exist for vessels that exceed the allowable draft. Vessels may:

- Wait for higher tides.
- Partially offload cargo onto scows before entering the Port (this practice is called lightering). Both the lightered vessel and the scows are offloaded at the Port.
- Deballast in order to transit San Bruno Shoal channel, then reballast to transit under the San Mateo Bridge, and then deballast again to enter the RWC Channel.

Vessels that are waiting for higher tides as well as vessels that are being lightered anchor at Anchorage 9 (Marine Safety and Security Information Bulletin (MSSIB) 10-06 and 33 CFR 156.118).

Other Vessel Traffic

Ferries comprise more than 50% of the vessel transits in San Francisco Bay. Ferries operate on regular schedules and routes, and have maximum speeds of up to 40 knots. Existing and planned ferry routes are shown in ***Figure A-9***. It is important to note that the planned ferry route for Redwood City shown in ***Figure A-9*** would not begin construction until 2024 or later, well after the proposed RWC Project's construction phase is over.

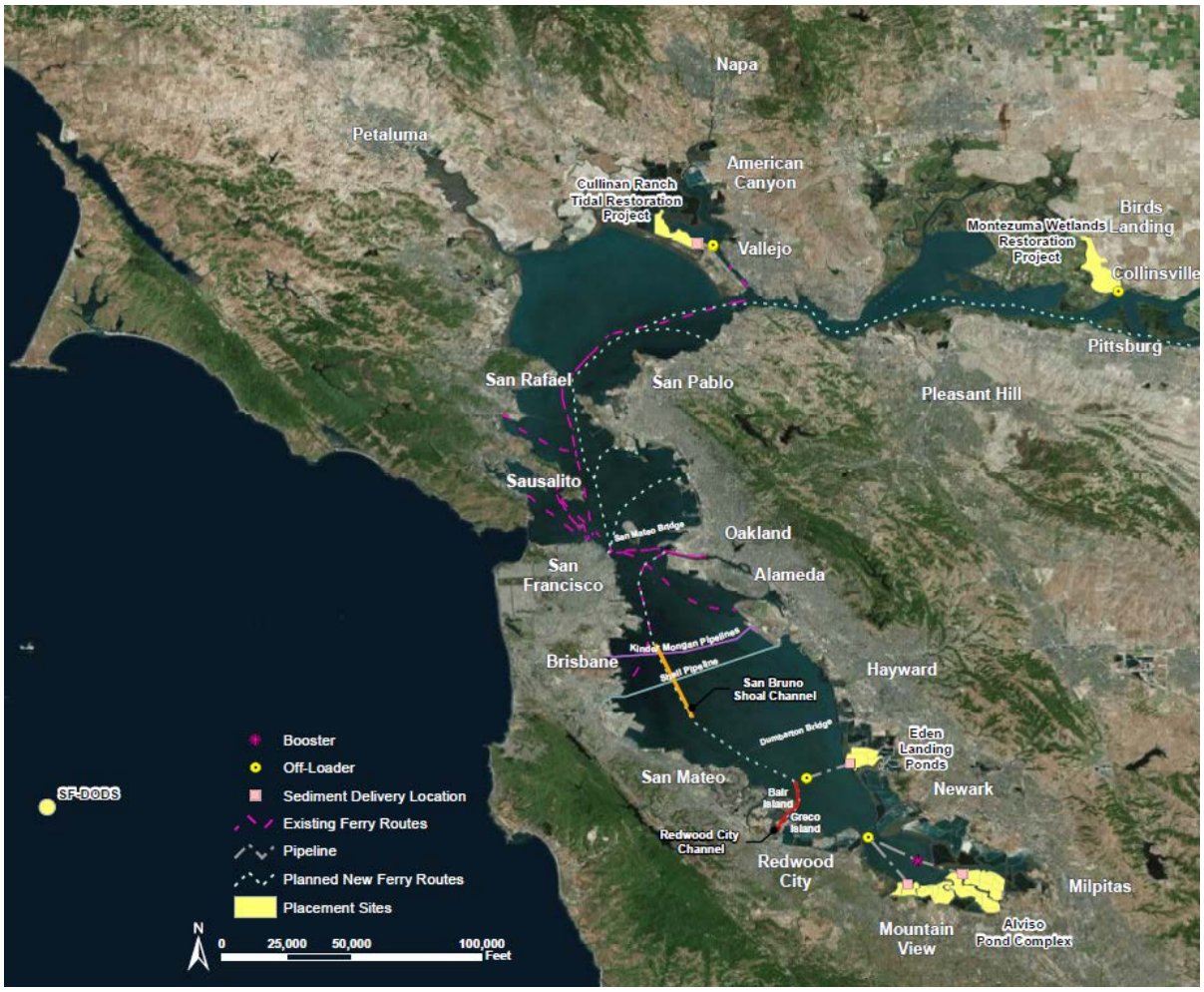


Figure A-9. Existing and Planned Ferry Routes in San Francisco Bay

Regionally, the Marine Highway Initiative is an effort to establish a "container on scow" service stretching from West Sacramento to Oakland, with stops in Stockton, to provide a viable marine highway that facilitates short sea shipping service between regional ports to improve goods movement throughout Northern California. In addition, this initiative is expected to help decrease congestion on major roadways, and reduce the truck emissions associated with the current distribution system. Service started in July 2013 between the Port of Stockton and the Port of Oakland (recordnet.com 2013).

A.13.1.2 Dredging Sites

Redwood City Harbor

The existing Federal navigation channel and turning basins at Redwood City Harbor have an authorized depth of -30 feet MLLW, and are maintained on a one- to two-year dredging cycle. The Federal channel extends from the mouth of Redwood Creek to deep water in San Francisco Bay. It was partially dredged in 2014 and will be fully dredged to its authorized depth of -30 feet MLLW in 2015. The latest Port statistics show that 1.8M tons of commodities passed

through in FY 14 (Jul 12 – June 13). Over the past 15 years, the Port's tonnage has increased at an average annual growth rate of 2.8%. Based on this growth rate, total tonnage is expected to reach the Port's maximum throughput capacity of 2.5 million tons in about 2025. The Port has no plans for future infrastructure improvements, and commodity throughput is expected to remain level after 2025. ***Table A-18*** shows the vessel calls from 2002 to 2014 and the associated commodity volumes.

Table A-18. Commercial Traffic and Commodity Volumes, Port of Redwood City

Port of Redwood City Commercial Traffic					
Fiscal Year	Cargo Metric Tons	Vessel Calls			Percent Barges
		Barges	Ships	Total	
2014	1,784,659	25	64	89	28%
2013	1,493,190	19	51	70	27%
2012	1,319,198	26	48	74	35%
2011	871,940	11	36	47	23%
2010	842,727	16	33	49	33%
2009	986,727	11	37	48	23%
2008	1,487,064	65	50	115	57%
2007	1,436,626	94	46	140	67%
2006	1,833,022	91	60	151	60%
2005	1,908,172	96	60	156	62%
2004	1,484,720	88	54	142	62%
2003	1,111,000	58	42	100	58%
2002	899,652	65	30	95	68%
Note: July/June is the fiscal year.					
Source: Port of Redwood City					

In addition to commercial vessel traffic, the Redwood City public marina and several private marinas are located adjacent to RWC Channel and use the federal channel for recreational boat access in and out of San Francisco Bay (Port of Redwood City 2010). These marinas have approximately over five hundred berths for recreational boats between them (see ***Section A.11***, Recreation).

Popular routes of travel and locations for nonmotorized small boat recreation, nature observation and environmental education include the area around Bair Island Ecological Reserve and Corkscrew Slough.

San Bruno Shoal Channel

SBS Channel also has an authorized depth of and is maintained at -30 feet MLLW. There are no port or other facilities in the immediate vicinity of SBS Channel. The channel is underlain by three fuel pipelines at 3 to 6 feet below the bottom of the channel. Commercial vessel traffic in SBS Channel consists primarily of vessels en route to the Port of Redwood City. Recreational use of the Bay occurs throughout the South and Central Bays, including in the vicinity of SBS Channel.

A.13.1.3 Placement Sites

Cullinan Ranch Restoration Project

The Cullinan offloading site would be located in Napa River, and the sediment delivery site would be located on a levee adjacent to Dutchman Slough. To reach the Cullinan offloading site, scows would have to transit the through South and Central San Francisco Bays and San Pablo Bay into Mare Island Strait, which is the entrance to the Napa River. Barges would use the existing navigation channels where necessary. Mare Island Strait is a federally authorized channel, with an authorized depth of -30 feet MLLW. It currently has depths between -24 and -38 feet MLLW (NOAA 2006). Napa River has a federally-authorized ship channel nominally maintained at -15 feet MLLW; however, no maintenance dredging has been conducted in the past 10 years (Keith Caldwell, pers. comm. 2015). In the vicinity of the proposed offloading location, Napa River has depths of approximately 20 to 21 feet. Dutchman Slough has depths between 8 and 13 feet MLLW in the vicinity of the offloading and the dredged material delivery area (NOAA 2006).

Mare Island Strait is used by some commercial vessels and is on an active ferry route (Vallejo-San Francisco). The Vallejo Marina is located north of the ferry terminal, and there is extensive recreational motorized and non-motorized boat traffic in Mare Island Strait and Napa River north of Mare Island Strait. Vessel traffic in Dutchman Slough is exclusively recreational except during periods of levee maintenance and the recent restoration activities at Cullinan Ranch.

Montezuma Wetlands Project

The Montezuma offloader location is in open water near the confluence of the Sacramento and San Joaquin Rivers. Scows in transit to the Montezuma placement site would use would have to transit through South and Central San Francisco Bays, San Pablo Bay, and Suisun Bay. The scows would use the existing navigation channels where necessary. Just west of the entrance to the Sacramento Deep Water Channel, scows would head in a northerly heading around the north side of Chain Island to the Montezuma offloader.

In addition to supporting commercial traffic, Suisun Bay and the Delta are used extensively by recreational boaters. Commercial traffic in the immediate vicinity of the offloader would consist primarily of vessels bound for the offloader, and periodic maintenance vessels headed for the DWR gates in Montezuma Slough.

SF-DODS

SF-DODS is located in the deep ocean east of the Golden Gate Bridge. Scows en route to SF-DODS would have to transit through South and Central San Francisco Bays, under the Golden Gate Bridge and then through the western San Francisco Bay RNA and the Golden Gate Precautionary Area (see Appendix N, RNA Figures), using designated shipping lanes. San Francisco Bay between San Francisco and Oakland, near the San Mateo Bridge, and around the entrance to the Bay at the Golden Gate Bridge are all trafficked by ferries, as well as commercial vessels heading to the Ports of Oakland, San Francisco, and those heading north towards San Pablo Bay and the Port of Stockton. Once out on the open ocean, ***Figure A-10*** shows the typical route that a disposal vessel would take to reach SF-DODS. As noted in the figure, the vessel remains within established shipping lanes in the vicinity of the Farallon Islands, as required (USEPA 2015) to minimize effects to the Monterey Bay and Gulf of the Farallones National Marine Sanctuaries, and avoid the Farallon Islands exclusion zone. .

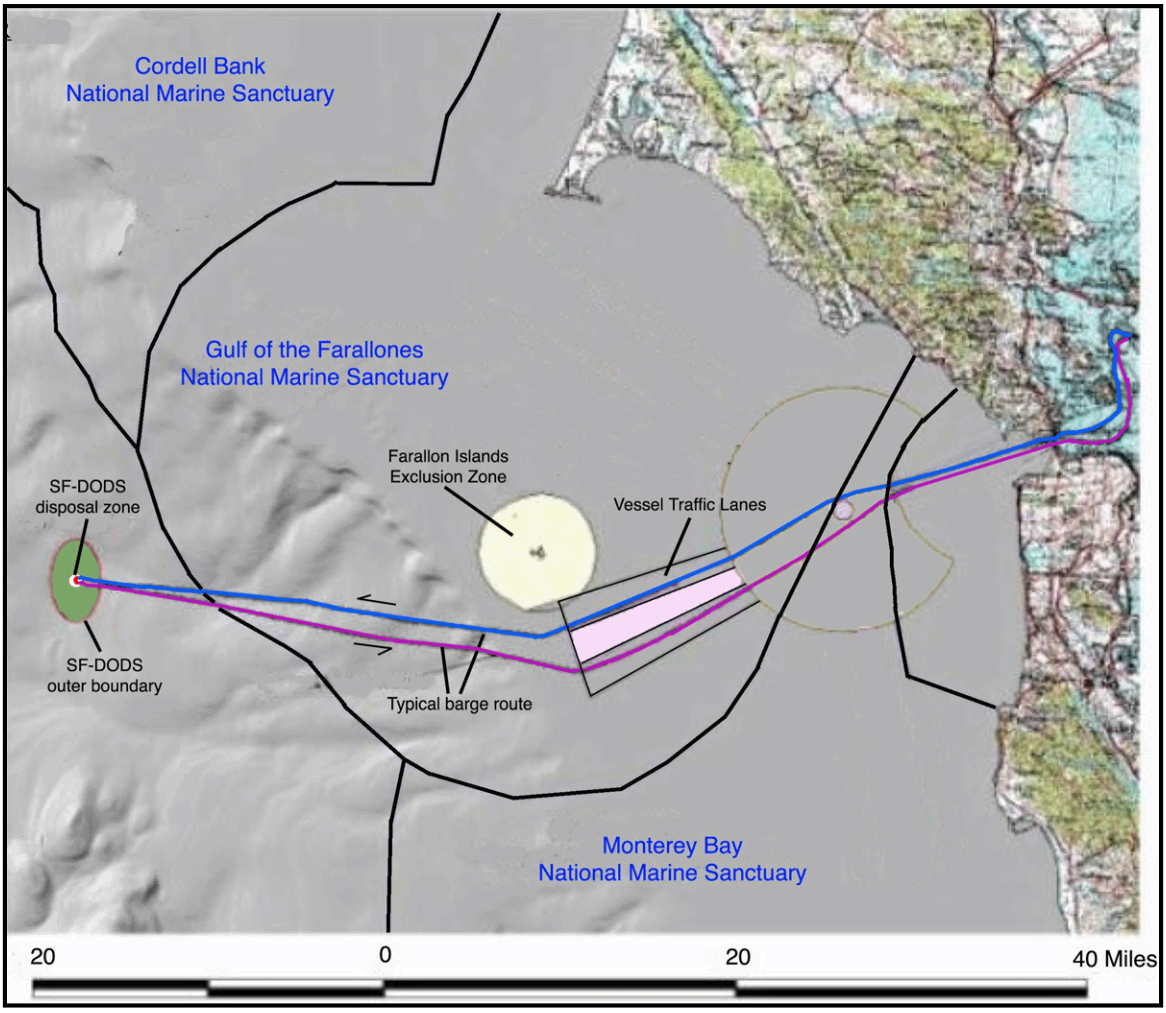


Figure A-10. Transit Route to and from SF-DODS

Sea conditions in the open Pacific Ocean off central California can be extreme, therefore there are strict limitations on the transit route and allowable weather and wave conditions for accessing SF-DODS that project contractors must comply with.

Eden Landing Restoration Project

Eden Landing is located on the east side of the South Bay, opposite Redwood Creek/RWC Channel. Alameda Creek (sometimes called Coyote Hills Slough) runs along the south edge of Ponds E2 and E4. The proposed offloader location is just east of the entrance to the RWC Channel on the east side of the natural deepwater channel (***Figure A-8***).

Compared to the Central Bay and areas closer to San Francisco and Oakland, this area has limited boat traffic, though there is some commercial ship traffic nearby, heading to the Port and there are several public and private marinas in the vicinity of the Port.

Alviso Ponds Restoration Area

Alviso Pond Complex is located in the South Bay. Coyote Creek runs along the northern edge of the pond complex. Guadalupe Slough and Alviso Slough run through the Pond Complex, with the sediment delivery location at Pond A9 located just within the entrance to Alviso Slough, and the sediment delivery location at Pond A2W just inside Mountain View Slough. If the Pond A9 sediment delivery location is used, another booster pump would be located in open water midway between the delivery location and the offloader (***Figure A-8***).

The sloughs and open waters around the Alviso Pond Complex are used recreationally. There is little or no commercial traffic, except during levee maintenance activities for the nearby community of Alviso and commercial fishing boats that fish in the Bay. Alviso Marina County Park is located on the banks of Alviso Slough and provides a public boat launch ramp for motorized and non-motorized boats. The South Bay Yacht Club (SBYC) is located along the bank of Alviso Slough. The Blue Whale Sailing School is also located along the levee of Alviso Slough, adjacent to and downstream of SBYC.

A.13.1.4 Land Based Traffic

Effects to land-based traffic from construction-related activities would be *de minimis* for this Project. Most, if not all, of the heavy equipment (dredges, scows, tugboats, etc.) would transit to the site over water. If heavy equipment would need to use local roadways to access the Project areas during construction, a Traffic Control Plan would be completed and implemented to avoid and minimize impacts to local traffic.

Construction crew travel effects would also be minimal. Construction workers for the dredge sites would consists of a 16 or 18 member crew, depending on the type of dredge (16 for clamshell and 18 for a cutterhead), working 12-hour shifts. These workers would most likely drive to the Port and park there before taking a skiff to the dredge.

There would also be a five person crew staffing an offloader at Eden Landing, Alviso, or Cullinan, if any of these sites are used to place dredged material. Offloader crews would likely drive and park at a marina near the placement sites and take a boat to the offloader for their 12-hour shift. If the maximum amount of material went to each of these sites, it would mean five offloader workers traveling to and from the site (two crews per 24-hour period) for up 24 months out of a 4 year period at Eden Landing and Alviso, and 58 months out of a 10-year period at Cullinan, which has a slower placement rate. This effect on land based traffic would be *de minimis*.

In a regional context, both dredge sites are located in San Mateo County, where roughly three quarters of a million people live. Eden Landing and Alviso Ponds are close to one another, but span two counties—Alameda and Santa Clara County. Together these counties have well over three million residents, while Cullinan Ranch is part of Solano County, which has just under half a million residents.

The south portion of the San Francisco Bay region, the broader location of RWC and SBS Channels as well as both Eden Landing and Alviso Ponds, is an urbanized area. Due to the large scale of existing land based traffic in these populated urban areas, adding five to 18 daily commuters for up to 6 months out of the year during of construction is unlikely to have a noticeable impact. Primary access to the Port of Redwood City would be via Highway 101. In 2011 US-101 had an annual average daily traffic (AADT) maximum of 209,000 vehicles in the portion near Redwood City (Caltrans 2013). Thirty-six vehicles per day (72 total trips) compared to the daily traffic is less than 0.001%. Near Alviso, the Highway 101 AADT was similarly high at 197,000 AADT (max) (Caltrans 2013). Twenty total vehicle trips would not contribute to any noticeable traffic effects. Eden Landing would be accessed via Interstate 880 or Highway 92. Both of these roads are also major transportation arteries, and adding a small number of daily commute trips would not affect overall traffic on these roads. Any impact from construction workers commuting to work would also be *de minimis*.

Traffic effects during operation would be largely limited to effects from trucks exiting the Port. There would be no effects associated with public transportation, or bicycle and pedestrian access; small increases in the local workforce could also occur. However, the growth in cargo projected for the Port (up to a 38% increase in cargo throughput) would not be attributable to the Project. As discussed in Section 4.2, growth would occur with or without the Project. Increases in truck traffic would be due to projects that result in increases in Port throughput capacity. The most recent project completed at the Port, the improvement of Wharves 1 and 2, was projected to add to the baseline cargo throughput, and provided traffic mitigation for that increase (Port of Redwood City 2010). Based on the information provided above, land based traffic is not analyzed in further detail. However, waterborne transportation effects are assessed.

Regulatory Setting

This section discusses the regulatory setting for navigation in the Project Area, including which laws and agencies governing navigation in the area.

A.13.1.5 Federal, State, and Regional Laws, Regulations, Policies and Agencies

Under Federal law, the USCG regulates marine traffic and sets "rules of the road" for navigation. The USCG's Vessel Traffic Service (VTS) for San Francisco Bay, which is located on Yerba Buena Island, controls marine traffic throughout the Bay Area. (VTS performs a function similar to air-traffic control for airports.) Although some small and private vessels are not required to coordinate their movements by contacting the VTS, the Coast Guard monitors all commercial, Naval, and private marine traffic within San Francisco Bay and local coastal waters.

The California Department of Boating and Waterways (Cal Boating) establishes and enforces recreational boating operation and equipment regulations in conformity with federal navigation rules promulgated by the Coast Guard.

The San Francisco Bay Water Emergency Transportation Authority (WETA) is a regional agency authorized by the State of California (SB 976) with control of all public transportation ferries in the Bay Area region, except those owned and operated by the Golden Gate Bridge District. WETA was created in 2007 from the San Francisco Water Transit Authority (WTA). WTA adopted an Implementation and Operations Plan which describes the current ferry system within the Bay. WETA later adopted the Final Transition Plan, which describes the expansion of the existing ferry service within the Bay.

A.13.1.6 Regulated Navigation Areas

Within San Francisco Bay, the USCG has established RNAs (Regulated Navigation Areas) as depicted in Appendix N. The RNAs increase navigational safety by organizing traffic flow patterns; reducing meeting, crossing, and overtaking situations between large vessels in constricted channels; and limiting vessel speed.

RNAs apply to "large vessels" (defined as power-driven vessels of 1,600 or more gross tons, or tugs with a tow of 1,600 or more gross tons). When navigating within the RNAs, large vessels follow specific guidelines. They must have their engines ready for immediate maneuver, must operate their engines in a control mode and on fuel that allows for an immediate response to any engine order, and must not exceed a speed of 15 knots through the water.

San Francisco Bay RNA

The first RNA encountered by inbound ships is the San Francisco Bay RNA, which extends from the precautionary zone east of the Golden Gate Bridge to Alcatraz Island (see Appendix N for RNA maps). Because of the large number of vessels entering and departing San Francisco Bay, traffic lanes were established under the Golden Gate Bridge and in the Central Bay to separate

opposing traffic and reduce vessel congestion. Use of these lanes and adherence to the indicated direction of travel is required for large vessels and recommended for all other vessels.

Due to the presence of shoals and rocks in the Central Bay, the Central Bay Two-Way Deep Water Traffic Lane (DWTL), located north of Harding Rock, provides the best water depth safety margin for inbound vessels with a draft of 45 feet or greater, and for outbound vessels with a draft of 28 feet or greater. These deep draft vessels are required to use the DWTL.

North Ship Channel RNA and San Pablo Straight Channel RNA

The North Ship Channel and San Pablo Strait Channel RNAs consist of the existing charted channels and delineate the only areas where the depths of water are sufficient to allow the safe transit of large vessels. The strong tidal currents in these channels severely restrict the ability of large vessels to safely maneuver to avoid smaller vessels.

Pinole Shoal Channel RNA

The Pinole Shoal Channel RNA is a constricted waterway, the use of which is currently restricted to vessels with of 1600 gross tons or greater or tugs with tows of 1600 gross tons or greater (as per regulation 33CFR165.1181).

Benicia Martinez Railroad Drawbridge RNA

The Benicia Martinez Railroad Drawbridge RNA consists of a small circular area, 200 yards in radius, centered on the middle of the channel under the Benicia Martinez Railroad Drawbridge. The limited horizontal clearance results in a greater chance of vessel collisions with the bridge. This risk of collision is significantly increased when there is poor visibility. The regulation precludes large vessels from transiting the Benicia Martinez Railroad Drawbridge RNA when visibility is less than a half nautical mile.

A.13.1.7 Critical Maneuvering Areas

Critical Maneuvering Areas (CMAs) are areas within the Bay where additional standards of care are required due to the restrictive nature of the channel, proximity of hazards, or the prevalence of adverse currents. CMAs were established by the Harbor Safety Committee as best practices in response to the Cosco Busan bridge allision. While they are best practices,the VTS can enforce compliance under the National VTS Regulations (per MSIB 15-05 dated 13 February 2015). Tugs with tows are advised not to transit through CMAs when visibility is less than 0.25 nautical mile. Locations in the Bay identified as CMAs pertinent to this project are Redwood Creek, San Mateo-Hayward Bridge, Oakland Bar Channel, the east span of Richmond-San Rafael Bridge, and Union Pacific Railroad Bridge (HSC 2014).

Significance Thresholds

Because this transportation evaluation focuses on marine navigation, many of the California Environmental Quality Act (CEQA) Appendix G thresholds for transportation/traffic, as written, do not apply to the project alternatives because they are focused on land-based or

air transportation. Therefore, the following project-specific thresholds were established to evaluate the potential for navigation impacts under NEPA and CEQA. Navigational safety risks are discussed in **Section A.8**, Hazards and Hazardous Materials.

Waterborne transportation impacts would be considered significant if the Project vessel traffic or vessel traffic generated by the Project alternatives would cause or create:

- Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade.
- Substantially interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area.

Potential navigational safety risks are addressed in the Hazards and Hazardous Materials discussion (***Section A.8***).

Environmental Consequences

Dredging Options

Redwood City Harbor Channel

Impact NAV-1: Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade

Dredging and Construction Phase

RWC Channel does not currently experience congestion problems and is a relatively low-traffic area, with an average of roughly 9 vessel calls per month in 2014. The channel is 300 to 900 feet wide and the largest vessels that call on it (Panamax vessels) are 110 feet wide. Dredging operations in the channel would be planned and impermanent, lasting a maximum of 67 months (-37 ft alternative with 2 feet of overdepth and the minimum dredge rate per day at RWC Channel with placement at SF-DODS). This would occur during the 180-day dredging windows only and would therefore span about twelve dredging windows. While dredging operations would result in a small number of additional vessels and scows using RWC Channel during the construction phase, the Port and marinas along the channel would still be accessible. There could be up to approximately seven pieces of equipment in use during for dredging. In addition to the dredge itself, accompanying equipment for a clamshell dredge would include scows, tugboats to position the dredge and scows, a crew boat, and a tender tug. For a cutterhead dredge, there would be a booster pump(s) at the dredge, a derrick barge, a crew boat and two tender tugs. Slight delays are possible as a result of the dredging, but these would not be unreasonable. A notice to mariners would be publically posted so that recreational users and commercial vessels are aware of dredging locations and schedules. This impact is less than significant.

Post-Construction

By 2025, the total tonnage throughput at the Port is expected to reach 2.5 million, up from roughly 1.8 million tons in 2014. This growth would occur as a result of regional economic activity rather than the proposed Project. Vessel traffic would be expected to increase slightly over time. Vessel traffic with the Project would be expected to decline slightly relative to the No Action/No Project condition. Since dredging a deeper channel would reduce the need for light-loading and lightering, deep draft ships would be able to carry more cargo to Port, resulting in less lightering into barges and potentially fewer deep draft vessel calls as well.

Under the current conditions, roughly two per month are used at RWC Channel for lightering. Under the -32 foot MLLW dredging option, this would decrease to about one per month. Thus, the long-term effect of the deepening would be about a 33% decrease in barge calls, as well as a 10 to 24% reduction in deep draft vessel calls. The Proposed Project would also reduce the wait times for vessels wishing to enter the Port. The Project would have a beneficial effect on navigation in the post-construction phase.

Impact NAV-2: Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area

The existing RWC Channel capacity is expected to handle the temporary increase in vessel movement during construction, without substantially interfering with navigation. Though the number of large vessel movements in RWC Channel would noticeably increase, this increase would not substantially impede other vessel movement and would be temporary. This impact is less than significant.

San Bruno Shoals Channel

Impact NAV-1: Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade

Dredging and Construction Phase

SBS Channel is located in a wide part of the Bay. Though deep draft vessels must use the deep draft channel, all other vessels, such as barges, ferries, and recreational vessels, have adequate water depth and ample room to move in the shallower parts surrounding the channel. A notice to mariners would be posted with dredging and pipeline removal maps and schedules to help guide mariners away from the construction area.

Pipeline relocation activities could block portions of the channel while the pipeline segments crossing the channel are relocated (lowered). The preferred method for the relocation effort would be selected during the Project design phase. If directional drilling is used, there would be no blockage of the channel, as all work could be completed from outside the channel boundaries. If clamshell construction is chosen, the work duration in the channel would require up to 3 weeks; however, work would be done by a dredge, and dredging activities would be coordinated with vessel calls to the degree feasible. Furthermore, the channel is 500 feet wide,

and vessels are likely to be able to transit past the dredge during the majority of the work period in the channel. If the jet sled method is chosen, construction in the channel could require from 50-100 months, working 10 hours per day. Because the jetsled is deployed from a vessel, the vessel could be moved out of the channel when there is no construction activity, and thus allow vessels to transit the channel. The potential obstruction of vessel traffic during construction and dredging in SBS Channel is less than significant.

Post-Construction

The current SBS Channel is slightly depth constricted and this Project would add needed depth to the deep draft channel. The Project would have a beneficial effect on navigation in the post-construction phase.

Impact NAV-2: Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area

SBS Channel dredging or pipeline relocation would not result in substantial interference with vessel navigation, nor a substantial increase in vessel volume. No impact is expected.

Placement Sites

Cullinan Ranch Tidal Restoration Project

Impact NAV-1: Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade

The proposed offloader locations on the western edge of the deep water channel in the Napa River and the proposed pipeline alignments in the shallow water adjacent to the levees along Dutchman Slough were chosen in part to minimize impact on vessel traffic in the area. Scow delivering sediment are not expected to cause delays to commercial vessels in the Federal channel, and there is ample room for smaller vessels to divert around the scows. There would be no impact.

Impact NAV-2: Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area

This area is relatively well-trafficked already, with many recreational boaters on the Napa River, periodic recreational boat traffic on Dutchman Slough, and an existing Federal Navigation Channel in the area and in Mare Island Strait. The maximum traffic added from use of Cullinan Ranch would be two to three scows delivering sediment to the offloader per day. This would not substantially interfere with vessel navigation or substantially increase vessel volume. The impact is less than significant.

Montezuma Wetland Restoration Project

Impact NAV-1: Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade

The waters near Montezuma experience some commercial traffic on the way to the Sacramento River, and there is recreational boat traffic near the offloader, as well. There are no marinas or other sources of recreational vessel traffic near the site, however. The offloader is located close to the northern shore, north of Chain Island; there would be no commercial vessel traffic other than that bound for the offloader north of Chain Island. Recreational vessel traffic can either pass by the tug and scow north of Chain Island, or could divert to the south of Chain Island. No construction is proposed at this site. Delays to commercial vessels would not be expected to result from placing material at Montezuma. There is no impact.

Impact NAV-2: Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area

With only two to three scow arrivals per day, and no construction proposed at this site, the potential impact to navigation is less than significant.

SF-DODS

Impact NAV-1: Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade

The scow trip to SF-DODS involves navigating through the busier parts of the San Francisco Bay. The Bay experienced over 130,000 vessel movements in 2014. Contractors transporting materials would follow all rules for vessel navigation. A maximum of two to three scows transiting to SF-DODS per day would not be expected to cause any delays to commercial vessels. This impact is less than significant.

Impact NAV-2: Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area

Contractors transporting material to SF-DODS would follow all rules for vessel navigation, including use of the transit route around sensitive habitat areas and adhering to any weather restrictions, should they arise. With a maximum of two to three scow deliveries per day, no interference is expected with vessel navigation and this would not be considered a substantial increase in vessel movement volume in the study area. Any impact would be less than significant.

Alviso Ponds

Impact NAV-1: Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade

The Alviso offloader location, on the eastern edge of the natural deep water channel in the Bay, between the Dumbarton Bridge and the railroad bridge was chosen specifically to avoid delays

and hazards to scows transiting the railroad bridge. Boat traffic in the South Bay is mostly recreational. There would be no unreasonable delays to commercial vessels.

Impact NAV-2: Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area

Offloader construction and operation would not substantially increase the volume of vessel movements in area, and would not create any substantial interference with recreational vessel traffic. With no more than two to three scows offloading at Alviso per day, this would not cause substantial interference with vessel navigation, nor would it substantially increase the volume of vessel movements. There would be ample room for recreational vessels to divert around the offloader and construction activities associated with the offloader and dredged sediment pipeline. The proposed pipeline alignments are also designed to avoid interfering with recreational vessel traffic. They would be located in deep to shallow water, crossing mudflats and shallow water prior to terminating at the top of the levees at either Pond A2W or A9. Booster pumps would be located on top of the levee at the sediment delivery location. The additional booster pump required to deliver sediment to Pond A9 would be in relatively shallow water east of the natural deep water channel. There would be no impact.

Eden Landing Ponds

Impact NAV-1: Unreasonable (unplanned, regularly occurring) delays to commercial vessels plying their trade

The proposed offloader location for Eden Landing is the closest to the dredging areas of any of the proposed placement sites, adjacent to the eastern edge of the deep water channel near the entrance to RWC Channel. Mariners would expect to encounter larger vessels in this area. Delays to commercial vessels resulting from scows transiting to the offloader would be unlikely and on-going communications between the vessels would prevent vessel interference. Any delays would be minor, as the tug crossing the channel would typically require less than 1 minute to complete the transit. This delay would not be unreasonable, and there would be no impact. The pipeline from the cutterhead to the dredged sediment delivery location may cross RWC Channel. It would be submerged and placed on the bottom of the channel to avoid impacts to vessel navigation. The pipeline from the offloader to the dredged sediment delivery location would be well marked, and would be partially located on the Bay bottom to allow continued transit of various types of smaller commercial and recreational vessels. The impact would be less than significant.

Impact NAV-2: Substantial interference with vessel navigation, and/or substantially increased the volume of vessel movement in the study area

As discussed previously, dredging activities would result in 2 to 3 scows being delivered to the offloader each day. Vessel movement in the study area would not increase substantially. The transits of the channel would be of short duration, and there is ample space for shallower draft

vessels to divert around the offloader area during construction and operation. Construction of the dredged sediment delivery pipeline across the channel could result in a temporary blockage to vessel traffic in RWC Channel, and would be coordinated with vessel movements to avoid interference. For the reasons described above, the dredged sediment delivery pipeline would not pose a substantial obstacle to navigation. The impact would be less than significant.

Mitigation Measures

There are no significant impacts, and no mitigation is required.

A.14 Utilities/Service Systems

Affected Environment

This section addresses potential effects to public services, utilities, and related infrastructure that could be affected by Project activities. The focus is on the potential for damage to these types of facilities, the need to possibly relocate or otherwise protect the facilities, and the potential for disruption in these services/utilities during dredging or placement activities. The analysis does not address the proposed Project's effect on supply and demand for these public services, since these would not be substantively affected by the proposed Project. Potential hazards associated with relocation of the fuel pipeline are addressed in ***Section A.8***.

A.14.1.1 Dredging Sites

Redwood City Harbor

There are no underground utilities in/across the channel in the vicinity of the Port. Above ground high tension electrical power lines cross RWC Channel east of the mouths of Corkscrew and Westpoint Sloughs, about 0.5 miles north of the Port. Power towers are located on the mudflats adjacent to the channel. These power lines are not the controlling height for the channel deepening. The controlling height is the San Mateo Bridge and would continue to be so after the deepening is completed. All of the utility mains serving the wharf areas are located in upland areas. The utilities serving the wharves include electrical, water, sanitary sewer, and storm sewer fuel lines. Potable water is received from Redwood City; sanitary waste is treated at the Silicon Valley Clean Water Treatment Plant in Redwood Shores. There are no active fuel lines in the Port area, and all abandoned fuel lines have been cleaned up in accordance with California EPA Department of Toxic Substances Control and USCG requirements.

San Bruno Shoal Channel

As described in ***Section 4.2 of the Main Integrated Report*****,** three fuel pipelines are known to exist below SBS Channel. A single southern pipe is owned by Shell; two northern pipelines located in one trench are owned by Kinder-Morgan. The Shell pipeline is reported to be inactive. The Kinder-Morgan pipelines provide fuel to San Francisco International Airport and Metropolitan Oakland International Airport. No other utilities are known to be present in the immediate vicinity of SBS Channel.

A utility survey was conducted to locate the pipelines. The Shell pipeline is located between 3.8 and 6.2 feet below the bottom of the channel; the channel in this area had a bottom elevation ranging from -30 feet MLLW to -33 feet MLLW.

The Kinder-Morgan petroleum lines were located in the horizontal plane; however, the subbottom profiling was unable to confidently determine the pipeline depths. A filled-in trench ranging from 20 -30 feet in width was found, with the bottom of the trench at depths between 2.8 and 6.8 feet below the bottom of the channel. While it can be assumed that the pipelines would have been laid into the bottom of the trench, the report indicates that no pipeline could be confidently located within the trench. Channel depths in this area ranged from -29 feet MLLW to approximately -33 feet MLLW. The eastern approximately 215 feet of pipeline in the channel could not be surveyed; the channel bottom materials changed, and sub-bottom profiling was unsuccessful. Divers confirmed that dense armor rock was present in this area at depths ranging from 1.8 to 3 feet below the bottom of the channel. In the center of the channel divers were able to probe through the armor rock and locate pipelines approximately 5 feet below the bottom of the channel. The pipelines were separated about 5 feet. A secondary reflector of unknown source was consistently found at depths of approximately 15 feet below the channel bottom (Fugro and HDR 2014).

A.14.1.2 Placement Sites

None of the placement sites would require the use of any service systems such as waste water treatment or potable water treatment. Therefore, this section focuses on only utilities that may be present in the Project Area.

Cullinan Ranch Restoration Project

There are no known above ground or buried utilities in the immediate vicinity of the Cullinan offloading locations, nor are there any utilities along the proposed pipeline locations. Electrical power could be provided from Mare Island to the southern offloader location.

Montezuma Wetlands Project

There are no known utilities in the immediate vicinity of the Montezuma site. Electrical power to the Montezuma offloader is provided from the shore.

SF-DODS

There are no known utilities in the vicinity of SF-DODS.

Eden Landing Restoration Project

There are no known above-ground or buried utilities in the immediate vicinity of the Eden Landing dredged sediment delivery location. The nearest utility is an electrical distribution line along Old Alameda Creek that powers a pump at Pond E1 (J. Krause pers. comm. 2015). There are also no known above ground or buried utilities near the proposed offloader location.

Alviso Ponds Restoration Area

There are no known underground utilities in the immediate vicinity of the Alviso dredged sediment delivery sites. High tension power lines are located north of the Dumbarton Bridge. Underground cables and potable water lines are present between the Dumbarton and railroad bridge in the vicinity of the proposed offloader location for the Alviso ponds. High tension power lines cross Pond A2W near the entrance to Mountain View Slough. A power tower is located in the vicinity of the proposed dredged sediment delivery location at Ponds A2W. High tension power lines also cross Coyote Creek near the mouth of Alviso Slough.

Significance Thresholds

Impacts associated with utilities and service systems would be considered significant if the dredging and/or sediment delivery activities would:

- Potentially damage services or utilities
- Interfere with the operation of fuel pipelines such that customers served by these pipelines would lack adequate access to fuel supplies for their day-to-day operations or cause other disruptions to utilities or service systems, or
- Require or result in the need to relocate or otherwise protect or replace services or utilities where those activities are not already incorporated into the proposed Project

Environmental Consequences

Environmental effects on service systems and utilities were evaluated by assessing the location of utilities relative to project activities, and the need to take any utilities out of service during construction.

A.14.1.3 Dredging Options

Potential effects on utilities and service systems are the same for all three dredging options. There would be no impacts to service systems, as there would be no activities near any existing service systems, and no need for increased capacity at any existing service systems. Thus, the discussion below focuses on utilities.

Impact UTIL-1: Potential Damage to Utilities or Service Systems

There are no utilities underneath the channel in RWC Channel or the adjacent berths. Should deepening of the berths require any work on the wharves, affected utilities would be modified as needed to provide safe and reliable service to the upgraded wharf. Existing utilities at wharves would be appropriately protected to avoid any damage to utilities that are scheduled to be retained.

Relocation of the fuel lines would be subject to the plans and specifications prepared by the USACE, the pipeline owners or another qualified party, and conducted in accordance with all applicable safety standards and the best management practices outlined in Section 4.2. The fuel lines would be lowered to a depth of 6 feet below the maximum depth of the future channel (design channel depth plus two feet of overdepth). Lowering the fuel lines would

reduce the potential for any damage to the fuel lines following construction. Given that the current cover over the fuel lines is less than 3 feet in some locations, the post-construction conditions would be an improvement over current conditions. This impact is less than significant.

Impact UTIL-2: Interfere with Operations of or Cause Other Disruptions to Utilities or Service Systems

Relocation of the fuel lines could cause a temporary disruption in service of the fuel lines while the replacement lines are being tied into the existing lines, and potentially due to unplanned incidents during construction. This disruption would be limited to the time required to cut the existing fuel lines and connect the existing fuel lines with the relocated (deeper) segments. This activity is expected to require up to 14 days at each tie-in location.

The Shell fuel line is reportedly inactive. Therefore, taking this fuel line out of service for an estimated 14 days would not cause an unacceptable disruption to fuel supplies. The tie-in of the replacement pipeline could be accomplished at both ends simultaneously or sequentially at each end.

One Kinder-Morgan pipelines would be tied in at a time, allowing one line to remain in service to provide fuel as needed. These fuel lines supply the Kinder Morgan Terminal in Brisbane, which in turn provides fuel to San Francisco International Airport. It is anticipated that to expedite the return of these pipelines to service that both end of the replacement pipeline would be tied in simultaneously. As part of the Fuel Pipeline Relocation and Response Plan, the contractor would be required to coordinate with the pipeline owners regarding fuel supply and contingency plans for unintended interruptions in the fuel supply. The plan would address storage capacity, include provisions for a continued fuel supply if disruptions occur or the available conveyance capacity of the single Kinder-Morgan pipeline is inadequate, and create an agreed-upon ranked menu of choices. Every effort would be made to avoid interference with airport operations or any other critical commercial or industrial function.

The electrical lines crossing above RWC Channel would be above the maximum height of the dredge equipment, and safety awareness training conducted as part of routine construction operations would ensure that the dredge operator and other employees would be aware of the potential hazard. This impact is less than significant.

Impact UTIL-3: Need to Relocate or Otherwise Protect or Replace Utilities or Service Systems

As discussed above, as part of the Project the three fuel pipelines underneath SBS Channel would be relocated to a deeper depth. Also, should deepening of the berths require any work on the wharves, affected utilities would be modified as needed to provide safe and reliable service to the upgraded wharf. The potential changes to utilities at the wharves would be minor, and are a normal part of construction activities. Finally, if the dredge working in RWC Channel is electrically powered, electrical service would have to be provided near the wharf.

This would most likely entail connecting to the existing substation at Wharves 1 and 2, and running a cable to a small substation on the dredge to step down the current to a voltage usable by the dredge. No other utilities would be required, nor would any other utilities require relocation or replacement. This impact is less than significant.

A.14.1.4 Placement Sites

Cullinan Ranch Restoration Project

Impact UTIL-1: Potential Damage to Utilities or Service Systems

There are no existing utilities or service systems located at or near the Cullinan site; therefore there is no potential for damage to occur. There would be no impact.

Impact UTIL-2: Interfere with Operations of or Cause Other Disruptions to Utilities or Service Systems

There are no existing utilities or service systems located at or near the Cullinan site; therefore there is no potential for interference or disruptions. There would be no impact.

Impact UTIL-3: Need to Relocate or Otherwise Protect or Replace Utilities or Service Systems

The contractor may choose to operate the Cullinan offloader using electrical power. Electrical power would be provided from Mare Island. A small substation would most likely be constructed at the offloader to step down the current to one usable by the offloader and support equipment. Several power poles would most likely have to be installed on Mare Island to lay the electrical cable to the offloader location. It is anticipated that an ample power supply is available at Mare Island (R. Lowgren, pers. comm. 2015). No other utilities would be required, nor would any other utilities require relocation or replacement. This impact is less than significant.

Montezuma Wetlands Project

All utilities at the Montezuma site are at the offloader or closer to shore. There would be no impacts from transporting sediment to the offloader location.

SF-DODS

There are no utilities at SF-DODS, and there would be no impacts.

Alviso Pond Complex

Impact UTIL-1: Potential Damage to Utilities or Service Systems

The electrical lines crossing above Coyote Creek and Mountain View Slough would be above the maximum height of the construction equipment used to lay the pipeline, and safety awareness training conducted as part of routine construction operations would ensure that the equipment operators and other workers would be aware of the potential hazard.

The precise locations of the existing water lines and cables between the Dumbarton and railroad bridges would be determined during design, and the offloader would be located at a safe distance from these existing lines and cables. This impact is less than significant.

Impact UTIL-2: Interfere with Operations of or Cause Other Disruptions to Utilities or Service Systems

The Alviso offloader and dredged sediment delivery pipeline would not use any utilities. The offloader and booster pumps would be diesel-fueled. Therefore, the only potential disruptions and interference that could occur would be as a result of damage. As described above, the design and construction process would avoid damage to utilities. This impact is less than significant.

Impact UTIL-3: Need to Relocate or Otherwise Protect or Replace Utilities or Service Systems

The proposed Project would avoid all existing utilities in the vicinity of the offloader and dredged sediment delivery locations. No utilities would be required, nor would any utilities require relocation or replacement. This impact is less than significant.

Eden Landing Restoration Project

There are no existing utilities or service systems located at or near the proposed Eden Landing offloader and sediment delivery locations and no utilities are proposed; therefore, there would be no impacts. The offloader and booster pumps would be diesel-fueled.

Mitigation Measures

There are no significant impacts from the Project associated with utilities and service systems; no mitigation is required.

A.15 Water Quality and Hydrology

Affected Environment

A.15.1.1 Hydrology and Salinity in San Francisco Bay

San Francisco Bay extends from the confluence of the Sacramento and San Joaquin Rivers to the Golden Gate Bridge and south to the shoreline of Santa Clara County. The Sacramento and San Joaquin Rivers collectively contribute roughly 90 percent of the total freshwater input to the estuary; the other ten percent is provided by creeks, streams and water treatment plants outfalls that drain directly into the Bay (CSCC 2010). The Bay's hydrology determines the salinity in different portions of the estuary and controls the circulation of water through the channels and bays. Freshwater inflows, tidal currents, and their interactions largely determine variations in the hydrology of the Bay. The Bay is a "mixed semi-diurnal" tidal system of two high tides and two low tides of unequal magnitude each day. This tidal exchange determines water surface levels, direction, volume of flow and salinity and influences the biological, chemical, and physical conditions of the Bay (CSCC 2010).

The North Bay of San Francisco Bay (comprising Suisun Bay, Carquinez Strait, and San Pablo Bay) is geographically and hydrologically distinct from the Central and South bays (see ***Figure A-11***). The North Bay is dominated by seasonally varying river inflow and tidal influence through the Golden Gate. The timing and magnitude of the seasonal river freshwater and the ocean tides influences the estuarine circulation. The tidal amplitude increases in the North Bay from the Golden Gate to the eastern shores of San Pablo Bay, where it is the highest. The tides are then attenuated when passing through the Carquinez Strait so that the tidal range is diminished in Suisun Bay (CSCC 2010). In the North Bay the Sacramento/San Joaquin Delta freshwater inflow into the Bay results in significant seasonal salinity variation. The salinity in the North Bay fluctuates relative to the Central Bay with salinities also influenced by local stream and river inflows in addition to the Sacramento/San Joaquin Delta freshwater inflow. Residence times of water in the North Bay can be as low as days during periods of high river discharge, or months in drier periods (CSCC 2010).



Figure A-11. Sub-bays of San Francisco Bay

Suisun Bay is hydrologically complex with the Sacramento and San Joaquin Rivers entering the eastern end of Suisun Bay (in the immediate vicinity of the Montezuma site) and the variation in salinity can vary greatly on Delta outflow. As a result, the salinity gradient in Suisun Bay is the greatest found in the San Francisco Bay (CSCC 2010). The western end of Suisun Marsh is

more strongly influenced by the tides and tidal influence dissipates further upstream in the Delta.

In the Central Bay, tides and currents are a stronger influence than the North Bay, especially during the dryer months of the year. The Sacramento and San Joaquin rivers freshwater inflows can extend through the Central Bay and into the South Bay during wet winters. The Central Bay is characterized by Pacific waters that are cold, saline, and low in total suspended sediment (TSS) (USACE and RWQCB 2014). The Central Bay is most similar to ocean salinity levels (32 parts per thousand).

The South Bay receives only minor amounts of freshwater inflow from the surrounding watersheds and limited influence from the Sacramento and San Joaquin rivers during wet years; it is often considered in effect a tidal lagoon (USACE and RWQCB 2014). The South Bay receives less than 10 percent of the freshwater budget of San Francisco Bay. It also receives the largest direct freshwater inflows of treated wastewater in the Bay. The greatest tidal range in San Francisco Bay is found in the South Bay, where the spring tidal range (mean lower low water [MLLW] to mean higher high water [MHHW]) is approximately nine feet. This compares to the spring range of approximately six feet at the Golden Gate (Central Bay) (CSCC 2010).

South Bay circulation is limited and water residence times are much longer than in the North Bay. Water residence times in the South Bay during the summer months can be on the order of several months; in the winter, the residence time can be less than a month. South Bay salinity fluctuates with exchange with the Central Bay, freshwater inflows from creeks and local municipal wastewater treatment plants, and evaporation. Typical salinities within the South Bay as a whole are near oceanic levels, whereas the lower South Bay (south of Dumbarton Bridge) is brackish year-around due to the freshwater inflows from the watershed and wastewater treatment (CSCC 2010).

A.15.1.2 Offshore Environment

To the west of San Francisco Bay, the Project Area includes increasingly deep water as the scows transit to SF-DODS. SF-DODS is in the open ocean on the lower continental slope approximately 50 miles west of the California coastline and water depth at the site ranges between approximately 2,500 meters and 3,000 meters (USACE and RWQCB 2014). The ocean is influenced by currents and counter currents as well as tides, which account for 35 to 60% of the current variability on the continental shelf. Tidal currents can affect the resuspension of material deposited on the seabed and dispersion of material suspended in the water column; however, USEPA studies of SF-DODS have shown it is depositional. In addition, currents in the vicinity of SF-DODS are generally slow, which helps to minimize the extent of sediment plumes within the water column during and immediately after sediment placement events (USACE and RWQCB 2014).

A.15.1.3 Water Quality in San Francisco Bay

The primary water quality parameters of concern in the Bay are salinity (as discussed above), dissolved oxygen (DO), chemical contaminants, and TSS/turbidity.

Dissolved Oxygen

Dissolved oxygen is required for the survival of aquatic life. DO concentrations are affected by many variables including water temperature, circulation, wind (which contributes to local water mixing), biological and chemical oxygen demand, and activity of algae. Waters in San Francisco Bay are generally well oxygenated with typical concentrations of dissolved oxygen ranging from 9 to 10 mg/l during high periods of river flow, 7 to 9 mg/l during moderate river flow, and 6 to 9 mg/l during the late summer months when flows are lowest.

In areas with anoxic sediments, disruption of the sediments can decrease DO levels. The minimum DO threshold typically set by the RWQCB in its permits is 5.0 mg/lLow DO levels are more common in the South Bay due to the higher residence time of water in the South Bay, and during warmer times of year.

Contaminants

The Regional Monitoring Program (RMP) is a program operated by the San Francisco Estuary Institute (SFEI). The RMP publishes a summary report of water quality data that includes monitoring results of major chemical contaminants that are of greatest concern in San Francisco Bay and/or are included on the Clean Water Act's Section 303(d) List. These chemical pollutants are of concern because they bioaccumulate (accumulate to high concentrations) and can have negative effects on wildlife and humans. The RMP also evaluates long term trends and spatial patterns of contamination. The following information from the 2013 Pulse of the Estuary and 2014 RMP Update summarize the status and trends of these contaminants (SFEI 2013 and SFEI 2014).

Mercury

Mercury is transported to the Bay in runoff of both contaminated sediment and contaminated surface water. The yearly mercury load in the San Francisco Bay estuary depends on hydrologic conditions, with higher loads associated with increased runoff. Mercury contamination is one of the top water quality concerns and mercury is included on the Clean Water Act's Section 303(d) List. The SFRWQCB has established a Total Maximum Daily Load (TMDL) target for Baywide suspended sediment mercury concentration of 0.2 mg/kg dry sediment to achieve the human health and wildlife, fish tissue, and bird egg targets and to attain water quality standards (RWQCB 2015). Mercury is a problem because it accumulates to high concentrations and poses direct risks to some fish and wildlife species as well as health risks to humans and the wildlife that consume fish (SFEI 2014).

Inorganic mercury is converted to the bioavailable form of methylmercury by bacteria. Because concentrations of methylmercury are driven primarily by biological activity rather than total mercury concentration, the total mercury concentration is not a good predictor of methylmercury concentrations. Methylmercury production can vary tremendously over small distances and over short time periods (SFEI 2014). Methylmercury typically represents only

about 1% of the total of all forms of mercury in water or sediment, but it is the form that is readily accumulated in the food web and poses the greatest toxicological threat.

Water from Lower South Bay had the highest average concentration of methylmercury (0.109 ng/L) of any Bay segment from 2006 to 2013. The South Bay had the next highest average (0.054 ng/L). No regulatory guideline exists for methylmercury in water. The Bay-wide average in 2013 was 0.023 ng/L. The Bay-wide average between 2002 and 2011 was 0.042 ng/L. The Bay-wide averages for the period from 2008 to 2011 were lower than those observed in 2006 and 2007 (SFEI 2014).

San Pablo Bay had the highest average concentrations of total mercury in sediment between 2002 and 2011 (0.27 ppm). The average concentrations were slightly lower in Lower South Bay and Central Bay (both 0.26 ppm) and South Bay (0.22 ppm), and lowest in Suisun Bay (0.17 ppm) (SFEI 2014). During the same time period, however, methylmercury concentrations were highest in sediment from Lower South Bay and South Bay (average concentration of 0.68 and 0.72 parts per billion (ppb), respectively) and lower in San Pablo Bay (0.27ppb) and Suisun Bay (0.20ppb) (SFEI 2014). Concentrations of methylmercury in sediment south of the Bay Bridge have been consistently higher than those in northern San Francisco Bay.

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are included on the Clean Water Act's Section 303(d) List for several Bay locations. Concentrations are often higher near the Bay margins, due to proximity to anthropogenic sources. Contributing sources are historic industrial activity as well as combustion products (including motor vehicle exhaust), waste oil, and road run-off. Increasing population and motor vehicle use in the Bay Area suggests that PAH concentrations could increase over the next 20 years, due to deposition of combustion products from the air directly into the Bay and from the air to roadway runoff and into the Bay via stormwater (SFEI 2013).

Average dry season PAH concentrations in sediment have been highest along the southwestern shoreline of the Central Bay. The Central Bay has had the highest average dry season concentration (4.1 ppm) with the South Bay having the next highest average concentration (2.6 ppm), followed by Lower South Bay (2.1 ppm), San Pablo Bay (1.1 ppm), and Suisun Bay (0.6 ppm). The Bay-wide average in 2012 (wet season) was 1.7 ppm; the second lowest annual average observed over the period of record (SFEI 2014).

Polybrominated Diphenyl Ethers (PBDEs)

PBDEs, bromine-containing flame retardants, increased rapidly in San Francisco Bay through the 1990s. The production of PBDEs began to be phased out in 2004 and the material is no longer manufactured in the U.S. The California Legislature has banned the use of three types of PBDE mixtures: Penta-BDE (represented by BDE-47), Octa-BDE, and Deca-BDE (represented by BDE - 209) (SFEI 2013).

Concentrations of BDE-47 in sediment, consistent with the data for water and biota, appear to be on the decline. The Bay-wide average for 2012 (0.26 ppb, a wet season value) was the lowest observed during the period of record, and 50% lower than the average observed in 2002. Long-term average dry season concentrations of BDE-47 in sediment have been highest, by far, in Lower South Bay (0.65 ppb). Average concentrations in the other segments ranged from 0.35 ppb in South Bay to 0.46 ppb in Central Bay (SFEI 2014).

BDE-209 (also known as decabromodiphenyl ether) represents the last PBDE mixture to be phased out of production in the US. In contrast to BDE-47, Bay-wide average concentrations of BDE-209 in sediment do not appear to be declining. The average concentration in the wet season sampling of 2012 (1.8 ppb) was equal to the long-term dry season average. Similar to BDE-47 in sediment, long-term average dry season concentrations of BDE-209 from 2004-2009 were highest in Lower South Bay (5.2 ppb), followed by San Pablo Bay (2.1 ppb), Central Bay (1.9 ppb), South Bay (1.7 ppb), and Suisun Bay (0.8 ppb) (SFEI 2014).

Polychlorinated Diphenyls (PCBs)

PCB contamination remains a significant water quality concern in San Francisco Bay, and PCB cleanup is a primary focus of the SFRWQCB. PCBs are a problem because they accumulate to high concentrations in some Bay fish and pose health risks to consumers of those fish (SFEI 2013). The SFRWQCB has established TMDL target for PCBs concentrations in fish tissue of 10 ug/kg for San Francisco Bay (SFRWQCB 2015). PCBs enter the Bay primarily through small tributaries and storm water and are associated with older urban and industrial land uses. Long-term average dry season PCB concentrations in Bay sediment have been highest in the South Bay with concentrations in the Lower South Bay at 14.2 ppb. Concentrations in the Central Bay are also elevated (12.9 ppb), while concentrations are considerably lower in San Pablo Bay (6.2 ppb) and Suisun Bay (4.5 ppb). The Bay-wide average for the wet season sampling in 2012 was 7.1 ppb which was the lowest annual average observed over the period of record(2003-2013 excluding 2004-2006 due to data problems). Models suggest that sediment PCB concentrations must decline to about 1 ppb for concentrations in sport fish to fall below the threshold of concern. Suisun Bay has been closest to this level, with a minimum annual average of 2.0 ppb in 2011 (SFEI 2014).

Selenium

Selenium contamination is a concern in San Francisco Bay due to bioaccumulation in wildlife. Selenium accumulates in diving ducks to concentrations that pose a potential health risk to human consumers (SFEI 2013). Selenium concentrations in water are below the water quality objective established by the California Toxics Rule (5 ppb), but there are still concerns regarding wildlife exposure including early life-stages of fish. The highest concentration observed in water at random stations from 2002 to 2013 was 0.63 ppb (in Central Bay in 2002), much lower than the Toxics Rule objective. The Lower South Bay had a higher average concentration over

this period (0.25 ppb) than the other Bay segments, which had very consistent average concentrations (all other averages were between 0.13 and 0.15 ppb)(SFEI 2014).

Turbidity and Suspended Sediment

Suspended sediment is a key component of an estuarine system. The terms turbidity and suspended sediment are often used interchangeably. Turbidity refers to a number of different suspended particulates including biological materials (plankton) and mineral particles (sediment). Suspended sediment refers to the actual sediment component in the water column and is measured as TSS. Most near-shore environments, and estuaries in particular, tend to have higher levels of turbidity or suspended sediment loads due to discharges from rivers, drainages and the relative shallow nature of the environment. Suspended sediment concentrations in San Francisco Bay tend to be extremely variable and strongly correlated to season and water depth

Sediment quality in the Bay varies with the physical and chemical characteristics of the sediments and is discussed in ***Section A.8***, Hazards and Hazardous Materials. The deposition and resuspension rate of sediment in the Bay changes with location, season, bathymetry, general estuarine circulation patterns, direct input from rivers and surface runoff, wind-driven re-suspension of sediment by waves, tidal currents, mining and dredging activities, and disturbance by vessels.

Suspended sediment has the potential to affect aquatic organisms in three ways: (1) physical impacts related to the physical properties of suspended sediments (e.g., reduced light transmission that can decrease phytoplankton photosynthesis, increased turbidity that can clog gills); (2) chemical impacts, related to the chemicals associated with suspended solids (including effects on phytoplankton and fish); and (3) resettling effects that can smother aquatic benthic habitats and organisms. Finer-grained sediments (clay and silt) are more readily suspended than sandy material and remain suspended in the water column longer. Suspended sediments can influence the behavior, distribution and growth of listed species. Disturbance of sediments during the construction activities is likely to result in temporarily increased levels of suspended sediments/turbidity and potential release of contaminants from sediments.

TSS levels in the Estuary vary greatly, ranging from 10 mg/l to over 1000 mg/l (USACE and RWQCB 2014). Existing deposits of typical fine-grained surface sediments in the shallow areas of the Bay and natural processes such as wind-driven wave action and tidal currents, are the primary source of TSS and turbidity throughout the Bay (USACE and RWQCB 2014). In addition to the sediment that is carried into the Bay by the inflow from the Delta, sediments are carried by the Napa, Sonoma, Petaluma Rivers and a variety of smaller streams and watersheds and other drainages (including storm drains and flood control channels) throughout the Bay. Small tributaries adjacent to San Francisco Bay supply 61 percent of the new suspended sediment to San Francisco Bay (USACE and RWQCB 2014). The Central Bay generally has the lowest TSS

concentrations but the levels vary depending on wind-driven wave action, run off, tidal currents, dredged material placement and sand mining operations (USACE and RWQCB 2014).

A.15.1.4 Dredging Sites

Redwood City Harbor

The RWC Channel is subject to tidal and wind effects. The water velocity in the channel is generally less than 0.45 m/sec throughout the water column (USACE and Weston 2005). A study of ambient turbidity in found the turbidity in the channel was consistently between 8 to 22 NTU. In this study, plumes generated from knocking down sediment high spots in the channel had TSS levels as high as 600 mg/l which decayed to 100 mg/l within 7-9 minutes. The plumes remained in the lower half of the water column. Residual plumes of 50-100 mg/l range persisted for 13 minutes or longer (USACE and Weston 2005). Higher fluctuations occurred in the measured turbidity and may be influenced by the ebb flows from the two intersecting sloughs, Steinberger and Westpoint sloughs, as well as higher outflows during a storm event.

Pollutant sources discharging into RWC Channel include both point and nonpoint discharges. Point sources in the Project Area include discharges through pipelines and open drainage swales that drain from the Port into RWC Channel. The Port of Redwood City has five storm water discharge points/outfalls and other surrounding industrial and urban areas also have storm water discharge points draining into RWC Channel.

Dredged material in RWC Channel is expected to consist primarily of Young Bay Mud, a predominantly fine-grained material. Dredged material from Redwood City Harbor has typically been more than 80 percent fines and suitable for suitable for unconfined aquatic disposal (SUAD). Maintenance dredging in RWC Channel typically occurs every 1 to 2 years. Berth 1 through 4 maintenance dredging is planned for late 2015 as well as the Port's Fiscal Year 2017.

Construction of the Project would require dredging between approximately 920,000 cy and 2.8 MCY of sediment from RWC Channel. Berth deepening would also be required. The estimated volume for berth deepening for the four actively-used berths combined is 17,000 cy for deepening commensurate with a -32 feet MLLW channel depth, 34,000 cy for a channel depth of -34 feet MLLW, and 60,000 cy for a channel depth of -37 feet MLLW. Dredging of the berth area would most likely occur at the same time as dredging of the RWC channel.

A temporary staging area would be located onshore in the Port area during construction operations. The temporary staging area would be located on an impervious surface and located away from areas that could make it susceptible to damaging waves. Materials, fuels, and other potentially hazardous material may be stored in the staging areas. The staging area would comply with the Port's storm water discharge permit and BMPs. Any liquids or other materials on the site that could spill or runoff during storm events would be located in a bermed area or an area with other secondary containment.

The Port lies in the San Mateo Plain sub basin of Santa Clara Valley groundwater basin in the San Francisco Bay Hydrologic Region (Port of Redwood City 2010). Historically, water was supplied from the groundwater basin but potable water is now supplied by the San Francisco Public Utilities District (SFPUD). There are no drinking wells in or immediately adjacent to the Project Area (City of Redwood City 2010a). There are wells on the Port's Cemex leased property at confluence of Redwood City Harbor and Westpoint Slough and also other wells nearby in Redwood City that are used for irrigation/dust control (Snaman, pers. comm.). The proposed Project would not require the extraction of any groundwater and there would be no potable water supplied to the Project.

San Bruno Shoal Channel

San Bruno Shoal Channel is located approximately 2.5 miles east of the western shoreline of the Bay, and 6 miles west of the eastern shore of the Bay. The channel is located in the northern most part of the South Bay, and is west of the main portion of the shoal. Water depths in the vicinity of the channel range from -25 feet to -34 feet MLLW; further to east, in the main portion of the shoal, water depths range from as low as -2 feet to around -15 feet MLLW (NOAA 2013b). Between SBS Channel and the entrance to RWC Channel is a natural deepwater channel extending the length of the South Bay with a channel depth of -33 feet to -50 feet MLLW. At the SBS Channel/San Bruno Shoal area the Bay widens and gets shallower (USACE 2014a). Dredged sediment at SBS Channel is expected to contain up to 30% sand with the remaining sediment consisting of fine-grained materials (USACE 2014d).

Construction of the Project would require dredging between approximately 480,000 cy and 3.1 MCY of sediment from SBS Channel. In addition, relocation of the three fuel pipelines underneath SBS Channel could require removal of between 8,000 cy and 12,000 cy of sediment. The three fuel pipelines crossing SBS Channel would be removed and replaced with three new sections of the pipeline at deeper depths (between -40 and -45 feet MLLW, depending on the selected channel depth). The three possible construction methods for pipeline relocation are described in ***Section 4.2.3.4 of the Main Integrated Report***. Relocation of the fuel pipelines would include removal of sediment above the existing pipeline in the area of the replacement pipeline section, if the chosen construction method uses clamshell excavation or the jet sled process.

In addition, there would be a temporary onshore staging area for staging of equipment and materials either at the former Shell dock at San Francisco Airport or at the Brisbane Marina. The temporary staging area would be located on an impervious surface and located away from areas that could make it susceptible to damaging waves. Materials, fuels, and other potentially hazardous material may be stored in the staging areas. The staging area would comply with the Port's storm water discharge permit and BMPs. Any liquids or other materials on the site that could spill or runoff during storm events would be located in a bermed area, or an area that has other acceptable forms of secondary containment.

A.15.1.5 Placement Sites

The dredged material placement sites consist of four beneficial reuse sites and SF-DODS. The hydrology and water quality for each of these sites is described below. Groundwater is not addressed because there would be no Project-related activities that could affect groundwater at the placement sites.

Cullinan Ranch Tidal Restoration Project

The area affected by the RWC Project at the Cullinan placement site would include the construction of a temporary offloader in Napa River and pipeline extending along a portion of Dutchman Slough or alternately just tying up the loaded scow to an existing permitted offloader (that would have been constructed by the Cullinan Project) at the same location in Napa River (***Figure A-8***). The construction of the offloader would require driving 2 spuds and up to 3 mooring piles to allow scows to tie up alongside. The pipeline would be floating with anchors to hold it in placed along Dutchman Sough. It would be expected that the offloader would be in place for 2-5 years, depending on the volume of sediment delivered to the site. An offloader and pipeline were permitted for the Cullinan Project for the placement of sediments into Cullinan in 2013 (BCDC 2013) and similar regulatory requirements would be expected if the Project constructs the offloader and pipeline.

Montezuma Wetlands Restoration Project

Montezuma Project is located at the eastern margin of Suisun Marsh, near the confluence of Suisun Bay and the Sacramento-San Joaquin River Delta. The permanently installed offloading facility is located immediately offshore in a deep water channel (***Figure A-8***). The Montezuma Project portion within the RWC Project is located at the offloading facility in the Suisun Bay/Sacramento River. For the RWC Project, impacts associated with transporting dredged material by scow to this offloading facility are attributable to the RWC Project but impacts associated with dredged sediment offloading, management of the offloading facility, placement, and Montezuma site management have been evaluated under separate environmental reviews/permits and would occur independently of the RWC Project.

Dredged sediments are transported to Montezuma in scows escorted by tugboats and the scows would be tied up to the offloader. At the point where the scow docks at the offloader the Montezuma Wetlands Restoration Project would take over the operations required to slurry and offload the sediment to the Montezuma site. Accidental spill of slurried sediment that might occur as part of the slurring process are covered under the existing Montezuma Wetlands LLC permits.

SF-DODS

SF-DODS is located 50 miles to the west of the Golden Gate Bridge and is approximately 2.5 nautical miles wide by 4.5 nautical miles long (6.5 square nautical miles). The water depth at the site ranges between approximately 2,500 meters and 3,000 meters. The impacts from the

RWC Project would be from accidental spills during transit to the site. The site is permitted to bottom dump suitable dredge sediment. To avoid environmental impacts due to the potentially rough ocean conditions scows transporting material to SF-DODS are monitored and there are limitations on transit routes, allowable weather and wave conditions, maximum scow load and scow performance (no spills or leakage) (USEPA 2014). Extensive monitoring at SF-DODS has confirmed that no significant impacts to ocean resources (including EFH) have occurred (USEPA 2010b).

Alviso Pond Complex

The Alviso Ponds are located in the South Bay. The width of the South Bay ranges from less than 1.2 miles near the Dumbarton Bridge (the Dumbarton Narrows) to more than 12 miles north of the San Mateo Bridge. The mean (average) depth of the South Bay is less than 13 feet, with a channel depth of 33 to 50 feet. The hydrology of the area adjacent to the Alviso ponds is influenced by the Coyote Creek and Guadalupe river watersheds and San Francisco Bay.

For the RWC Project the sediment would be taken by scow to an offloader where it would then be pumped through a floating and submerged pipeline and booster pump(s) to a sediment delivery location either on the top of the levee adjacent to Pond A2W or Pond A9. The offloader would be located in deep open water habit to allow fully loaded scows to transit during low tide. Floating and/or submerged pipelines would cross from the offloader through the open water habitat, mudflats and intertidal marsh to the pond levees. In addition to booster pumps at the offloader and on the levee, an intermediate booster pump would be required to transfer sediment from the offloader to the dredged sediment delivery location Pond A9. It would located on a barge of platform in shallow water approximately mid-way between the offloader and the levee.

Sediment from RWC Channel dredging could also be delivered using a hydraulic cutterhead dredge. The sediment would be pumped from the dredge head through a floating and submerged pipeline directly to the sediment delivery location at either Pond A2W or Pond A9. Several booster pumps would likely be required; at the dredge, at one or more intermediate locations, and on the levee at the dredged sediment delivery location.

Eden Landing Ponds

The Eden Landing ponds are located in the South Bay. The portion of the Eden Landing Ecological Reserve within the Project Area includes open water, mudflats, tidal salt marsh and adjacent levee habitats. For the RWC Project the sediment would be taken by scow to an offloader where it would then be pumped through a floating and/or submerged pipeline and booster pump to a sediment delivery location on the top of the levee adjacent to Pond E2. The offloader would be located in deep open water habit to allow fully loaded scows to reach the offloader during low tide. Alternatively, sediment could be delivered using a hydraulic cutterhead dredge. The sediment would be pumped from the dredge head through a floating

and submerged pipeline directly to the sediment delivery location at Pond E2. Two booster pumps would likely be required for material dredged in RWC Channel; one at the dredge and one at the Pond E2 levee. Due to the much longer pumping distance, multiple booster pumps would be required to support delivery from SBS Channel to the Pond E2 levee.

Significance Thresholds

The effects of a project or alternative on surface water or groundwater are considered to be significant if the proposed project or alternatives would result in any of the following:

1. Discharges that create contamination, pollution or a nuisance as defined by the California Water Code, the Clean Water Act, or that would cause regulatory standards to be violated.
2. An increase in vessel wake force that would increase turbidity as a result of an accelerated rate of shoreline erosion, especially at Bair Island or Greco Island.
3. Acceleration of the natural processes of sedimentation resulting in substantial sediment deposition that could not be contained or controlled onsite and that would have a permanent significant effect on receiving water quality or aquatic habitat
4. Substantial adverse effect on state- or federal-protected wetlands (as defined by Section 404 of the Clean Water Act) through direct removal, filling, hydrological interruption, or other means.
5. A significant increase in salinity in public or private wells from salt water intrusion as a result of dredging, which reduces the ability of a user to continue to use the groundwater from the wells for their present uses.

Environmental Consequences

Potential effects to water quality and hydrology were evaluated by determining whether the project activities had the potential to generate or release suspended solids or contaminants into the water column, and comparing the potential for these effects with applicable standards. The potential for project activities to result in erosional or other sediment transport effects that could have an effect on sensitive habitat was also examined. Finally, the evaluation considered the potential for dredging operations to adversely affect groundwater resources through creating new pathways for salt water intrusion into existing groundwater supplies.

A.15.1.6 Dredging Options

Potential effects of all three dredging options are very similar; consequently the three dredging options are analyzed together.

Impact WQ-1: Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standard

Dredging and pipeline relocation operations would occur in compliance with all permit requirements and best management practices. Dredging of fine grained sediments would be

done in a way to minimize sediment loss and turbidity during the dredging cycle, including possibly slower cycling times and the use of environmental buckets.[14] While using a cutterhead dredge, undercutting would be prohibited to prevent sediment above the area being dredged from slumping in on the cutterhead thereby minimizing turbidity spikes. Scows would be filled to 80% (for scows to SF-DODS) or 90% of their rated capacity (for scows bound for in-Bay placement sites), and no overflow would be permitted.

Relocating the three fuel pipelines crossing SBS Channel could be accomplished using conventional clamshell excavation, the "jet sled" method of construction, or directional drilling from a water-based staging area in San Francisco Bay as described in ***Section 4.2.3.4 of the Main Integrated Report***. Up to 2,500 feet of each of the three existing pipelines would be removed and replaced at greater depths. The clamshell construction method would take approximately 2-3 months per pipeline segment; however the bottom sediment disturbance would be less than 20 days. The directional drilling construction pipeline construction method would be expected to take approximately one month. The jet sled construction method is expected to take up to 50-100 months for all pipeline segments.

Water quality could be affected by dredging and pipeline relocation operations. Impacts on water quality could result from the suspension of sediments and/or the introduction of contaminants to the water column. Sediment suspension could also result in the short term release of contaminants into the water column by desorption (separation) from suspended particles. The potential water quality effects from berth and channel dredging from the proposed Project construction could include:

- Increased turbidity (reduced water clarity and light transmittance),
- Increased sediment suspension (increased suspended solids),
- Increased dissolved or particulate contaminants,
- Reduced dissolved oxygen (from suspension of sediments with low oxygen),
- Reduced pH,
- Plankton blooms (from suspension of nutrient-laden sediments), and
- Potential construction-related accidental spills.

The biological effects on marine biota from potential water quality impacts are discussed in ***Section A.4*****,** Biological Resources – Fish and Aquatic Resources.

Sediment Suspension and Turbidity at the Dredging Site/SBS Fuel Pipeline Relocation Site

Sediment resuspension caused by a dredging operation is defined as those sediment particles suspended into the water column during the dredging operation that do not rapidly settle out of the water column following disturbance of the sediment (Anchor 2003). For the purposes of this EIS/R, the same definition is used for sediment suspension following pipeline removal

[14] . An environmental bucket is a special type of clamshell bucket that is fully enclosed and therefore retains most of the water and loose sediments generated during each cut.

and/or placement at the pipeline relocation site. Sediment suspension occurs every time materials are dredged or otherwise disturbed, regardless of the dredge type or precautions taken during dredging operations.

Different types of dredge/pipeline excavation equipment release different percentages of the dredged sediment into the water column. However, the degree of resuspension of sediments from dredging and disposal depends on several variables (Anchor 2003) such as:

- Dredge site characteristics
- Physical characteristics the material. Sandy material released to the water column settles out more quickly than silty fine grained sediment. Fine grained sediments can remain in suspension for an extended period of time while being subjected to the processes of diffusion, settling and transport
- Nature of the dredging operation (dredge type and size, discharge-cutter configuration, discharge rate, production rate, etc.)
- Characteristics of the water quality and hydrologic regime in the vicinity of the operation, including salinity and hydrodynamic forces (waves, current, etc.)

Characteristics of Dredged Material

Field and laboratory analyses examining the dispersion of dredged material indicate that sediment suspended during dredging either remains suspended in the upper water column at relatively low concentrations or forms high concentration suspensions that cover the bottom (Anchor 2003). Very fine material such as clay and silt has a tendency to readily go into suspension during the dredging process. Because the settling velocity of such fine particles is very slow, these particles remain in suspension for a longer time compared with coarse-grained particles such as sand that settle fairly quickly. The degree of turbidity or the degree of suspended sediment, therefore, largely depends on the size of the sediment particles (Anchor 2003).

Sediments at RWC Channel are predominantly (greater than 80%) fine-grained and could create a larger plume. Dredging sediments and/or excavation of the fuel pipeline trench at SBS Channel would likely generate a smaller turbidity plume due to the higher sand content.

Sediment Resuspension by Hydraulic Dredges (with Sediment Transfer Pipeline)

The majority of sediment resuspension occurs near the point of sediment removal at the cutterhead (Anchor 2003). With this method sediments cannot directly enter the middle and upper water column since they are directly suctioned into the dredge head and transported via the pipeline to the placement site.

Sediment Resuspension by Mechanical Dredges

Sediment resuspension that occurs during the operation of a clamshell dredge is primarily due to four major sources (Anchor 2003):

- Sediment resuspension occurring when the bucket impacts the sediment bed, closes, and is pulled off the bottom;
- Sediment losses from the bucket as the bucket is pulled up through the water column (or lowered down into the water column);
- Further loss of sediment when the bucket breaks the water surface; and/or
- Turbid water leaking through the openings between the jaws of the bucket during hoisting and swinging from water to the haul scow

Sediment Resuspension During Pipeline Relocation

The removal and replacement of the fuel pipeline segments may significantly increase turbidity due to excavation of the trench by clamshell dredging or, the jet sled process. Directional drilling would have a minor increase in turbidity only at the point where the drill enters and exits the Bay bottom. A small amount of sediment may be trailed through the water column as the pipeline is lifted onto a barge, however, this would be a one-time, very short duration event. The clamshell excavation would increase turbidity over the short term but the duration of this excavation method is expected to be less than 3 months per pipeline segment and, similar to the channel dredging, the turbidity plume would be expected to settle out within a short distance of the work given the high sand content at the SBS site.

There is no information specifically regarding the turbidity generated by the jet sled process or from jetting out pipelines. However, due to the greater level of disturbance to the sediments and the duration of the jet sled work, it would be expected that the turbidity plume would be more dispersed than sediments disturbed by the channel dredging and have a more significant impact. The jet sled method uses high pressure water jets to remove material on top of the existing pipelines, to create the trench, and/or to lift the pipeline out of the water. This method could result in considerable turbidity in the vicinity of the active construction area, as the process uses water to slurry sediment in place and then uses pumps to pumps the material out of the trench and deposit it on both sides of the trench. Pipeline tie-in above water would also require “jetting” out up to 2,000 feet of pipeline. Water would be jetted under and around the pipeline to loosen if and allow it to be lifted out of the sediment. Up to 1,000 feet of pipeline would have to be loosed to allow sufficient slack to lift the center portion of that section of pipeline onto a barge.

Sediment resuspension from use of the jet sled would be expected to occur predominantly near the bottom, as there would be no vertical movement of the jet sled and discharge of the slurried sediment would be horizontally to areas adjacent to the trench. Similarly, jetting of the pipeline would also predominantly generate turbidity near the bottom of the water column.

TSS Generated During Dredging Operations

Many studies have attempted to quantify loss of sediment during dredging as either TSS concentrations or resuspension rates. Turbidity levels at various dredging project sites were not compared because there is such a high degree of variability in turbidity values even within the same site.

During dredging operations, elevated turbidity would occur in the immediate vicinity of the dredge. Concentrations of TSS vary with the material being dredged and the type of dredge employed. The majority of suspended sediments settle within a short period after dredging. Transport of suspended particles by tidal currents and other means would result in some redistribution of sediment and any associated contaminants and the presence of a turbidity plume. The amount of contaminants redistributed in this manner would be small and localized in the channel adjacent to the work area.

Monitoring studies at other dredge sites have documented that a dredging-related turbidity plume dissipates rapidly with distance from dredging operations (USACE and RWQCB 2014). Within areas of sediment resuspension, DO could be slightly reduced. Reductions in DO concentrations, however, would be brief and are not expected to persist or cause detrimental effects to biological resources. Contaminants, including metals and organics, could be released into the water column during the dredging. Any increase in contaminant levels in the water is expected to be localized and of short duration.

In comparison with the clamshell dredge, the percentage of suspended material from a hydraulic (cutterhead) dredge is typically relatively small and typically in the lower water column. Disturbance of sediment may occur as the cutterhead of the dredge is dragged across the bottom and not all sediments being suspended by the cutterhead would be drawn into the suction tube. Pipelines that extend from the seafloor to the scows during cutterhead dredging minimize mid-water and surface plumes. Suspended materials are restricted to the immediate vicinity of the cutterhead itself. When all other factors are equivalent (e.g., the sediment sizes, hydrodynamic conditions, etc.) suspended sediment concentrations above background near hydraulic dredging are usually lower than those for mechanical dredging. However, there have been projects that have reported lower suspended sediment using mechanical dredging than those using a hydraulic dredge (Anchor 2003).

A study characterizing the spatial extent of turbidity plumes during clamshell dredging operations in Oakland Harbor found that the closed bucket dredge generated elevated concentration of suspended sediments. While exact plume trajectories were dynamic, turbidity levels above ambient concentrations were detected up to 400 meters both up- and down-current from the source. Ambient TSS concentrations were typically less than 50 mg/l. Significantly elevated TSS concentrations, greater than 225 mg/l, were detected up to 250 meters from the source. The proposed Project would use an environmental bucket during clamshell dredging of contaminated sediments which can reduce suspended solids up to 35 to 45%.

The removal and replacement of the fuel pipeline by clamshell dredge or directional drilling is expected to have short term localized less than significant effects on TSS similar to channel dredging using a clamshell dredge. There is little information regarding the impacts from a jet sled or pipeline jetting operation; however, the TSS levels would be expected to be substantially higher throughout the water column than dredging operations. The plume would extend from the pipeline replacement site for a variable distance which would be influenced by tides and currents. The duration of the pipeline excavation is expected to be 50-100 months which is substantially longer than the other two pipeline replacement methods. Although the TSS levels would be expected to be high during the jet sled construction period, after completion, the plume would be expected to settle quickly, particularly due to the expected higher sand content of the sediment in the area, and no long term turbidity effects are expected.

Studies cited in O'Connor (USACE and Port of Oakland 1998) demonstrate that direct biological effects of suspended sediment are caused by extremely high concentrations (greater than 3,400 mg/l) that extend for long periods. For the dredging of the RWC, TSS levels are anticipated to be raised over ambient levels in the localized area of the dredging operations for short durations. The short duration and localized effect of the elevated TSS levels would have short term significant effect during construction; however, with the implementation of Mitigation Measure WQ-M1 (***Section A.15.4***) the impact would be reduced to less than significant. The dredging of the SBS channel would be expected to have a similar less than significant impact with the implementation of Mitigation Measure WQ-M1 (***Section A.15.4***).

The dredging operations at SBS would be done in conjunction with the pipeline replacements to minimize mobilization of equipment which would extend the duration of elevated turbidity and TSS levels at the site. Dredging of the trench would add up to 3 weeks to the total dredging duration. If the clamshell or directional drilling pipeline replacement methods are used the impact would be expected to be less than significant impact with the implementation of Mitigation Measure WQ-M1 (***Section A.15.4***). If the jet sled pipeline excavation method is used, the impact would be expected to be significant and unavoidable due to the longer duration of high turbidity and TSS levels and the lack of feasible mitigation measure (i.e. use of a silt curtain or other barrier device).

Significant long-term impacts after construction is complete due to elevated suspended sediment concentrations are not expected.

Salinity, Temperature and pH

There are no projected effects to salinity or temperature from construction and operation of the proposed Project. The Corps studied the effect of a hydraulic cutterhead and clamshell dredge on the water column (USACE and Port of Oakland 1998). This Corps study revealed that dredging operations did not typically cause significant fluctuations in salinity, temperature, or pH over the short or long term. Slight fluctuations were detected only 25 percent of the time

while the dredges were monitored. Surface water quality objectives for these parameters are expected to be satisfied.

Dissolved Oxygen

Dissolved oxygen (DO) concentrations may decline in the vicinity of dredging operations with the suspension of dredged sediments. In a Corps study of DO levels (USACE and Port of Oakland 1998), DO concentrations declined in only four of the 12 measurements. Reductions in DO concentrations were greatest in the lower 2 meters of the water column. The greatest fluctuation in dissolved oxygen (3.5 ppm) occurred at a near-bottom sampling location within 50 meters of the dredge. Concentrations declined from 9.0 ppm to 5.5 ppm (USACE and Port of Oakland 1998). This meets the minimum DO requirement of 5.0 mg/l set by the RWQCB for downstream of the Carquinez Bridge. In all cases, background levels of DO reestablished within 10 minutes of the sampling event.

Studies conducted by SFEI have also indicated that there is no risk to the ecosystem due to increased nutrient loading caused by dredging activities and that sediment disruption caused by dredging activities does not pose an environmental risk related to decreased DO concentrations.

While the available data suggests it is unlikely, concentrations in the immediate vicinity of the dredging operations may become depressed below the minimum RWQCB threshold for a short period. However, due to the fact that this effect would be localized and of short duration, impacts on DO in the water column would be less than significant.

Release of Metals and Contaminants from Resuspended Particulate Matter

Urban waterways have received large amounts of toxic metals, pesticides, and hydrocarbons from past releases from a variety of urban sources, spills, and other processes. These contaminants are not very soluble in natural surface waters, but instead tend to sorb onto particulate matter and eventually accumulate in sediments. As a result, the sediments in the waterways and ports of many urban areas are contaminated with a wide variety of these substances. There is therefore concern that dredging and placement of these contaminated sediments may result in the release of toxic substances back to the open water where they may have negative impacts on exposed biota.

Sediments within the proposed dredging prism would be characterized as per DMMO and LTMS guidance to determine the quality of the sediment and its suitability for various placement options. Characterization would be completed before the dredging project permits are approved. The presence of measurable metals contamination in seawater is highly affected by pH and, to a certain degree, salinity. Oxidation of organic material during dredging could release metals, but field monitoring data rarely demonstrate significant contamination. The small concentrations of metals that could be released into the water column would be highly diluted by the surrounding water. The majority of heavy metals, nutrients, petroleum, and

chlorinated hydrocarbons are typically associated with the fine-grained and organic components of the sediment. The available data suggest that biologically significant releases of these constituents during dredging has not been routinely observed (USACE and Port of Oakland 1998, USACE and RWQCB 2014).

Chemical reactions between suspended sediments and the water column have the potential to release metals to the environment during dredging operations. Chemical reactions are highly dependent on the redox potential of the seawater, pH and, to a certain degree, salinity. Field monitoring data from numerous dredging projects has rarely demonstrated significant contamination. This is due to the fact that metals adsorb to available particulates within the sediment and water column. This reaction rapidly binds metals and the small amounts of metals that are released within the water fraction are highly diluted by the surrounding water.

Organic compounds are generally less soluble than metals. Consequently, direct toxicity via organic compounds dissolved in the water column is typically less likely. However, organic compounds tend to bioaccumulate in organisms. This can occur both through dissolved phase exposure through the water column and from organic compounds adsorbed to particulate matter.

Past maintenance dredging characterizations for the Port of Redwood City indicated that generally sediment concentrations were similar to ambient levels in the Bay. 2008, 2010 and 2014 testing indicated a lack of toxicity in elutriate and solid phase biological tests which would support the conclusion that contaminant concentrations are not available in the water fraction. The minimization of the suspended sediment load through operational controls and dilution at most dredging sites occurs quickly, and as a result substantial releases of contaminants would not be expected.

Dredging and sediment disposal operations would disturb and resuspend bottom sediments, including contaminated sediments. Project-related operations could result in temporary and localized decreases in DO and possibly water column sediment concentrations; however, these conditions would not persist following the completion of the dredging operations. Compliance with applicable water quality regulations, permits, the implementation of BMPs and Mitigation Measure WQ-M1 (***Section A.15.4***) would ensure that potential water quality impacts would be less than significant. Sediment dredging would not result in discharges that create pollution, contamination, or a nuisance as defined as defined by the California Water Code, the Clean Water Act, or that would cause regulatory standards to be violated and therefore the impact is less than significant.

Impact WQ-2: Increased Erosion, Especially at Bair Island or Greco Island, due to Increased Vessel Wake Force.

The tugs attending the dredge and towing scows a could create a wake that could scour the channel banks and contribute to erosion of mudflats and the shoreline adjacent to RWC

Channel and increase turbidity and affect habitat as a result. As discussed in ***Section A.4.1***, however, provided tugs move at slow speeds, the wave heights and energy generated by passing tugs would be similar to those generated by wind waves, and would not be expected to cause increased erosion. During construction up to five single tug trips per day could occur in RWC Channel (i.e., two complete round trips and a partial trip). This would increase the vessel wake energy by a factor of approximately 40 compared to the energy generated by the barge calls, to approximately 8% of the average wind wave energy. This impact is less than significant.

Impact WQ-3: Acceleration of Sedimentation resulting in Significant Effects on Receiving Water Quality or Aquatic Habitat

Natural sedimentation processes, such as river and surface runoff, wind-driven resuspension of sediment by waves, and tidal currents would not be changed by the Project. However, the deepening of the channels could result in greater volumes of sediment depositing in the channels, and increase maintenance dredging requirements, as discussed in **Section 4.2 of the Main Integrated Report**.

There would be a short term effect from the dredging of the RWC and SBS Channels and the berth deepening that would suspend sediments and cause a small amount of the sediment to settle on the site, possibly several hundreds of feet from the dredging activity.

Resuspended sediments in RWC Channel (from berth deepening and/or channel deepening) and SBS Channel may be circulated in the area and re-deposited. Waters moving through the channels would deposit the suspended sediment load into the depressions or adjoining aquatic areas; however, current velocities would not change. Impacts to channel hydrology would not be significant during or after dredging.

This would be a short term effect during construction. Sediment dredging associated with implementation of the dredging options would not result in sediment deposition outside the Project Area that would result in a permanent significant effect on receiving water quality or aquatic habitat and therefore the impact is less than significant.

Impact WQ-4: Substantial Adverse Effect on State- or Federally-Protected Wetlands

The realignment of the RWC Channel has been engineered to limit expansion of the top width of the channel while still providing for the required slope stability for the channel and would avoid removal of mudflats adjacent to Bair and Greco Islands. In the vicinity of Greco Island the channel top width could increase by 6 to 42 feet, depending on the dredging option selected. The channel would be tapered to avoid any removal of mudflat outboard of Greco Island. This impact would be less than significant.

Impact WQ-5: Substantial Increase in Salinity in Public or Private Wells from Salt Water Intrusion

The City of Redwood City, including the Port and the adjacent Pacific Shores Center development, do not use water wells for potable water; all the drinking water is delivered by SFPUD. According to the RWQCB, saltwater intrusion has occurred into groundwater within the San Mateo Plain sub-basin (City of Redwood City 2010a). However, several commercial and institutional properties in the Project area (including the Sequoia Union High School District (1 well), PSC (3 wells with depths between 250 and 330 bgs), and the Cemex Company (3 wells with depths between 330 and 375 bgs) extract groundwater using private wells (City of Redwood City 2010a). The City of Redwood City is located in the San Mateo Plain Groundwater sub-basin which is believed to be divided into the upper and lower aquifer systems closer to the Bay. The majority of the groundwater production wells in the sub-basin appear to be completed in and are likely to be screened in the deeper aquifer. Thus deepening of the channel is unlikely to intersect or adversely affect the water-bearing units of the wells in the vicinity of the channel. Recent borings completed as part of the geotechnical studies for the Wharves 1 & 2 Replacement Project (Treadwell and Rollo 2011) indicate that the predominant geologic materials encountered adjacent to the channel are clay silt to very stiff clay with likely low transmissivity. This impact is less than significant.

Placement Sites

The Project would not conduct excavation or any other activities at the placement sites that could affect any groundwater aquifer. Therefore this issue not evaluated further.

Cullinan Ranch Tidal Restoration Project

Impact WQ-1: Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standard

At the Cullinan Ranch site the Project would either deliver the sediment by scow to the offloader (operated by or on behalf of USFWS, the site owner) or construct the necessary offloader and piping from the offloader to the levee top. If the Project only delivers the sediment by scow to an offloader, there would be no change in water quality. The transit of the scow to the placement site would not be expected to impact salinity, pH, temperature, DO, or increase turbidity (USACE and RWQCB 2015). Barges transporting sediment would be required to meet requirements to prevent the discharge of fuel, harmful substances, garbage and accidental discharges. The impacts from delivering the sediment by scow to the offloader would be less than significant.

The USFWS currently has SLC authorization to lease, construct and operate the offloader, and approval from BCDC, and has assessed the impacts relevant to that work in the *Addendum to the Final EIR for the Cullinan Ranch Project* (SLC 2012). If USFWS does not construct and operate the offloader, the Project would obtain permits to construct and operate the offloader. Construction and operations would occur in compliance with all permit requirements.

Construction of the offloader would require driving pilings for 2-3 mooring dolphins as well as 2-3 spuds into the channel to secure the offloader. In addition, laying the floating pipeline requires installation of small dead weight anchors to secure the pipeline in place. It is likely that pile driving and construction of the pipeline would disturb the channel bottom and suspend sediment for a short period. Sediment would settle out after the short term disturbance. The disturbance would occur in a naturally relatively turbid environment near the shoreline of the Napa River. The impacts would be expected to be short term and temporary. There would be a potential for an impact from the offloader operations if accidental spills were to occur during construction or operations; however BMPs are included as part of the Project and therefore the impact is less than significant.

Impact WQ-2: Increased Erosion, Especially at Bair Island or Greco Island, due to Increased Vessel Wake Force

During construction of the offloader, boats would be required to lay the pipeline in Dutchman Slough and to construct the offloader. Scows would also be tied up to the offloader once the construction is complete to offload sediment. Both of these operations would be very intermittent and the vessels speeds would be slow in the areas adjacent to Dutchman Slough (during construction) and adjacent to the offloader during operation. Impacts from vessel wake force are expected to be less than significant.

Impact WQ-3: Acceleration of Sedimentation Resulting in Significant Effects on Receiving Water Quality or Aquatic Habitat

Sedimentation from the construction of the offloader and piping is expected to be short term and localized within the Project site. No impacts to receiving water or aquatic habitat due to accelerated sedimentation are expected as a result of sediment delivery; potential impacts associated with decant water and management of sediment within the Cullinan site are the responsibility of the site owner. Impacts from sediment suspended by the RWC Project are expected to be less than significant.

Impact WQ-4: Substantial Adverse Effect on State- or Federally-Protected Wetlands

The pipeline from the offloader would cross a small area of mudflats and possibly a very narrow strip of tidal marsh along the levee (the levee is heavily eroded and has a very steep slope; there is little outboard habitat). A work area of up to 40 to 50 feet in width would be required to lay the pipe; the pipe itself could be up to 36 inches in diameter. Most of the pipeline would be located offshore in Dutchman Slough. The impact to the mudflats and tidal marsh would be temporary and after the operation of the offloader any affected tidal marsh is expected to revegetate quickly. Although there would be short term impacts to wetland, no long term effects are anticipated after operations are complete. The purpose of the sediment delivery is to raise grades at Cullinan to support rapid tidal marsh creation in Cullinan; reducing the time required for tidal marsh to establish from 60 to 100 years to several years. The accelerated habitat formation on 290 acres of the site would not be possible without sediment delivery. The short term impacts from pipeline construction would be small in comparison to the benefit

provided by sediment delivery and the extensive wetlands present in the area. The impact is less than significant.

Montezuma Wetland Restoration Project

Impact WQ-1: Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standards

The Project would deliver the sediment by scow to the offloader (operated by Montezuma LLC). Impacts associated with offloader operations and the operations at the Montezuma site are the responsibility of the site owner. The transit of the scow to the placement site would not be expected to impact salinity, pH, temperature, DO, or increase turbidity (USACE and RWQCB 2015). Barges transporting sediment would be required to meet requirements to prevent the discharge of fuel, harmful substances, garbage and accidental discharges. The impacts from delivering the sediment by scow to the offloader would be less than significant.

Impact WQ-2: Increased Erosion, Especially at Bair Island or Greco Island, due to Increased Vessel Wake Force

Impacts associated with the offloader and the operations at the Montezuma site have been evaluated as part of the permitting process. There would be no impact to the shoreline from the Project.

Impact WQ-3: Acceleration of Sedimentation Resulting in Significant Effects on Receiving Water Quality or Aquatic Habitat

The Project would not accelerate natural sedimentation during the transit to the offloader. There would be no impact.

Impact WQ-4: Substantial Adverse Effect on State- or Federally-Protected Wetlands

The Project would not adversely affect wetlands. There would be no impact from the Project.

SF-DODS

Impact WQ-1: Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standards

The Project would deliver the sediment by scow to SF-DODS; the sediment would be bottom dumped from the scow at that point. Disposal of the sediment at SF-DODS would occur in compliance with all applicable permit requirements. Impacts associated with bottom dumping of the sediment have been evaluated as part of the site's permitting process. The only effect on water quality would be a short term sediment plume as the scow bottom dumps the sediment. The plume dissipates quickly to background levels (USACE and RWQCB 2014). The transit of the scow to the placement site would not be expected to impact salinity, pH, temperature, DO, or increase turbidity (USACE and RWQCB 2015). Barges transporting sediment would be required to meet requirements to prevent the discharge of fuel, harmful

substances, garbage and accidental discharges. The impacts from delivering the sediment by scow to the site would be less than significant.

Impact WQ-2: Increased Erosion, Especially at Bair Island or Greco Island, due to Increased Vessel Wake Force

Once a scow leaves RWC channel or SBS Channel it would not transit near the shoreline. There would be no impact to the shoreline from the Project's use of this site.

Impact WQ-3: Acceleration of Sedimentation resulting in Significant Effects on Receiving Water Quality or Aquatic Habitat

The Project would not accelerate natural sedimentation during the transit to the SF-DODS. There would be no significant effect from this Project due to accelerated sedimentation on receiving water or aquatic habitat.

Impact WQ-4: Substantial Adverse Effect on State- or Federally-Protected Wetlands

The Project would not adversely affect wetlands. There would be no impact from the Project.

Eden Landing Ponds

Impact WQ-1: Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standard

Sediment could be transported to the Eden Landing Pond site by two potential methods. If cutterhead dredging is used, the dredged sediment would be pumped through up to 15 miles of piping from the RWC or SBS Channels to the top of the Pond E2 levee. Sediment would be suspended during the construction of the pipeline as small temporary dead weight anchors are placed to secure the pipeline in place. Piping would cross the mudflats in a shallow 2- to 3-foot wide area with minor disturbance to sediment as it is laid across the mudflats. Securing the pipe to the levee at Pond E2 would require a work area estimated to be 40 to 50 feet wide.

Alternately, the Project would construct an offloader in deep water and piping from the offloader to the levee top at the Eden Landing Pond E2. Sediment would be loaded onto a scow at the dredge site and be transported to the offloader where it would be slurried prior to being pumped through a pipeline to the top of the Eden Landing levee. Construction of the offloader would require driving pilings for 2-3 mooring dolphins and several piles to be used to secure the offloader to the Bay bottom. In addition laying the floating and/or submerged pipeline requires installation of small dead weight anchors to secure the pipeline in place. It is likely that pile driving and construction of the pipeline would disturb the Bay bottom and suspend sediment for a short period. There would be little impact from the offloader facilities operations unless an accidental spill occurs. The offloader would be in at least 20 feet of water so only minor short term disturbance of sediment may occur as the scow transits to the offloader.

The transit of the scow to the placement site would not be expected to impact salinity, pH, temperature, DO, or increase turbidity (USACE and RWQCB 2014). Barges transporting sediment would be required to meet requirements to prevent the discharge of fuel, harmful substances, garbage and accidental discharges.

Compliance with applicable water quality regulations, permits, the implementation of BMPs and Mitigation Measure WQ-M1 (***Section A.15.4***) would ensure that potential water quality impacts would be less than significant.

Impact WQ-2: Increased Erosion, Especially at Bair Island or Greco Island, due to Increased Vessel Wake Force

During construction of the offloading pipeline, boats would be required to lay the pipeline in the mudflats adjacent to Eden Landing ponds and to construct the offloader. These operations would be very intermittent in nature and the vessels would be required to slow in the areas adjacent to the ponds. The proposed offloader location is more than 3 miles from shore, and there would be no effects to the shoreline during operation. Impacts from vessel wake force are less than significant.

Impact WQ-3: Acceleration of Sedimentation Resulting in Significant Effects on Receiving Water Quality or Aquatic Habitat

Sedimentation associated with the construction of the offloader and piping is expected to be short term and localized to the Project site. No impacts to receiving water or aquatic habitat due to accelerated sedimentation are expected during the operation of the offloader and sediment delivery pipeline. Impacts from sedimentation by the Project are less than significant.

Impact WQ-4: Substantial Adverse Effect on State- or Federally-Protected Wetlands

The pipeline from the offloader would cross an extensive area of mudflats and a narrow strip of tidal marsh along the levee. The sediment delivery location was chosen to minimize the effects on habitat from the pipeline. The required work area for pipeline construction is 40 to 50 feet, and the work would likely occur on wooden mats as described in ***Section 4.2***. The pipeline itself would be 2 to 3 feet in diameter. A portion of the pipeline would be submerged offshore of the Eden Landing ponds. The impact to the mudflats and tidal marsh outboard of Pond E2 would be limited in area and temporary. Although there would be short term impacts to wetland, no long-term effects are anticipated after operations are complete. After the pipeline is removed, the marsh area is expected to revegetate readily. The purpose of the sediment delivery is to raise grades at Eden Landing to accelerate tidal marsh formation in the ponds and/or support creation of ecotone habitat or other desired habitat features. The accelerated habitat formation on the site would not be possible without sediment delivery. The short term impacts from pipeline construction would be small in comparison to the benefit provided by sediment delivery. The impact is less than significant.

Alviso Ponds

Impact WQ-1: Creation of or Increase in Contamination, Pollution or a Nuisance, or Violation of a Regulatory Standard

Sediment would be transported to the Alviso site by constructing an offloader, booster pump(s) and piping from the offloader to the levee top at the either pond A2W or A9. Sediment from RWC Channel could also be delivered by hydraulic cutterhead, as described for Eden Landing, above. Sediment delivery would occur in the same manner as for Eden Landing. Potential effects from offloader and pipeline construction and operation would be the same as for Eden Landing.

Compliance with applicable water quality regulations, permits, the implementation of BMPs and Mitigation Measure WQ-M1 (see ***Section A.15.4,*** below) would ensure that potential water quality impacts are less than significant.

Impact WQ-2: Increased Erosion, Especially at Bair Island or Greco Island, due to Increased Vessel Wake Force

During construction of the offloading pipeline, boats would be required to lay the pipeline in the mudflats adjacent to the Alviso ponds and to construct the offloader. These operations would be very intermittent in nature and the vessels would be required to slow in the areas adjacent to the ponds. The proposed offloader location is more than 3,000 feet from the closest shore, and there would be no effects to the shoreline during operation. Impacts from vessel wake force are less than significant.

Impact WQ-3: Acceleration of Sedimentation Resulting in Significant Effects on Receiving Water Quality or Aquatic Habitat

Sedimentation associated with the construction of the offloader and piping is expected to be short term and localized to the Project site. No impacts to receiving water or aquatic habitat due to accelerated sedimentation are expected during the operation of the offloader and sediment delivery pipeline. Impacts from sedimentation due the Project are less than significant.

Impact WQ-4: Substantial Adverse Effect on State- or Federally-Protected Wetlands

The pipelines from the offloader would cross an extensive area of mudflats and narrow strips of tidal marsh along the levee. The sediment delivery locations were chosen to minimize the effects on habitat from the pipeline (i.e., are located in areas with minimal tidal marsh). Construction activities would be very similar to those for Eden Landing, and impacts to the mudflats and tidal marsh outboard of the two sediment delivery locations would be limited in area and temporary. Although there would be short term impacts to wetlands, no long-term effects are anticipated after operations are complete. After the pipeline is removed, the marsh area is expected to revegetate readily. The purpose of the sediment delivery is to raise grades at Alviso to accelerate tidal marsh formation in the ponds and support creation of ecotone

habitat or other desired habitat features. The accelerated habitat formation on the site would not be possible without sediment delivery. The short term impacts from pipeline construction would be small in comparison to the benefit provided by sediment delivery. The impact is less than significant.

Mitigation Measures

With implementation of this mitigation measure, potential impacts to water quality and water resources from the proposed Project would be less than significant.

Mitigation Measure WQ-M1: Monitor Turbidity and Implement Minimization Measures

Conduct monitoring of turbidity in accordance with regulatory agency permits. If regulatory thresholds are exceeded at the designated monitoring location, implement turbidity minimization measures. Possible turbidity minimization measures include:

- Increased cycle time/reduced bucket deployment: longer cycle times reduce the velocity of the ascending bucket through the water column, which reduces potential sediment wash from the bucket.
- For clamshell dredging operations: Use an environmental (closed) bucket instead of an excavator.
- Use floating debris booms/silt curtains to contain turbidity and suspended sediments in shallow waters as required by the permitting agency.

A.16 References

ACTA Environmental Inc. 2014. Report on Sediment and Water Quality Monitorint-2012Montezuma Wetland Project, Solano County, California. September.

Ahlborn. 1990. California Wildlife Habitat Relationships System, California Department of Fish and Game. G. Ahlborn, reviewed by M. White, edited by M., California Interagency Wildlife Task Group. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=2357, Accessed 10 February 2015.

Alameda County. 1973. Alameda County General Plan Safety Element. May 30. http://acgov.org/cda/planning/generalplans/index.htm. Last Accessed March 2, 2015.

Alameda County. 1994. Alameda County General Plan Countywide Elements Conservation Element. May 5. http://acgov.org/cda/planning/generalplans/index.htm. Accessed April 1, 2015.

Alameda County, Community Development Agency, Planning Department. March 2012. Castro Valley General Plan. Chapter 7: Biological Resources. http://acgov.org/cda/planning/generalplans/documents/Chapter-7-Biological-Resources.pdf. Last Accessed on 6 January 2015.

Alameda County Flood Control and Water Conservation District (ACFCWCD). 2015. Eden Landing Salt Ponds. http://acfloodcontrol.org/projects-and-programs/environmental-restoration/eden-landing-salt-ponds. Accessed February 22, 2015.

Alameda Social Services, 2014. *Alameda County Industry Clusters, New Trends in the Workforce.* April 9, 2014. Available at: http://alamedasocialservices.org/acwib/info-research/documents/display.cfm?folder=documents&filename=Alameda_County_-_New_Trends_in_the_Workforce.pdf. Accessed on 18 March 2015.

Allen, Thomas B. 1974. *Vanishing Wildlife of North America*. Washington, D.C.: National Geographic Society, 1974.

Anchor Environmental C.A. L.P. (Anchor). 2003. Literature review of effects of resuspended sediments due to dredging operations. Prepared for Los Angeles Contaminated Sediments Task Force, Los Angeles, CA, June 2003.

Anderson, S. 2002. "Lasiurus cinereus" (On-line), Animal Diversity Web. Accessed February 10, 2015 at http://www.biokids.umich.edu/accounts/Lasiurus_cinereus/

Association of Bay Area Governments (ABAG). 2013. Plan Bay Area Environmental Impact Report, Appendix H: Biological Resources Special-Status. Association of Bay Area Governments and the Metropolitan Transportation Commission. http://planbayarea.org/pdf/Draft_EIR_Chapters/Appendix_H_Biology.pdf. Accessed on February 10, 2015.

Association of Bay Area Governments (ABAG). 2015. Earthquake and Hazards Program-Liquefaction Susceptibility. http://gis.abag.ca.gov/website/Hazards/?hlyr=liqSusceptibility. Accessed March 15.

Barnard, W.D., 1978. Prediction and Control of Dredged Material Dispersion around Dredging and Open-Water Pipeline Disposal Operations, Technical Report DS -78- 13, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Benfield, M. C. AND T. J. Minello. 1996. Relative effects of turbidity and light intensity on reactive distance and feeding of an estuarine fish. *Environmental Biology of Fishes* 46:211–216.

BioKIDS is sponsored in part by the Interagency Education Research Initiative. It is a partnership of the University of Michigan School of Education, University of Michigan Museum of Zoology, and the Detroit Public Schools. This material is based upon work supported by the National Science Foundation under Grant DRL-0628151.

Bay Area Census, 2010. San Francisco Bay Area Census Data. Sources: Census 2000 SF1, SF3, DP1-DP4, Census 2010 DP-1, American Community Survey (ACS) 2006-2010. MTC-ABAG Library, 101 Eighth Street, Oakland CA 94607. http://www.bayareacensus.ca.gov/bayarea.htm. Accessed on 18 March 2015.

British Columbia Ministry of Environment, 2014. Available at: http://www.env.gov.bc.ca/wld/fishhabitats/sturgeon/. Accessed on 10 February 2015.

Butterfly Conservation Initiative (BFCI), 2015. Myrtle's silverspot butterfly. Available at: http://butterflyrecovery.org/species_profiles/myrtles-silverspot-butterfly/. Accessed on 9 February 2015.

California Department of Transportation (Caltrans). 2013. 2012 All Traffic Volumes on CSHS. http://traffic-counts.dot.ca.gov/2012all/Route101.html. Accessed May 2015.

California Department of Fish and Game (CDFW). 2009. Species Fact Sheets. Available at: http://www.dfg.ca.gov/delta/data/longfinsmelt/documents/LongfinsmeltFactSheet_July09.pdf. Last Accessed March 25, 2015.

California Department of Fish and Game (CDFW). 2015a. Bair Island Ecological Reserve-San Mateo County. http://www.dfg.ca.gov/lands/er/region3/bair.html. Accessed February 4, 2015.

California Department of Fish and Wildlife (CDFW). 2015b. Threatened and endangered animal list, Threatened, Endangered and Rare Plant List, and Fully Protected Animal List. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed 3/3/2015.

California Department of Fish and Wildlife (CDFW). 2015c. State and Federally Listed Endangered, Threatened, and Rare Plants of California. Janaury. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed March 1, 2015.

California Department of Fish and Wildlife (CDFW). 2015d. State and Federally Listed Endangered and Threatened Rare Plants of California. January. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed March 1, 2015.

California Department of Fish and Wildlife, Natural Diversity Database. 2015. Special Animals List. Periodic publication. January.

California Native Plant Society, Rare Plant Program (CNPS). 2015. Inventory of Rare and Endangered Plants (online edition, v8-02). http://www.rareplants.cnps.org Accessed 10 February 2015.

California State Coastal Conservancy (CSCC). 2010. San Francisco Bay Area Draft Water Trail Plan Draft Revised EIR. August. http://scc.ca.gov/2010/07/30/san-francisco-bay-area-water-trail/. Accessed March 24, 2015.

California State Coastal Conservancy (CCSC). 2015. Letter of Intent to Coordinate with the U.S. Army Corps of Engineers, San Francisco District for the Delivery of Dredged Material to the South Bay Salt Ponds Restoration Project, dated March 3, 2015, signed by John Bourgeois, Executive Project Manager

California State Coastal Conservancy and U.S. Fish and Wildlife Service (CSCC and USFWS). 2015. SBSP Phase 2 Restoration Administrative Draft Environmental Impact Statement/Environmental Impact Report. May.

California State Lands Commission (SLC). 2012. Addendum to the Final Environmental Impact Report for the Cullinan Ranch Restoration Project, Solano and Napa Counties (prepared by URS and Ducks Unlimited, Inc.).

California State Lands Commission (SLC). 2014. Mitigated Negative Declaration, Hercules LLC/Prologis Pipeline Removal Project, March 2014. Lead Agency: California State Lands Commission, Applicant: Hercules LLC/Prologis. Accessed 21 April 2015. Available at: http://www.slc.ca.gov/division_pages/DEPM/Reports/Hercules/Hercules.html

California State Lands Commission (SLC). 2015. SLC Shipwreck Database. (http://shipwrecks.slc.ca.gov/ShipwrecksDatabase/Shipwrecks_Database.asp). Accessed February 11, 2015.

California State University Stanislaus. 2006. Endangered Species Recovery Program, Department of Biologicial Science. San Joaquin Dune Beetle. http://esrp.csustan.edu/speciesprofiles/profile.php?sp=cogr. Accessed on February 9, 2015.

City-data.com, 2015. Website. www.city-data.com. Last accessed on 18 March 2015.

City of Alameda, 1991, *City of Alameda General Plan*. http://www.cityofalamedaca.gov/City-Hall/General-Plan. Accessed January 14, 2013

City of Alameda, 2012, *Alameda Municipal Code.* http://library.municode.com/index.aspx?clientId=16753&stateId=5&stateName=California. Accessed January 14, 2013

City of Brisbane, 1994, *General Plan*, Chapter IX: Conservation; Chapter X: Community Health and Safety. http://www.ci.brisbane.ca.us/general-plan Last accessed on March 5, 2015..

City of Brisbane. 1994. City of Brisbane General Plan Chapter V Land Use. June 21. http://www.ci.brisbane.ca.us/general-plan. Accessed January 8, 2015.

City of Fremont, 2011, *A Vision for Fremont's Future: General Plan 2030*, Chapter 7 Conservation Element—Biological Resources, Chapter 2—Land Use. Last accessed on January 8, 2015. https://www.fremont.gov/398/General-Plan

City of Fremont, 2011, *City of Fremont General Plan*. Decembe.

City of Fremont, 2013, *Fremont Municipal Code*. (http://www.codepublishing.com/ca/fremont/. Accessed January 29, 2013

City of Hayward, 2011a, *Hayward Municipal Code*. http://www.hayward-ca.gov/CITY-GOVERNMENT/DEPARTMENTS/CITY-CLERK/. Accessed January 14, 2013

City of Hayward, 2011b, *City of Hayward General Plan*. Amended May 2011.

City of Hayward. 2014, *Hayward General Plan—Looking Forward 2040*, Policy Document Part 3: Natural Resources Element; Part 3.6: Hazards; Policy Document: Part 3 Economic Development Element. July. http://www.hayward-ca.gov/generalplan/ Last accessed April 9, 2015.

City of Inglewood, 2014. Appendix B Sensitive Species Potentially Occurring within the City of Inglewood. http://www.cityofinglewood.org/generalplan/AppB_SensitiveSpecies_web.pdf. Last accessed on 7 January 2015.

City of Menlo Park, 2013, *City of Menlo Park General Plan*, May 2013, "Open Space/Conservation, Noise and Safety Elements". http://www.menlopark.org/DocumentCenter/View/234. Last accessed on 7 January 2015.

City of Mountain View, 2012. Chapter 7: Noise, Mountain View 2030 General Plan, prepared by City of Mountain View Community Development Department, 500 Castro Street, Mountain View, CA 94041, July 10, 2012.

http://www.mountainview.gov/depts/comdev/planning/regulations/general.asp. Last Accessed on April 9, 2015.

City of Mountain View. 2012. City of Mountain View General Plan. July 10. http://www.ci.mtnview.ca.us/civicax/filebank/blobdload.aspx?blobid=10702. Last Accessed March 2015.

City of Redwood City. 2008. "Redwood City General Plan Update, Geology, Soils and Seismicity Background Report."

City of Redwood City, 2009. Public Information Summary for Community Meeting Held on October 11, 2009. Redwood Shores Lagoon Improvement - Dredging. http://www.redwoodcity.org/bit/infrastructure/shores_dredge_2009/shores_dredge.html. Accessed 21 April 2015.

City of Redwood City. 2010a, Redwood City General Plan, Chapter 1 The Built Environment Element, Chapter 5 Natural Resources Element, and Appendix E: Potential Plant and Animal Species Occurring in Plan Area. http://www.redwoodcity.org/phed/planning/generalplan/FinalGP_Docs.html. October 11. Last Accessed March 15, 2015.

City of Redwood City. 2010b. Redwood City New General Plan, DEIR. May.

City of San Francisco Planning Department. *San Francisco General Plan,* Environmental Protection Element. http://www.sf-planning.org/ftp/general_plan/I6_Environmental_Protection.htm#ENV_GEN_1. Last Accessed on 6 January 2015.

City of San Jose. 2007. City of San Jose Envision San Jose 2040 General Plan. August. http://www.sanjoseca.gov/index.aspx?nid=1737. Last Accessed April 9, 2015.

City of San Jose. 2011. *Envision San José 2040 General Plan*, Chapter 3 Environmental Leadership, Community Forest (p 23), Natural Communities and Wildlife Habitat (p 26-32), Wildlife Movement (p 32-33). http://www.sanjoseca.gov/DocumentCenter/Home/View/474. Last accessed on 8 January 2015.

City of San Jose. 2012. Municipal Code, Section 20.100.450. *Hours of construction within 500 feet of a residential unit.*

City of San Mateo, 2009. General Plan Update Appendix E of ADEIR. April 2009. http://www.cityofsanmateo.org/DocumentCenter/Home/View/5230. . Last accessed on 8 January 2015.

City of South San Francisco. City of South San Francisco General Plan – Chapter 7 Open Space and Conservation Element; Chapter 8 Health and Safety Element; Chapter 9 "Noise". http://www.ssf.net/360/Read-the-Plan. Last Accessed April 9, 2015.

City of Sunnyvale. 2011. *General Plan* . (pp 3-39; 7-26). http://sunnyvale.ca.gov/CodesandPolicies/GeneralPlan.aspx. Last Accessed on 8 January 2015

Clarke, D. G., and Wilber, D. H.. 2000. "Assessment of potential impacts of dredging operations due to sediment resuspension," DOER Technical Notes Collection (ERDC TN-DOER-E9), U. S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/dots/doer.

CNT Group. 2015. Bay Area Sea Accident Timeline. http://mapreport.com/na/west/ba/news/subtopics/d/n.html. Accessed 4/18/2015.

Congressional Record. 1930. 71st Cong., 2d sess., vol. 72 pt. 10.

Cook, et al, 2010. *Distribution and Ecology of the Russian River Tule Perch*, David Cook, Shawn Chase, and David Manning, Sonoma County Water Agency, Environmental Resources, 2010. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=47316. Accessed on February 5, 2015.

Coosa-Alabama River Improvement Association. www.caria.org/barges_tugboats.html Accessed April 20, 2015.

Cornell Lab of Ornithology website. All About Birds. http://www.allaboutbirds.org/guide/chipping_sparrow/lifehistory. Accessed on 5 February 2015.

County of San Mateo, 1986. *General Plan*. Environmental Services Agency, Planning and Building Division. San Mateo County, California. http://planning.smcgov.org/sites/planning.smcgov.org/files/SMC-GP%201986.pdf. Last Accessed on March 16, 2015.

County of San Mateo. 1986. General Plan-Vegetation, Water, Fish and Wildlife Resources Chapter. November 8. http://planning.smcgov.org/documents/general-plan-policies. Accessed April 1, 2015.

County of San Mateo, 2004. *County of San Mateo Profile*. http://www.co.sanmateo.ca.us/bos.dir/budget/recommend2004/CountyProfile.pdf. Accessed on March 18, 2015.

County of Santa Clara, Planning Office, December 1994, Santa Clara County General Plan: Charting a Course for Santa Clara County's Future: 1995-2010 http://www.sccgov.org/sites/planning/PlansPrograms/GeneralPlan/Pages/GP.aspx. . Last accessed on January 6, 2015.

County of Santa Clara. 2015. Santa Clara County Parks- "Alviso Marina County Park." https://www.sccgov.org/sites/parks/parkfinder/Pages/AlvisoMarina.aspx. Accessed February 28, 2015.

Delta Modeling Associates. 2014. *South San Francisco Bay Sediment Transport Modeling*, Final Report, Prepared for U.S. Army Corps of Engineers, San Francisco District, June .

Delta Modeling Associates. 2015. *Sediment Transport Modeling for Navigation Channel Deepening of Redwood City Harbor, Redwood City Harbor Navigation Improvement Feasibility Study*, prepared for the U.S. Army Corps of Engineers, San Francisco District.

Dickerson, C., K.J. Reine, and D.G. Clarke, 2001. "Characterization of underwater sounds produced by bucket dredging operations," DOER Technical Notes Collection (ERDC TN-DOER-E14), U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi. www.wes.army.mil/el/dots/doer.

Ducks Unlimited. 2015. Cullinan Ranch Tidal Restoration Project. http://restorecullinan.info/history.htm. Accessed February 8, 2015.

East Contra Costa County, 2006. Species Accounts, Plants. Available at: http://www.co.contra-costa.ca.us/depart/cd/water/HCP/archive/final-hcp-rev/pdfs/apps/AppD/19a_brittlescale_9-28-06_profile.pdf. Accessed on February 9, 2015.

Environmental Science Associates (ESA). Planning and Building Division, San Mateo County, California, November 1986, General Plan, Vegetative, Water, Fish and Wildlife RESOURCES POLICIES. http://planning.smcgov.org/sites/planning.smcgov.org/files/documents/files/GP%20Ch%2001-VegWaterFish%26Wildlife%20Policies.pdf. Last accessed on January 6, 2015.

Eslinger, Bonnie, 2013. "Redwood City gets $1 million fireboat bought with homeland security funds," San Jose Mercury News. http://www.mercurynews.com/ci_23564994/redwood-city-gets-1-million-fireboat-bought-homeland. Accessed on 15 April 2015.

Field, E.H., and 2014 Working Group on California Earthquake Probabilities (Field et al.). 2015. UCERF3: A New Earthquake Forecast for California's Complex Fault System: USGS 2015–3009, 6 p., http://dx.doi.org/10.3133/fs20153009.

Fugro Consultants, Inc. 2012. *Geotechnical Data Report Redwood City Deep Water Ship Channel, Redwood City, CA.* December.

Fugro Pelagos, Inc. and HDR Engineering Inc (Fugro and HDR.) 2014. San Bruno Shoal Navigation Channel Pipeline Location and Depth of Burial Survey, San Francisco, California Marine Survey Report; Survey Period: June 4 – 8, 2014.

Germano & Associates, Inc. 2010. "Review/Synthesis of Historical Environmental Monitoring Data Collected at the San Francisco Deep Ocean Disposal Site (SF-DODS) in Support of EPA Regulatory Decision to Revise the Site's Management and Monitoring Plan." June.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, Calif./S.F. Bay Regional Water Quality Control Board, Oakland, Calif. http://www.sfei.org/node/2123. Accessed March 27, 2015.

Golden Gate National Parks Conservancy, 2015. Mission Blue Butterfly. Accessed on 9 February 2015. http://www.parksconservancy.org/conservation/plants-animals/endangered-species/mission-blue-butterfly.html

Goldman, Harold B. 1969. "Special Report 97 - Geologic and Engineering Aspects of the San Francisco Bay - Geology of the San Francisco Bay." California Division of Mines and Geology. https://archive.org/stream/geologicengineer97sanf#page/n1/mode/2up

Harbor Safety Committee of the San Francisco Bay Region (HSC). 2014. San Francisco, San Pablo, and Suisun Bays Harbor Safety Plan. June 12.

Harris Miller Miller & Hanson Inc. (HMMH). 2014. Figure 1: Noise Impact Boundary 12-Month CNEL Contours for January 2013-December 2013 for Oakland International Airport. Oakland, California. Annual 2013 Noise Contours, February 7, 2014. Source: Port of Oakland ANOMS. Published in HMMH Report No. 302551.002.003-4.

Hayes DF, Engler RM. 1986. Environmental Effects of Dredging. Technical Notes. US Army Engineer Waterways Experiment Station, Vicksburg.

HDR Engineering (HDR). 2014. Draft Interim Feasibility Report and Environmental Impact Statement / Report South San Francisco Bay Shoreline Phase I Study. December.

Helley, Edward J. et al. 1979. Flatland Deposits – Their Geology and Engineering Properties and Their Importance to Comprehensive Planning. USGS Professional Paper 943.

Herbich, J.B.,S. B. Brahme. 1991. Literature Review and Technical Evaluation of Sediment Resuspension During Dredging, Contract Report HL-91-1, Prepared for the Department of the Army, Washington, D.C: U.S. Army Corps of Engineers.

H.T. Harvey & Associates. 2005. South Bay Salt Pond Restoration Project Biology and Habitats Existing Condition Report. March. http://www.southbayrestoration.org/documents/technical/. Accessed March 10, 2015.

HT Harvey & Associates (Harvey, et al), 2007, South San Francisco Bay Shoreline Study Existing Biological Conditions Report (Appendix Q to the 2014 Shoreline Study Report).

ICF Jones & Stokes. 2009. Sears Point Wetland and Watershed Restoration Project Draft Environmental Impact Report/Environmental Impact Statement, DES-08-32, August. Prepared for California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

Illingworth & Rodkin, Inc. 2004. *City of Oakland Noise Element Update, Environmental Noise Background Report*. December.

Illingworth & Rodkin, Inc. 2010. *Envision San Jose 2040 General Plan Comprehensive Update Environmental Noise Assessment, San Jose, California*. December 2010.

iNaturalist.org, 2015. http://www.inaturalist.org/taxa/68424-Ranunculus-lobbii. Accessed on 10 February 2015.

Jepsen, 2011. Prepared by Sarina Jepsen, The Xerces Society for Invertebrate Conservation, December 2009. Edited by Sarah Foltz Jordan, December 2009. Final edits by Rob Huff, Conservation Planning coordinator, FS/BLM, March 2011. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/sfs-iibi-gonidea-angulata-2011-03.doc . Accessed on 10 February 2015.

Johnson, B. H., and Parchure, T. M. (1999). Estimating dredging sediment resuspension sources, *DOER Technical Notes Collection* (TN DOER-E6), U.S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/dots/doer

Jones and Stokes. 2003. Napa River Salt Marsh Restoration Project DEIR/DEIS. April.

Jones and Stokes. 2004. Final Napa River Salt March Restoration Project Environmental Impact Report. April. http://napa-sonoma-marsh.org/documents/FEIR/feir.html. Accessed April 13, 2015.

Kinnetic Laboratories and Atkins North America, Inc. (Kinnetic and Atkins). 2015. Supplemental Report – Redwood City Harbor 2014 O&M Dredging Composite Area 07 High Resolution Sampling and Analysis Results. January.

Long Term Management Strategy (LTMS). 2014. LTMS Update Draft Programmatic ESA Consultation with NOAA: Proposed Windows Modification and Additional Measures for Salmonids and Green Sturgeon. April 7.

MarineBio. 2015. "Sea Otters, Enhydra lutris ~ MarineBio.org." MarineBio Conservation Society. Web. http://marinebio.org/species.asp?id=157. Last update: 1/14/2013 Accessed Tuesday, February 10, 2015.

Marshall, Don B. 1978. *California Shipwrecks, Footsteps in the Sea.* Seattle. Superior Publishing Company.

Moffat and Nichol. 2015. SBSP Restoration Project Beneficial Reuse Feasibility Study. January.

Moratto, Michael J. 1984. California Archaeology. San Diego: Academic Press, Inc.

Morey, S. et al, 2000. *California Wildlife Habitat Relationships System,* California Department of Fish and Game. Written by S. Morey, reviewed by T. Papenfuss, edited by R. Duke, D. Alley, updated by CWHR Program Staff, March 2000. California Interagency Wildlife Task Group. http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentVersionID=17641. Accessed 10 February 2015.

Moyle, P. B. 2002. Inland Fish of California. Berkeley: University of California Press.

National Oceanic and Atmospheric Administration (NOAA). 2006. Navigation Chart 18655. October. http://www.charts.noaa.gov/OnLineViewer/18651.shtml. Accessed April 13, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2010. Essential Fish Habitat Consultation for Operations and Maintenance Dredging in the San Francisco Bay Area and Associated Dredged Material Placement. July 13.

National Oceanic and Atmospheric Administration (NOAA). 2012. Sei Whale *(Balaenoptera borealis),* Updated November 23, 2013. http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/seiwhale.htm. Accessed on 5 February 2015.

National Oceanic and Atmospheric Administration (NOAA). 2013a. Fin Whale (*Balaenoptera physalus)*, Updated September 4, 2013. http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm. Accessed on 5 February 2015.

National Oceanic and Atmospheric Administration (NOAA). 2013b. Navigation Chart 18651. http://www.charts.noaa.gov/OnLineViewer/18651.shtml. December. Accessed April 13, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2013c. Black Abalone, Updated 27 February 2013. http://www.nmfs.noaa.gov/pr/species/invertebrates/blackabalone.htm. Accessed on February 9, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2014a. White abalone, Updated November 25, 2014. Accessed on February 10, 2015. http://www.nmfs.noaa.gov/pr/species/invertebrates/whiteabalone.htm

National Oceanic and Atmospheric Administration (NOAA). 2014b. Guadalupe fur seal, Updated November 4, 2014. http://www.nmfs.noaa.gov/pr/species/mammals/pinnipeds/guadalupefurseal.htm. Accessed on February 10, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2014c. Leatherback Turtle, Updated June 23, 2014. http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm. Accessed on February 10, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2014d. Loggerhead Turtle, Updated December 15, 2014. http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm. Accessed on February 10, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2014e. Olive Ridley Turtle, Updated October 30, 2014. http://www.nmfs.noaa.gov/pr/species/turtles/oliveridley.htm. Accessed on February 10, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2014f. Coho salmon. Updated May 15, 2014. http://www.nmfs.noaa.gov/pr/species/fish/cohosalmon.htm. Accessed on 10 February 10, 2015.

National Oceanic and Atmospheric Administration (NOAA). 2015. North Atlantic Right Whales (*Eubalaena glacialis)*. Updated January 15, 2015. http://www.nmfs.noaa.gov/pr/species/mammals/whales/north-atlantic-right-whale.html. Accessed on 5 February 2015.

National Wildlife Federation (NWF). 2015. Green Sea Turtles. http://www.nwf.org/wildlife/wildlife-library/amphibians-reptiles-and-fish/sea-turtles/green-sea-turtle.aspx. Accessed 10 February 2015

NatureServe. 2013. Hysterocarpus traskii. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>. Accessed on 11 February 2015.

NatureServe, 2014. Hoover's Cryptantha. http://explorer.natureserve.org/servlet/NatureServe?searchName=Cryptantha+hooveri. Accessed February 10, 2015.

Navsource Naval History. 2015. http://www.navsource.org/archives/05/305.htm. Accessed March 5, 2015.

Nightingale, B., and C. Simenstad. 2001. *Overwater structures: Marine issues.* Aquatic Habitat Guidelines: An integrated approach to marine, freshwater, and riparian habitat protection and restoration. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington State Department of Transportation by University of Washington, Seattle, Washington.

Office of Coast Survey. 2010. Automated Wreck and Obstruction Information System. http://www.nauticalcharts.noaa.gov/hsd/awois.html. Accessed February 26th, 2015.

Oregon Department of Fish and Wildlife (Oregon DFW). 2015. http://www.dfw.state.or.us/resources/fishing/warm_water_fishing/Sac_perch.asp. Accessed on 5 February 2015.

Pacific Biology. 2014. Pinole Creek at Interstate 80 Fish Passage Improvement Project--Biological Habitat Evaluation. September.

Pacific EcoRisk. 2008. DATA REPORT Characterization of Port of Redwood City Sediments: Results of Dredge Materials Sampling and Analysis. March. http://www.dmmosfbay.org/site/alias__8931/170540/default.aspx. Accessed April 24, 2015.

Pacific EcoRisk. 2010. Sediment Characterization Sampling and Analysis Results (SAR) for the Port of Redwood City Berths 1-4: 2010 Re-Sampling and Analyses Dredge Maintenance Program. September. http://www.dmmosfbay.org/site/alias__8931/170540/default.aspx. Accessed April 24, 2015.

Paddison, Joshua. 2015. 1821-1847: Missions, Ranchos, and the Mexican War for Independence. University of California, Calisphere, http://www.calisphere.universityofcalifornia.edu/calcultures/eras/era3.html. Accessed January 28th, 2015.

Peddicord, R. K., and McFarland, V. A. .1978. "Effects of suspended dredged material on aquatic animals," Technical Report D-78-29, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS., NTIS No. AD A058 489. http://el.erdc.usace.army.mil/elpubs/pdf/trd78-29.pdf

Pennekamp, J G S and Quaak, M P. 1990. Impact on the environment of turbidity caused by dredging. *Terra etAqua,* Vol. 42: 10-20.

Port of Redwood City. 2010. Port of Redwood City Wharves 1 and 2 Redevelopment Project Draft EIR. March.

Port of Redwood City. 2014. Board of Port Commissioners Terminal Tariff No. 8; Effective July 1, 2014.

Port of Redwood City. 2015. Welcome to the Port of Redwood City- Municipal Marina. http://www.redwoodcityport.com/p7iq/html/MunicipalMarina.html. Accessed March 20, 2015.

Recordnet.com. 2013. *Port of Stockton officials celebrate at dedication of Marine Highway*. November. http://www.recordnet.com/apps/pbcs.dll/article?AID=/20131102/A_NEWS/311020326/-1/NEWSMAP Accessed May 17 2015.

Reine, K.J., D.G. Clarke, C. and Dickerson, 2002. "Acoustic characterization of suspended sediment plumes resulting from barge overflow," DOER Technical Notes Collection

(ERDC TN-DOER-E15), U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Reine, K.J., and C. Dickerson, 2014. "Characterization of Underwater Sounds Produced by a Hydraulic Cutterhead Dredge during Maintenance Dredging in the Stockton Deepwater Shipping Channel, California," DOER-E38, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Reeves, et al, 1998. Recovery Plan for the Blue Whale. Prepared by Randall R. Reeves, Phillip J. Clapham, Robert L. Brownell, Jr., and Gregory K. Silber for the Office of Protected Resources National Marine Fisheries Service National Oceanic and Atmospheric Administration Silver Spring, Maryland. July. http://www.nmfs.noaa.gov/pr/pdfs/recovery/whale_blue.pdf. Accessed on 5 February 2015.

Robinson A, Greenfield BK. 2011. LTMS Longfin Smelt Literature Review and Study Plan. SFEI Contribution XXX. San Francisco Estuary Institute, Oakland, CA. 40 pp.

San Francisco Bay Conservation and Development Commission, USACE, RWQCB, State Water Resources Control Board (BCDC et al). 1998. *Long Term Management Strategy for Bay Area Dredged Material Final Environmental Impact Statement/Environmental Impact Report*. August.

San Francisco Bay Conservation and Development Commission, USACE, RWQCB, State Water Resources Control Board (BCDC et al). 2012. *Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region, 12-Year Review Process*. June.

San Francisco Bay Conservation and Development Commission (BCDC). 2013. Application Summary for Consistency Determination No. C2004.005.03, for the proposed construction and use of a new 16,000-square-foot offloading facility at Cullinan Ranch. October 25.

San Francisco Bay Conservation and Development Commission, USACE, RWQCB, State Water Resources Control Board (BCDC et al).2014. LTMS Draft LTMS Update Programmatic ESA Consultation with NOAA: Proposed Windows Modifications and Additional Measures for Salmonids and Green Sturgeon. April 7.

San Francisco Bay Regional Water Quality Control Board (RWQCB). 2000. Draft Staff Report - Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines. May.

San Francisco Bay Regional Water Quality Control Board (RWQCB). 2011. Basin Plan. San Francisco Bay Basin (Region 2).

San Francisco Bay Regional Water Quality Control Board (RWQCB). 2015. San Francisco Bay (Region 2) Water Quality Control Plan. March 20. http://www.waterboards.ca.gov/sanfranciscobay/basin_planning.shtml. Accessed April 25, 2015.

Stanford,B. K., K. Ridolfi, and B. Greenfield. 2009. Summary Report: Green Sturgeon, Longfin Smelt, and Dredging in San Francisco Bay. Prepared for USACE. SFEI Contribution #598. http://www.sfei.org/cb/greensturgeon/. Accessed May 24, 2015.

San Francisco Estuary Project. 2007. Comprehensive Conservation and Management Plan. http://www.sfestuary.org/about-us/strategic-plan/. Accessed March 29, 2015.

San Francisco Estuary Institute (SFEI). 2013. Pulse of the Bay: Contaminants of Emerging Concern. SFEI Contribution 701. San Francisco Estuary Institute, Richmond, CA. http://www.sfei.org/rmp/pulse.

San Francisco Estuary Institute (SFEI). 2014. Regional Monitoring Program Update. San Francisco Estuary Institute, Richmond, CA. http://www.sfei.org/news_items/regional-monitoring-program-rmp-update-2014-now-ebook.

San Francisco Estuary Institute (SFEI). 2015. Data Center. http://www.sfei.org/data-center Accessed May 2015.

San Francisco International Airport (SFO). 2015. Website. *Fly Quiet Program.* Available at: http://www.flysfo.com/community-environment/noise-abatement/fly-quiet. Accessed on March 16, 2015.

Santa Clara County. 1994. Santa Clara County General Plan Book A and Book B. December 12. http://www.sccgov.org/sites/planning/PlansPrograms/GeneralPlan/Pages/GP.aspx. Accessed December 10, 2014.

Santa Clara County. 2003. Code of Ordinances, Title B Regulations, Division B11-Environmental Health, Chapter VII. Control of Noise and Vibration.

Santa Clara Valley Water District (SCVWD). 2000, Safe Clean Water Report and Clean, Safe Creeks and Natural Flood Protection Plan. http://www.valleywater.org/SafeCleanWater.aspx. Last accessed on January 8, 2015.

Santa Clara Valley Water District (SCVWD). 2009. DEIR Alviso Slough Restoration Project. May. http://www.valleywater.org/services/alvisoslough.aspx. Accessed March 1 2015.

Save the Bay. 2015. The Story of Cullinan Ranch. http://blog.savesfbay.org/2015/01/the-story-of-cullinan-ranch/. Accessed February 9, 2015.

Seattle Audubon Society, 2015. Bird Web. http://birdweb.org/birdweb/bird/brewers_sparrow. Last accessed on January 8, 2015.

SeaVision. 2011. *Survey Report: Sub-Bottom Profiler Survey (Final Report), Combined Bathymetry/ Sub-Bottom Survey, Redwood City and San Bruno Shoal Deepwater Ship Channels.* May 20.

Shakal, Anthony, et al. 2014. "*Proceedings of SMIP14 Seminar on Strong-Motion Data from the M6.0 South Napa Earthquake of August 24, 2014.* California Strong-Motion Instrumentation Program, California Geological Survey.

Shuford, W. D., and Gardali, T., editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento. http://www.dfg.ca.gov/wildlife/nongame/ssc/birds.html

Solano County. 2008. Solano County General Plan. Chapter 2-Land Use; Chapter 4 Resources; Chapter 5- Public Health and Safety. August 5. http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp. Last Accessed February 22, 2015.

Solano County and Solano Economic Development Corporation. 2015. *Solano County 2014 Index of Economic and Community Progress*, March. http://www.solanocounty.com/civicax/filebank/blobdload.aspx?BlobID=19863. Accessed on March 18, 2015.

Solano County Water Agency. 2012. Solano Habitat Conservation Plan. October. http://scwa2.com/water-supply/habitat/solano-multispecies-habitat-conservation-plan. Accessed March 19, 2015.

Sonoma.edu. 2015. California Coastal Prairie, Animals. http://www.sonoma.edu/preserves/prairie/prairie_desc/animals.shtml. Last accessed on January 8, 2015.

Sonoma State University, Anthropological Studies Center. 2015. Shipwrecks. http://www.sonoma.edu/asc/publications/vestiges/Shipwrecks.html. Accessed February 4, 2015.

South Bay Salt Ponds Restoration Project (SBSP). 2015. "Track our Progress". http://www.southbayrestoration.org/track-our-progress/. Accessed February 23, 2015

"Sperm Whales, Physeter macrocephalus ~ MarineBio.org." MarineBio Conservation Society. Web. <http://marinebio.org/species.asp?id=190>. Accessed February 10, 2015.

Starratt, Wes, PE, 2006. "Two Fireboats Save the Waterfront," San Francisco Bay Crossings, http://www.baycrossings.com/dispnews.php?id=1515. Accessed April 15, 2015.

Stern, E.M., W.B. Stickle. 1978. Effects if Turbidity and Suspended Material in Aquatic Environments; Literature Review. Technical Report D-78-21, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, MS.

Sturtevant, William C. (gen. ed.). 1978. *Handbook of North American Indians*. 20 vols. Smithsonian Institution, Washington, D.C. https://books.google.com/books?id=I6b6EEE1YlIC&pg=PA299&lpg=PA299&dq=malaria+epidemic+california+1822&source=bl&ots=EVWoKYVPu7&sig=GmAk2nVhNfMCB3AOz4E5SYuh0Lw&hl=en&sa=X&ei=CYDBVNaHAYGlNqrPgLgK&ved=0CB4Q6AEwAA#v=onepage&q=malaria%20epidemic%20california%201822&f=false).

Tessler, et al. 2007. Black Oystercatcher (*Haematopus bachmani)* Conservation Action Plan, April 1, 2007, Prepared by David Tessler, James Johnson, Brad Andres, Sue Thomas, and Richard Lanctot for the Alaska Department of Fish and Game, the U.S. FWS, Manomet Center for Conservation Science, and WHSRN (Western Hemisphere Shorebird Reserve Network). http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/FocalSpecies/Plans/BLOY.pdf. Accessed on February 5, 2015.

Tetra Tech Inc. 2005. Guadalupe River Watershed Mercury TMDL Report. Final Conceptual Model Report.

Tetra Tech Inc. 2006. Conceptual Model of Mercury in San Francisco Bay.

Thackston, E.L., Palermo, M.R. (a). 2000. Improved Methods for Correlating Turbidity and Suspended Solids for M onitoring, DOER Technical Notes Collection, ERDC TN-DOER-E8, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Treadwell and Rollo. 2011. *Geotechnical Progress Report Redwood City, California Preliminary Conclusions and Recommendations Port of Redwood City, Wharves 1 and 2.* September 23.

United States Army Corps of Engineers (USACE). 1989. Dredging Guidance Letter No. 89-01. March.

United States Army Corps of Engineers (USACE). 1998a. Oakland Harbor Deep Draft Navigation (50 foot) Improvement Project Draft Final Environmental Impact Report/Environmental Impact Statement. March

United States Army Corps of Engineers (USACE). 1998b. Oakland Harbor Deep Draft Navigation (50 foot) Improvement Project Draft Final Feasibility Report with Revisions. April

United States Army Corps of Engineers (USACE). 2003. "EM 1110-2-1902, Engineering and Design, Slope Stability."

United States Army Corps of Engineers (USACE). 2005. Mare Island Dredged Material Disposal Ponds, Final EIS/EIR. October. http://mareisland.org/EIS_EIR/Final%20EIS-EIR/Volume%20I%20Environmental%20Analysis/_%20Cover%20Volume%20I,%20Title,%20Contents.pdf.

United States Army Corps of Engineers (USACE). 2009, *Port of Los Angeles Channel Deepening Project, Volume I, Final Supplemental Environmental Impact Statement/Supplemental Environmental Impact Report*. April.

United States Army Corps of Engineers (USACE). 2012. Environmental Assessment for Suisun Bay Channel and New York Slough Maintenance Dredging for Calendar Year 2012. September.

United States Army Corps of Engineers (USACE). 2013, Sutter Basin Pilot Feasibility Final Report--Final Environmental Impact Report / Supplemental Environmental Impact Statement, Prepared by the U.S. Army Corps of Engineers Sacramento District, Central Valley Flood Protection Board, and Sutter Butte Flood Control Agency. t http://www.spk.usace.army.mil/Portals/12/documents/civil_works/Sutter/Final_Report/SutterPilotFeasibilityReport_FEIR-SEIS.pdf, Last accessed on 26 December 2014

United States Army Corps of Engineers (USACE). 2014a. Draft South San Francisco Bay Shoreline Phase I Study, Integrated Document Environmental Impact Statement/Report. December.

United States Army Corps of Engineers (USACE). 2014b. Environmental Assessment of Redwood City Harbor Federal Channels, Maintenance Dredging, San Francisco, California, Calendar Year 2014 and 2015, draft document. August.

United States Army Corps of Engineers (USACE). 2014c. Redwood City Harbor 2014 O&M Dredging Sampling and Analysis Results.

United States Army Corps of Engineers (USACE). 2014d. Report Synopsis Redwood City Harbor, California Navigation Improvement Feasibility Study Alternatives Milestone IPR, March 2014. March.

United States Army Corps of Engineers (USACE). 2015. Supplemental Report Redwood City Harbor 2014 O&M Dredging Composite Area 07 High Resolution Sampling and Analysis Results USACE Contract No. W912:7-D-0001 Kinetic Laboratories, Inc. and Atkens North America, January.

United States Army Corps of Engineers and Port of Oakland (USACE and Port of Oakland). 1998. Oakland Harbor Deep Draft Navigation (-50-foot) Improvement Project Draft Final Environmental Impact Report/Environmental Impact Statement. March.

United States Army Corps of Engineers and Port of Sacramento (USACE and Port of Sacramento). 2011. Draft Supplemental EIS/Subsequent EIR Sacramento River Deep Water Ship Channel. February. http://www.spn.usace.army.mil/Missions/ProjectsandPrograms/ProjectsAZ/SacramentoRiverDeepWaterShipChannel%28C%29/Main/Documents.aspx . Accessed 4/1/2015.

United States Army Corps of Engineers and San Francisco Bay Regional Water Quality Control Board (USACE and RWQCB). 2014. Draft Environmental Assessment/Environmental Impact Report, Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay, Fiscal Years 2015-2024. December. http://www.swrcb.ca.gov/sanfranciscobay/water_issues/programs/dredging/Fed%20Nav%20Channels_DEAEIR_Dec2014.pdf.

United States Army Corps of Engineers and San Francisco Bay Regional Water Quality Control Board (USACE and RWQCB). 2015. Final Environmental Assessment/Environmental Impact Report, Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay, Fiscal Years 2015-2024. April. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/dredging/Fed%20Nav%20Channels_FEAEIR_April%202015.pdf

United States Army Corps of Engineers and Santa Clara Valley Water District (USACE and SCVWD). 2014. Draft South San Francisco Bay Shoreline Phase I Study EIS/EIR. December. http://www.valleywater.org/SSFBS-DEIR.aspx)

United States Army Corps of Engineers and US Environmental Protection Agency (USACE and USEPA). 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the US – Testing Manual for Discharge in Inland and Near Coastal Water. February. http://water.epa.gov/type/oceb/oceandumping/dredgedmaterial/upload/2009_10_09_oceans_regulatory_dumpdredged_itm_feb1998.pdf

United States Army Corps of Engineers and US Environmental Protection Agency (USACE and USEPA). 2011. Letter to Mr. Robert S. Hoffman, Assistant Regional Administrator for Habitat Conservation, National Marine Fisheries Service, entitled: *Agreement on Programmatic EFH Conservation Measures for Maintenance Dredging Conducted under the LTMS Program (Tracking Number 2009/06769).* June 9.

United States Army Corps of Engineers and US Environmental Protection Agency (USACE and USEPA). 2012. Letter to Mr. Steve A. Edmondson, Northern California Habitat Conservation Manager, National Marine Fisheries Service, entitled: *Modification to the*

2011 "Agreement on Programmatic EFH Conservation Measures for Maintenance Dredging Conducted under the LTMS Program (Tracking Number 2009/06769)" – Concerning Mercury Bioaccumulation and Residuals Testing. June 9.

United States Army Corps of Engineers and Weston. 2005. Characterization of Suspended Sediment Plumes Associated with Knockdown Operations at Redwood City Harbor, California. October 12.

US Army Engineer Research and Development Center Vicksburg (USERDC). 2014. Entrainment of Smelt in San Francisco Bay by Hydraulic Dredges: Rates, Effects, and Reduction of Impacts. March 28.

United States Census Bureau. 2010-2014. Quickfacts. http://quickfacts.census.gov/qfd/states/06000.html. Accessed on March 18, 2015.

United States Department of the Navy. 2015. Naval History and Heritage Command official website. http://www.history.navy.mil/research/underwater-archaeology/sunken-military-craft-act/smca.html

United States Department of Transportation Federal Highway Administration (USDOT Federal Highway Administration), 2003, Public Roads, Volume 67. No. 1. "Living With Noise" by Chris Corbisier, July/August 2003.. https://www.fhwa.dot.gov/publications/publicroads/03jul/06.cfm. Accessed March 25, 2015.

United States Environmental Protection Agency (USEPA). 2010a. Endangered Species Protection Program, Endangered Species Fact Sheet.

United States Environmental Protection Agency (USEPA). 2010b. Final Report: Review/Synthesis of Historical Environmental Monitoring Data Collected at the San Francisco Deep Ocean Disposal Site (SF-DODS) in Support of EPA Regulatory Decision to Revise the Site's Management and Monitoring Plan. June. http://www.epa.gov/region9/water/dredging/sfdods/SfDodsMonitorSynRev6-10final.pdf .

United States Environmental Protection Agency (USEPA). 2010c. San Joaquin Kit Fox. February. http://www.epa.gov/espp/factsheets/san-joaquin-kitfox.pdf. Last accessed on February 10, 2015.

United States Environmental Protection Agency (USEPA). 2012. Noise Pollution website. http://www.epa.gov/air/noise.html. Accessed January 14, 2013.

United States Environmental Protection Agency (USEPA). 2014. Dredging and Sediment Management, San Francisco Deep Ocean Disposal Site. http://www.epa.gov/region9/water/dredging/sfdods/ Accessed May 19, 2015.

United States Fish and Wildlife Service (USFWS). 1998. Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area. http://ecos.fws.gov/docs/recovery_plans/1998/980930c.pdf. Accessed on February 9, 2015.

United States Fish and Wildlife Service (USFWS). 2008a. Oregon Fish and Wildlife Office, Species Fact Sheet: Short-tailed albatross, Last updated April 17, 2008. http://www.fws.gov/oregonfwo/Species/Data/ShortTailedAlbatross/. Accessed on February 5, 2015.

United States Fish and Wildlife Service (USFWS). 2008b. Draft EIS/EIR Cullinan Ranch Restoration Project, Solano and Napa Counties, California. April. http://www.fws.gov/cno/refuges/cullinan/

United States Fish and Wildlife Service (USFWS). 2009. Final EIS/EIR Cullinan Ranch Restoration Project, Solano and Napa Counties, California. April. http://www.fws.gov/cno/refuges/cullinan/

United States Fish and Wildlife Service (USFWS). 2013. Oregon Fish and Wildlife Office, Species Fact Sheet: Pacific lamprey, Last updated February 25, 2013. http://www.fws.gov/oregonfwo/Species/Data/PacificLamprey/. Accessed on 5 February 2015.

United States Fish and Wildlife Service (USFWS). 2014a. Species Assessment and Listing Priority Assignment Form--*Hypomesus transpacificus* Delta smelt, May 2, 2014. https://ecos.fws.gov/docs/species/uplisting/doc4452.pdf. Accessed on 5 February 2015.

United States Fish and Wildlife Service (USFWS). 2014b. Oregon Fish and Wildlife Office, Species Fact Sheet: Vernal pool fairy shrimp, Last updated April 28, 2014. http://www.fws.gov/oregonfwo/Species/Data/VernalPoolFairyShrimp/ . Accessed on February 5, 2015.

United States Fish and Wildlife Service (USFWS). 2014c. Oregon Fish and Wildlife Office, Species Fact Sheet: Northern spotted owl, Last updated May 27, 2014. http://www.fws.gov/oregonfwo/species/data/northernspottedowl/ . Accessed on February 5, 2015.

United States Fish and Wildlife Service (USFWS). 2014d. Oregon Fish and Wildlife Office, Vernal Pools, Last updated September 30, 2014. http://www.fws.gov/oregonfwo/FieldOffices/Roseburg/VernalPools/ . Accessed on February 5, 2015.

United States Fish and Wildlife Service and California Department of Fish and Game (USFWS and CDFW). 2007. South Bay Salt Pond Restoration Project Final EIS/EIR, December. http://www.southbayrestoration.org/EIR/downloads.html.

United States Geological Survey (USGS). 2008. Bay Area Earthquake Probabilities. http://earthquake.usgs.gov/regional/nca/ucerf/. Accessed March 15, 2015.

United States National Parks Service (NPS). 1992. National Register Bulletin 20. Nominating Historic Vessels and Shipwrecks to the National Register of Historic Places. http://www.cr.nps.gov/nr/publications/bulletins/nrb20/vs1.htm

United States National Parks Service (NPS). 1997. National Register Bulletin 15. How to Apply the National Register Criteria for Evaluation. http://www.nps.gov/nr/publications/bulletins/pdfs/nrb15.pdf

United States National Parks Service (NPS). 2015a. Abandoned Shipwreck Act Guidelines. http://www.nps.gov/archeology/submerged/NRShips.htm. Accessed February 11, 2015.

United States National Parks Service (NPS). 2015b. Nature & Science section. Accessed 10 February 2015. www.nps.gov

University of California, Berkeley, UC Museum of Paleontology. 2015a. http://ucmpdb.berkeley.edu/loc.html, Accessed February 25, 2015.

Woodward-Lundgren & Associates. 1971. Soil and Geologic Data Collection, Bay Lands Flood Control Planning Study.

University of California, Davis (UCD), Center for Watershed Sciences, 2011. *Mylopharodon Conocephalus.* http://pisces.ucdavis.edu/content/mylopharodon-conocephalus. Accessed on 5 February 2015.

University California, Davis (UCD). 2015. California Fish Website. 2015. http://calfish.ucdavis.edu/species/?uid=38&ds=241. Accessed on 5 February

University of Rhode Island and USEPA. 2015. Estuarine Science - San Francisco Bay. http://omp.gso.uri.edu/ompweb/doee/science/descript/baysfran.htm. Accessed April 24, 2015.

URS Group, Inc. (URS). 2004. Wave and Wake Baseline Analysis. June.

URS Group, Inc (URS). 2014a. South Bay Salt Pond Restoration Project Eden Landing Preliminary Alternatives Analysis Report. June.

URS Group, Inc. (URS). 2014b. Final Environmental Assessment for Waterfront Repairs at United States Coast Guard Station Monterey - Monterey, California. Prepared for U.S. Coast Guard, January 2014. http://www.nmfs.noaa.gov/pr/pdfs/permits/uscg_monterey_ea.pdf. Accessed: April 21,2015.

Walker, B. 2004. Effects of management practices on grassland birds: Brewer's Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/literatr/grasbird/brsp/brsp.htm (Version 12AUG2004). Accessed on 9 February 2015.

Wikipedia. 2015. USS Thompson. http://en.wikipedia.org/wiki/USS_Thompson_(DD-305). Accessed April, 2015.

WILDLIFE PROGRAM REPORT NO2010-10. Accessed on 11 February 2015. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0CCwQFjAC&url=https%3A%2F%2Fnrm.dfg.ca.gov%2FFileHandler.ashx%3FDocumentID%3D24503&ei=BQXZVMLND8SnggSN0IGwCQ&usg=AFQjCNG28ku_fMH8u2B0YtB4qyTOoeA_DA&bvm=bv.85464276,d.eXY

Williams, 2013. Transcontinental Gas Pipe Line Company, LLC. Request for an Incidental Harassment Authorization Under the Marine Mammal Protection Act. Rockaway Delivery Lateral Offshore Pipeline Route. October. Submitted to NMFS. Available at http://www.nmfs.noaa.gov/pr/pdfs/permits/rockaway_iha_application2014.pdf

Wise, Charles L. President. 1921. Shipping, Volume 13, No. 1 "Marine Mishaps." New York: Shipping Publishing Company. January 10. https://books.google.com/books?id=HTQfAQAAMAAJ&pg=RA6-PA66&lpg=RA6-PA66&dq=%22city+of+glendale%22+and+schooner+and+Redwood&source=bl&ots=s_iP0u4pU5&sig=RdNJpHMaARZiiejczwOdCg8ZZnY&hl=en&sa=X&ei=CLjrVPaVB5CvoQT_loLADw&ved=0CB4Q6AEwAA#v=onepage&q=%22city%20of%20glendale%22%20and%20schooner%20and%20Redwood&f=false

Zembal, et al. 2010. *A Survey of the Belding's Savannah Sparrow*. State of California Resources Agency, Department of Fish and Game -- Wildlife Branch.

Zembal, Richard and Susan M. Hoffman. 2010. Clapper Rail Recovery Fund. Huntington Beach Wetlands Conservancy. September. NONGAME Index

US Army Corps of Engineers ®
San Francisco District

Redwood City Harbor, California, Navigation Improvement Feasibility Study

Appendix B

Contents

1. Purpose of Report 3
2. Background 3
3. Dredge Quantities 4
4. Utility Survey 6
   4.1. Water-Based Field Reconnaissance Survey 6
   4.2. Water-Jet Probing Diver Survey 6
5. Redwood City Harbor and San Bruno Shoal Channel 7
6. Montezuma Wetland Restoration Site 8
7. Cullinan Ranch Tidal Restoration Site 8
8. San Francisco Deep Ocean Disposal Site SF-DODS 8
9. References 9

Figures

Figure 1 - Study Area

Tables

Table 1, Redwood City Channel at -32 ft
Table 2, Redwood City Channel at -34 ft
Table 3, Redwood City Channel at -37 ft
Table 4, San Bruno Shoal Channel at -32 ft
Table 5, San Bruno Shoal Channel at -34 ft
Table 6, San Bruno Shoal Channel at -37 ft
Table 7. Water Based Field Reconnaissance Survey Results
Table 8. Diver Survey Results

Attachments

Attachment I – Redwood City Harbor Channel Plans

Attachment II – San Bruno Shoal Channel Plans

1. Purpose of Report

This report summarizes the utility survey, the Redwood City Harbor and San Bruno Shoal Channel design criteria and the dredged material placement site required to support the planning and Federal interest determination of a civil works navigation project in the Redwood City Harbor Channel and San Bruno Shoal Channel. This project is referred to as the "Redwood City Harbor, California, Navigation Improvement Feasibility Study", or more generically as the "study" or "study area" in this report. This report will serve as an appendix to the study's integrated feasibility study and environmental impact statement report.

2. Background

The study area is Redwood City Harbor, which is located in San Mateo County, California, on the southwest side of San Francisco Bay, approximately 18 miles south of San Francisco, California. The study area includes two existing navigation channels: the Redwood City Harbor Channel and San Bruno Shoal Channel (Figure 1). The Redwood City Harbor Channel extends from the mouth of Redwood Creek to deep water in the San Francisco Bay, while the San Bruno Shoal Channel is located in San Francisco Bay. Both channels are maintained at -30 ft mean lower low water (MLLW) with 2 ft of allowable over depth. The tentatively selected plan was to deepen both channels to -32 ft MLLW and to transport and dispose the dredged material at the San Francisco Ocean Disposal Site SF-DODS.

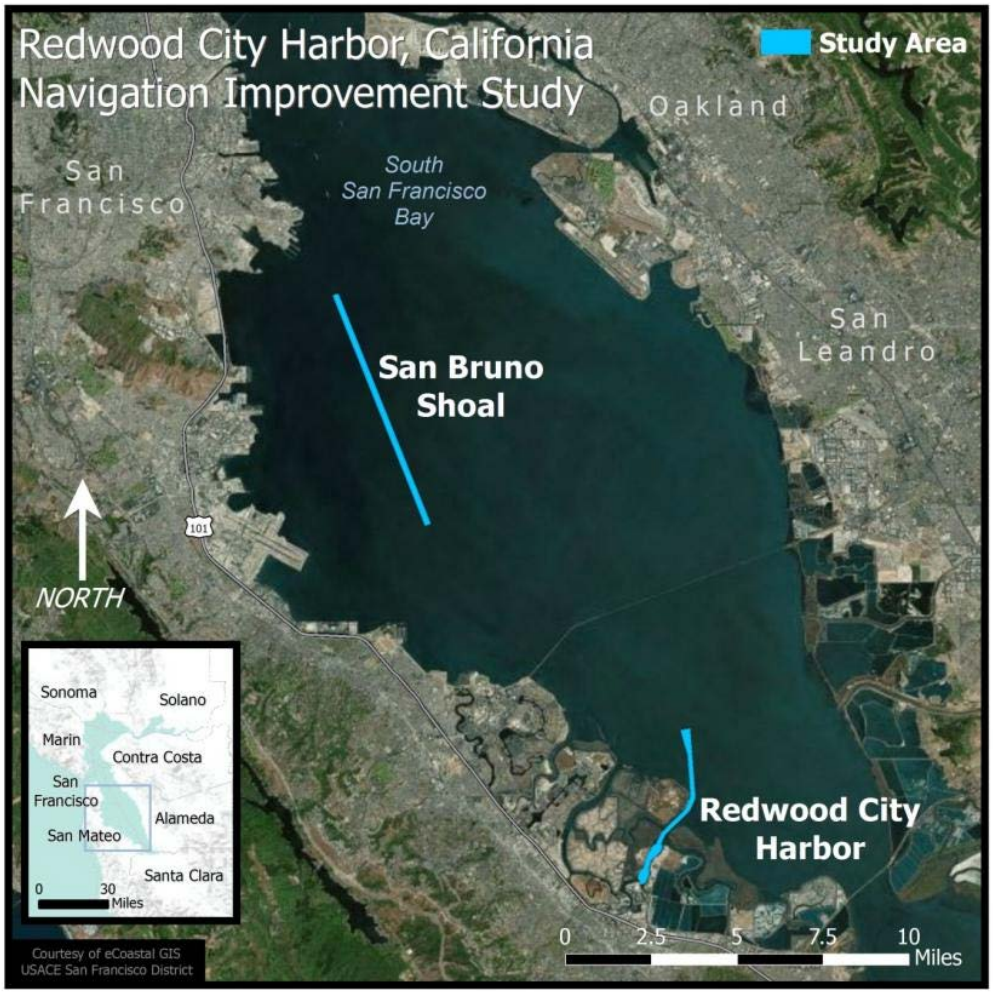


Figure 1. Study area

3. Dredge Quantities

The dredge quantities for both the Redwood City Harbor and San Bruno Shoal Channels were computed with Hypack. The dredge quantities for the Redwood City Harbor Channel are summarized in tables 1, 2 and 3 and the quantities for the San Bruno Shoal Channel are summarized in tables 4, 5 and 6.

Table 1, Redwood City Channel at -32 ft

Reach	Station	-32 ft (CY)	1 ft Overdepth (CY)	Total (CY)
1	0+00 to 42+00	34,221	22,402	56,622
2	42+00 to 84+00	102,156	46,913	149,069
3	84+00 to 126+00	137,899	61,783	199,683
4	126+00 to 168+00	378,149	76,273	454,422
5A	168+00 to 186+00	143,363	34,529	177,892
5B	186+00 to 208+49	197,808	57,132	254,940

	TOTAL	993,595	299,031	1,037,687

Table 2, Redwood City Channel at -34 ft

Reach	Station	-34 ft (CY)	1 ft Overdepth (CY)	Total (CY)
1	0+00 to 42+00	86,890	36,068	122,958
2	42+00 to 84+00	201,548	56,040	257,588
3	84+00 to 126+00	260,221	68,880	329,101
4	126+00 to 168+00	523,400	77,340	600,740
5A	168+00 to 186+00	207,013	34,872	241,885
5B	186+00 to 208+49	304,251	57,145	361,397
	TOTAL	1,583,324	330,346	1,552,273

Table 3, Redwood City Channel at -37 ft

Reach	Station	-37 ft (CY)	1 ft Overdepth (CY)	Total (CY)
1	0+00 to 42+00	217,531	54,819	272,349
2	42+00 to 84+00	374,864	61,435	436,300
3	84+00 to 126+00	474,685	76,993	551,677
4	126+00 to 168+00	738,009	77,644	815,653
5A	168+00 to 186+00	301,582	34,911	336,492
5B	186+00 to 208+49	461,508	57,143	518,651
	TOTAL	2,568,178	362,945	2,931,122

Table 4, San Bruno Shoal Channel at -32 ft

-32 ft (CY)	1 ft Overdepth (CY)	Total (CY)
118,161	221,248	339,410

Table 5, San Bruno Shoal Channel at -34 ft

-34 ft (CY)	1 ft Overdepth (CY)	Total (CY)
701,134	492,075	1,193,209

Table 6, San Bruno Shoal Channel at -37 ft

-37 ft (CY)	1 ft Overdepth (CY)	Total (CY)
2,350,129	641,445	2,991,574

4. Utility Survey

Three pipelines run beneath San Bruno Shoal in San Francisco Bay. Two of the pipelines are owned by Kinder Morgan and one is owned by Shell. The USACE and Port of Redwood City did not have any documentation, pre- existing surveys, or other information that would indicate the depth of these pipelines. As a result, a water-based field reconnaissance survey was conducted in June 2014 with a STARFIX DGPS Satellite Navigation System, a single beam echo sounder, an edgetech DS 2000 Side Scan Sonar, sub-Bottom profiler systems and a magnetometer and a water-jet probing diver survey was conducted in October 2014 using divers and water-jet probes.

4.1. Water-Based Field Reconnaissance Survey

A Marine Magnetic Corporation SeaSPY marine magnetometer was deployed from the starboard stern of the survey vessel, and run in order to confirm man-made objects versus natural objects. Magnetic anomalies occur when the towed magnetometer sensor passes near an object containing iron. The size of the magnetic anomaly depends mostly on how close to the iron object the sensor is and the amount (mass) of iron. The size (intensity) of magnetic anomalies is expressed in gammas (or nanoteslas). Total field readings were logged to the acquisition computer through the SeaSPY's communications transceiver.

The results from the survey are summarized below in Table 1, Water Based Field Reconnaissance Survey Results.

Table 7, Water Based Field Reconnaissance Survey Results

Approximate Surveyed Project Stationing	Channel	Description	Owner	Depth of Burial	Bottom of Trench Elevation (MLLW) Range
38+00	San Bruno Shoal	10" and 12" Pipelines	Kinder Morgan	2.6' to 6.8'	-35.80 to -39.67
148+70	San Bruno Shoal	Non-Operational 10" Pipeline	Shell	3.7' to 6.2'	-34.11 to -36.63

The water based field reconnaissance survey was only able to detect a trench during the survey of the Kinder Morgan pipelines. The Kinder Morgan pipelines could not be detected during the water based field reconnaissance survey. As a result, the diver survey was conducted in order to determine the depth of the Kinder Morgan pipelines.

4.2. Water-Jet Probing Diver Survey

Four divers utilized a 1" jet probe to survey the Kinder Morgan pipelines on October 22, 2014. The results from the survey are summarized below in Table 2, Diver Survey Results.

Table 8, Diver Survey Results

Approximate Pipeline Station	Description of Activity	Results
1124+20	Eastern Limit of Channel	
1124+65	Probed approximately 10 to 15 feet north and south of pipeline alignments.	Armoring rock found 2 to 3 feet below mudline. Unable to penetrate rock.
1125+18	Probed approximately 10 to 15 feet north and south of pipeline alignments.	Armoring rock found 2 to 3 feet below mudline. Unable to penetrate rock.
1125+45	Probed approximately 23 feet north to end of armoring rock. Probed 10 feet south of pipeline alignments.	Armoring rock found 1 to 2 feet below mudline. Unable to penetrate rock.
1125+77	Probed approximately 20 feet north to end of armoring rock. Probed 10 feet south of pipeline alignments.	Armoring rock found 1 to 2 feet below mudline. Unable to penetrate rock.
1126+80	Channel Center Line	
1128+06	Probed Channel alignments. Touched pipelines.	Armoring rock detected. Pipelines found with 5 feet (plus or minus 2-3 inches) depth and 5 feet horizontal separation between pipelines.
1128+80	Probed Channel alignments. Touched pipelines.	Armoring rock detected. Pipelines found with 5 feet (plus or minus 2-3 inches) depth and 5 feet horizontal separation between pipelines.
1129+45	Western Limit of Channel	

5. Redwood City Harbor and San Bruno Shoal Channel

The Redwood City Harbor Channel is located in San Mateo County, California and extends from the mouth of the Redwood Creek to deep water in the San Francisco Bay (Attachment I). The San Bruno Shoal Channel is located in the San Francisco Bay (Attachment II). Bair and Greco Islands, part of the Don Edwards National Wildlife Refuge, are adjacent to the Redwood City Harbor.

In order to reduce the environmental impacts that the deepening project could have on the refuge, the Redwood City Harbor channel boundaries are different from the current authorized channel boundaries. The USACE coordinated with the San Francisco Bar Pilots regarding the channel boundary changes from the current authorized channel boundaries. From station 80+00 to station 122+00, the channel was realigned 6 feet away from Bair Island. From Station 127+00 to station 140+00, the channel was realigned 6 feet away from Greco Island. From station 140+00 to station 155+00, the channel was realigned 6 feet away from Bair Island. From station 155+00 to station 162+00, the channel width was reduced by 12 ft. From station 162+00 to the end of the turning basin, the channel width was reduced by 6 ft on the Bair Island side only.

A ship simulation study is required for the Redwood City Harbor Channel Deepening Project and it is normally conducted during the feasibility phase. However, the USACE and the Port of Redwood City made the decision to conduct the ship simulation study during the PED phase.

The Redwood City Harbor Channel and San Bruno Channel side slopes of 3H: 1V were determined appropriate for the feasibility phase. Soundings were taken by a fathometer and are based on the Mean Lower Low Water (MLLW) datum. The plane grids and coordinates are based on the Lambert projection, NAD 83 California Zone 3.

6. Montezuma Wetland Restoration Site

Montezuma Wetlands Restoration Project is a privately owned, ongoing restoration effort. Montezuma Wetland Restoration Project accepts both wetland cover and wetland non-cover (foundation) quality material from new work and maintenance projects. This site is currently accepting sediment and has an off-loader in place and operating. The project site comprises approximately 2,400 acres at the eastern edge of Suisun Marsh, approximately 17 miles southeast of Fairfield, California.

Ground elevations at the site have subsided up to 10 feet since its tidal marshlands were diked and drained for agricultural purposes more than 100 years ago. All site preparation, monitoring, and reporting is handled by the MWP, which charges a tipping fee for accepting dredged sediment. The tipping fee includes use of the offloader.

7. Cullinan Ranch Tidal Restoration Site

Cullinan Ranch Tidal Restoration Project is a permitted wetland restoration site that comprises more than 1,500 acres and is located in western Solano County near the city of Vallejo. It is located between State Highway 37 and Dutchman Slough. It is considered a beneficial reuse site and is currently permitted and available. Cullinan Ranch is a former hay/cattle farm that is being restored to tidal marsh. It has a total capacity of 3 million cubic yards of dredged sediment. The sediment will be used to raise up to 290 acres of the site to marsh plain elevation. The site has two locations, both located in Napa River, north and south of the mouth of Dutchman Slough, respectively. Both locations are accessible by large scows.

8. San Francisco Deep Ocean Disposal Site SF-DODS

SF-DODS is located in the Pacific Ocean, approximately 55 nautical miles west of the Golden Gate Bridge. The site is approximately 85 nautical miles from RWC Harbor and approximately

75 nautical miles from SBS channel. The site was established in 1994 by the Long Term Management Strategy agencies, and is managed by the EPA.

Dredged material is not allowed be leaked or spilled from the scows during transit to the SFDODS. Transportation of dredged material to the SF-DODS can only be allowed when weather and sea state conditions do not interfere with safe transportation and do not create risk of spillage, leak or other loss of dredged material in transit to the SF-DODS. No scow trips are allowed to be initiated when the National Weather Service has issued a gale warning for local waters during the time period necessary to complete dumping operations, or when wave heights are 16 feet or greater.

9. References

HDR, *Utility Survey for the Redwood City Deepening Project*. Prepared for the U.S. Army Corps of Engineers, San Francisco District. November, 2014.



US Army Corps of Engineers ®
San Francisco District

Redwood City Harbor, California, Navigation Improvement Feasibility Study

Appendix C

Cost Engineering

DRAFT

Contents

1. Introduction 3
2. Project Description 3
3. Basis, Facts, and Assumptions 3
3.1 Construction Window 4
3.2 Overtime 4
3.3 Acquisition Plan 5
3.4 Construction Method 5
3.5 Equipment, Labor Availability, and Distance Traveled 5
3.6 Environmental Coordination 5
3.7 Labor Rates 5
4. References 5

1. Introduction

Reference materials used to prepare the Current Working Estimates (CWE) along with the basis for the estimates and any applicable facts and/or assumptions impacting the CWEs are documented below.

2. Project Description

The tentatively selected plan is to deepen the channels at RWC Harbor and San Bruno Shoal to 32 ft MLLW and place dredged material at SF-DODS.

If implemented, the channel at Redwood City Harbor would vary in width from 350 ft near the entrance, and as narrow as 294 ft between the inner and outer turning basins in the rest of the channel. The channel alignment at the turn into Redwood City Harbor would retain the existing width, but would be shifted 6 ft to the East to avoid adverse impacts to the Bair Island. As the channel moves West between Bair and Greco Islands in Reach 3 and continues to the end of the project at the inner turning basin in Reach 5, the channel would narrow, with the existing side slopes remaining undisturbed on either side of the channel. The channel boundary adjacent to the Port of Redwood City side of the channel would remain unchanged to avoid interference with existing port infrastructure. The channel would narrow by 6 ft, assuming 3:1 side slopes between -30 ft and -32 ft on the Bair Island side of the channel across from the Port of Redwood City.

All dredging, material transportation and material placement shall be in accordance with the project plans, specifications, permits, regulatory guidance and applicable contract clauses.

3. Basis, Facts, and Assumptions

- A single 21 CY clamshell dredge was assumed for each estimate. Multiple dredge crews were not assumed, but may want to be considered to shorten the construction schedule.

- Three fuel pipelines have been identified and cross the San Bruno Shoal. Relocation costs have been estimated at $5 million each based on the Feasibility & Budgetary Cost report located in the references. Since the owners of each pipeline are responsible for the relocation costs, the pipeline work is reflected only in the benefit cost ratio and net benefits, and not the total project cost.

- Tipping fees for Montezuma ($12.50/CY) and Cullinan Ranch ($8.00/CY) were both based on historical rates provided by the Civil Design Section.

- An additional mobilization and demobilization was included for every additional dredge season needed to complete the dredging work.

- Cullinan Ranch does not own an offloader, therefore, an offloader cost was assumed to include the mobilization of a hydraulic dredge, modifications to the pumping system,

and pipeline costs. $3/CY was assumed for a pumping cost from the offloader to Cullinan Ranch (based on the San Francisco Bay to Stockton Deepening Project Cost Estimate).

- 5% of the total dredge quantity (not including Reach 5b) was assumed to be upland non-cover but could be disposed of at SF-DODS.

- Material located between -32' and -34' at Reach 5b of the Redwood City Harbor was assumed to be contaminated and must be disposed of at Berth 10 and transported to a landfill. The following details the development of the Redwood City unit price for disposal at Berth 10.

  Historical unit price for the Oakland Deepening Project in 2009:

$$Oakland\ Deepening\ Project\ (2009) = \frac{\$608{,}871}{7{,}000\ CY} = \$87\ per\ CY$$

  Historical Oakland unit price plus a $13/CY tipping fee and $22,000 docking fee for an assumed one year time period:

$$Redwood\ City\ Deepening\ (2009) =$$
$$\$87\ per\ CY + \$13\ per\ CY + \$22{,}000\ x\ \frac{12\ months}{121{,}000\ CY}$$
$$= \$102\ per\ CY$$

  Escalated Redwood City Deepening unit price based on CWCCIS:

$$Redwood\ City\ Deepening\ (2015) = \$102\ per\ CY\ x\ \left(\frac{856.96}{703.47}\right) = \$125\ per\ CY$$

  An updated unit price based on historical production rates and fees will be developed after the TSP milestone.

- The future increase in operations and maintenance costs for the deepened channel was based on quantities provided by *Delta Modeling Associates, Inc*. Future maintenance material was assumed to be disposed at SF-11.

3.1 Construction Window

Due to endangered species, the dredging window begins June 1st to November 30th each year.

3.2 Overtime

Work will be completed using two 12 hour shifts 7 days a week.

3.3 Acquisition Plan

The acquisition is unknown at this time, however, SDB and 8(a) contractors were not included in the development of unit prices.

3.4 Construction Method

Typical clamshell dredging is standard. No special construction technologies are required for the job.

3.5 Equipment, Labor Availability, and Distance Traveled

The project is located in Northern California. All labor and equipment is assumed available within a 1,010 mile radius (Tacoma, WA) in order to allow for fair competition.

3.6 Environmental Coordination

No special environmental concerns beyond those stated in the basis/facts/assumptions and Construction Window.

3.7 Labor Rates

The estimate meets the Davis-Bacon wage rates for Northern California.

4. References

- Report Synopsis, Redwood City Harbor, California, Navigation Improvement Feasibility Study Tentatively Selected Plan Milestone (31 March 2014)
- Sediment Transport Modeling for Navigation Channel Deepening of Redwood City Harbor, Interim Draft Report (16 December 2014)
- Feasibility & Budgetary costs to lower Kinder-Morgan Pipelines and Shell Pipeline across San Bruno Shoal (23 FEB 2015)
- 3E_Reach 11_Challenged Material_19August09.mlp.
- CSRA Abbreviated RWC -3X Feet (Disposal Site).xlsx
- FutureO&M.xlsx
- Array of Alternatives Cost Table.xlsx



US Army Corps
of Engineers ®
San Francisco District

Redwood City Harbor, California, Navigation Improvement Feasibility Study

Appendix D

Geotechnical Engineering

DRAFT – April 2015

Contents

1 Purposes of Report 3
2 Background 3
3 References and Summary of Previous Investigations 4
4 Operations and Maintenance Dredging 8
5 Avoiding Adjacent Environmentally Sensitive Areas 9
6 Conclusions and Recommendations 9

Figures

Figure 1. Study area 3
Figure 2. Plan View of Redwood City Harbor Boring Locations from Fugro Geotechnical Data Report. 5
Figure 3. Typical Section – Station 124+00 – Redwood City Harbor Channel – Seavision Sub-Bottom Profiler Report. 6
Figure 4. . Typical Section – Station 180+00 – San Bruno Shoals Channel – Seavision Sub-Bottom Profiler Report. 6
Figure 5. Typical Section in Wharf Area – Treadwell and Rollo Report 7
Figure 6. Typical Section in Wharf Area – Treadwell and Rollo Report 7
Figure 7. Typical O&M Dredging Sections – Existing Slopes (Curved Lines) Next to 3H: 1V Planned Slopes (Straight Lines) Demonstrating Acceptability of Proposed 3H: 1V Excavation Cut Slopes. 8

1 Purposes of Report

This report summarizes the geotechnical information used to support the planning and Federal interest determination of a civil works navigation project in the Redwood City Harbor and San Bruno Shoal Channels. The project is referred to as the "Redwood City Harbor, California, Navigation Improvement Feasibility Study" or the "study" in this report. A brief summary of available geotechnical, O&M dredging, and spatial constraint information is summarized as possibly impacting and supporting the decision to select a 3H: 1V dredging excavation cut slope for the deepening project. Refer also to the Civil Design Appendix for additional information and discussion pertaining to these issues. Suggestions for additional data collection, analyses and study are also provided in brief summary. This report will serve as an appendix to the study's integrated feasibility study and environmental impact statement report.

2 Background

The study area is Redwood City Harbor, located in San Mateo County, CA on the southwest side of San Francisco Bay, about 18 miles south of San Francisco, CA. The study area includes two existing navigation channels: the Redwood City Harbor and San Bruno Shoal Channels (Figure 1). The Redwood City Harbor Channel extends from the mouth of Redwood Creek to deep water in the San Francisco Bay, while the San Bruno Shoal Channel is located northeast of San Francisco International Airport. Both channels currently have an authorized depth of 30 feet mean lower low water (MLLW) with 2 feet of allowable over depth maintenance dredging.



Figure 1. Study area

3 References and Summary of Previous Investigations

The primary reports used as references to assist with evaluating and selecting the feasibility-level excavation cut slope suitability are;

(1) – December, 2012 "Geotechnical Data Report" (GDR) prepared by Fugro, Inc. for HDR Engineering, Inc. & the US Army Corps of Engineers, San Francisco District (USACE);

(2) - May 20, 2011, Survey Report: Sub-Bottom Profiler Survey – Combined Bathymetry/Sub-Bottom Profile Survey – Redwood City and San Bruno Shoals Deepwater Ship Channels Final Report prepared by Seavision Underwater Solutions for the USACE and to a lesser extent;

(3) – September 23, 2011 Geotechnical Progress Report – Wharves 1 and 2 – by Treadwell and Rollo for the Port of Redwood City and;

(4) – February 17, 1999 "Geotechnical Investigation" Report prepared by Hultgren-Tillis Engineers for Moffat & Nichol Engineers for RMC Lonestar's Redwood City, California wharf facilities.

Sampling of soils in the study area indicates there are three broad generalizations of sedimentary units that may be encountered during excavations; (1) – Young Bay Mud; (2) – Bay deposits (Sand) and (3) – Old Bay Mud. Figures 2 (Plan of Fugro GDR Report borings), 3, 4, and 5 (cross sections from the above reports) demonstrate typical observed conditions.

The Young Bay Mud generally consists of very soft to soft, appears gray to grayish green and black, and has fine sands-to-fat clays grading form courser to finer gradations. These are the more recent marine sediments that are exposed at the mud-line throughout the project area at both channel locations. These soils have a high water contents, high plasticity, and often contain shell fragments and organics. In the Redwood City Channel, Young Bay Mud extends to depths between -24 and -54 feet with deeper occurrences generally trending towards the north end of the channel and shallower occurrences taking place to the south. As depth increases more consolidation results in stiffer clays in the Young Bay Mud.

Below the Young Bay Mud the soil encountered generally consists of soft to stiff gray to olive brown to light brown lean clay (CL's) with varying amounts of sand and lesser amounts of fat clay with sand, sand and clayey sand. This material has been characterized as alluvial deposits and generally has a lower water content and lower plasticity than the overlying Young Bay Mud. It has been classified as a sandier Bay Deposit found between the Young and Old Bay Mud deposits and is not consistently observed throughout the Bay Area but has been observed in the San Bruno Shoal area.

Underlying the Young Bay Mud is a firm, stiff, dark greenish-gray silty clay. It is typically very stiff and over-consolidated clay that is markedly different from overlying Young Bay Mud by virtue of the presence of greater compressive strength, thin sand and gravel lenses, and absence of shell fragments in the clay. This material may or may not impact selection of excavation cut-slope(s) because of stability but could impact selection of optimum dredging equipment type(s) depending on aerial extent and depth of occurrence by alternative.



Figure 2. Plan View of Redwood City Harbor Boring Locations from Fugro Geotechnical Data Report.

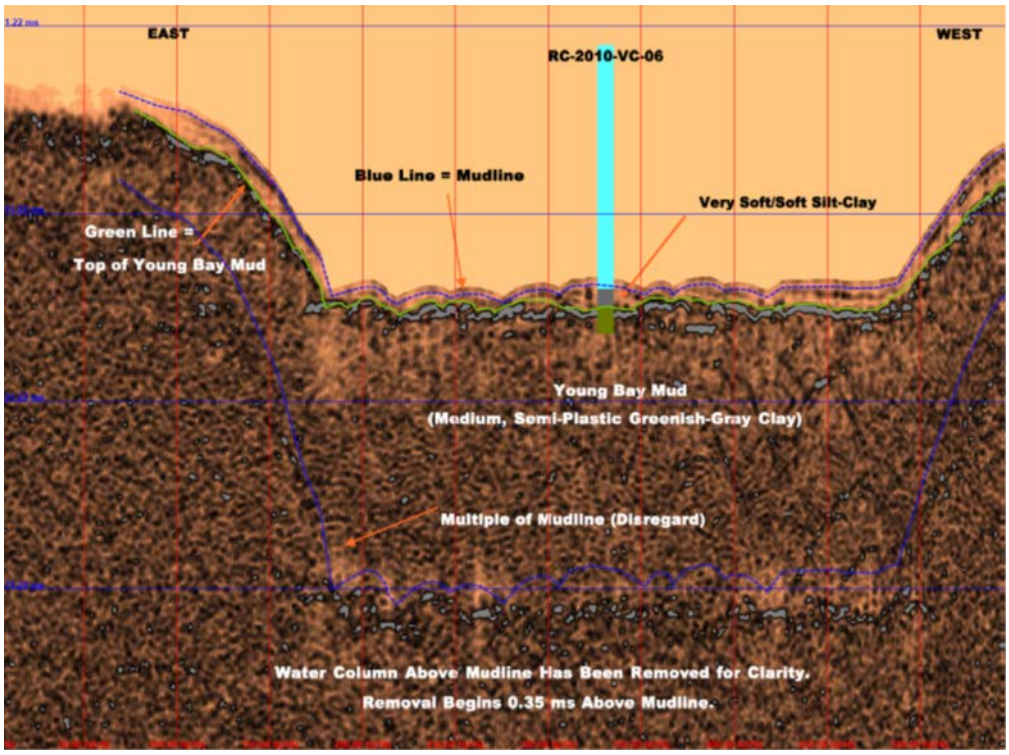


Figure 3. Typical Section – Station 124+00 – Redwood City Harbor Channel – Seavision Sub-Bottom Profiler Report.

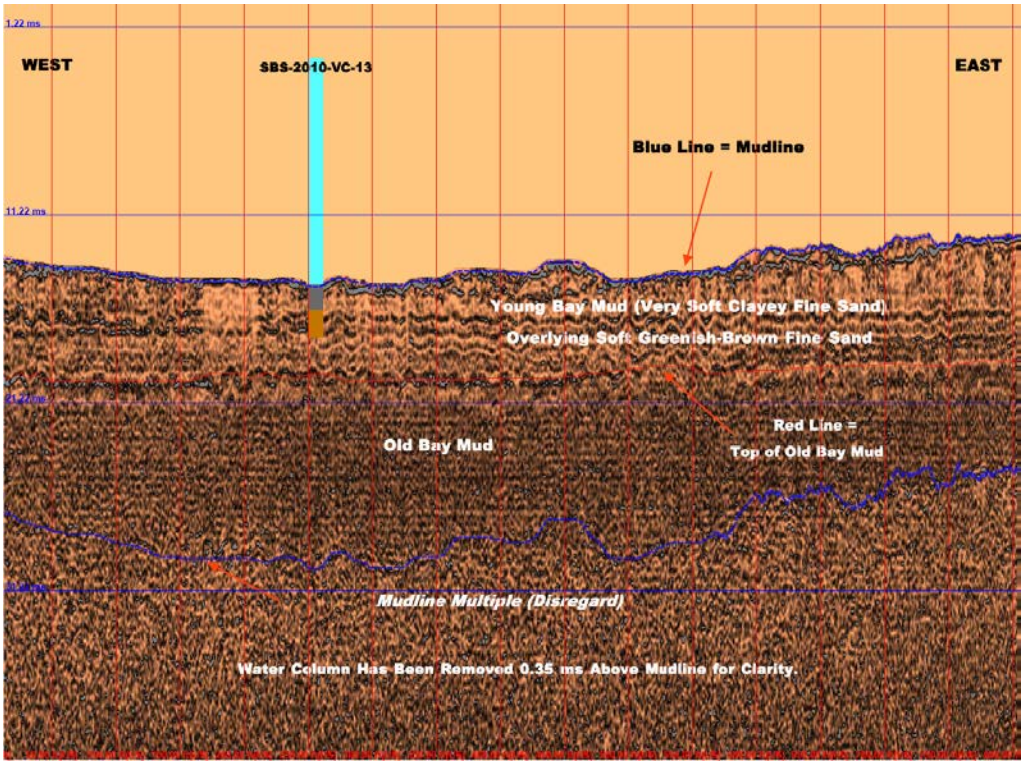


Figure 4. . Typical Section – Station 180+00 – San Bruno Shoals Channel – Seavision Sub-Bottom Profiler Report.

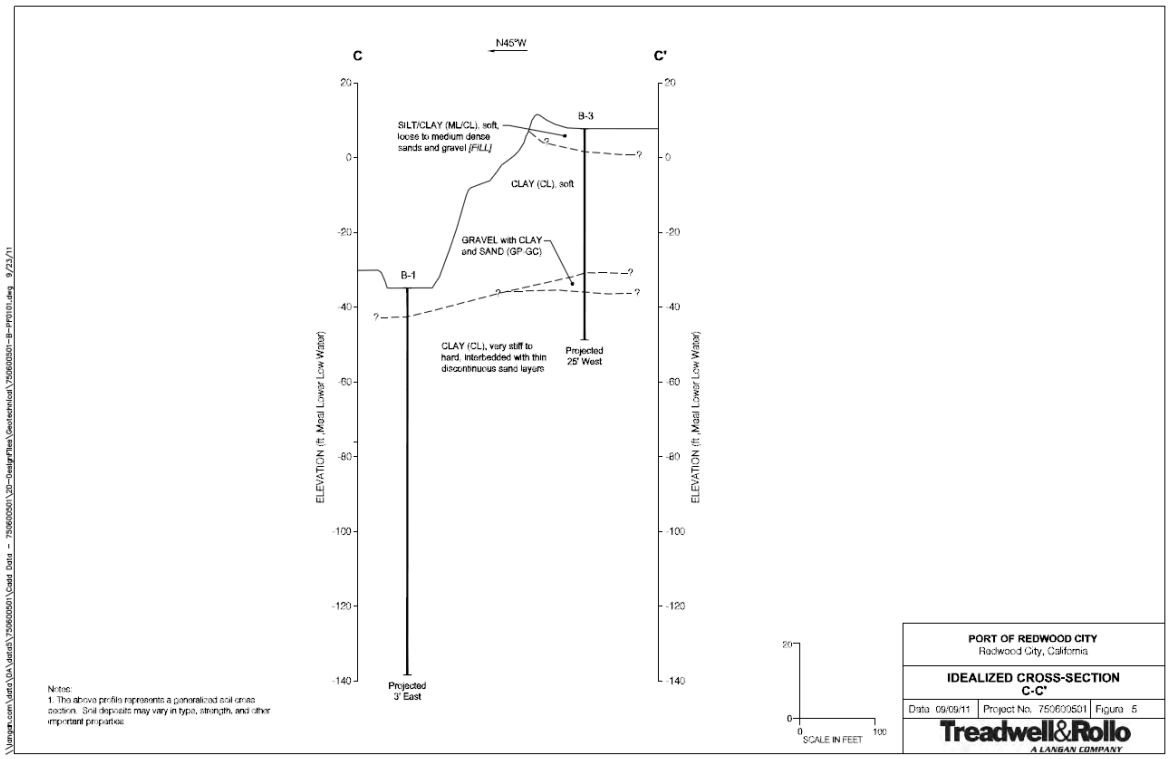


Figure 5. Typical Section in Wharf Area – Treadwell and Rollo Report

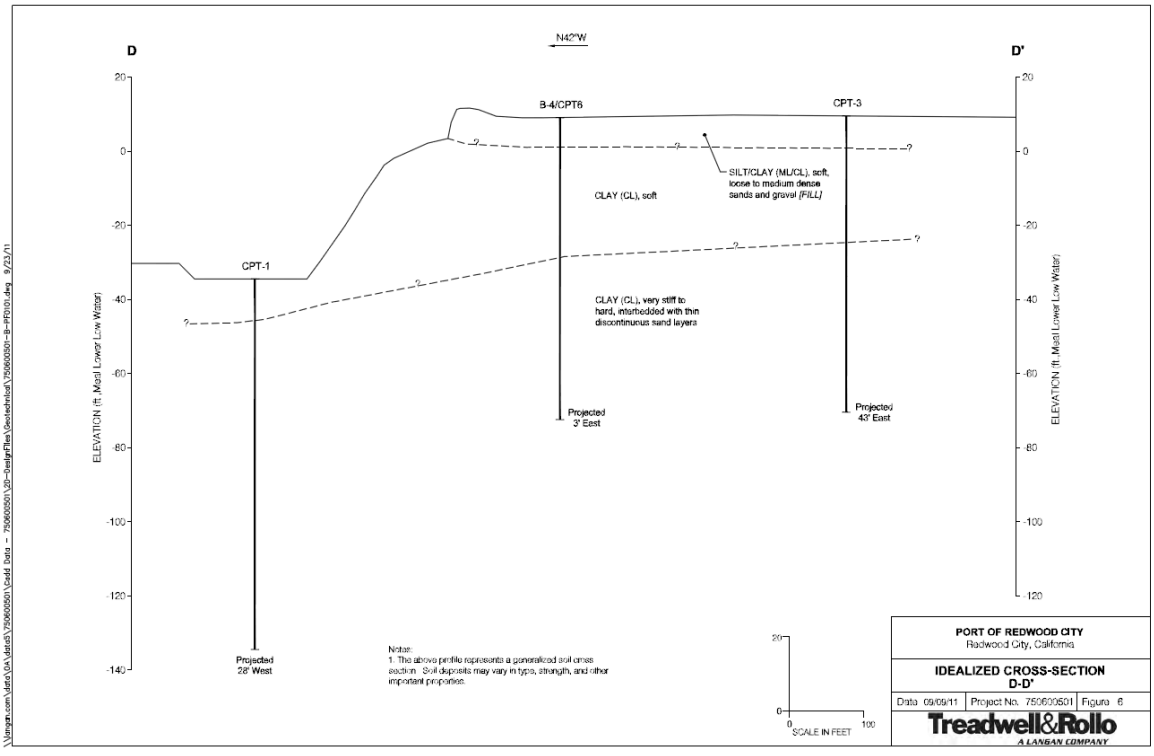


Figure 6. Typical Section in Wharf Area – Treadwell and Rollo Report

The existing and proposed slope of the deepening excavations along the alignment of the project can become unstable under seismic or static conditions. Detailed stability evaluations

of the proposed 3H: 1V excavation cut slopes were not performed for feasibility-level study. However, final slope selection will be analyzed and the future slope(s) designed and constructed in accordance with EM 1110-2-1902 (USACE 2003).

4 Operations and Maintenance Dredging

The Redwood City Harbor channels range from 300 to 900 feet wide and are about 20,800 feet long. The project area currently requires operations and maintenance (O&M) dredging to remove sediment deposition and ensure safe navigation by vessels in and out of the channel. Slopes are excavated to near 3H: 1V. The Entrance Channel, Outer Harbor Turning Basin, Connecting Channel and Inner Harbor Turning basin are dredged every 1 to 2 years and were last dredged in 2014. The San Bruno Channel is only dredged about every 10 years, and was last dredged in 2005.

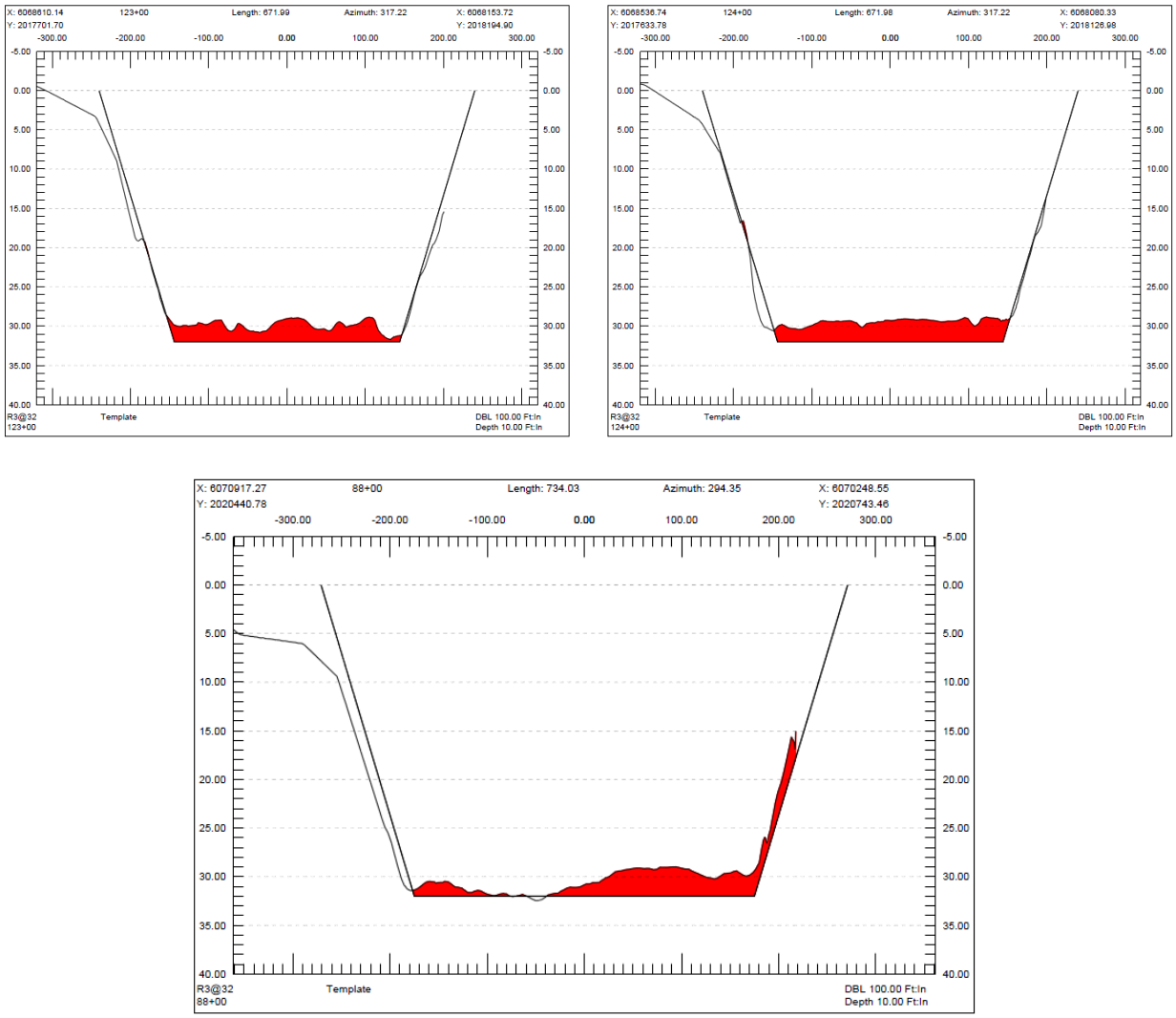


Figure 7. Typical O&M Dredging Sections – Existing Slopes (Curved Lines) Next to 3H: 1V Planned Slopes (Straight Lines) Demonstrating Acceptability of Proposed 3H: 1V Excavation Cut Slopes.

Figure 7 demonstrates typical 2014 pre-dredge existing ground surfaces along more critical areas of the project (Reaches 3 and/or 4 that are bordered by the Bair Island Wildlife Refuge). Note existing slopes are stable at the present 3H: 1V steepness. They may be stable at steeper slopes in certain areas. Represented on these sections is the 32-foot deepening alternative. Also of note is the approximately 3H: 1V existing O&M slopes have held up very well during over 50 years of project operations. No caving or loss of ground has been observed near the critical environmental habitat areas. This demonstrates the selected 3H: 1V excavation slopes are acceptable for feasibility estimating purposes.

The existing mud-line along the San Bruno Shoal Channel appears to be deepest in the center of the channel (elevations near 34 feet MLLW) in comparison to outer edges (small areas approaching elevation 28 MLLW) which has partially justified the reduced frequency of O&M dredging operations along this part of the project. Increased or decreased expected O&M frequency and/or dredging quantities for the TSP alternative depth and proposed alignment should be confirmed with additional study.

5 Avoiding Adjacent Environmentally Sensitive Areas

Refer to the Civil Design Appendix for detailed discussions concerning this issue.

6 Conclusions and Recommendations

Excavation cut slopes of 3H: 1V were determined appropriate for feasibility-level study of the TSP focused alternatives array based on the following reasoning:

(1) – Project O&M dredging episodes over the past 50 years have demonstrated adequate performance of 3H: 1V excavation cut slopes;
(2) – USACE experience on other projects in the Bay Area indicate 3H: 1V cut slopes are appropriate;
(3) – The selected 3H: 1V cut slope daylights within the existing channel so as to avoid impacts to surrounding environmentally sensitive areas located on both sides of the project leading into the wharf area; and
(4) – Review of available geotechnical reports and supporting information indicates soils to be encountered during project excavations are suitable in providing stable 3H: 1V cut slopes.

There is the possibility during future investigations and analyses to identify localized areas within the channel excavation that may not meet with bar pilot navigation desires to maintain existing channel bottom width(s), may unnecessarily encroach upon surrounding environmentally sensitive areas, and/or require adjustments to turning radius to maximize efficiency leading into the Port of Redwood city. Ship modeling studies are planned during future study to identify and evaluate potential operational constraints and possible impacts to alignment and channel location while optimizing efficiency. One option to address and minimize any potential negative impacts resulting from these studies would be to provide localized over-steepening of excavation cut slopes in the bottom of the channel.

Areas where localized over-steepening of cut slopes is selected as an option should be further investigated and evaluated from a geotechnical slope stability perspective. Borings, samples and laboratory testing are recommended in the location-specific over-steepening areas and to minimum depths of 10 feet below expected channel bottom to allow more detailed stability analyses to be done in these areas. The geotechnical investigation program should be coordinated with any environmental sampling and testing along the sides and bottom of the channel for efficiency and minimizing cost for the two programs.

Additional sampling and testing in the future, (after completion of TSP efficiency studies and for final design), along the sides and centerline of the channel should also be conducted a minimum of 10 feet below the planned maximum depth (including O&M over-excavation) of the channel bottom. Investigations should be spaced at appropriate intervals based on evaluation and determination of expected materials variability across the site during these later phases of study.

Further details for these future geotechnical investigation programs will be provided at a later date.



US Army Corps
of Engineers ®
San Francisco District

Redwood City Harbor, California, Navigation Improvement Feasibility Study

Appendix E

Water Resources Engineering

May 2015

Contents

1. Purpose of Report 2
2. Background 2
2.1 Study Area 2
2.2 Sediment Supply for San Francisco Bay 3
3. Water Resource Engineering Analyses for the Study 3
3.1. Hydrographic Surveys 3
3.2. Numerical Hydrodynamics and Salinity Modeling 4
3.2.1. Background on the Model 4
3.2.2. Model Setup 4
3.2.3. Model Assumptions 6
3.2.4. Completed Sediment Transport Model Run Scenarios 7
3.2.5. Completed Hydrodynamics Model Run Scenarios 9
4. Results from Analyses of Hydrographic Surveys for Without-Project (30 feet MLLW) Conditions 9
5. Results from Analyses of Sediment Transport Model Runs for With-Project (32 feet and 37 feet MLLW) Conditions 11
6. Results from Analyses Hydrodynamic Model Runs for With-Project (32 feet and 37 feet MLLW) Conditions 14
7. References 20

1. Purpose of Report

This report summarizes the water resource engineering analyses required to support the planning and Federal interest determination of a civil works navigation project in the Redwood City Harbor Channel and San Bruno Shoal Channel. This project is referred to as the "Redwood City Harbor, California, Navigation Improvement Feasibility Study", or more generically as the "study" or "study area" in this report. This report will serve as an appendix to the study's integrated feasibility study and environmental impact statement report.

2. Background

2.1 Study Area

The study area is Redwood City Harbor, which is located in San Mateo County, California, on the southwest side of San Francisco Bay, approximately 18 miles south of San Francisco, California. The study area includes two existing navigation channels: the Redwood City Harbor Channel and San Bruno Shoal Channel (Figure 1). The Redwood City Harbor Channel extends from the mouth of Redwood Creek to deep water in the San Francisco Bay, while the San Bruno Shoal Channel is located in San Francisco Bay. Both channels currently have an authorized depth of 30 feet mean lower low water (MLLW) and 2 feet of allowable over depth.

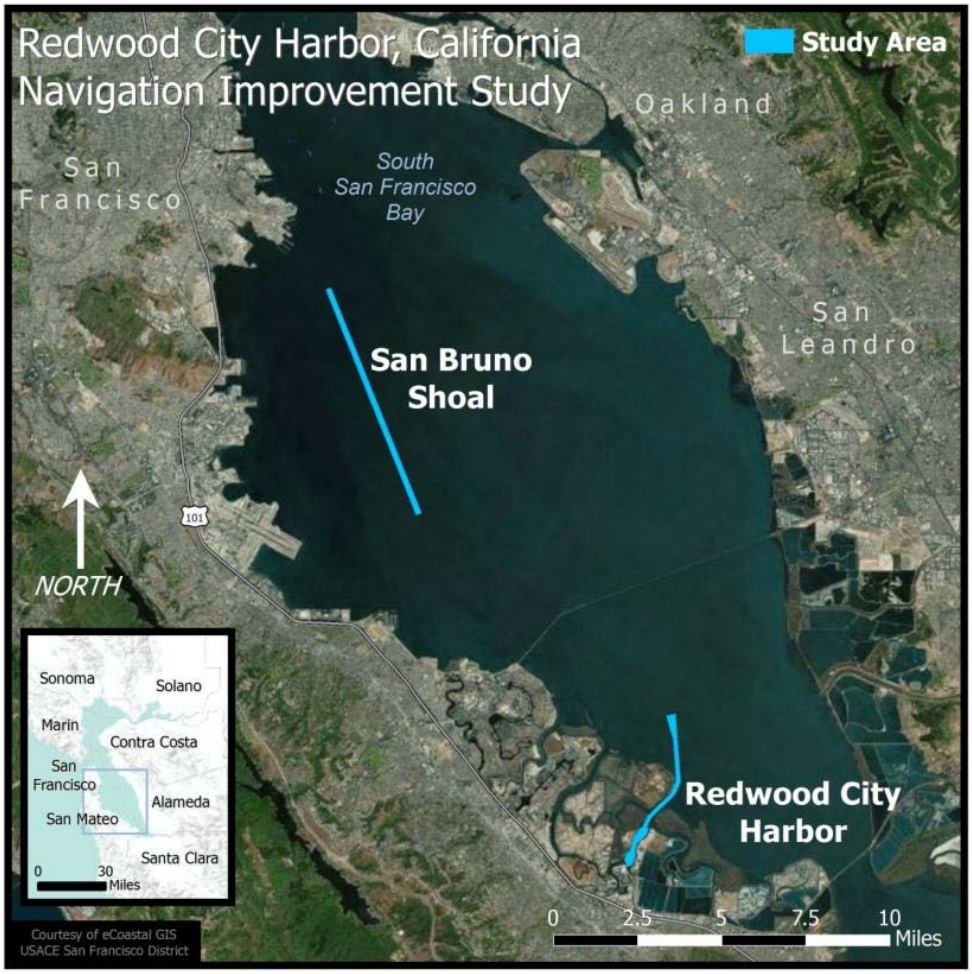


Figure 1. Study area

2.2 Sediment Supply for San Francisco Bay

The Redwood City Harbor Channel currently requires operations and maintenance (O&M) dredging to remove sediment deposition and ensure safe navigation by vessels in and out of the channel. Within the last decade, O&M dredging of the channel has not occurred on annual basis, but has occurred when funding was available.

An analysis conducted for the Regional Sediment Management Program of the San Francisco District provides background about the sediment supply for San Francisco Bay (Zoulas, 2013). The primary source of sediment to the San Francisco Bay is delivery from streams draining a network of 483 contributing watersheds covering approximately 165,142 square kilometers. These contributing watersheds are often divided into two categories: the Central Valley, and small local tributaries. The Central Valley includes the Sacramento and San Joaquin Rivers, which drain a large portion of northern and central California (approximately 154,000 square kilometers) and converge east of the San Francisco Bay to form a large delta. The small local tributaries comprise a much smaller area (approximately 8,145 square kilometers), but still contribute a significant amount of sediment to the San Francisco Bay. The tributaries that contribute sediment to South San Francisco Bay, adjacent to the study area, include, but are not limited to: Alameda Creek, Coyote Creek, and San Francisquito Creek.

3. Water Resource Engineering Analyses for the Study

To help determine a Federal interest of a civil works navigation project in the study area, it is necessary to evaluate impacts to coastal hydrodynamics and sediment transport as a result of potential navigation channel deepening and/or realignment. The Water Resources Section (of the San Francisco District) evaluated these impacts by reviewing previous hydrographic survey data information of the study area and by conducting simulations via a numerical model of the study area.

The project delivery team (PDT) determined that a National Economic Development (NED) plan would potentially involve navigation channel deepening ranging from 32 feet to 37 feet mean lower low water (MLLW), plus 2 feet of over depth. As a result, all water resource engineering analyses for this study did not evaluate dredging depths shallower than the current authorized project depth nor deeper than this range.

3.1. Hydrographic Surveys

A review of hydrographic surveys was conducted of the study area from years 2004 to 2014. The purpose of the review was to identify areas where shoaling or erosion may have been prevalent within the within the study area since 2004. Areas of repeated shoaling or erosion would inform the PDT of potential needs for advanced dredging activities or realignment of navigation channels for without and/or with-project conditions.

The hydrographic surveys consisted of condition, before dredging, and after dredging surveys. Some surveys included the entire navigation channels while a select few were only partial surveys. The partial surveys were not used in the analysis that is described later in this report.

3.2. Numerical Hydrodynamics and Salinity Modeling

3.2.1. Background on the Model

The UnTRIM Bay-Delta Model (UnTRIM) was applied together with the Simulating WAves Nearshore (SWAN) wave model and the SediMorph sediment transport model to simulate three-dimensional hydrodynamics, wind waves, and sediment transport in the study area for without and with-project conditions. UnTRIM as a standalone hydrodynamic model and the coupled UnTRIM-SWAN-SediMorph model have been utilized for various other studies within the San Francisco District. These studies include, but are not limited to: Sacramento River Deep Water Ship Channel Project, San Francisco Bay to Stockton Navigation Project, the South San Francisco Bay Shoreline Study, the Central Bay and Oakland Harbor Sediment Transport Modeling Study, and sediment transport modeling for support of the Dredged Material Management Plan (DMMP). The setup and results of UnTRIM as a standalone hydrodynamic model and the coupled UnTRIM-SWAN-SediMorph model for these studies have been reviewed by various resource agencies in the San Francisco Bay Area, and have been published in numerous papers and peer-reviewed publications (e.g. Bever and MacWilliams, 2013; Bever et al., 2014; MacWilliams et al., 2014; MacWilliams et al., 2015). These resource agencies include, but are not limited to: U.S. Environmental Protection Agency, San Francisco Bay Conservation and Development Commission, Contra Costa Water District, and the California Department of Water Resources (DWR).

3.2.2. Model Setup

The coupled model domain extends from the Pacific Ocean near San Francisco to the San Francisco Bay and Sacramento-San Joaquin Delta (Figure 2). The coupled model utilizes an unstructured grid system with very fine grid cells at the two navigation channels contained within the study area (Figure 3). The coupled model boundary conditions include inflows, drinking water export facilities, wind stations, evaporation and precipitation, and flow control structures. The UnTRIM Bay-Delta model has been calibrated and validated using water level, flow, and salinity data collected in San Francisco Bay and the Sacramento-San Joaquin Delta at National Oceanic Atmospheric Administration, United States Geological Survey (USGS), and DWR monitoring stations. The SediMorph model has been calibrated and validated using sediment concentration data collected in San Francisco Bay and the Sacramento-San Joaquin Delta at USGS monitoring stations and hydrographic survey data of Redwood City Harbor Channel and San Bruno Shoal Channel.

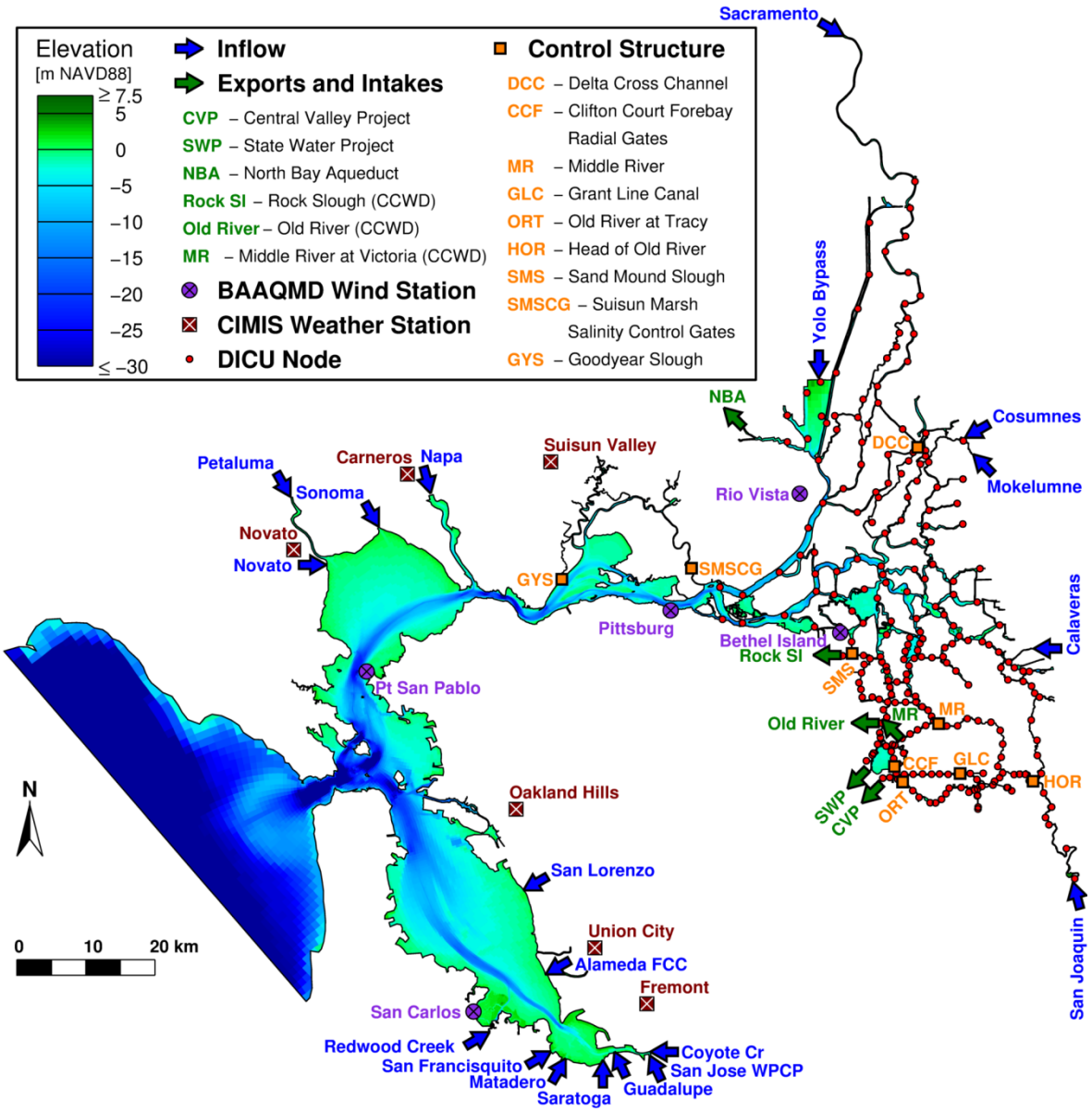


Figure 2. Coupled model domain

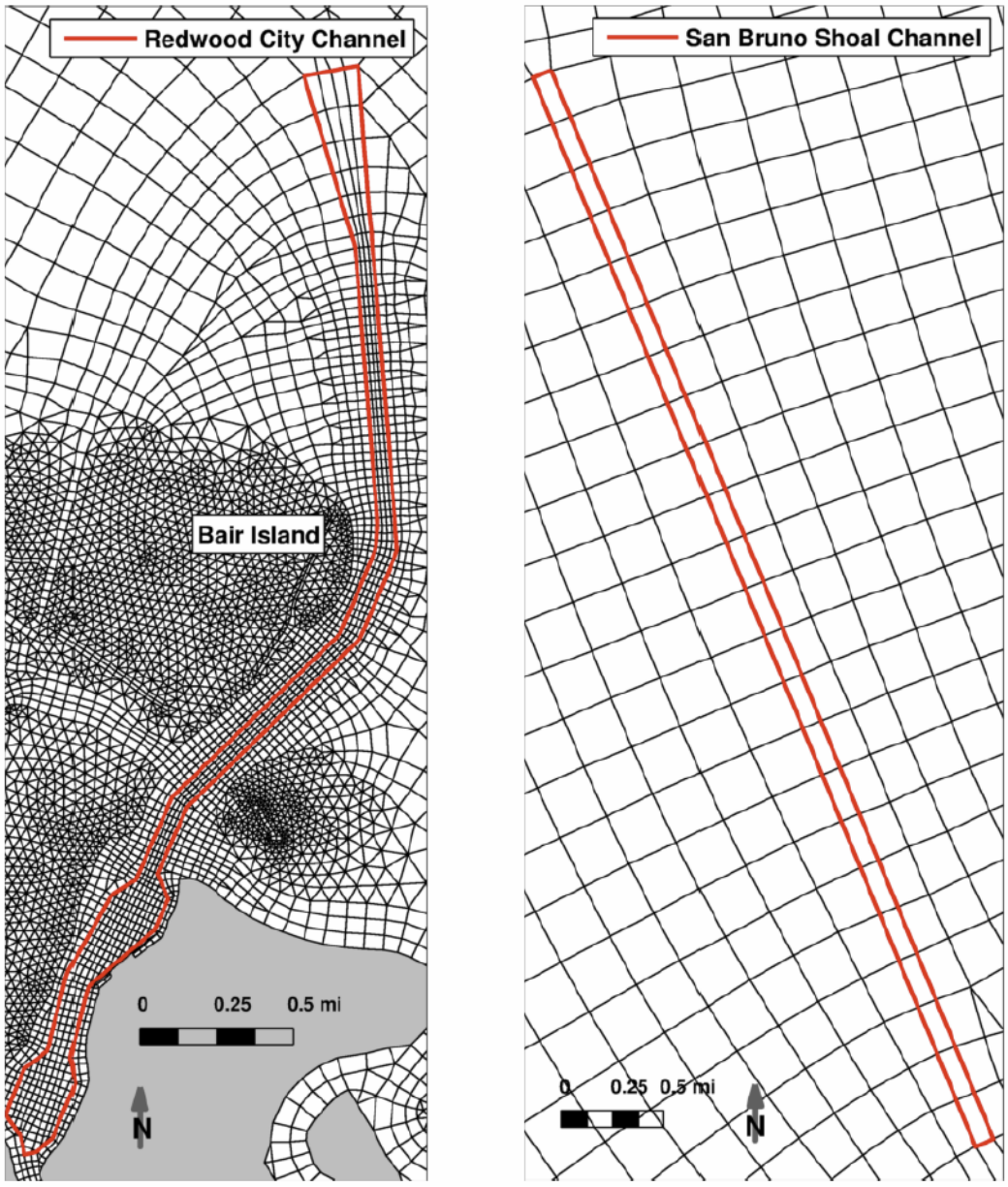


Figure 3. Coupled model grid system for Redwood City Harbor Channel and San Bruno Shoal Channel

3.2.3. Model Assumptions

It is assumed that any potential navigation channel deepening and/or realignment for either Redwood City Harbor Channel or San Bruno Shoal Channel would result in channels with 3:1 (horizontal:vertical) side slopes. This side slope configuration was based on input from the Geosciences Section of the San Francisco District and was incorporated into the model grid system.

For the potential realignment of the Redwood City Harbor Channel, it is assumed that the section of the old (existing) alignment would not be filled in the match the grade of the

surrounding mudflat elevation, but would be rather left as the relatively deep existing channel conditions.

The coupled model grid includes Bair Island and the restoration measures that are expected to be implemented prior to 2018 by USFWS, such as levee breaches, channel blocks, flow constrictors, and flooded areas.

3.2.4. Completed Sediment Transport Model Run Scenarios

The coupled model was run to evaluate effects of deepening the two navigation channels within the study area on shoaling rates. All of the coupled model runs that were conducted with respect to sediment transport are summarized in Table 1. The depths considered were 30 feet (the current authorized depth), 32 feet, and 37 feet MLLW plus two feet of allowable overdepth. In addition to deepening, the coupled model was also used to evaluate the effects of realigning the Redwood City Harbor Channel adjacent to Outer Bair Island on shoaling rates. Realignment was proposed as a measure by the PDT per results that were obtained in the review of previous hydrographic surveys, which indicated that certain areas of the channel were prone to shoaling (results that are discussed in further detail in section 4.1 of this report). The configuration of the channel realignment was reviewed by the San Francisco Bar Pilots Association. A comparison of the existing channel alignment vs. the channel realignment is shown in Figure 4. This realignment measure was combined with channel deepening of 37 feet MLLW plus two feet of allowable overdepth. Water Year 2006, a wet water year, was chosen as the simulation period for all of the coupled model run scenarios. For the analysis, Water Year 2006 was divided into two seasonal periods: fall-winter and spring-summer. The fall through winter period contains the first flush from the Sacramento-San Joaquin Delta and relatively high tributary sediment input to San Francisco Bay. The spring through summer period has elevated daily winds that drive wind waves and local sediment resuspension, but relatively low tributary sediment supply to San Francisco Bay.

Table 1. Completed sediment transport model run scenarios

Scenario	Depth (feet, MLLW)	Seasonal Period of Water Year 2006	Channel Alignment	Note
1	30 (+2 over depth)	Fall-Winter	Existing	Currently Authorized Depth
2	32 (+2 over depth)	Fall-Winter	Existing	Deepening
3	37 (+2 over depth)	Fall-Winter	Existing	Deepening
4	30 (+2 over depth)	Spring-Summer	Existing	Currently Authorized Depth
5	32 (+2 over depth)	Spring-Summer	Existing	Deepening
6	37 (+2 over depth)	Spring-Summer	Existing	Deepening
7	37 (+2 over depth)	Fall-Winter	Realignment	Deepening
8	37 (+2 over depth)	Spring-Summer	Realignment	Deepening

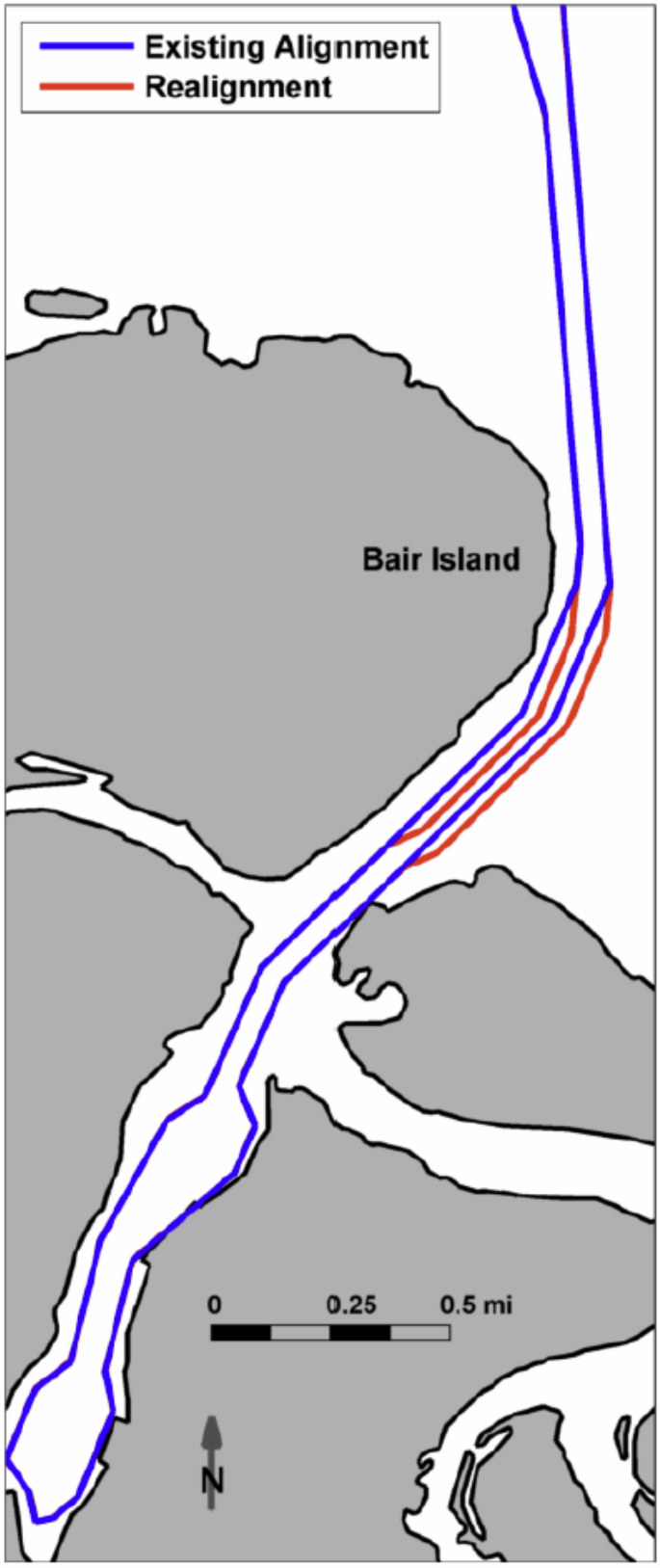


Figure 4. Channel alignments considered in the coupled model runs

3.2.5. Completed Hydrodynamics Model Run Scenarios

The coupled model was run to evaluate effects of deepening the two navigation channels within the study area on hydrodynamics for Year 0 and Year 50 conditions. Year 0 was assumed to be 2018 and Year 50 was assumed to be 2068. Because weather, hydrology, and operating conditions cannot be predicted years in advance, water conditions for 2018 and 2068 were developed using 2005 hydrology but modified to account for both sea level rise and to include changes to the Bair Island Restoration Project that are expected to occur prior to 2018. Sea level rise was included in the model scenarios by adjusting the water level from the model forcing year of 2005 for the projected sea level rise from 2005 to the project start year (Year 0, 2018) and from 2005 to 50 years after the project start year (Year 50, 2068). A projected sea level rise of 0.09 foot from the model forcing year (2005) to Year 0 (2018) was applied based on the NRC Curve 1. The NRC Curve 1 was used to adjust for sea level rise from 2005 to 2018 instead of the more conservative NCR Curve 3 because the sea level rise in the San Francisco Bay over the last 30 years has been below the historic trend. A projected sea level rise of 2.51 feet from the model forcing year (2005) to Year 50 (2068) was applied based on NRC Curve 3. All of the coupled model runs that were conducted with respect to hydrodynamics are summarized in Table 2.

Table 2. Completed hydrodynamic model run scenarios

Scenario	Depth (feet, MLLW)	Project Year	Note
1	30 (+2 over depth)	Year 0	Currently Authorized Depth
2	32 (+2 over depth)	Year 0	Deepening
3	30 (+2 over depth)	Year 50	Currently Authorized Depth
4	32 (+2 over depth)	Year 50	Deepening

4. Results from Analyses of Hydrographic Surveys for Without-Project (30 feet MLLW) Conditions

The review of the hydrographic surveys indicated that Redwood City Harbor Channel has an average shoaling rate of approximately 183,000 cubic yards per year. The hydrographic surveys indicated there are two areas within this channel that are prone to shoaling: one is located near the entrance of the channel and another is adjacent to the southeast side of Outer Bair Island (Figure 5).

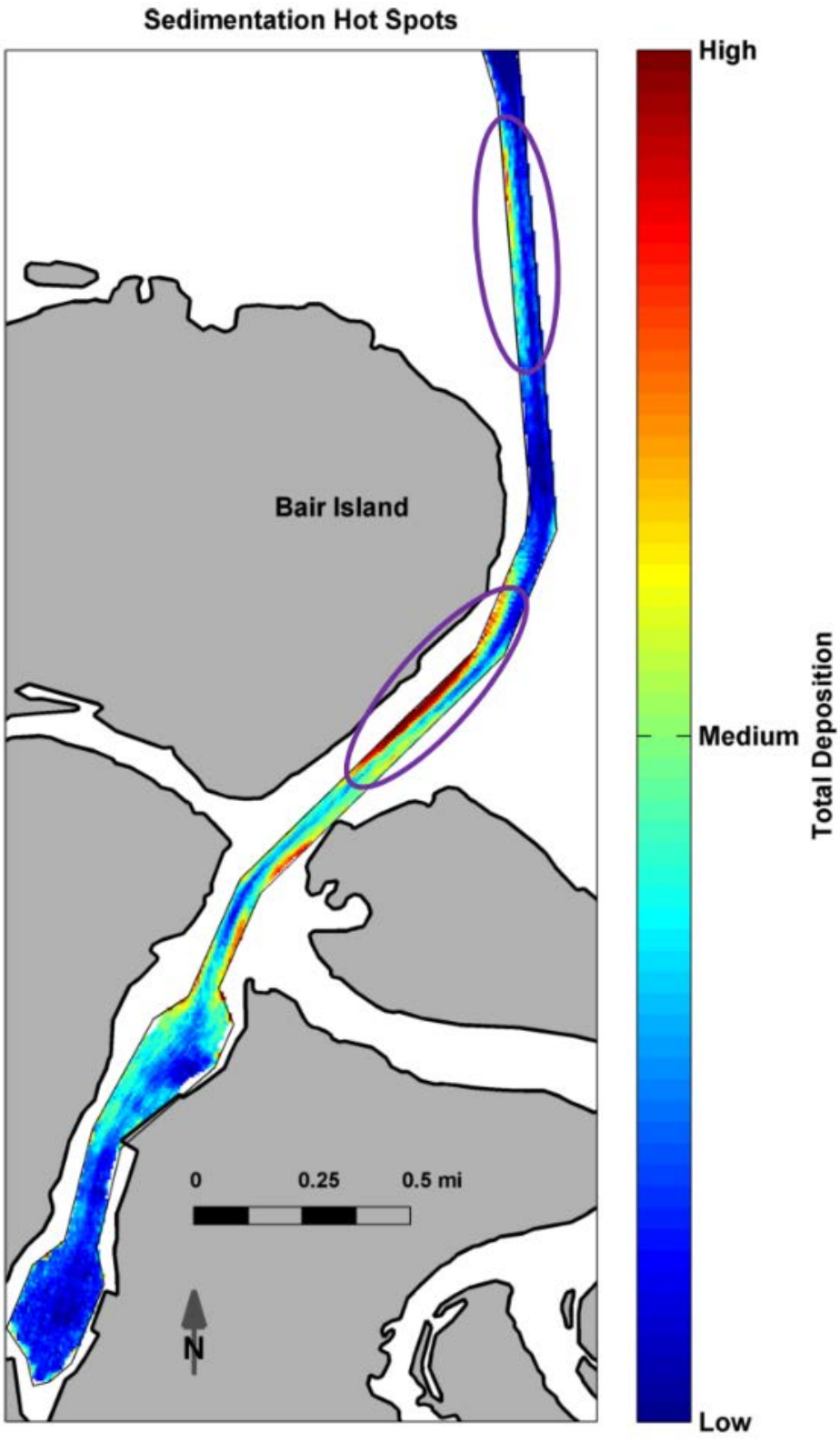


Figure 5. Sedimentation hot spots in Redwood City Harbor Channel

Because of the two identified hot spots, channel realignment was considered by the PDT to address this shoaling issue and was modeled in the coupled UnTRIM-SWAN-SediMorph model (as mentioned in section 3.2.4 of this report). The PDT had hypothesized that moving the channel away from Bair Island would potentially reduce shoaling. The review of the hydrographic surveys also indicated that San Bruno Shoal Channel does not have a consistent rate of shoaling, but rather both periods of shoaling and erosion that lead to relatively little long term net change of sediment volume in the channel. Full results from the analysis of the hydrographic surveys can be found in a report that is included as an attachment to this appendix (Anchor QEA, 2015).

5. Results from Analyses of Sediment Transport Model Runs for With-Project (32 feet and 37 feet MLLW) Conditions

The coupled model runs predicted that deepening the two navigation channels within the study area would increase shoaling rates (Table 3). Predicted channel sediment thicknesses for various channel depths are depicted in Figure 6 and Figure 7. Results from the coupled model runs also predicted that realigning the Redwood City Harbor Channel in the manner that is depicted in Figure 4 would have a small effect on shoaling rates, as illustrated in Figure 8. Full results from the coupled model runs evaluating effects on sediment transport rates can be found in a report that is included as an attachment to this appendix (Anchor QEA, 2015).

Table 3. Predicted Increase in sedimentation rates due to channel deepening

Navigation Channel	Proposed Deepening Depth (feet, MLLW)	Increase in Sedimentation Rate Relative to the Currently Authorized Depth of 30 feet MLLW Plus 2 feet of Overdepth
Redwood City Harbor Channel	32 (+2 over depth)	13%
Redwood City Harbor Channel	37 (+2 over depth)	51%
San Bruno Shoal Channel	32 (+2 over depth)	54%
San Bruno Shoal Channel	37 (+2 over depth)	86%

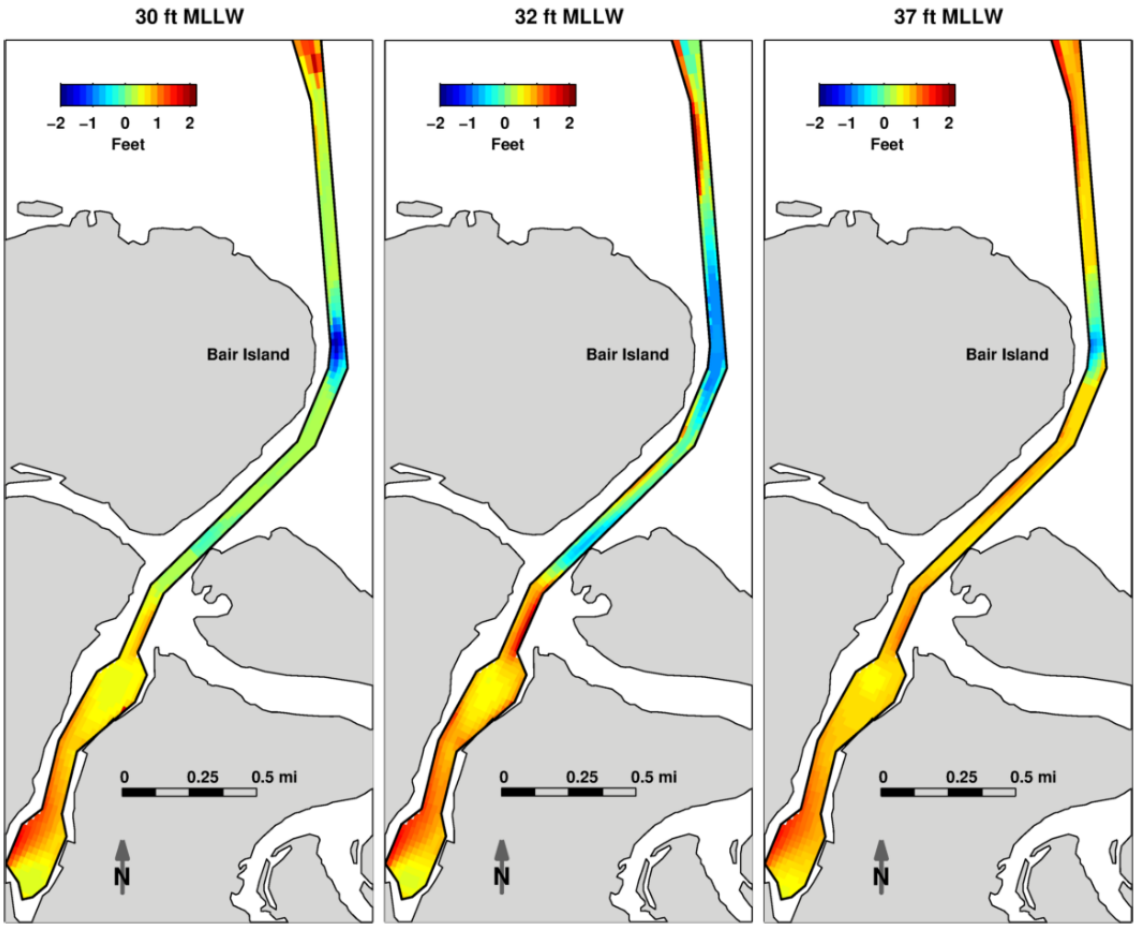


Figure 6. Predicted sediment deposition thickness in Redwood City Harbor Channel for various channel depths

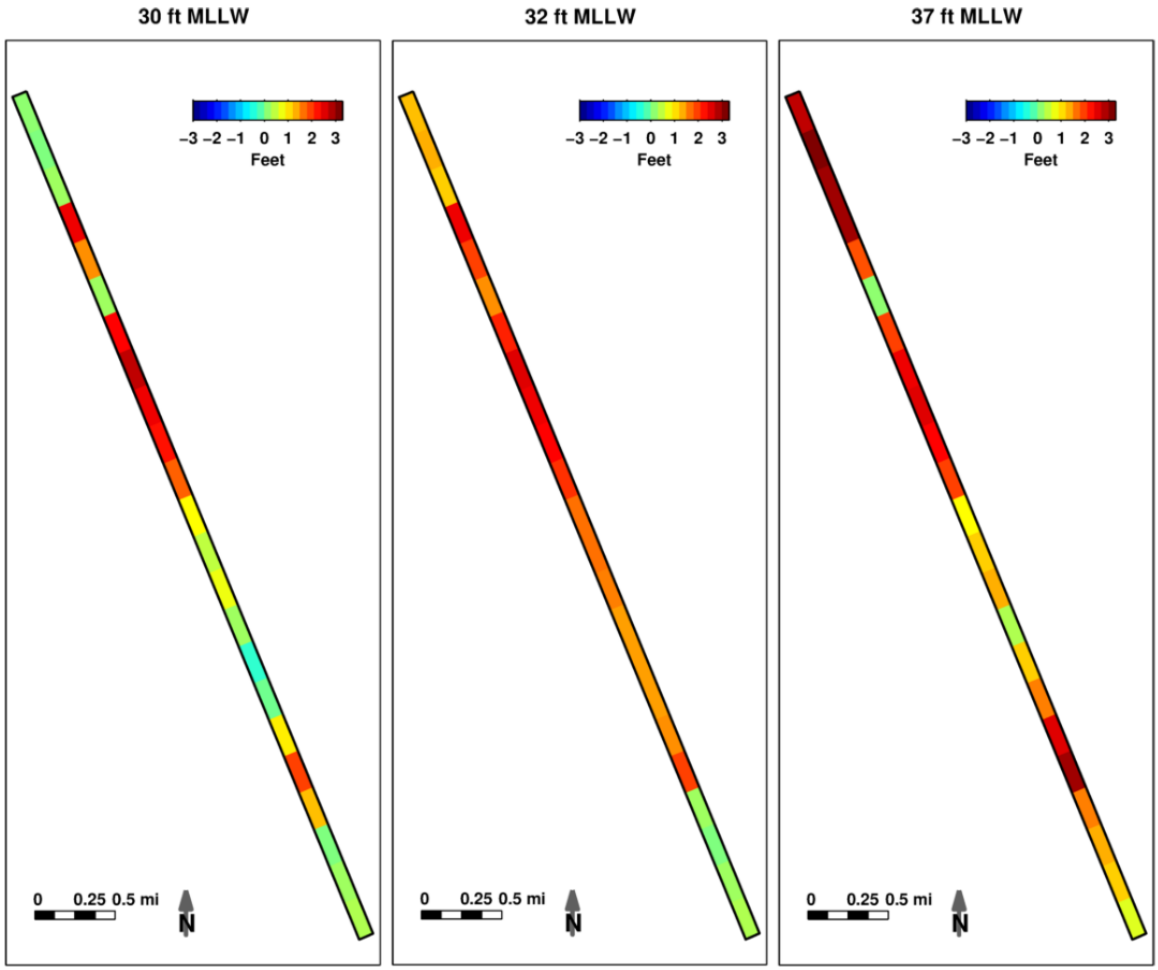


Figure 7. Predicted sediment deposition thickness in San Bruno Shoal Channel for various channel depths

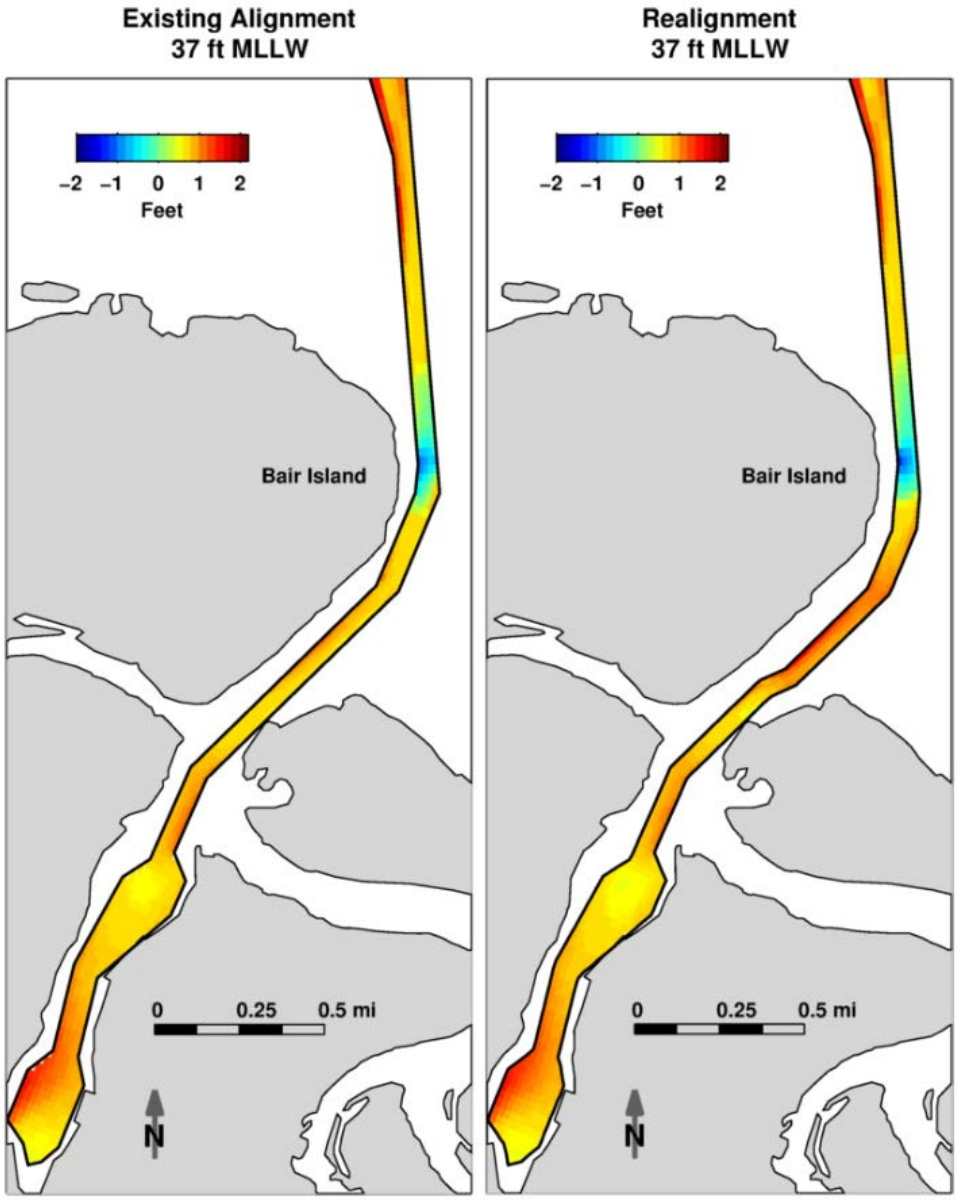


Figure 8. Predicted Sediment Deposition Thickness in Redwood City Channel for the Existing Alignments vs. Proposed Realignment

6. Results from Analyses Hydrodynamic Model Runs for With-Project (32 feet and 37 feet MLLW) Conditions

The coupled model runs predicted that deepening the two navigation channels within the study area would essentially have no effect on hydrodynamics within Redwood City Harbor Channel and Bair Island for both Year 0 and Year 50 conditions. The locations within the model domain that were evaluated for water levels are shown in Figure 9. The locations within the model domain that were evaluated for flow rates are shown in Figure 10. Predicted water elevations at the Redwood City Harbor Channel station for Year 0 and Year 50 conditions are shown in Figure 11 and Figure 12. Note that the bottom panel of the three panels illustrates the

predicted change in water levels between the existing 30 ft and deepened 32 ft MLLW depths. Predicted flow rates at the Redwood City Harbor Channel north station for Year 0 and Year 50 conditions are shown in Figure 13 and Figure 14. Note that the bottom panel of the three panels illustrates the predicted change in flow rates between the existing 30 ft and deepened 32 ft MLLW depths. Full results from the coupled model runs evaluating effects on hydrodynamics can be found in a report that is included as an attachment to this appendix (Anchor QEA, 2015)

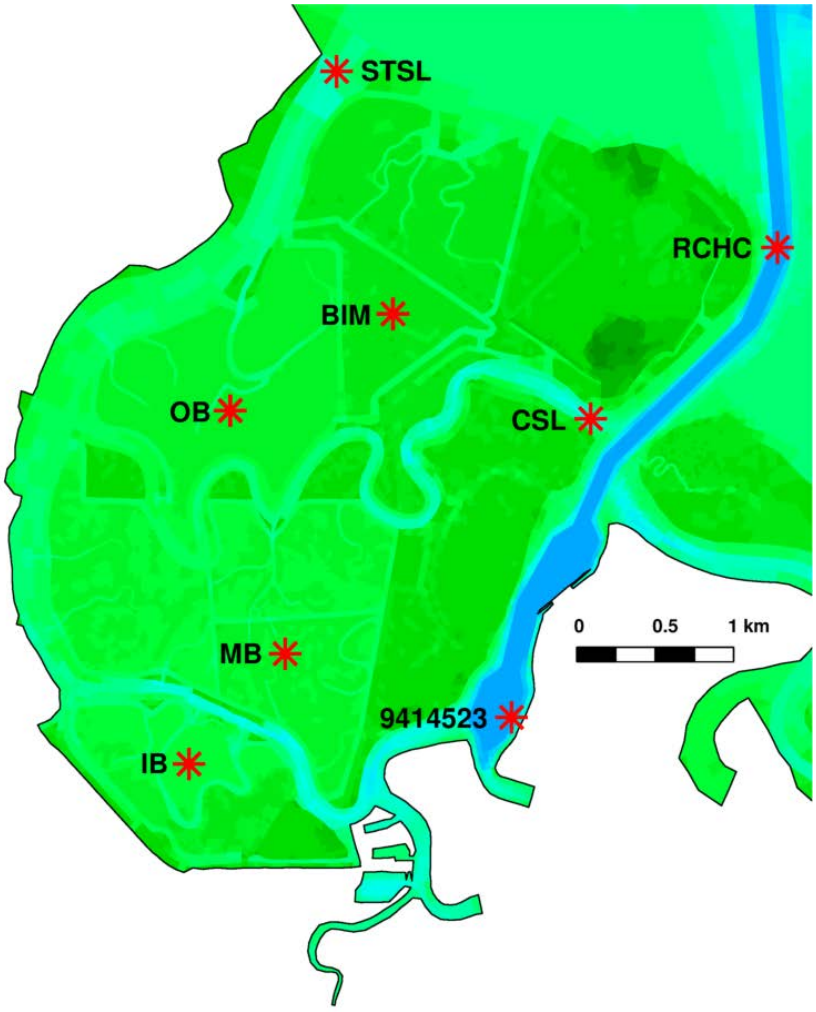
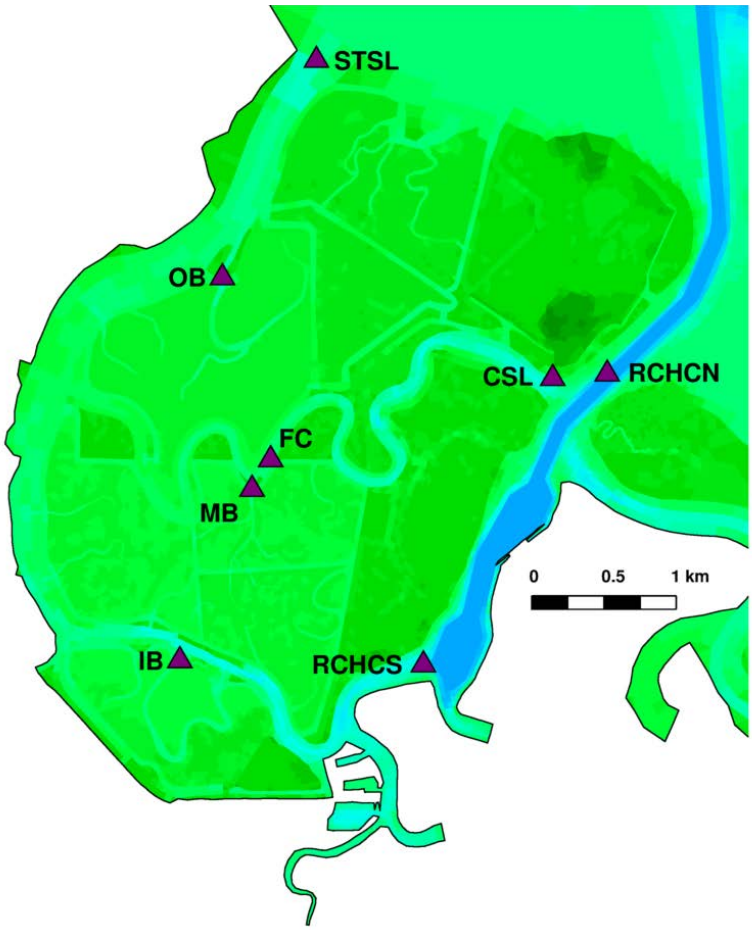


Figure 9. Locations within the coupled model domain where water levels were evaluated



Redwood City Harbor Channel North (RCHCN)
Corkscrew Slough Near Redwood City Harbor Channel (CSL)
Redwood City Harbor Channel South (RCHCS)
Steinberger Slough (STSL)
Corkscrew Slough Flow Constrictor (FC)
Outer Bair Island Breach (OB)
Middle Bair Island Breach (MB)
Inner Bair Island Breach (IB)

Figure 10. Locations within the coupled model domain where flow rates were evaluated

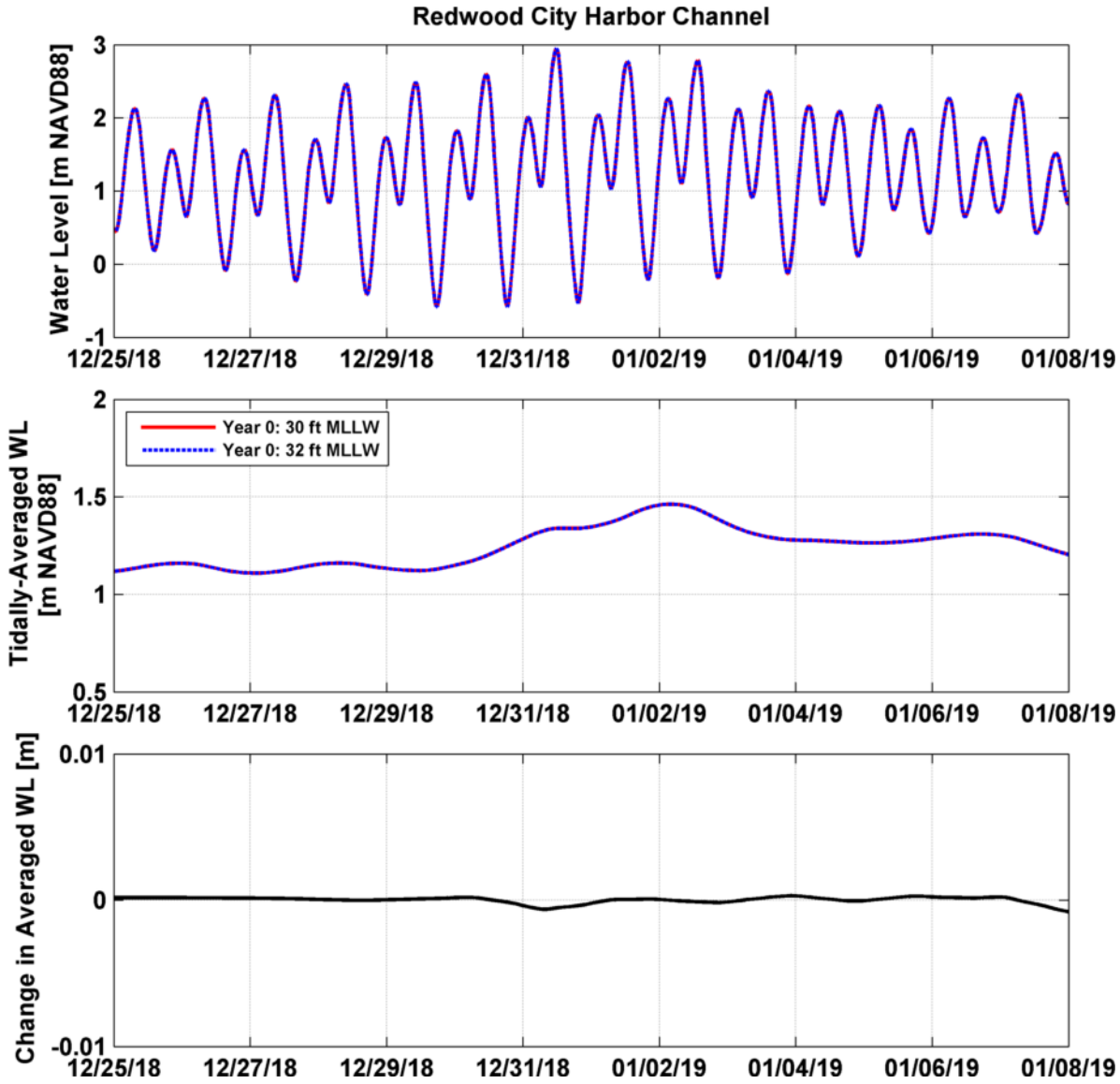


Figure 11. Predicted water elevations at the Redwood City Harbor Channel station for Year 0 conditions

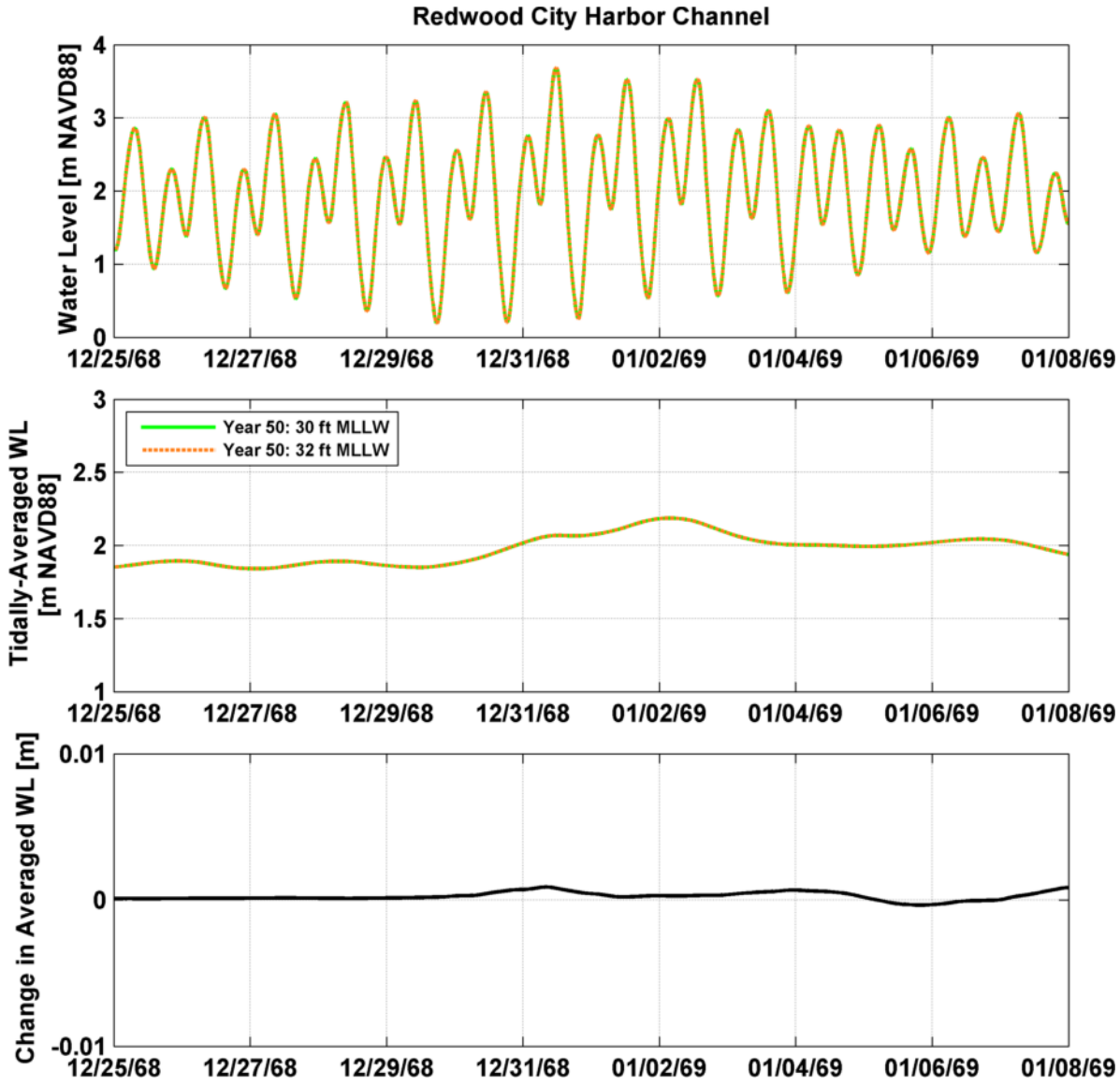


Figure 12. Predicted water surface elevations at the Redwood City Harbor Channel station for Year 50 conditions

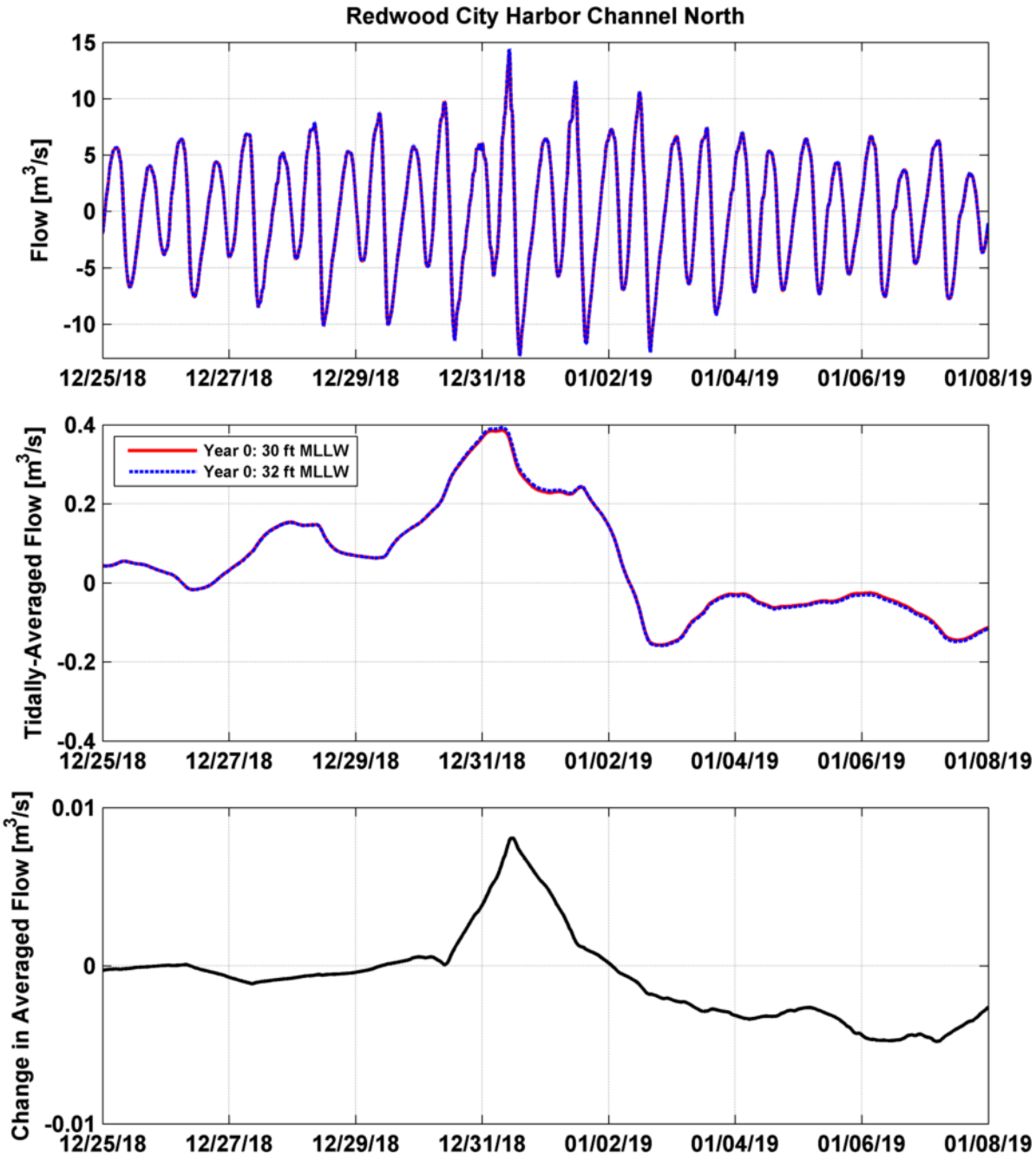


Figure 13. Predicted flow rates at the Redwood City Harbor Channel North station for Year 0 conditions

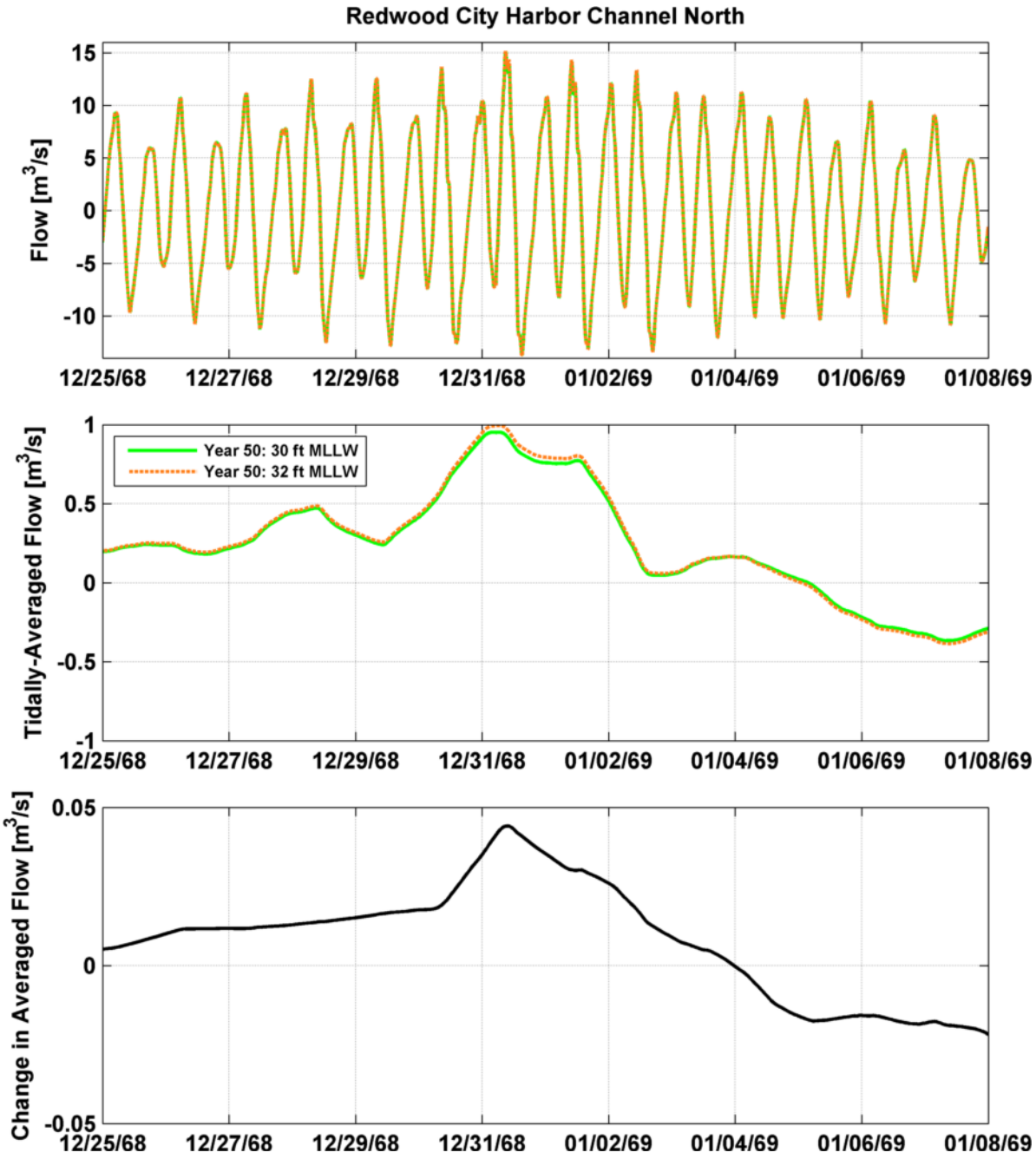


Figure 14. Predicted flow rates at the Redwood City Harbor Channel North station for Year 50 conditions

7. References

Anchor QEA. Redwood City Harbor Navigation Improvement Feasibility Study, Hydrodynamic and Sediment Transport Modeling for Navigation Channel Deepening of Redwood City Harbor, Draft Final Report. Prepared for U.S. Army Corps of Engineers, San Francisco District. May 2015.

Bever, A.J. and MacWilliams, M.L., 2013. Simulating sediment transport processes in San Pablo Bay using coupled hydrodynamic, wave, and sediment transport models. Marine Geology. 345, 235-253. http://dx.doi.org/10.1016/j.margeo.2013.06.012

Bever, A.J., MacWilliams, M.L., Wu, F., Andes, L., and Conner, C.S., 2014. Numerical modeling of sediment dispersal following dredge material placements to examine possible augmentation of the sediment supply to marches and mudflats, San Francisco Bay, USA. in Proceedings of 33rd PIANC World Congress, San Francisco, CA, June 2014. 18 p.

MacWilliams M.L., Sing, P.F., Wu, F., and Hedgecock, N., 2014. Evaluation of the potential salinity impacts resulting from the deepening of the San Francisco Bay to Stockton Navigation Improvement Project, in Proceedings of 33rd PIANC World Congress, San Francisco, CA, June 2014. 13 p.

MacWilliams, M.L., Bever, A.J., Gross, E.S., Ketefian, G.A., Kimmerer, W.J., 2015 (In Press). Three-Dimensional Modeling of Hydrodynamics and Salinity in the San Francisco Estuary: An Evaluation of Model Accuracy, X2, and the Low Salinity Zone, San Francisco Estuary and Watershed Science.

Zoulas, J. A Sediment Budget for the San Francisco Bay, and Implications for Regional Sediment Management. FY13 Regional Sediment Management Program. September 30, 2013.

REDWOOD CITY HARBOR NAVIGATION IMPROVEMENT FEASIBILITY STUDY

HYDRODYNAMIC AND SEDIMENT TRANSPORT MODELING FOR NAVIGATION CHANNEL DEEPENING OF REDWOOD CITY HARBOR
DRAFT FINAL REPORT

Prepared for

U.S. Army Corps of Engineers

San Francisco District

1455 Market Street

San Francisco, California 94103

Prepared by

Anchor QEA, LLC

130 Battery Street, Suite 400

San Francisco, California 94111

May 2015

EXECUTIVE SUMMARY

This project was conducted for the U.S. Army Corps of Engineers (USACE) San Francisco District in support of the Redwood City Harbor Navigation Improvement Feasibility Study. The objective of this project was to investigate shoaling rates under a range of conditions of the Redwood City Harbor Channel and San Bruno Shoal Channel. To this end, the Unstructured Tidal, Residual, Intertidal & Mudflat (UnTRIM) Bay-Delta Model (MacWilliams et al. 2007, 2008, 2009, 2015) coupled with the Simulating WAves Nearshore (SWAN) wave model (SWAN Team 2009a) and the SediMorph (BAW 2005) sediment transport model was used to simulate three-dimensional hydrodynamics, wind waves, and sediment transport in San Francisco Bay and the Sacramento-San Joaquin Delta. The focus of this model application was on sediment deposition in the Redwood City Harbor Channel and the San Bruno Shoal Channel under different project depths. Sediment deposition was also evaluated for a potential realignment of the Redwood City Harbor Channel to assess whether the realignment of the channel could potentially decrease the above grade shoaling. The potential influence of channel deepening and sea level rise on water levels, flow, salinity, and shear stress in the vicinity of the Redwood City Harbor Channel was also evaluated.

Data from 21 repeated USACE bathymetric surveys of the Redwood City Harbor Channel were used to estimate a yearly sedimentation rate within the channel. Based on the evaluation of the available hydrosurveys since 2004, it was estimated that the annual average shoaling rate within the Redwood City Harbor Channel is approximately 183,000 cubic yards per year ($yd^3\ yr^{-1}$). Further analysis of the hydrosurvey data highlighted two "hot spots" within the channel that experienced relatively more extensive shoaling than the other portions of the channel (see Figure 4.3-12). One hot spot is located southeast of Bair Island on the northwest side of the channel and the other hot spot is located on the west side of the northern portion of the channel. The hydrosurvey data indicate that these two locations are potential candidates for advanced maintenance dredging to limit the duration and thickness that these regions aggrade above the project depth. Nine bathymetric surveys of the San Bruno Shoal Channel were used to estimate shoaling rates since 2002. The analyses of these surveys indicated that the San Bruno Shoal Channel has not undergone a consistent rate of sediment accretion since 2002, but rather periods of sediment accretion and erosion leading to relatively little net change.

The model predictions of sediment transport were validated using observations of suspended sediment concentration in Central Bay and South Bay, sediment deposition volumes and thicknesses in the Redwood City Harbor Channel and the San Bruno Shoal Channel, and the percentage of the Redwood City Harbor Channel that shoaled to above project depth. Water years 2006 and 2008 were simulated for the model validation. Water year 2006 is classified as a wet water year, and water year 2008 is classified as a critical (dry) water year, so the simulation of these two years allows for an assessment of model accuracy under both wet and dry hydrologic conditions.

The model predicted a lower total volume of sediment deposited in the Redwood City Harbor Channel than was estimated from the hydrosurvey data; however, the model prediction was within the error bars of the hydrosurvey derived deposition volumes for both years simulated. The model correctly predicted the locations of the two shoaling hot spots south of Bair Island and near the northern end of the channel that were identified in the hydrosurvey analysis. The model also predicted the correct across-channel location of the hot spots on the western side of the channel in the 2006 simulation. The predicted reduction in the sedimentation rate in the Redwood City Harbor Channel from the wet water year in 2006 to the critically dry water year in 2008 agreed with the observed reduction in shoaling rate derived from the hydrosurvey data (23% vs. 21%). This indicates that the model very accurately predicted the relative change in the sedimentation rate due to different channel depths and environmental conditions between the 2006 and 2008 simulation periods. The model also predicted the same order of magnitude change in the area of the channel that shoaled to above project depth as the hydrosurvey data for the Redwood City Harbor Channel. The model predicted a larger volume of sediment deposition in the San Bruno Shoal Channel than was estimated from the hydrosurvey data; however, the predicted deposition volume was the same order of magnitude as the deposition volume derived from the hydrosurvey data and was within the error bars of the hydrosurvey derived deposition volumes for both years simulated.

The model validation indicated that the model was sufficiently accurate for investigating relative changes in the sediment deposition volume due to channel deepening of the Redwood City Harbor Channel and San Bruno Shoal Channel. The validation also indicated that the predicted percentage difference in the sedimentation rate between scenarios will

have less uncertainty and likely be more accurate than the corresponding absolute differences in deposition volumes between scenarios. Because there is less uncertainty in analyses that compare the relative difference in sediment depositional volumes between scenarios, the analyses in this report focused on the relative difference between scenarios and less on absolute differences between the scenarios. That is, the effect of channel deepening on sedimentation rates in the navigation channels is discussed predominantly as a percentage increase from the currently authorized 30-foot mean lower low water (MLLW) project depth and not as absolute deposition volume increases.

The base year conditions are defined based on the expected bathymetric, hydrologic, and operating conditions in year 2018 for the Redwood City Harbor Channel and the San Bruno Shoal Channel. The base year scenario represents the "Year 0" conditions, which are an estimate of conditions that may exist at the approximate time that the project is completed. Because the exact weather, hydrology, and operating conditions cannot be predicted in advance, representative conditions for 2018 were developed for the sediment transport simulations using 2006 hydrology, and modified to account for both sea level rise and to include changes to the Bair Island Restoration Project that are expected to occur prior to 2018. The planned changes to the Bair Island Restoration Project were included based on information provided by the U.S. Fish and Wildlife Service (E. Mruz, Pers. Comm. 2014; A. Payne, Pers. Comm. 2014).

Six scenarios were used to investigate how deepening the Redwood City Harbor Channel and San Bruno Shoal Channel project depths would affect the shoaling rates in the channels under base year conditions (Table ES-1). Increasing the project depth from 30 feet MLLW (Baseline) to either 32 feet MLLW or to 37 feet MLLW was predicted to result in an increase in sedimentation rates in both the Redwood City Harbor Channel and the San Bruno Shoal Channel. This suggests that the proposed channel deepening would result in an increase in annual maintenance dredging in both the Redwood City Harbor Channel and the San Bruno Shoal Channel. The annual sedimentation rate in the Redwood City Harbor Channel was predicted to increase by 13% as a result of increasing the project depth from 30 feet MLLW to 32 feet MLLW. A larger increase in annual sedimentation rate was predicted for the 37 feet MLLW deepening scenario, with the annual sedimentation rate in the Redwood City Harbor Channel predicted to increase by 51% as a result of increasing the project depth from

30 feet MLLW to 37 feet MLLW. Based on the hydrosurvey derived average sedimentation rate of about 183,000 $yd^3\ yr^{-1}$, the predictions suggest an average future dredging requirement for the Redwood City Harbor Channel of about 207,000 $yd^3\ yr^{-1}$ with the 32 feet MLLW project depth. The average future dredging requirement for the Redwood City Harbor Channel with the 37 feet MLLW project depth was predicted to be about 276,000 $yd^3\ yr^{-1}$. However, these should be treated as approximations due to uncertainty in the model predictions, and potential variations due to interannual variability or future changes to sediment supply to San Francisco Bay.

The annual sedimentation rate in the San Bruno Shoal Channel was predicted to increase by 54% as a result of deepening the San Bruno Shoal Channel from 30 feet MLLW to 32 feet MLLW. For the 37 feet MLLW project depth, the annual sedimentation rate in the San Bruno Shoal Channel was predicted to be 86% higher than for the baseline 30 feet MLLW project depth. The change in the sedimentation rate predicted for the San Bruno Shoal Channel may underestimate the increase in dredging requirements resulting from deepening the San Bruno Shoal Channel relative to the existing 30 feet MLLW project depth. This is because the results suggest that a larger portion of the channel may begin to experience above grade shoaling and may require dredging for both the 32 feet MLLW and 37 feet MLLW project depths than currently occurs for the 30 feet MLLW project depth.

Two additional scenarios were used to evaluate the influence of a proposed realignment of the Redwood City Harbor Channel on sedimentation in the channel for the 37 feet MLLW project depth and to evaluate whether or not the realignment of the channel would decrease the above grade shoaling south of Bair Island or decrease the annual maintenance dredging requirements (Table ES-1). For the 37 feet MLLW project depth, the proposed realignment of the Redwood City Harbor Channel was predicted to have a minimal effect on the annual sedimentation rate in the channel. The sedimentation rate was predicted to increase by 3% in the realignment scenario compared to the existing alignment. The thickness of the hot spot south of Bair Island was also predicted to increase in the realignment scenario relative to the existing alignment. This suggests that the proposed channel realignment would not be likely to result in decreased shoaling south of Bair Island. Although the channel realignment was evaluated only for the 37 feet MLLW project depth, it is not expected that a different result would occur for either the 30 feet MLLW or the 32 feet MLLW project depths.

Simulations were conducted to evaluate the effect of deepening the project depth on hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island under both Year 0 and Year 50 conditions. Without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions were evaluated under Year 0 and Year 50 conditions over a 2-week period that included elevated outflow from Redwood Creek, high winds, and spring tides, resulting in a total of four scenarios (Table ES-2). The influence of deepening the project depth on the hydrodynamics was determined by examining the water level, tidal flows, salinity, and shear stress in the vicinity of the Redwood City Harbor Channel and Bair Island. These comparisons demonstrated that the deepening of the project depth from 30 feet MLLW to 32 feet MLLW resulted in essentially no effect on the water level, flows, salinity, or shear stress in the vicinity of Redwood City Harbor and Bair Island for both the Year 0 and the Year 50 scenarios.

The four scenarios used to evaluate the effect of deepening the project depth on hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island under both Year 0 and Year 50 conditions were also used to provide flow fields for future ship navigation simulations. The predicted flow field was provided for two different regions: one in the vicinity of the Redwood City Harbor Channel and another in the vicinity of the San Bruno Shoal Channel. The depth-averaged velocity at each model grid cell in the two flow field regions was calculated at times of peak flood velocity, peak ebb velocity, and slack water. These four scenarios used for the ship navigation simulation output included both without-project and with-project channel bathymetry and Year 0 and Year 50 conditions (Table ES-2). These flow field data were provided to the USACE for future ship navigation simulations which are expected to be conducted during a later phase of this project.

Five additional scenarios were used to evaluate the effects of the channel deepening on peak water levels and storm surge in the Redwood City Harbor during a large storm event. One simulation was used to validate the peak water levels during the December 1983 storm, which had the highest peak water level ever measured at the National Oceanic and Atmospheric Administration (NOAA) Redwood City station. Without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions were then simulated for both Year 0 and Year 50 conditions, which included sea level rise (Table ES-2). These four scenarios were used to determine the effect of increasing the project depth on water level resonance in

Redwood City by examining the peak water levels in each scenario. Deepening the project depth from 30 feet MLLW to 32 feet MLLW was predicted to have almost no effect on the peak water levels and harbor resonance at Redwood City. The peak water level was predicted to change by less than 0.01 foot after deepening the project depth from 30 feet MLLW to 32 feet MLLW for both the Year 0 and Year 50 scenarios.

Table ES-1
The scenario matrix used to evaluate how the Redwood City Harbor Channel and San Bruno Shoal Channel project depths and the proposed realignment of the Redwood City Harbor Channel influence sedimentation in the channels.

Scenario	Channel Project Depth (feet MLLW)	Seasonal Period	Water Year	Notes
1	30	Fall – Winter	2006	Bathymetry set as deeper of existing conditions or project depth, plus 2 feet of overdepth.
2	32			
3	37			
4	30	Spring - Summer		
5	32			
6	37			
7	37	Fall – Winter		Realignment of Redwood City Harbor Channel. Bathymetry set the same as in Scenarios 1 through 6.
8	37	Spring - Summer		

Table ES-2

The scenario matrix used to determine how deepening the project depth will affect the hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island and the water level resonance in the Redwood City Harbor Channel.

Model Forcing Year	Scenario	Channel Project Depth (feet MLLW)	Project Year For Sea Level Rise	Notes
2005	1	30 (Without-Project)	Year 0 (2018)	Deepening the project depth had almost no effect on water level and flow in the vicinity of the Redwood City Harbor Channel and Bair Island. The predicted flow fields were provided for ship navigation simulations.
	2	32 (With-Project)		
	3	30 (Without-Project)	Year 50 (2068)	
	4	32 (With-Project)		
1983	1	2005 Hydrosurvey Data	No Sea Level Rise	The model accurately predicted peak water levels from historic storm conditions.
	2	30 (Without-Project)	Year 0 (2018)	Deepening the project depth had a less than 0.01 foot effect on the peak water level at Redwood City.
	3	32 (With-Project)		
	4	30 (Without-Project)	Year 50 (2068)	
	5	32 (With-Project)		

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

1 INTRODUCTION 1

2 REDWOOD CITY HARBOR SEDIMENT TRANSPORT MODELING PROJECT OVERVIEW 3

2.1 Project Study Area 3

2.2 Modeling Approach 3

2.3 Project Objectives 6

3 NUMERICAL MODEL DESCRIPTIONS 7

3.1 UnTRIM Model Description 7

3.1.1 Turbulence Model 8

3.1.2 Previous Applications 8

3.1.3 UnTRIM Bay-Delta Model 8

3.2 SWAN Model Description 11

3.2.1 SWAN Overview 11

3.2.2 Previous Applications 12

3.3 SediMorph Model Description 12

3.3.1 SediMorph Overview 12

3.3.2 Treatment of the Sediment Bed 13

3.3.3 Sediment Transport Modeling Setup 15

3.3.4 Previous Applications 17

4 ANALYSIS OF HYDROGRAPHIC SURVEY DATA 19

4.1 Navigation Channel Sediment Volume Change Overview 19

4.2 Hydrographic Survey Bathymetric Data 19

4.3 Sediment Volume Change in the Navigation Channels 21

4.3.1 Calculations of Channel Area above Project Depth, Sediment Volume Above Project Depth and Sediment Volume Change 21

4.3.2 Redwood City Harbor Channel 23

4.3.3 San Bruno Shoal Channel 41

4.4 Hydrographic Survey Data Conclusions 45

5 VALIDATION OF THE MODELED SEDIMENT TRANSPORT IN CENTRAL BAY AND SOUTH BAY 47
5.1 Validation Simulations 48
5.1.1 Grid Refinement in the Vicinity of the Navigation Channels 48
5.1.2 Redwood Creek Inflow 48
5.1.3 Validation Simulation Time Periods 48
5.1.4 Navigation Channel Bathymetry 49
5.1.5 Validation of Sedimentation in the Navigation Channels 49
5.2 Validation of Central Bay and South Bay Suspended Sediment Concentrations 54
5.3 Validation of Sediment Deposition in the Redwood City Harbor Channel 61
5.4 Validation of Sediment Deposition in the San Bruno Shoal Channel 65
5.5 Model Validation Conclusions 67
6 INFLUENCE OF PROJECT DEPTH ON SHOALING 69
6.1 Project Depth Scenarios Overview 69
6.2 Overview of Scenario Analysis 74
6.3 Influence of Project Depth on Sedimentation Rate 75
6.3.1 Redwood City Harbor Channel 75
6.3.2 San Bruno Shoal Channel 78
6.4 Project Depth Conclusions 81
7 INFLUENCE OF CHANNEL ALIGNMENT ON SHOALING 84
7.1 Channel Alignment Overview 84
7.2 Influence of Channel Alignment on Sedimentation 86
7.3 Channel Alignment Conclusions 88
8 INFLUENCE OF PROJECT DEPTH ON HYDRODYNAMICS AND SEDIMENT DEPOSITION IN THE VICINITY OF THE REDWOOD CITY HARBOR CHANNEL 90
8.1 Model Scenarios Overview 90
8.1.1 Effect of Increased Project Depth on Hydrodynamics 90
8.1.2 Effect of Increased Project Depth on Water Level Resonance in Redwood City Harbor 92
8.2 Effect of Increased Project Depth on Hydrodynamics 95
8.2.1 Effect of Increased Project Depth on Water Level, Flow, and Salinity 95
8.2.2 Effect of Increased Project Depth on Shear Stress 96

8.2.3 Effect of Increased Project Depth on Bair Island Sedimentation and the Mudflat Surrounding the Redwood City Harbor Channel 97
8.3 Effect of Increased Project Depth on Harbor Resonance and Peak Water Levels ...162

9 FLOW FIELD FOR SHIP NAVIGATION SIMULATIONS 166
9.1 Regions of Provided Flow Field 166
9.2 Descriptions of Modeled Scenarios for Ship Simulation Flow Fields....166
9.3 Flow Field Output Provided to USACE 167

10 SUMMARY AND CONCLUSIONS....176

11 ACKNOWLEDGMENTS....181

12 REFERENCES 182

A.1 Data Sources Used Within the UnTRIM Bay-Delta Model....1
A.2 UnTRIM Numerical Model Uncertainty 5
A.3 SWAN Numerical Model Uncertainty....8
A.4 SediMorph Numerical Model Uncertainty....8
A.5 Sediment Transport Modeling Assumptions and Limitations 9
B.1 UnTRIM-SWAN-SediMorph Coupling Overview 1
C.1 Water Level Validation....1
C.2 Salinity Validation....1

List of Appendices

Appendix A Assumptions and Limitations of the Coupled Modeling System
Appendix B Coupling of the UnTRIM, SWAN, and SediMorph Numerical Models
Appendix C Validation of Central Bay and South Bay Water Level and Salinity

LIST OF ACRONYMS AND ABBREVIATIONS

µm	micrometer
3-D	three-dimensional
BAAQMD	Bay Area Air Quality Management District
BAW	Bundesanstalt für Wasserbau (German Federal Waterways Engineering and Research Institute)
CCWD	Contra Costa Water District
CDEC	California Data Exchange Center
CDWR	California Department of Water Resources
CIMIS	California Irrigation Management System
dbSEABED	database SEABED
DEM	Digital Elevation Model
DICU	Delta Island Consumptive Use
DWR	Department of Water Resources
ft	feet
GLS	generic length scale
kg	kilogram
L	liter
LTMS	long-term management strategy
m	meter
mm	millimeter
MLLW	mean lower low water
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
Pa	Pascals
PSU	Practical Salinity Unit
r^2	coefficient of determination
RDMMP	Regional Dredged Material Management Plan

RMS	root-mean-square
s	second
SCCOOS	Southern California Coastal Ocean Observing System
SFPORTS	San Francisco Physical Oceanographic Real-Time System
SWAN	Simulating WAves Nearshore
TRIM	Tidal, Residual, Intertidal & Mudflat Model
ubRMSD	unbiased root-mean-square difference
UnTRIM	Unstructured Tidal, Residual, Intertidal & Mudflat Model
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
yd^3	cubic yard

1 INTRODUCTION

This report documents the three-dimensional (3-D) hydrodynamic, wind wave, and sediment transport modeling that was completed in support of the Redwood City Harbor Navigation Improvement Feasibility Study. This report also includes a description of the hydrographic survey data in the Redwood City Harbor Channel and the San Bruno Shoal Channel and the estimated sediment volume accretion rates from this data. This report is divided into ten major sections and three appendices:

- **Section 1. Introduction.** This section provides a summary of the scope and organization of the report.
- **Section 2. Redwood City Harbor Sediment Transport Modeling Project Overview.** This section provides a brief overview of the project study area, project approach, and project objectives.
- **Section 3. Numerical Model Descriptions.** This section provides brief descriptions of the Unstructured tidal, Residual, Intertidal & Mudflat (UnTRIM) hydrodynamic model, the UnTRIM Bay-Delta model, the Simulating WAves Nearshore (SWAN) wave model, and the SediMorph seabed morphology model.
- **Section 4. Analysis of Hydrographic Survey Data.** Repeated bathymetric surveys and dredged sediment volumes from the U.S. Army Corps of Engineers (USACE) were used to estimate the rate of sediment deposition and locations of relatively high sediment accumulation in the Redwood City Harbor Channel and the San Bruno Shoal Channel.
- **Section 5. Validation of the Modeled Sediment Transport in Central Bay and South Bay.** Model predictions of suspended sediment concentration in the Central Bay and South Bay were compared to continuous monitoring data and sediment deposition in the two navigation channels to hydrographic survey data.
- **Section 6. Influence of Project Depth on Shoaling.** The effects of increasing the project depth on shoaling in the two navigation channels were evaluated using the hydrodynamic, wave, and sediment transport numerical model.
- **Section 7. Influence of Channel Alignment on Shoaling.** The effects of a proposed realignment of the Redwood City Harbor Channel on shoaling were evaluated using the hydrodynamic, wave, and sediment transport numerical model.

- **Section 8. Influence of Project Depth on Hydrodynamics in the Vicinity of the Redwood City Harbor Channel.** The effects of deepening the project depth on hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island were evaluated using numerical modeling.
- **Section 9. Flow Field for Ship Navigation Simulations.** This sections details the scenarios and output format for the predicted flow field velocities that were provided to USACE for future ship navigation simulations.
- **Section 10. Summary and Conclusions.** This section presents a brief summary of the analysis and the results.
- **Appendix A. Assumptions and Limitations of the Coupled Modeling System.** This appendix details some of the major assumptions inherent in the numerical modeling effort and the limitations that arise because of them.
- **Appendix B. Coupling of the UnTRIM, SWAN, and SediMorph Numerical Models.** This appendix explains the mechanics of the coupling between the UnTRIM, SWAN, and SediMorph models.
- **Appendix C. Validation of Central Bay and South Bay Water Level and Salinity.** This appendix includes validation figures for predicted water level and salinity near the study region.

2 REDWOOD CITY HARBOR SEDIMENT TRANSPORT MODELING PROJECT OVERVIEW

This project was conducted for the USACE San Francisco District in support of the Redwood City Harbor Navigation Improvement Feasibility Study. An existing 3-D hydrodynamic, wind wave, and sediment transport model was applied to estimate sediment transport in San Francisco Bay and the Sacramento-San Joaquin Delta. The objective of the project was to estimate the rate of sediment accretion within the Redwood City Harbor Channel and the San Bruno Shoal Channel to estimate how future maintenance dredging volumes could potentially change as a result of the proposed deepening of the project depth and as a result of a proposed realignment of the Redwood City Harbor Channel near Bair Island. The project also evaluated the effects of deepening the Redwood City Harbor Channel on the hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island.

2.1 Project Study Area

The project study area is located in South San Francisco Bay and includes the Redwood City Harbor Channel and the San Bruno Shoal Channel (Figure 2-1). However, the model domain for this study encompasses all of San Francisco Bay and the Sacramento-San Joaquin Delta region (see Figure 3-1). Because the Sacramento-San Joaquin Delta region has historically been one of the largest sediment sources to San Francisco Bay, it is essential that the entire system is simulated so that sediment dynamics throughout the system and their effect on shoaling rates within the project study area can be evaluated.

2.2 Modeling Approach

The UnTRIM Bay-Delta model (MacWilliams et al. 2008, 2009, 2015) was applied together with the SWAN (SWAN Team 2009a) wave model and the SediMorph (BAW 2005) sediment transport and seabed morphology model, as a fully coupled hydrodynamic-wave-sediment transport model. The coupled model predicts the continuous erosion, deposition, and transport of sediment by waves and currents throughout the Bay-Delta system. This coupled model has been used in previous studies to evaluate sediment transport processes in the San Francisco Estuary (MacWilliams et al. 2012a; Bever and MacWilliams 2013, 2014; Delta Modeling Associates 2014) and sediment deposition in the Oakland Harbor Channel

resulting from deepening project depths and differing water year types (Delta Modeling Associates 2015). The model was calibrated and verified to sediment deposition volumes within the Redwood City Harbor Channel and the San Bruno Shoal Channel. The model was then applied to evaluate how channel deepening and proposed channel realignment will influence future dredging requirements within the channel. Descriptions of the UnTRIM Bay-Delta model, the SWAN wave model, and the SediMorph sediment transport model are provided in Section 3.

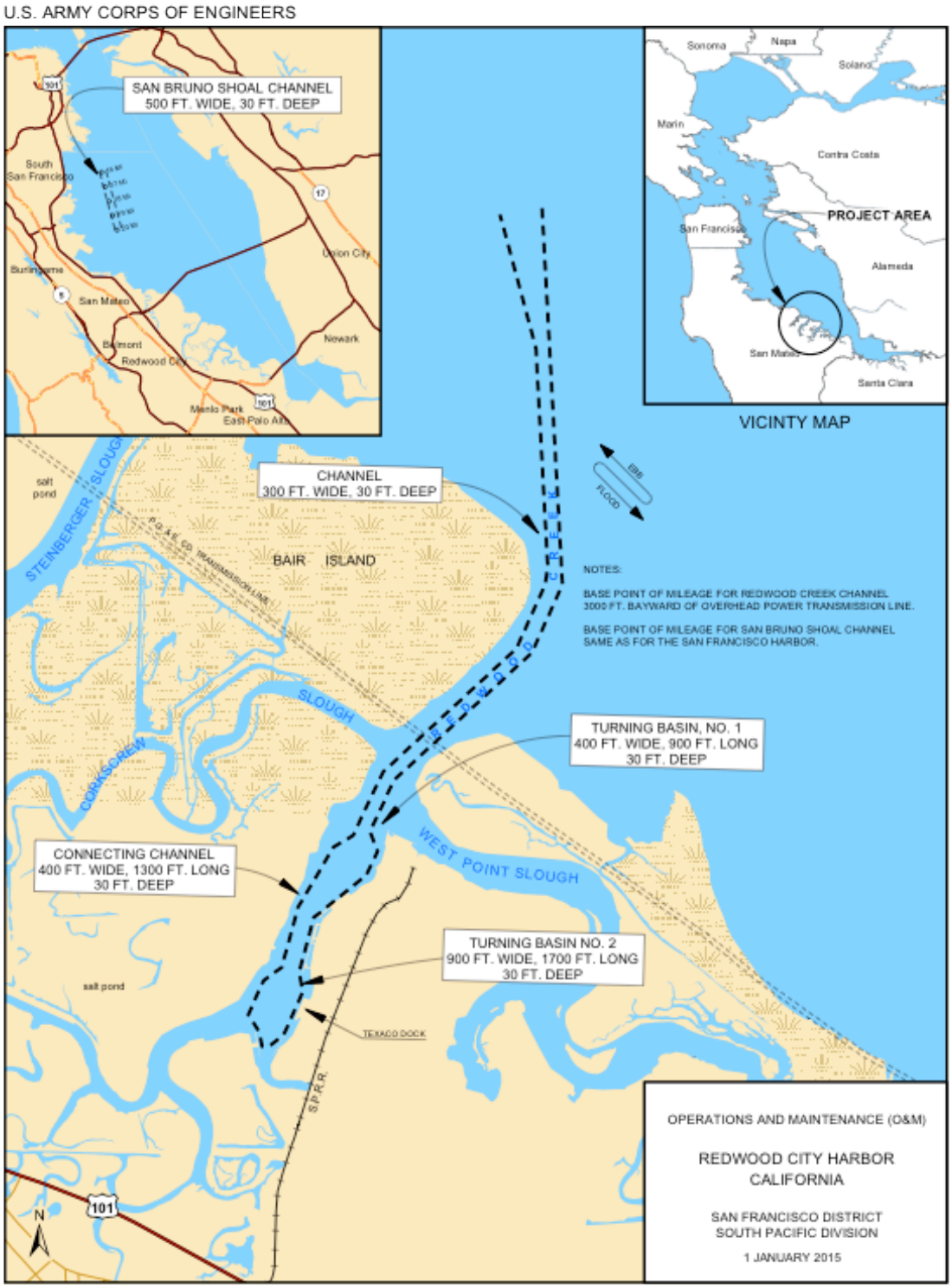


Figure 2-1
Location of project area which includes Redwood City Harbor and the San Bruno Shoal Channel (Source: USACE, San Francisco District).

2.3 Project Objectives

The primary objective of this project was to apply the coupled 3-D hydrodynamic, wind wave, and sediment transport model to evaluate how a deepening project depth and a proposed channel realignment could potentially impact the sediment deposition within the Redwood City Harbor Channel and San Bruno Shoal Channel. The model was also applied to evaluate the effects of deepening the project depth on the hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island. These objectives were accomplished by the following:

- Estimating the sedimentation rate and locations of depositional "hot spots" in the two channels from repeated USACE hydrographic surveys (Section 4)
- Validating model predictions of sediment depositional volumes within the Redwood City Harbor Channel and San Bruno Shoal Channel based on repeated USACE hydrographic survey data (Section 5)
- Evaluating changes to shoaling in the Redwood City Harbor Channel and San Bruno Shoal Channel as a result of channel deepening (Section 6) and proposed channel realignment (Section 7)
- Determining the effects of deepening the Redwood City Harbor Channel project depth on hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island (Section 8)
- Provide flow field velocities for future ship navigation simulations under both Year 0 and Year 50 conditions (Section 9)

3 NUMERICAL MODEL DESCRIPTIONS

The UnTRIM Bay-Delta model (MacWilliams et al. 2008, 2009, 2015) was applied together with the SWAN (SWAN Team 2009a) wave model and the SediMorph sediment transport and seabed morphology model (BAW 2005), as a fully coupled hydrodynamic-wave-sediment transport model. The simulations were conducted such that SWAN was run and the waves were updated every hour, while the SediMorph model exchanged information with UnTRIM at every hydrodynamic time step. In this way, the erosion and deposition on the seabed was calculated on the same time step as the hydrodynamic model (90 seconds) and the morphologic change of the seabed directly affected the hydrodynamics.

Abbreviated backgrounds of the three models are provided in this section, along with citations to full descriptions of the numerical models, model coupling, and previous applications. Validation of the coupled modeling system, including validation of the coupling of the models and initial wave and sediment transport results within San Francisco Bay is presented in MacWilliams et al. (2012a) and Bever and MacWilliams (2013, 2014). Appendix A presents some of the main areas of uncertainty within the numerical models. Appendix B provides more detail on the coupling of the three models.

3.1 UnTRIM Model Description

The hydrodynamic model used in this technical study is the 3-D hydrodynamic model UnTRIM (Casulli and Zanolli 2002). A complete description of the governing equations, numerical discretization, and numerical properties of UnTRIM are described in Casulli and Zanolli (2002, 2005), Casulli (1999), and Casulli and Walters (2000).

The UnTRIM model solves the 3-D Navier-Stokes equations on an unstructured grid in the horizontal plane. The boundaries between vertical layers are at fixed elevations, and cell heights can be varied vertically to provide increased resolution near the surface or other vertical locations. Volume conservation is satisfied by a volume integration of the incompressible continuity equation, and the free-surface is calculated by integrating the continuity equation over the depth, and using a kinematic condition at the free-surface as described in Casulli (1990). The numerical method allows full wetting and drying of cells in the vertical and horizontal directions. The governing equations are discretized using a finite

difference-finite volume algorithm. Discretization of the governing equations and model boundary conditions are presented in detail by Casulli and Zanolli (2002). All details and numerical properties of this state-of-the-art 3-D model are well-documented in peer reviewed literature (Casulli and Zanolli 2002, 2005).

3.1.1 Turbulence Model

The turbulence closure model used in the present study is a two-equation model comprised of a turbulent kinetic energy equation and a generic length-scale equation. The parameters of the generic length-scale (GLS) equation are chosen to yield the k-ε closure (Umlauf and Burchard 2003). The Kantha and Clayson (1994) quasi-equilibrium stability functions are used. All parameter values used in the k-ε closure are identical to those used by Warner et al. (2005), including the minimum eddy diffusivity and eddy viscosity values, which were $5x10^{-6}$ m^2 s^{-1}. The numerical method used to solve the equations of the turbulence closure is a semi-implicit method that results in tridiagonal positive-definite matrices in the water column of each grid cell and ensures that the turbulent variables remain positive (Deleersnijder et al. 1997).

3.1.2 Previous Applications

The Tidal, Residual, Intertidal & Mudflat (TRIM) 3-D model (Casulli and Cheng 1992) and UnTRIM model have been applied previously to San Francisco Bay (Cheng and Casulli 2002; MacWilliams and Cheng 2007; MacWilliams and Gross 2007; MacWilliams et al. 2007, 2008, 2015). The TRIM3-D model (Casulli and Cattani 1994) which follows a similar numerical approach on structured horizontal grids has been widely applied in San Francisco Bay (e.g., Cheng et al. 1993; Cheng and Casulli 1996; Gross et al. 1999, 2006), and a 2-D version, TRIM2D, was used in the San Francisco Bay Physical Oceanographic Real-Time System (SFPORTS, Cheng and Smith 1998). Thus, the UnTRIM numerical approach has been well-tested in San Francisco Bay, and is very well suited to perform the types of analysis used in this study.

3.1.3 UnTRIM Bay-Delta Model

The UnTRIM San Francisco Bay-Delta model (UnTRIM Bay-Delta model) is a three-dimensional hydrodynamic model of San Francisco Bay and the Sacramento-San Joaquin

Delta, which has been developed using the UnTRIM hydrodynamic model (MacWilliams et al. 2007, 2008, 2009, 2015). The UnTRIM Bay-Delta model extends from the Pacific Ocean through the entire Sacramento-San Joaquin Delta (Figure 3-1). The UnTRIM Bay-Delta model takes advantage of the grid flexibility allowed in an unstructured mesh by gradually varying grid cell sizes, beginning with large grid cells in the Pacific Ocean and gradually transitioning to finer grid resolution in the smaller channels of the Sacramento-San Joaquin Delta. This approach offers significant advantages both in terms of numerical efficiency and accuracy, and allows for local grid refinement for detailed analysis of local hydrodynamics, while still incorporating the overall hydrodynamics of the larger estuary in a single model. The UnTRIM Bay-Delta model has been calibrated using water level, flow, and salinity data collected in San Francisco Bay and the Sacramento-San Joaquin Delta (MacWilliams et al. 2008, 2009, 2015). Predicted water levels were compared to observed water levels at National Oceanic and Atmospheric Administration (NOAA) and Department of Water Resources (DWR) stations in San Francisco Bay, and DWR and United States Geological Survey (USGS) flow and stage monitoring stations in the Sacramento-San Joaquin Delta.

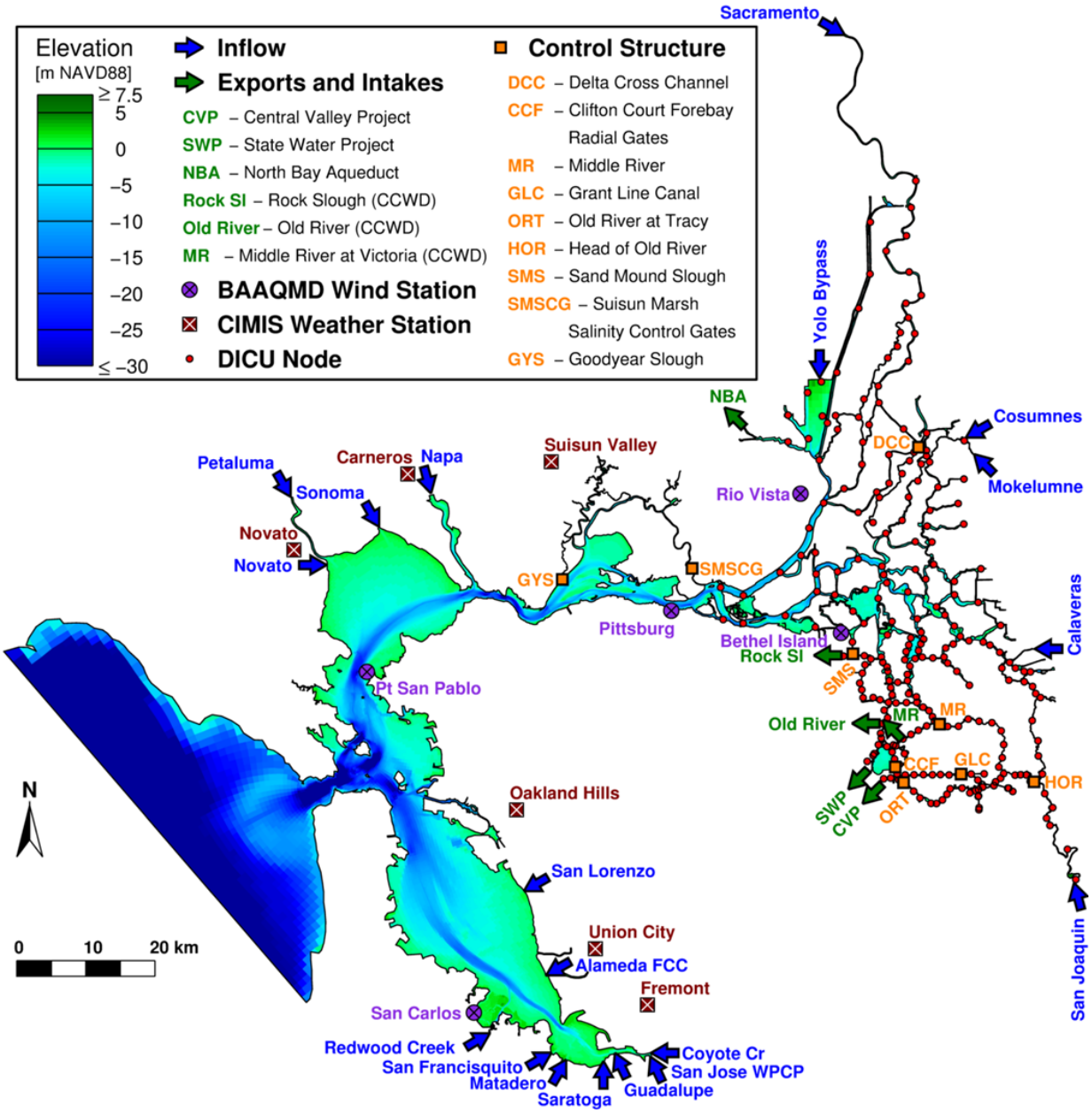


Figure 3-1.
UnTRIM San Francisco Bay-Delta model domain, bathymetry, and locations of model boundary conditions which include inflows, export facilities, intakes for the Contra Costa Water District (CCWD), wind stations from the Bay Area Air Quality Management District (BAAQMD), evaporation and precipitation from California Irrigation Management Information System (CIMIS) weather stations, Delta Island Consumptive Use (DICU), and flow control structures.

3.2 SWAN Model Description

Wind wave properties must be estimated in order to accurately calculate bottom stress in SediMorph for the sediment transport calculations. In the approach documented here, the wind wave properties are predicted by the SWAN model (SWAN Team 2009a). SWAN supports the use of unstructured grids (Zijlema 2010) allowing fairly straightforward application with UnTRIM. A one-way coupling of SWAN and UnTRIM has been implemented in which information is written by UnTRIM for use in SWAN. After each SWAN wave prediction is complete, the significant wave height, peak wave period, and wave direction are passed back to UnTRIM to be used by SediMorph to calculate bottom shear stress.

3.2.1 SWAN Overview

The SWAN model (SWAN Team 2009a) is a widely used model for predicting wind wave properties in coastal areas (e.g., Funakoshi et al. 2008). SWAN "represents the effects of spatial propagation, refraction, shoaling, generation, dissipation and nonlinear wave-wave interactions" on wind waves (SWAN Team 2009b). Therefore, SWAN can estimate the wind waves in coastal regions with variable bathymetry and ambient currents. SWAN can also accommodate spatial variability in bottom friction parameters and wind velocity. SWAN is a freely available model developed at Delft University of Technology (SWAN Team 2009a).

The SWAN options used for this project were in most cases the model's default values. As such, the model included wind generated waves, whitecapping, wave refraction, quadruplet wave-wave interactions, and wave breaking. A Madsen et al. (1988) bottom friction formulation was used based on the seabed grain size provided by UnTRIM. SWAN also included the influence of the UnTRIM current velocities in the wave calculations. A method from Rogers et al. (2003) to reduce the artificial reduction of lower frequencies by dissipation was included. A functionality to limit the wave turning from refraction based on the Courant-Friedrichs-Lewy (CFL) condition was included based on Dietrich et al. (2013) to limit unreasonably large wave periods near steep bathymetric gradients.

3.2.2 Previous Applications

SWAN has been widely applied in many settings, including estuaries. Published applications of SWAN in the San Francisco Estuary include studies of wind waves in South San Francisco Bay by Bricker (2003) and Bricker et al. (2004). Bricker et al. (2004) found that the representation of wave breaking and refraction are important capabilities of SWAN. In contrast, an approach using analytical equations, documented by Inagaki et al. (2001), which does not represent effects of wave breaking and refraction provided substantially different estimates of wave properties at the study site near Coyote Point (Bricker et al. 2005). Zimmerman et al. (2008) applied SWAN to study wind waves near Hunter's Point and predicted significant wave height accurately during periods with strong winds. van Der Wegen (2010) applied SWAN in morphological modeling of San Pablo Bay. Bever and MacWilliams (2013) used the coupled UnTRIM-SWAN-SediMorph model to investigate wave dynamics across the San Pablo Bay shoals. SWAN wave predictions were also used in the South Bay sediment transport modeling of Bever and MacWilliams (2014).

3.3 SediMorph Model Description

The seabed morphologic model SediMorph was originally developed by the German Federal Waterways Engineering and Research Institute (BAW) in Hamburg. SediMorph is currently being used and developed in a framework of several hydraulic research institutes (Weilbeer 2005). The SediMorph model is used with several different hydrodynamic models at BAW, including UnTRIM (Casulli and Zanolli 2002, 2005) and TELEMAC (Electricité de France 2000). For the current study, the SediMorph module was coupled with the UnTRIM Bay-Delta model to allow for sediment transport and seabed morphological change calculations in San Francisco Bay.

3.3.1 SediMorph Overview

The primary purpose of the SediMorph module is to compute the sedimentological processes at the alluvial bed of a free-surface flow, including the following (Weilbeer 2005):

- The roughness of the bed resulting from grain and form roughness (ripples and/or dunes)
- The bottom shear stress as a result of roughness, flow, and waves
- Bed load transport rates (fractioned)

- Erosion and deposition rates (fractioned)
- Bed evolution
- Sediment distributions within the bed exchange layer

A full description of the model capabilities of SediMorph and the validation of the SediMorph model is presented by BAW (2005). The physics modeled in SediMorph is described in detail by Malcherek (2001). A full description of the governing equations for the SediMorph model is presented by BAW (2005). A full description of the numerical setup of the SediMorph model as used in the UnTRIM-SWAN-SediMorph modeling system is presented in Bever and MacWilliams (2014).

3.3.2 Treatment of the Sediment Bed

SediMorph is designed to use the same horizontal computational mesh as the UnTRIM hydrodynamic model. In the vertical, the SediMorph module allows for evolution of the bed elevation above a pre-defined rigid layer in each cell. Above the rigid layer, SediMorph includes at least one exchange layer, in which sediments are mixed and exchange processes such as erosion and deposition occur. Figure 3-2 shows the horizontal and vertical grid structure of the UnTRIM and SediMorph models and provides a schematic representation of the location of the sediment transport processes within the model grid structure.

SediMorph allows for the use of multiple seabed layers that can help the model armor the seabed, or keep deposited yet easily erodible fine sediment at the surface. With the use of multiple seabed layers, sediment is eroded or deposited into layers at the sediment water interface that have a set maximum thickness (approximately 1.7 centimeters in this modeling work). These layers can be winnowed of fine sediment, creating an armored sediment bed. The layers can also store easily erodible fine sediment on the bed surface for later resuspension. Physically, these layers behave like a surface mixed layer, where the deposited sediment is mixed within a thin layer at the surface without being mixed within the entire sediment bed, and then remains near the sediment surface for later resuspension. When one seabed layer fills up with sediment through deposition, subsequent sediment deposition is then added to the layer above. Conversely, when the thickness of the upper seabed layer is less than the thickness of the exchange layer, the upper layer is mixed with the layer below and is considered eroded away. The thickness of the exchange layer between the seabed and

the water column is dictated by the seabed grain size and the bed shear stress, and only sediment within this layer is available for sediment mobilization during any one time-step. The exchange layer thickness is calculated similarly to that from Harris and Wiberg (1997) using:

$$\textit{If } \tau_b > \tau_C \qquad ELT = \frac{\tau_b}{\tau_C} D_{90}(1 - P)$$
$$\textit{otherwise} \qquad ELT = D_{90}(1 - P)$$

where ELT is the exchange layer thickness, τ_b is the bed shear stress, τ_C is the critical Shields shear stress using the grain size of the 50th percentile, D_{90} is the grain size of the 90th percentile sediment and P is the porosity of the exchange layer.

SediMorph runs concurrently with UnTRIM, and uses the hydrodynamics and wave properties in the calculation of seabed shear stress, which feeds into the sediment erosion and bedload calculations. In the shear stress calculations, the Nikuradse and ripple roughnesses at each grid cell are used to allow for a spatially varying roughness.

SediMorph allows for the use of multiple sediment classes, and these classes are considered well mixed within any single seabed layer. A single porosity value is specified for the entire seabed within the model. All sediment classes are used in their relative proportions within a layer in the calculation of bulk seabed properties, such as determining the average grain size. For sediment deposition and erosion, however, all the sediment classes are treated individually within a seabed layer. If the shear stress is above the critical shear stress of any given sediment class, then that class can be eroded from the surface exchange layer according to Ariathuria and Arulanandan (1978). The sediment density of each sediment class is used with the single porosity value to determine the deposition and erosion thickness (from the calculated deposited or eroded sediment mass) of each sediment class individually. These thicknesses are summed and combined with the bedload transport based on Meyer-Peter and Müller (1948) to calculate the net seabed deposition or erosion, dependent on each sediment class eroded from the layer or deposited from the overlying water column.

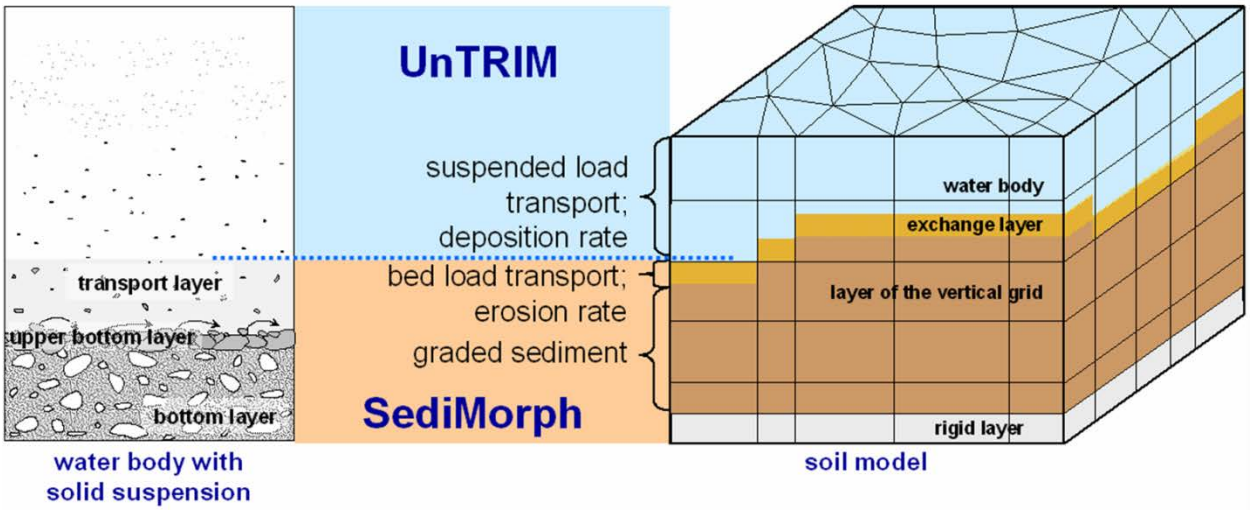


Figure 3-2
Horizontal and vertical grid structure of the UnTRIM and SediMorph models (right); schematic (left) and process list (middle) show the location of the sediment transport processes within the model grid structures (Source: BAW).

3.3.3 Sediment Transport Modeling Setup

To limit the number of grain classes within the model, the continuously varying grain size distribution within the real world was simplified to represent the most dominant constituents, as has previously been done in 3-D sediment transport modeling of San Francisco Bay (Ganju and Schoellhamer 2009; van der Wegen et al. 2011; Bever and MacWilliams 2013). Increasing the number of sediment classes within the modeled grain size distribution increases the complexity of the calibration because of the increased number of tunable parameters and increases the run time of each model simulation. Sediment transport calculations for this project included four sediment classes, each with different particle size, settling velocity, critical shear stress, density, and erosion rate parameter (Table 3.3-1). The four sediment classes were chosen to represent the dominant constituents in the real San Francisco Bay grain size distribution, and were single particle silt, flocculated silts and clays called "flocs," sand and gravel. The final sediment class parameters shown in Table 3.3-1 were determined as described in Bever and MacWilliams (2014).

Table 3.3-1
The sediment grain class parameters used in the sediment transport modeling.

Sediment class	Settling Velocity ($mm\ s^{-1}$)	Critical Shear Stress (Pa)	Diameter	Density ($kg\ m^{-3}$)	Erosion Rate Parameter ($kg\ m^{-2}\ s^{-1}$)
Silt	0.0774	0.0275	11 µm	2,650	$3.5x10^{-5}$
Flocculated Silt and Clay	2.25	0.15	200 µm	1,300	$5x10^{-5}$
Sand	23	0.19	250 µm	2,650	$5x10^{-5}$
Gravel	N/A	N/A	8 mm	2,650	N/A

Observed surface grain size distributions were used to generate a realistic initial sediment bed for the entire San Francisco Bay-Delta system. Grain size distribution data was compiled from a USACE Long Term Management Strategy (LTMS) report (Pratt et al. 1994), the west coast surface grain size distribution database (dbSEABED, Jenkins 2010), the USGS sand provenance study (Barnard et al. 2013) and the Delta sediment grain size study (S. Wright, Pers. Comm. 2012). The method presented in Bever and MacWilliams (2013, 2014) was used with more than 1,300 surface grain size distributions to generate the initial sediment bed (Figure 3-3). A porosity of 70% was specified for the seabed. This porosity is near the average of values reported for the San Francisco Bay in Caffrey (1995) of about 65%.

Suspended sediment was supplied through river input to the Sacramento-San Joaquin Delta, the North Bay and the South Bay. Sediment was supplied to the Delta by the Sacramento, San Joaquin, Cosumnes, and Mokelumne Rivers and the Yolo Bypass as described in Bever and MacWilliams (2013, 2014), representing nearly 100% of the sediment inflow to the Delta (Wright and Schoellhamer 2005). Sediment was supplied to the South Bay by Alameda Creek, San Lorenzo Creek, Coyote Creek, and the Guadalupe River as described in Bever and MacWilliams (2013, 2014). Sediment was supplied to the North Bay by the Napa River in the same manner as the South Bay tributaries.

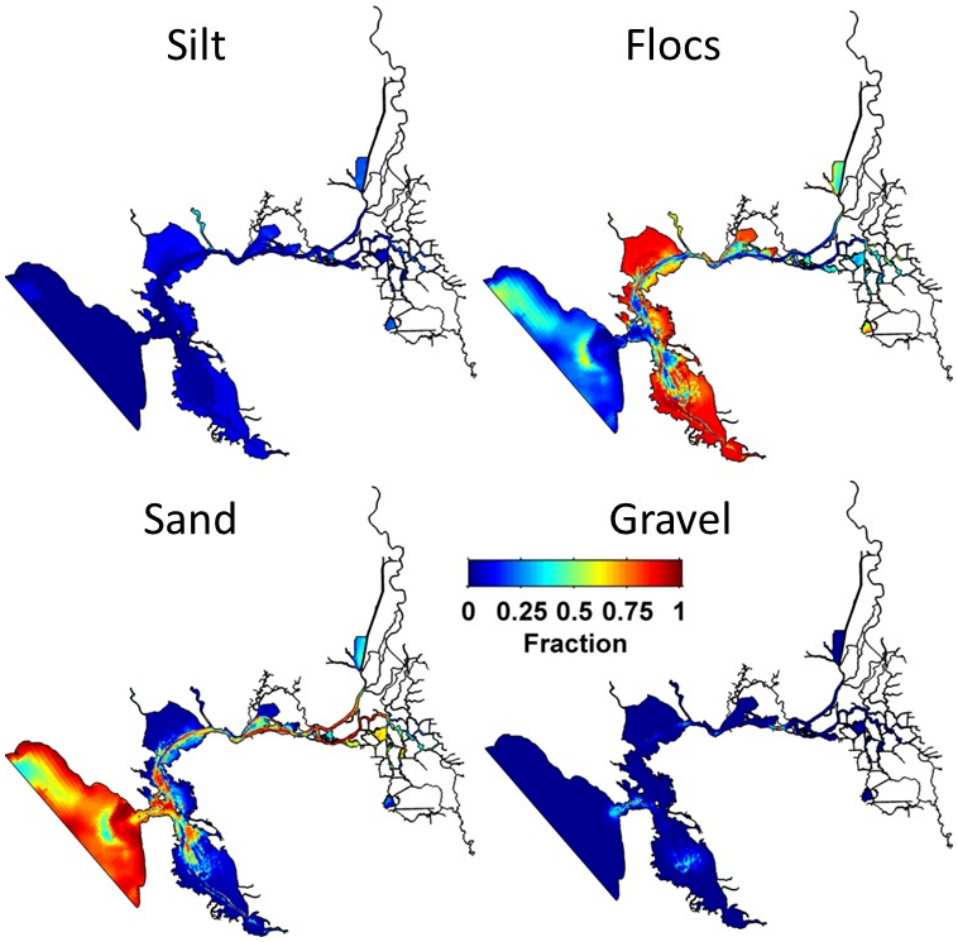


Figure 3-3
The fraction of each sediment class making up the initial sediment bed.

3.3.4 Previous Applications

The SediMorph model has been used for a wide range of applications at the BAW. Initial applications used in the validation of the SediMorph model are presented by BAW (2005). Weilbeer (2005) presents the simulation of sediment transport processes in the Ems-Dollard estuary using UnTRIM-SediMorph. Kahlfeld and Schüttrumpf (2006) apply the UnTRIM-SediMorph model to evaluate the potential morphodynamic impacts of the proposed construction of a container port in the Jade-Weser estuary. Sohrmann and Weilbeer (2006) use the UnTRIM-SediMorph model to evaluate the effect of channel deepening on sediment transport in the Elbe estuary using data from repeated bathymetric surveys spanning 30 years of channel deepening. Additional applications at BAW include the simulation of dredged

material placement. SediMorph has also been used with UnTRIM and SWAN to simulate dredged material dispersal in North San Francisco Bay (MacWilliams et al. 2012a) and sediment fluxes between the channel and shoals in San Pablo Bay (Bever and MacWilliams 2013). Bever and MacWilliams (2014) used the UnTRIM-SWAN-SediMorph modeling system to evaluate the fate of dredged material following in-Bay open-water placements and investigated if open-water placements can potentially be used to augment mudflat and marsh sedimentation. Delta Modeling Associates (2015) used the model to predict sedimentation rates in the Oakland Harbor Channel under different water year types and project depths. These applications demonstrate the suitability of the SediMorph model for the types of applications conducted as part of this study.

4 ANALYSIS OF HYDROGRAPHIC SURVEY DATA

USACE conducts regular hydrographic surveys of navigation channels in San Francisco Bay to determine minimum water depths for navigation and estimate dredging requirements. Bathymetric data from the Redwood City Harbor Channel and the San Bruno Shoal Channel were used in this study to estimate the rate of shoaling of these two channels through time. The data also highlighted areas within the Redwood City Harbor Channel that are prone to high rates of sediment accumulation relative to the rest of the channel, indicating areas where channel realignment can potentially reduce dredging needs or advanced maintenance dredging can potentially reduce the occurrence of above grade shoaling. The sediment volume change within the two channels was also used to validate the predicted sediment deposition from the numerical modeling.

4.1 Navigation Channel Sediment Volume Change Overview

Hydrographic survey data from USACE was used to estimate the change in sediment volume within the Redwood City Harbor Channel and the San Bruno Shoal Channel through time. This rate of sediment accretion appears to be relatively uniform near 183,000 $yd^3\ yr^{-1}$ since January of 2004 for the Redwood City Harbor Channel. The data also show the channel southeast of Bair Island frequently accretes to an above grade condition and is the region with the highest sediment accumulation rates. Data from the San Bruno Shoal Channel suggest the channel does not undergo consistent sediment accretion, but rather both periods of sediment accretion and erosion.

4.2 Hydrographic Survey Bathymetric Data

Hydrographic surveys of the Redwood City Harbor Channel and the San Bruno Shoal Channel were obtained from USACE (Lisa Andes, Pers. Comm., 2012; Patrick Sing, Pers. Comm., 2013). The survey data provide locations in State Plane feet and the depth of the seabed below mean lower low water (MLLW) in and around the channels as individual location and depth soundings. The survey data were further processed onto a 10-meter Digital Elevation Model (DEM) in MLLW and Universal Transverse Mercator (UTM) to allow for the direct comparison of each hydrographic survey during analysis. During the conversion to a DEM, any depths of the seabed greater than 50 feet below MLLW were deemed bad data and were removed. Also, all bathymetric data outside of the federally

authorized navigation channels were disregarded to prevent sediment erosion or deposition outside of the channels from influencing the channel shoaling analysis. Some surveys included nearly the entire channel while others were only partial surveys (Tables 4.2-1 and 4.2-2). Although the partial surveys are referenced in Tables 4.2-1 and 4.2-2, only the full surveys were used in the analysis presented here. The date of the survey used in the analysis (Table 4.2-1) was set as the first day the surveys were conducted because some hydrographic surveys spanned multiple days.

Table 4.2-1
Dates and extent of the hydrographic surveys for the Redwood City Harbor Channel. The Survey Notes are the USACE designation of Before Dredging, After Dredging, or Condition surveys.

Navigation Channel	Survey Date	Extent of Survey	Survey Notes
Redwood City Harbor	01/08/2004	Full	Condition
	06/07/2004	Partial	Condition
	06/16/2004	Partial	After Dredging
	09/08/2004	Partial	Before Dredging
	10/20/2004	Partial	Before Dredging
	11/09/2004	Full	Condition
	03/23/2005	Full	Condition
	09/13/2005	Full	Before Dredging
	11/16/2005	Full	Before Dredging
	12/15/2005	Partial	After Dredging
	12/24/2005	Full	After Dredging
	11/19/2006	Full	Condition
	04/13/2007	Full	Condition
	02/05/2008	Full	Condition
	10/28/2008	Full	Before Dredging
	08/30/2009	Full	Before Dredging
	10/14/2009	Full	Before Dredging
	11/03/2009	Full	After Dredging
	07/22/2010	Full	Condition
	05/26/2011	Full	Condition
	01/04/2012	Full	After Dredging
	03/19/2012	Partial	Condition
	06/28/2012	Full	Condition
	09/06/2012	Full	After Dredging
	11/25/2013	Full	Condition
	05/06/2014	Full	Condition
	08/04/2014	Full	Condition

Table 4.2-2
Dates and extent of the hydrographic surveys for the San Bruno Shoal Channel. The Survey Notes are the USACE designation of Before Dredging, After Dredging or Condition surveys.

Navigation Channel	Survey Date	Extent of Survey	Survey Notes
San Bruno Shoal	06/18/2002	Full	Condition
	04/15/2004	Full	Condition
	03/17/2005	Full	Condition
	10/15/2005	Full	Before Dredging
	11/21/2005	Partial	After Dredging
	11/20/2006	Full	Condition
	02/08/2008	Full	Condition
	06/21/2010	Full	Condition
	06/07/2011	Full	Condition
	04/15/2014	Full	Condition

4.3 Sediment Volume Change in the Navigation Channels

4.3.1 Calculations of Channel Area above Project Depth, Sediment Volume Above Project Depth and Sediment Volume Change

The USACE hydrographic surveys in the Redwood City Harbor Channel and the San Bruno Shoal Channel were used to calculate the area of the channels above the authorized project depth (30 feet MLLW), the volume of sediment in the channels above the project depth and the change in the sediment volume in the channels through time. These calculations used the processed USACE bathymetric data in MLLW which were converted into a 10-meter DEM as described in Section 4.2. The area above the project depth for each full survey was calculated by a summation of the area of each DEM grid cell in which the seabed depth was above the project depth. The volume of sediment above the project depth was also calculated by summing the sediment volume in each DEM grid cell that was above the project depth for each survey. These area and volume calculations were also performed for seabed depths of 1 foot above the project depth, 2 feet above the project depth, and 3 feet above the project depth. These calculations provide the area and volume at multiple elevations above the project depth for each of the full surveys, but no direct information on any time varying rate of sedimentation in the channel between the surveys. Because the data do not provide information on the channel between surveys, all plots of the area and volume above the project depth assume a linear trend between each survey.

The relative sediment volume change in the channels through time was calculated from the hydrosurvey data to estimate the volumetric sediment accumulation rate in each channel. Using periodic hydrosurveys to calculate the sediment volume change was suggested by Trawle (1981) to be a relatively accurate way of estimating the shoaling rate within dredged channels. The depth of the seabed below MLLW from each full survey of the channels was compared to the first full survey to estimate the sediment volume change between the surveys. This sediment volume change shows whether there was a net increase or a net decrease in the sediment volume in the channel between any two surveys or from one date to another. A linear trend is assumed between the surveys. An increase in the sediment volume indicates accretion, and a decrease indicates erosion or dredging. The volume of sediment in the channel was set to zero when the channel depth was the deepest, essentially making the sediment volumes relative to when the channel was the most dredged. This zeroing of the sediment volumes when the channel was the most dredged is arbitrary, but allows for an evaluation of the change in sediment volume in the channel through time and avoids negative sediment volumes. Using this approach, the change in sediment volume is not referenced to the project depth. However, the change in sediment volume relative to the project depth is better evaluated as the sediment volume above project depth as discussed above. Instead, these relative sediment volumes in the channel highlight the total sediment volume change in the channel, including both above the project depth and in any dredged overdepth that might be present. Figures of deposition volumes and shoaling rates are presented as $1x10^5$ yd^3, hundreds of thousands of cubic yards, which is the same order of magnitude as has historically been dredged from the Redwood City Harbor Channel. Uncertainty in the sediment volume within each channel was estimated by assuming a maximum potential measurement error in the seabed depth below MLLW of 6 inches over the surveyed area of each channel (Kilmon 2010). This gives error estimates of about ±137,000 yd^3 for Redwood City Harbor and ±276,000 yd^3 for San Bruno Shoal. These error estimates are considered very high estimates of the uncertainty in the sediment volume in the channels; the real error in the estimates is probably much smaller.

The hydrographic surveys were also used to identify areas that had higher sedimentation rates than the rest of the channel, termed "hot spots." The total sediment deposition in each DEM grid cell was used as a basic metric for the relative magnitude of sediment deposition through time. To estimate the relative total deposition throughout the channel the positive

(accretion) seabed elevation change from one hydrosurvey to the next was summed for each DEM grid cell between all successive surveys. In this way, only sediment deposition is summed and periods of negative seabed change (predominantly dredging) are not considered, providing an indication of areas that experienced relatively high rates of sedimentation compared to the rest of the channel. As such, the relative total deposition from all of the hydrosurveys gives a simple metric that highlights the hot spots in the channel that experienced repeated sediment accretion/shoaling and is relatively insensitive to variations in dredging depths or times and changing project depths. The hot spots stand out as having high relative deposition compared to other parts of the channel.

4.3.2 Redwood City Harbor Channel

The hydrographic surveys show the Redwood City Harbor Channel frequently aggraded above the project depth and was then dredged to either return the channel to the project depth or remove highly shoaled regions. Figures 4.3-1 through 4.3-11 highlight the thickness and the area of the seabed that was above project depth for each of the hydrographic surveys. Shoaling of the channel is shown by the continual increase in the area and thickness of the channel above the project depth, for example, from November 19, 2006, through October 28, 2008 (Figures 4.3-4 and 4.3-5). Conversely, dredging between September 13, 2005, and December 24, 2005, resulted in a reduction in the area and thickness above the project depth (Figures 4.3-2 and 4.3-3). Two sections of the Redwood City Harbor Channel consistently shoaled to above project depth. The regions that have historically been most prone to shoaling are on the western side of the channel southeast of Bair Island and in the north/south trending portion of the channel. These regions are most evident on Figures 4.3-5 and 4.3-6. Figure 4.3-12 shows that these regions have the greatest cumulative sediment deposition, indicating that they are hot spots undergoing a higher amount of shoaling than the rest of the channel. A possible effect of shipping traffic on sedimentation in the channel is highlighted by a generally narrow and deep region within the Redwood City Harbor Channel that remains even as the channel infills. Presumably, shipping traffic resuspends sediment from the center of the channel and the sediment is then deposited along the sides of the channel. This possible influence of shipping traffic on sedimentation is clearly seen in Figures 4.3-5, 4.3-10, and 4.3-11, where there is a relatively narrow and deep sub-channel inside the Redwood City Harbor Channel.

Each hydrographic survey was compared to the authorized project depth to estimate both the area of the channel above the project depth and the volume of sediment above the project depth. The hydrographic surveys show that both the area of the channel above the project depth and the sediment volume above the project depth increase as sediment is deposited within the channel (Figures 4.3-13 and 4.3-14). Dredging then reduces the area and volume above project depth. This dredging is highlighted on the figures by a break in the assumed linear trends between the surveys (dashed lines) and a reduction in the areas and volumes. The hydrosurveys indicate that a knockdown is effective at reducing the area and volume of the regions that are far above the project depth. For example, the surveys suggest a knockdown event in late 2009 when the volume from 0 to 1 foot above project depth increases while the volume greater than 1 foot above the project depth decreases (Figure 4.3-14). Even though the volume of sediment from 0 to 2 feet above project depth was decreased by this knockdown, the area of the channel in the same range was increased (Figure 4.3-13, light blue markers). The effects of the knockdown on the height of the seabed above the project depth throughout the channel can be seen on Figure 4.3-6.

The relative change in sediment volume in the Redwood City Harbor Channel can give insight into the rate of sediment accretion in the channel through time and the amount of dredging required. Figure 4.3-15 highlights six repeated episodes of sediment accretion followed by dredging within the Redwood City Harbor Channel. The fall 2005 and fall 2009 dredging episodes completely deepened the channel to the authorized project depth (30 feet MLLW).

The change in sediment volume in the channel was used to estimate the average rate of sediment accretion in the Redwood City Harbor Channel. Five periods of variable duration were available that had both an after dredging survey to give a starting sediment volume in the channel and then a before dredging survey giving an ending sediment volume (Figure 4.3-15). These after dredging and before dredging surveys provided changes in the sediment volume in the channel over discrete lengths of time and were used for calculating rates of sediment accretion within the channel. A simple weighted average based on the duration and magnitude of the five individual accretion rates was also calculated to estimate a longer term sediment accretion rate from about 8 years of data.

By using only the after dredging and before dredging surveys, the average sedimentation rate from one dredging episode to the next can be estimated (Figure 4.3-16). The average sedimentation rate between dredging episodes was estimated by calculating the change in sediment volume in the channel from the after dredging surveys to the before dredging surveys and dividing by the length of time between the surveys. The hydrosurvey data in the Redwood City Harbor Channel allowed for the estimation of five individual sedimentation rates ranging from about 159,000 $yd^3\ yr^{-1}$ to about 291,000 $yd^3\ yr^{-1}$. The five episodes of sediment accretion followed by dredging were used to calculate an average rate of sediment accretion of about 183,000 $yd^3\ yr^{-1}$ using about 8 years of data. The estimated sediment deposition within the channel from one dredging episode to the next was greater than the maximum uncertainty in the sediment volumes (described in Section 3.1), highlighting that the calculated rate of sediment accretion is robust with regard to uncertainty in the calculated channel sediment volumes (Figure 4.3-17). The short 176-day accretion rate calculated in 2012 during a winter to spring time period potentially indicates the sediment deposition in the Redwood City Harbor Channel is not constant throughout the year, but rather experiences periods of relatively higher sedimentation either seasonally or in response to storm events. The estimated 183,000 $yd^3\ yr^{-1}$ sedimentation rate based on the hydrosurvey data agreed with an independent estimate of 180,000 $yd^3\ yr^{-1}$ that was made using dredging information from 1993 through 2009 provided by USACE.

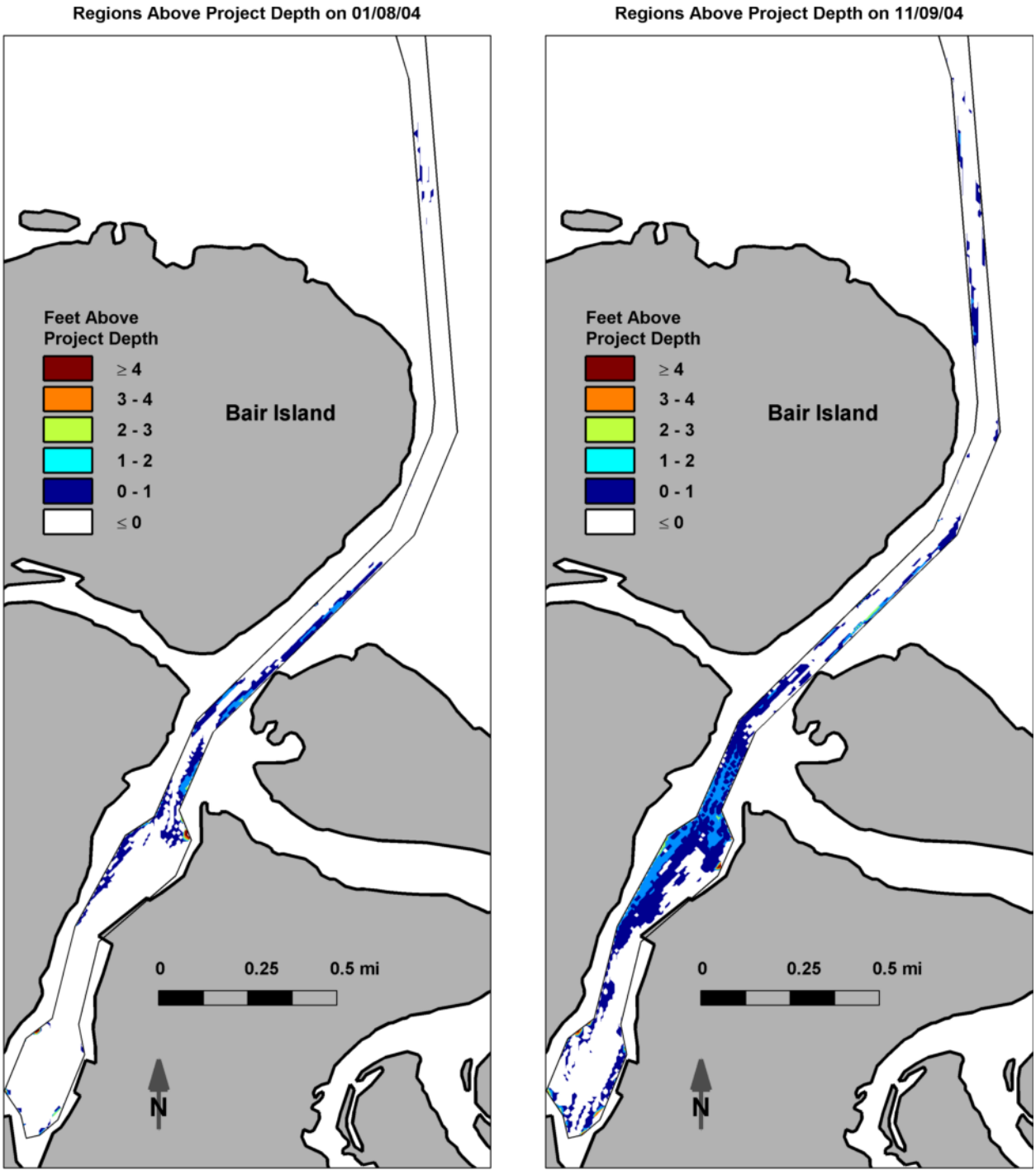


Figure 4.3-1
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on January 8, 2004, and November 9, 2004. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

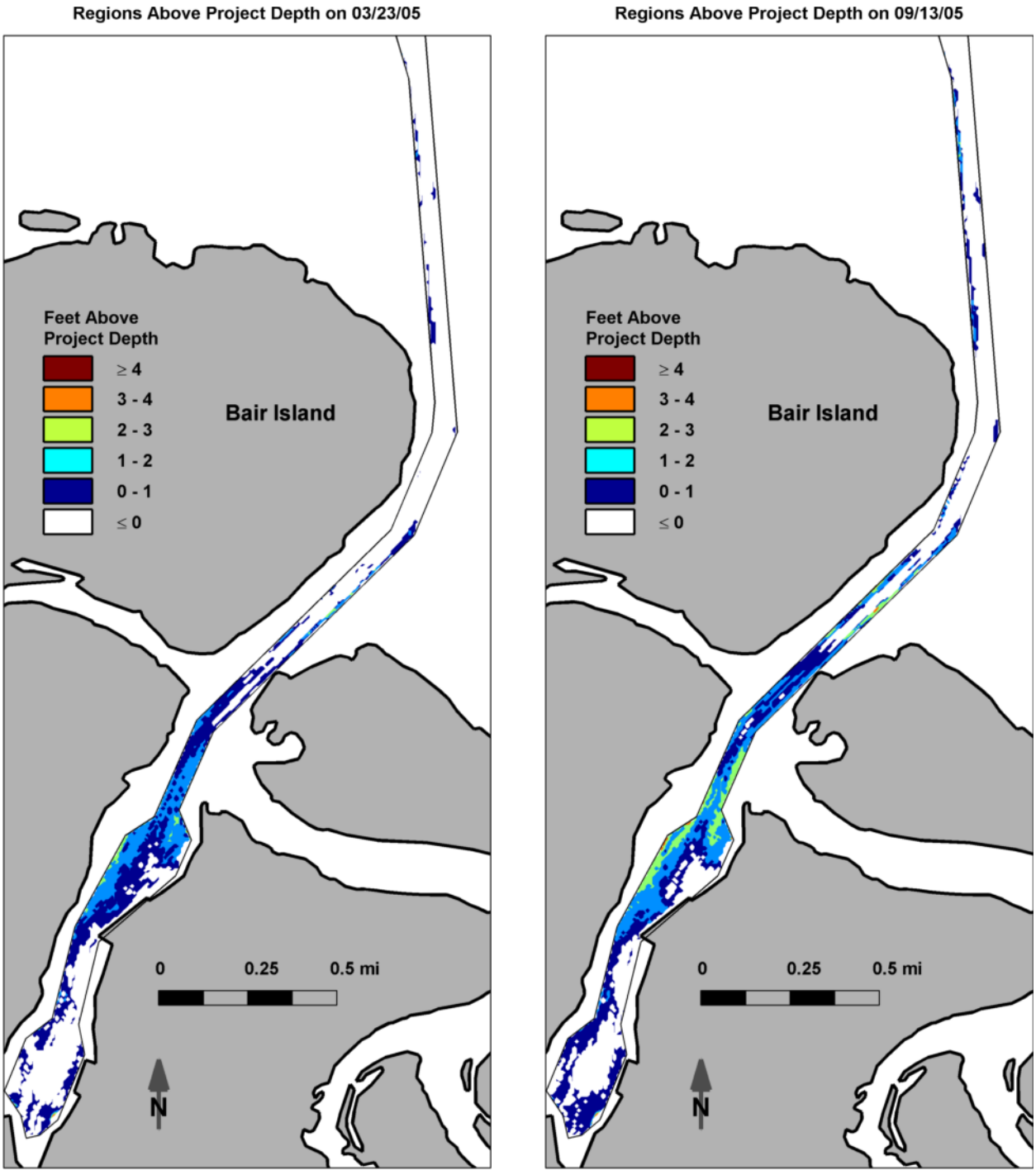


Figure 4.3-2
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on March 23, 2005, and September, 13 2005. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

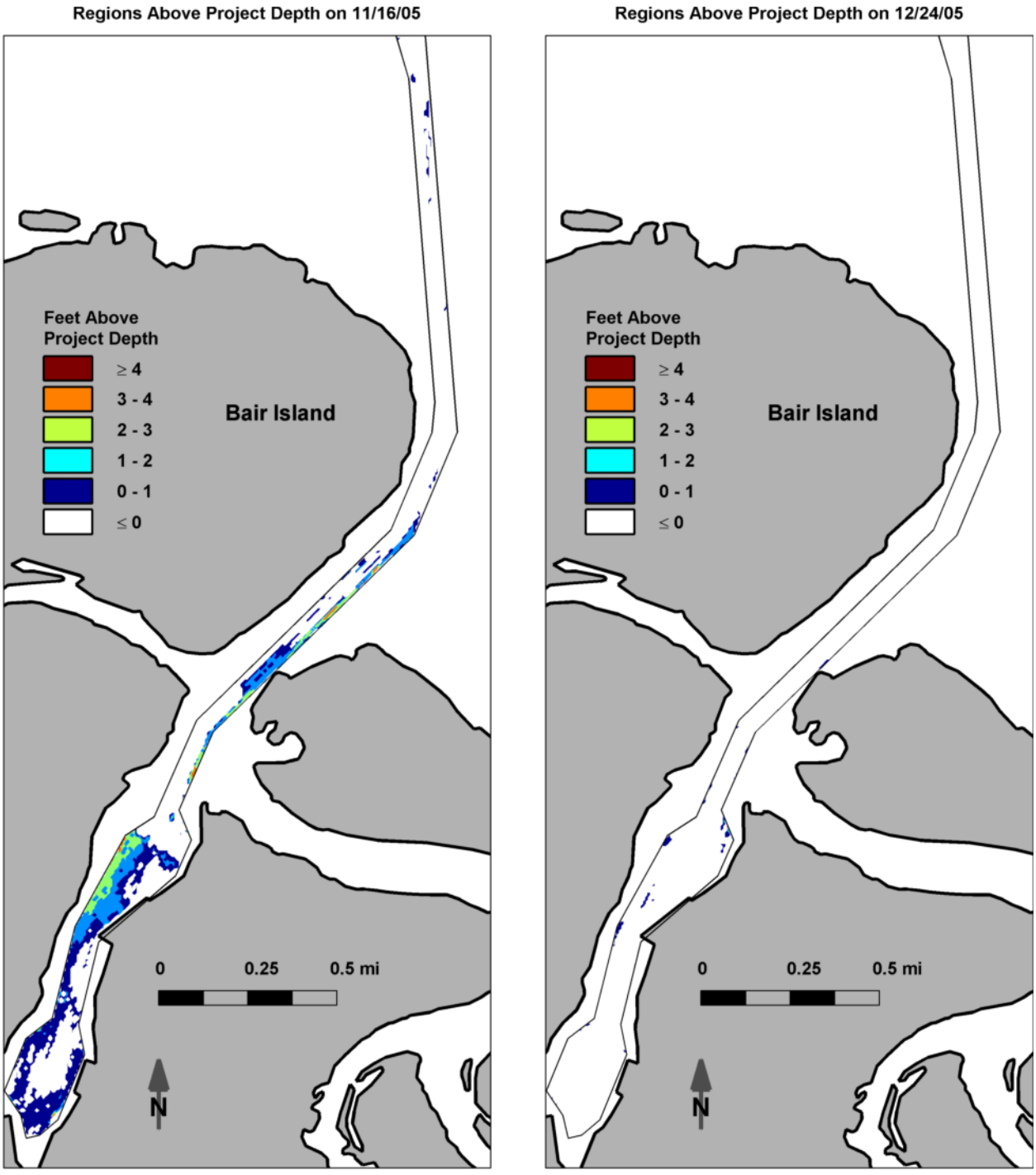


Figure 4.3-3
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on November 16, 2005 and December 24, 2005. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

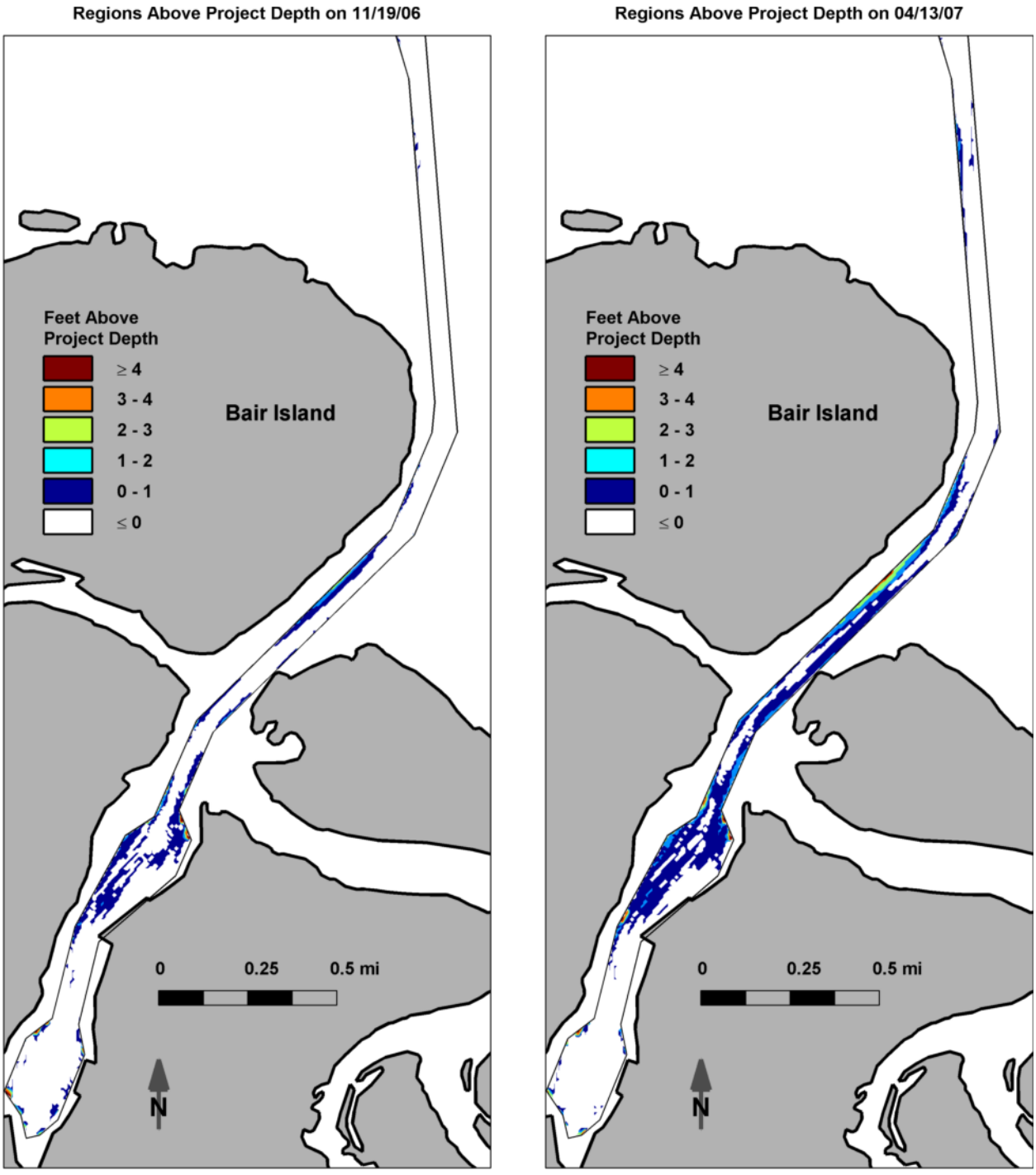


Figure 4.3-4
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on November 19, 2006, and April 13, 2007. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

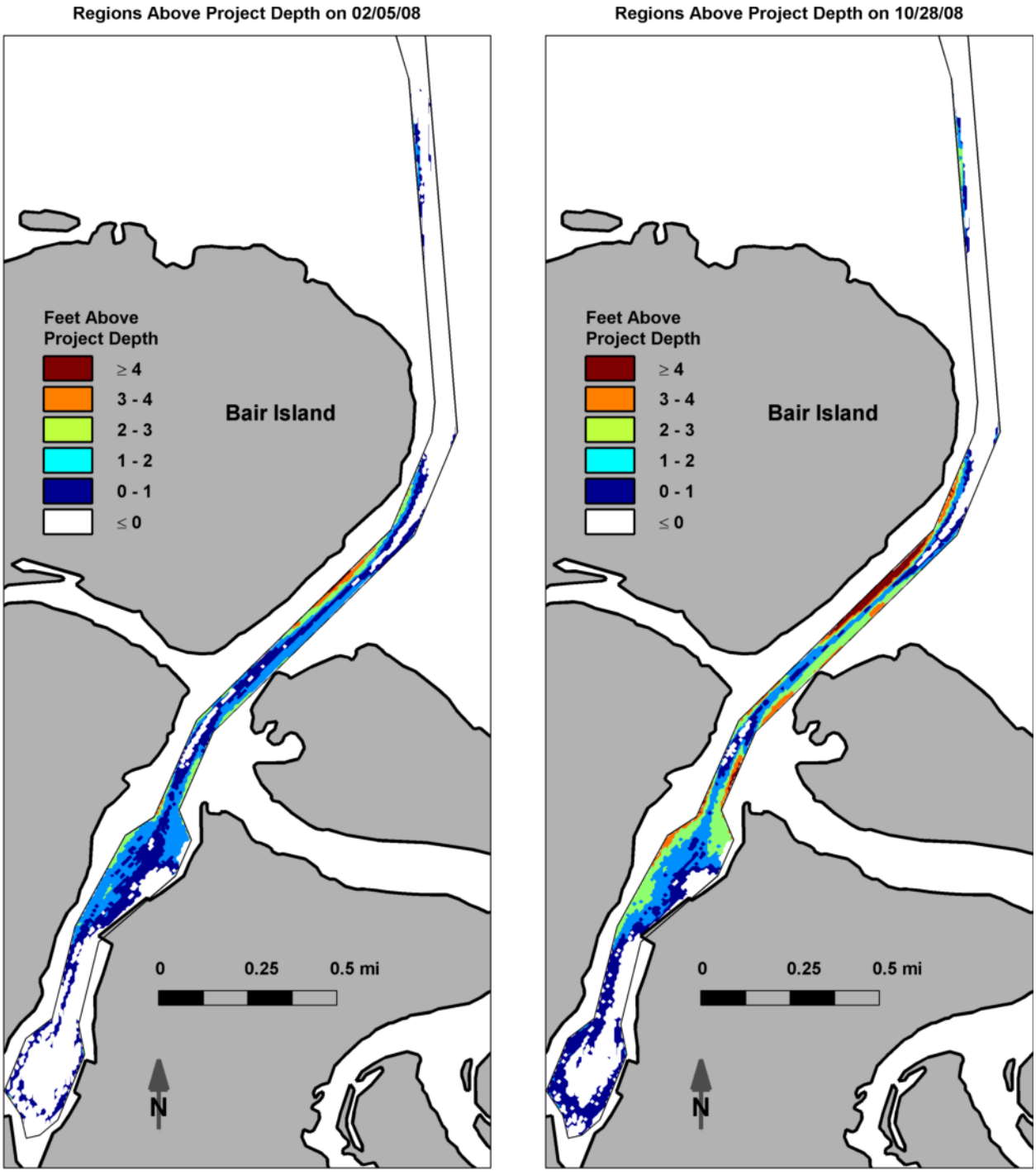


Figure 4.3-5
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on February 5, 2008, and October 28, 2008. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

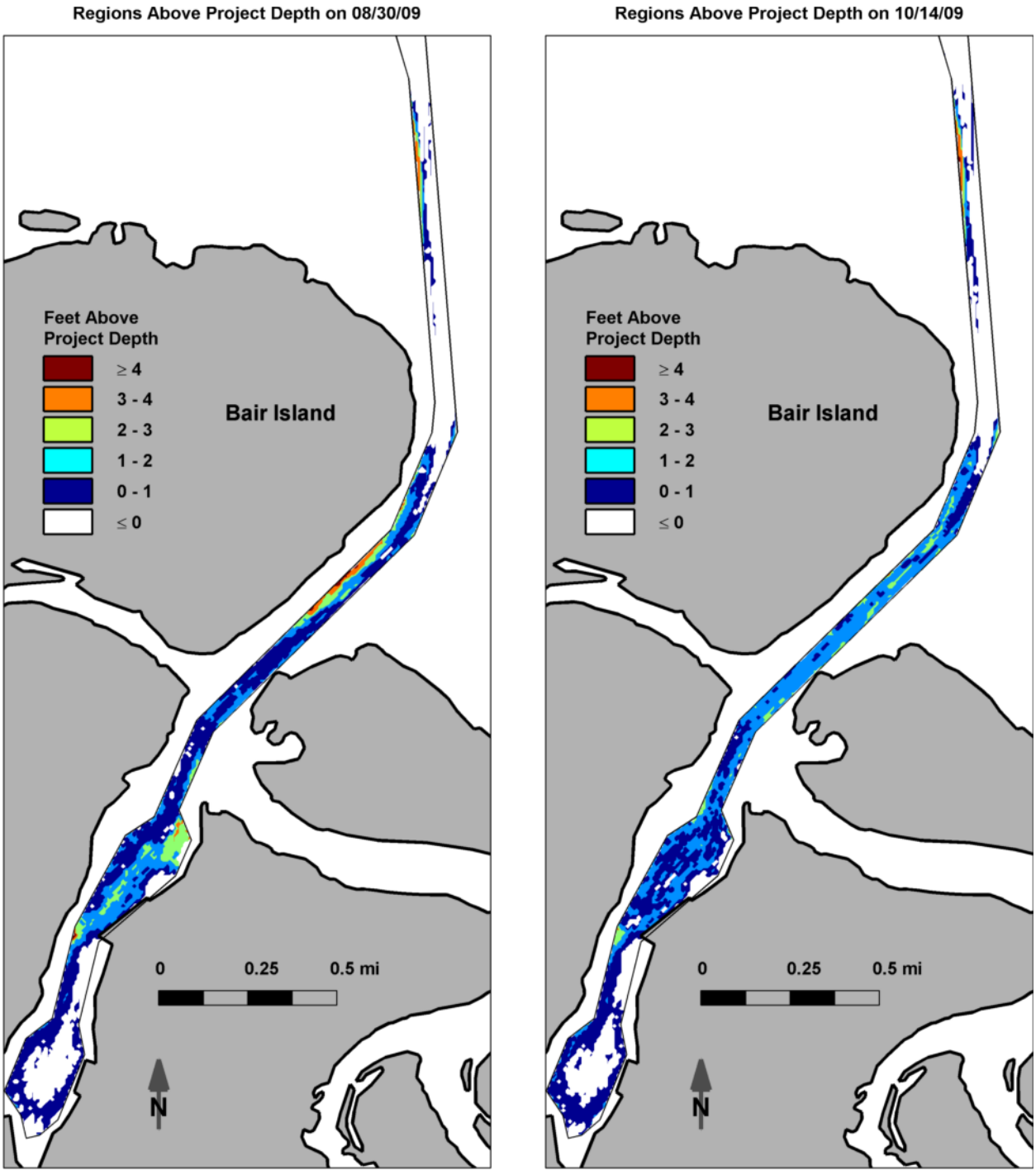


Figure 4.3-6
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on August 30, 2009, and October 14, 2009. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

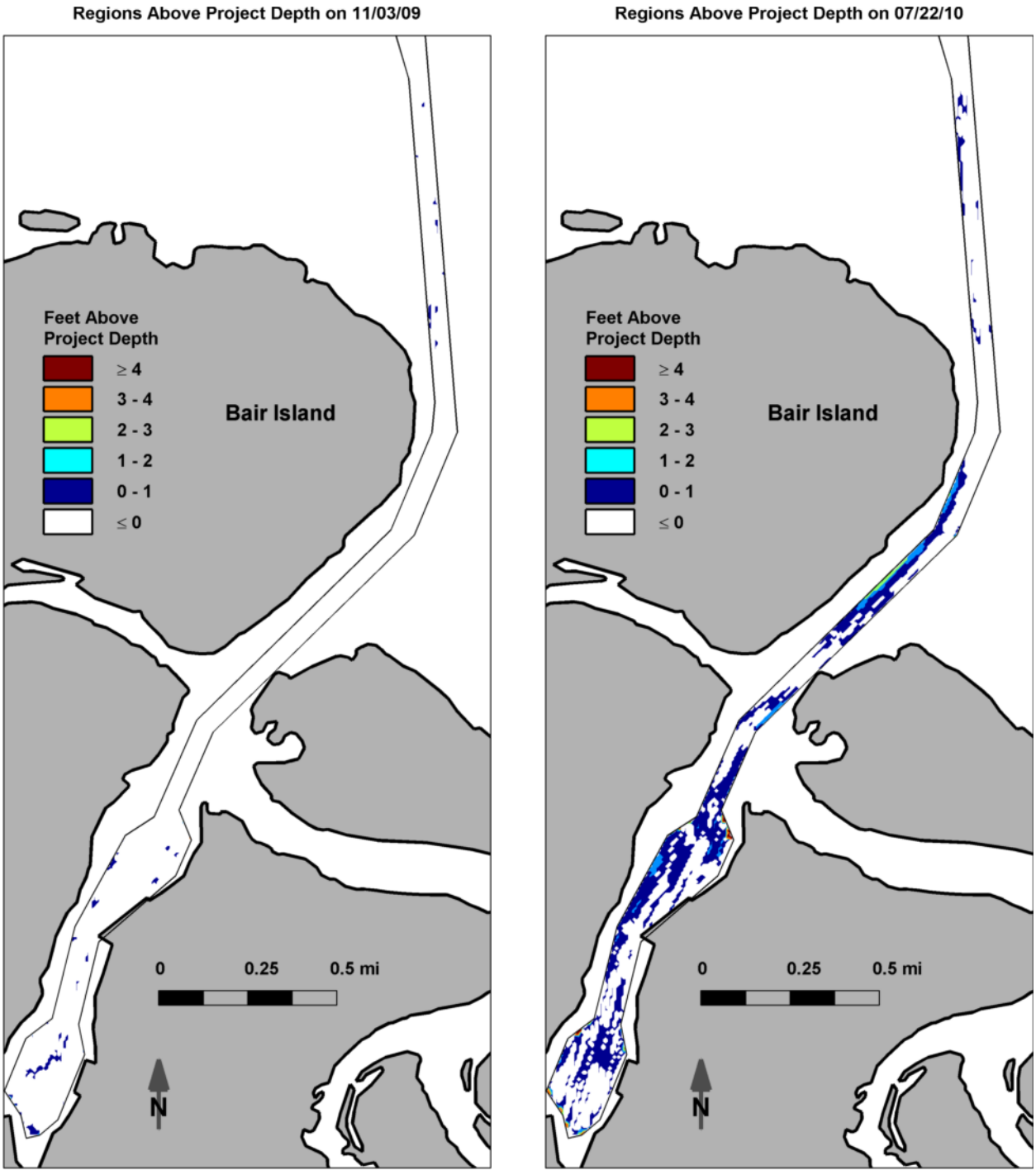


Figure 4.3-7

The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on November 3, 2009 and July 22, 2010. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

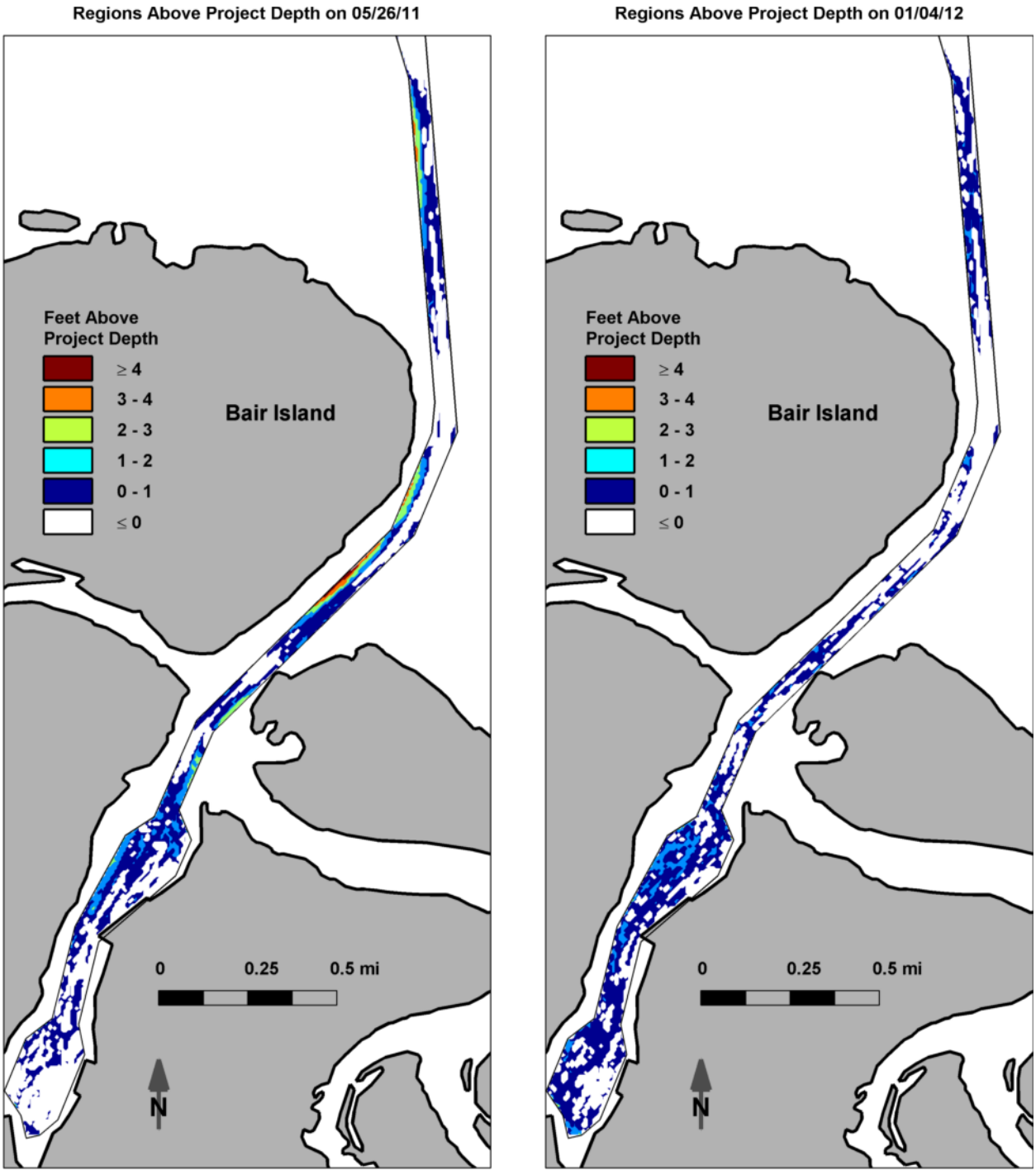


Figure 4.3-8.
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on May 26, 2011, and January 4, 2012. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

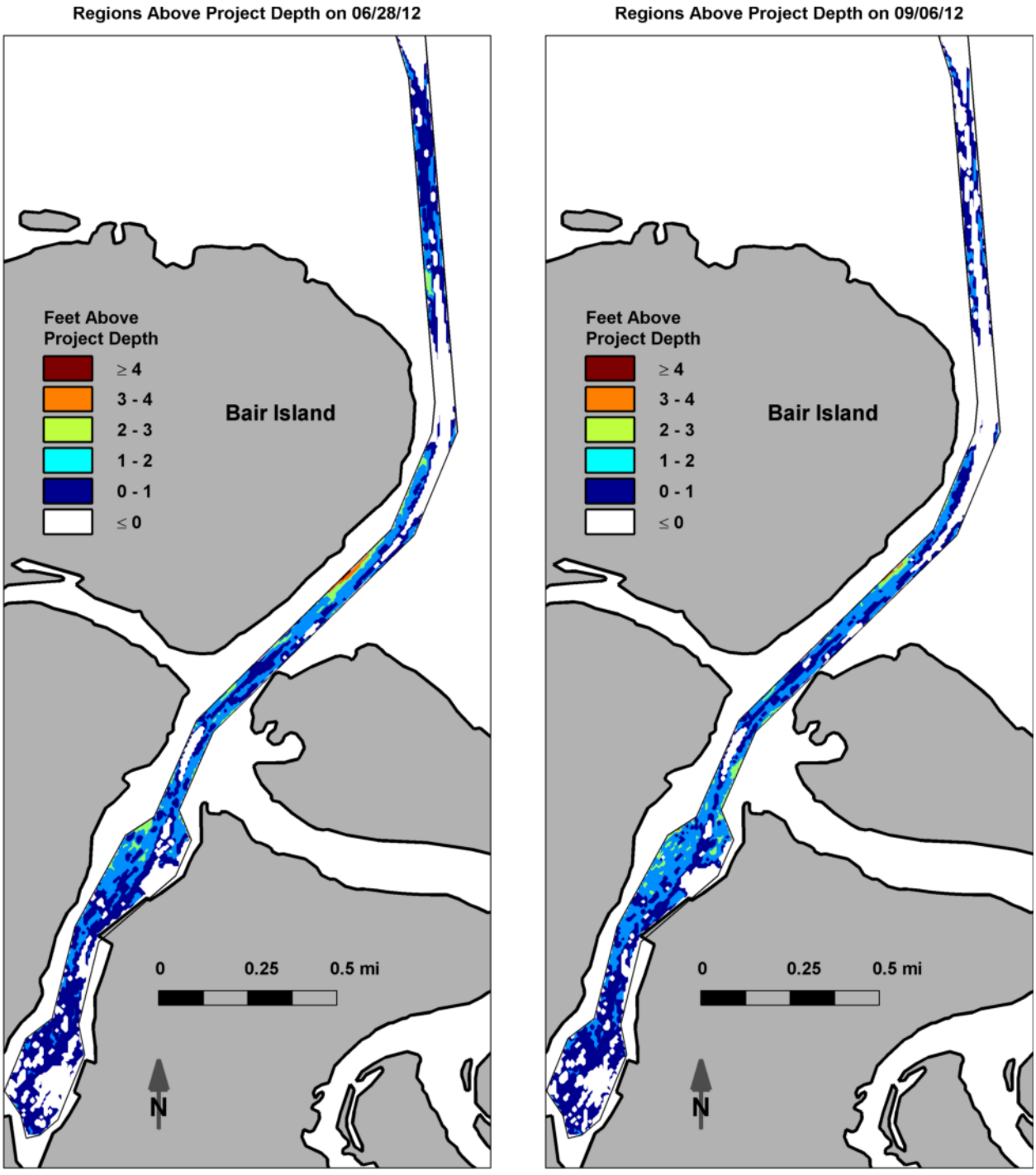


Figure 4.3-9
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on July 28, 2012, and September 6, 2012. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

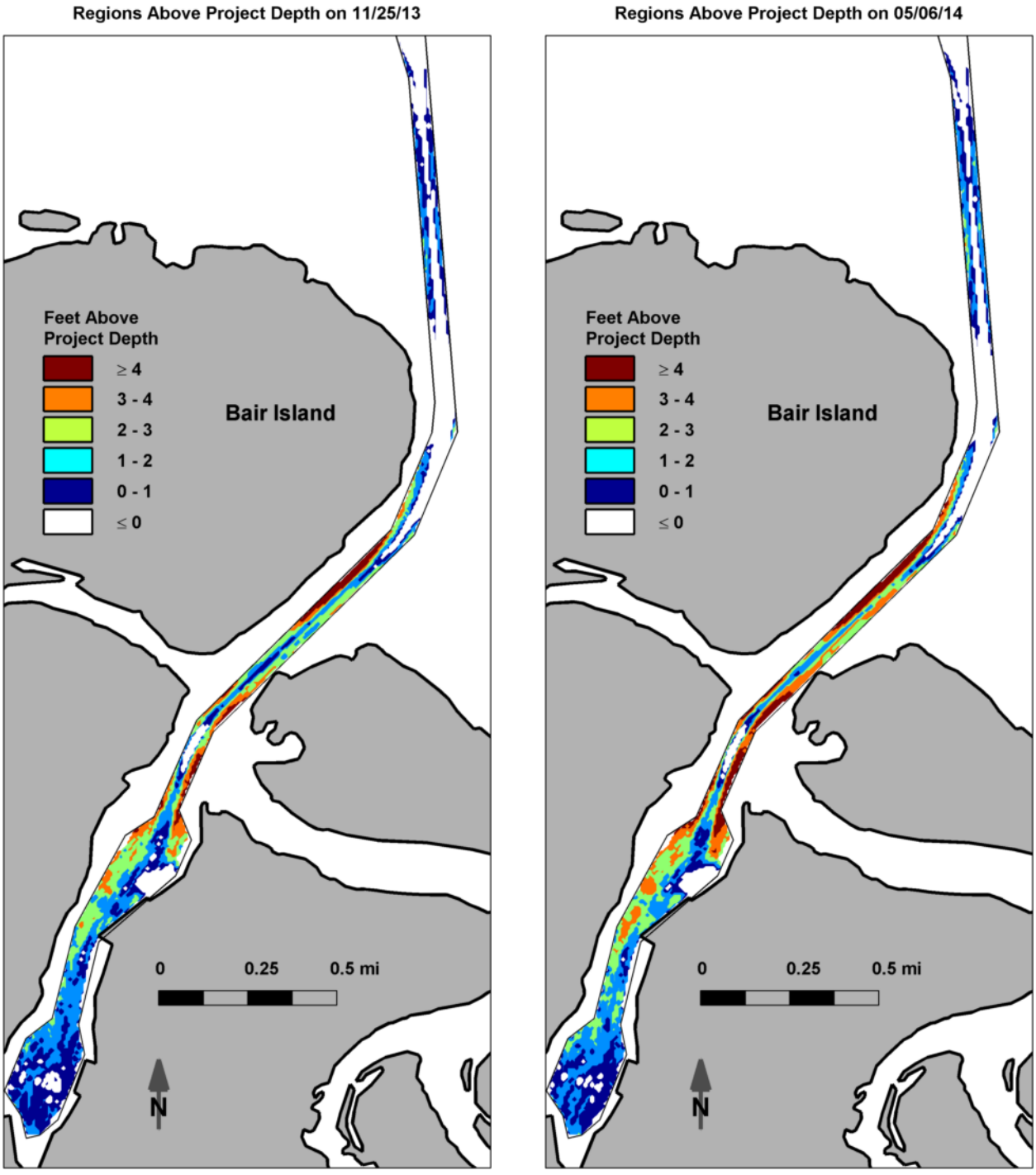


Figure 4.3-10
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on November 25, 2013, and May 6, 2014. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

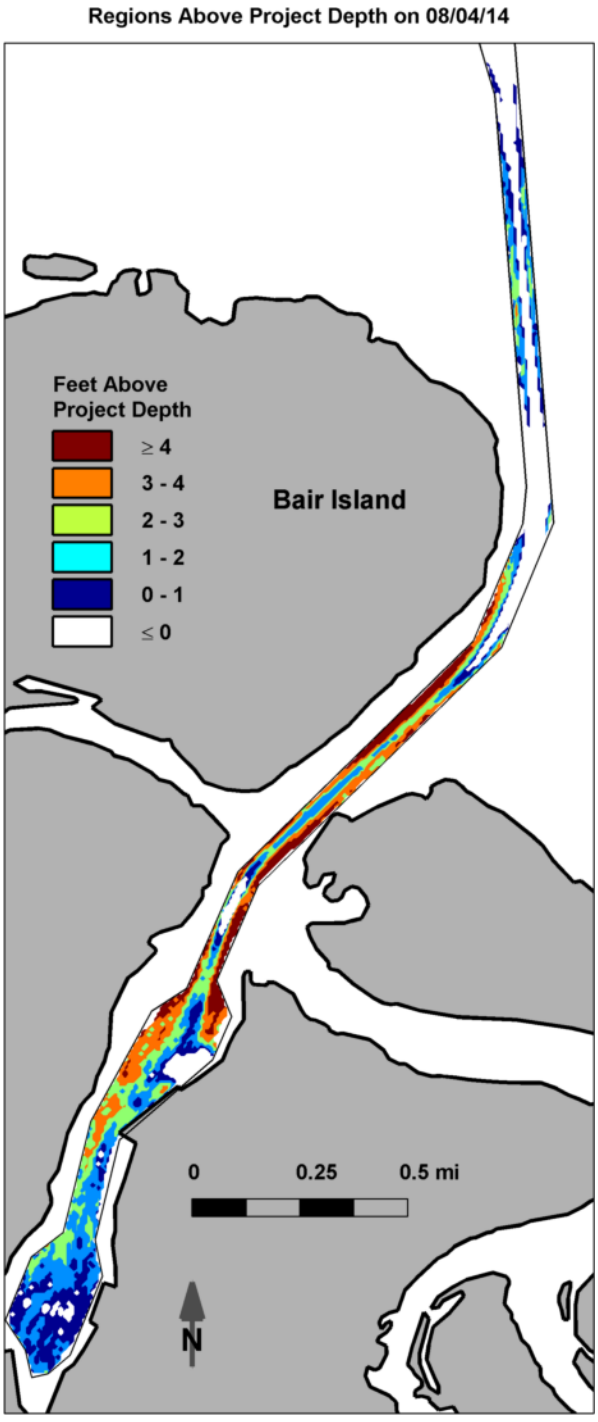


Figure 4.3-11
The regions above the Redwood City Harbor Channel project depth for five different heights above the project depth on August 4, 2014. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white.

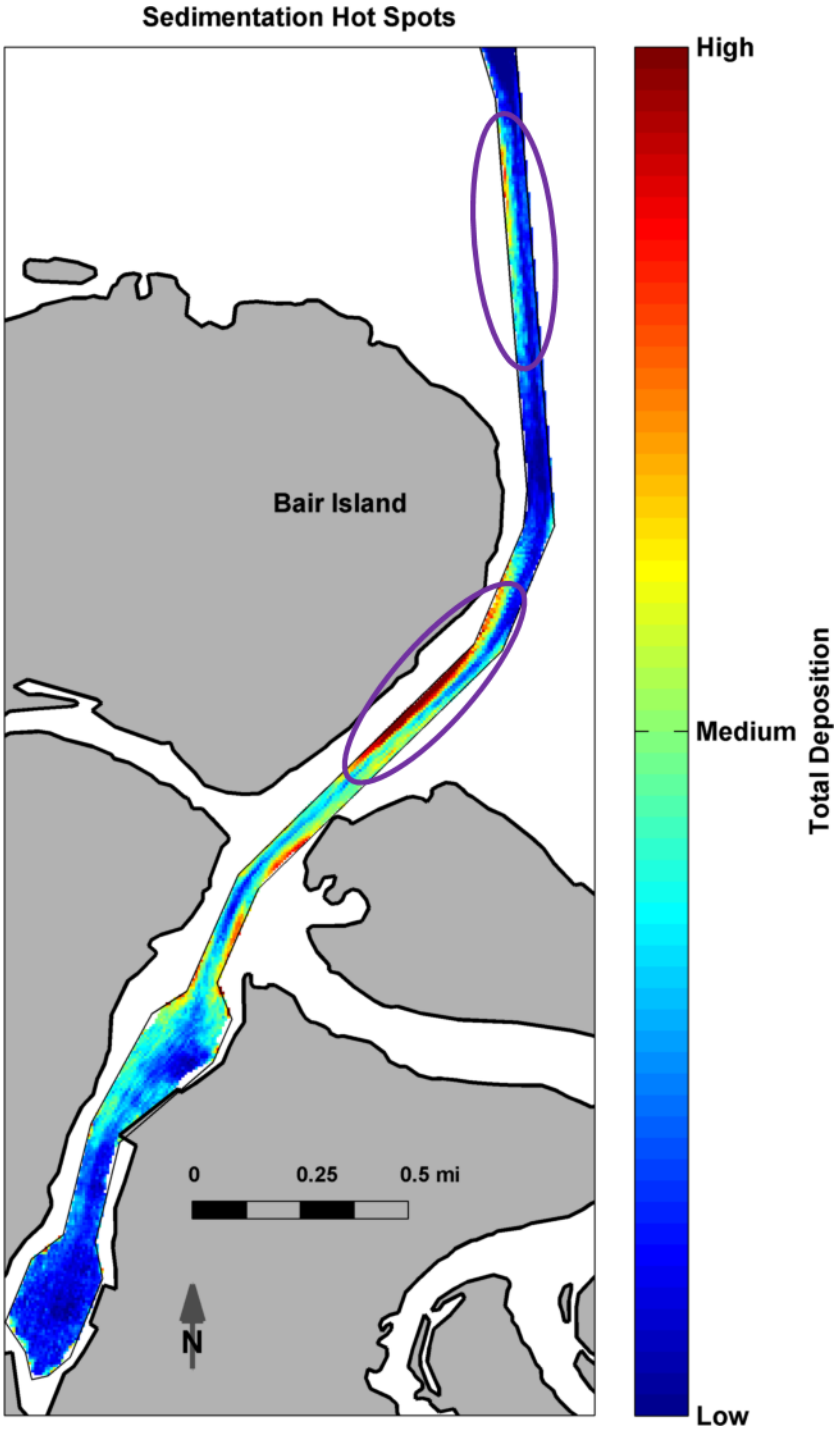


Figure 4.3-12
The relative sedimentation throughout the Redwood City Harbor Channel. Regions of relatively high sedimentation are indicative of areas experiencing a relatively high amount of shoaling. The predicted hot spots for sediment deposition in the channel are circled.

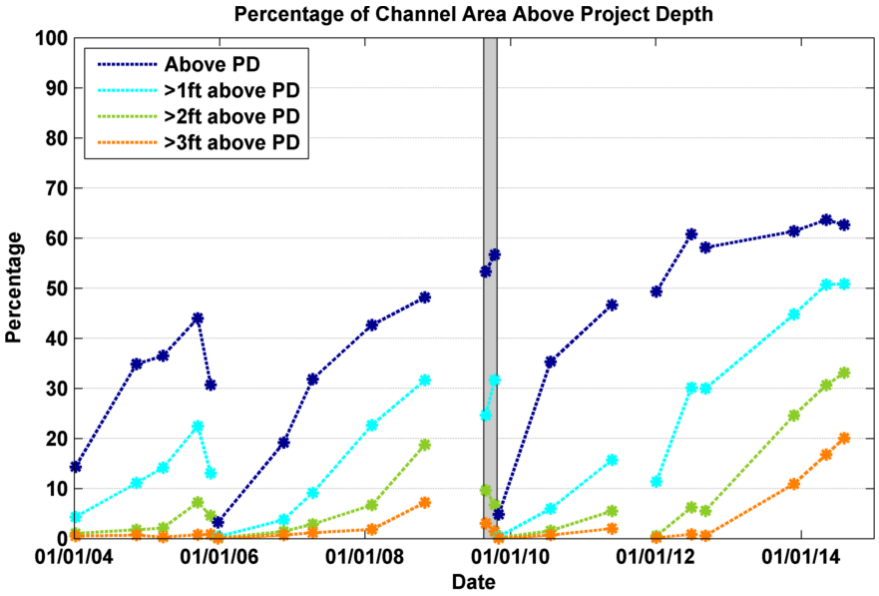


Figure 4.3-13
The percentage of the Redwood City Harbor Channel above the project depth for four different height ranges (stars). Dashed lines show an assumed linear trend between the surveys. Breaks in the lines are due to periods of dredging. The large reduction in area above project depth in late 2005 is shown because a full survey was conducted midway through dredging. Shading highlights a knockdown event.

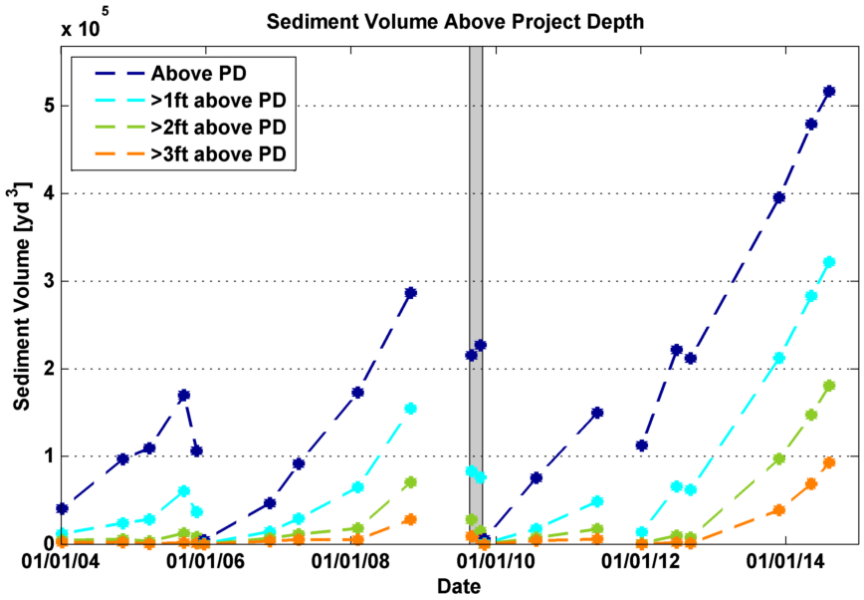


Figure 4.3-14
The volume of sediment above the Redwood City Harbor Channel project depth for four different height ranges (stars). Dashed lines show an assumed linear trend between the surveys. Breaks in the lines are due to periods of dredging. The large reduction in volume above project depth in late 2005 is shown because a full survey was conducted midway through dredging. Shading highlights a knockdown event.

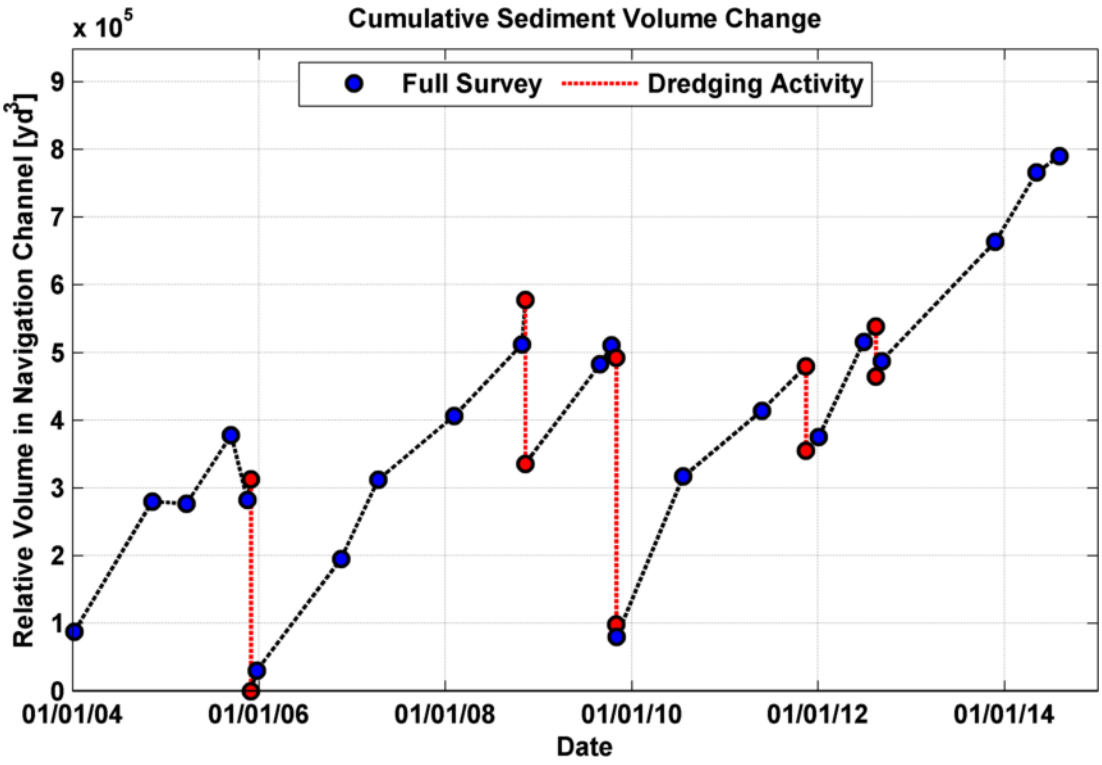


Figure 4.3-15
Relative sediment volume through time in the Redwood City Harbor Channel highlighting the change in the sediment volume through time due to accretion and dredging. Sediment volume in the channel is zeroed at the lowest sediment volume and is calculated using only the full surveys. As such the sediment volume in the channel is relative to after dredging in the late fall of 2005. Dark blue dots show the relative sediment volume in the channel calculated from the full surveys of the channel and are connected by an assumed linear sediment deposition trend between surveys (black dotted lines). Red dots show inferred approximate sediment volumes before and after dredging. The vertical red lines are the reported dredge volumes.

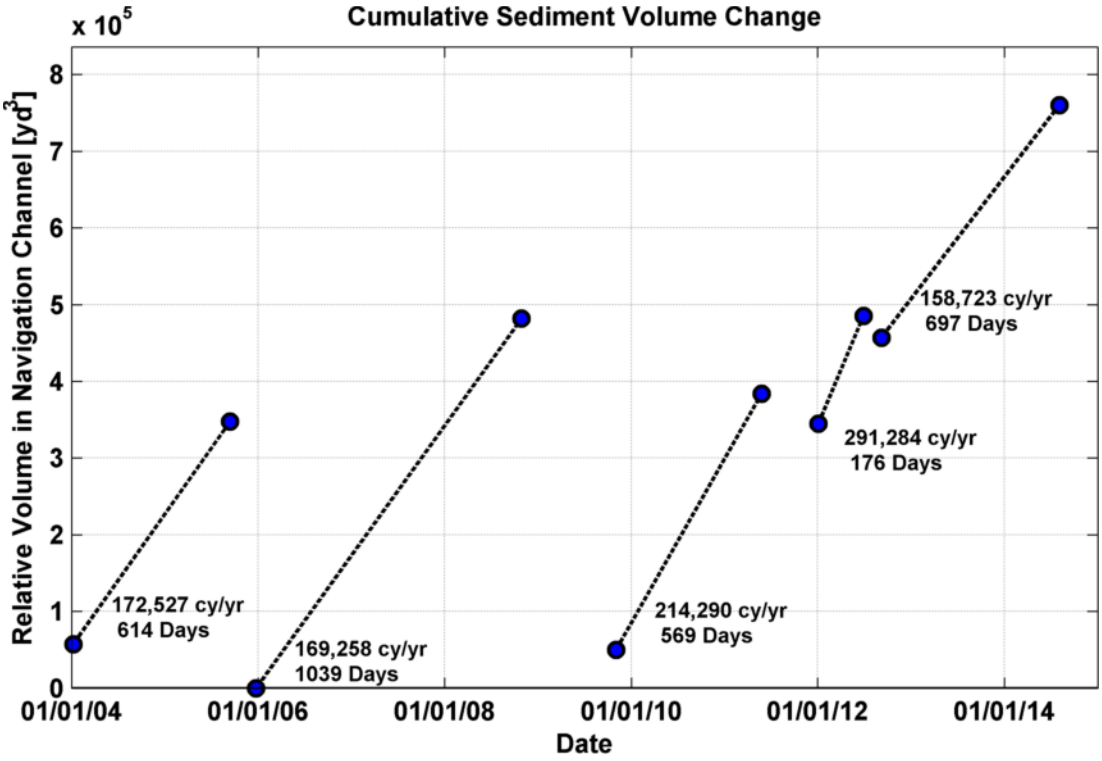


Figure 4.3-16.
Relative sediment volume through time in the Redwood City Harbor Channel highlighting the change in the sediment volume through time due to accretion and dredging. Sediment volume in the channel is zeroed at the lowest sediment volume and is calculated using only the full surveys. As such, the sediment volume in the channel is relative to post dredging in the late fall of 2005. Dark blue dots show the relative sediment volume in the channel calculated from the full surveys of the channel and are connected by an assumed linear sediment deposition trend (black dotted lines). Only time periods with surveys following and then preceding dredging are shown. The text labels show the average sedimentation rates and the length of time of each depositional episode.

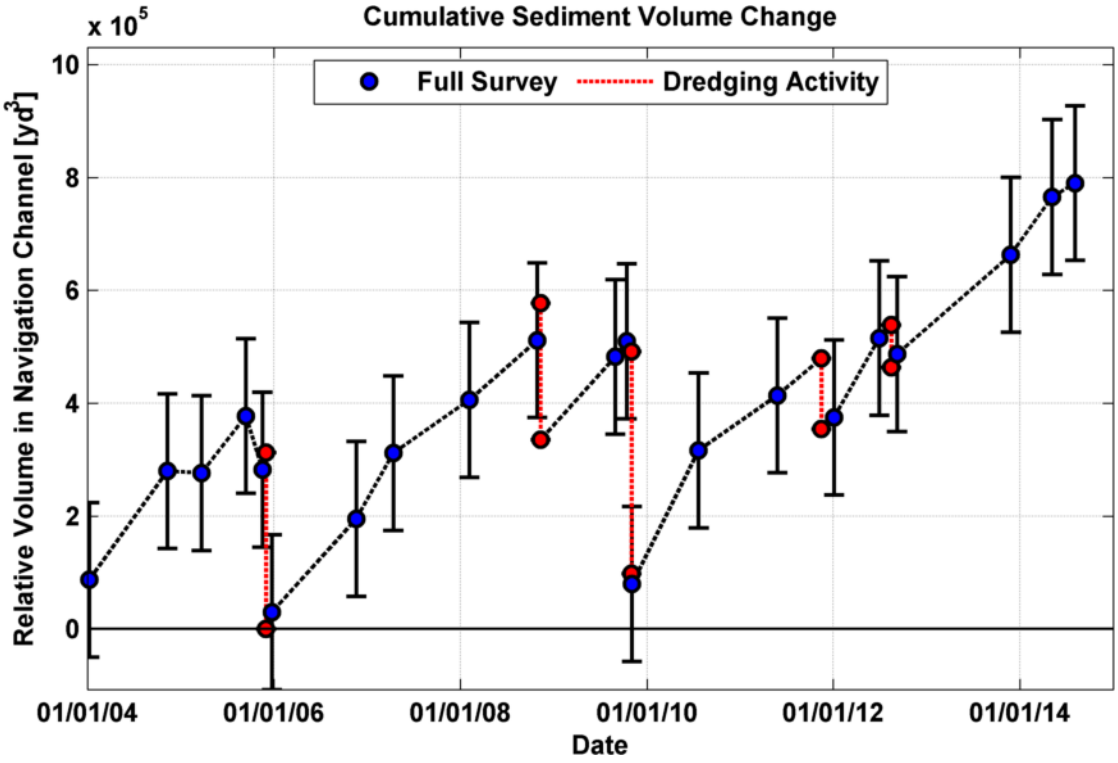


Figure 4.3-17
Relative sediment volume through time in the Redwood City Harbor Channel highlighting the change in the sediment volume through time due to accretion and dredging. Sediment volume in the channel is zeroed at the lowest sediment volume and is calculated using only the full surveys. As such, the sediment volume in the channel is relative to after dredging in the late fall of 2005. Dark blue dots show the relative sediment volume in the channel calculated from the full surveys of the channel and are connected by an assumed linear sediment deposition trend between surveys (black dotted lines). Red dots show inferred approximate sediment volumes before and after dredging. The vertical red lines are the reported dredge volumes. Error bars denote the maximum estimate of uncertainty in the sediment volume calculations from the hydrographic surveys (about ±137,000 yd^3, Section 4.3.1).

4.3.3 San Bruno Shoal Channel

The hydrographic surveys show the San Bruno Shoal Channel rarely aggraded above the project depth over the period when hydrosurvey data were available between July 2002 and April 2014. Figure 4.3-18 highlights surveys on October 15, 2005, when the largest volume of sediment was above the project depth (30 feet MLLW) and November 20, 2006, following a targeted dredging episode that returned the channel to below the project depth. Less than 3.5% of the channel area was above the authorized project depth during the analysis period

(Figure 4.3-19), and less than 16,000 yd^3 of sediment was above the project depth (Figure 4.3-20).

Figure 4.3-21 highlights the sediment volume change in the San Bruno Shoal Channel from July 2002 to April 2014. Only a single and relatively small dredging episode occurred during this time period (Patrick Sing, USACE, Pers. Comm., 2013). The 2002 through 2014 time period shows both periods of net erosion from the channel and periods of sediment accretion. All of the sediment volumes within the channel are within the maximum potential error of nearly every other survey, limiting the applicability of calculating net sediment accretion or erosion rates. Because of this, and the lack of a clear trend in the relative sediment volume in the channel, accretion rates have not been calculated for the San Bruno Shoal Channel.

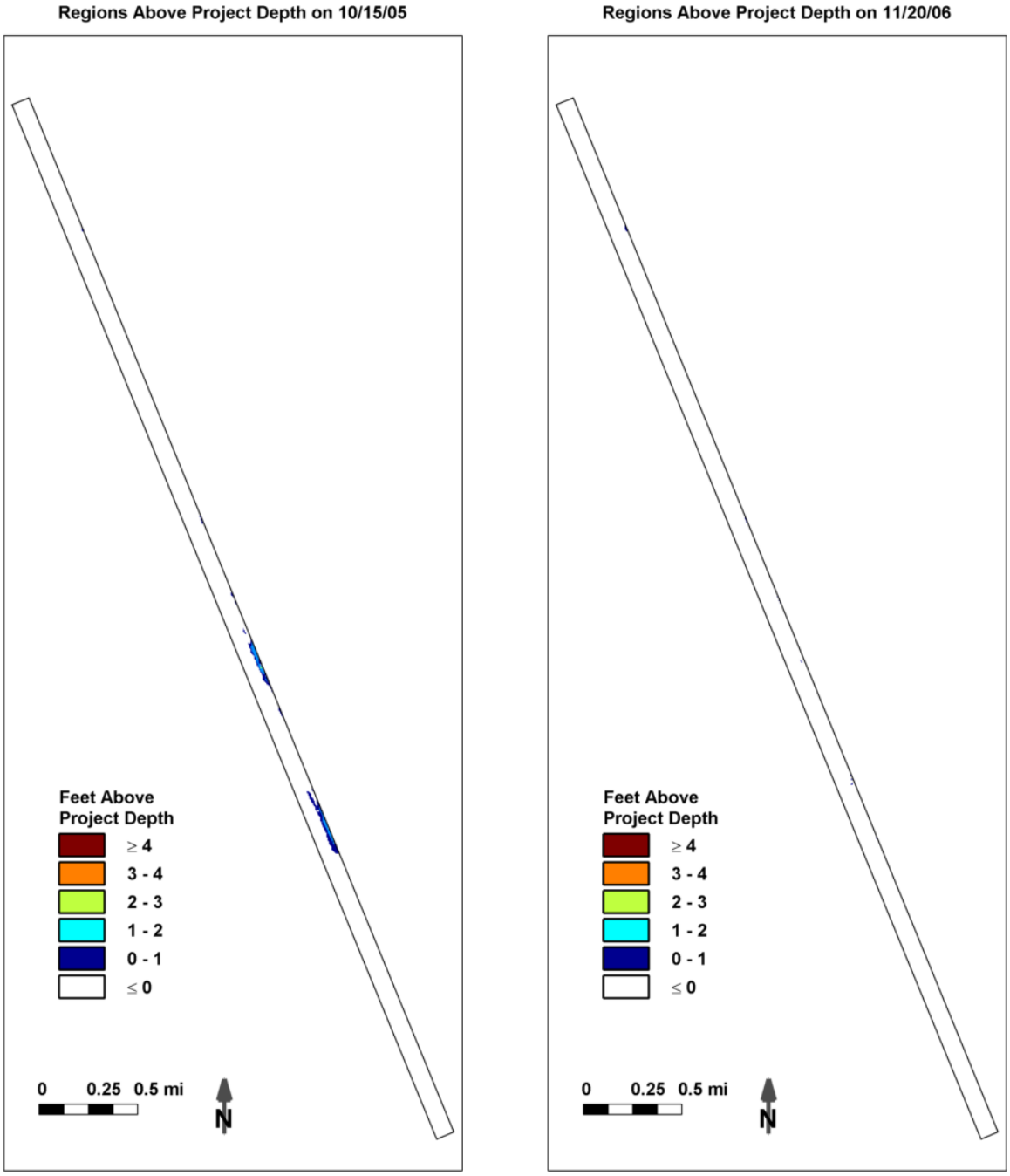


Figure 4.3-18
The regions above the San Bruno Shoal Channel project depth for five different heights above the project depth on about November 15 2005, and November 20, 2006. The outline of the authorized navigation channel is shown as the thin black line. Regions in the channel below project depth are colored white. Dredging was conducted between the dates of these surveys.

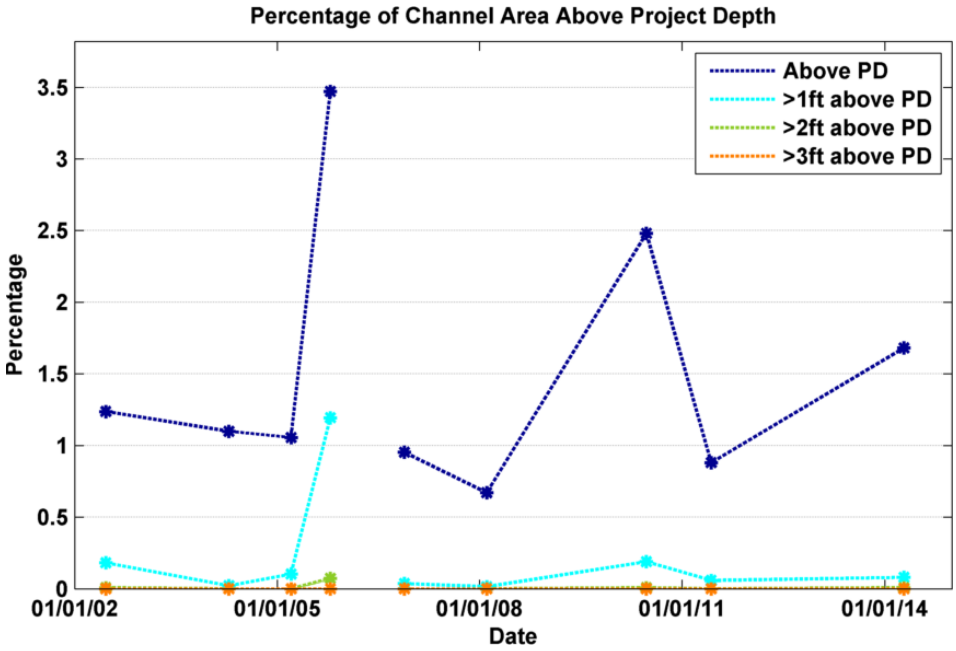


Figure 4.3-19
The percentage of the area of the San Bruno Shoal Channel above the authorized project depth for four different height ranges (stars). Dashed lines show an assumed linear trend between the surveys. The break in the lines is due to a dredging episode.

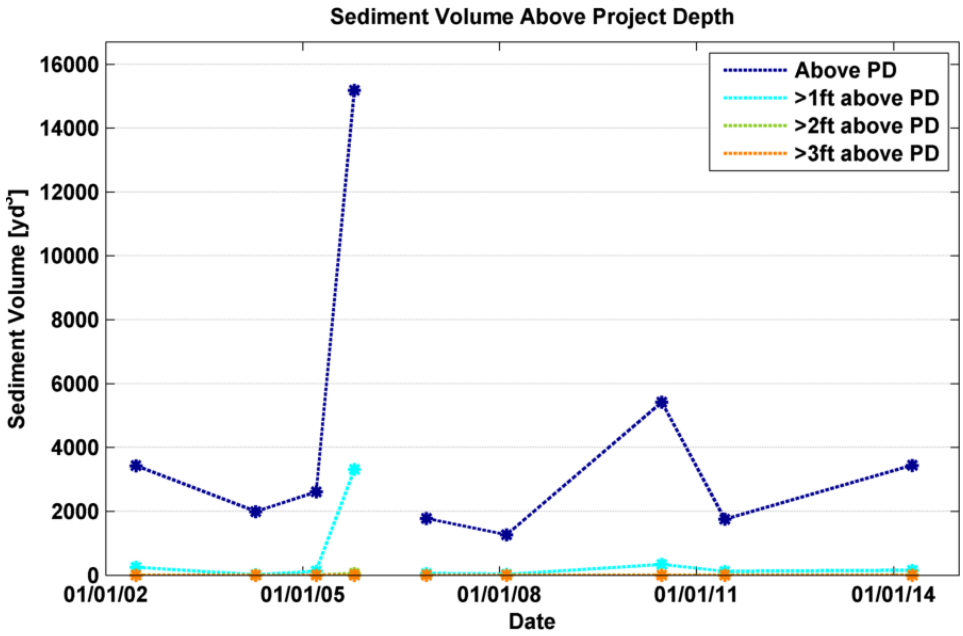


Figure 4.3-20
The volume of sediment above the San Bruno Shoal Channel authorized project depth for four different height ranges (stars). Dashed lines show an assumed linear trend between the surveys. The break in the lines is due to a dredging episode.

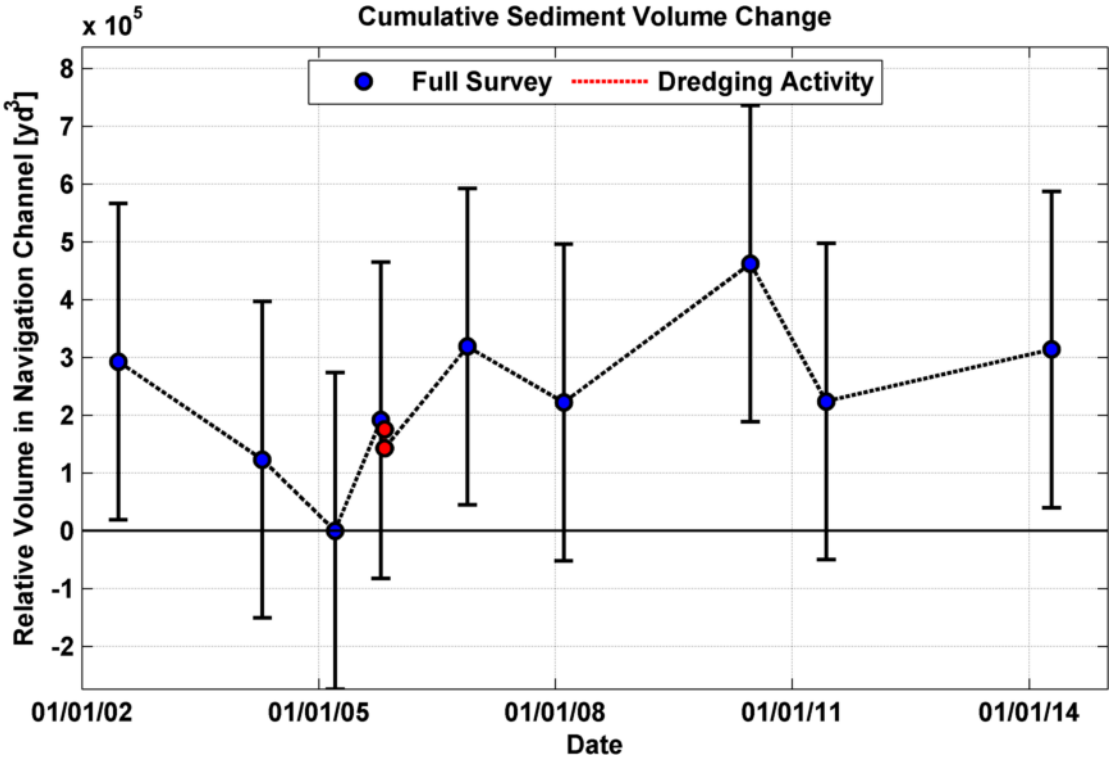


Figure 4.3-21
Relative sediment volume through time in the San Bruno Shoal Channel highlighting the change in the sediment volume through time due to accretion, erosion and dredging. Sediment volume in the channel is zeroed at the lowest sediment volume and is calculated using only the full surveys. As such the sediment volume in the channel is relative to March 17, 2005. Dark blue dots show the relative sediment volume in the channel calculated from the full surveys of the channel and are connected by an assumed linear sediment deposition trend (black dotted lines). Red dots show inferred approximate sediment volumes before and after dredging. Error bars denote the maximum estimate of uncertainty in the sediment volume calculations from the hydrographic surveys (about ±276,000 yd^3, Section 4.3.1).

4.4 Hydrographic Survey Data Conclusions

Regular bathymetric surveys of the Redwood City Harbor Channel were used to calculate an average sediment accretion rate of about 183,000 yd^3 yr^{-1} using 8 years of data. The short 176 day accretion rate calculated in 2012 during a winter to spring time period potentially indicates the sediment deposition in the Redwood City Harbor Channel is not constant throughout the year, but rather experiences periods of relatively higher sedimentation either seasonally or in response to storm events. The estimated 183,000 yd^3 yr^{-1} sedimentation rate based on the hydrosurvey data agreed with an independent estimate of 180,000 yd^3 yr^{-1} made

using dredging information from 1993 through 2009 provided by USACE. Two hot spots within the channel were identified, both on the western side of the channel, one southeast of Bair Island and another on the north/south section of the channel. These hot spots are potential candidates for advanced maintenance dredging or channel realignment to reduce the above grade shoaling problems in those areas.

The hydrographic surveys of the San Bruno Shoal Channel suggested that historically the channel has not had a consistent rate of sediment accretion, but rather both periods of sediment accretion and erosion that have led to relatively little long-term net change of sediment volume in the channel.

5 VALIDATION OF THE MODELED SEDIMENT TRANSPORT IN CENTRAL BAY AND SOUTH BAY

The model predictions of sediment transport in Central Bay and South Bay surrounding the study region were validated using observed suspended sediment concentration, sediment deposition volume in the Redwood City Harbor Channel and San Bruno Shoal Channel derived from hydrosurvey data (Section 4), sediment deposition thickness in the channels, and the area of the channel above project depth. Validation of the suspended sediment concentration throughout Central Bay and South Bay was used to show that the model generally predicted the regional suspended sediment concentrations around the study area, while the deposition in the Redwood City Harbor Channel was used to demonstrate that the model was suitable for predicting sediment deposition volumes in the channel and general locations where the deposition occurred. Previous studies have compared suspended sediment concentration predicted by the UnTRIM Bay Delta model to data throughout the San Francisco Bay-Delta system (Bever and MacWilliams 2013, 2014; Delta Modeling Associates 2015), and as such this section is limited to an abbreviated suspended sediment validation. Validation of the water level in the Central Bay and South Bay is presented in Appendix C. In this report, the term "validation" is used to mean determining if the model satisfactorily reproduced observed data, while a model calibration refers to the parameters within the model and the act of improving the model predictions through changing the parameters within the model or the boundary conditions. For example, if a model validation showed that the model was not satisfactorily predicting a set of observations, the model could be calibrated by adjusting the boundary conditions or sediment characteristics until the predictions were within a threshold that indicated the predictions were satisfactory.

Because the calibration and validation of the UnTRIM Bay-Delta model has already been well-documented in previous studies (e.g., MacWilliams et al. 2007, 2008, 2009, 2015; Bever and MacWilliams 2014; Delta Modeling Associates 2015) only a short validation of the model predictions of suspended sediment concentration at the two closest continuous monitoring stations to the focus region and of sediment deposition within the Redwood City Harbor Channel and the San Bruno Shoal Channel are included in this report (Section 5).

5.1 Validation Simulations

5.1.1 Grid Refinement in the Vicinity of the Navigation Channels

The Redwood City Harbor and San Bruno Shoal regions of the UnTRIM Bay-Delta model grid were refined to directly resolve the two navigation channels (Figure 5.1-1). With the grid refinement the grid cells in the Central Bay are about 200 by 250 meters, the cells in the San Bruno Shoal Channel were about 150 by 400 meters, and the cells in the Redwood City Harbor Channel near the Redwood City Harbor were refined to about 25 by 40 meters. The model grid included the eastern portion of Bair Island that was open to tidal flow and Corkscrew, Steinberger, Smith, and Westpoint Sloughs. The model grid also encompassed Outer, Middle, and Inner Bair Island, however these areas were not breached in either the 2006 or 2008 validation simulations.

5.1.2 Redwood Creek Inflow

Inflow data for Redwood Creek were available from a USGS gauging station (11162800) for the period from 1959 through 1997 (USGS 2014). However, flow data were not available for either 2006 or 2008. To estimate Redwood Creek inflows for 2006 and 2008, a scaling relationship was developed to relate the flow in Redwood Creek to the flow in San Francisquito Creek using the data available for the period between 1957 and 1997. The simple derived relationship indicated that the flow in Redwood Creek was 0.0487 times the flow in San Francisquito Creek (Figure 5.1-2). For the period from 1997 through 2014, an inflow hydrograph for Redwood Creek was developed using this scaling relationship and the observed flows in San Francisquito Creek (Figure 5.1-3). Measurements of sediment inflow from Redwood Creek were not available for any time periods, so it was not possible to develop a flow-based sediment rating for Redwood Creek. Because the magnitude of the sediment inflow was assumed to be small compared to the sediment supply to the Redwood City Harbor Channel from the South Bay, sediment inflow from Redwood Creek was not included in the simulations.

5.1.3 Validation Simulation Time Periods

Simulations of water years 2006 and 2008 were used to validate the sediment transport around the Redwood City Harbor Channel and San Bruno Shoal Channel. Water year 2006 was classified as a wet water year, and water year 2008 was classified as critical water year

(CDEC 2014). Thus the simulation of these two years allowed for model validation of sediment concentrations and shoaling rates for both wet and dry conditions.

5.1.4 Navigation Channel Bathymetry

The initial bathymetry in the Redwood City Harbor Channel for the 2006 simulation was set using hydrosurvey data from December 24, 2005 (Figure 5.1-4). The initial bathymetry in the Redwood City Harbor Channel for the 2008 simulation were set using hydrosurvey data from February 5, 2008 (Figure 5.1-4). The initial San Bruno Shoal Channel bathymetry for the 2006 simulation was set using hydrosurvey data from October 15, 2005, and the initial San Bruno Shoal Channel bathymetry for the 2008 simulation was set using hydrosurvey data from February 8, 2008 (Figure 5.1-5). The hydrosurvey data were converted from MLLW to the North American Vertical Datum of 1988 (NAVD88) for use in the UnTRIM Bay-Delta model using constant offsets of 1.13 feet provided by USACE for the Redwood City Harbor Channel and 0.46 foot for the San Bruno Shoal Channel.

5.1.5 Validation of Sedimentation in the Navigation Channels

Validation of the suspended sediment concentration spanned the 2006 and 2008 water years, from October 1 through September 30. Validation of sediment deposition in the Redwood City Harbor Channel spanned consecutive full hydrosurveys, with the predicted deposition during the 2006 simulation validated using the observed deposition between the hydrosurvey on December 24, 2005 and the subsequent hydrosurvey on November 19, 2006. Validation of the sediment deposition in the Redwood City Harbor Channel for the 2008 simulation spanned from the hydrosurvey on February 5, 2008, through the hydrosurvey on October 28, 2008. Predicted sediment deposition in the San Bruno Shoal Channel from the 2006 simulation was compared to the deposition derived for the period between the hydrosurveys on October 15, 2005, and November 20, 2006. A more qualitative sediment deposition comparison was performed for the 2008 simulation because consecutive hydrosurveys of the San Bruno Shoal Channel were not available for the 2008 period.

The model setup including the initial sediment bed, seabed grain fractions, and porosity were nearly identical to that used in previous modeling of sediment deposition in the Oakland Harbor Channel (Delta Modeling Associates 2015). Only the sediment bed fractions near

Dumbarton Bridge and in the far South Bay were modified from the previous modeling application. Maintaining the consistency of the model applications facilitates the comparison of results between the two projects and further demonstrates that the model is sufficiently accurate for predicting the relative change in sediment deposition in navigation channels under a wide range of channel and environmental conditions.

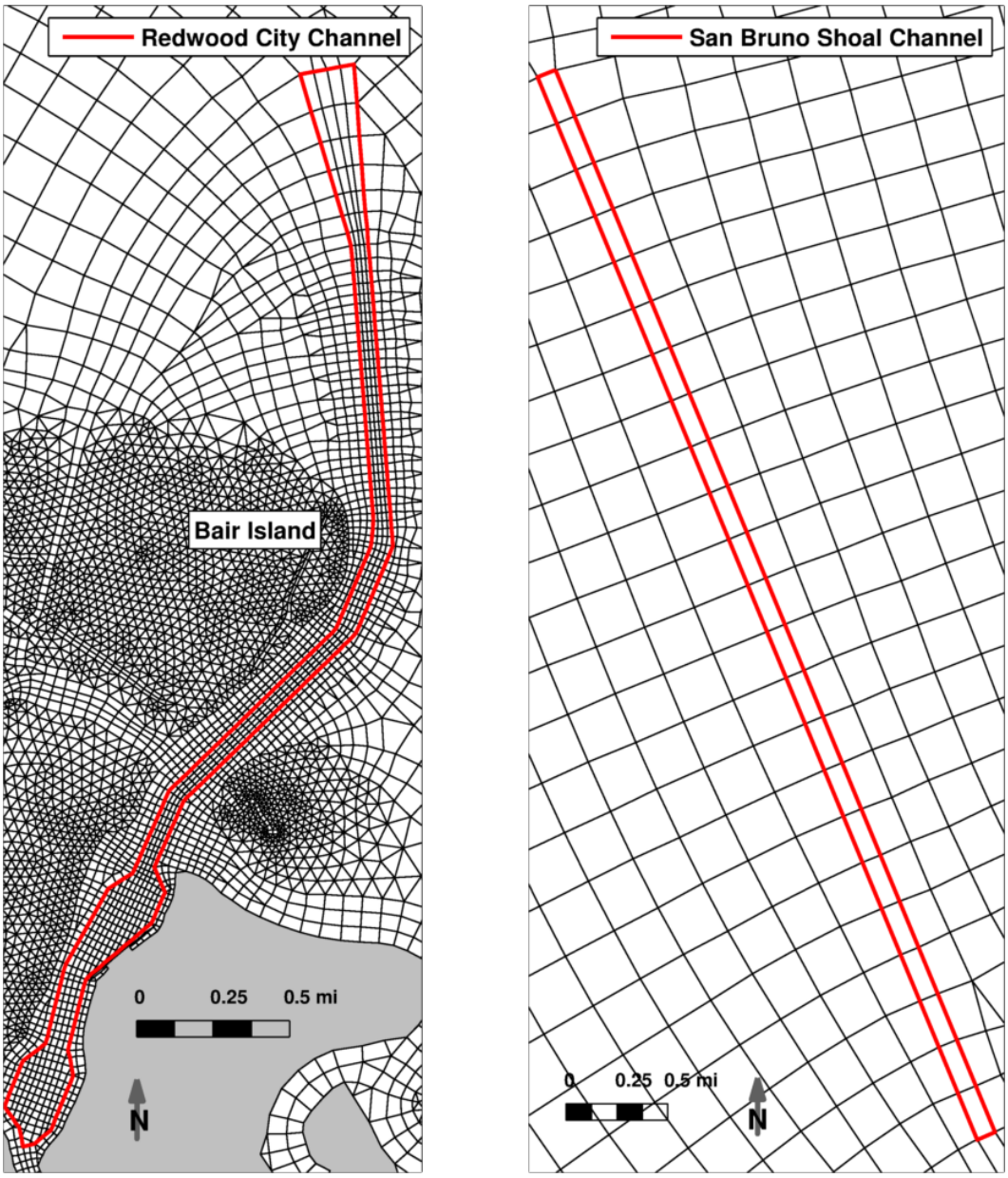


Figure 5.1-1
The model grid around Redwood City Harbor (left) and San Bruno Shoal Channel (right). The designated navigation channels are outlined in red.

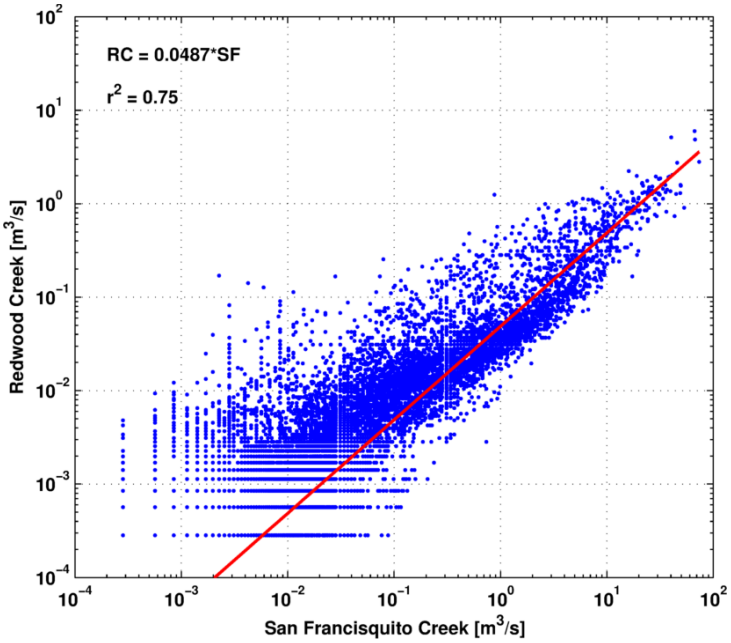


Figure 5.1-2
Scatter plot and best fit line between the flows in San Francisquito Creek and Redwood Creek from 1959 through 1997. RC stands for Redwood Creek and SF stands for San Francisquito Creek.

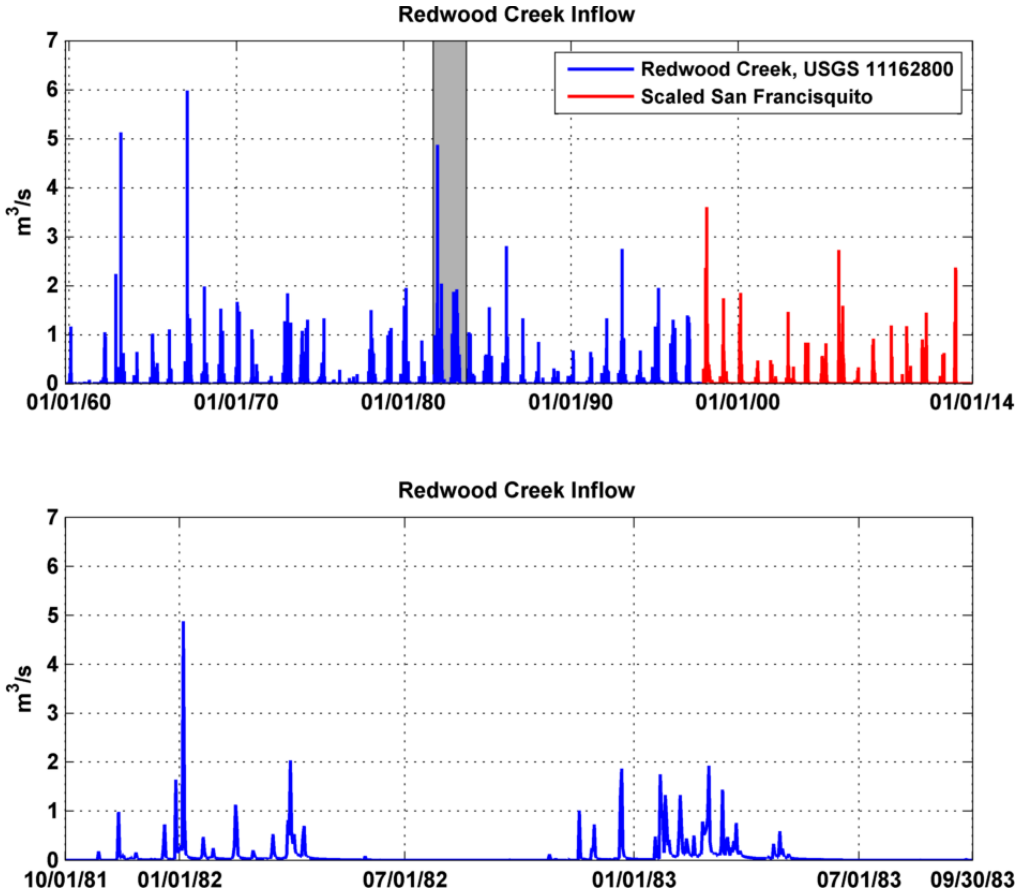


Figure 5.1-3
Redwood Creek inflow measured by USGS and based on the scaling relationship with San Francisquito Creek. The shaded portion of the top panel is highlighted in the bottom panel.

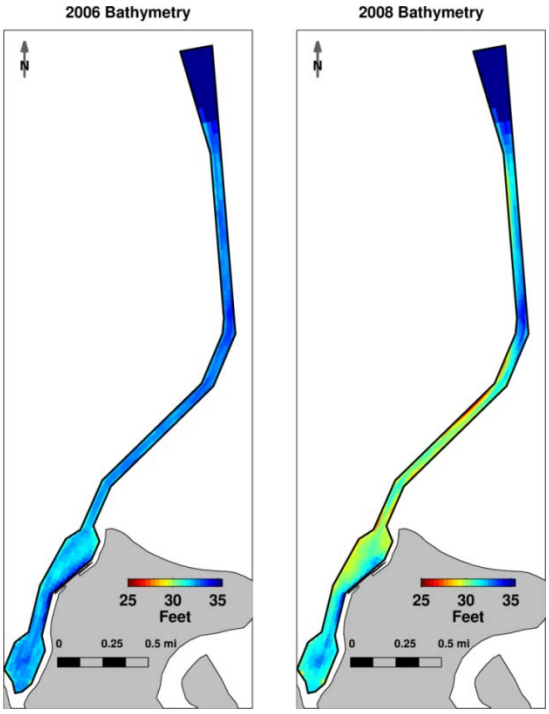


Figure 5.1-4
Model bathymetry in the Redwood City Harbor Channel for the 2006 (left) and 2008 (right) simulations.

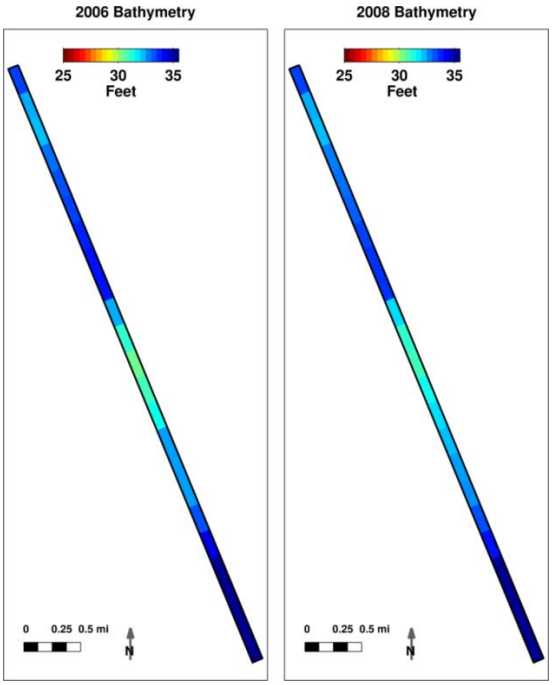


Figure 5.1-5
Model bathymetry in the San Bruno Shoal Channel for the 2006 (left) and 2008 (right) simulations.

5.2 Validation of Central Bay and South Bay Suspended Sediment Concentrations

Predicted suspended sediment concentrations were validated using USGS time series observations of suspended sediment concentrations at the Alcatraz station in the Central Bay and at Dumbarton Bridge in the South Bay for the 2006 and 2008 simulations (Figure 5.2-1). At Dumbarton Bridge, observation data was available at both the upper and lower sensors. The time series suspended sediment concentrations were validated in the same manner as in Bever and MacWilliams (2014) and MacWilliams et al. (2015), which give detailed descriptions of the model validation methods and the statistics used. In short, the model validation statistics included the observed and predicted means, the amplitude ratio, lag time in minutes, coefficient of determination (r^2), model skill between the observed and predicted values based on Willmott (1981), and target diagram statistics (Jolliff et al. 2009; Hofmann et al. 2011). The assessment of model accuracy focused on the model skill based on Willmott (1981) and the target diagram statistics. The model skill gives a quantitative metric that varies from zero to one, with zero indicating no model skill and one indicating a perfect prediction of the observations. The target diagram statistics give information about whether the model predictions were on average too high or too low (bias) and whether the modeled variability in the values was higher, positive unbiased root-mean-square difference (ubRMSD) or lower, negative ubRMSD, than from the observations. The target diagram statistics were normalized by the observed standard deviation, as discussed in Bever and MacWilliams (2014), MacWilliams et al. (2015), and Jolliff et al. (2009).

The accuracy of the predicted instantaneous time series of suspended sediment concentration was assessed using a combination of thresholds for model skill similar to those used in MacWilliams et al. (2015), with model skill values of 0.4 to 0.5 indicating the predictions could benefit from more calibration, 0.5 to 0.65 indicating the model acceptably predicted the observations and 0.65 to 1.0 indicating the model accurately predicted the observations. A second metric used the length of a vector composed of the two target diagram statistics, with values greater than one indicating the model predictions would benefit from increased calibration, 1.0 to 0.5 indicated the model acceptably predicted the observations, 0.5 to 0.25 indicated accurate model predictions and less than 0.25 indicated very accurate model predictions. These accuracy classification thresholds were identical to those used for

validating suspended sediment concentration in simulations predicting sediment deposition in the Oakland Harbor Channel (Delta Modeling Associates 2015).

During 2006 water year the suspended sediment concentration was acceptably to accurately predicted at the Alcatraz station, with the mean concentration very well predicted (Figure 5.2-2, Tables 5.2-1 and 5.2-2). The model also accurately predicted the spring to neap signal seen in the observed suspended sediment concentration at the Alcatraz station (Figure 5.2-2). The model predicted a higher mean suspended sediment concentration yet lower peak concentrations than the observations at both the upper and lower Dumbarton Bridge sensors during the 2006 simulation (Figures 5.2-3 and 5.2-4). During the 2008 simulation the suspended sediment concentration at the Alcatraz station was acceptably predicted, but the model predicted higher concentrations than observed in the later 3 months of the simulation (Figure 5.2-5, Tables 5.2-1 and 5.2-2). The mean concentrations at the Dumbarton Bridge station were better predicted by the model in the 2008 simulation than for 2006, but the 2008 predictions had lower suspended sediment concentration peaks and less variability in the concentrations than the observations (Figures 5.2-6 and 5.2-7, Tables 5.2-1 and 5.2-2).

The horizontal and vertical structure of the predicted suspended sediment concentration were also validated for the 2006 simulation using vertical profiles of suspended sediment concentration measured by USGS along a transect spanning from the far South Bay to Rio Vista (Figures 5.2-8 and 5.2-9). Analysis of the suspended sediment concentration transects showed the model predicted the correct horizontal and vertical structure in the suspended sediment concentrations, but tended to predict higher concentrations in the South Bay than were observed. Both the predictions and the observations showed generally higher concentration near Dumbarton Bridge than were observed either near San Mateo Bridge or in the Central Bay. The predictions and observations also showed higher concentrations between Point San Pablo and Carquinez Bridge than the surrounding area in the North Bay. The model predicted the suspended sediment concentration better near San Mateo Bridge than near Dumbarton Bridge, indicating that the predicted suspended sediment concentration near the Redwood City Harbor Channel was likely better predicted than at Dumbarton Bridge but not as well as at the Alcatraz station. The model also predicted the correct vertical structure to the suspended sediment concentration, with generally higher concentrations near the seabed than near the water surface.

Table 5.2-1

Predicted and observed suspended sediment concentrations, cross-correlation statistics, model skills, and target diagram statistics for suspended sediment concentration continuous monitoring stations in the Central Bay and South Bay. The ubRMSD is the unbiased root-mean-square difference. The bias and ubRMSD have both been normalized by the observed standard deviation. Station locations are shown on Figure 5.2-1.

Station Location	Data Source	Figure Number	Mean Concentration		Cross Correlation		r^2	Skill	Target Diagram	
			Observed (mg L^{-1})	Predicted (mg L^{-1})	Amp Ratio	Lag (min)			Bias	ubRMSD
2006 Suspended Sediment Concentration Stations										
Alcatraz	USGS	5.2-2	19.90	22.77	0.584	-7	0.578	0.845	0.147	-0.655
Dumbarton Bridge Upper	USGS	5.2-3	40.65	55.02	0.148	6	0.061	0.474	0.375	-1.032
Dumbarton Bridge Lower	USGS	5.2-4	47.45	84.66	0.160	0	0.023	0.397	1.001	1.346
2008 Suspended Sediment Concentration Stations										
Alcatraz	USGS	5.2-5	20.81	20.42	0.599	-55	0.303	0.738	-0.037	1.061
Dumbarton Bridge Upper	USGS	5.2-6	55.98	44.66	0.103	9	0.188	0.377	-0.207	-0.922
Dumbarton Bridge Lower	USGS	5.2-7	83.75	68.00	0.081	58	0.097	0.346	-0.176	-0.964

Table 5.2-2

The standard deviation of the observed and predicted suspended sediment concentrations and the number of individual data points used in the time series analysis.

Station Location	Data Source	Figure Number	Standard Deviation		Number of Data Points
			Observed (mg L^{-1})	Predicted (mg L^{-1})	
2006 Suspended Sediment Concentration Stations					
Alcatraz	USGS	5.2-2	19.57	15.13	22443
Dumbarton Bridge Upper	USGS	5.2-3	38.27	23.05	29138
Dumbarton Bridge Lower	USGS	5.2-4	37.18	39.54	25934
2008 Suspended Sediment Concentration Stations					
Alcatraz	USGS	5.2-5	10.42	11.42	28775
Dumbarton Bridge Upper	USGS	5.2-6	54.52	13.02	21275
Dumbarton Bridge Lower	USGS	5.2-7	89.82	23.42	23690

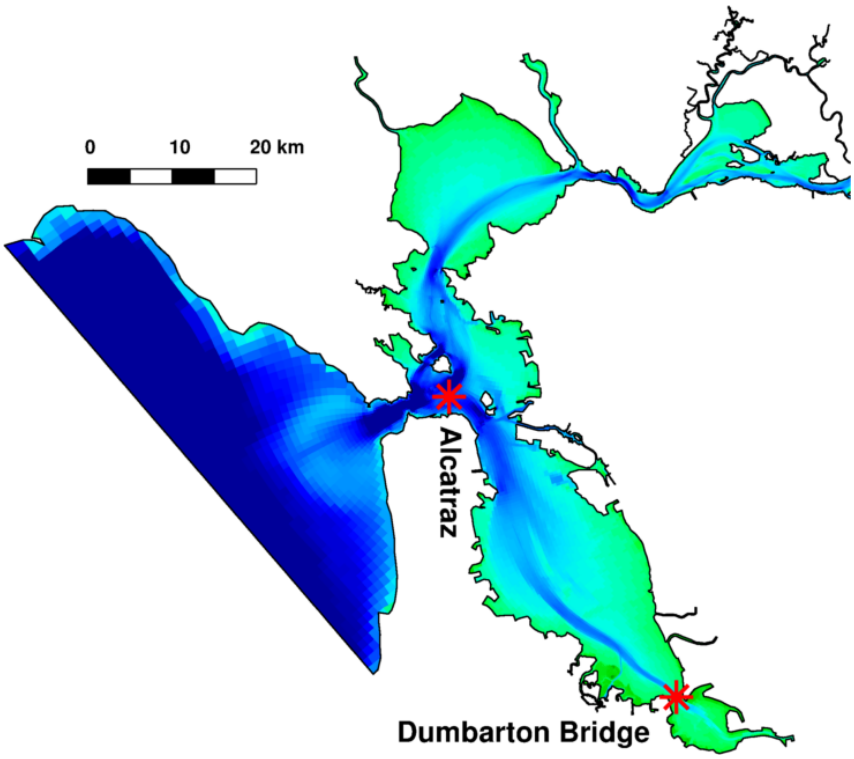


Figure 5.2-1
Location of USGS suspended sediment concentration monitoring stations in Central Bay and South Bay used for model validation.

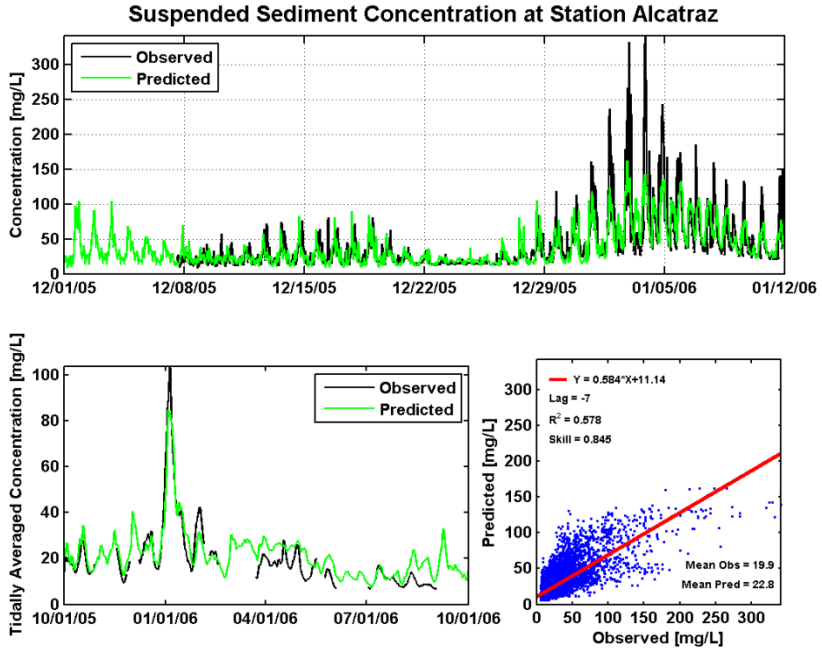


Figure 5.2-2
Observed and predicted suspended sediment concentration at Alcatraz during the 2006 simulation period.

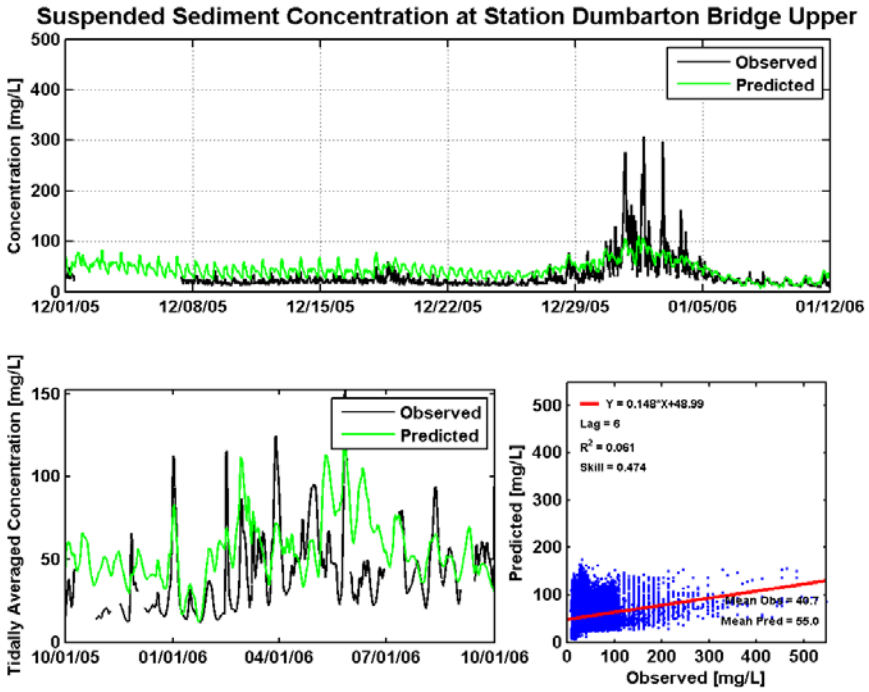


Figure 5.2-3
Observed and predicted suspended sediment concentration at Dumbarton Bridge (upper sensor) during the 2006 simulation period.

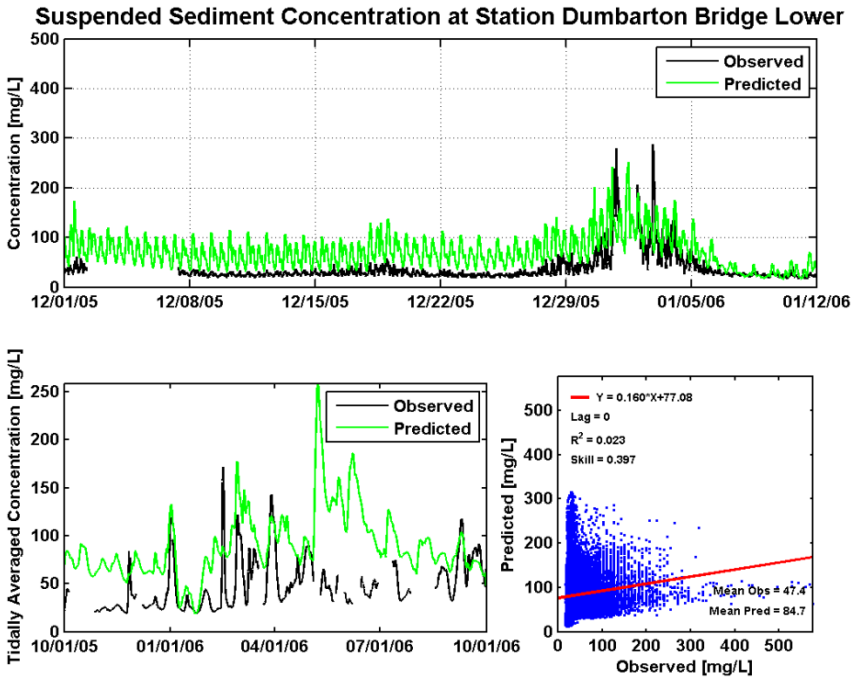


Figure 5.2-4
Observed and predicted suspended sediment concentration at Dumbarton Bridge (lower sensor) during the 2006 simulation period.

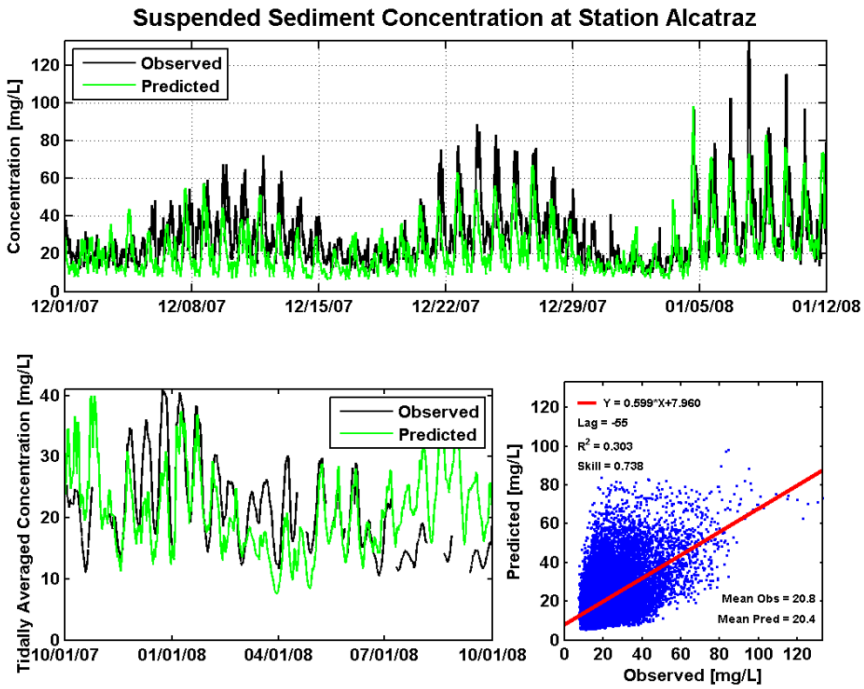


Figure 5.2-5
Observed and predicted suspended sediment concentration at Alcatraz during the 2008 simulation period.

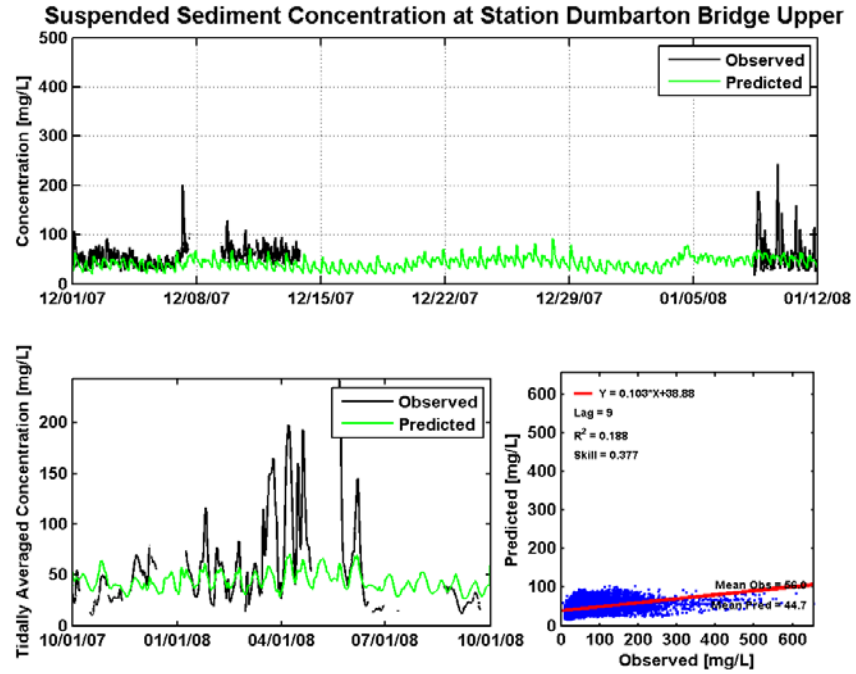


Figure 5.2-6
Observed and predicted suspended sediment concentration at Dumbarton Bridge (upper sensor) during the 2008 simulation period.

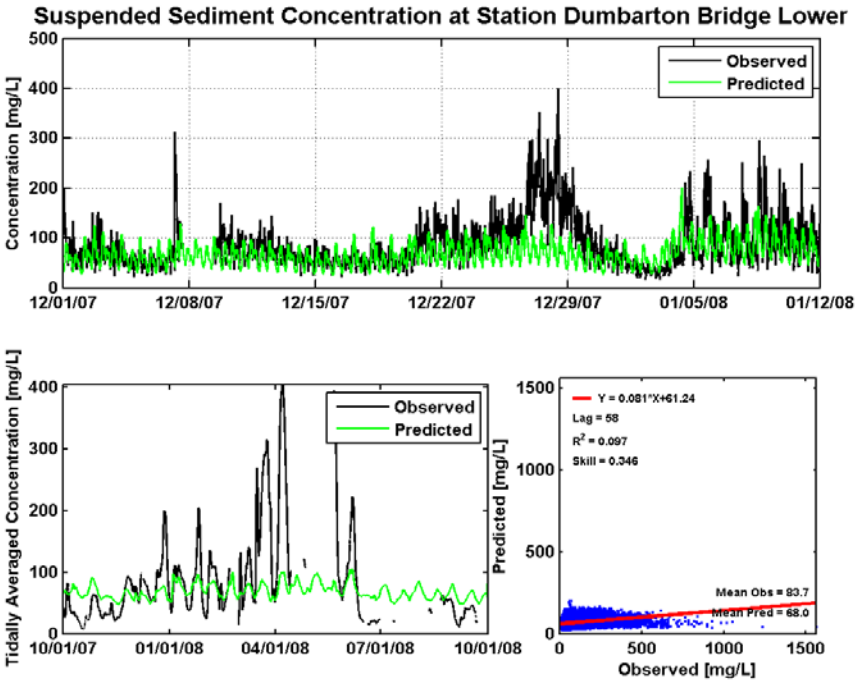


Figure 5.2-7
Observed and predicted suspended sediment concentration at Dumbarton Bridge (lower sensor) during the 2008 simulation period.

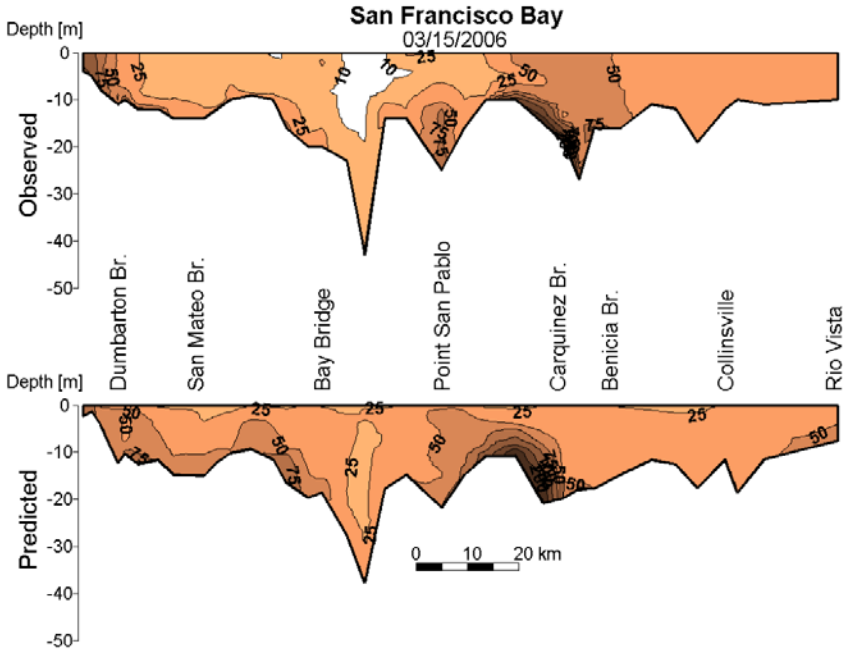


Figure 5.2-8
Observed and predicted suspended sediment concentration profiles for San Francisco Bay, interpolated to a transect from the far South Bay to Rio Vista on March 15, 2006.

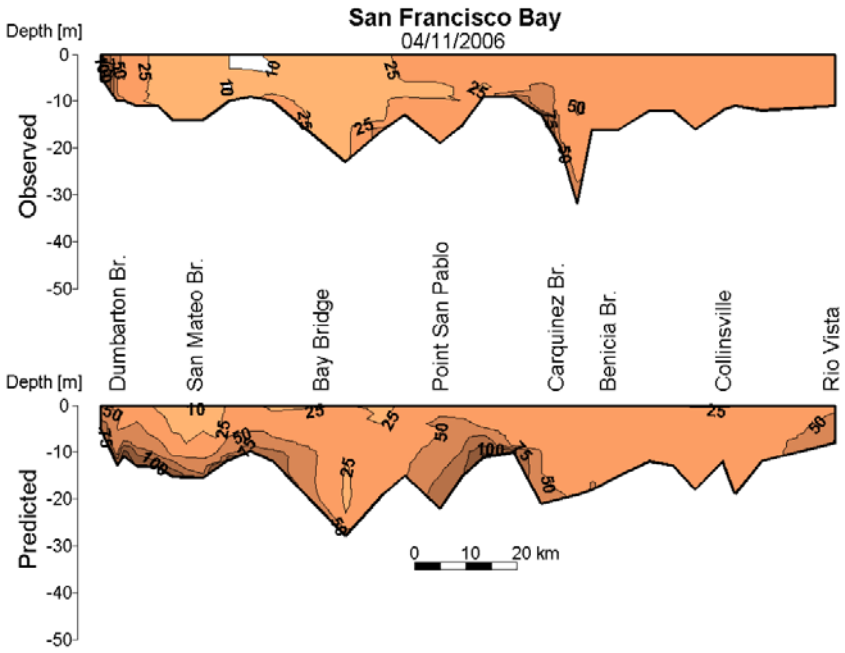


Figure 5.2-9
Observed and predicted suspended sediment concentration profiles for San Francisco Bay, interpolated to a transect from the far South Bay to Rio Vista on April 11, 2006.

5.3 Validation of Sediment Deposition in the Redwood City Harbor Channel

The hydrosurvey data presented in Section 4 were used to validate the predicted sedimentation rate, area above project depth, deposition thickness, and deposition location in the Redwood City Harbor Channel. When comparing the predicted deposition to the sediment deposition estimated from the hydrosurvey data, the deposition predicted by the model over the period between two hydrosurveys was compared to the change in volume derived from the consecutive hydrosurveys. This approach allowed for a comparison of observed and predicted deposition over identical time periods. The model predicted a sedimentation rate 48% lower than that estimated from the hydrosurvey data in the 2006 simulation and 49% lower in the 2008 simulation (Figure 5.3-1, Table 5.3-1). However, the model predictions of deposition for both the simulations were well within the error bars on the deposition derived from the hydrosurvey data, indicating the model acceptably predicted the sediment deposition volumes. The model predicted a decrease of 23% in the sedimentation rate in the Redwood City Harbor Channel from the 2006 to the 2008 simulations. This decrease of 23% matched very well with the hydrosurvey derived decrease

in the sedimentation rate of 21% from the 2006 to the 2008 simulations, indicating that the model very accurately predicted the relative change in the sedimentation rate due to different channel depths and environmental conditions.

When comparing predicted area above the project depth to the observed area above the project depth, it was not necessary to limit the evaluation only to the time between the hydrosurveys. However, some uncertainty is introduced in this type of comparison because the initial bathymetry for each simulation was derived using a hydrosurvey from a day that was not identical to the start date of each simulation. The model predicted the percentage of the Redwood City Harbor Channel that shoaled above the project depth sufficiently well for both simulations (Figure 5.3-2). The model predicted a larger change in the percent of the channel that shoaled to above project depth in the 2006 simulation than in the 2008 simulation, as also seen in the hydrosurvey data. Both the model predictions and the hydrosurvey data suggest regions of relatively higher sediment deposition just south of Bair Island and toward the northern end of the channel, although the model predicted less deposition thickness near Bair Island and more deposition thickness near the northern end of the channel than was estimated from the hydrosurvey data (Figures 5.3-3 and 5.3-4). In 2006 the model correctly predicted the increased depositional thicknesses to be primarily toward the northwest side the channel south of Bair Island and toward the western side of the channel near the northern end of the channel.

Table 5.3-1
Estimated and predicted sedimentation rate in the Redwood City Harbor Channel for the 2006 and 2008 simulations. The volume percent is the model predictions divided by the hydrosurvey deposition volume times 100 and the duration is the length of time from one survey to the next. The change from 2006 to 2008 is the percentage change in the sedimentation rate between the 2006 and 2008 estimates.

Year	Hydrosurvey or Predicted	Deposition Volume ($1x10^5$ yd^3)	Sedimentation Rate ($1x10^5$ yd^3 yr^{-1})	Volume Percent	Duration (days)	Change From 2006 to 2008
2006	Hydrosurvey	1.65	1.83	52	330	not applicable
	Predicted	0.86	0.96			
2008	Hydrosurvey	1.06	1.45	51	266	-21%
	Predicted	0.54	0.74			-23%

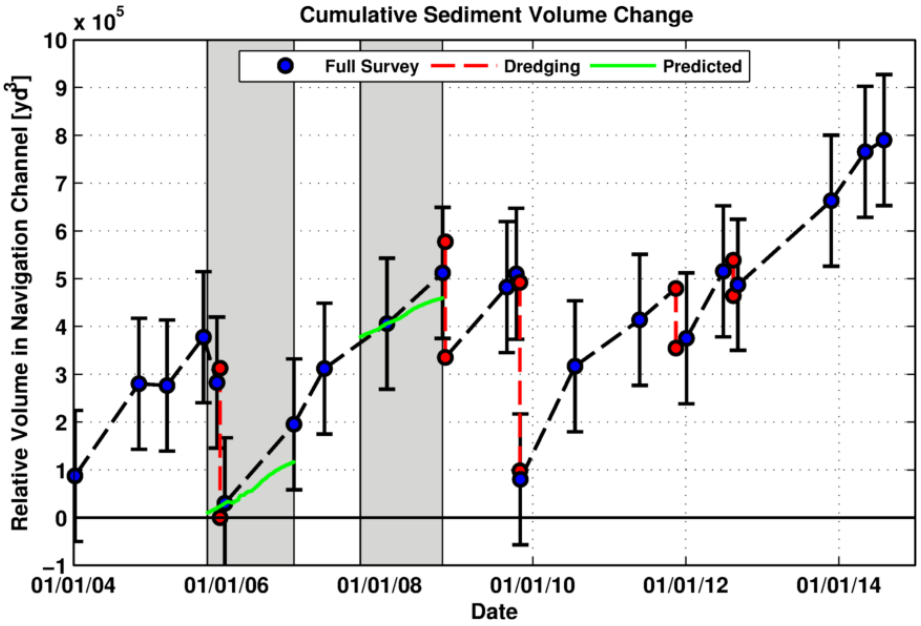


Figure 5.3-1
Relative sediment volume in the Redwood City Harbor Channel through time. The hydrosurvey data is shown as explained in Section 4 and the model predictions are represented by the thick green lines. The model predictions are shown for the entire simulation period (grey shading).

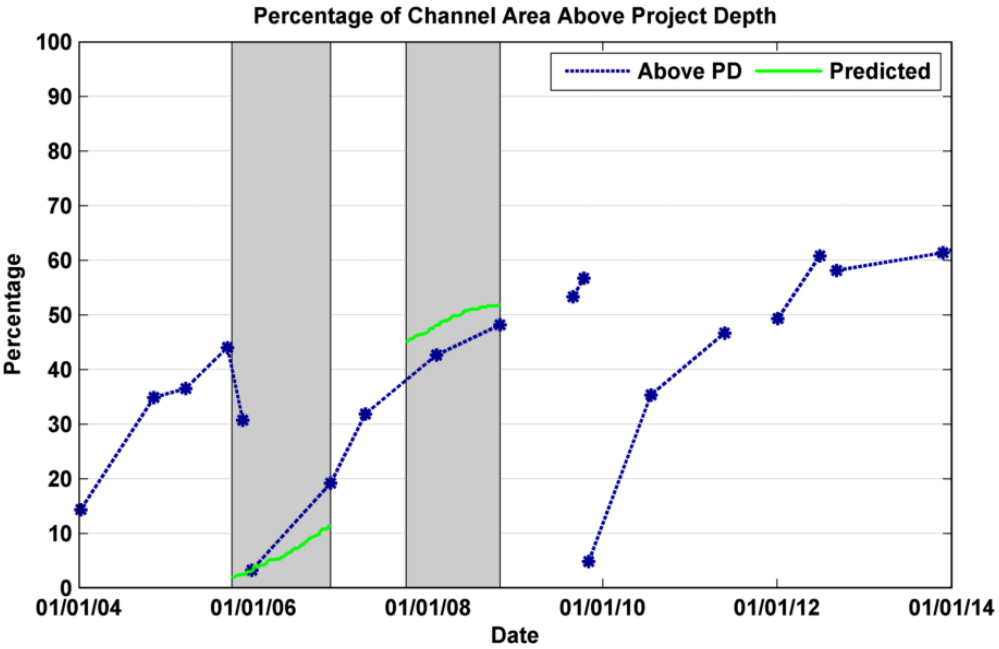


Figure 5.3-2
The percentage of the Redwood City Harbor Channel that is shallower than the project depth estimated from the hydrosurvey data (blue) and predicted by the model (green). The model predictions are shown for the entire simulation period (grey shading).

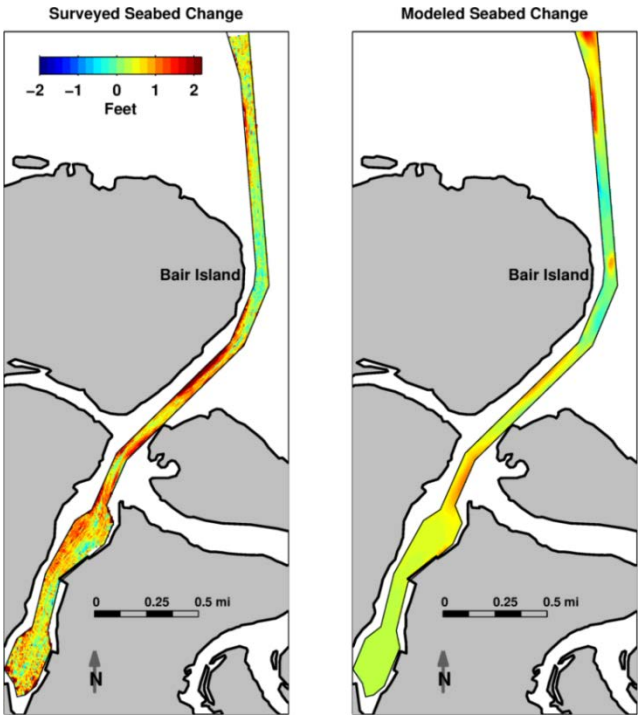


Figure 5.3-3
Sediment deposition thicknesses in the Redwood City Harbor Channel estimated from the hydrosurvey data and predicted by the model for the 2006 simulation.

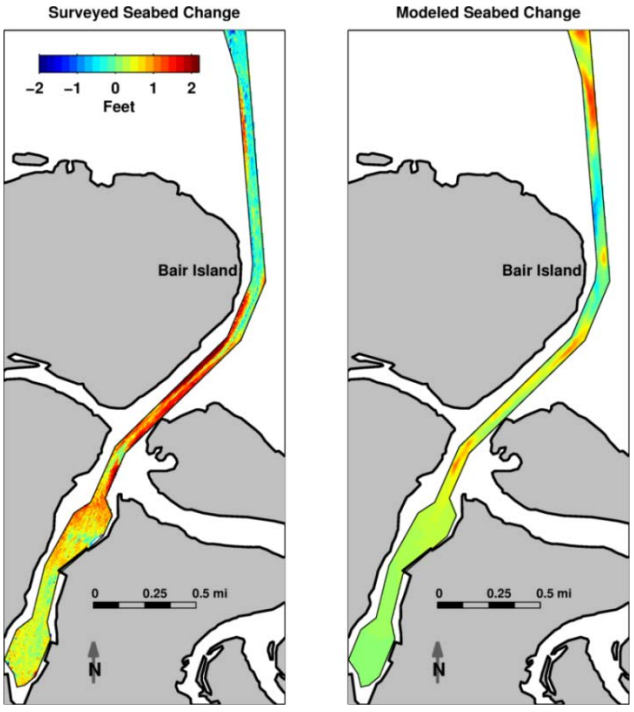


Figure 5.3-4
Sediment deposition thicknesses in the Redwood City Harbor Channel estimated from the hydrosurvey data and predicted by the model for the 2008 simulation.

5.4 Validation of Sediment Deposition in the San Bruno Shoal Channel

The hydrosurvey data presented in Section 4 were used to validate the predicted sedimentation rate, deposition thickness, and deposition location in the San Bruno Shoal Channel. Consecutive full surveys of the San Bruno Shoal Channel without dredging between the surveys were not available during either the period simulated for 2006 or 2008. As a result, only a qualitative assessment of model predictions of sediment deposition volume in San Bruno Shoal Channel was possible from the data available. For comparison purposes, the relative volume in the navigation channel was set to zero at the start of each simulation. Based on this, it appears that the model predicted higher than observed deposition in the San Bruno Shoal Channel for both the 2006 and 2008 simulation periods (Figure 5.4-1). However, sediment deposition volumes were predicted to the correct order of magnitude, and the ending sediment volume in the channel for each simulation is within the error bars of the volume derived from the subsequent survey for which hydrosurvey data were available.

Even though the model predicted higher sedimentation in the San Bruno Shoal Channel than suggested by the hydrosurvey data, the available data do not allow for an examination of how shorter time scale variability may influence the deposition in the San Bruno Shoal Channel and the validation of the modeled sedimentation rates. For example, the observed sedimentation rate immediately prior to the 2006 simulation seems too much better match the predicted sedimentation rate than the observed data over the simulation period, indicating that the model predicted sedimentation rate is reasonable. Also, as the time between consecutive surveys in the San Bruno Shoal Channel increases the rate of change (slope of the connecting line) generally decreases. The hydrosurveys during and after the 2008 simulation spanned a large length of time (about 865 days), which may lead to the overall sedimentation rate between those surveys not being representative of the sedimentation rate over the shorter 2008 simulation period.

Predicted deposition thicknesses for the period from October 15, 2005, to November 20, 2006, were compared to the observed deposition for the same period (Figure 5.4-2). However, dredging occurred between these two hydrosurveys. The location of the thickest predicted deposition matched with a location of deposition in the hydrosurvey data. Sharp transitions between depositional and erosional areas in the hydrosurvey data (Figure 5.4-2,

left panel) were caused by dredging between the October 2005 and November 2006 hydrosurveys. Consecutive hydrosurveys of the San Bruno Shoal Channel within the simulated date range were not available to compare the deposition thicknesses for the 2008 simulation.

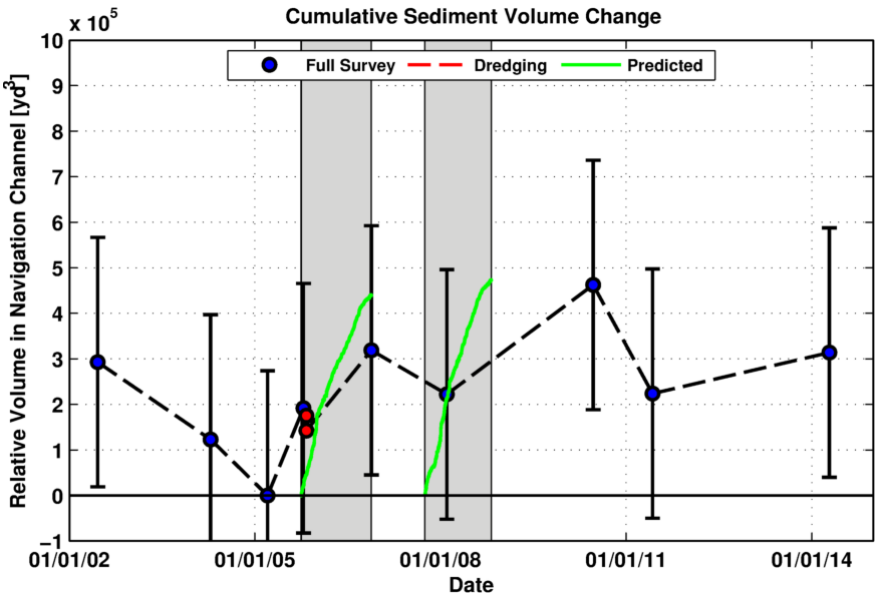


Figure 5.4-1
Relative sediment volume in the San Bruno Shoal Channel through time. The hydrosurvey data is shown as explained in Section 4 and the model predictions are represented by the thick green lines. The model predictions are shown for the entire simulation period (grey shading).

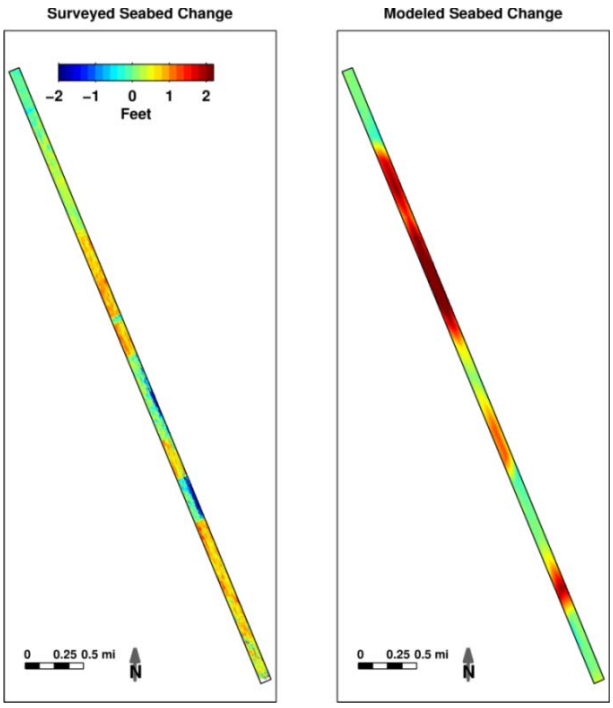


Figure 5.4-2
Sediment deposition thickness in the San Bruno Shoal Channel estimated from the hydrosurvey data and predicted by the model for the 2006 simulation.

5.5 Model Validation Conclusions

The model predictions of sediment transport were validated using observations of suspended sediment concentration, sediment deposition volume and thickness in the Redwood City Harbor Channel and San Bruno Shoal Channel, and the percentage of the channels that shoaled to above project depth. The model accurately predicted the suspended sediment concentration at the Alcatraz station in the Central Bay for the 2006 simulation and acceptably for the 2008 simulation. Predicted suspended sediment concentrations were higher than observed at the South Bay Dumbarton Bridge station in 2006 and slightly lower than observed in the 2008 simulation, while the peak concentrations were lower than observed in both simulations. The thresholds of model skill indicated the model could benefit from further calibration if the focus region were situated at Dumbarton Bridge. However, analysis of along-Bay transects suggested the model more accurately predicted the suspended sediment concentration near the Redwood City Harbor Channel and the San Bruno Shoal Channel than at Dumbarton Bridge, but less accurately than at the Alcatraz station. The model predicted a lower total volume of sediment deposited in the Redwood

City Harbor Channel than was estimated from the hydrosurvey data. The model correctly predicted the locations of both the hot spot south of Bair Island and near the northern end of the channel identified in the hydrosurvey analysis. The model also predicted the correct across-channel location of the hot spots on the western side of the channel in the 2006 simulation. The predicted reduction in the sedimentation rate in the Redwood City Harbor Channel from the 2006 to the 2008 simulations agreed very well with the hydrosurvey derived reduction (23% vs. 21%), indicating that the model very accurately predicted the relative change in the sedimentation rate due to different channel depths and environmental conditions. The model predicted the same order of magnitude change in the area of the channel that shoaled to above project depth as the hydrosurvey data. It is likely that model overpredicted the sediment deposition in the San Bruno Shoal Channel relative to the hydrosurvey data but the model did predict the correct order of magnitude deposition volume and was within the error bars of the hydrosurvey derived deposition volumes. A quantified assessment of deposition volumes for the San Bruno Shoal was not possible based on the hydrosurvey data available for the periods simulated.

The validation indicated that the model was sufficiently accurate for investigating relative changes in the sediment deposition volumes due to channel deepening of the Redwood City Harbor Channel. The validation also showed the model did not predict the sediment deposition in the San Bruno Shoal Channel as well as in the Redwood City Harbor Channel. However, even in the San Bruno Shoal Channel, the model predicted the correct order of magnitude for the sediment deposition volume in the channel and was within the error bars of the hydrosurvey derived deposition volumes, indicating that it is suitable for investigating the relative difference between scenarios.

6 INFLUENCE OF PROJECT DEPTH ON SHOALING

The application of the UnTRIM Bay-Delta model (MacWilliams et al. 2007, 2008, 2009, 2015) coupled with the SWAN wave model (SWAN Team 2009a) and the SediMorph sediment transport model (BAW 2005) was used to investigate the effects of deepening the project depth of the Redwood City Harbor Channel and the San Bruno Shoal Channel on shoaling rates. Six scenarios were used to estimate how the sedimentation rate in the channels would be changed by deepening the project depth from 30 feet MLLW to either 32 feet MLLW or to 37 feet MLLW. This analysis showed that increasing the project depth increased sedimentation in both of the channels.

The influence of the project depths on shoaling rates was evaluated for base year conditions. The base year conditions are defined based on the expected bathymetric, hydrologic, and operating conditions in year 2018 for the Redwood City Harbor Channel and the San Bruno Shoal Channel. The base year scenario represents the "Year 0" conditions, which are an estimate of possible conditions that may exist at the approximate time that the project is completed. Because the exact weather, hydrology, and operating conditions cannot be predicted in advance, representative conditions for 2018 were developed using 2006 hydrology, and modified to account for both sea level rise and to include changes to the Bair Island Restoration Project that are expected to occur prior to 2018. A projected sea level rise of 0.09 foot from the model forcing year (2006) to the project start year (2018) was applied based on the NRC curve 1 (USACE 2014). The model grid was refined to include all of Bair Island and levee breaches, channel blocks, flow constrictors, and flooded areas based on the current configuration and the planned future restoration of the system which is likely to occur prior to 2018 (Figure 6.1-1). The planned changes to the Bair Island Restoration Project were included based on information provided by the U.S. Fish and Wildlife Service (E. Mruz pers. comm. 2014; A. Payne pers. comm. 2014).

6.1 Project Depth Scenarios Overview

The analysis evaluated three project depths, which were combined to produce a set of scenarios in which only a single variable was changed within the scenario set. Varying only a single variable (project depth) within the set of scenarios allowed for an assessment of how the project depth affected the shoaling rate in the Redwood City Harbor Channel and the

San Bruno Shoal Channel. Thus, to evaluate how the depth of the Redwood City Harbor Channel and the San Bruno Shoal Channel influences the sedimentation rate, nearly identical model simulations were conducted using identical hydrological forcing, such that only the bathymetry in the navigation channels was changed between scenarios. These scenarios then allowed for the examination of how changing the Redwood City Harbor Channel and San Bruno Shoal Channel project depths influenced the sedimentation rates, because all variables were consistent between the scenarios except the project depth. Thus, any predicted differences in the sedimentation rate in the channel can be attributed solely to differences in the project depth.

Six scenarios were used to evaluate the influence of the project depth on the sedimentation rate in the Redwood City Harbor Channel and the San Bruno Shoal Channel (Table 6.1-1). All six scenarios used identical model boundary conditions for the base year (2018) conditions but had different project depths and were evaluated over different seasonal time periods (Table 6.1-1). The scenarios were based on project depths of 30 feet MLLW, 32 feet MLLW and 37 feet MLLW. All scenarios included 2 feet of overdepth and assumed 3:1 side slopes. These scenarios were used to estimate a relative change in the sedimentation rate after the Redwood City Harbor Channel and the San Bruno Shoal Channel were deepened from the current project depth (30 feet MLLW) to either 32 feet MLLW or to 37 feet MLLW.

The existing conditions bathymetry in the Redwood City Harbor Channel and the San Bruno Shoal Channel for the scenarios was derived using the most recent available hydrosurveys for each channel. The existing conditions bathymetry for the Redwood City Harbor Channel was derived using hydrosurvey data from August 2014 and June 2012. The June 2012 hydrosurvey data was primarily used for the channel sides because the August survey only covered the navigation channel and not the adjacent shoals. The existing condition for the San Bruno Shoal Channel was set based on hydrosurvey data from April 2014. The existing conditions bathymetry was used as the starting point for developing the channel bathymetry for each of the scenarios.

For the baseline conditions, the bathymetry in the Redwood City Harbor Channel and the San Bruno Shoal Channel was set as the deeper of the exiting conditions bathymetry or the elevation corresponding to 30 feet MLLW plus 2 feet of overdepth in each channel grid cell.

The overdepth was applied as a box-cut and did not affect the channel side slopes. Channel side slopes of 3:1 were applied from the edge of the channel and any areas shallower than the design side slopes were also deepened based on the distance from the channel. This approach ensured that all cells were at least as deep as the currently authorized project depth plus overdepth, but did not fill in any areas that are already deeper than the project depth plus overdepth.

The channel bathymetry for the two deepening scenarios were set using the same approach used to develop the baseline conditions. For the 32 feet MLLW deepening scenario, the bathymetry in the Redwood City Harbor Channel and the San Bruno Shoal Channel was set as the deeper of the exiting conditions bathymetry or the elevation corresponding to 32 feet MLLW plus 2 feet of overdepth in each channel grid cell. For the 37 feet MLLW deepening scenario, the bathymetry in the Redwood City Harbor Channel and the San Bruno Shoal Channel was set as the deeper of the exiting conditions bathymetry or the elevation corresponding to 37 feet MLLW plus 2 feet of overdepth in each channel grid cell. The overdepth and side slopes for the deepening scenarios were set using the same approach used for the baseline conditions grid. About 65% of the Redwood City Harbor Channel was deepened by more than 2 feet to develop the 30 feet MLLW scenario bathymetry from the existing conditions, indicating that a significant portion of the channel was shallower than the authorized depth plus 2 feet of overdepth under existing conditions. Deepening of 12 feet to 15 feet was necessary in some locations to develop the 37 feet MLLW scenario bathymetry including overdepth (Figure 6.1-2). The San Bruno Shoal Channel required less deepening relative to the existing conditions than the Redwood City Harbor Channel, because the majority of the San Bruno Shoal Channel was already deeper than the 30 feet MLLW project depth plus 2 feet of overdepth (Figure 6.1-3). With the exception of the navigation channel project depths, the model bathymetry, boundary conditions, and all other parameters were identical between the baseline scenario and each of the deepening scenarios.

Table 6.1-1
The scenario matrix used to estimate how the project depth influences the sedimentation rate in the Redwood City Harbor Channel and San Bruno Shoal Channel.

Scenario	Channel Project Depth (feet MLLW)	Seasonal Period	Water Year	Notes
1	30	Fall – Winter	2006	Bathymetry set as deeper of existing conditions or project depth plus 2 feet of overdepth.
2	32			
3	37			
4	30	Spring - Summer		
5	32			
6	37			

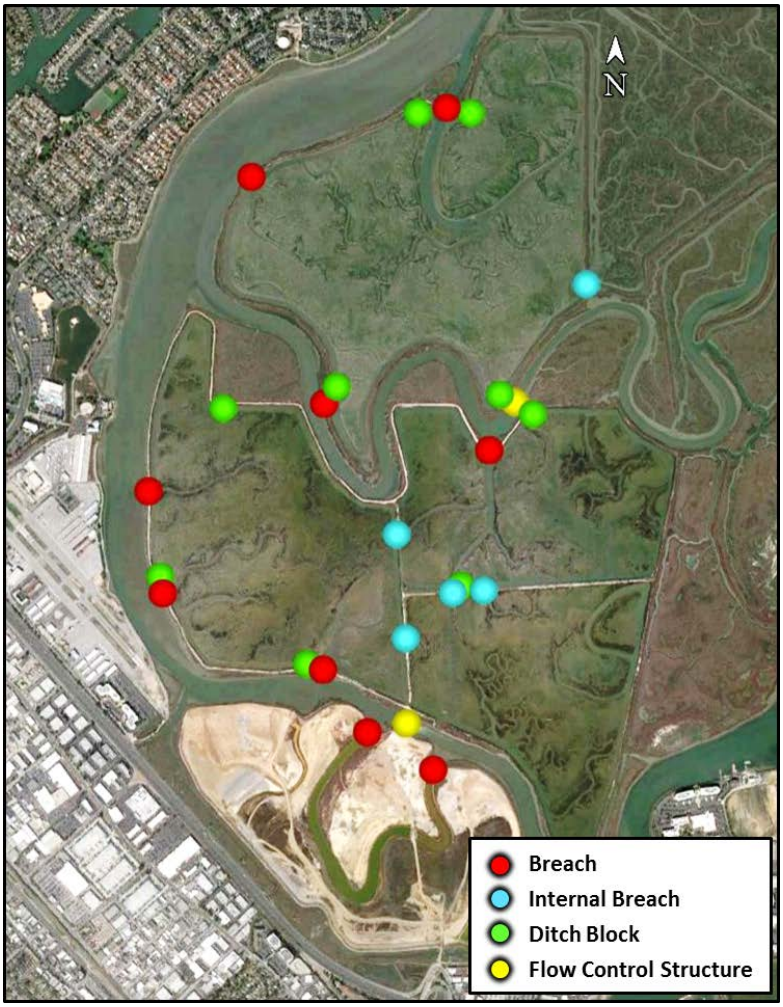


Figure 6.1-1
The levee breaches, channel blocks, and flow constrictors in Bair Island included in the numerical model.

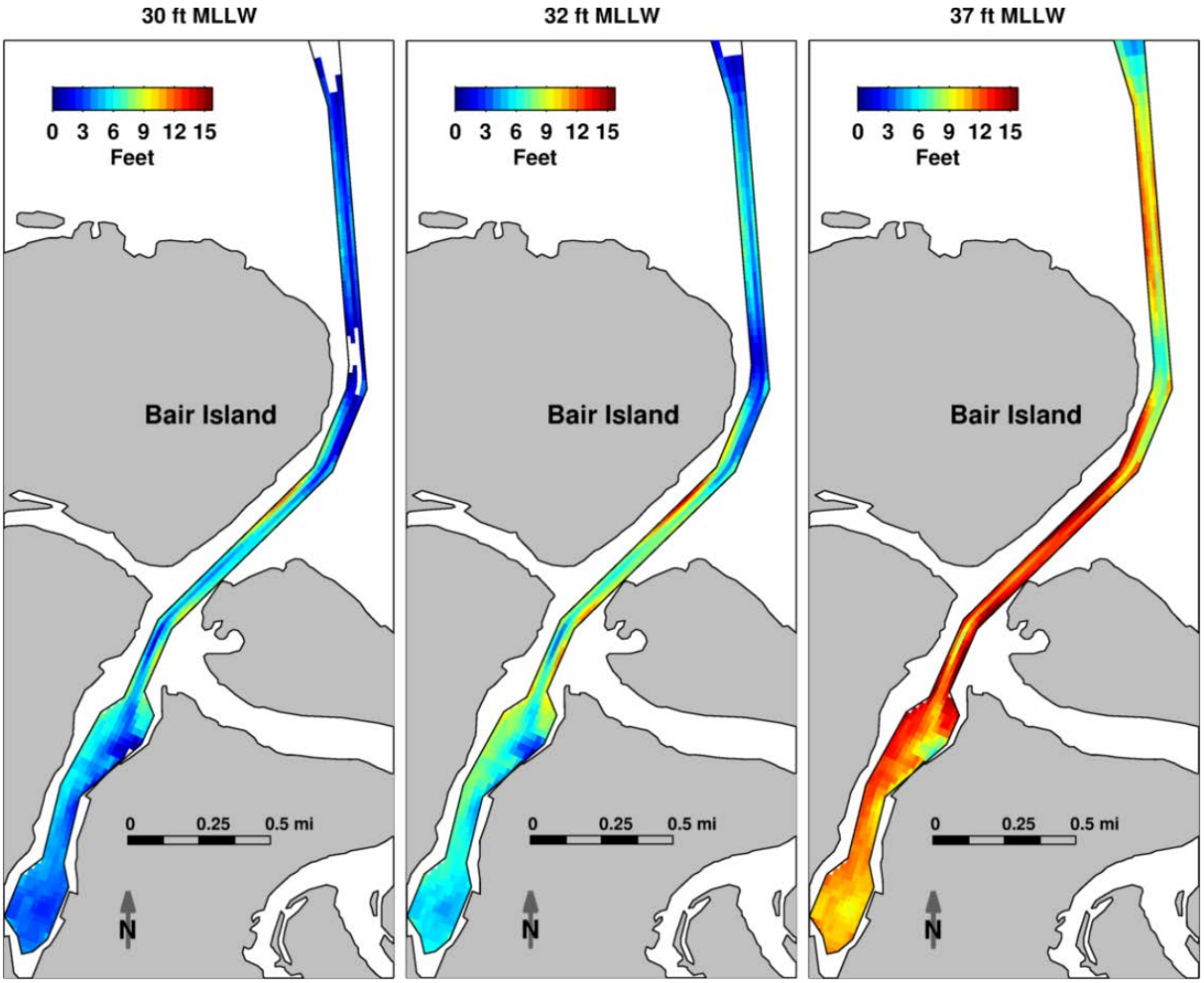


Figure 6.1-2
The amount the Redwood City Harbor Channel was deepened relative to existing conditions required to develop the 30 feet MLLW, 32 feet MLLW, and 37 feet MLLW scenarios (including 2 feet of overdepth). White areas inside the channel represent no deepening.

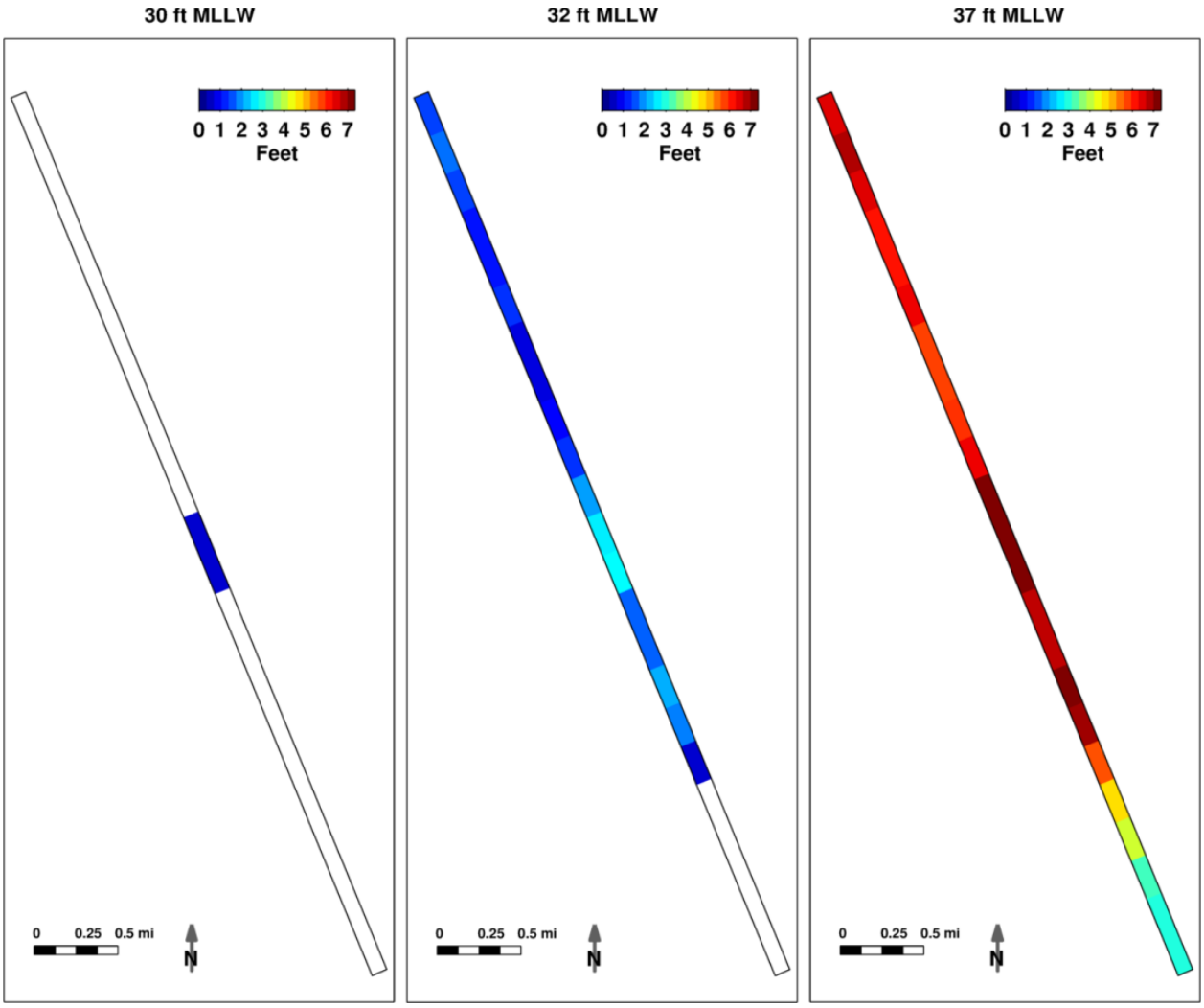


Figure 6.1-3
The amount the San Bruno Shoal Channel was deepened relative to existing conditions to develop the 30 feet MLLW, 32 feet MLLW, and 37 feet MLLW scenarios (including 2 feet of overdepth). White areas inside the channel represent no deepening.

6.2 Overview of Scenario Analysis

The relative change in sediment deposition between scenarios was used to evaluate the influence of increasing the project depth on the sedimentation rate within the Redwood City Harbor Channel and the San Bruno Shoal Channel. Because the model acceptably predicted the sediment deposition volume, deposition thickness, depositional locations, and area of the channel above project depth, yet very accurately predicted the relative change in deposition between two different years, the model is best suited to examine the percentage differences

in the sedimentation rate between the scenarios rather than quantify exact differences in deposition volume. That is, the predicted percentage difference in the sedimentation rate caused by different project depths will have less uncertainty than the corresponding absolute differences in deposition volumes between scenarios. As such, this analysis focuses more on the relative difference between scenarios and less on the absolute differences between the scenarios.

Six scenarios were used to estimate the relative change in the sedimentation rate. The simulations were analyzed over three time periods to assess whether seasonal changes in sediment transport influence the sediment deposition in the Redwood City Harbor Channel. The three time periods consisted of the fall and winter period of September 1 through February 28, the spring and summer period of March 1 through August 31, and the complete base year from September 1 through August 31. The analysis periods were shifted by one month from a water year start and end to better align with the fall/winter and spring/summer seasons. The fall through winter period is generally characterized as being composed of winter storms, the first flush from the Delta, and relatively high tributary sediment input to the Bay compared to the spring through summer period. The spring through summer period would be generally characterized as consistently having elevated daily winds that drive wind waves and local sediment resuspension but relatively low tributary sediment supply to the Bay relative to the fall through winter period.

6.3 Influence of Project Depth on Sedimentation Rate

6.3.1 Redwood City Harbor Channel

Increasing the project depth from 30 feet MLLW to either 32 feet MLLW or to 37 feet MLLW was predicted to increase the sedimentation rate in the Redwood City Harbor Channel (Figure 6.3-1, Table 6.3-1). During the fall through winter time period the sedimentation rate was predicted to increase relative to the 30 feet MLLW project depth by 5% with the 32 feet MLLW project depth and by 50% with the 37 feet MLLW project depth. During the spring through summer period, the sedimentation rate was predicted to increase relative to the 30 feet MLLW project depth by 22% with the 32 feet MLLW project depth and by 51% with the 37 feet MLLW project depth.

Over the complete year the sedimentation rate was predicted to increase relative to the 30 feet MLLW project depth by 13% with the 32 feet MLLW project depth and by 51% with the 37 feet MLLW project depth (Figure 6.3-1, Table 6.3-1). The model predicted the sediment deposition thicknesses to generally increase from the 30 feet MLLW to the 32 feet MLLW to the 37 feet MLLW project depths (Figure 6.3-2). The two hot spots located south of Bair Island and near the northern end of the channel were both predicted to thicken in both the 32 feet MLLW and 37 feet MLLW scenarios relative to the 30 feet MLLW scenario. The model also consistently predicted an area of no deposition east of Bair Island; however, this region of no deposition was smaller in the 37 feet MLLW project depth than in the 30 feet MLLW and 32 feet MLLW project depth scenarios. This area of no deposition is also seen in the hydrosurvey data as a region that both rarely shoals above project depth (Figures 4.3-1 through 4.3-11) and has a very small relative sediment deposition compared to the rest of the channel (Figure 4.3-12), indicating that the model correctly predicted this location of reduced sediment deposition.

The model predicted a relatively small difference in the sedimentation rate between the fall through winter and the spring through summer time periods in the Redwood City Harbor Channel. For example, with the 30 feet MLLW project depth the model predicted a sedimentation rate of 139,000 $yd^3\ yr^{-1}$ for the fall through winter and 129,000 $yd^3\ yr^{-1}$ for the spring through summer. The sediment transport and deposition in the Redwood City Channel during the fall-winter is influenced by winter storms and potentially any large sediment supply events from the Delta, while the sediment transport in the spring through summer is more strongly influenced by sediment resuspension driven by daily wind waves. During the period simulated, which is representative of wet 2018 conditions, the model predicted the influence of the fall through winter and spring through summer sediment transport processes to lead to a similar sedimentation rate within the Redwood City Harbor Channel for all three project depths.

Table 6.3-1
The predicted sedimentation rate in the Redwood City Harbor Channel for fall through winter, spring through summer, and a complete year.

Date Range	Project Depth (feet MLLW)	Channel Sedimentation Rate ($yd^3\ yr^{-1}$)	Percent Increase Relative To 30 feet MLLW Project Depth
Fall-Winter	30	139,000	n/a
	32	147,000	5
	37	209,000	50
Spring-Summer	30	129,000	n/a
	32	157,000	22
	37	195,000	51
Complete Year	30	134,000	n/a
	32	152,000	13
	37	202,000	51

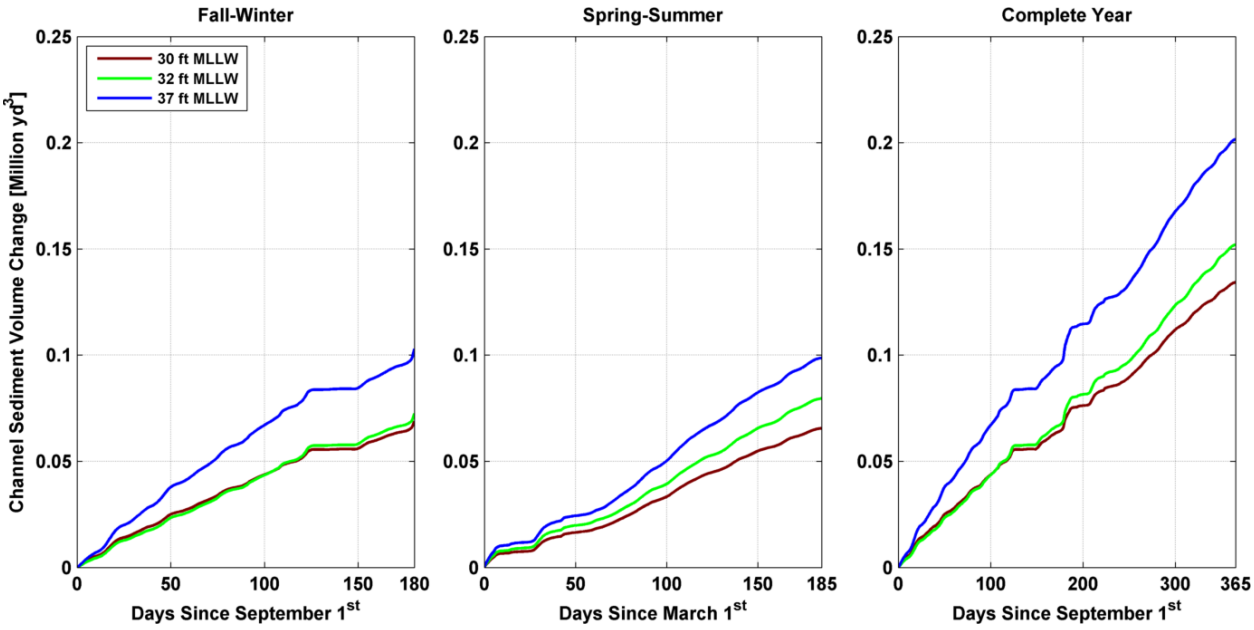


Figure 6.3-1
The predicted volume of sediment deposited in the Redwood City Harbor Channel for 30 feet MLLW, 32 feet MLLW, and 37 feet MLLW project depths.

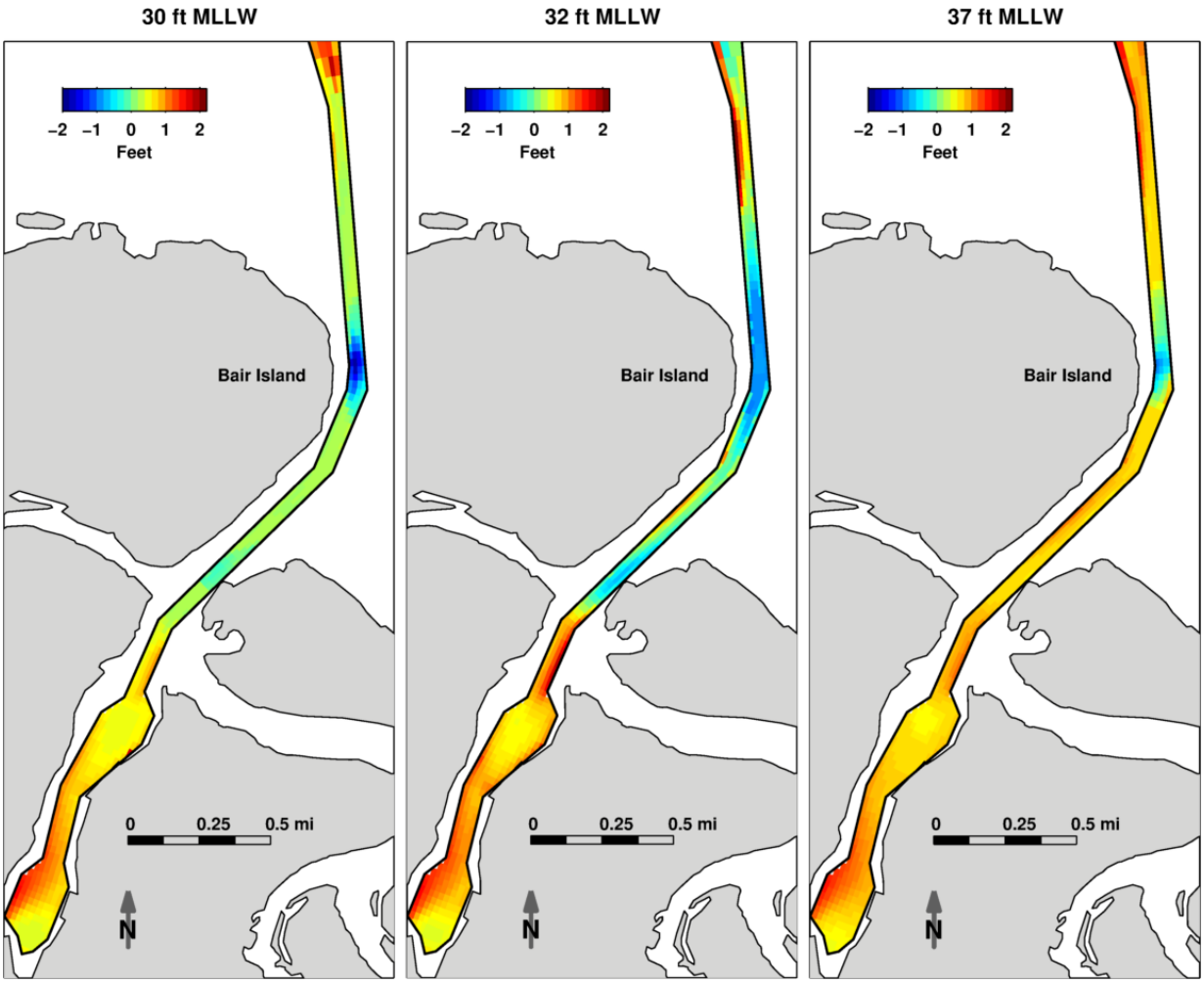


Figure 6.3-2
The predicted sediment deposit thickness in the Redwood City Harbor Channel over the complete year for 30 feet MLLW, 32 feet MLLW, and 37 feet MLLW project depths.

6.3.2 San Bruno Shoal Channel

Increasing the project depth from 30 feet MLLW to either 32 feet MLLW or to 37 feet MLLW was predicted to increase the sedimentation rate in the San Bruno Shoal Channel (Figure 6.3-3, Table 6.3-2). During the fall through winter time period the sedimentation rate was predicted to increase relative to the 30 feet MLLW project depth by 95% for the 32 feet MLLW project depth and by 79% for the 37 feet MLLW project depth (Figure 6.3-3). During the spring through summer time period the sedimentation rate was predicted to increase relative to the 30 feet MLLW project depth by 1% with the 32 feet MLLW project depth and by 94% with the 37 feet MLLW project depth (Figure 6.3-3).

Over the full year, the sedimentation rate in the San Bruno Shoal Channel was predicted to increase relative to the 30 feet MLLW project depth by 54% for the 32 feet MLLW project depth and by 86% for the 37 feet MLLW project depth (Figure 6.3-3, Table 6.3-2). The depositional thickness was also predicted to increase from the 30 feet MLLW to the 32 feet MLLW and to the 37 feet MLLW project depths, especially near the northern and southern ends of the channel (Figure 6.3-4).

The model predicted higher sedimentation rates in the San Bruno Shoal Channel during the fall through winter period than during the spring through summer period. For example, the model predicted a sedimentation rate of 569,000 $yd^3\ yr^{-1}$ during the fall through winter and 427,000 $yd^3\ yr^{-1}$ during the spring through summer periods with the 30 feet MLLW project depth. This increase in sedimentation in the fall through winter period relative to the spring through summer period is likely a result of the close proximity of the San Bruno Shoal Channel to the Central Bay. As the distance to the Central Bay is reduced, there will likely be a corresponding increase in the influence of the first flush and sediment supply from the Delta and North Bay tributaries on sedimentation in the channel. The period simulated is representative of a wet year with a large first flush, and thus the prediction of more sediment deposition in the fall through winter period than in the spring through summer is not surprising, especially considering sedimentation in the Oakland Harbor Channel was predicted to varying strongly with water year type with much higher sediment deposition predicted during wet water years (Delta Modeling Associates 2015).

The potential increase in dredging requirements in the San Bruno Shoal Channel due to increasing the project depth may be greater than the percentage increases in the sedimentation rate developed for the entire San Bruno Shoal Channel. The San Bruno Shoal Channel is currently only infrequently dredged and the majority of the channel is below the existing 30 feet MLLW project depth. Thus some of the deposition which currently occurs within the channel does not require dredging if the existing depth is below the project depth. However, both the 32 feet MLLW and the 37 feet MLLW project depths necessitated the deepening of a large percentage of the channel (Figure 6.1-3), such that deposition in regions that are naturally deeper than 30 feet MLLW but not naturally deeper than 37 feet MLLW would result in a larger maintenance dredging footprint in the deepened channel. A large portion of the deposition in the 30 feet MLLW scenario was predicted to occur in portions of

the channel where the existing depth is below the project depth plus 2 feet of overdepth and thus would not generally be dredged. This highlights that the necessary increase in dredging after deepening from the 30 feet MLLW to either the 32 feet MLLW or to the 37 feet MLLW project depths may be greater than the predicted relative increase in the sedimentation rate in the San Bruno Shoals Channel estimated in the analysis presented in this section.

Table 6.3-2
The predicted sedimentation rate in the San Bruno Shoal Channel for fall through winter, spring through summer, and a complete year.

Date Range	Project Depth (feet MLLW)	Channel Sedimentation Rate ($yd^3\ yr^{-1}$)	Percent Increase Relative To 30 feet MLLW Project Depth
Fall-Winter	30	569,000	N/A
	32	1,112,000	95
	37	1,019,000	79
Spring-Summer	30	427,000	N/A
	32	429,000	1
	37	828,000	94
Complete Year	30	497,000	N/A
	32	766,000	54
	37	922,000	86

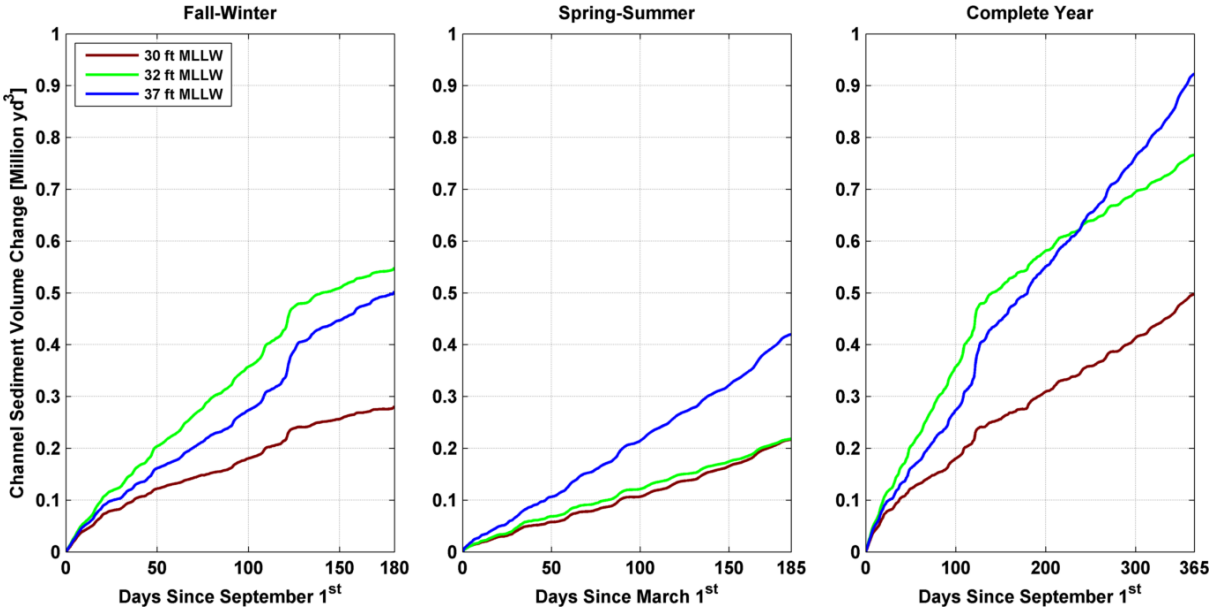


Figure 6.3-3
The predicted volume of sediment deposited in the San Bruno Shoal Channel for 30 feet MLLW, 32 feet MLLW, and 37 feet MLLW project depths.

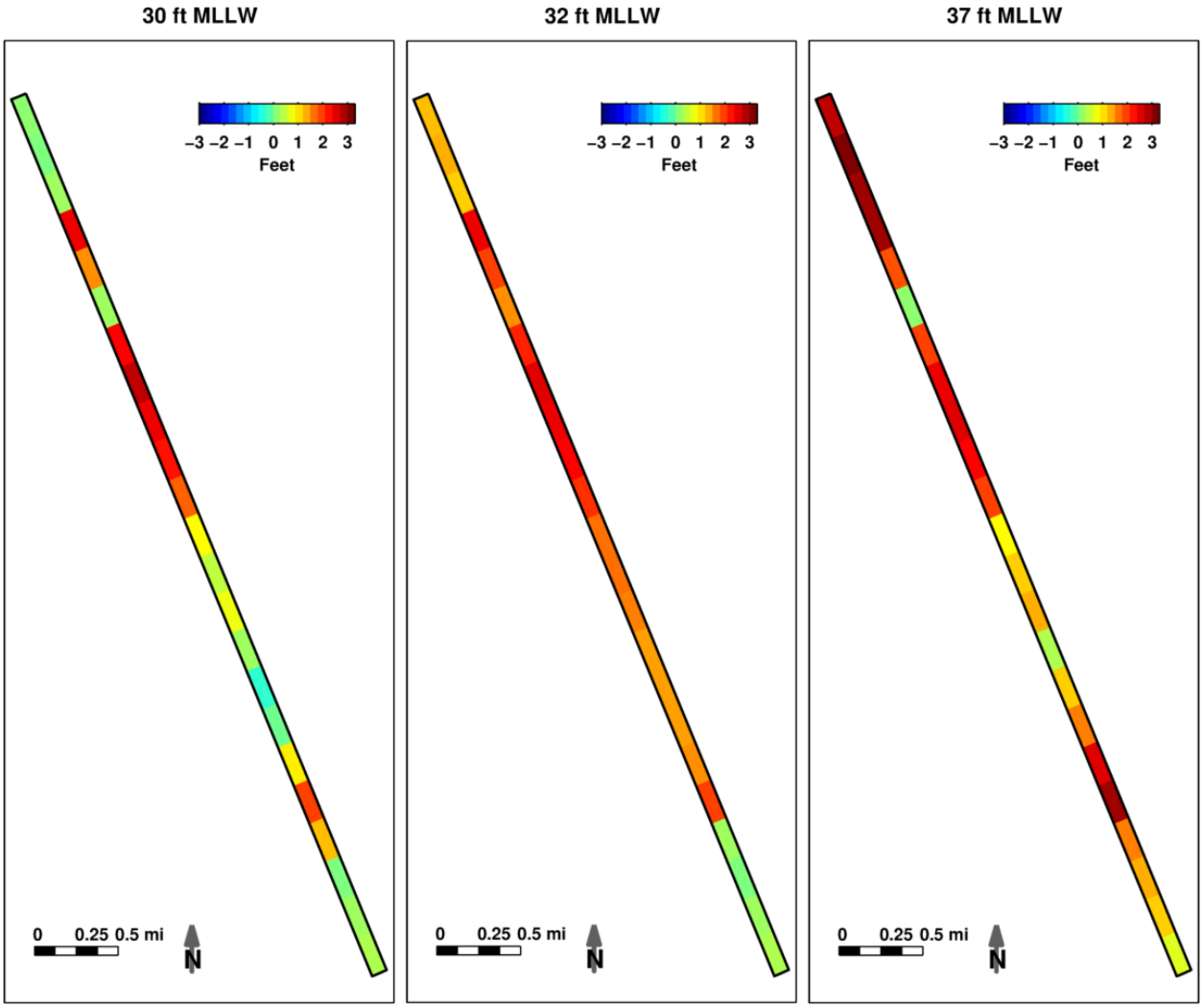


Figure 6.3-4
The predicted sediment deposit thickness in the San Bruno Shoal Channel over the complete year for 30 feet MLLW, 32 feet MLLW, and 37 feet MLLW project depths.

6.4 Project Depth Conclusions

Increasing the project depth from 30 feet MLLW to either 32 feet MLLW or to 37 feet MLLW was predicted to increase sedimentation rates in the Redwood City Harbor Channel and the San Bruno Shoal Channel. This suggests that the proposed channel deepening would result in an increase in annual maintenance dredging in both the Redwood City Harbor Channel and the San Bruno Shoal Channel. The annual sedimentation rate in the Redwood City Harbor Channel was predicted to increase relative to the 30 feet MLLW project depth by 13% with the 32 feet MLLW project depth and by 51% with the 37 feet MLLW project

depth for the full year evaluated. The annual sedimentation rate in the San Bruno Shoal Channel was predicted to increase relative to the 30 feet MLLW project depth by 54% with the 32 feet MLLW project depth and by 86% with the 37 feet MLLW project depth for the full year evaluated. The increases in the sedimentation rate with increasing project depth are consistent with results from Oakland Harbor, where the sedimentation rate was predicted to increase by 34% after deepening from 42 feet MLLW to 46 feet MLLW and by 55% after deepening from 42 feet MLLW to 50 feet MLLW (Delta Modeling Associates 2015). The relative increase in the sedimentation rate caused by deepening project depths is expected to remain relatively constant regardless of the water year type, even if the total deposition volume changes between different years, based on analysis of Oakland Harbor sedimentation rates (Delta Modeling Associates 2015).

The analysis of sedimentation rate over different seasonal time periods suggested the sedimentation rate in the Redwood City Harbor Channel is less sensitive to seasonal influences than the San Bruno Shoal Channel. This is potentially caused by the Redwood City Harbor Channel being located farther from the Central Bay than the San Bruno Shoal Channel. The influence of large sediment supply events from the Delta and North Bay are likely to be lower in the Redwood City Harbor Channel than in the San Bruno Shoal Channel.

Because of the acceptable validation of the modeled sediment deposition volumes in the two channels, yet a very accurate validation of the relative difference in sedimentation between two different years, the model analysis focused on the percentage difference in the sedimentation rate between the scenarios rather than the exact differences in deposition volume. That is, the predicted percentage difference in the sedimentation rate resulting from different project depths will have less uncertainty than the corresponding absolute differences in deposition volumes between scenarios. However, these percentages can be combined with the average observed shoaling rate derived from the hydrosurvey analysis (Section 4) to provide rough estimates of the potential shoaling rates associated with the 32 feet MLLW and 37 feet MLLW project depths. Based on the annual average shoaling rate within the Redwood City Harbor Channel of approximately 183,000 $yd^3\ yr^{-1}$ and the percent increase predicted by the model, this would suggest that annual maintenance dredging for the 32 feet MLLW project depth would average 207,000 $yd^3\ yr^{-1}$, and annual maintenance

dredging for the 37 feet MLLW project depth would average 276,000 yd^3 yr^{-1}. However, these should be treated as approximations due to uncertainty in the model predictions, and potential variations due to interannual variability or future changes to sediment supply in the Bay.

The change in the sedimentation rate predicted for the San Bruno Shoal Channel may underestimate the increase in dredging requirements resulting from deepening the San Bruno Shoal Channel relative to the existing 30 feet MLLW project depth. This is because the results suggest that a larger portion of the channel may begin to experience above grade shoaling and require dredging for both the 32 feet MLLW and 37 feet MLLW project depths than currently occurs for the 30 feet MLLW project depth. After deepening below the existing depths any buffer that currently exists between the existing conditions and the project depth will have been removed and sediment deposition that may not have caused above grade shoaling with the 30 feet MLLW project depth may cause above grade shoaling for both the 32 feet MLLW and the 37 feet MLLW project depths.

7 INFLUENCE OF CHANNEL ALIGNMENT ON SHOALING

The application of the UnTRIM Bay-Delta model (MacWilliams et al. 2007, 2008, 2009, 2015) coupled with the SWAN wave model (SWAN Team 2009a) and the SediMorph sediment transport model (BAW 2005) was used to investigate the effects of a potential realignment of the Redwood City Harbor Channel on shoaling rates and sediment deposition in the hot spot south of Bair Island. Two scenarios were used to estimate how the sedimentation rate in the channels would be changed by a potential realignment using the 37 feet MLLW project depth. This analysis predicted the proposed channel realignment would not decrease the sedimentation rate in the Redwood City Harbor Channel nor alleviate the above grade shoaling south of Bair Island.

7.1 Channel Alignment Overview

Two scenarios were used to evaluate the influence of a proposed realignment of the Redwood City Harbor Channel on sedimentation in the channel. The proposed realignment was designed to increase the distance between the channel and the southeastern side of Bair Island while still considering the ease of navigation. The scenarios evaluated whether this increased distance between the channel and Bair Island could potentially reduce the sediment deposition in the hot spot south of Bair Island.

The two scenarios used in this analysis were based on a 37 feet MLLW project depth and used the same boundary conditions for the base year (2018) described in Section 6. The 37 feet MLLW scenario described in Section 6 was used as the existing channel alignment scenario and a new model grid was created that included a more eastward alignment of the Redwood City Harbor Channel in the vicinity of Bair Island (Figure 7.1-1). The channel realignment was provided by USACE and developed by the Project Delivery Team based on feedback from the San Francisco Bar Pilots (Captain Tonny Coppo) to ensure the alignment would be navigable by vessels entering and exiting Redwood City Harbor. The bathymetry for the realignment grid was based on the most current hydrosurvey data, as explained in Section 6. The area within the realigned channel was set as the deeper of the hydrosurvey data or 37 feet MLLW plus 2 feet of overdepth. A 3:1 side slope was used outside of the channel. The region of the existing channel alignment that did not overlap with the realigned channel was not infilled to the surrounding mudflat elevation, but was rather left

as the relatively deep existing channel conditions. This method produced a realigned channel that only differed from the 37 feet MLLW scenario in the region around the channel realignment, with the remainder of the Redwood City Harbor Channel identical between the two scenarios.

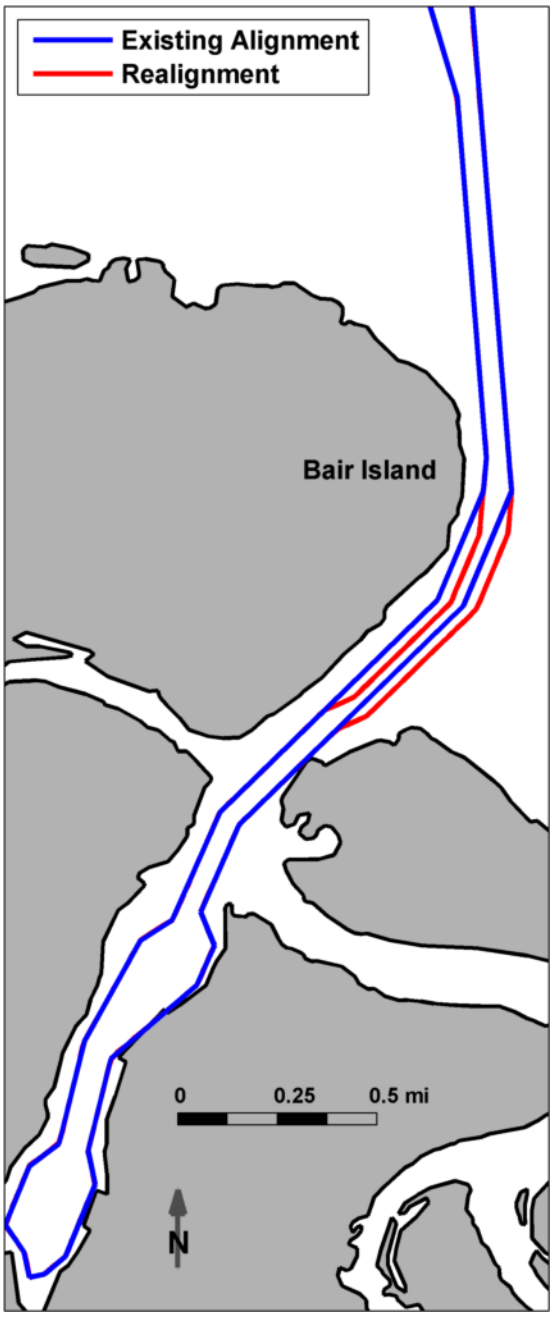


Figure 7.1-1
The existing alignment and proposed future alignment of the Redwood City Harbor Channel.

7.2 Influence of Channel Alignment on Sedimentation

The realignment of the Redwood City Harbor Channel was predicted to slightly increase the sedimentation rate in the channel. The sedimentation rate was predicted to increase in the realignment scenario relative to the 37 feet MLLW scenario by 3% over the fall through winter period, by 3% over the spring through summer period, and by 3% over the complete year (Figure 7.2-1, Table 7.2-1). Although the predicted sediment deposition thickness was very similar throughout the channel for the two scenarios, the realignment scenario did predict an increase in the deposition thickness of about 0.25 foot around the hot spot south of Bair Island over the one year simulation period (Figure 7.2-2). In the realignment scenario, the model predicted some erosion of the seabed in the portion of the existing channel that was excluded from the realignment channel, some of which likely deposited in the realigned channel and partially contributed to the predicted increase in sediment deposition south of Bair Island.

Table 7.2-1
The predicted sedimentation rate in the Redwood City Harbor Channel for fall through winter, spring through summer, and a complete year with the 37 feet MLLW project depth.

Date Range	Channel Alignment	Channel Sedimentation Rate [$yd^3\ yr^{-1}$]	Percent Increase Relative To Current Alignment
Fall-Winter	Existing	209,000	N/A
	Realignment	215,000	3
Spring-Summer	Existing	195,000	N/A
	Realignment	201,000	3
Complete Year	Existing	202,000	N/A
	Realignment	208,000	3

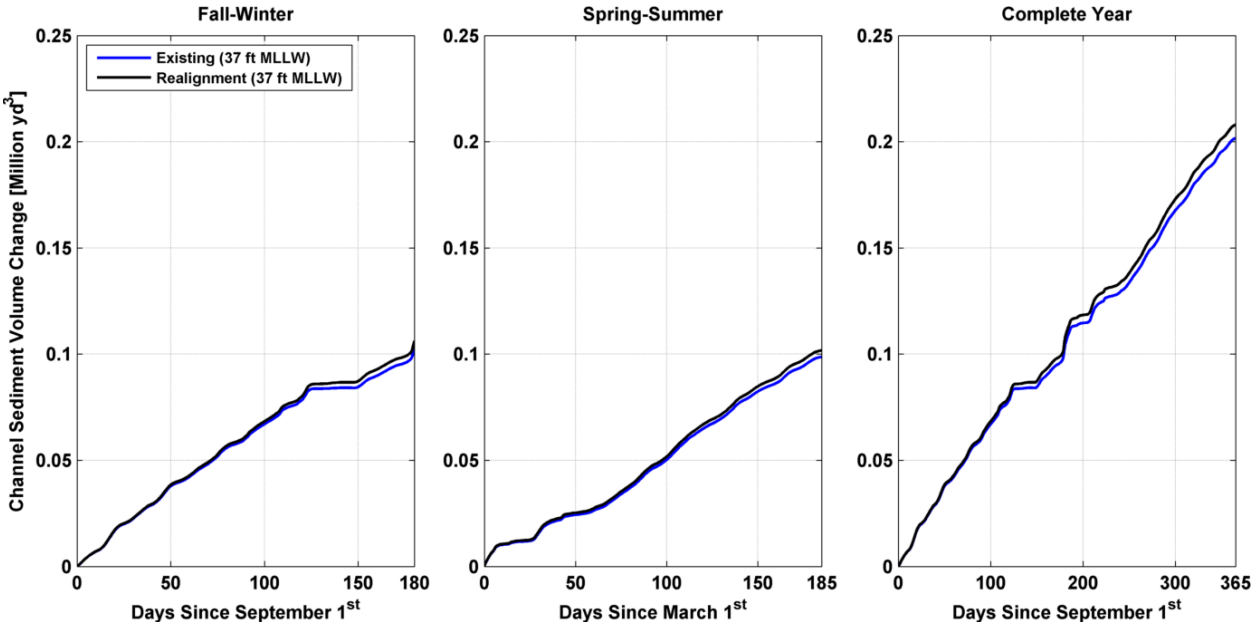


Figure 7.2-1
The predicted volume of sediment deposited in the Redwood City Harbor Channel for the existing alignment and proposed realignment scenarios.

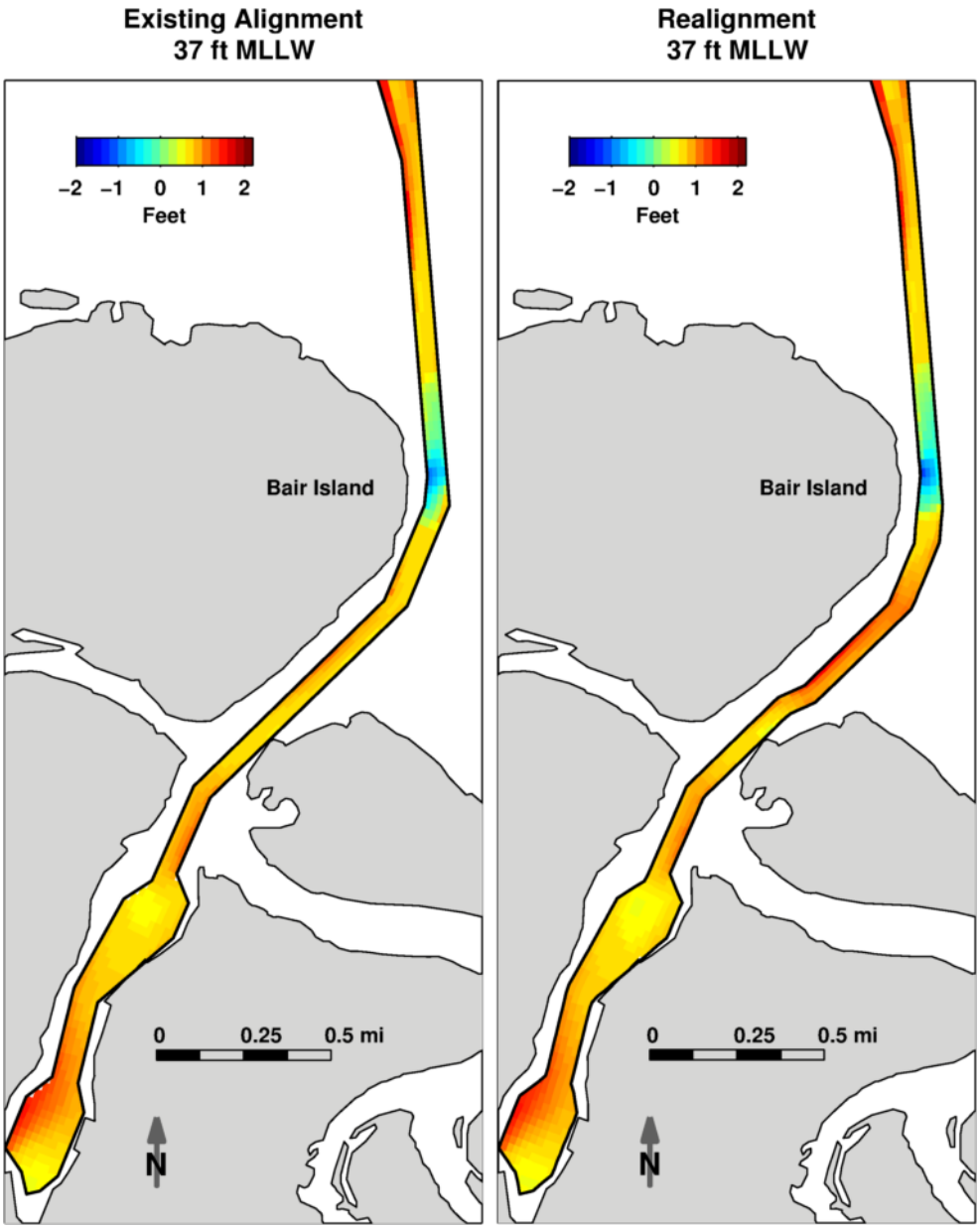


Figure 7.2-2
The predicted depositional thickness in the Redwood City Harbor Channel for the existing alignment and proposed realignment scenarios.

7.3 Channel Alignment Conclusions

The proposed realignment of the Redwood City Harbor Channel was predicted to have a minimal effect on the sedimentation in the channel with a 37 feet MLLW project depth, and thus the realignment was predicted to not likely decrease shoaling south of Bair Island with

project depths from 30 feet MLLW to 37 feet MLLW. The sedimentation rate was predicted to increase by 3% in the realignment scenario compared to the existing alignment. The thickness of the hot spot south of Bair Island was also predicted to increase in the realignment scenario relative to the existing alignment scenario.

The 37 feet MLLW project depth was used for the realignment scenarios because it had a higher predicted sedimentation rate in the Redwood City Harbor Channel than either the 30 feet MLLW or the 32 feet MLLW scenarios. Because there was more sediment deposition predicted for the 37 feet MLLW scenario, it is also likely that the scenario would show more sensitivity to the proposed channel realignment than the 30 feet MLLW and the 32 feet MLLW simulations. Because the proposed realignment did not result in a significant decrease in the sedimentation south of Bair Island for the 37 feet MLLW project depth, it is not expected that the realignment would significantly change the shoaling rate for either the 30 feet MLLW or the 32 feet MLLW project depths.

8 INFLUENCE OF PROJECT DEPTH ON HYDRODYNAMICS AND SEDIMENT DEPOSITION IN THE VICINITY OF THE REDWOOD CITY HARBOR CHANNEL

The UnTRIM Bay-Delta model was applied to evaluate potential effects on hydrodynamics and sediment deposition in the vicinity of the Redwood City Harbor Channel and Bair Island resulting from deepening the project depth from 30 feet MLLW to 32 feet MLLW. Without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions were evaluated for effects on the hydrodynamics under both Year 0 and Year 50 conditions over a 2-week period that included elevated outflow from Redwood Creek, high winds, and spring tides, resulting in a total of four scenarios. The influence of deepening the project depth on the hydrodynamics was determined by examining the water level, tidal flows, salinity, and shear stress in the vicinity of the Redwood City Harbor Channel and Bair Island. Without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions were evaluated for effects on sediment deposition outside of the Redwood City Harbor Channel under Year 0 conditions over the one year simulations detailed in Section 6.

Five additional scenarios were used to assess the effects of the channel deepening on peak water levels and storm surge in the Redwood City Harbor during a large storm event. One simulation was used to validate the peak water levels during the December 1983 storm, which had the second highest recorded water level at San Francisco at Fort Point and highest recorded water level at the NOAA Redwood City tide gauge (MacWilliams et al. 2012b). This storm event was then simulated under without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions for both Year 0 and Year 50 conditions which included sea level rise. These four scenarios were used to determine the effect of increasing the project depth on water level resonance in Redwood City by examining the peak water levels in each scenario.

8.1 Model Scenarios Overview

8.1.1 Effect of Increased Project Depth on Hydrodynamics

Because the exact weather, hydrology, and operating conditions cannot be predicted in advance, representative conditions for 2018 (Year 0) and 2068 (Year 50) were developed for the hydrodynamic simulations using 2005 hydrology, and modified to account for both sea level rise and to include changes to the Bair Island Restoration Project that are expected to

occur prior to 2018. The period from December 25 through January 8 was used for the evaluation of the effects of deepening the project depth on the water surface elevation, water flow, salinity, and bed shear stress in the vicinity of the Redwood City Harbor Channel and Bair Island. This period includes a historic storm that provided the necessary combination of Redwood Creek inflow, tides, and winds to examine how deepening the project depth will affect the hydrodynamics during a large storm event. Validation of the water level and salinity in the Central Bay and the South Bay during this analysis period under historic conditions is included in the validation period used for the sediment transport simulations (Appendix C).

The first set of four scenarios simulated without-project and with-project conditions from December 25 through January 8 under both Year 0 and Year 50 conditions. These scenarios were used to determine the effects of increasing the project depth on water levels, flows, salinity, and shear stress in the vicinity of the Redwood City Harbor Channel and Bair Island (Table 8.1-1). The four modeled scenarios included without-project and with-project conditions and included both a restored Bair Island (Figure 6.1-1) and sea level rise (Table 8.1-1). For the without-project conditions, the bathymetry inside the Redwood City Harbor Channel was set as the deeper of the existing conditions or 30 feet MLLW plus 2 feet of overdepth, for a total minimum depth of 32 feet MLLW. For the with-project conditions, the bathymetry inside the Redwood City Harbor Channel was set as the deeper of the existing conditions or 32 feet MLLW plus 2 feet of overdepth, for a total minimum depth of 34 feet MLLW. Channel side slopes of 3:1 were applied from the edge of the channel and any areas shallower than the design side slopes were also deepened based on the distance from the channel.

Sea level rise was included in the without-project and with-project scenarios by adjusting the San Francisco at Fort Point (NOAA 9414290) water level from the model forcing year of 2005 for the projected sea level rise from 2005 to the project start year (Year 0, 2018) and from 2005 to 50 years after the project start year (Year 50, 2068). A projected sea level rise of 0.09 foot from the model forcing year (2005) to Year 0 was applied based on the NRC curve 1 (USACE 2014). The NRC curve 1 was used to adjust for sea level rise from 2005 to 2018 because the sea level rise in the San Francisco Bay over the last 30 years has been below the historic trend. Using the NRC curve 3 for the relatively near-term project start year of 2018

would largely overpredict the sea level rise between the model forcing year and the project base year (Year 0). A projected sea level rise of 2.51 feet from the model forcing year to Year 50 was applied based on the NRC curve 3 (USACE 2014).

8.1.2 Effect of Increased Project Depth on Water Level Resonance in Redwood City Harbor

Five scenarios were used to evaluate the effects of the channel deepening on peak water levels and storm surge in the Redwood City Harbor during a large storm event (Table 8.1-2). One simulation was used to validate the predicted peak water levels during the December 1983 storm under historic conditions. This scenario used the Redwood City Harbor Channel bathymetry based on hydrosurvey data from December 24, 2005, as explained in Section 5.1.4. The model validation focused on the period between November 26 and December 8, 1983. This time period included the highest water level ever recorded at the NOAA Redwood City station and the second highest water level on record at the NOAA San Francisco tide gauge (MacWilliams et al. 2012b).

Without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions were then simulated for both Year 0 and Year 50 conditions which included sea level rise (Table 8.1-2). For each of these scenarios, the Bair Island configuration and bathymetry of the without-project and with-project Redwood City Harbor Channel were specified for the Year 0 and Year 50 scenarios as explained in Section 8.1.1. These four scenarios were used to determine the effect of increasing the project depth on water level resonance in the Redwood City Harbor by examining the peak water levels in each scenario. For each of these scenarios, the period between November 26 and December 8 was evaluated.

Sea level rise was included in the Year 0 and Year 50 scenarios by adjusting the San Francisco at Fort Point (NOAA 9414290) water level from the model forcing year of 1983 for the projected sea level rise from 1983 to Year 0 (2018) and from 1983 to Year 50 (2068). The amount of projected sea level rise was determined in two steps because the USACE guidance started in 1992 (USACE 2014). First, the sea level rise from 1983 to 1992 was estimated and then the sea level rise from 1992 to 2018 and from 1992 to 2068 was calculated. The sea level rise from 1983 to 1992 was estimated to be 0.05 foot based on a eustatic sea level rise of

0.005577 ft yr^{-1} (1.7 mm yr^{-1}, USACE 2014). For the Year 0 scenarios, the NRC curve 1 was then used to determine a sea level rise from 1992 to 2018 of 0.18 feet. For the Year 0 scenarios, the water level at San Francisco at Fort Point (NOAA 9414290) was adjusted by a total of 0.23 foot to account for sea level rise between 1983 and 2018. The NRC curve 1 was used to adjust for sea level rise from 1992 to 2018. The NRC curve 3 was used to determine a sea level rise of 2.66 feet from 1992 to 2068 (USACE 2014). For the Year 50 scenarios the water level at San Francisco at Fort Point (NOAA 9414290) was adjusted by a total of 2.71 feet to account for sea level rise between 1983 and 2068.

Table 8.1-1
The scenario matrix used to determine how deepening the project depth will affect the hydrodynamics in the Redwood City Harbor Channel. These scenarios were also used for the ship simulation flow field output detailed in Section 9.

Scenario	Channel Project Depth (feet MLLW)	Project Year For Sea Level Rise	Model Forcing Year
1	30 (Without-Project)	Year 0 (2018)	2005
2	32 (With-Project)		
3	30 (Without-Project)	Year 50 (2068)	
4	32 (With-Project)		

Table 8.1-2
The scenario matrix used to determine how deepening the project depth will affect the water level resonance and the peak water level in the Redwood City Harbor Channel.

Scenario	Channel Project Depth (feet MLLW)	Project Year For Sea Level Rise	Model Forcing Year
1	2005 Hydrosurvey Data	No Sea Level Rise	1983
2	30 (Without-Project)	Year 0 (2018)	
3	32 (With-Project)		
4	30 (Without-Project)	Year 50 (2068)	
5	32 (With-Project)		

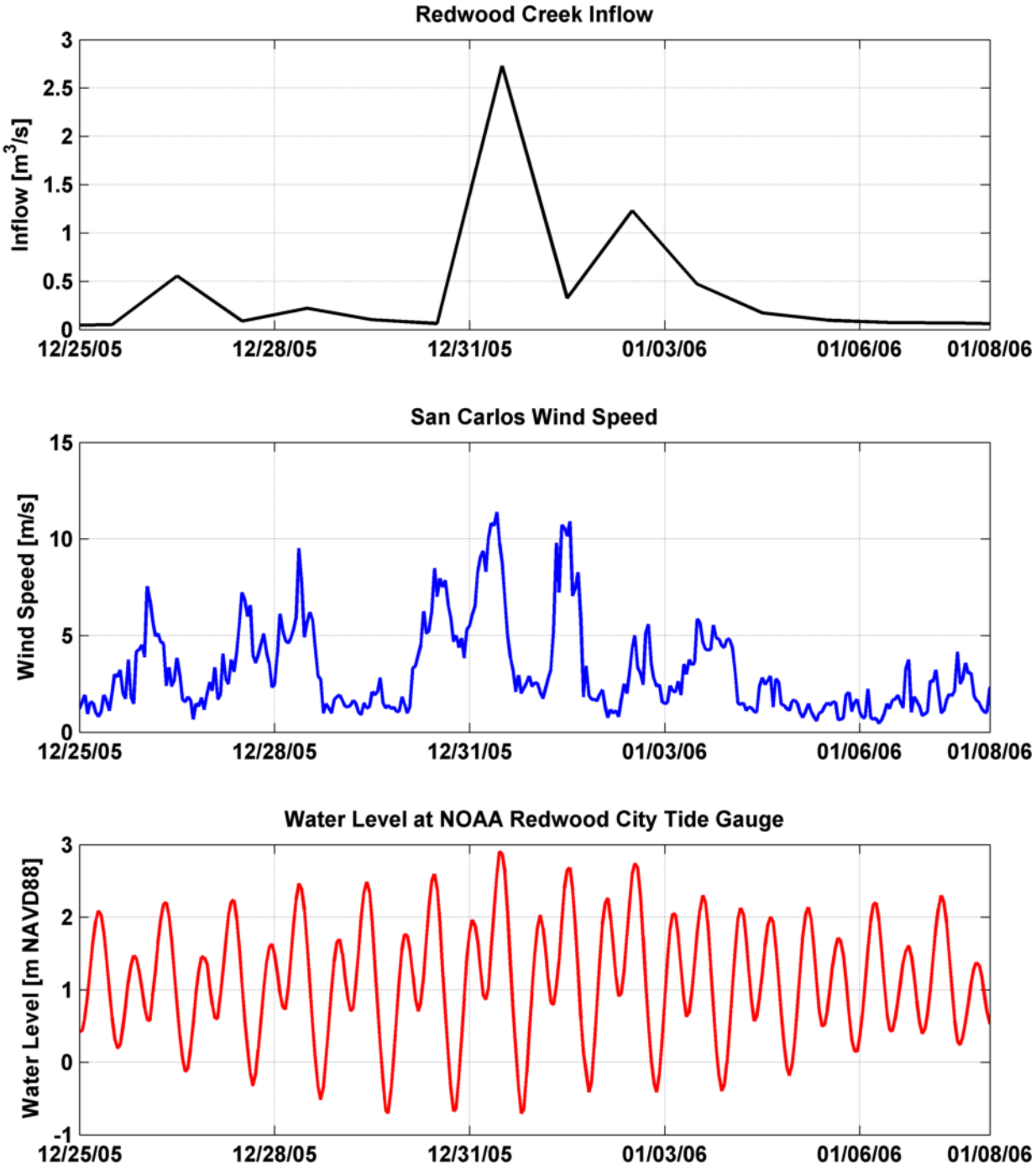


Figure 8.1-1
The Redwood Creek inflow, wind speed at San Carlos, and observed water level at the Redwood City NOAA tide gauge during the 2-week analysis period in December 2005 and January 2006 used to develop Year 0 and Year 50 conditions.

8.2 Effect of Increased Project Depth on Hydrodynamics

The model validation presented in Appendix C demonstrates that the model accurately predicted the water level and salinity at the Central Bay and South Bay validation stations, based on the thresholds for model accuracy detailed in MacWilliams et al. (2015).

The water levels in the vicinity of Bair Island, the water flow through channel cross sections in the vicinity of Bair Island, the salinity in the vicinity of Bair Island, and the bed shear stress were used to determine the effect of increasing the project depth on hydrodynamics in both the Year 0 and Year 50 scenarios. The model predictions were analyzed for the period between December 25 and January 8 detailed in Section 8.1.1 for both Year 0 (2018) and Year 50 (2068) conditions.

8.2.1 Effect of Increased Project Depth on Water Level, Flow, and Salinity

Water level (Figure 8.2-1), flow (Figure 8.2-2), and salinity (Figure 8.2-3), were examined at eight locations in the vicinity of Redwood City Harbor and Bair Island. Increasing the project depth from 30 feet MLLW to 32 feet MLLW was predicted to have essentially no effect on the water levels in the vicinity of Redwood City Harbor and Bair Island for both the Year 0 and the Year 50 scenarios. The model predicted nearly the same tidal phase, peak water level, mean water level, and tidal water level ranges throughout the Redwood City Harbor Channel and Bair Island in the without-project and with-project conditions for both the Year 0 (Figures 8.2-4 through 8.2-11, Table 8.2-1) and the Year 50 scenarios (Figures 8.2-12 through 8.2-19, Table 8.2-1).

The model also predicted increasing the project depth will have very little effect on the flow in the vicinity of Bair Island in both the Year 0 and the Year 50 scenarios. The model predicted nearly the same tidal phase, peak flow, mean flow magnitude, and tidal flow magnitude ranges throughout the Redwood City Harbor Channel and Bair Island for the without-project and with-project conditions in both the Year 0 (Figures 8.2-20 through 8.2-27, Table 8.2-2) and the Year 50 scenarios (Figures 8.2-28 through 8.2-35, Table 8.2-2).

Increasing the project depth from 30 feet MLLW to 32 feet MLLW was predicted to have very little effect on the salinity in the vicinity of Bair Island for both the Year 0 and the Year

50 scenarios. The model predicted nearly the same phasing of salinity and the same decrease in salinity over the duration of the scenarios at all eight analyzed locations in the without-project and with-project conditions for both the Year 0 (Figures 8.2-36 through 8.2-43) and the Year 50 scenarios (Figures 8.2-44 through 8.2-51). The mean difference in salinity between the without-project and with-project conditions was less than 0.1 PSU at all eight locations evaluations for both the Year 0 and Year 50 scenarios (Table 8.2-3).

8.2.2 Effect of Increased Project Depth on Shear Stress

The bed shear stress was examined spatially in the vicinity of the Redwood City Harbor Channel and Bair Island during slack water, peak flood velocity, and peak ebb velocity. Figure 8.2-52 highlights the timing of the peak velocities in the northern portion of the Redwood City Harbor Channel, centered around the elevated discharge from Redwood Creek, for the 30 feet MLLW project depth Year 0 scenario. For the Year 0 scenarios the shear stress was evaluated on December 31, 2018 at 06:00 (slack water), December 31, 2018 at 07:30 (peak flood), and December 31, 2018 at 15:45 (peak ebb). The timing of peak flood, slack water, and peak ebb were predicted to only change by up to 15 minutes (one output time step) in the Year 50 scenarios relative to the Year 0 scenarios. For the Year 50 scenarios the shear stress was evaluated on December 31, 2068 at 05:45 (slack water), December 31, 2068 at 07:15 (peak flood), and December 31, 2068 at 15:45 (peak ebb).

The shear stress maps were generated using the near-bed velocity predicted in the UnTRIM hydrodynamic simulations. Within each grid cell the bed shear stress was calculated as:

$$\tau = \rho C_d u_b^2$$

where ρ is the density of water, C_d is the drag coefficient, and u_b is the predicted velocity one meter above the bed. The drag coefficient applied was 0.0025 at one meter above the bed, as used in MacWilliams and Cheng (2008) and MacWilliams (2011). This value of the drag coefficient is consistent with the sediment transport analysis conducted as part of the Hamilton Wetlands Restoration Aquatic Transfer Facility technical study (Sea Engineering 2008).

Increasing the project depth from 30 feet MLLW to 32 feet MLLW was predicted to have a minimal effect on the bed shear stress in the vicinity of the Redwood City Harbor Channel and Bair Island near slack water (Figure 8.2-53), during peak flood tide (Figure 8.2-54), and during peak ebb tide (Figure 8.2-55) in the Year 0 scenarios. In the Year 50 scenarios, increasing the project depth from 30 feet MLLW to 32 feet MLLW was also predicted to have a minimal effect on the bed shear stress near slack water (Figure 8.2-56), during peak flood tide (Figure 8.2-57), and during peak ebb tide (Figure 8.2-58).

8.2.3 Effect of Increased Project Depth on Bair Island Sedimentation and the Mudflat Surrounding the Redwood City Harbor Channel

Analysis was conducted on the sedimentation in Bair Island and on the mudflat surrounding the Redwood City Harbor Channel to determine the effects of increasing the project depth on sedimentation in these two areas. This analysis used the without-project (30 feet MLLW) and with-project (32 feet MLLW) Year 0 simulations from Section 6 that were a full year long. The predicted sediment depositional volumes in five subregions of Bair Island were analyzed to determine if the deepening of the Redwood City Harbor Channel will influence the sediment transported into Bair Island. The five evaluated subregions were the three planned restoration areas of Inner Bair Island, Middle Bair Island, and Outer Bair Island, and the Middle Bair Island marsh and Outer Bair Island marsh (Figure 8.2-59). The change in sediment deposition thickness surrounding the Redwood City Harbor Channel was used to determine if the mudflats surrounding the channel are predicted to erode after deepening of the navigation channel.

The model predicted Bair Island to be net depositional during the simulated period, and that the increase in the project depth had a negligible effect on the amount of sediment predicted to accumulate in Bair Island. The average sediment depositional thickness in each Bair Island region was predicted to change by less than 0.001 feet after deepening from 30 feet MLLW to 32 feet MLLW (Table 8.2-4). The very small difference in the predicted sedimentation in Bair Island with increasing project depths indicates only a minimal predicted effect on the net sediment deposition in Bair Island from deepening the Redwood City Harbor Channel.

Figure 8.2-60 shows the difference in sedimentation between the 30 feet MLLW and the 32 feet MLLW scenarios over the full one-year simulation. Positive values indicate the seabed elevation in the deepened project depth scenario was predicted to be higher than in the 30 feet MLLW scenario, either due to increased deposition or decreased erosion in the deepened project depth scenario relative to the 30 feet MLLW scenario. Negative values indicate the seabed elevation in the deepened project depth scenario was predicted to be lower than the 30 feet MLLW scenario, either due to decreased deposition or increased erosion in the deepened project depth scenario relative to the 30 feet MLLW scenario.

Figure 8.2-60 highlights that the model predicted relatively little effect of deepening the Redwood City Harbor Channel project depth on sedimentation on the surrounding mudflat. The extent of differences in the seabed between the 30 feet MLLW and the 32 feet MLLW scenarios of more than 0.1 inch was generally limited to within one or two grid cells from the Redwood City Harbor Channel. Over the majority of the mudflats surrounding the Redwood City Harbor Channel the model predicted less than 0.1 inch of difference in the sediment deposition or erosion thicknesses from deepening the project depth. The deepening of the Redwood City Harbor Channel was predicted to have a negligible influence on the mudflats surrounding the channel because the model predicted relatively small changes to the deposition, erosion, and seabed elevation surrounding the Redwood City Harbor Channel between the 30 feet MLLW scenario and the scenarios with increased project depth. An exception to the predictions of negligible changes in the deposition or erosion thicknesses was seen on the side slopes and grid cells immediately adjacent to the channel. However, this region directly adjacent to the channel would be expected to show changes in the sedimentation between the scenarios because the depths of this region also increased with the increases in project depth.

Table 8.2-1
Predicted water levels in the vicinity of the Redwood City Harbor Channel and Bair Island under without-project and with-project conditions for the Year 0 and Year 50 scenarios during the two week analysis period.

Location	Project Year For Sea Level Rise	Channel Project Depth (feet MLLW)	Mean Water Level [m NAVD88]	Peak Water Level [m NAVD88]	RMS Difference in Tidally-Averaged Water Level (m)
Redwood City Harbor Channel	Year 0 (2018)	30 (Without-Project)	1.246	2.945	0.000
		32 (With-Project)	1.246	2.946	
	Year 50 (2068)	30 (Without-Project)	1.977	3.683	0.000
		32 (With-Project)	1.977	3.684	
Corkscrew Slough	Year 0 (2018)	30 (Without-Project)	1.268	2.952	0.000
		32 (With-Project)	1.268	2.953	
	Year 50 (2068)	30 (Without-Project)	1.979	3.686	0.000
		32 (With-Project)	1.979	3.687	
Redwood City Tide Gauge	Year 0 (2018)	30 (Without-Project)	1.250	2.966	0.001
		32 (With-Project)	1.250	2.965	
	Year 50 (2068)	30 (Without-Project)	1.981	3.692	0.000
		32 (With-Project)	1.981	3.693	
Steinberger Slough	Year 0 (2018)	30 (Without-Project)	1.331	2.911	0.000
		32 (With-Project)	1.331	2.912	
	Year 50 (2068)	30 (Without-Project)	1.997	3.662	0.000
		32 (With-Project)	1.997	3.662	
Bair Island Marsh	Year 0 (2018)	30 (Without-Project)	1.996	2.924	0.000
		32 (With-Project)	1.996	2.924	
	Year 50 (2068)	30 (Without-Project)	2.265	3.677	0.000
		32 (With-Project)	2.265	3.677	
Outer Bair Island	Year 0 (2018)	30 (Without-Project)	1.603	2.927	0.000
		32 (With-Project)	1.603	2.927	
	Year 50 (2068)	30 (Without-Project)	2.084	3.676	0.000
		32 (With-Project)	2.084	3.676	
Middle Bair Island	Year 0 (2018)	30 (Without-Project)	1.538	2.933	0.000
		32 (With-Project)	1.538	2.933	
	Year 50 (2068)	30 (Without-Project)	2.070	3.683	0.000
		32 (With-Project)	2.070	3.683	
Inner Bair Island	Year 0 (2018)	30 (Without-Project)	1.455	2.961	0.000
		32 (With-Project)	1.455	2.960	
	Year 50 (2068)	30 (Without-Project)	2.037	3.681	0.000
		32 (With-Project)	2.037	3.682	

Table 8.2-2
Predicted water flows in the vicinity of the Redwood City Harbor Channel and Bair Island under without-project and with-project conditions for the Year 0 and Year 50 scenarios during the two week analysis period.

Location	Project Year For Sea Level Rise	Channel Project Depth (feet MLLW)	Mean Flow Magnitude (m^3/s)	Peak Flow Magnitude (m^3/s)	RMS Difference in Tidally-Averaged Flow (m^3/s)
Redwood City Harbor Channel (Northern)	Year 0 (2018)	30 (Without-Project)	4.390	14.160	0.003
		32 (With-Project)	4.394	14.384	
	Year 50 (2068)	30 (Without-Project)	5.803	15.086	0.019
		32 (With-Project)	5.830	15.142	
Corkscrew Slough	Year 0 (2018)	30 (Without-Project)	0.827	3.662	0.001
		32 (With-Project)	0.828	3.688	
	Year 50 (2068)	30 (Without-Project)	1.297	3.789	0.002
		32 (With-Project)	1.298	3.793	
Redwood City Harbor Channel (Southern)	Year 0 (2018)	30 (Without-Project)	1.612	4.561	0.001
		32 (With-Project)	1.612	4.617	
	Year 50 (2068)	30 (Without-Project)	2.084	5.276	0.004
		32 (With-Project)	2.086	5.271	
Steinberger Slough	Year 0 (2018)	30 (Without-Project)	2.065	6.899	0.001
		32 (With-Project)	2.064	6.913	
	Year 50 (2068)	30 (Without-Project)	3.181	7.191	0.002
		32 (With-Project)	3.177	7.162	
Corkscrew Slough Flow Constrictor	Year 0 (2018)	30 (Without-Project)	0.217	0.981	0.000
		32 (With-Project)	0.217	0.986	
	Year 50 (2068)	30 (Without-Project)	0.339	1.038	0.000
		32 (With-Project)	0.340	1.045	
Outer Bair Island Breach	Year 0 (2018)	30 (Without-Project)	0.402	1.775	0.000
		32 (With-Project)	0.402	1.784	
	Year 50 (2068)	30 (Without-Project)	0.697	1.860	0.001
		32 (With-Project)	0.696	1.840	
Middle Bair Island Breach	Year 0 (2018)	30 (Without-Project)	0.383	1.752	0.000
		32 (With-Project)	0.383	1.744	
	Year 50 (2068)	30 (Without-Project)	0.609	1.851	0.000
		32 (With-Project)	0.609	1.845	
Inner Bair Island Breach	Year 0 (2018)	30 (Without-Project)	0.173	0.500	0.001
		32 (With-Project)	0.173	0.493	
	Year 50 (2068)	30 (Without-Project)	0.203	0.501	0.001
		32 (With-Project)	0.204	0.508	

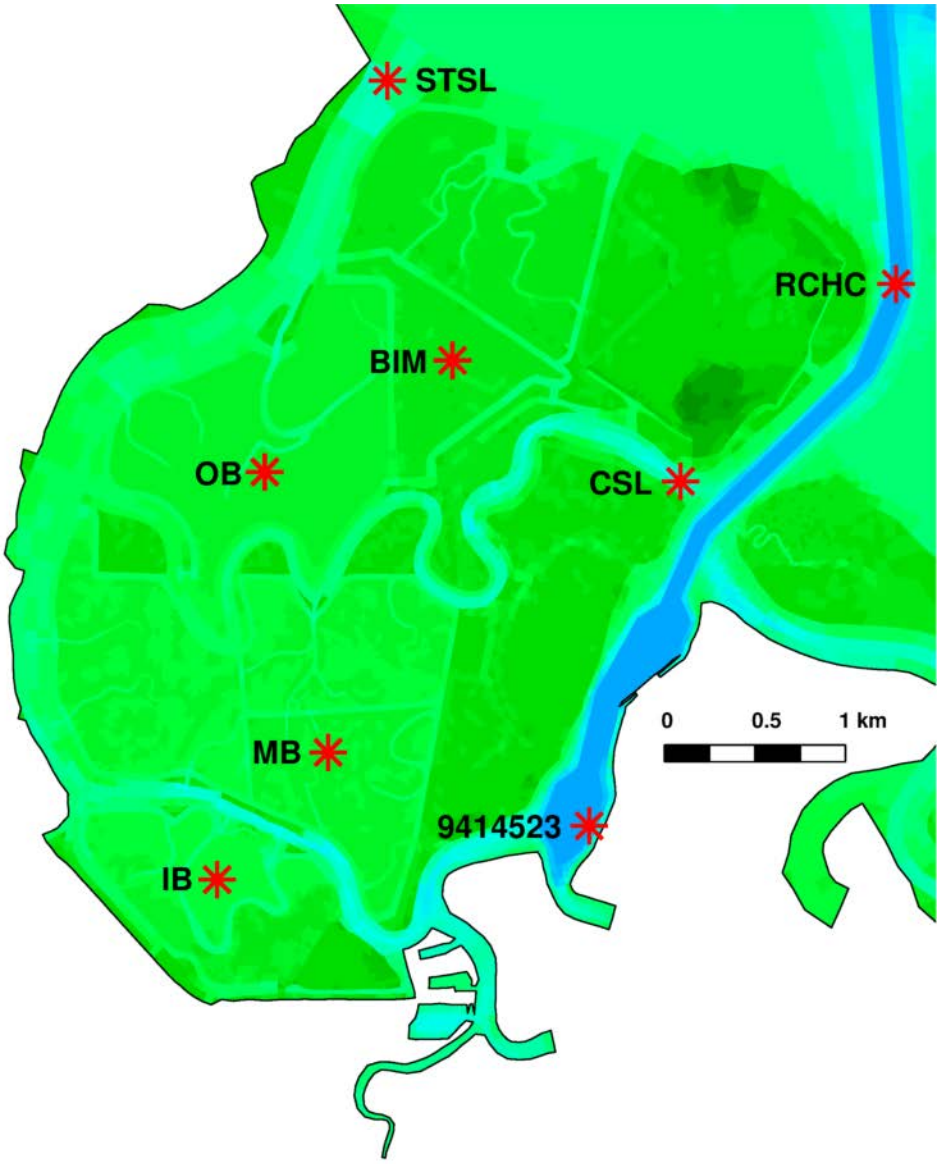
Table 8.2-3
Predicted differences in salinity in the vicinity of the Redwood City Harbor Channel and Bair Island between without-project and with-project conditions for the Year 0 and Year 50 scenarios during the two week analysis period.

Location	Project Year For Sea Level Rise	Mean Difference (PSU)	Maximum Difference in Daily-Average Salinity (PSU)
Redwood City Harbor Channel	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1
Corkscrew Slough	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1
Redwood City Tide Gauge	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1
Steinberger Slough	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1
Bair Island Marsh	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1
Outer Bair Island	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1
Middle Bair Island	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1
Inner Bair Island	Year 0 (2018)	<0.1	<0.1
	Year 50 (2068)	<0.1	<0.1

Table 8.2-4

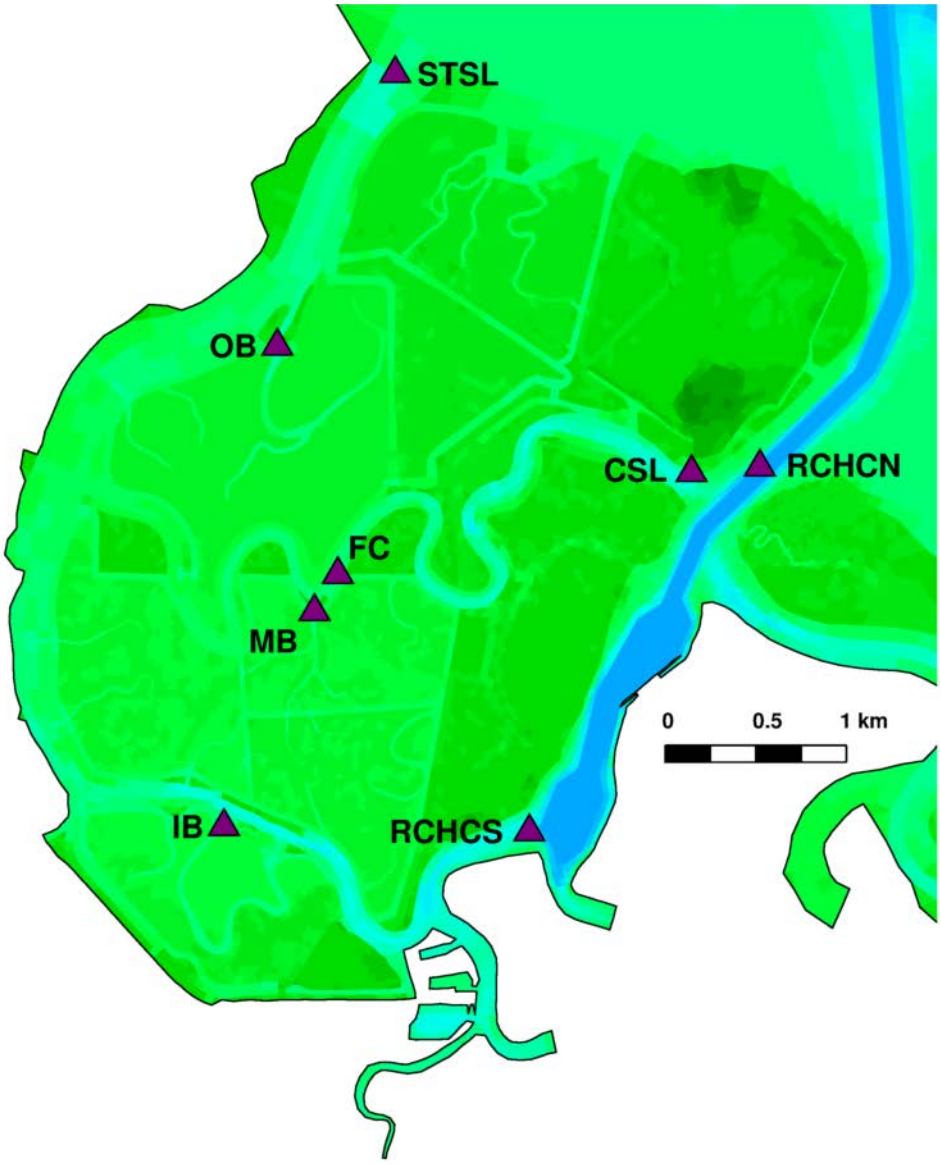
Predicted change in the average deposition thickness in each subregion of Bair Island after deepening the Redwood City Harbor Channel from 30 feet MLLW to 32 feet MLLW.

Bair Island Subregion	Predicted Change in Depositional Thickness [feet]
Outer Bair Island	<0.001
Middle Bair Island	<0.001
Inner Bair Island	<0.001
Middle Bair Island Marsh	<0.001
Outer Bair Island Marsh	<0.001



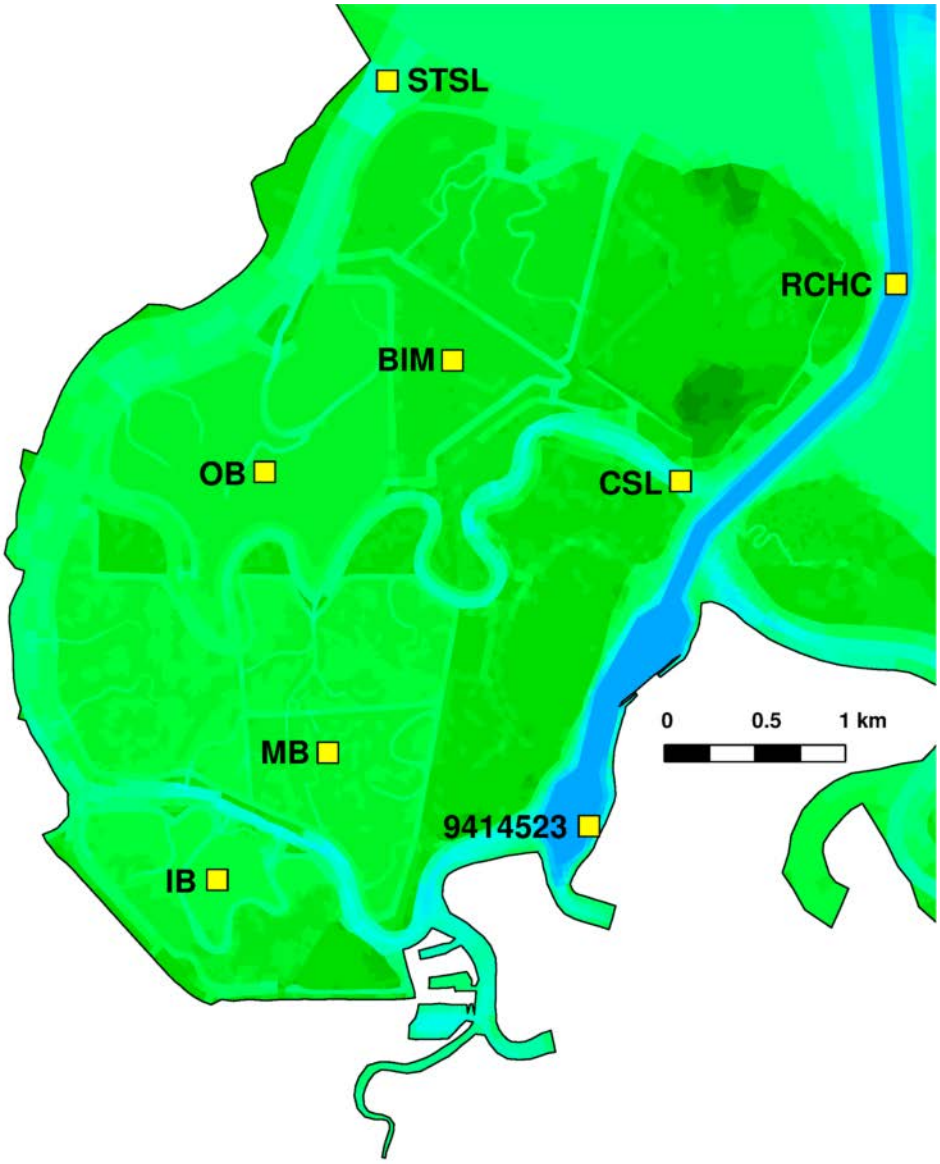
Redwood City Harbor Channel (RCHC)
Corkscrew Slough Near Redwood City Harbor Channel (CSL)
NOAA Redwood City Tide Gauge (9414523)
Steinberger Slough (STSL)
Bair Island Marsh (BIM)
Outer Bair Island (OB)
Middle Bair Island (MB)
Inner Bair Island (IB)

Figure 8.2-1
The locations used to determine the effects of deepening the Redwood City Harbor Channel project depth on water level in the vicinity of the Redwood City Harbor Channel and Bair Island.



Redwood City Harbor Channel North (RCHCN)
Corkscrew Slough Near Redwood City Harbor Channel (CSL)
Redwood City Harbor Channel South (RCHCS)
Steinberger Slough (STSL)
Corkscrew Slough Flow Constrictor (FC)
Outer Bair Island Breach (OB)
Middle Bair Island Breach (MB)
Inner Bair Island Breach (IB)

Figure 8.2-2
The locations used to determine the effects of deepening the Redwood City Harbor Channel project depth on water flow in the vicinity of the Redwood City Harbor Channel and Bair Island.



Redwood City Harbor Channel (RCHC)
Corkscrew Slough Near Redwood City Harbor Channel (CSL)
NOAA Redwood City Tide Gauge (9414523)
Steinberger Slough (STSL)
Bair Island Marsh (BIM)
Outer Bair Island (OB)
Middle Bair Island (MB)
Inner Bair Island (IB)

Figure 8.2-3
The locations used to determine the effects of deepening the Redwood City Harbor Channel project depth on salinity in the vicinity of the Redwood City Harbor Channel and Bair Island.

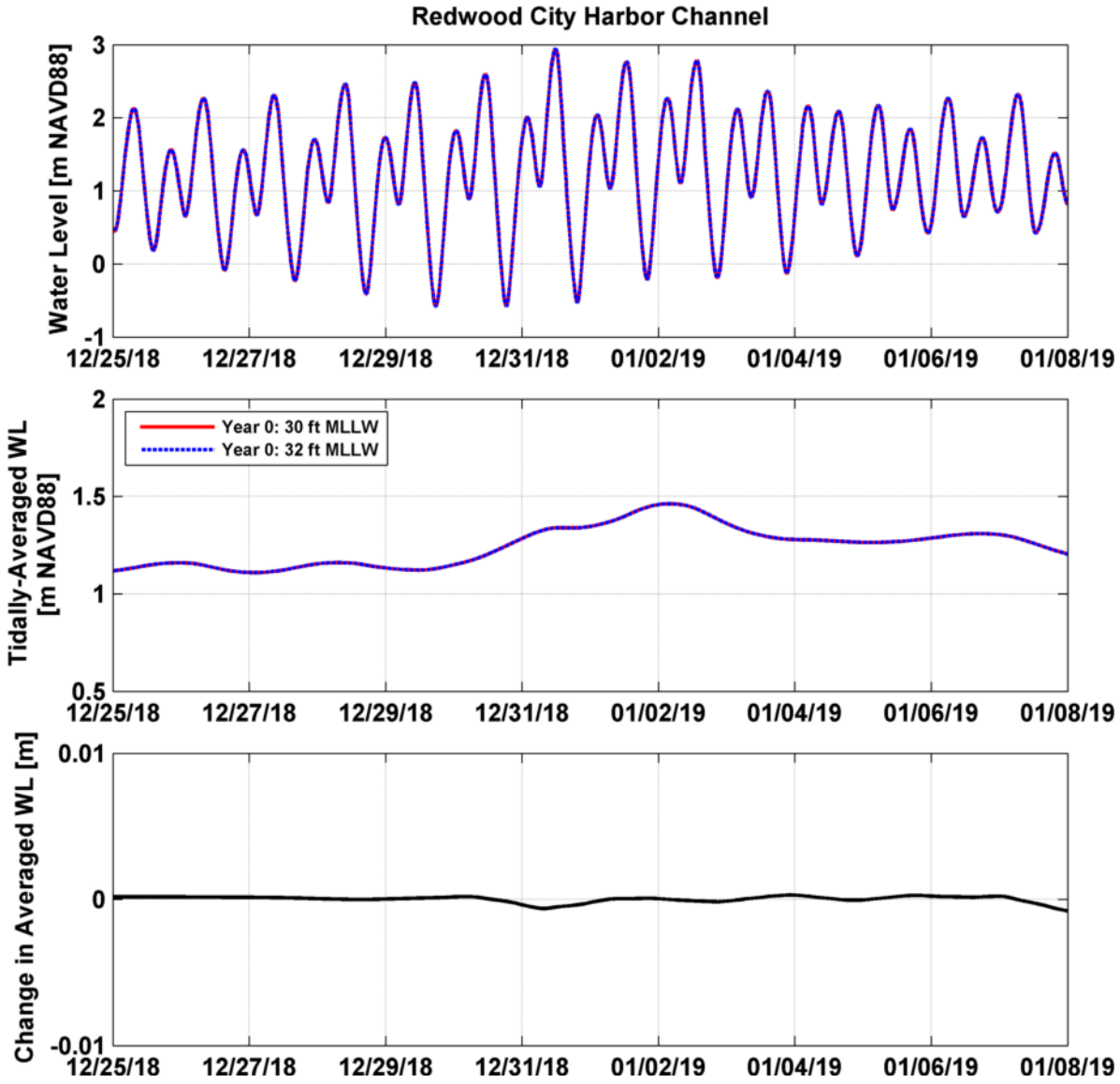


Figure 8.2-4
Predicted water levels in the Redwood City Harbor Channel (RCHC, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

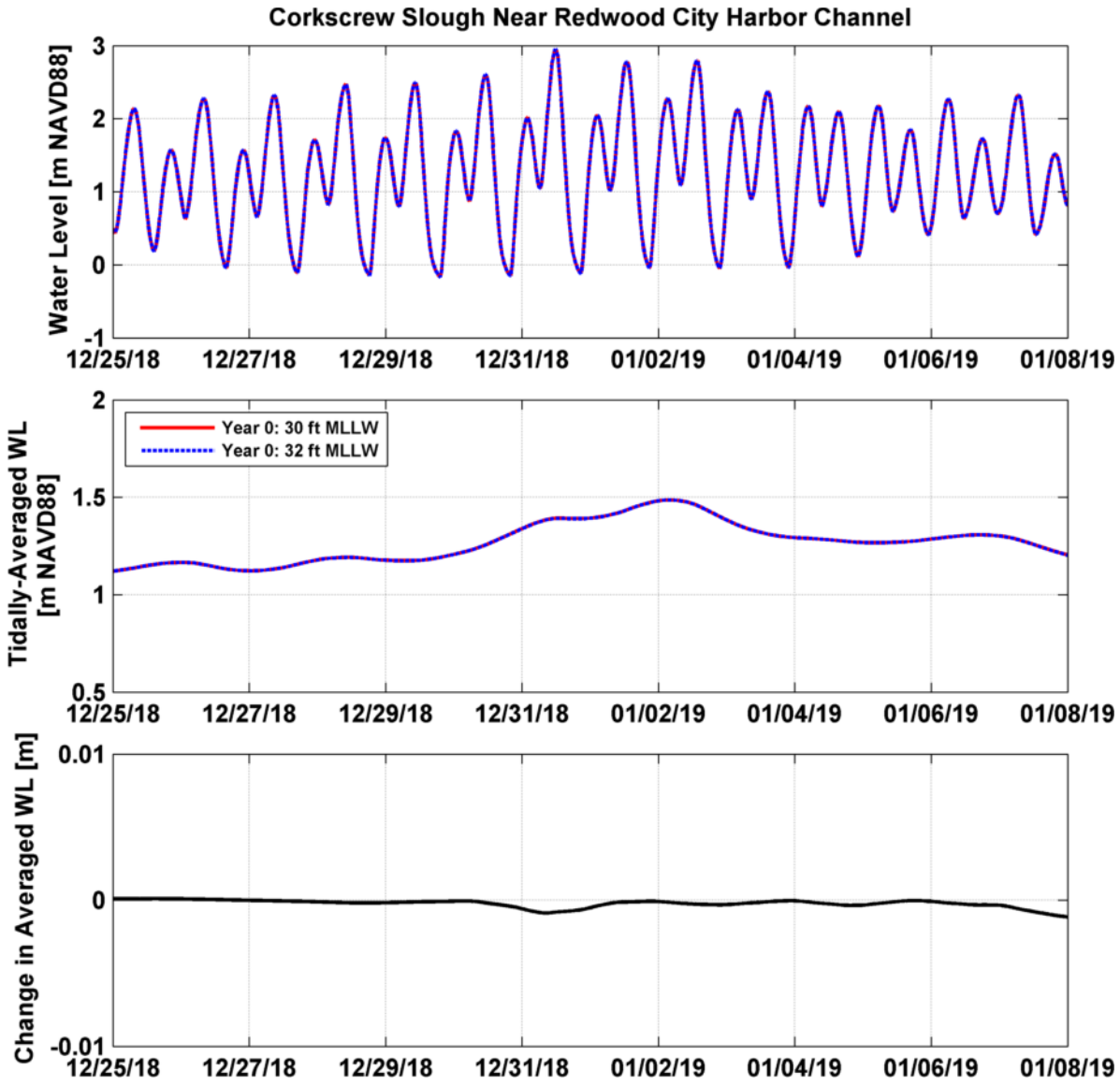


Figure 8.2-5
Predicted water levels in Corkscrew Slough near the Redwood City Harbor Channel (CSL, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

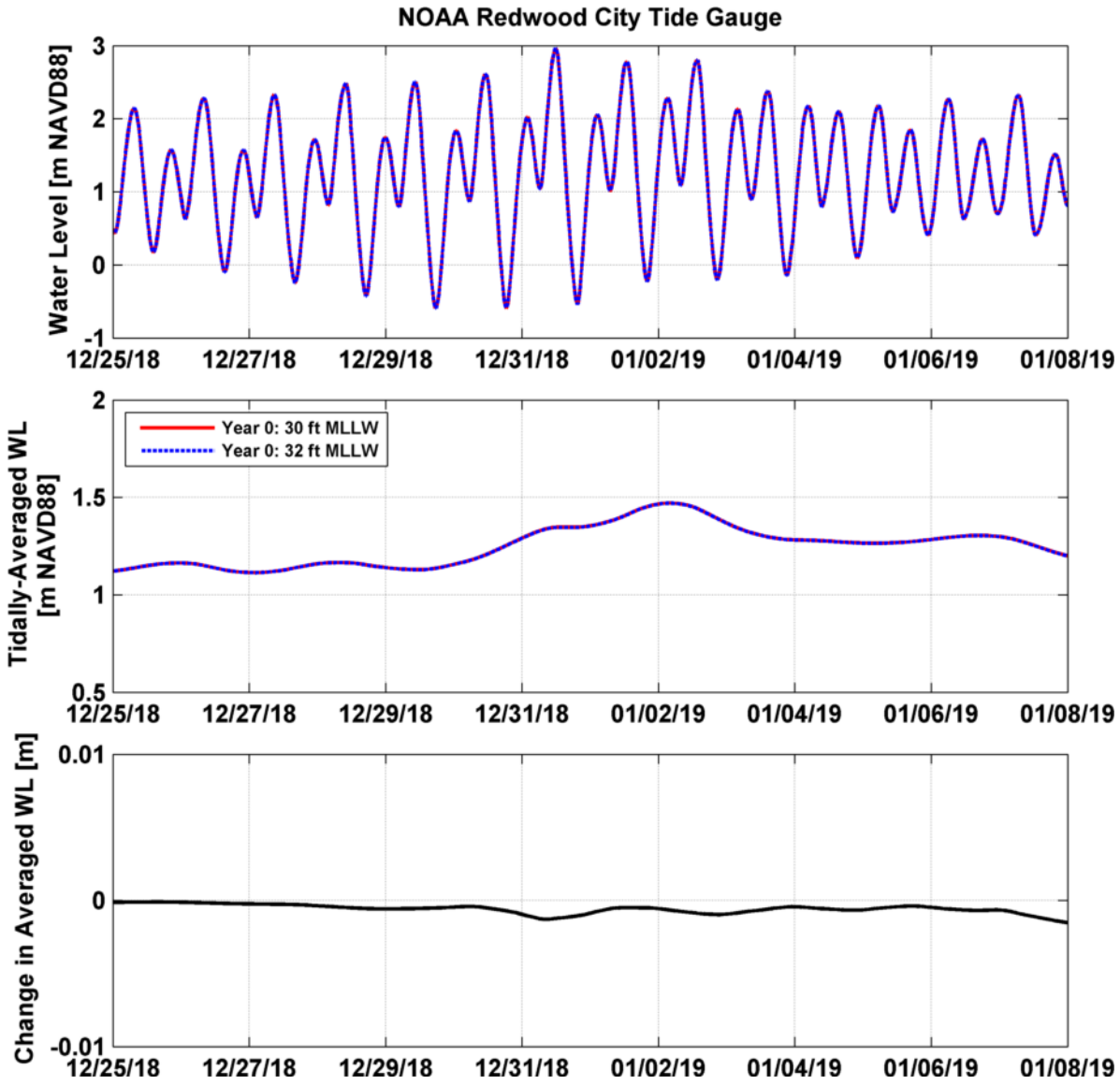


Figure 8.2-6
Predicted water levels at the NOAA Redwood City tide gauge (9414523, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

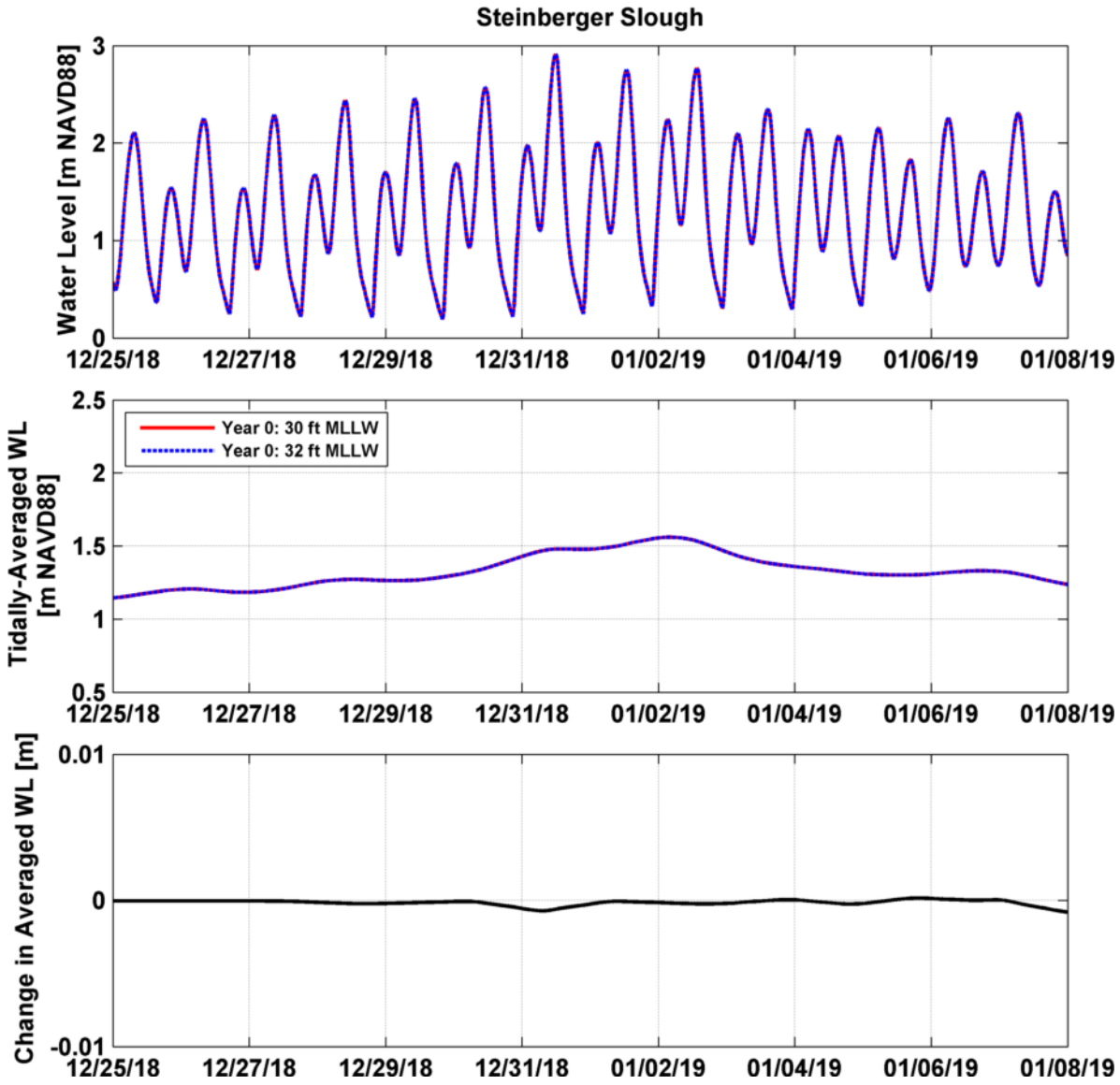


Figure 8.2-7
Predicted water levels in Steinberger Slough (STSL, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

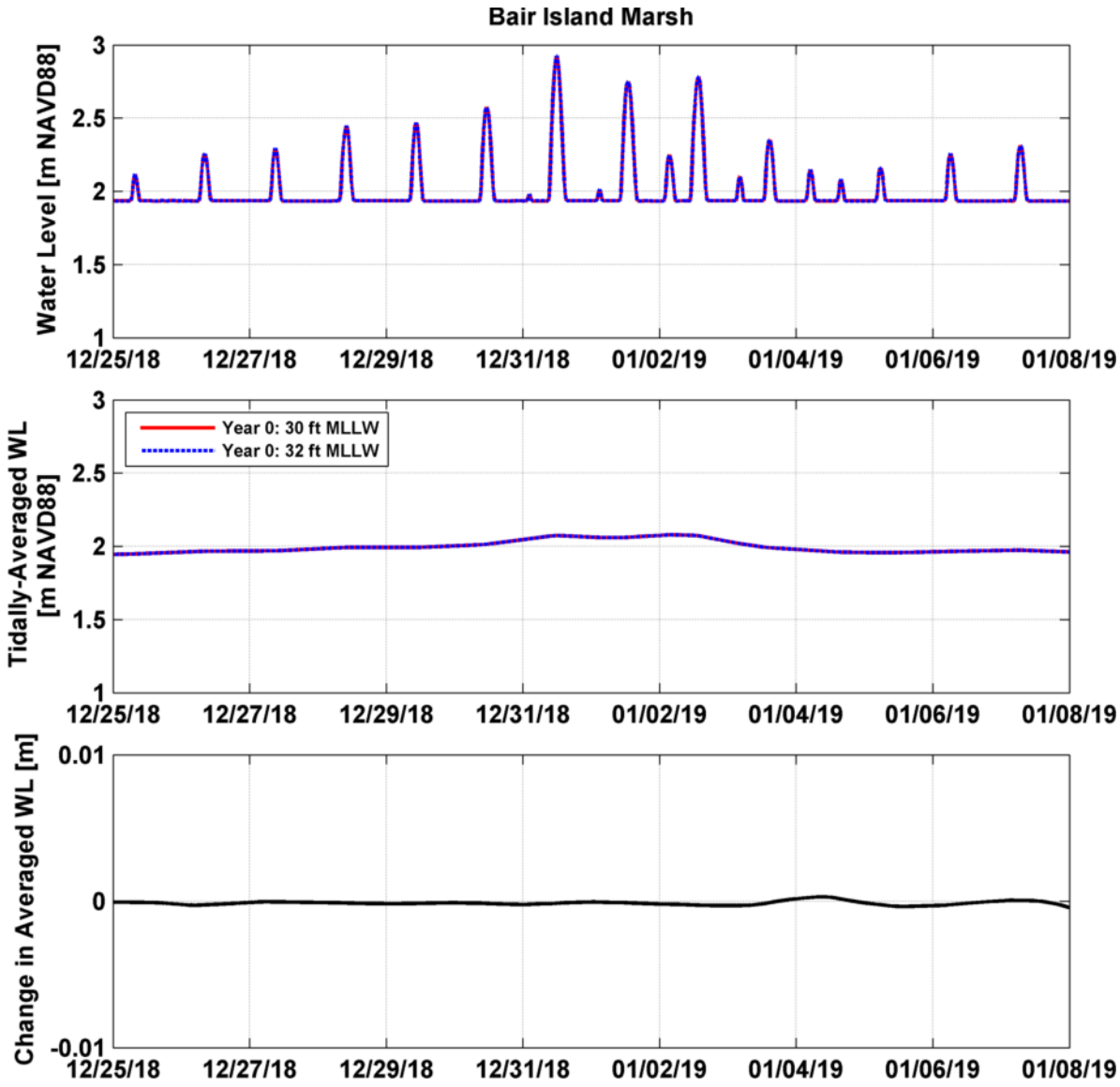


Figure 8.2-8
Predicted water levels in the Bair Island marsh (BIM, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

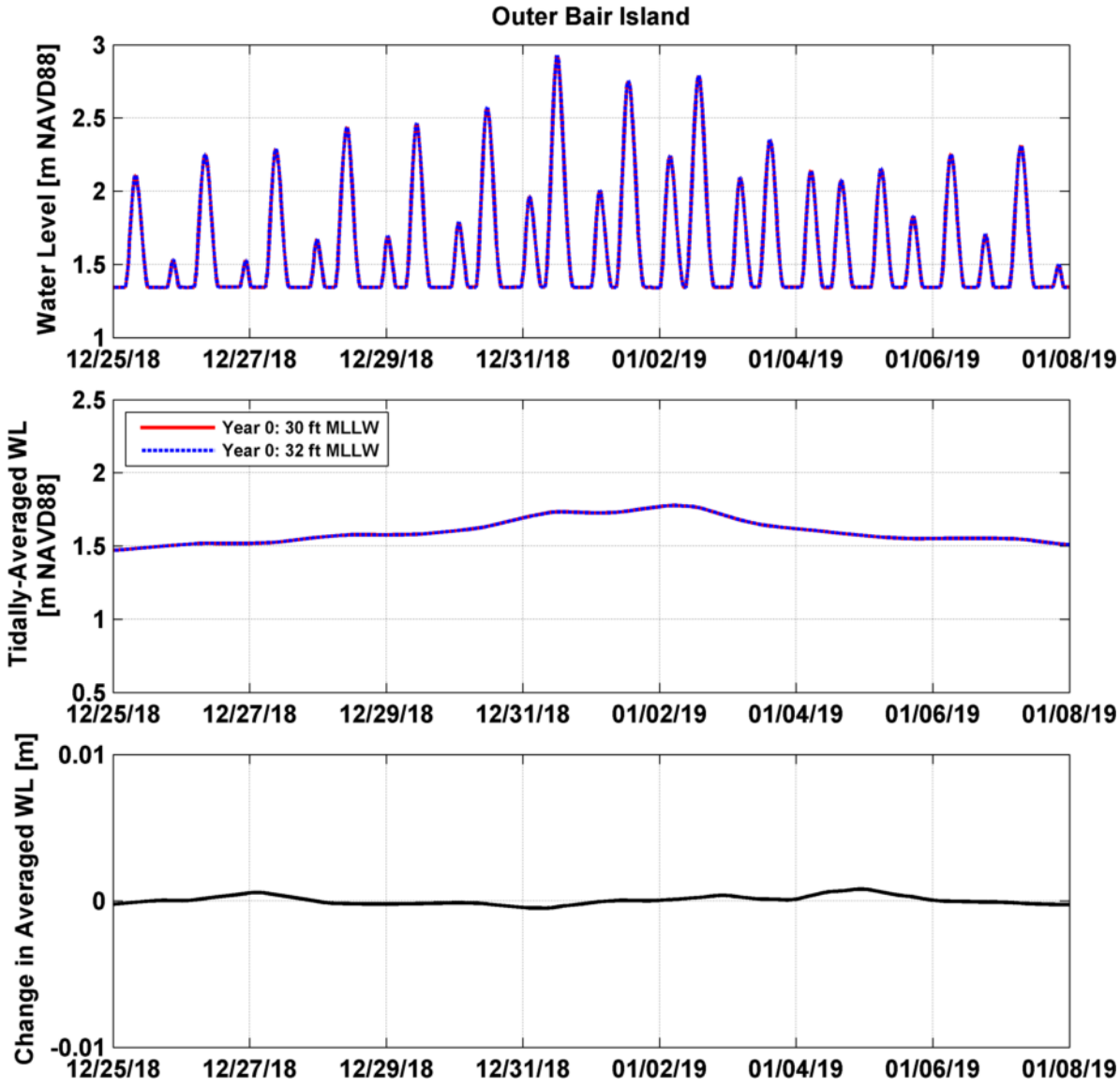


Figure 8.2-9
Predicted water levels in Outer Bair Island (OB, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

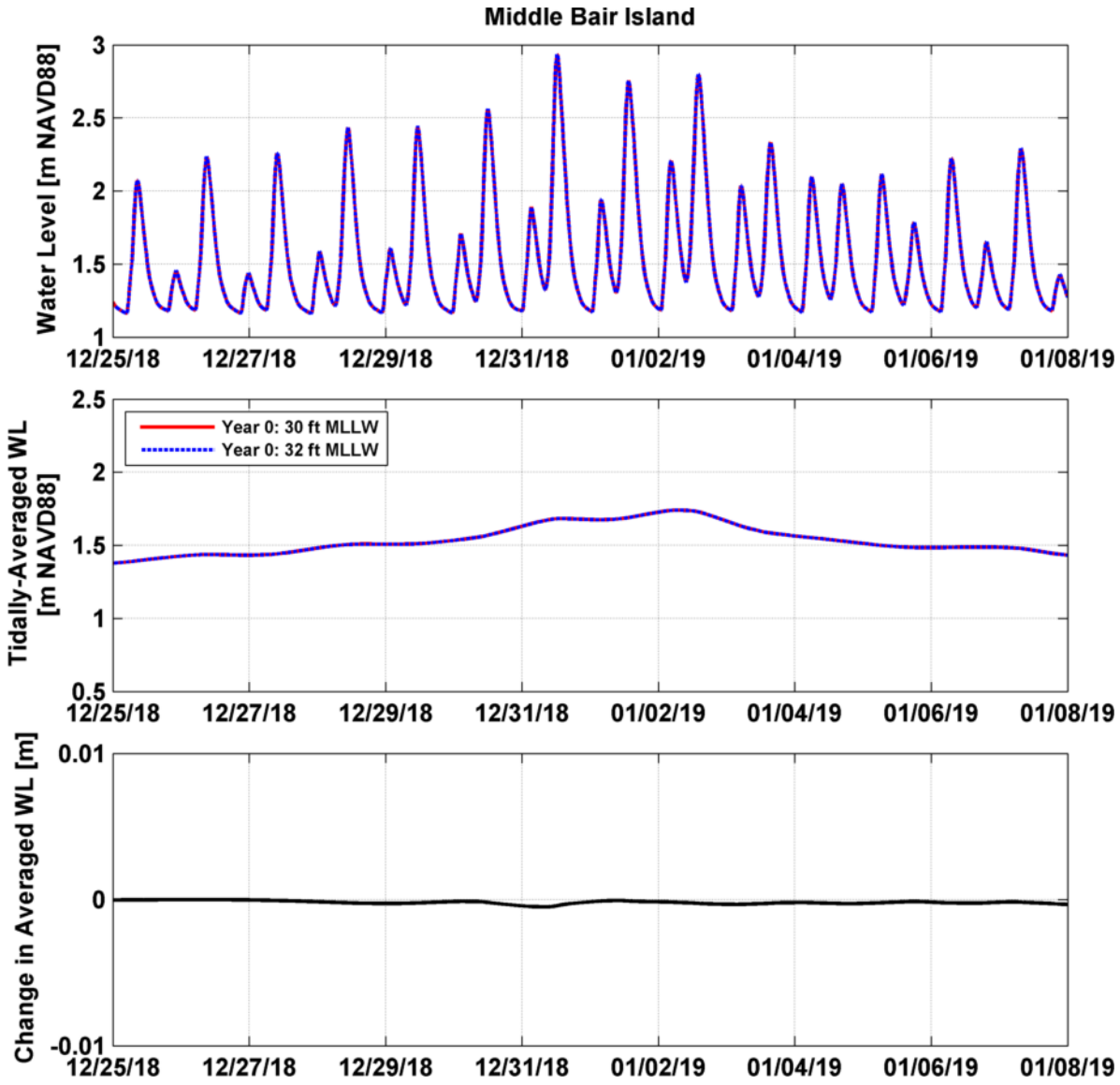


Figure 8.2-10
Predicted water levels in Middle Bair Island (MB, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

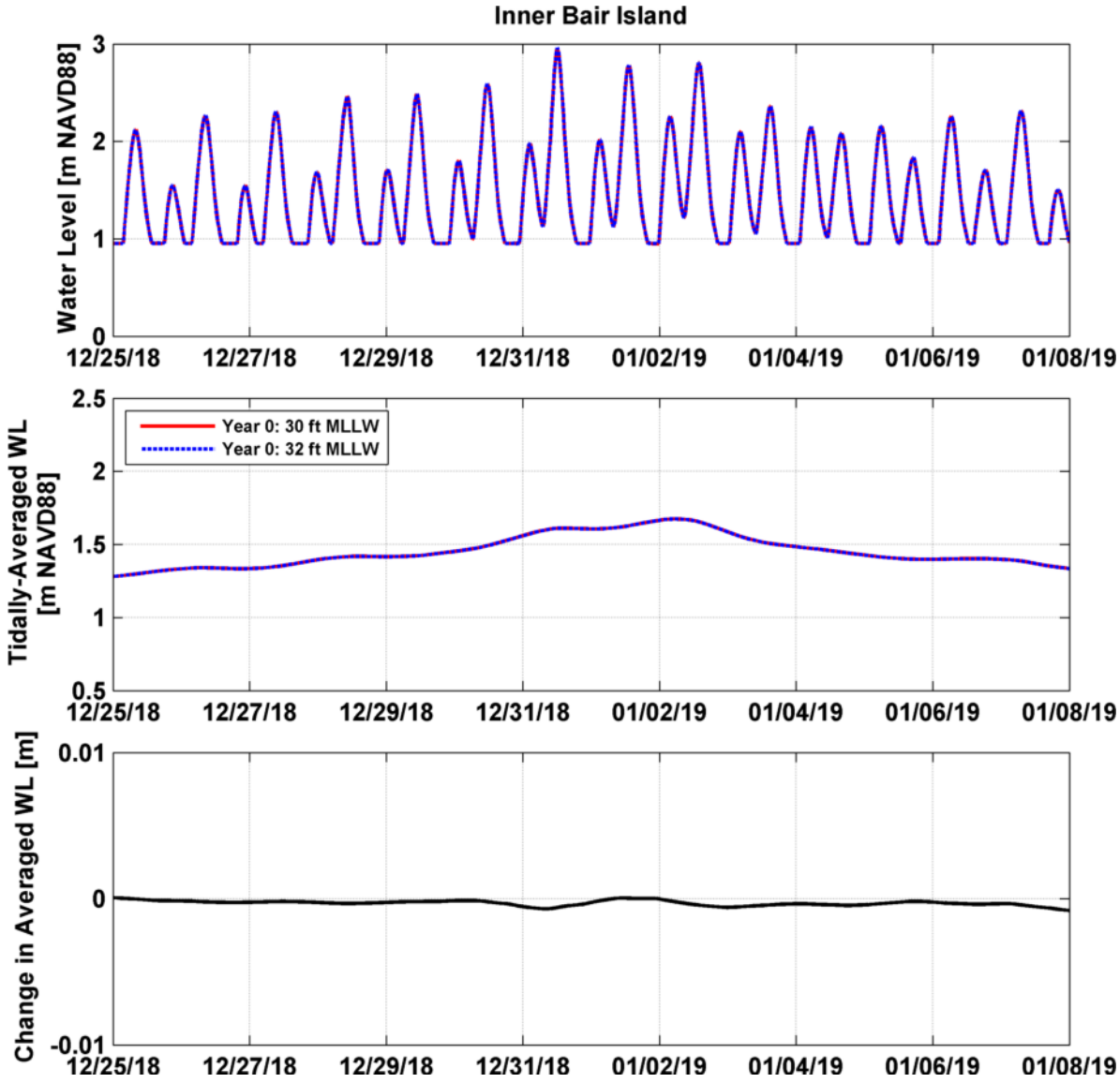


Figure 8.2-11
Predicted water levels in Inner Bair Island (IB, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

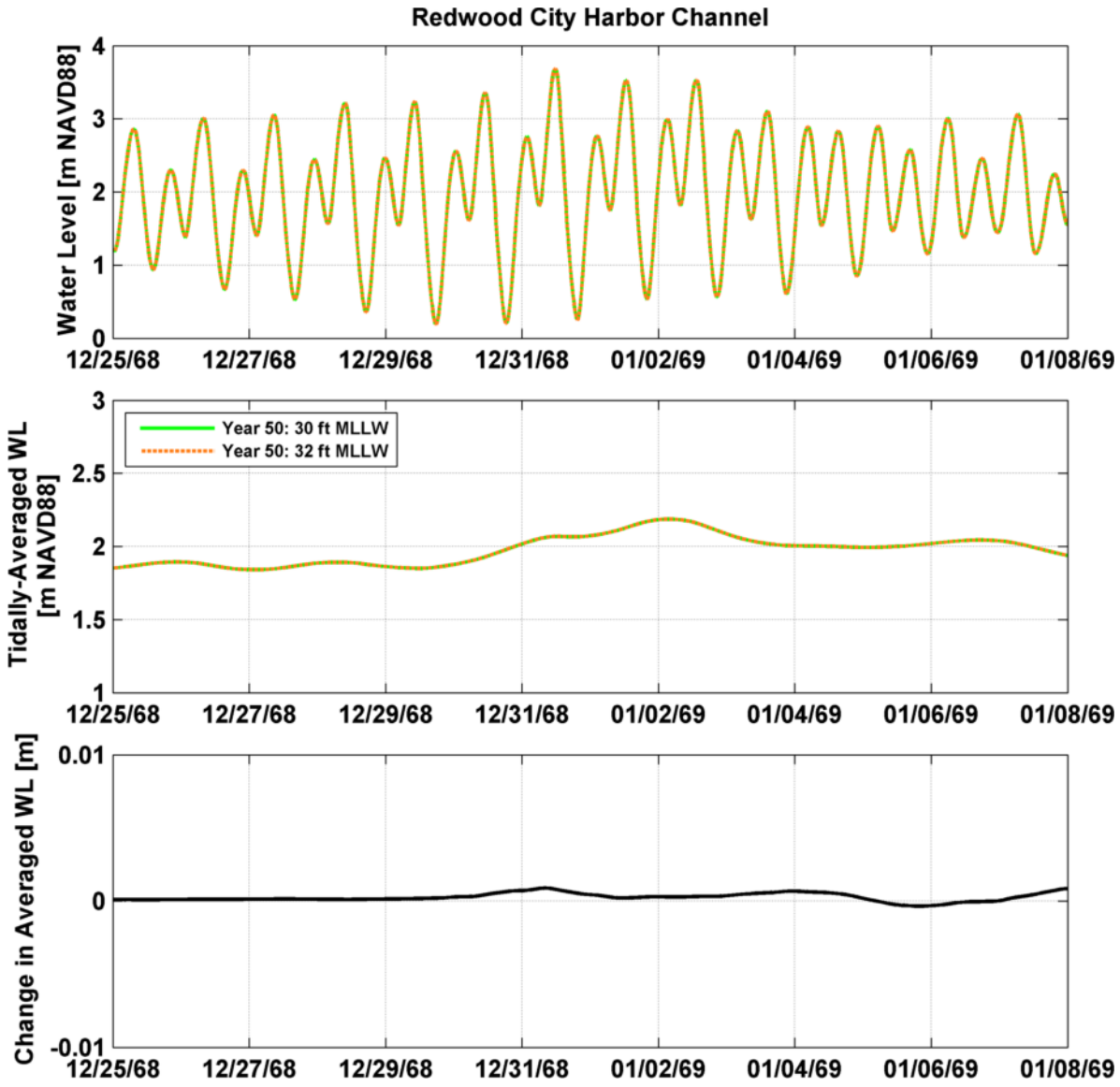


Figure 8.2-12
Predicted water levels in the Redwood City Harbor Channel (RCHC, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

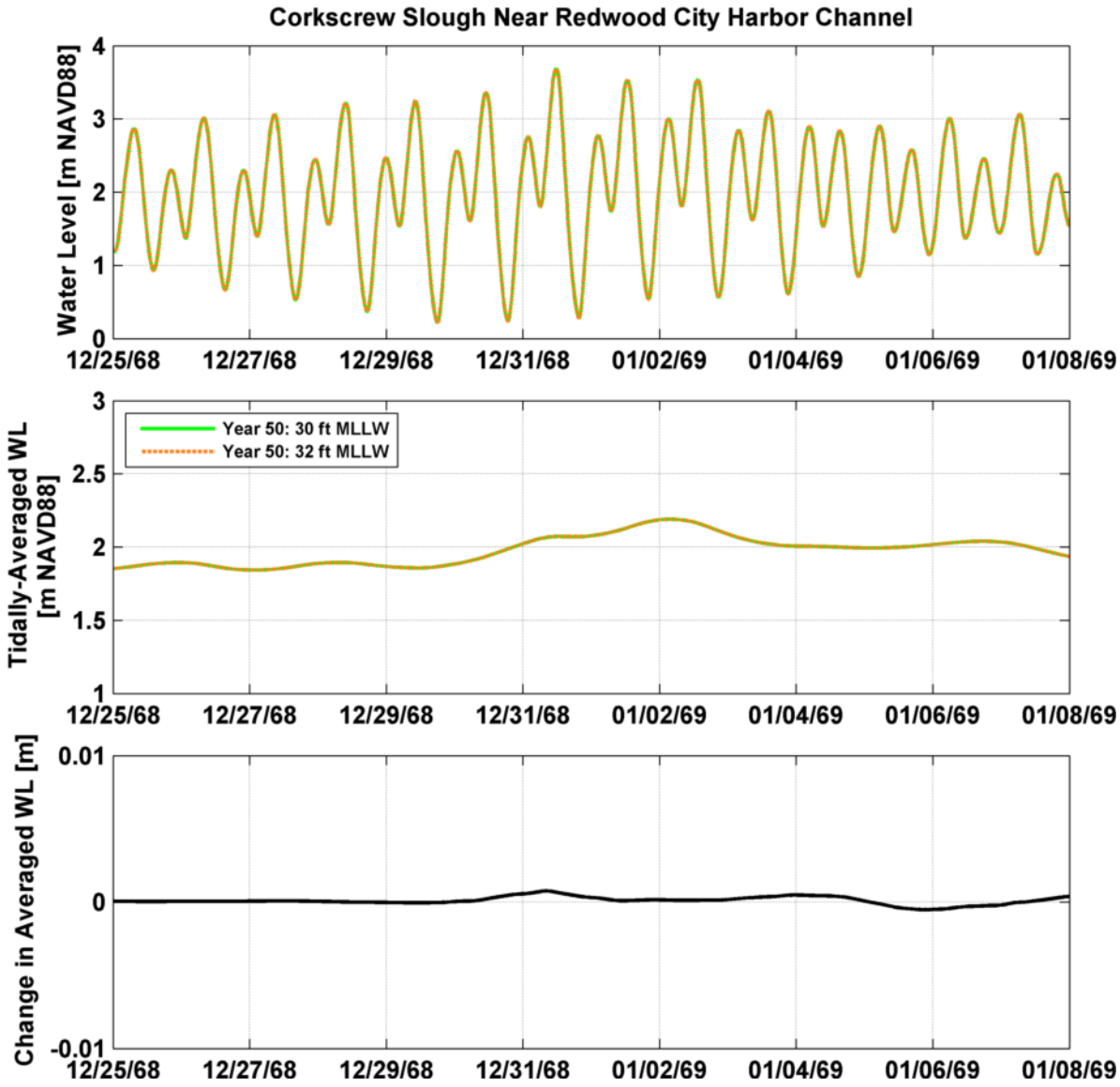


Figure 8.2-13
Predicted water levels in Corkscrew Slough near the Redwood City Harbor Channel (CSL, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

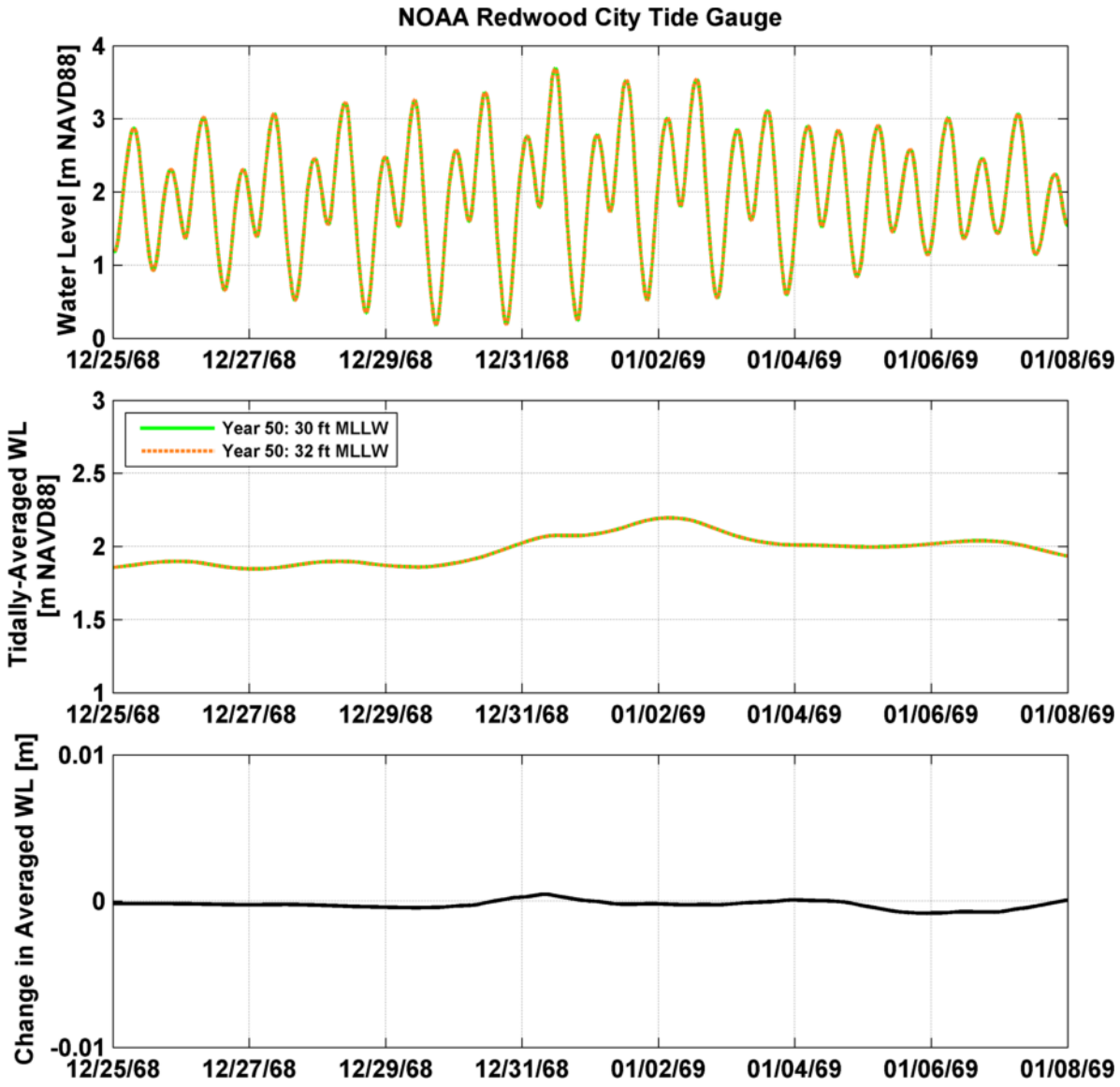


Figure 8.2-14
Predicted water levels at the NOAA Redwood City tide gauge (9414523, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

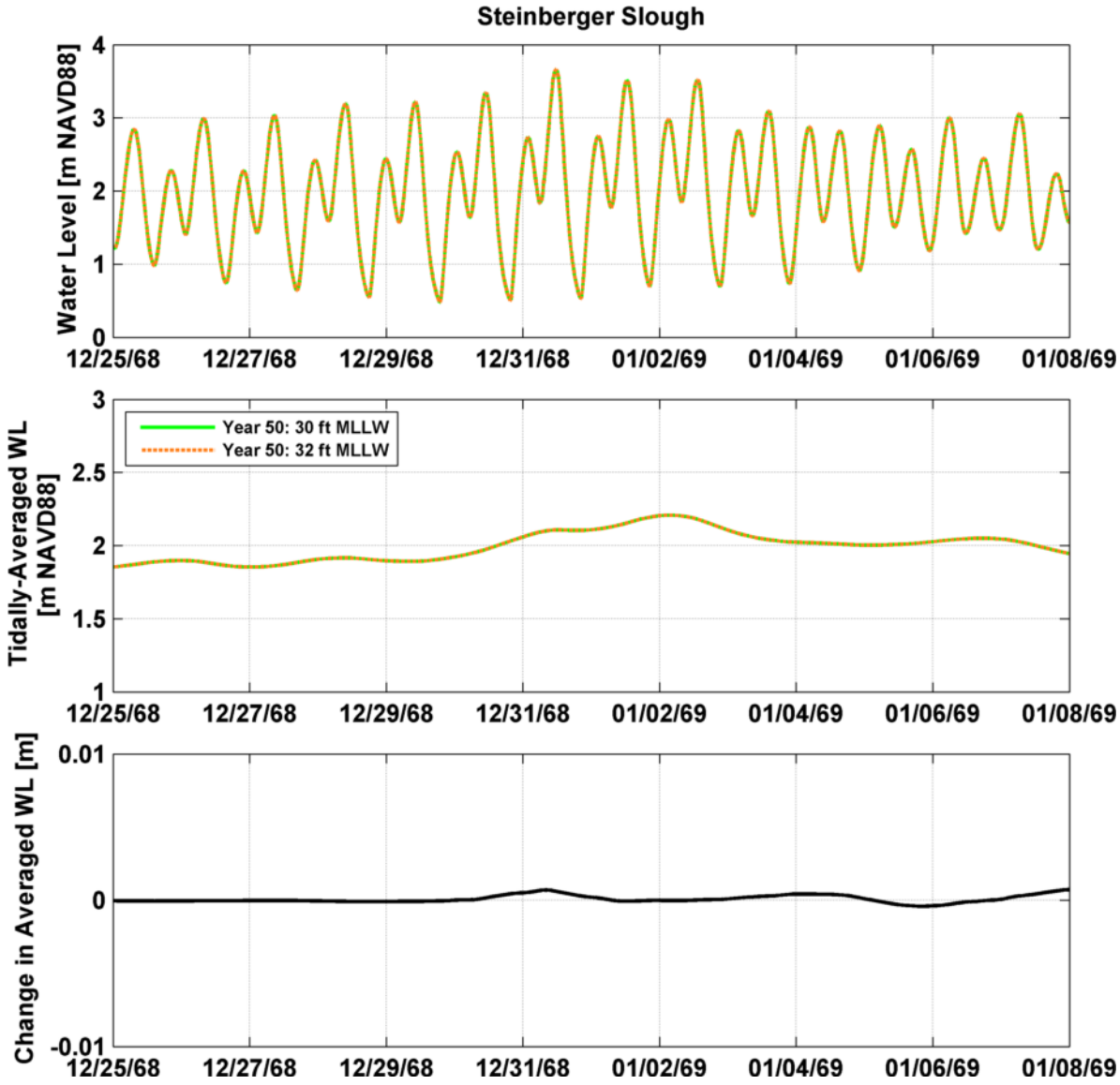


Figure 8.2-15
Predicted water levels in Steinberger Slough (STSL, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

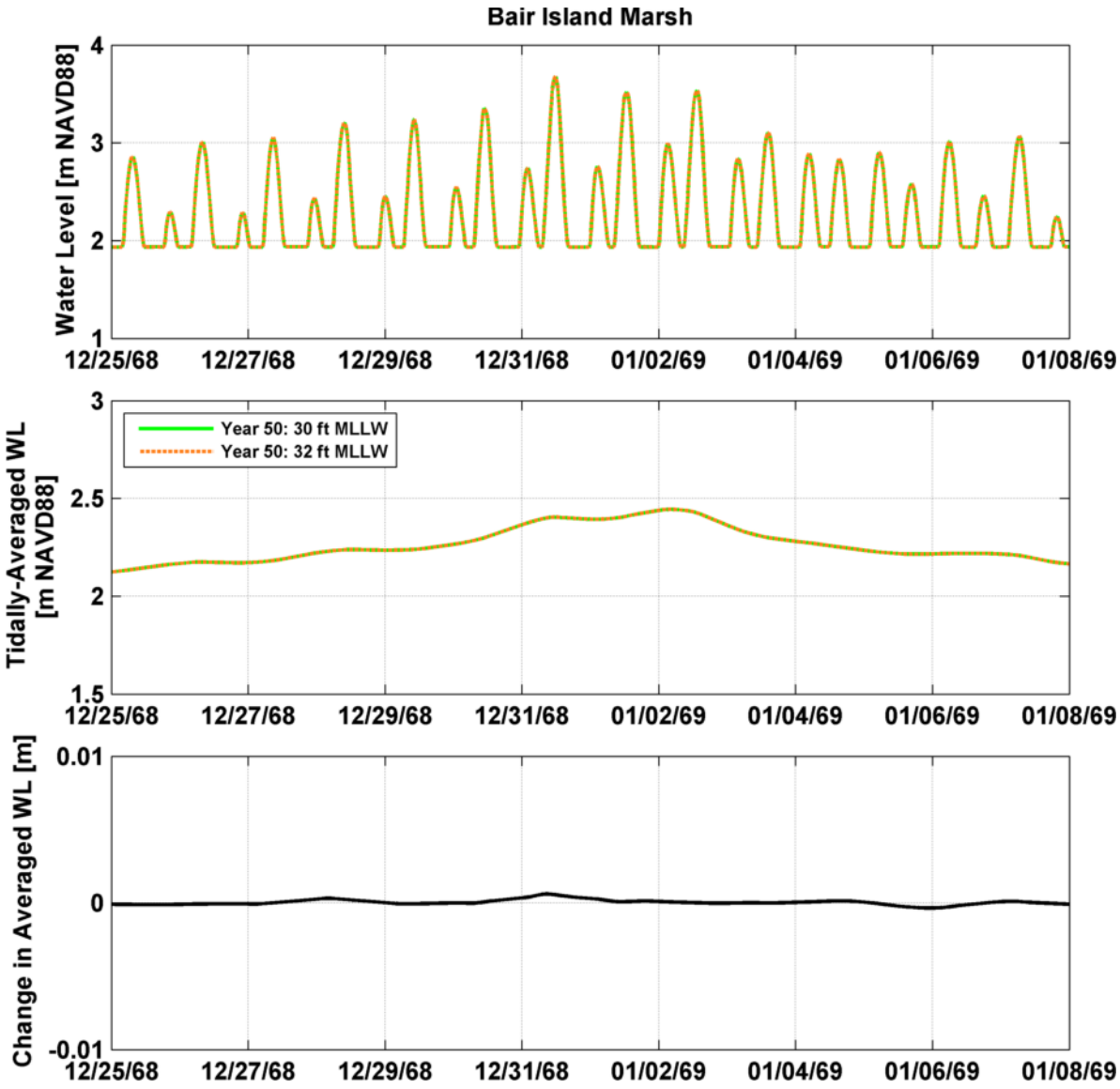


Figure 8.2-16
Predicted water levels in the Bair Island marsh (BIM, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

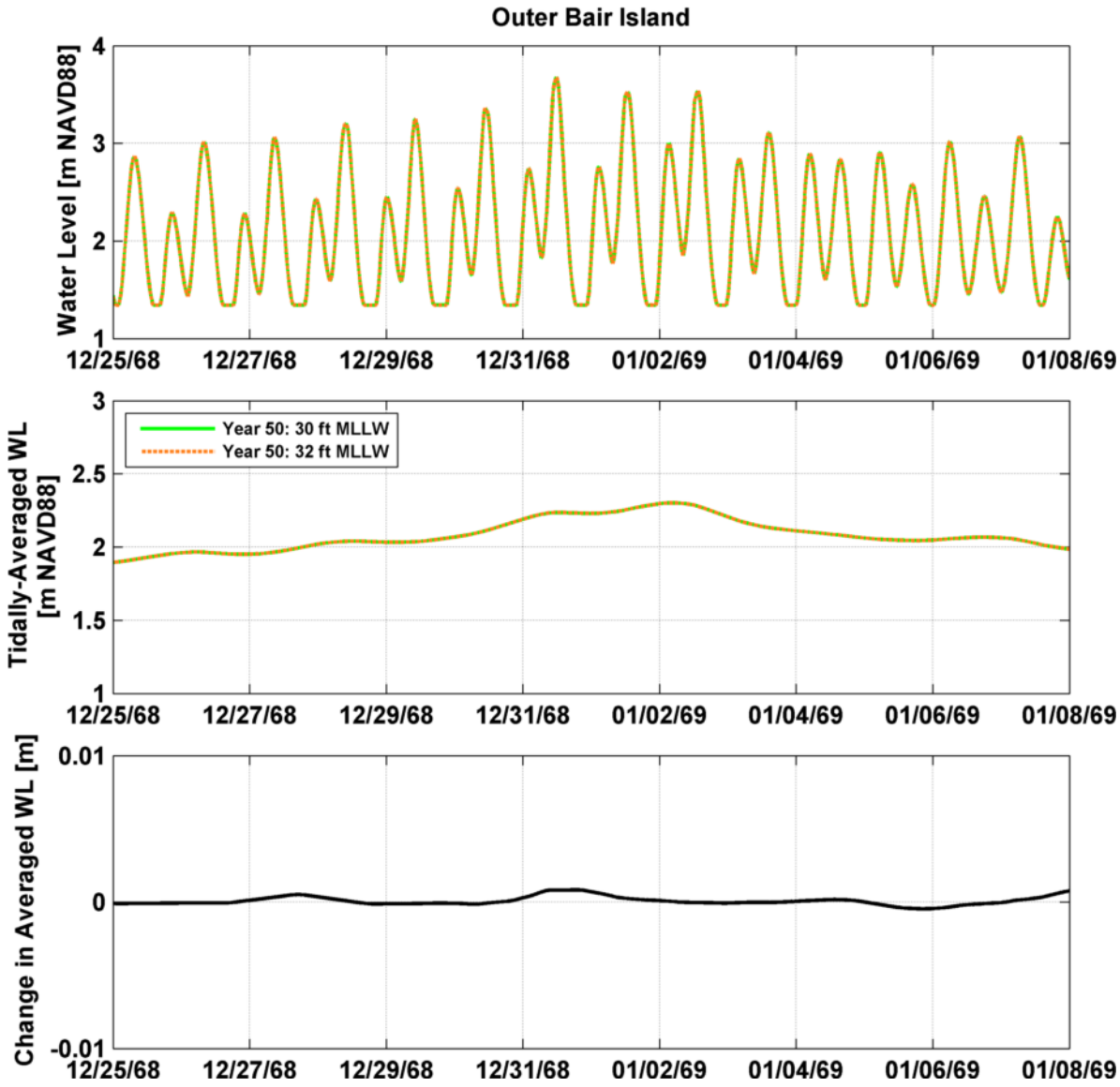


Figure 8.2-17
Predicted water levels in Outer Bair Island (OB, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

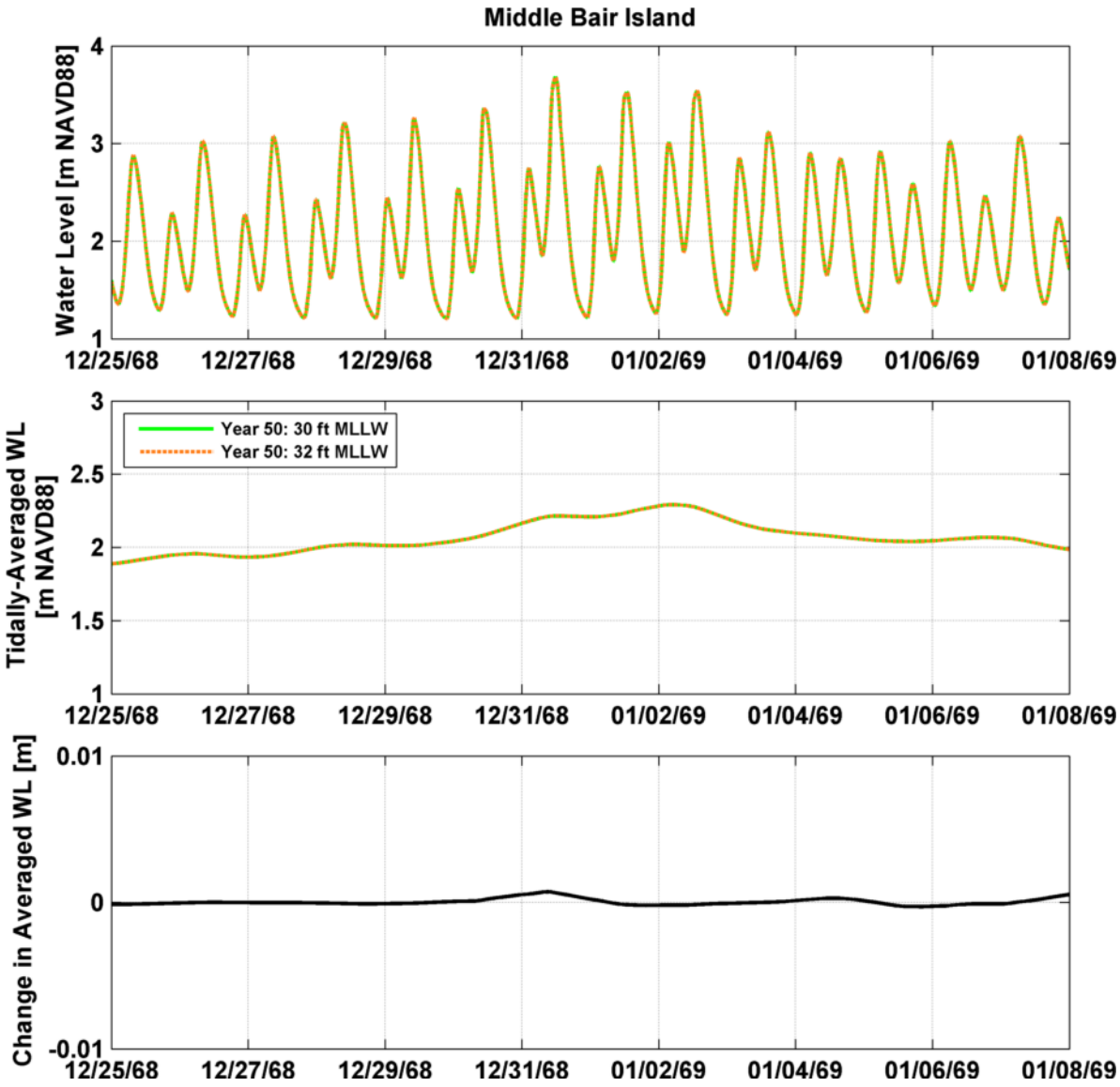


Figure 8.2-18
Predicted water levels in Middle Bair Island (MB, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

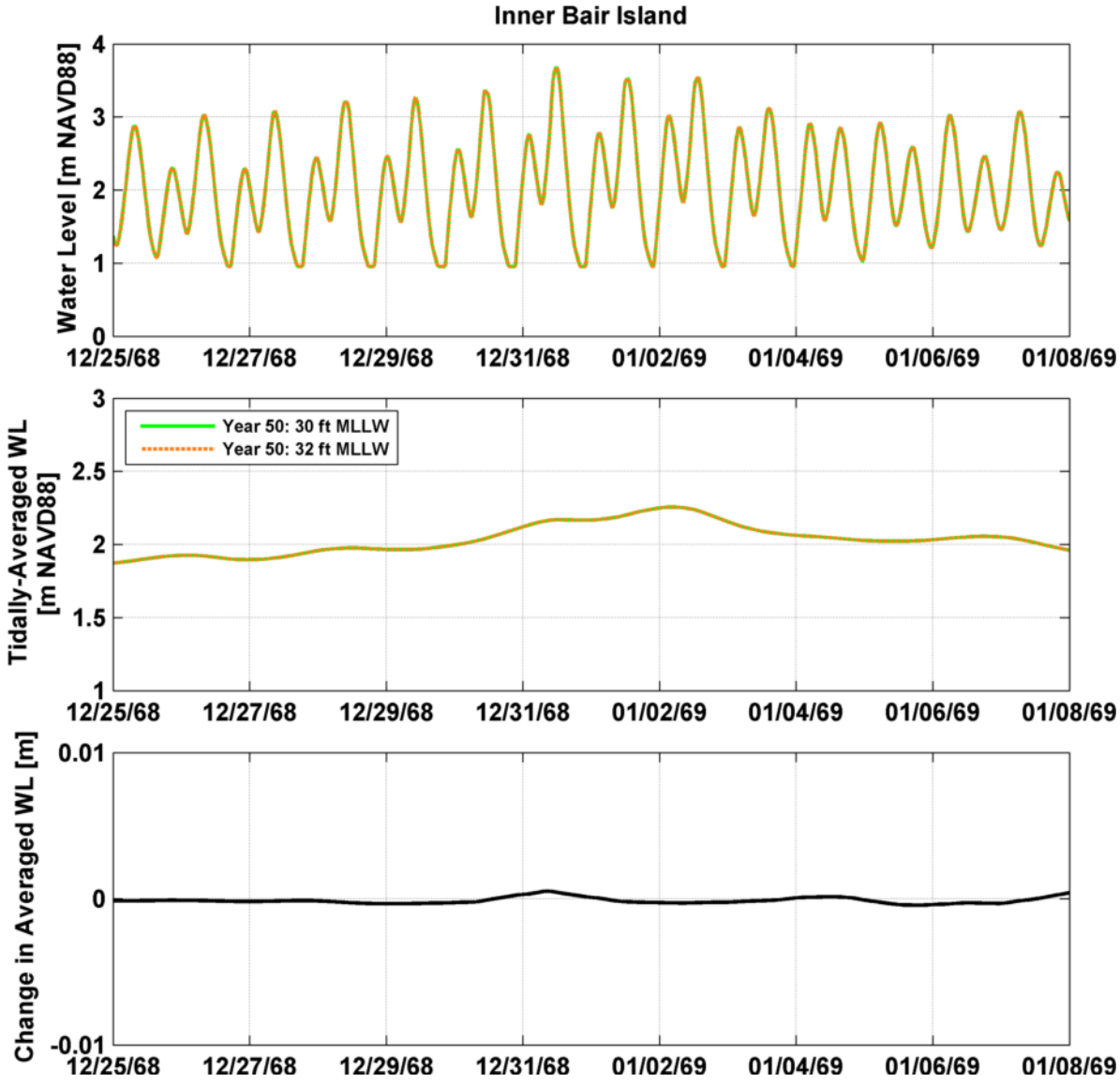


Figure 8.2-19
Predicted water levels in Inner Bair Island (IB, Figure 8.2-1) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

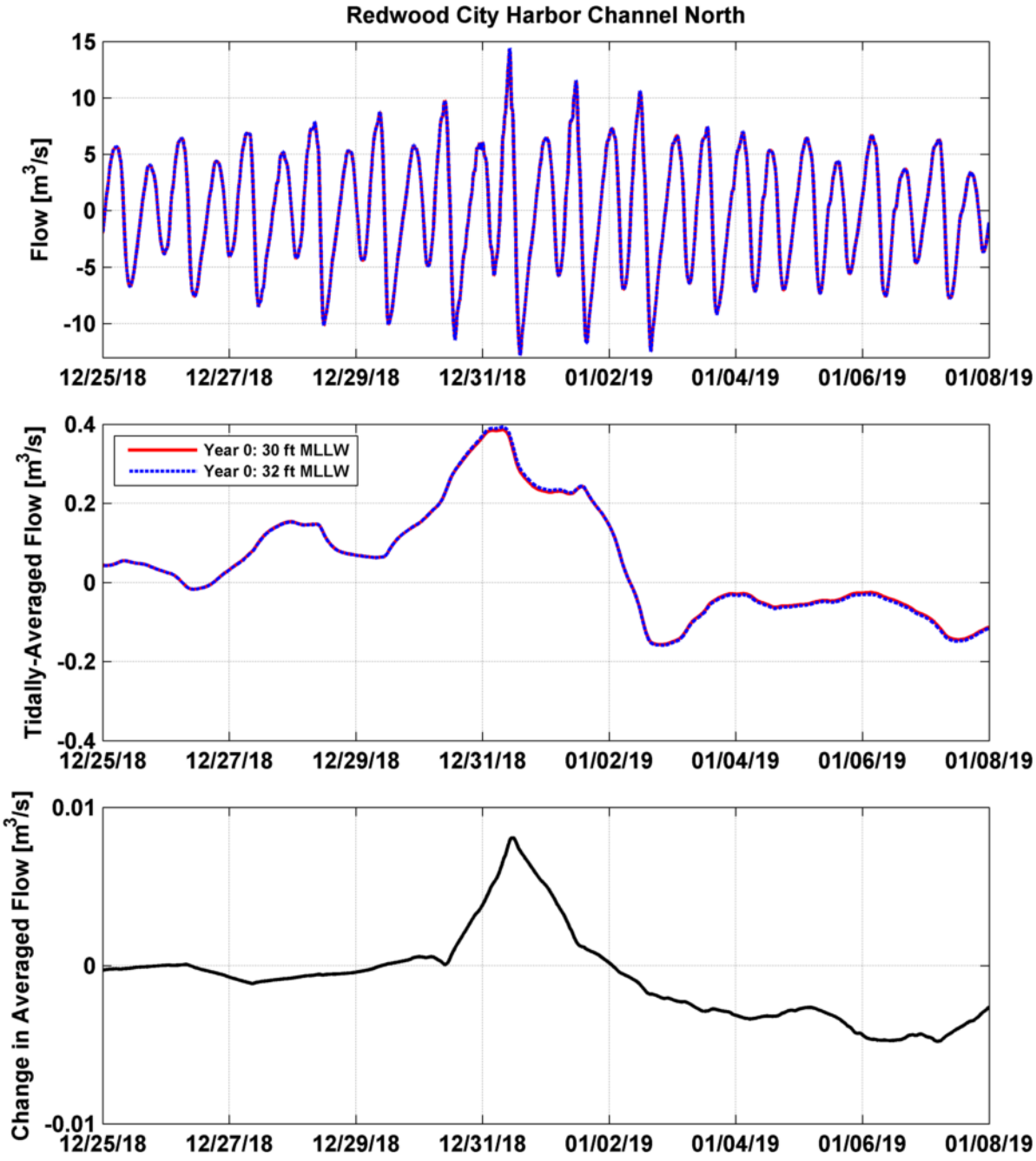


Figure 8.2-20
Predicted flow through the Redwood City Harbor Channel northern cross section (RCHCN, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

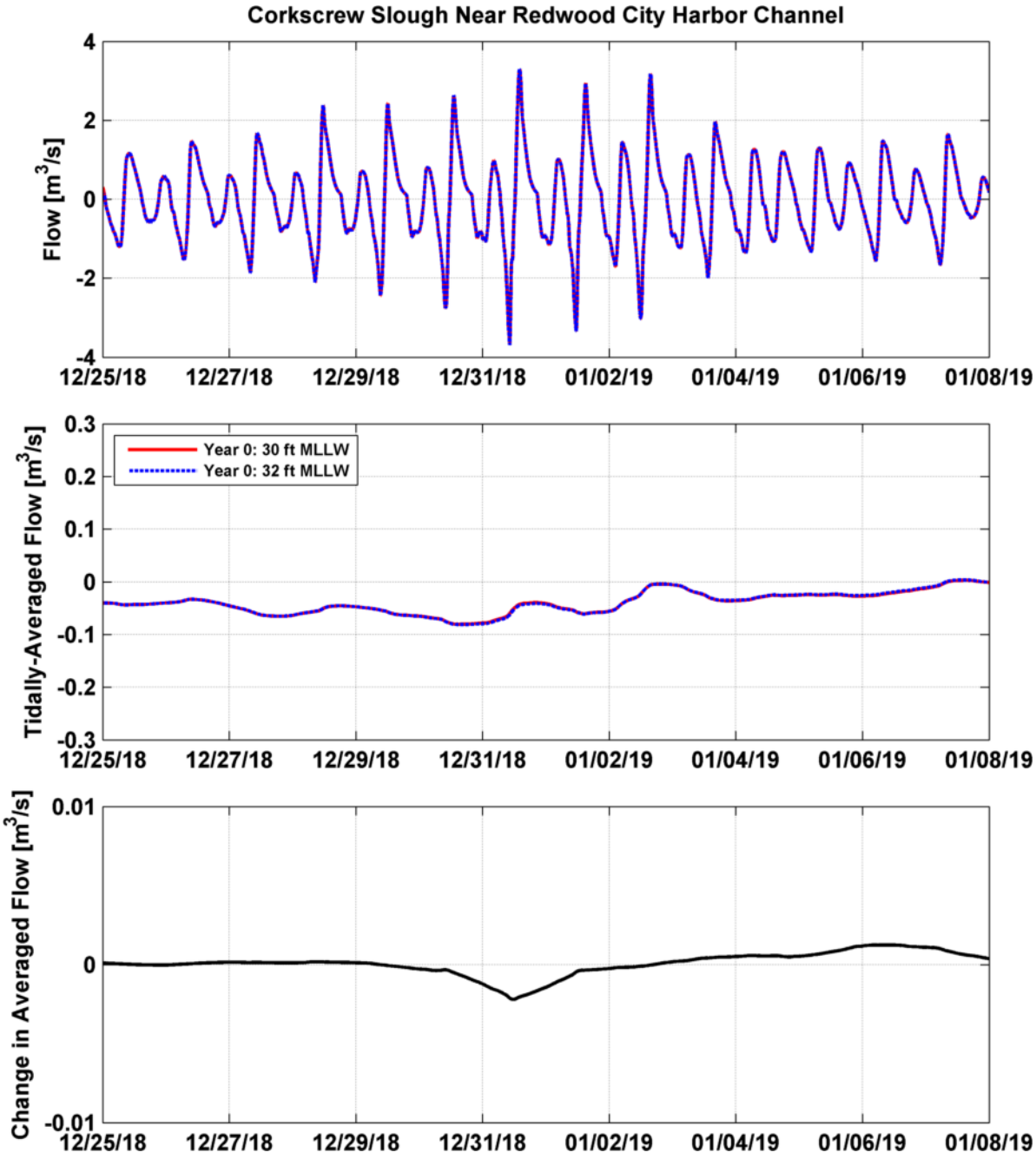


Figure 8.2-21
Predicted flow through Corkscrew Slough near the Redwood City Harbor Channel (CSL, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

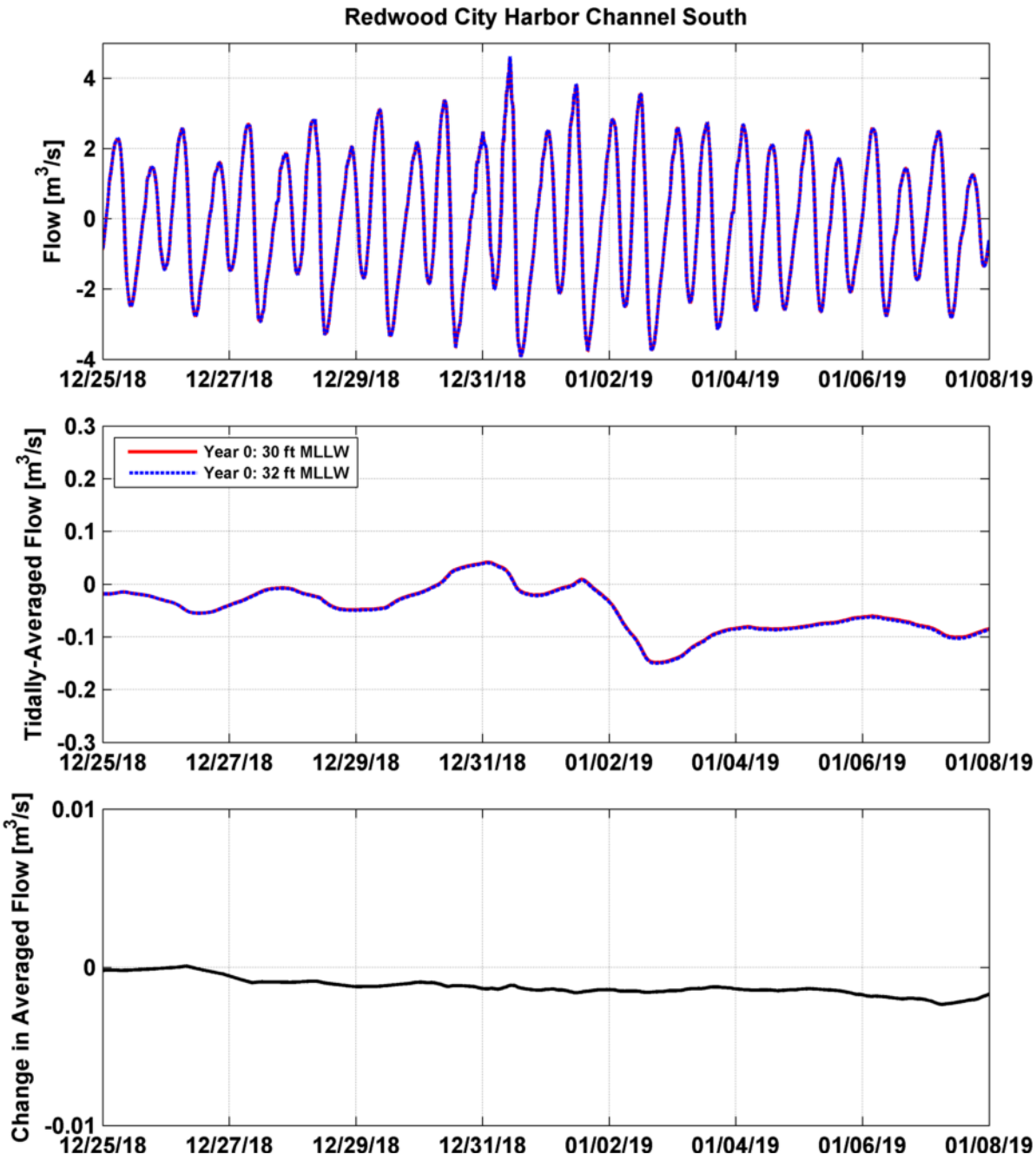


Figure 8.2-22
Predicted flow through the Redwood City Harbor Channel southern cross section (RCHCS, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

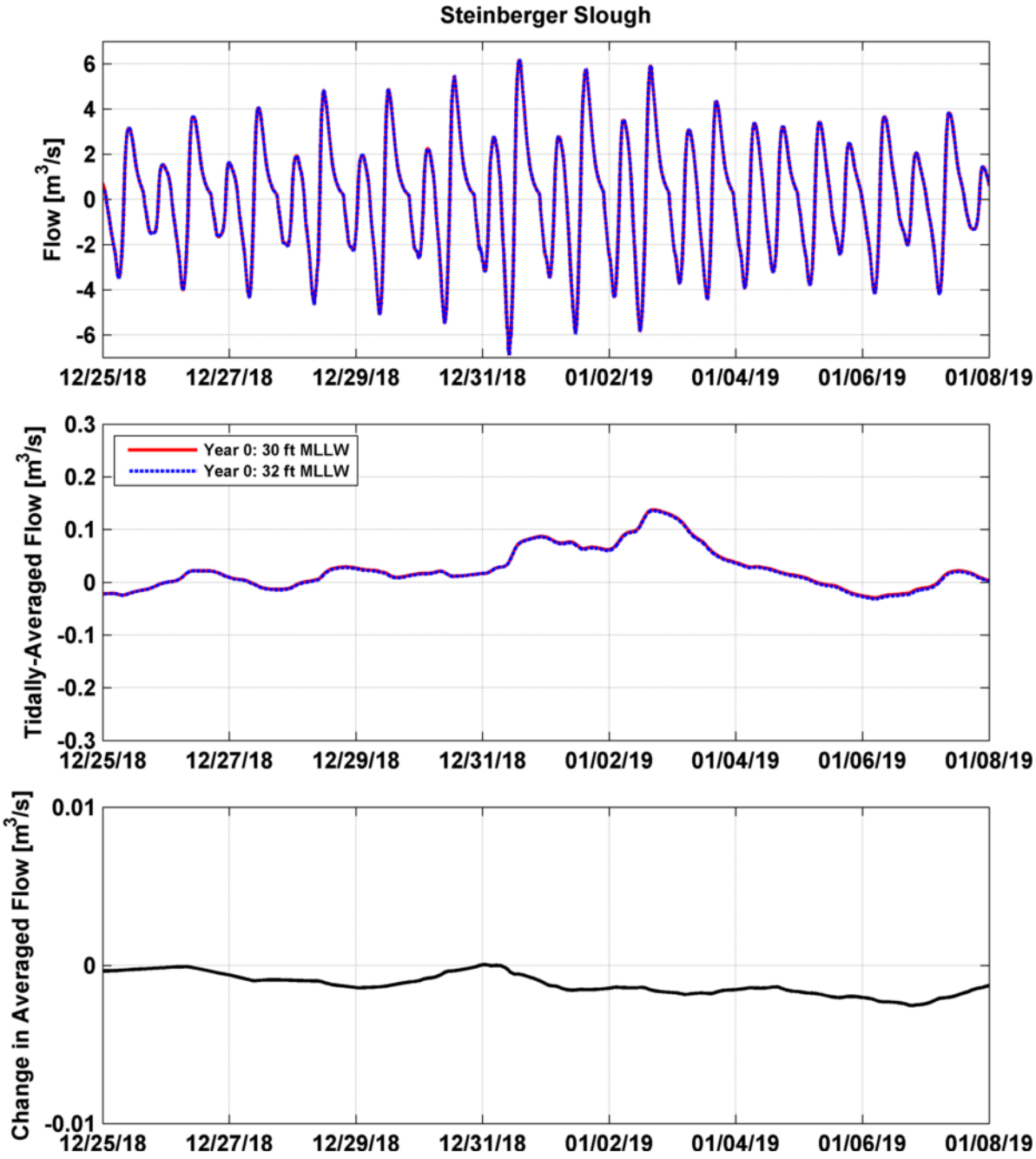


Figure 8.2-23
Predicted flow through Steinberger Slough (STSL, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

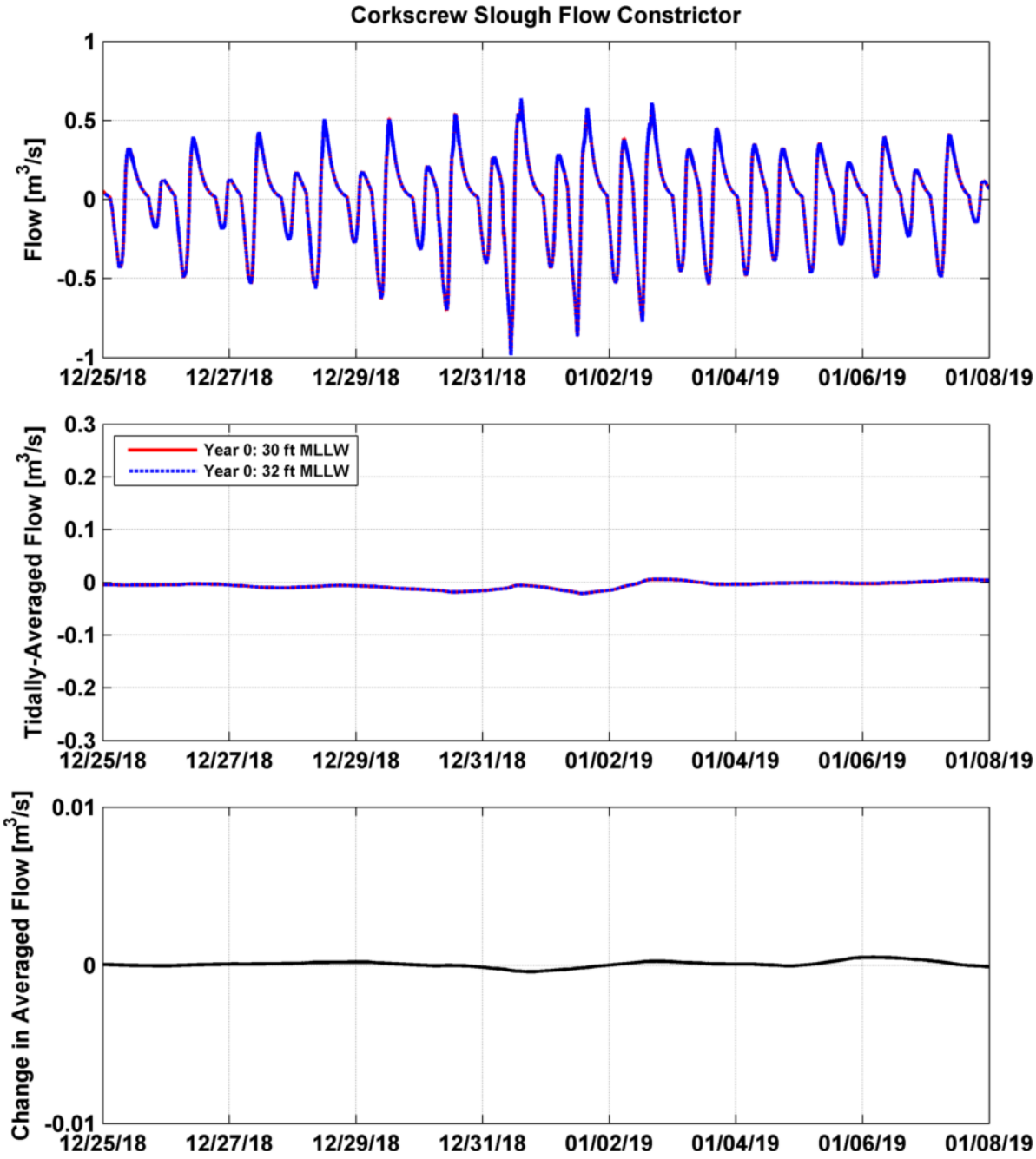


Figure 8.2-24
Predicted flow through the Corkscrew Slough flow constrictor (FC, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

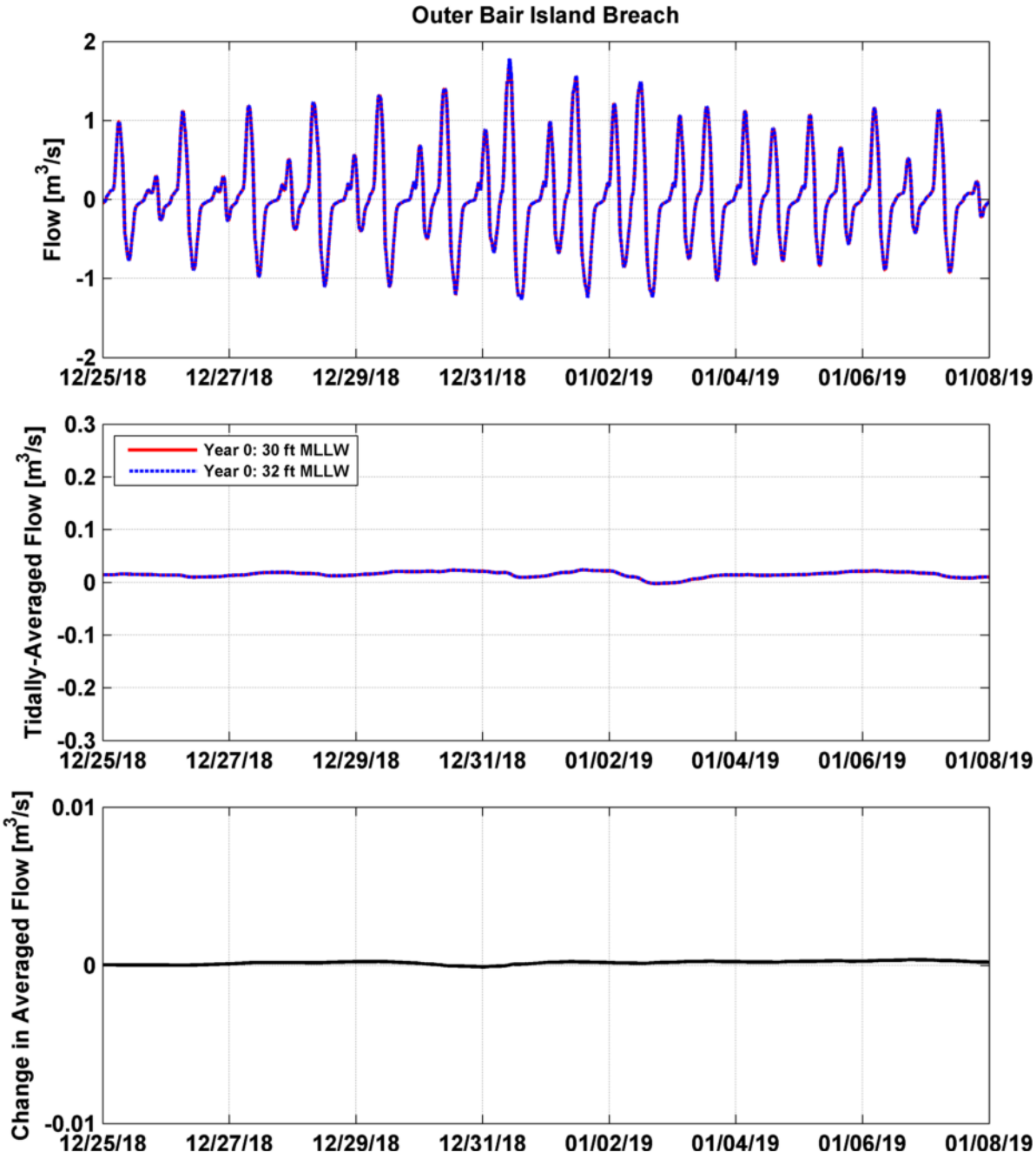


Figure 8.2-25
Predicted flow through a breach in Outer Bair Island (OB, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

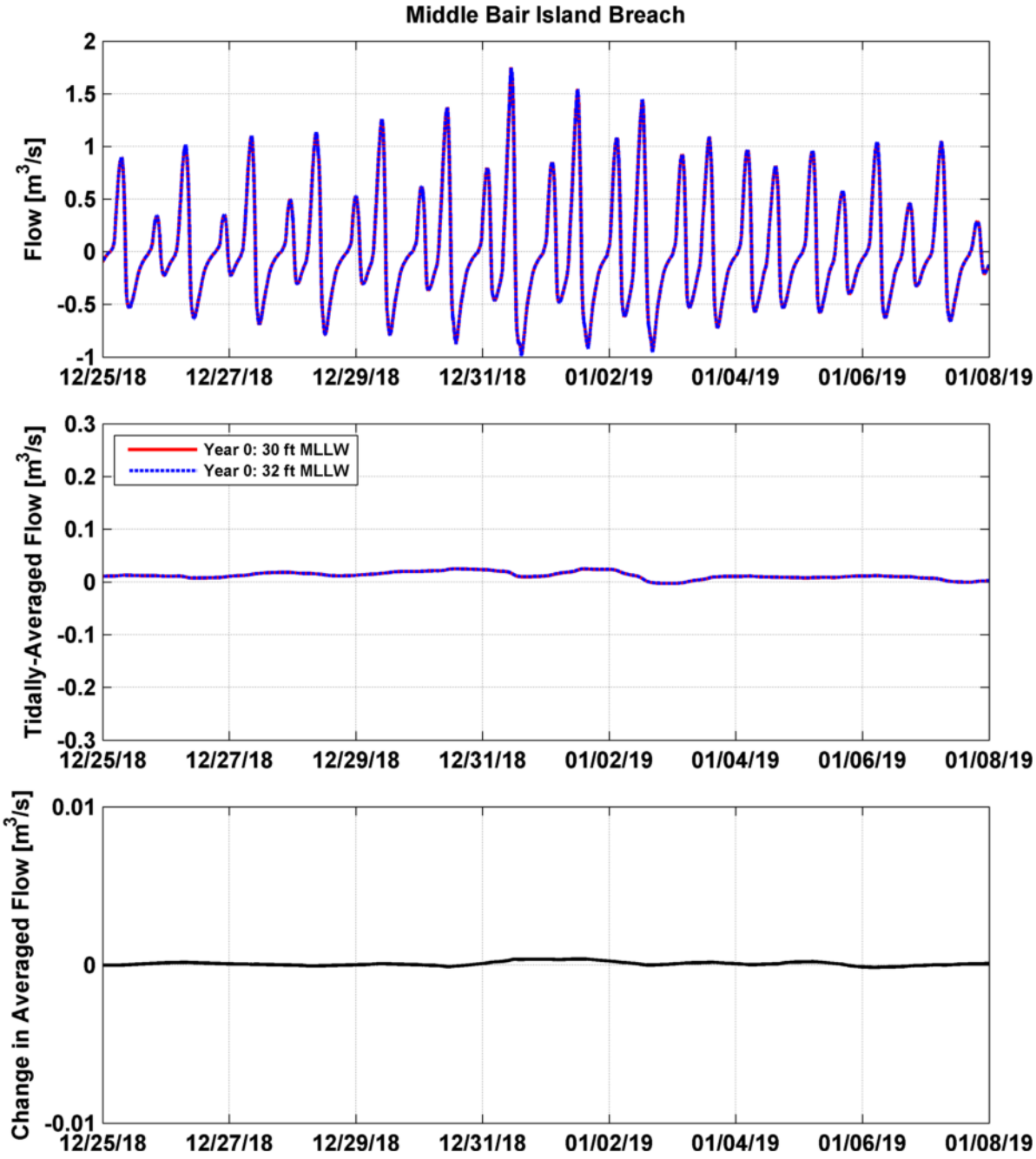


Figure 8.2-26
Predicted flow through a breach in Middle Bair Island (MB, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

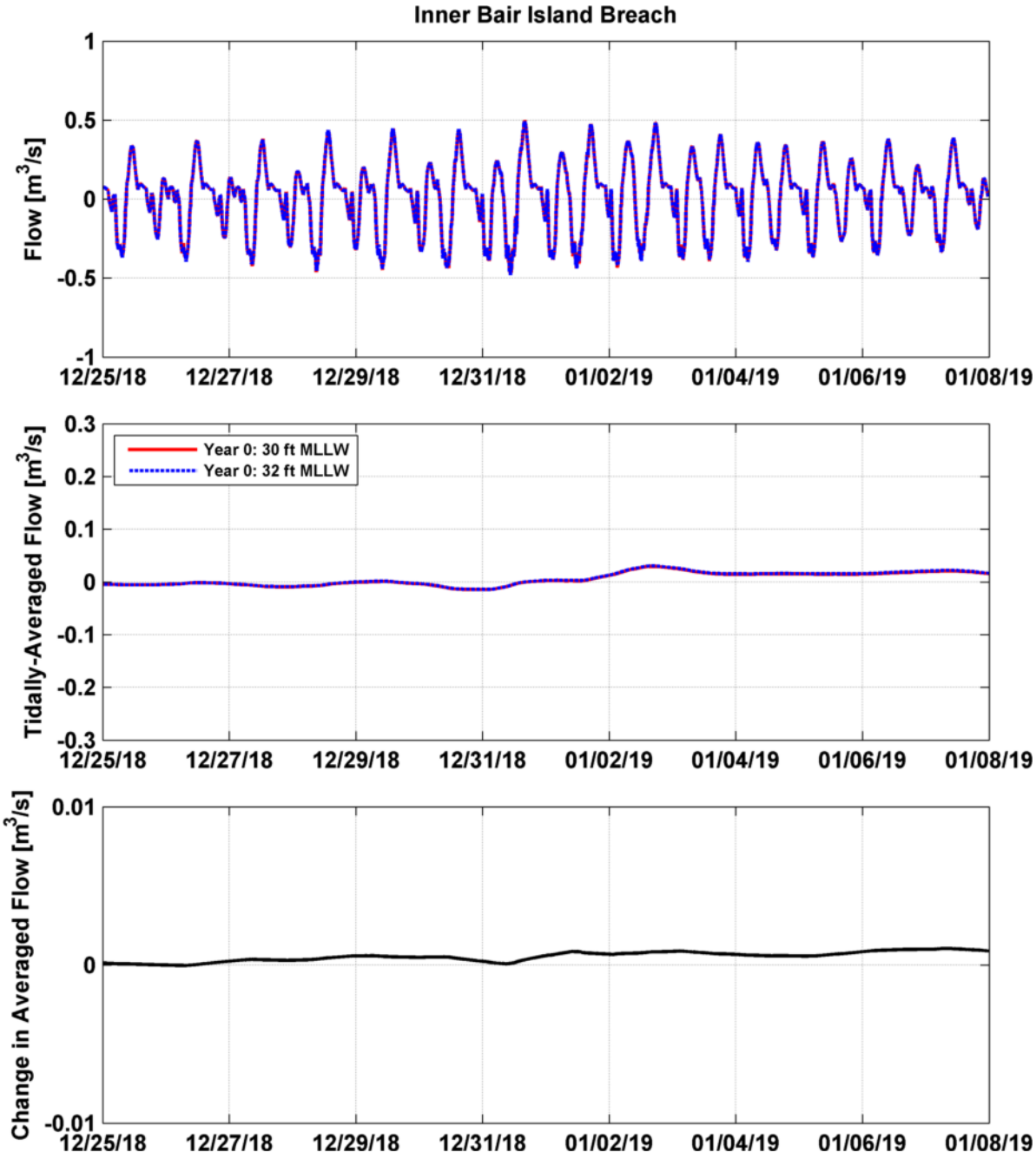


Figure 8.2-27
Predicted flow through a breach in Inner Bair Island (IB, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

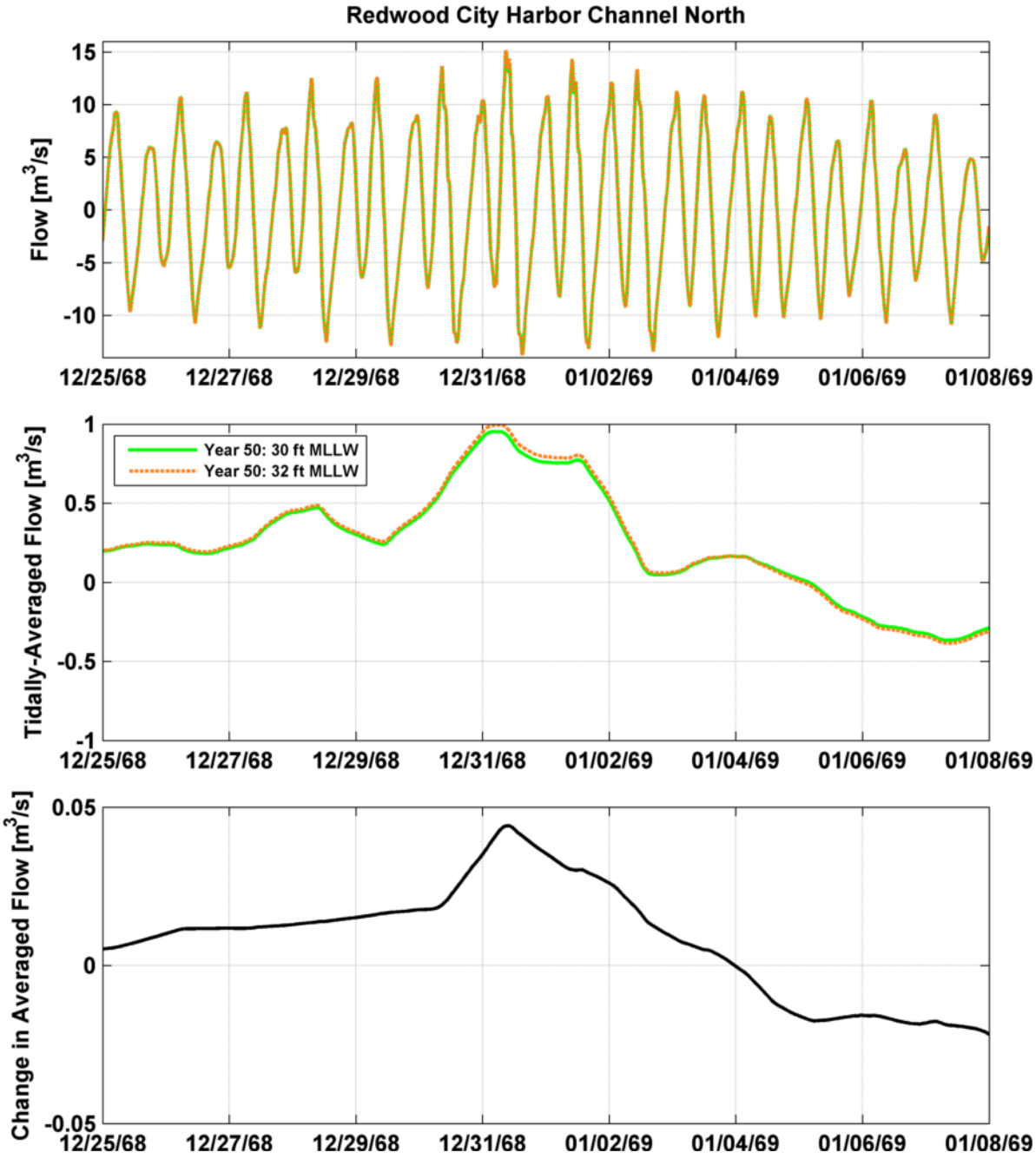


Figure 8.2-28
Predicted flow through the Redwood City Harbor Channel northern cross section (RCHCN, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

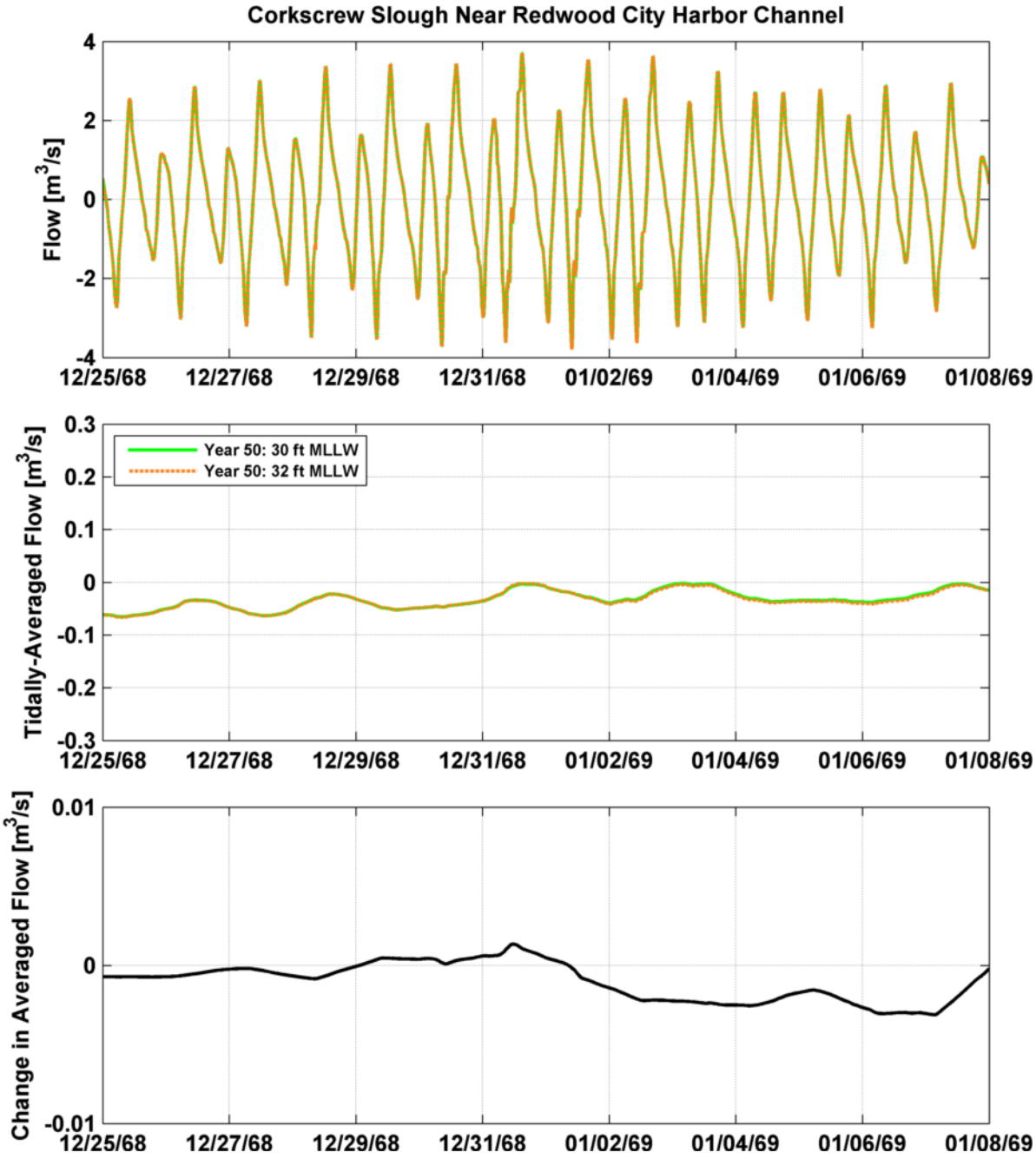


Figure 8.2-29
Predicted flow through Corkscrew Slough near the Redwood City Harbor Channel (CSL, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

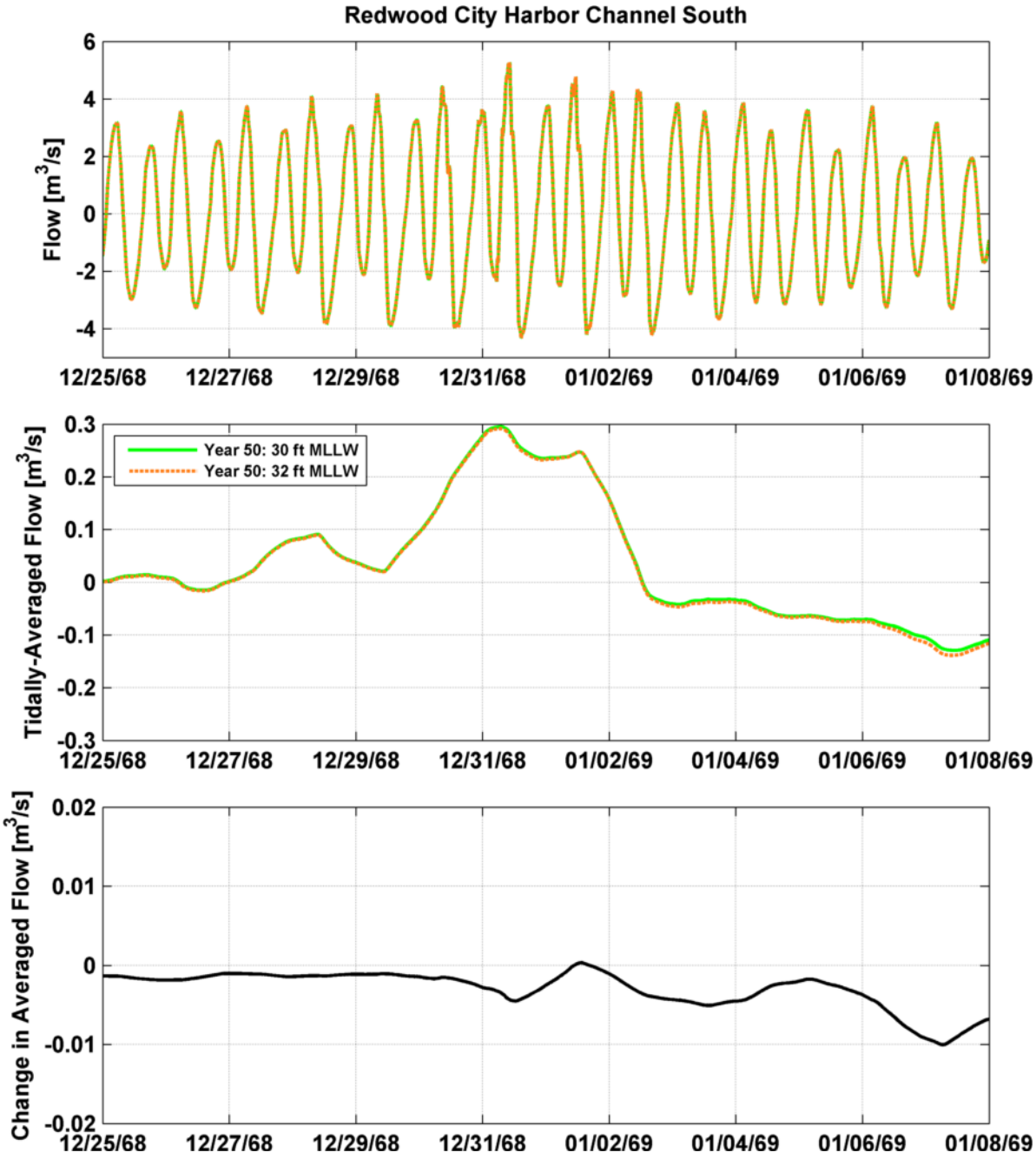


Figure 8.2-30
Predicted flow through the Redwood City Harbor Channel southern cross section (RCHCS, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

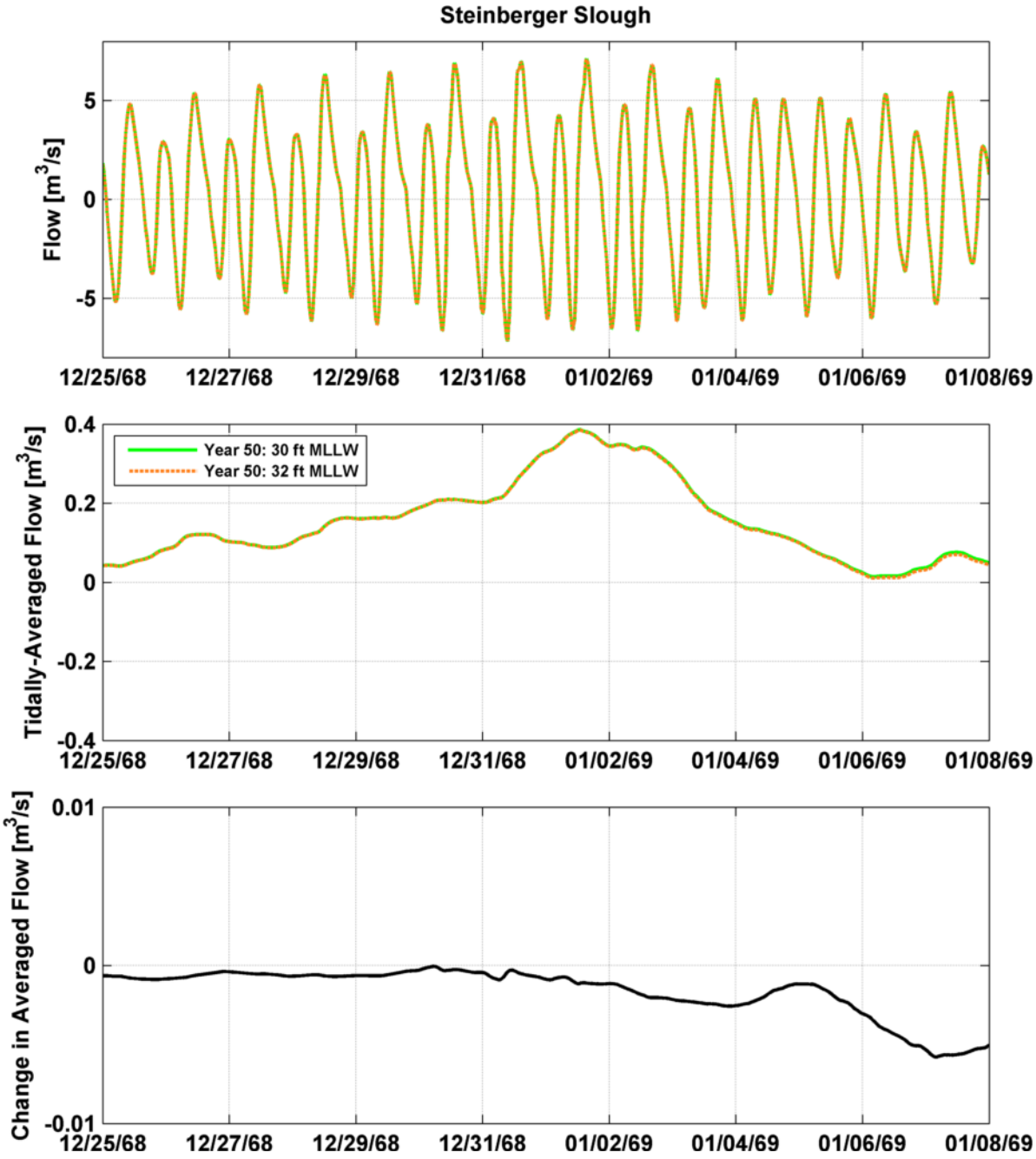


Figure 8.2-31
Predicted flow through Steinberger Slough (STSL, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

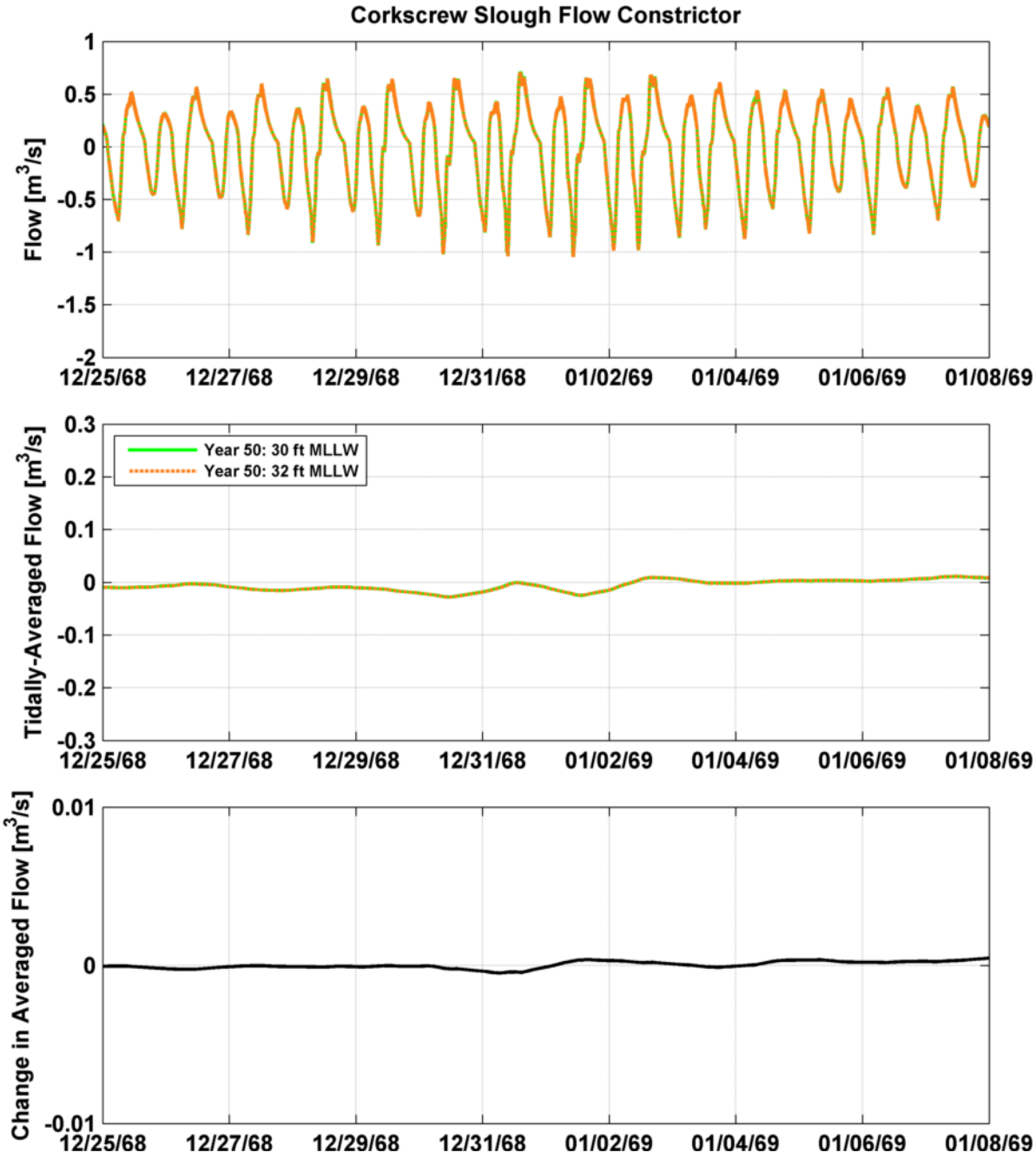


Figure 8.2-32
Predicted flow through the Corkscrew Slough flow constrictor (FC, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

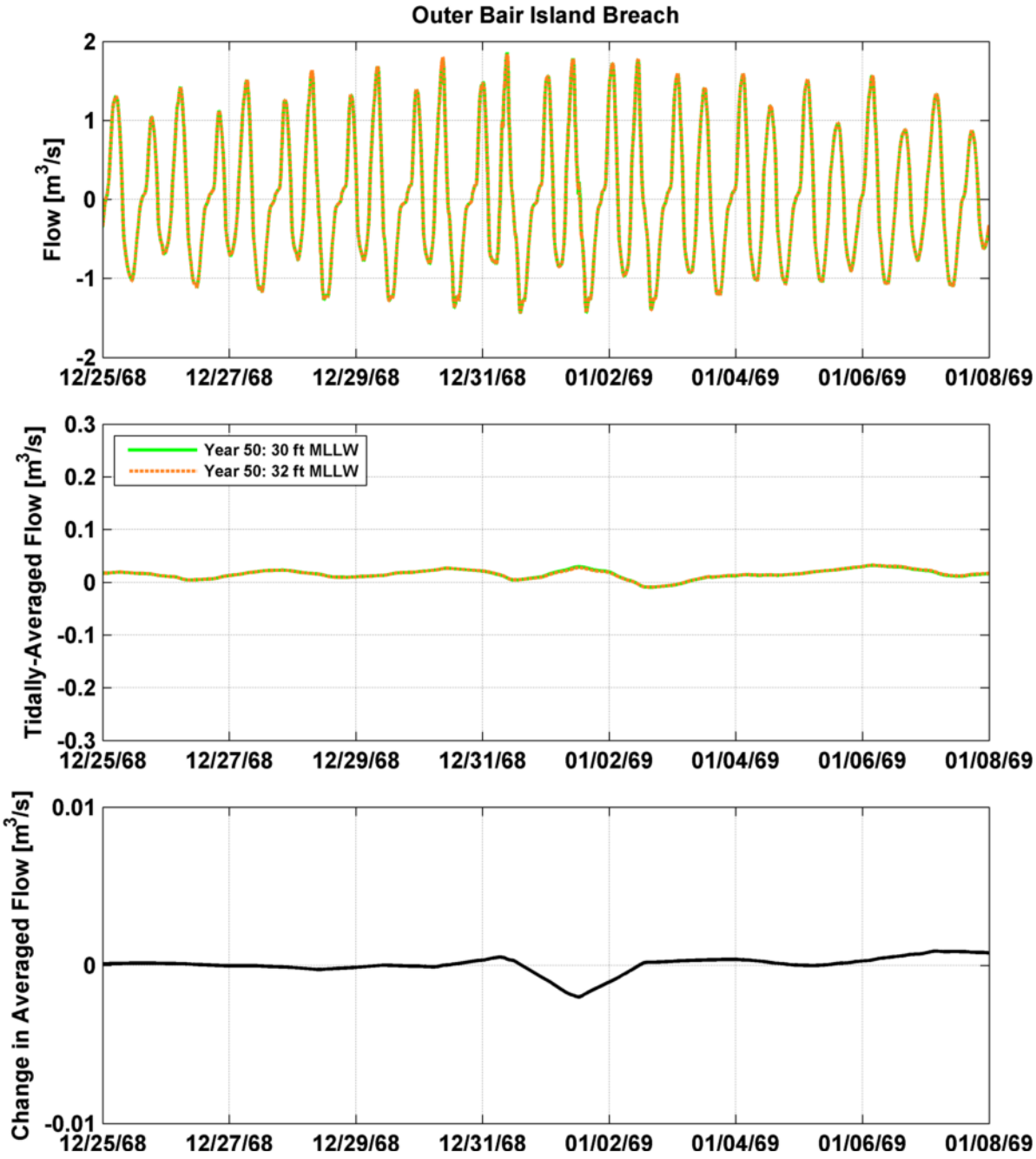


Figure 8.2-33
Predicted flow through a breach in Outer Bair Island (OB, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

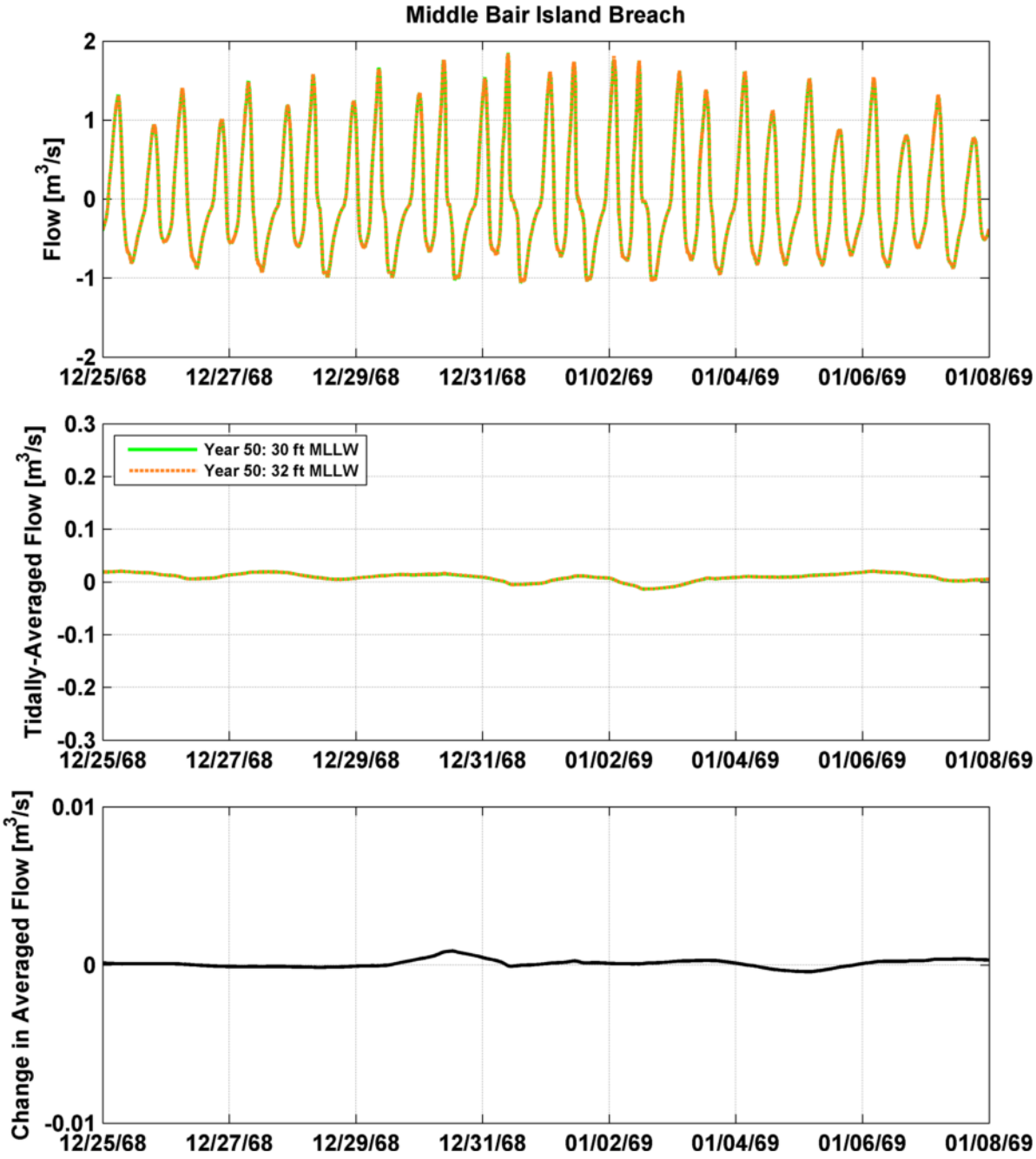


Figure 8.2-34
Predicted flow through a breach in Middle Bair Island (MB, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

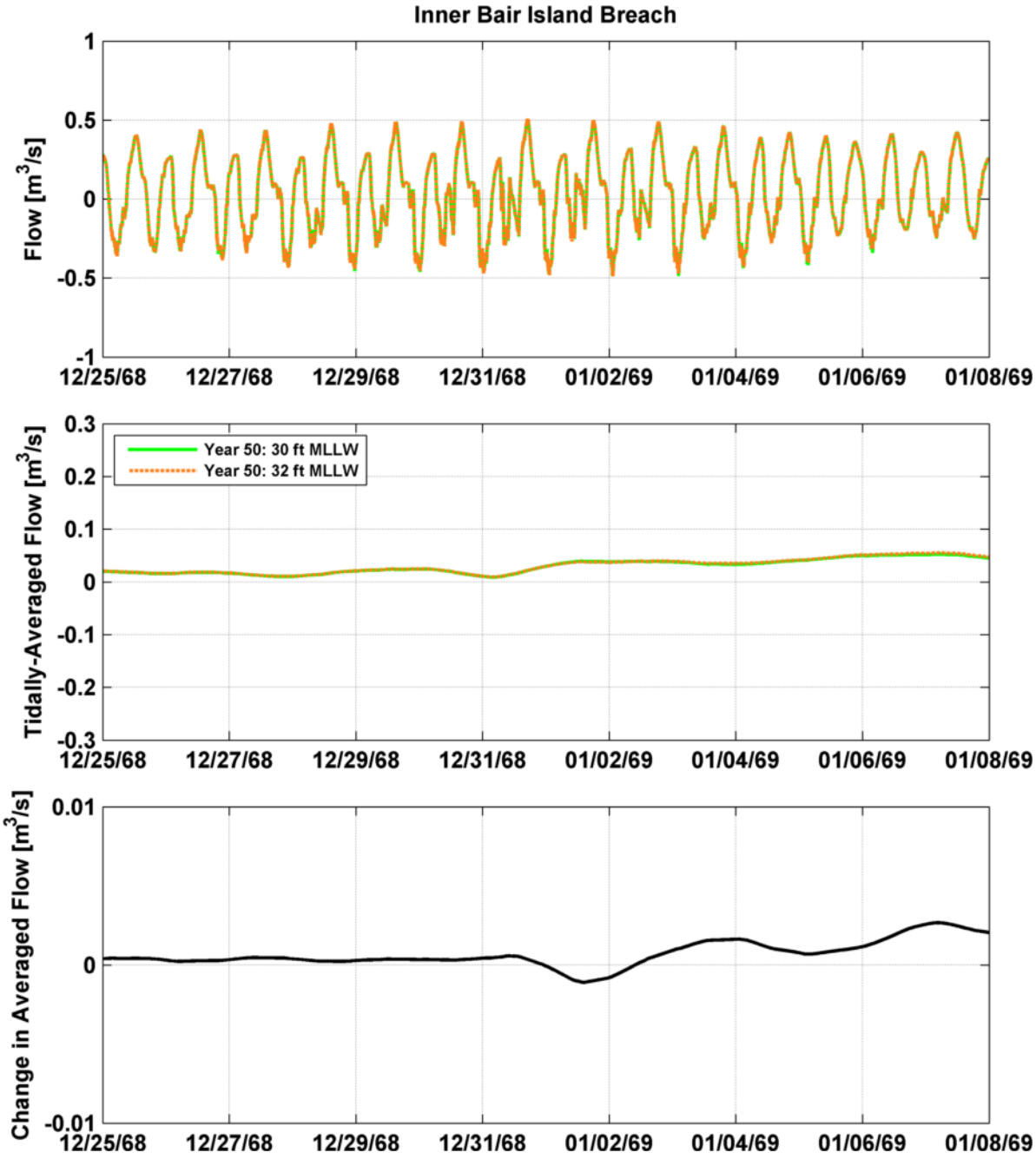


Figure 8.2-35
Predicted flow through a breach in Inner Bair Island (IB, Figure 8.2-2) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

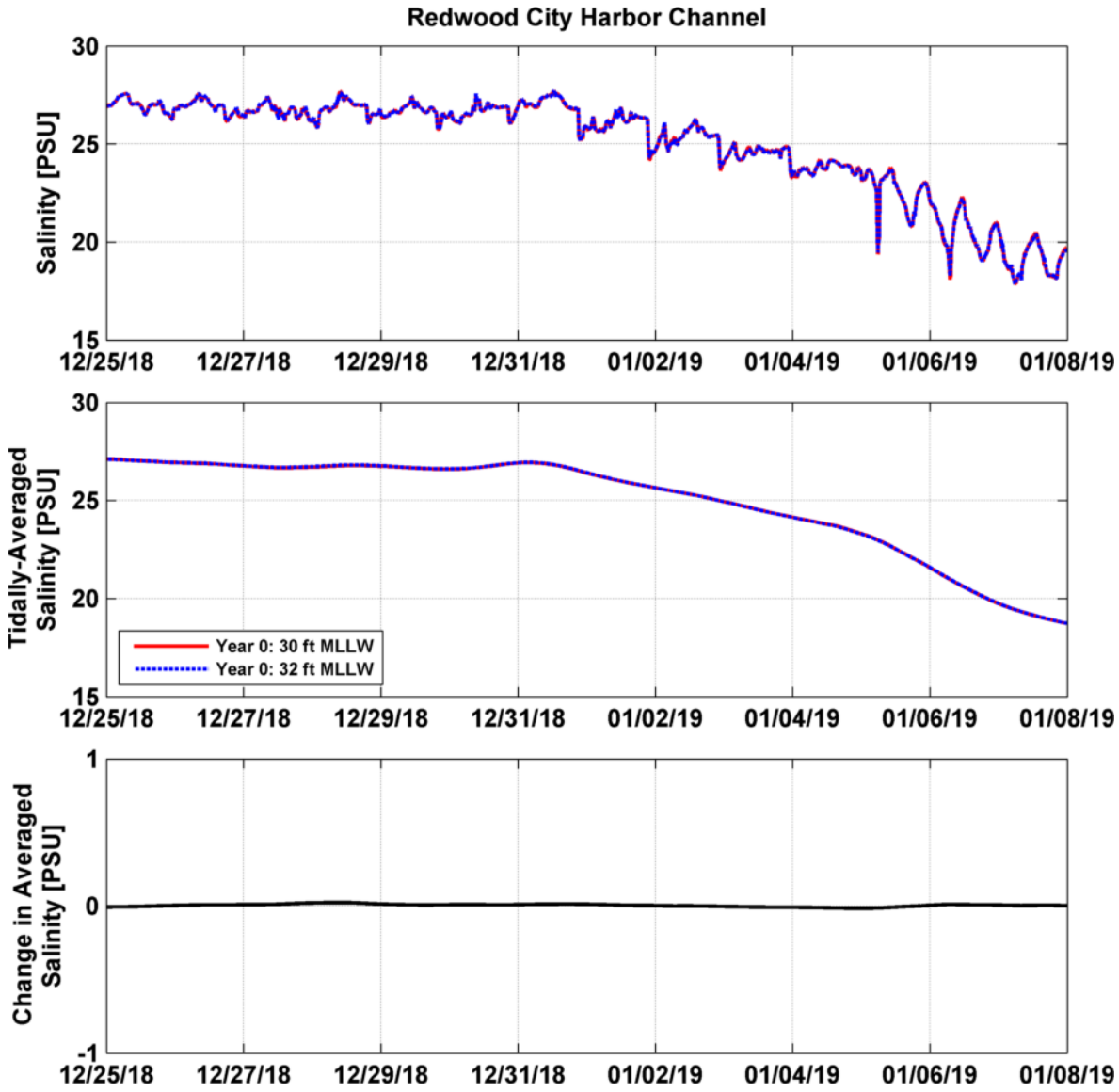


Figure 8.2-36
Predicted surface salinity in the Redwood City Harbor Channel (RCHC, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

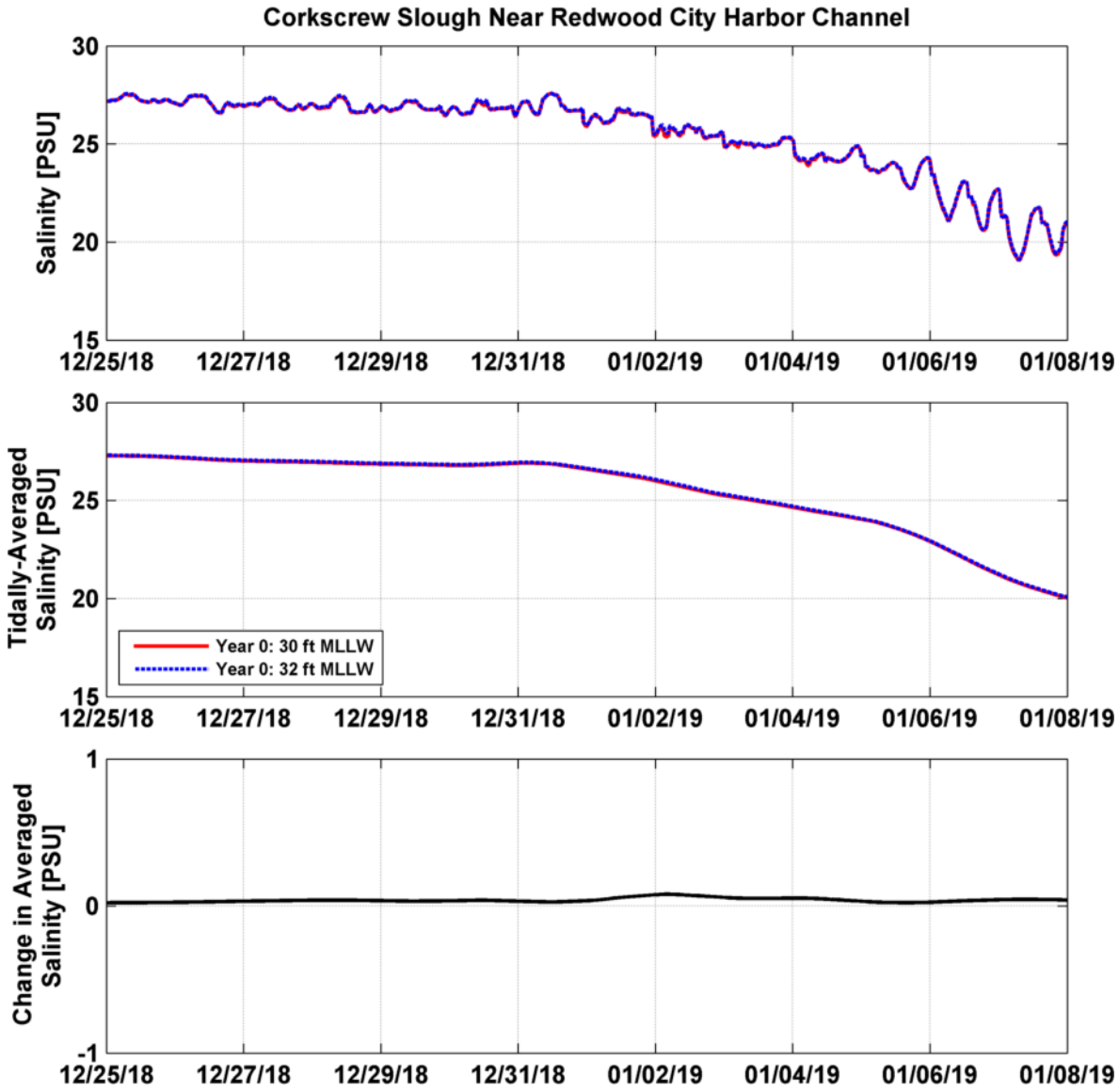


Figure 8.2-37
Predicted surface salinity in Corkscrew Slough near the Redwood City Harbor Channel (CSL, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

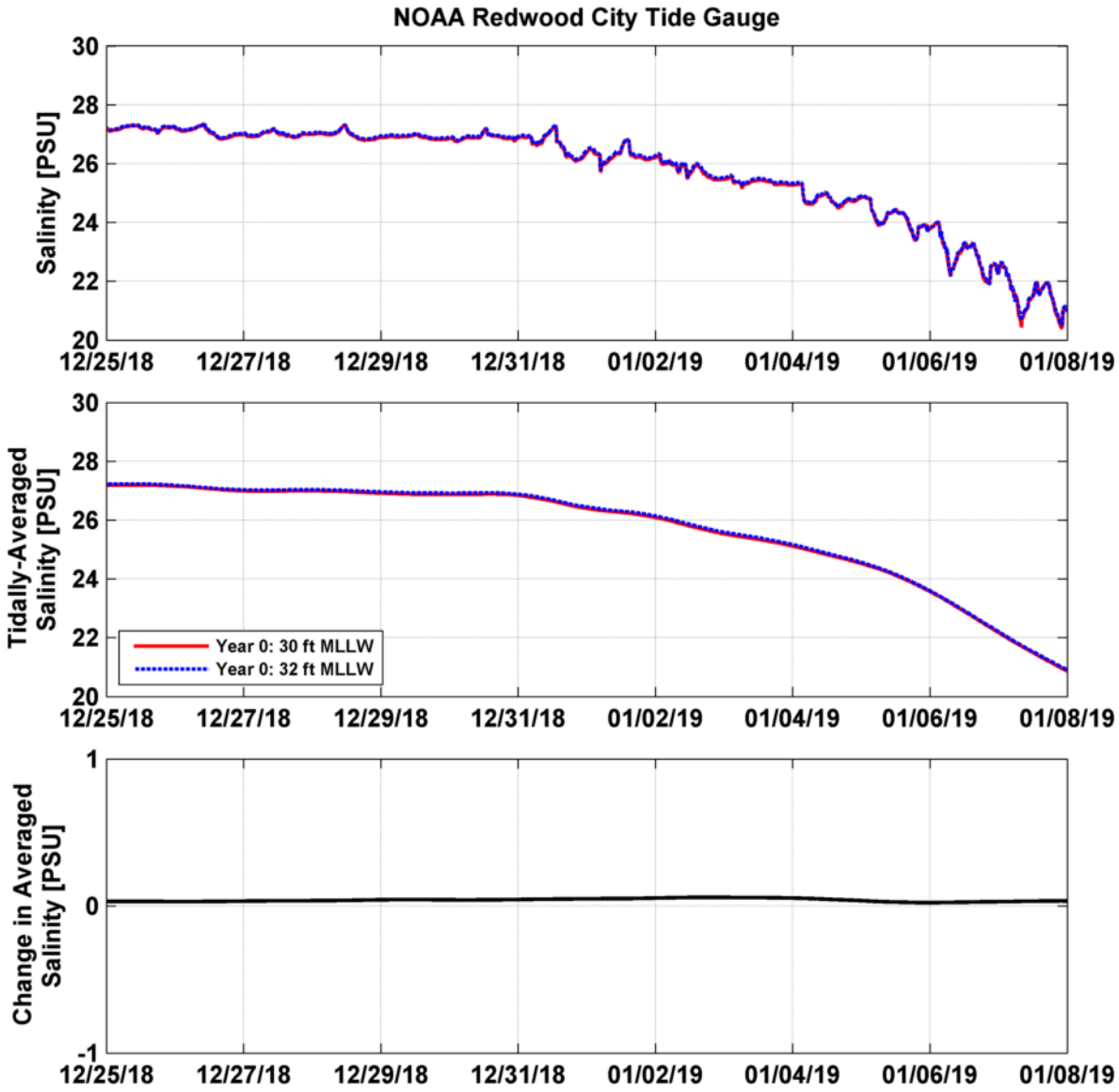


Figure 8.2-38
Predicted surface salinity at the NOAA Redwood City tide gauge (9414523, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

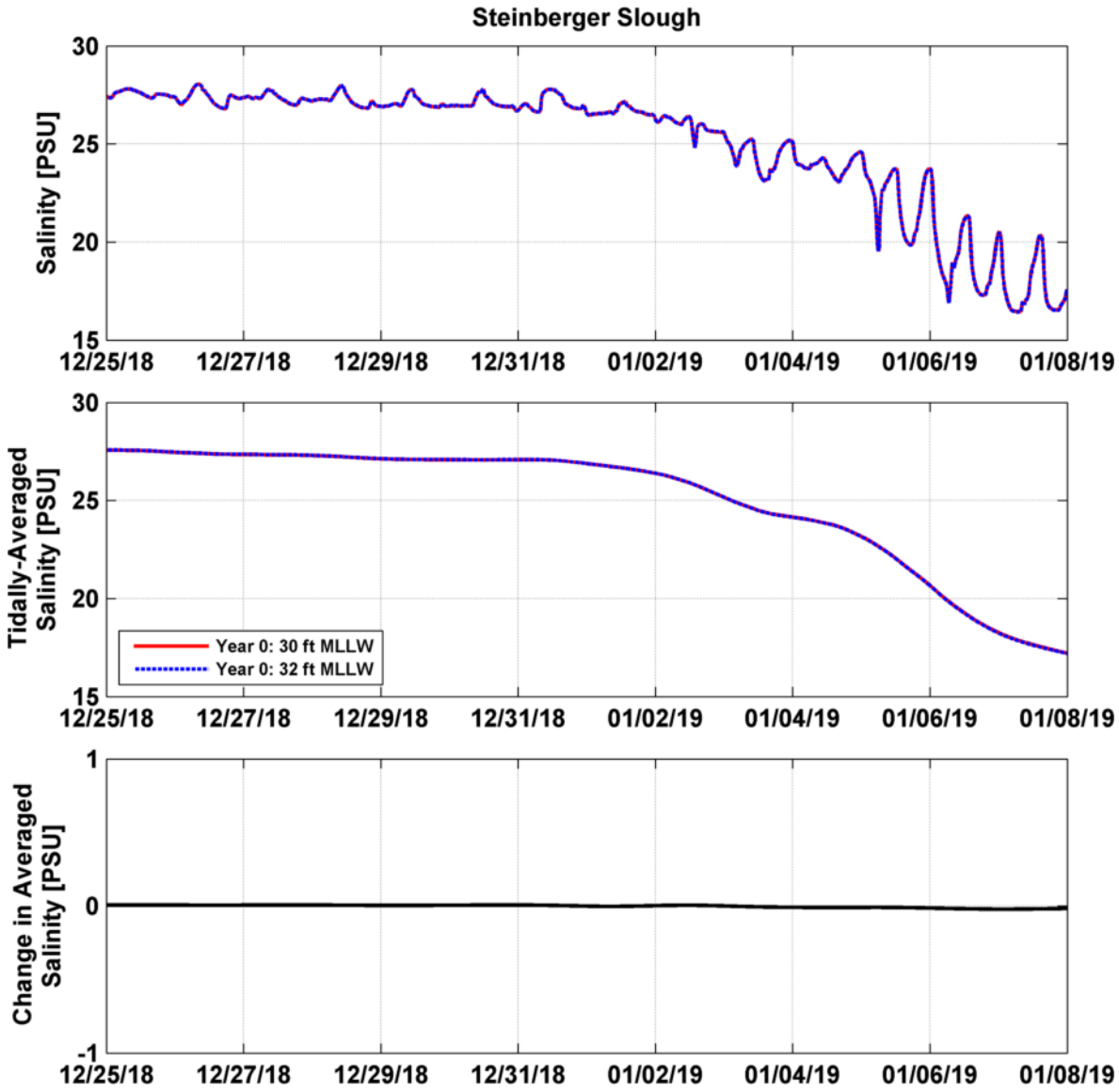


Figure 8.2-39
Predicted surface salinity in Steinberger Slough (STSL, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

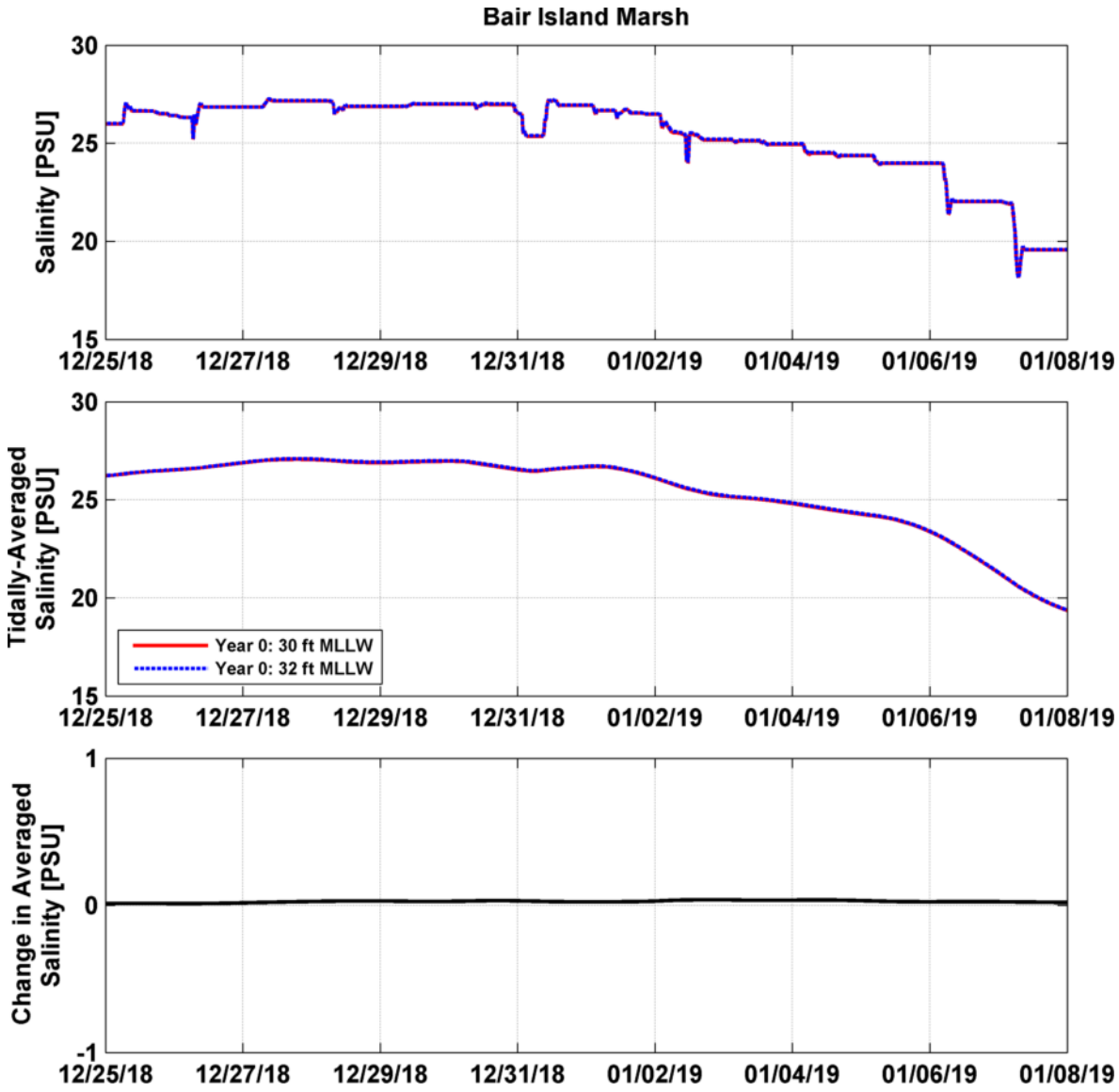


Figure 8.2-40
Predicted surface salinity in the Bair Island marsh (BIM, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

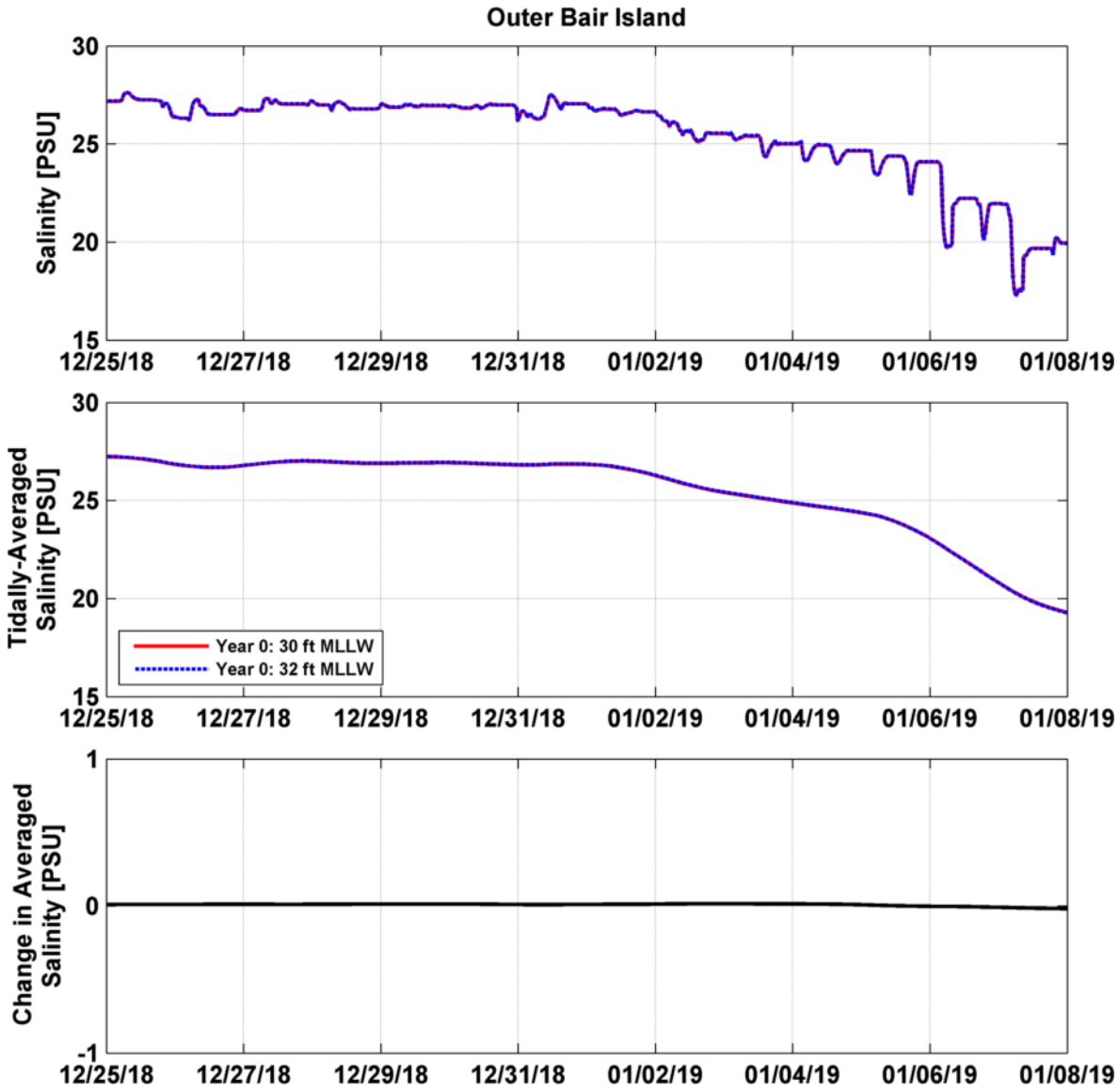


Figure 8.2-41
Predicted surface salinity in Outer Bair Island (OB, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

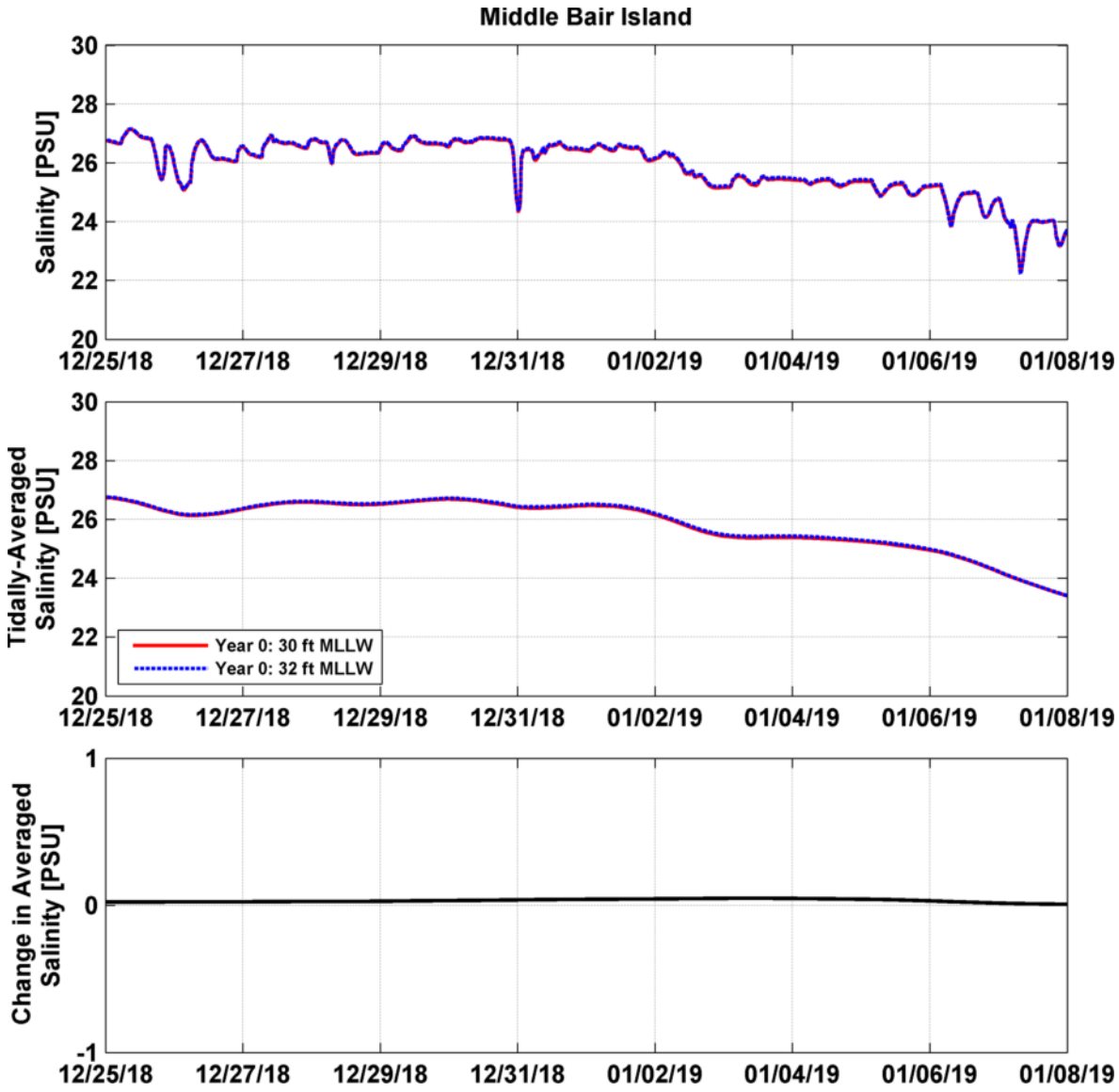


Figure 8.2-42
Predicted surface salinity in Middle Bair Island (MB, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

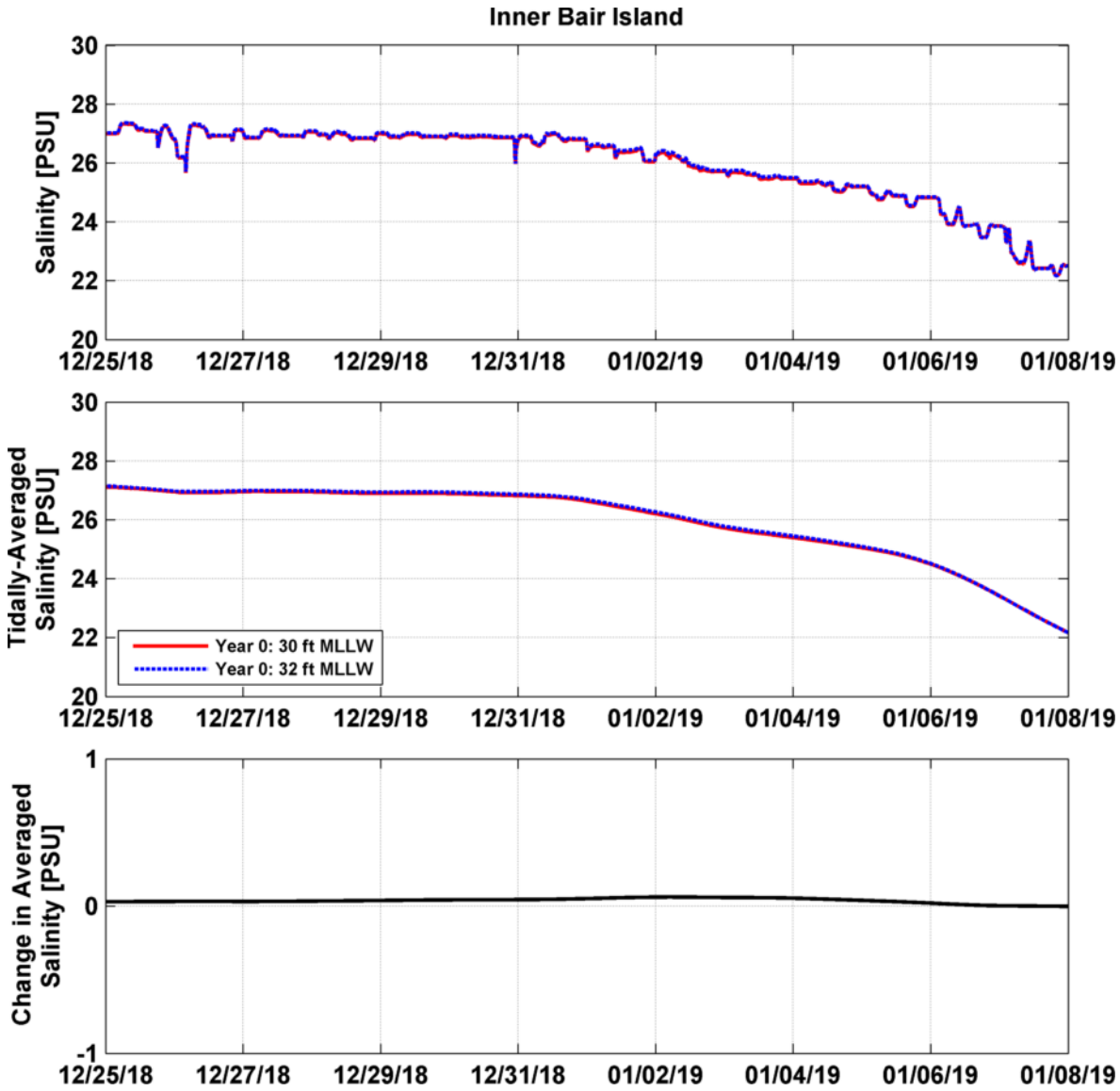


Figure 8.2-43 Predicted surface salinity in Inner Bair Island (IB, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 0 scenarios.

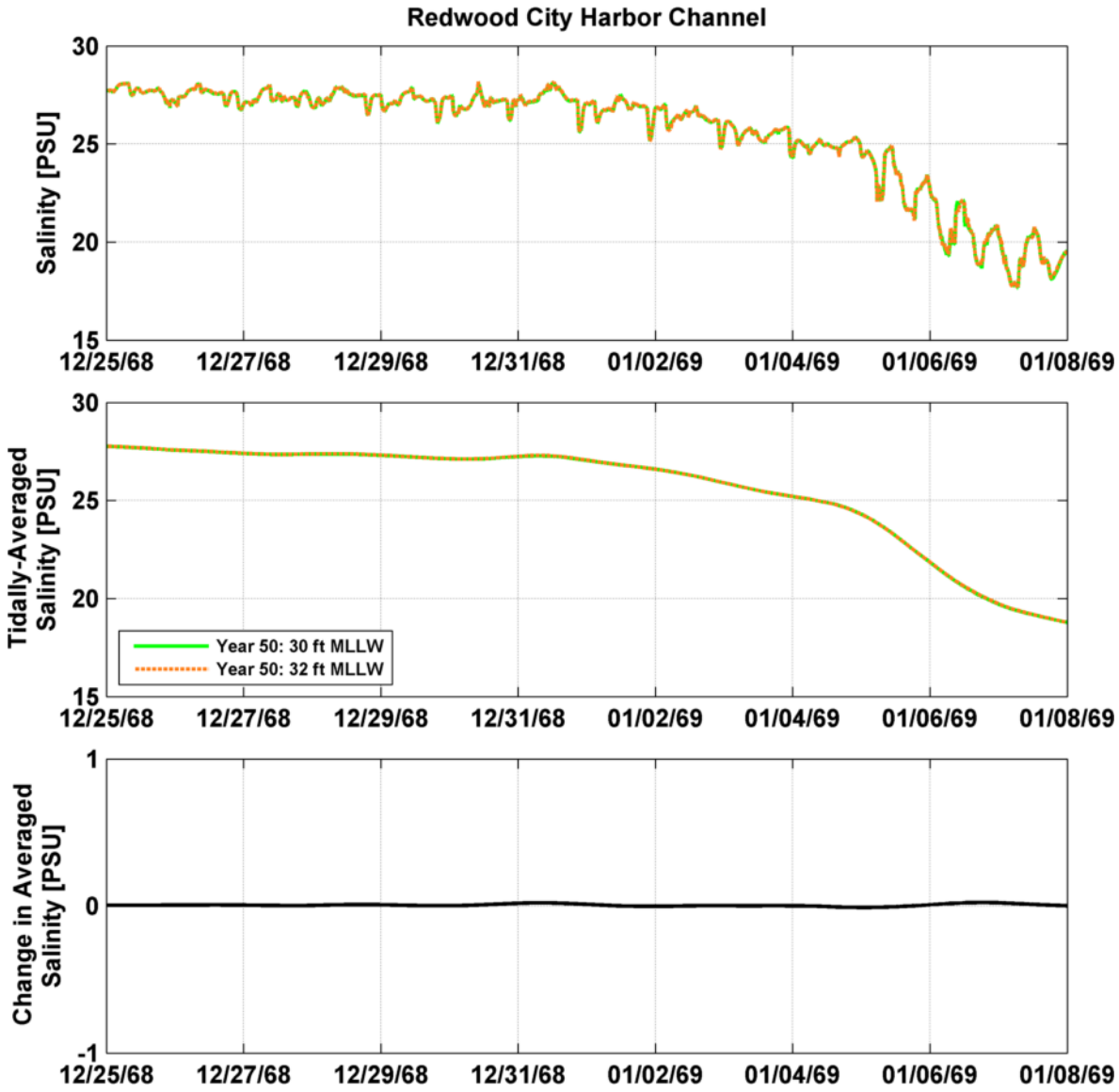


Figure 8.2-44

Predicted surface salinity in the Redwood City Harbor Channel (RCHC, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

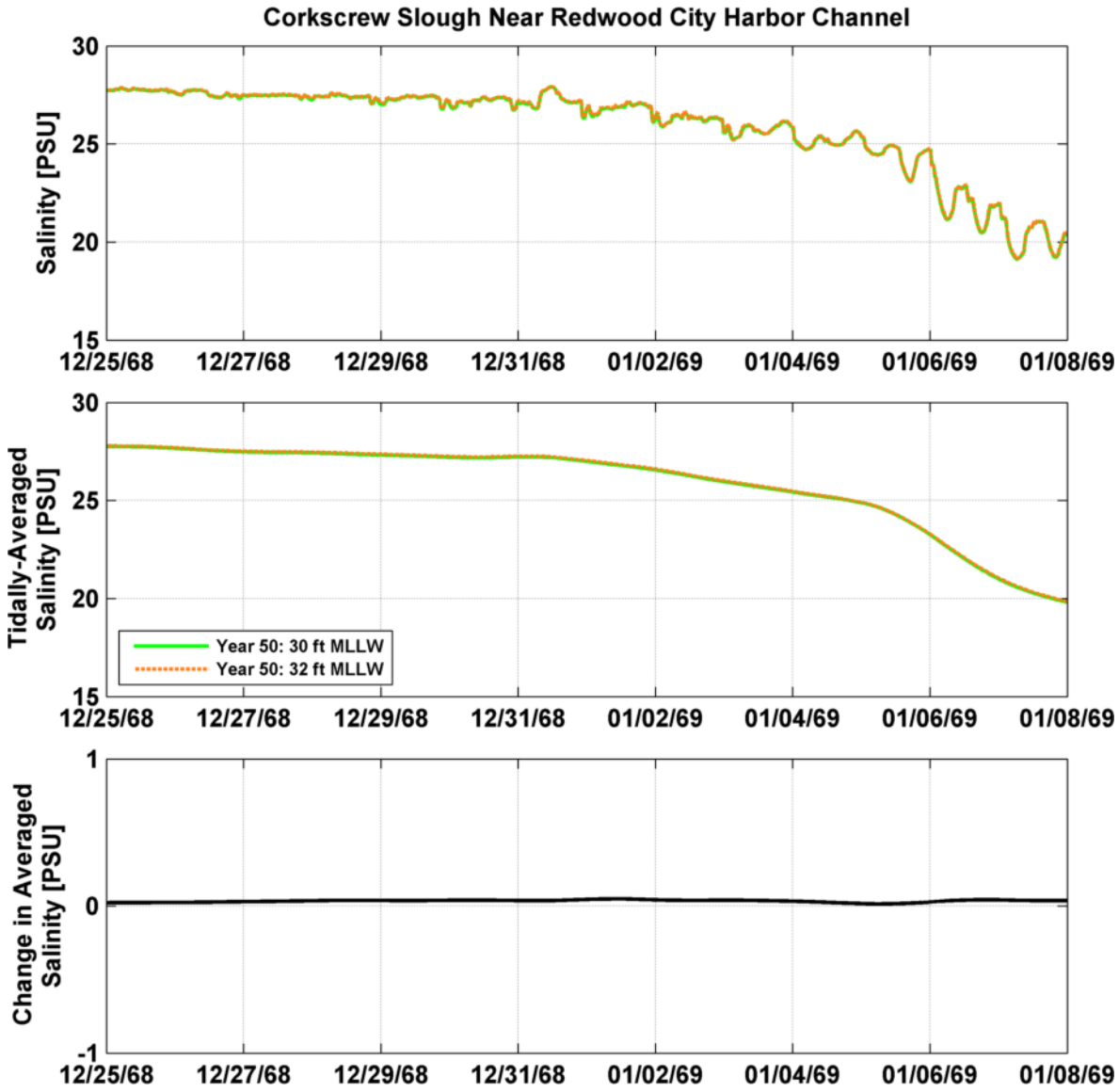


Figure 8.2-45
Predicted surface salinity in Corkscrew Slough near the Redwood City Harbor Channel (CSL, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

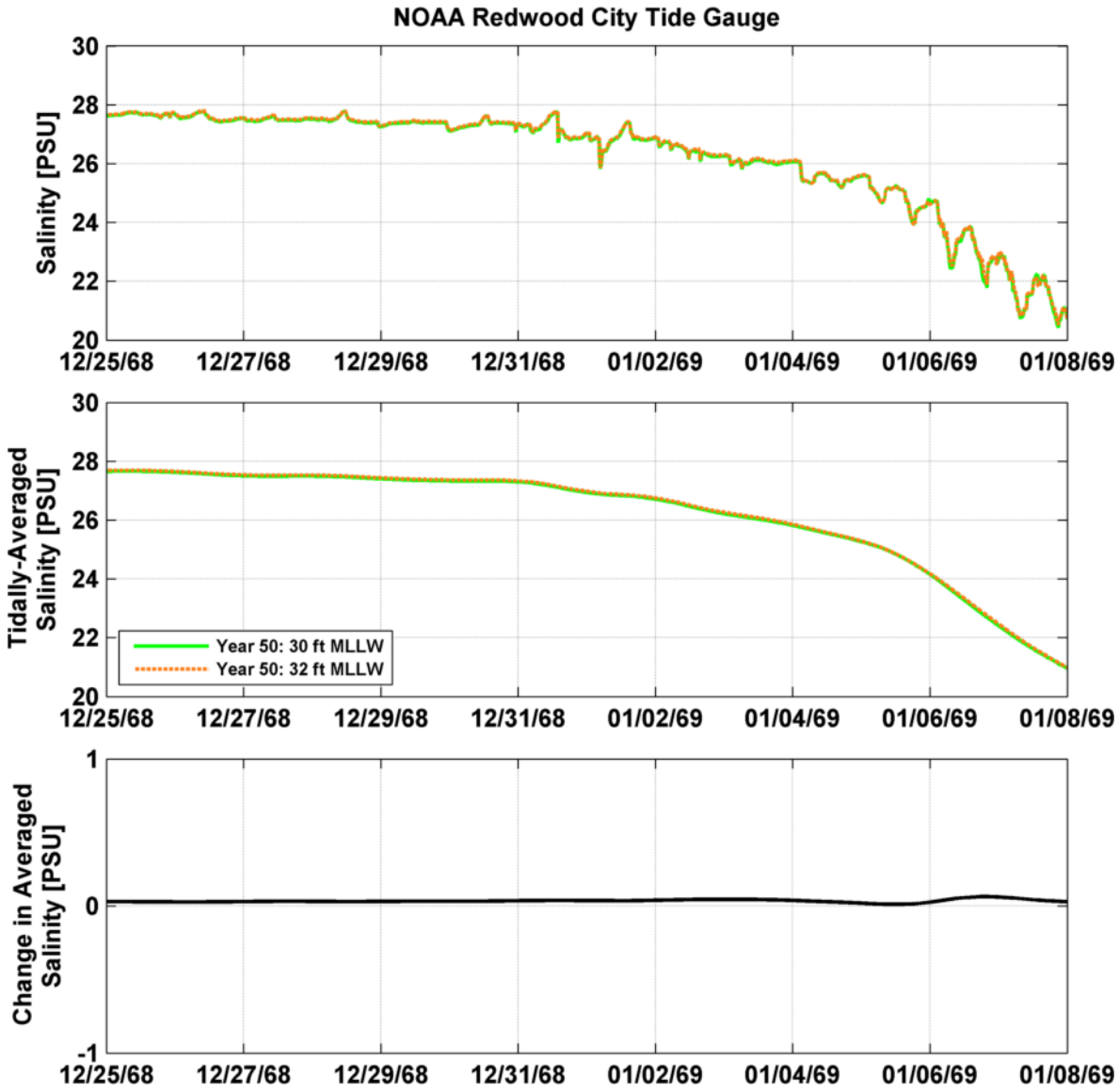


Figure 8.2-46
Predicted surface salinity at the NOAA Redwood City tide gauge (9414523, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

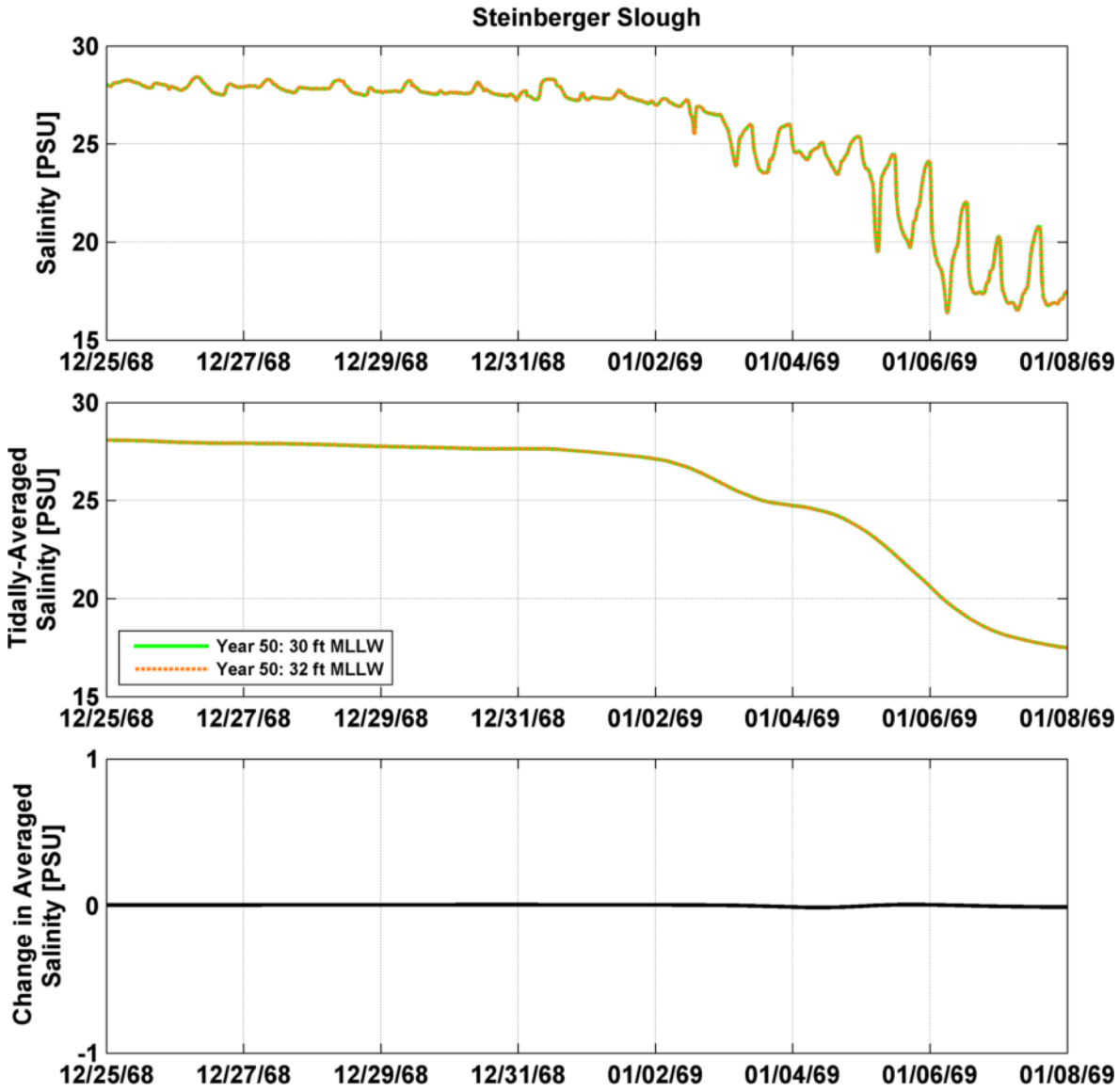


Figure 8.2-47
Predicted surface salinity in Steinberger Slough (STSL, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

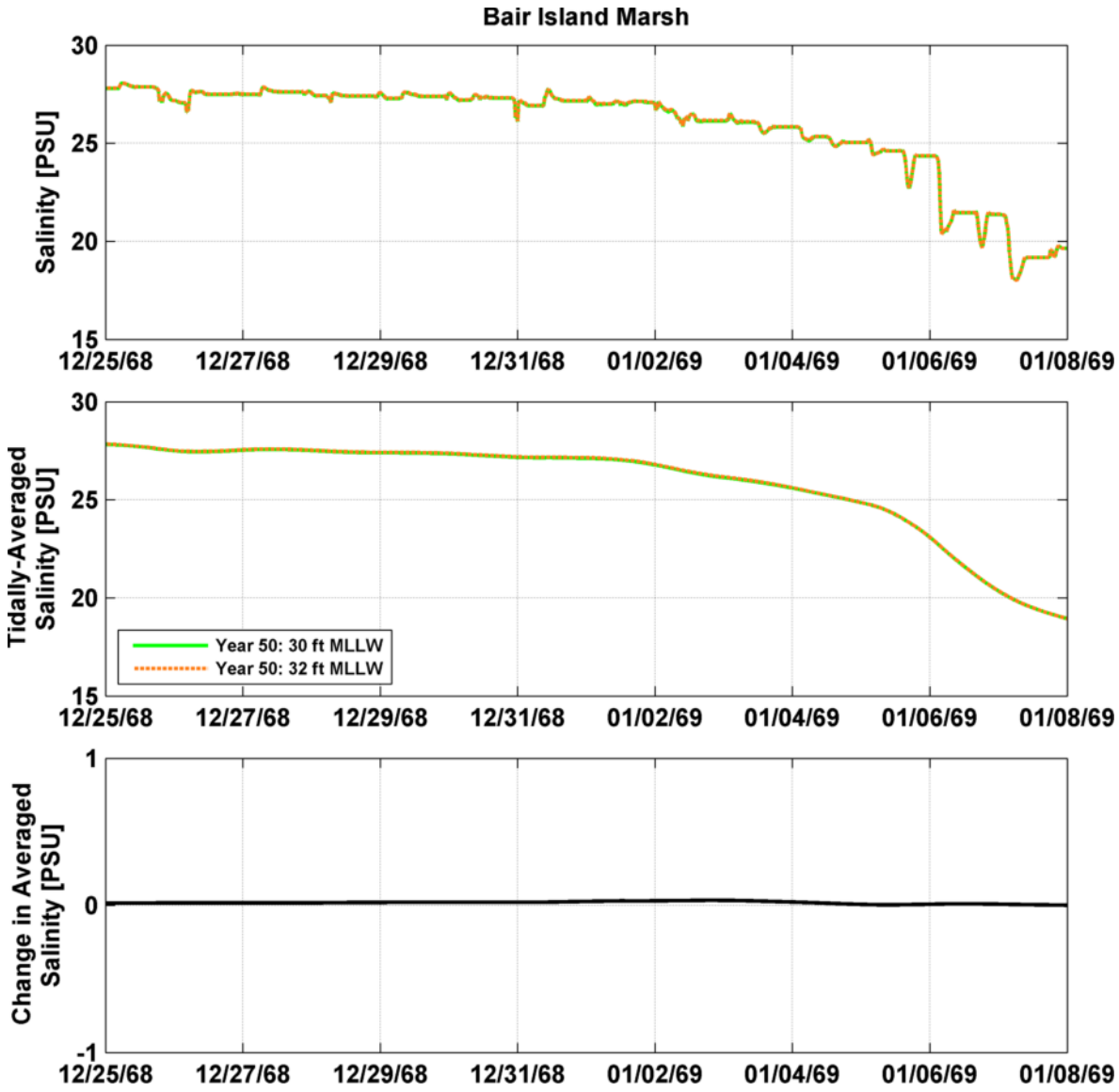


Figure 8.2-48
Predicted surface salinity in the Bair Island marsh (BIM, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

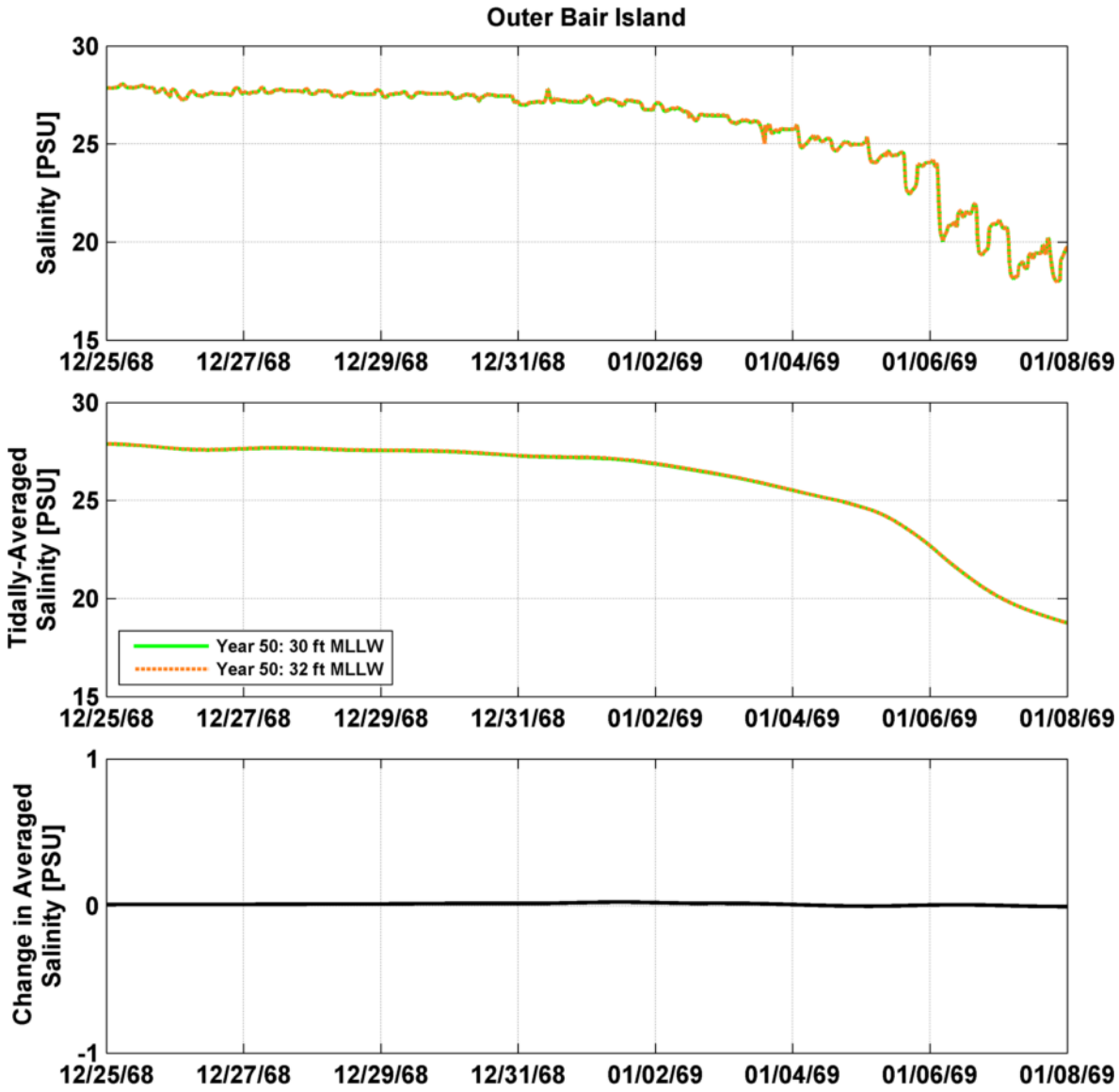


Figure 8.2-49
Predicted surface salinity in Outer Bair Island (OB, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

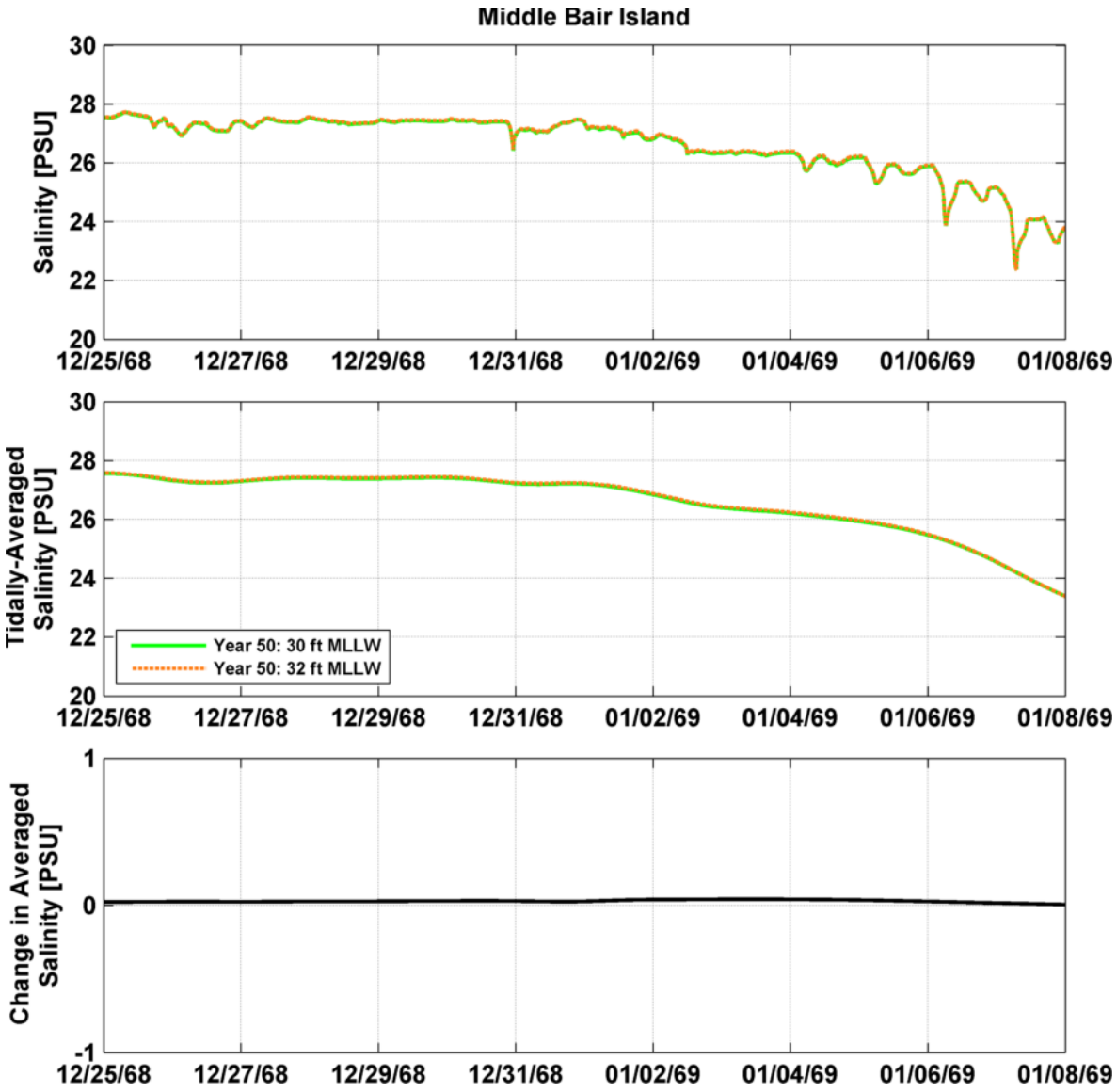


Figure 8.2-50
Predicted surface salinity in Middle Bair Island (MB, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

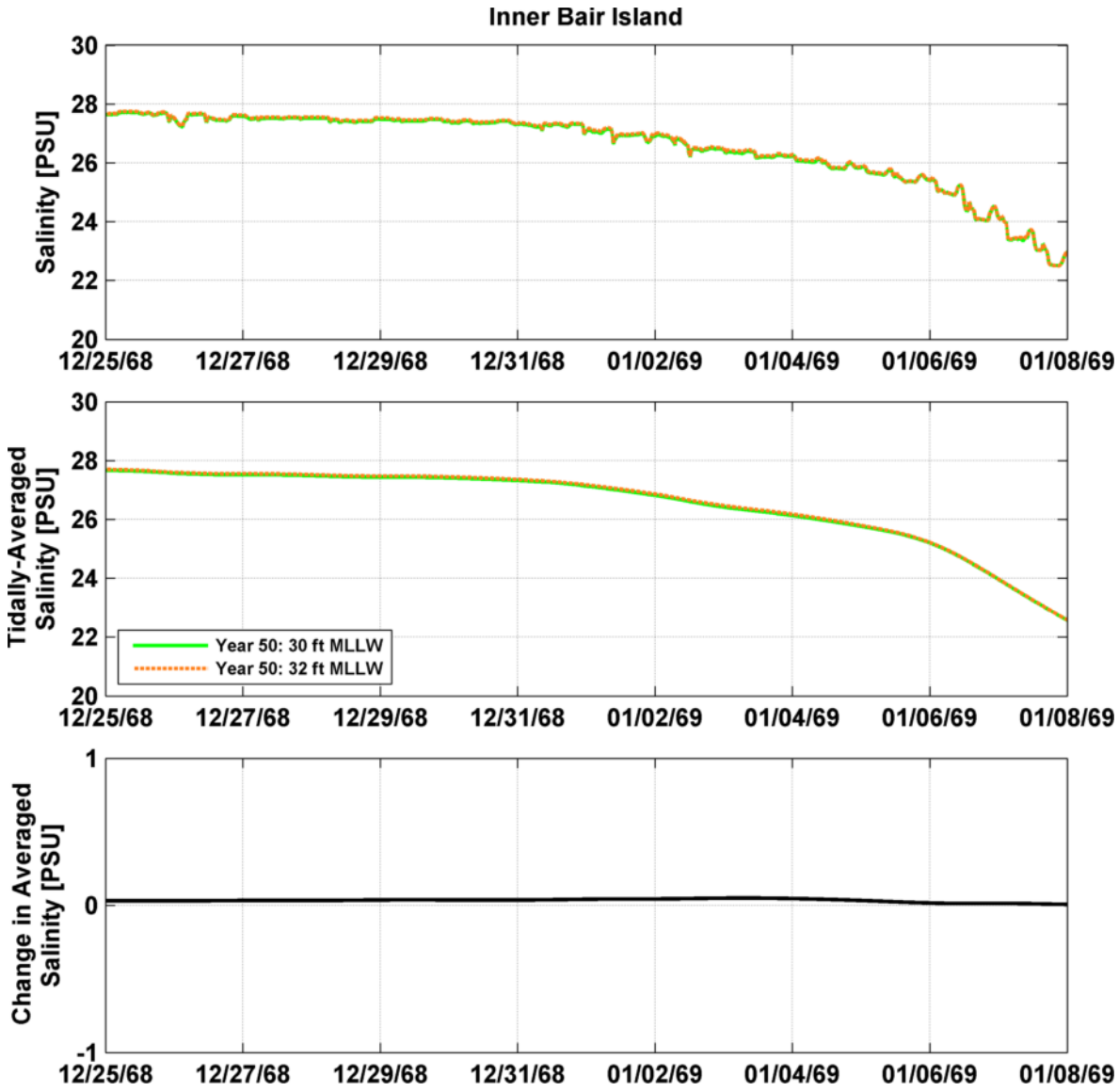


Figure 8.2-51
Predicted surface salinity in Inner Bair Island (IB, Figure 8.2-3) for without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions during the Year 50 scenarios.

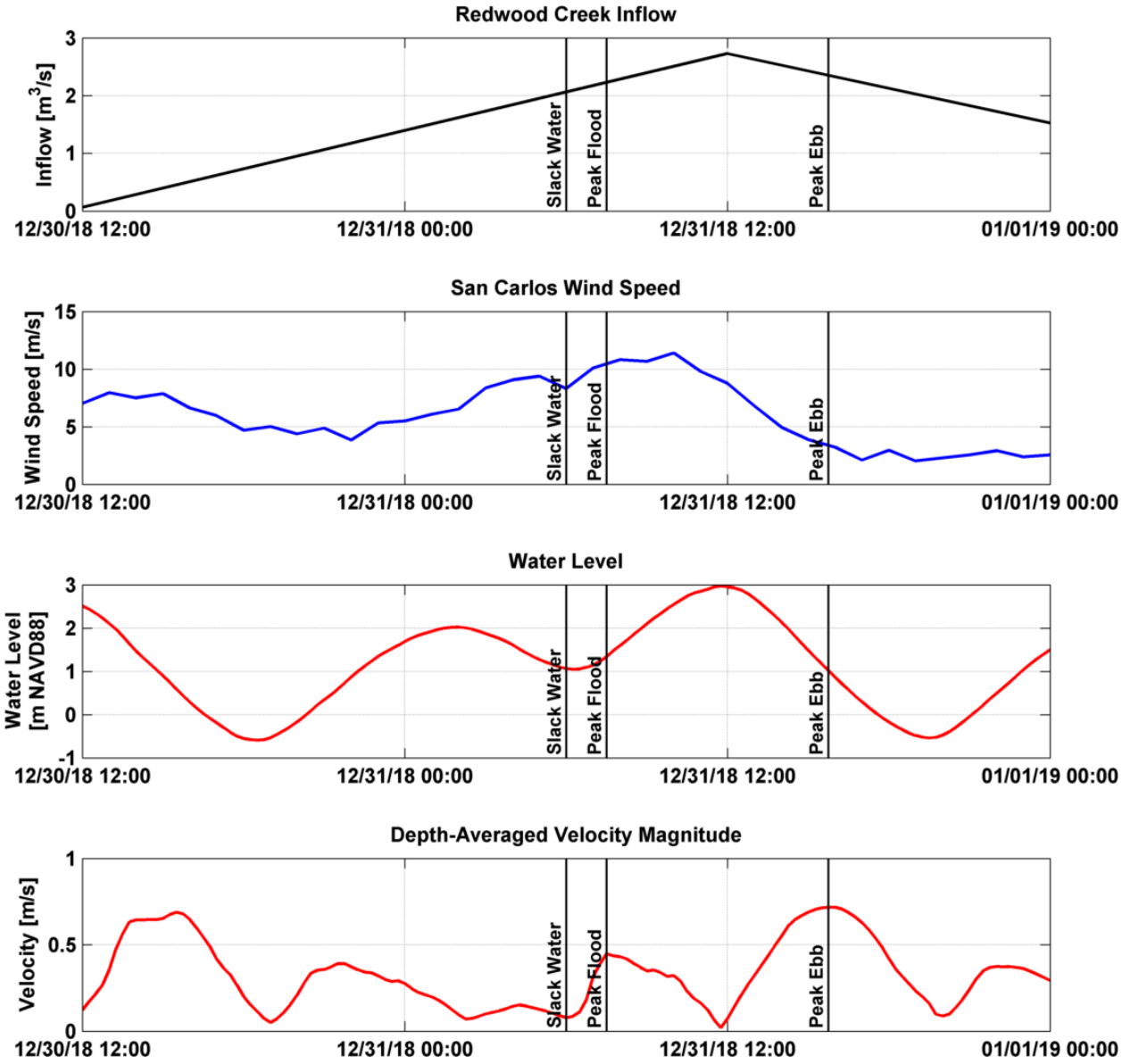


Figure 8.2-52

The Redwood Creek inflow, wind speed at San Carlos, predicted water level at the Redwood City tide gauge, and predicted depth-averaged velocity magnitude in the Redwood City Harbor Channel during the 30 feet MLLW project depth Year 0 simulation. Vertical lines mark the times of shear stress evaluation for slack water, peak flood velocity, and peak ebb velocity, from left to right.

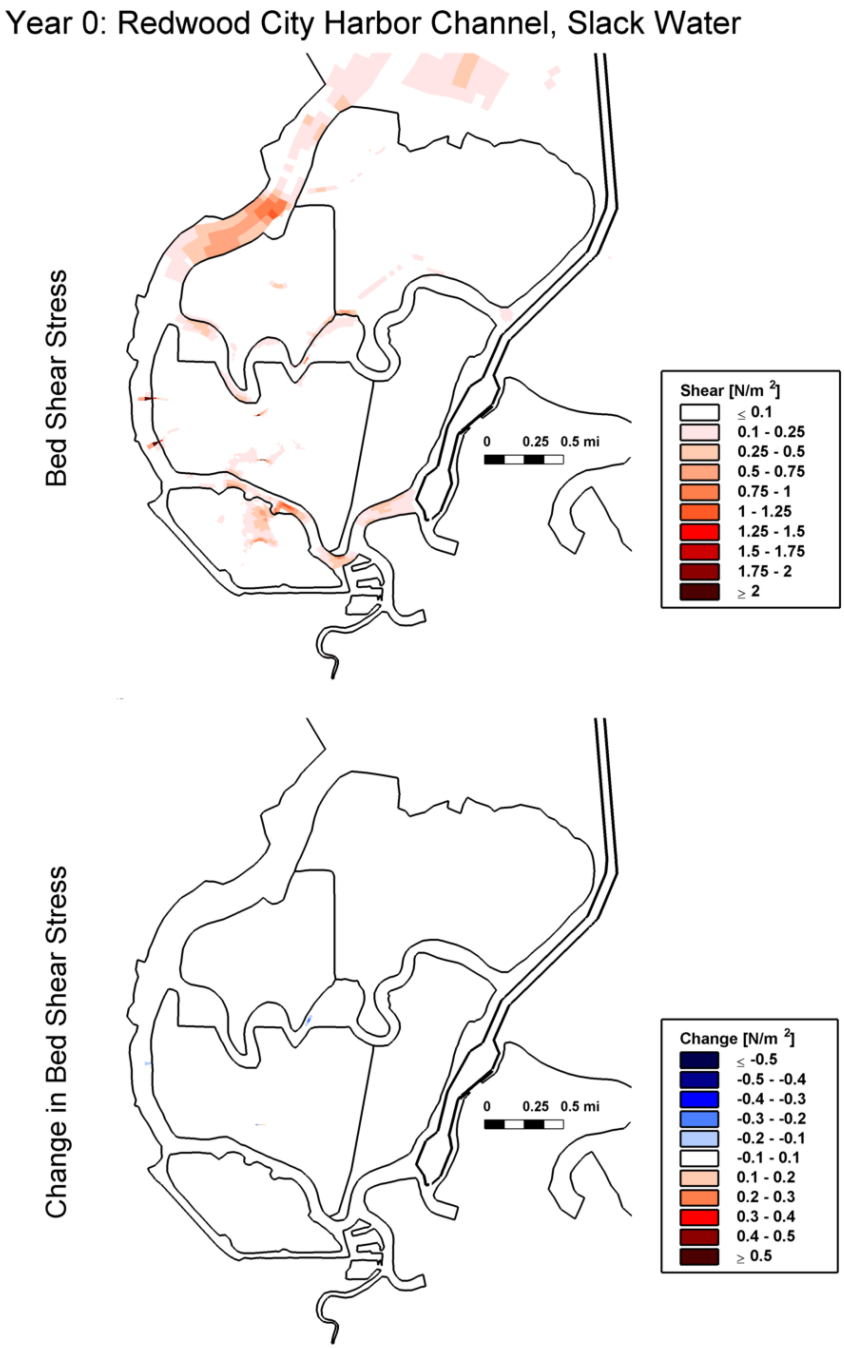


Figure 8.2-53
Predicted bed shear stress (Pa) in the vicinity of the Redwood City Harbor Channel and Bair Island during slack water for the 32 feet MLLW project depth Year 0 scenario (top); predicted change in bed shear stress in the 32 feet MLLW project depth Year 0 scenario relative to the 30 feet MLLW scenario (bottom).

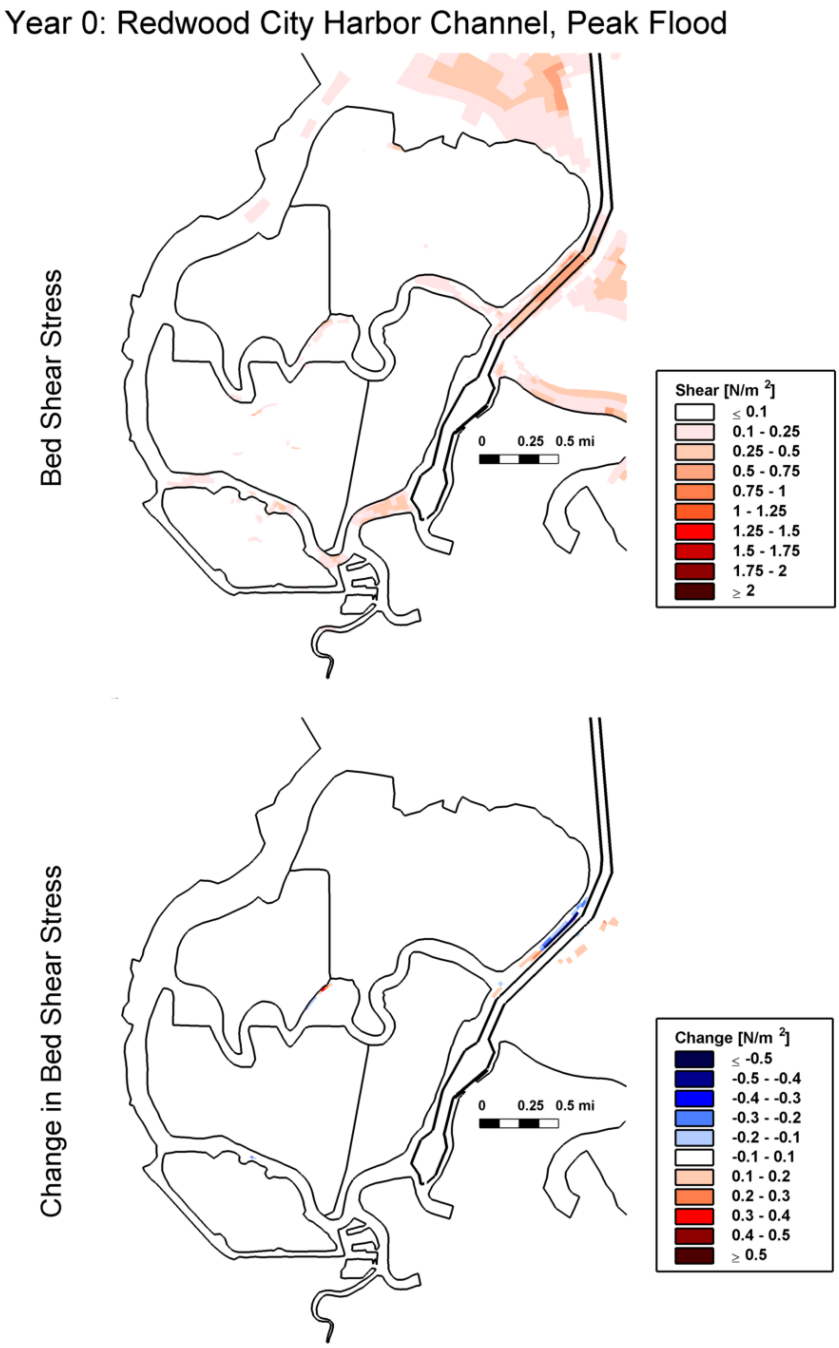


Figure 8.2-54
Predicted bed shear stress (Pa) in the vicinity of the Redwood City Harbor Channel and Bair Island during peak flood currents for the 32 feet MLLW project depth Year 0 scenario (top); predicted change in bed shear stress in the 32 feet MLLW project depth Year 0 scenario relative to the 30 feet MLLW scenario (bottom).

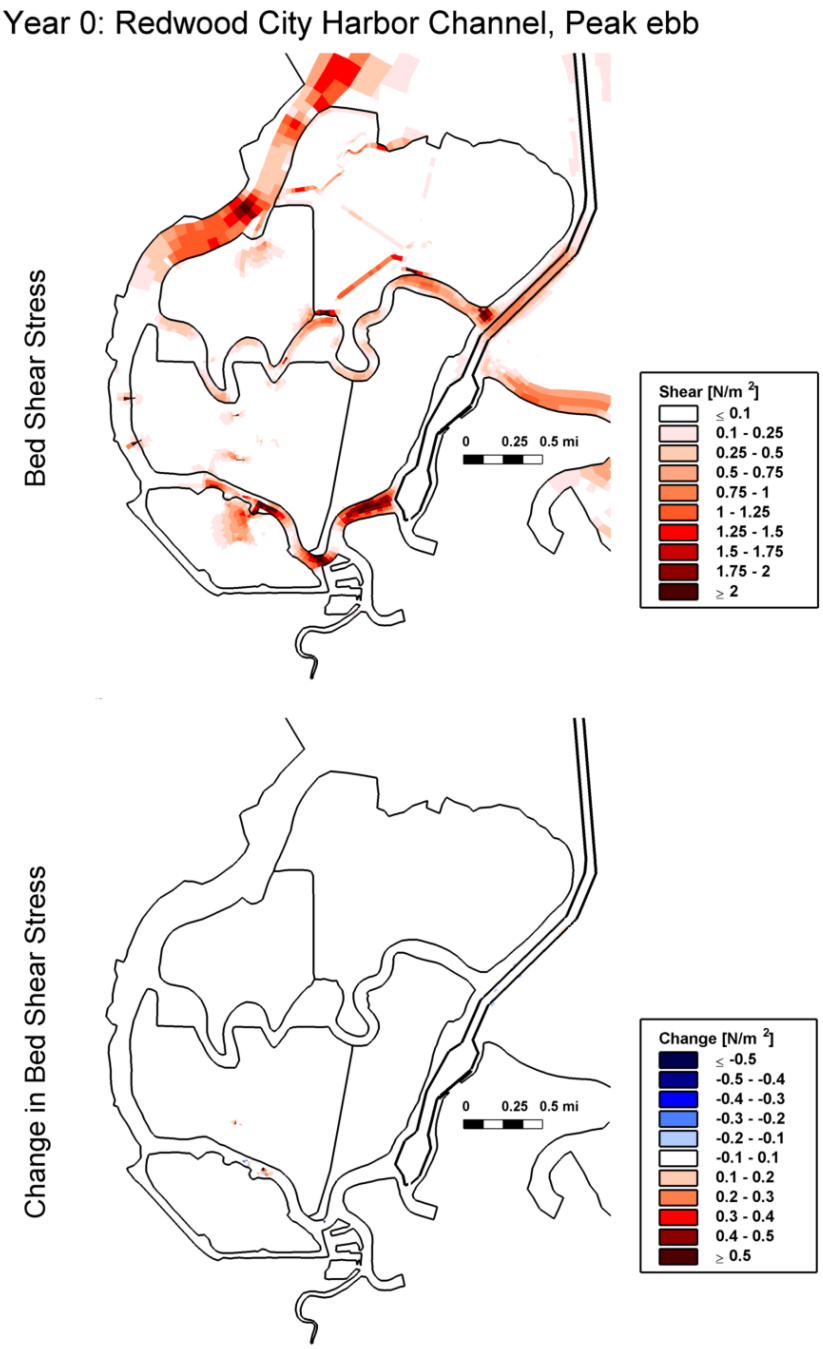


Figure 8.2-55
Predicted bed shear stress (Pa) in the vicinity of the Redwood City Harbor Channel and Bair Island during peak ebb currents for the 32 feet MLLW project depth Year 0 scenario (top); predicted change in bed shear stress in the 32 feet MLLW project depth Year 0 scenario relative to the 30 feet MLLW scenario (bottom).

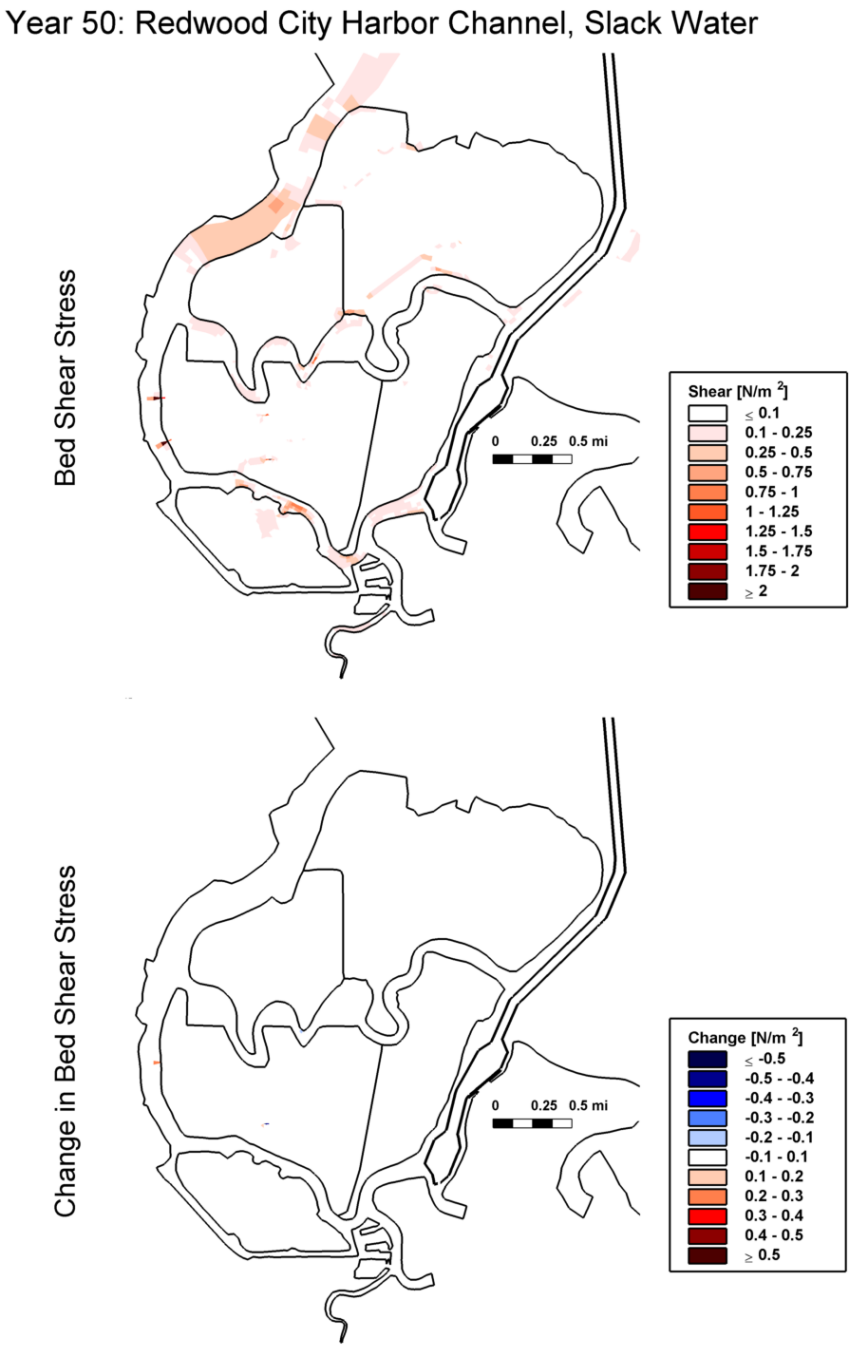


Figure 8.2-56
Predicted bed shear stress (Pa) in the vicinity of the Redwood City Harbor Channel and Bair Island during slack water for the 32 feet MLLW project depth Year 50 scenario (top); predicted change in bed shear stress in the 32 feet MLLW project depth Year 50 scenario relative to the 30 feet MLLW scenario (bottom).

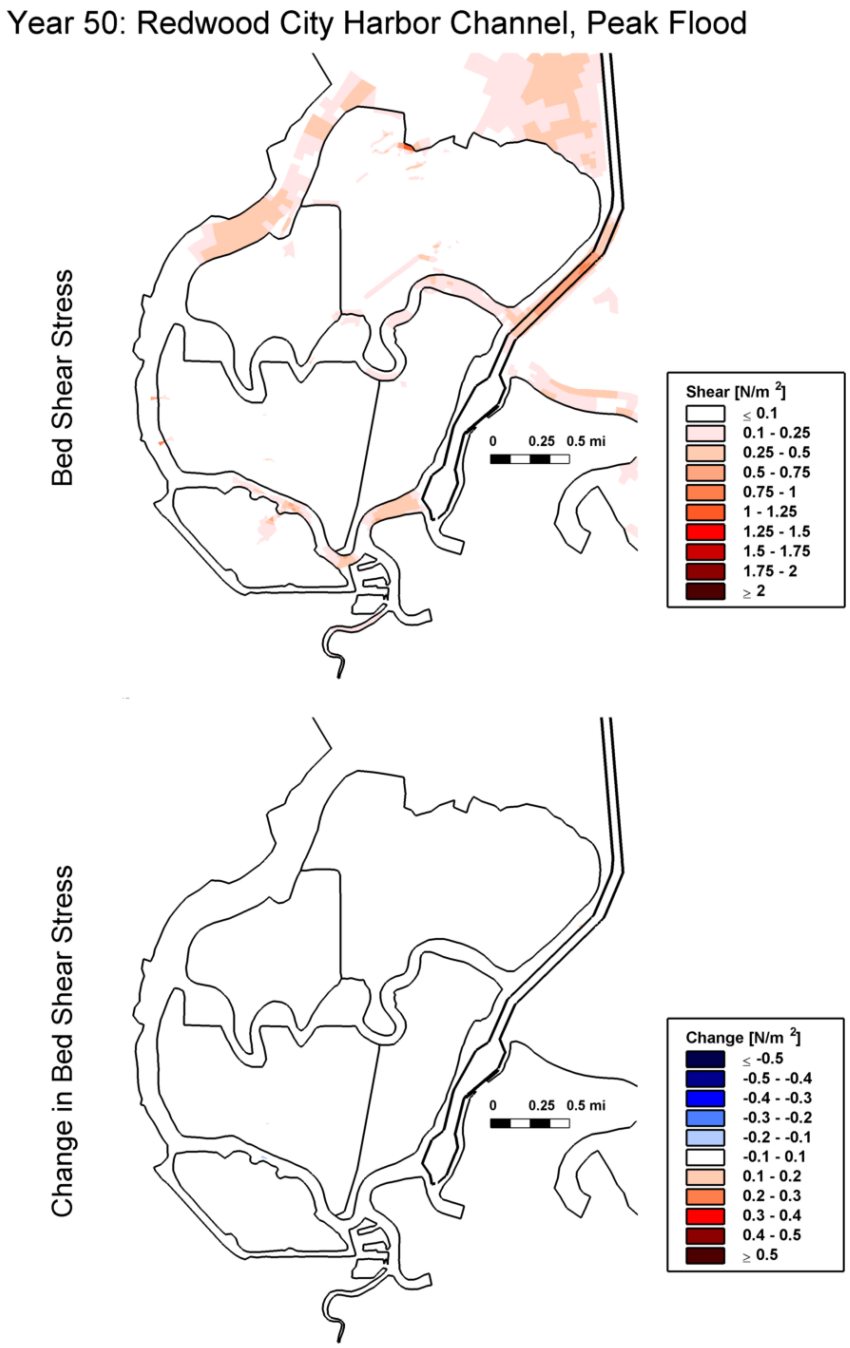


Figure 8.2-57
Predicted bed shear stress (Pa) in the vicinity of the Redwood City Harbor Channel and Bair Island during peak flood currents for the 32 feet MLLW project depth Year 50 scenario (top); predicted change in bed shear stress in the 32 feet MLLW project depth Year 50 scenario relative to the 30 feet MLLW scenario (bottom).

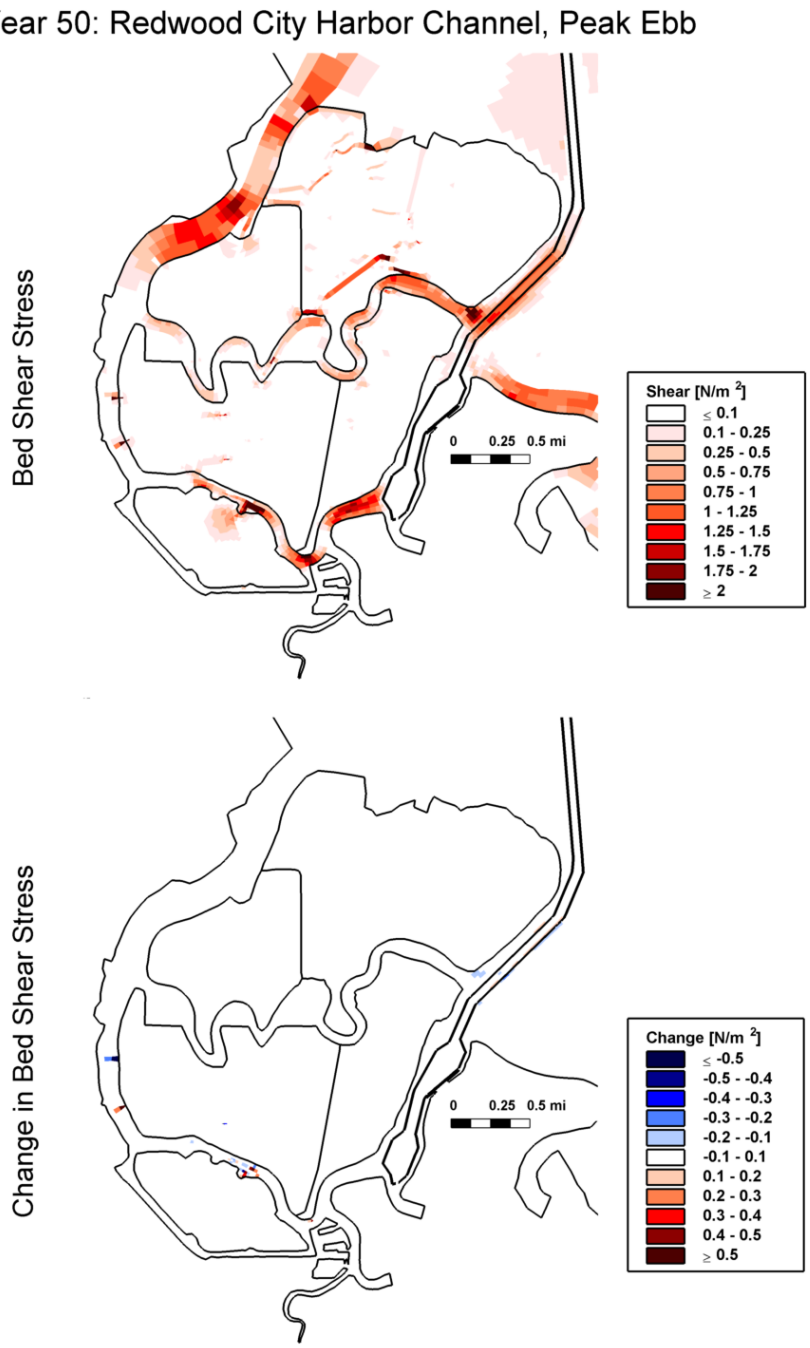


Figure 8.2-58
Predicted bed shear stress (Pa) in the vicinity of the Redwood City Harbor Channel and Bair Island during peak ebb currents for the 32 feet MLLW project depth Year 50 scenario (top); predicted change in bed shear stress in the 32 feet MLLW project depth Year 50 scenario relative to the 30 feet MLLW scenario (bottom).

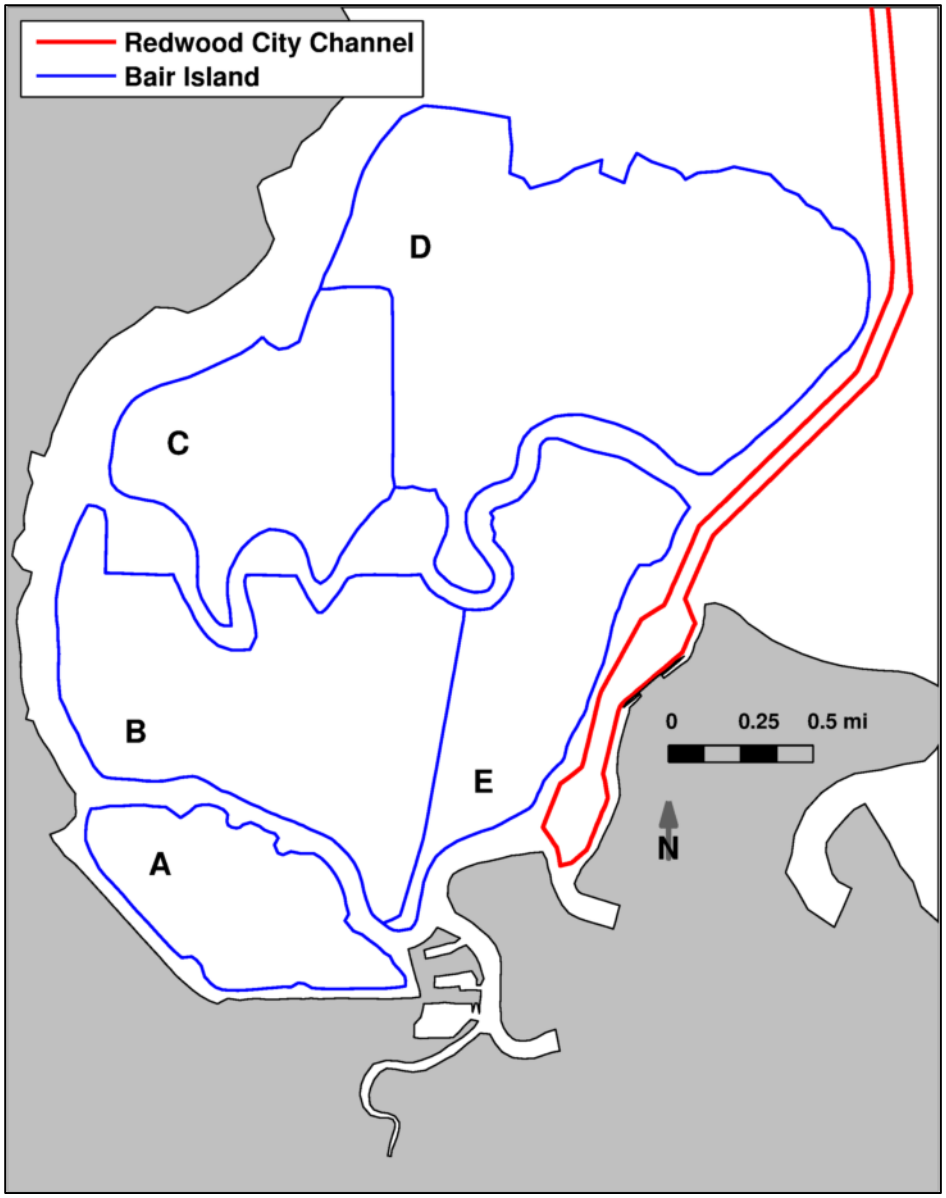


Figure 8.2-59
Outline of the five subregions of Bair Island considered in the calculation of sediment depositional volumes. The subregions are (A) Inner Bair Island, (B) Middle Bair Island, (C) Outer Bair Island, (D) the Outer Bair Island marsh, and the (E) Middle Bair Island marsh.

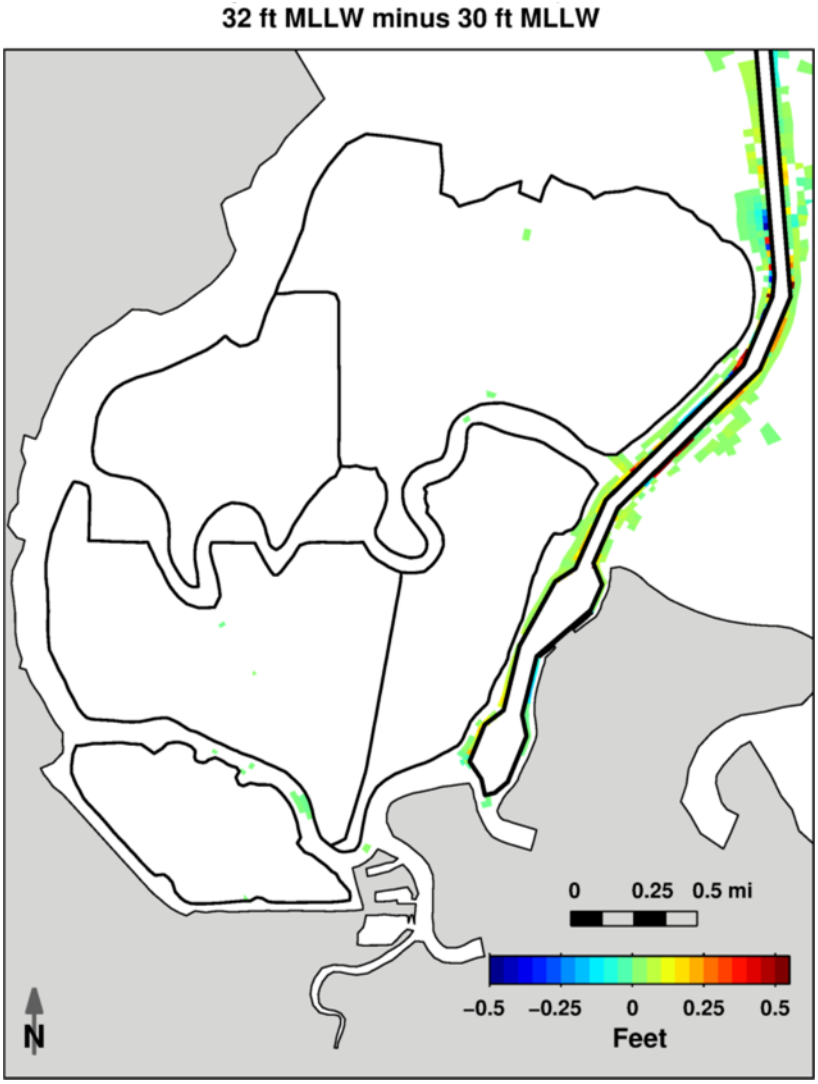


Figure 8.2-60
The predicted change in sedimentation resulting from increasing the project depth from 30 feet MLLW to 32 feet MLLW. Positive values indicate the deeper scenario had a thicker seabed while negative values indicate the deeper scenario had a thinner seabed. Areas inside the navigation channel are plotted as white to highlight the differences outside of the channel. Areas with less than 0.1 inch of difference were plotted as white. Regions of Bair Island are outlined for clarity.

8.3 Effect of Increased Project Depth on Harbor Resonance and Peak Water Levels

Detailed descriptions of the statistics used for model validation are available in Section 5.2 and MacWilliams et al. (2015). The water level validation during the 1983 storm

demonstrated the model accurately predicted the water level at the San Francisco at Fort Point and the Redwood City NOAA tide gauges (Figures 8.3-1 and 8.3-2, Table 8.3-1). The peak water level during this storm was also well predicted by the model (Table 8.3-2). This simulation was shown to have a very similar degree of accuracy at San Francisco and Redwood City as the validation simulation included in the South San Francisco Bay Shoreline Study (MacWilliams et al. 2012b), indicating that the model is suitable for examining peak water levels in the vicinity of the validation stations.

Sea level rise of 0.23 foot at San Francisco in the Year 0 scenarios was predicted to result in an increase in the peak water level at Redwood City of about 0.21 foot. Sea level rise of 2.71 feet at San Francisco in the Year 50 scenarios was predicted to result in an increase in the peak water level at Redwood City of about 2.53 feet.

The influence of deepening the Redwood City Harbor Channel project depth on water level resonance was examined by determining the effect of increasing the project depth on the peak water levels at Redwood City. Deepening the project depth from 30 feet MLLW to 32 feet MLLW was predicted to have almost no effect on the peak water levels at Redwood City for both the Year 0 and the Year 50 scenarios (Table 8.3-3). The peak water level was predicted to change by less than 0.01 foot after deepening the project depth from 30 feet MLLW to 32 feet MLLW for both the Year 0 and Year 50 scenarios.

Table 8.3-1
Predicted and observed water level, cross-correlation statistics, model skills, and target diagram statistics for water level monitoring stations. The ubRMSD is the unbiased root-mean-square difference. The bias and the ubRMSD have both been normalized by the observed standard deviation.

Station Location	Data Source	Figure Number	Mean Water Level		Cross Correlation		r^2	Skill	Target Diagram	
			Observed (m NAVD88)	Predicted (m NAVD88)	Amp Ratio	Lag (min)			Bias	ubRMSD
San Francisco (9414290)	NOAA	8.3-1	1.04	1.05	0.999	-1	0.997	0.999	0.016	0.052
Redwood City (9414523)	NOAA	8.3-2	1.09	1.12	0.989	4	0.996	0.999	0.036	-0.067

Table 8.3-2
The predicted and observed peak water levels during the 1983 storm.

Station Location	Observed Peak (feet NAVD88)	Predicted Peak (feet NAVD88)
San Francisco (9414290)	8.76	8.51
Redwood City (9414523)	9.74	10.06

Table 8.3-3
Predicted peak water levels at the Redwood City NOAA tide station (9414523) for the 1983 storm scenarios and the difference in peak water level between without-project and with-project conditions.

Analysis Year	Peak Water Level (feet)		
	Without-Project (30 feet MLLW)	With-Project (32 feet MLLW)	Difference
Year 0 (2018)	10.271	10.268	-0.003
Year 50 (2068)	12.590	12.586	-0.004

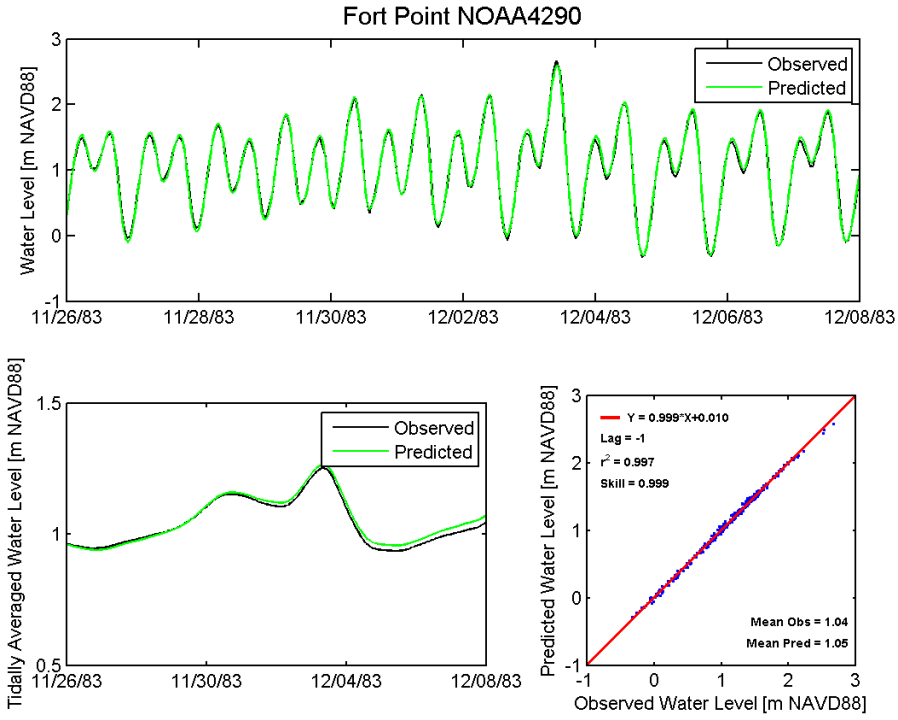


Figure 8.3-1
Observed and predicted water level at San Francisco at Fort Point during the 1983 simulation.

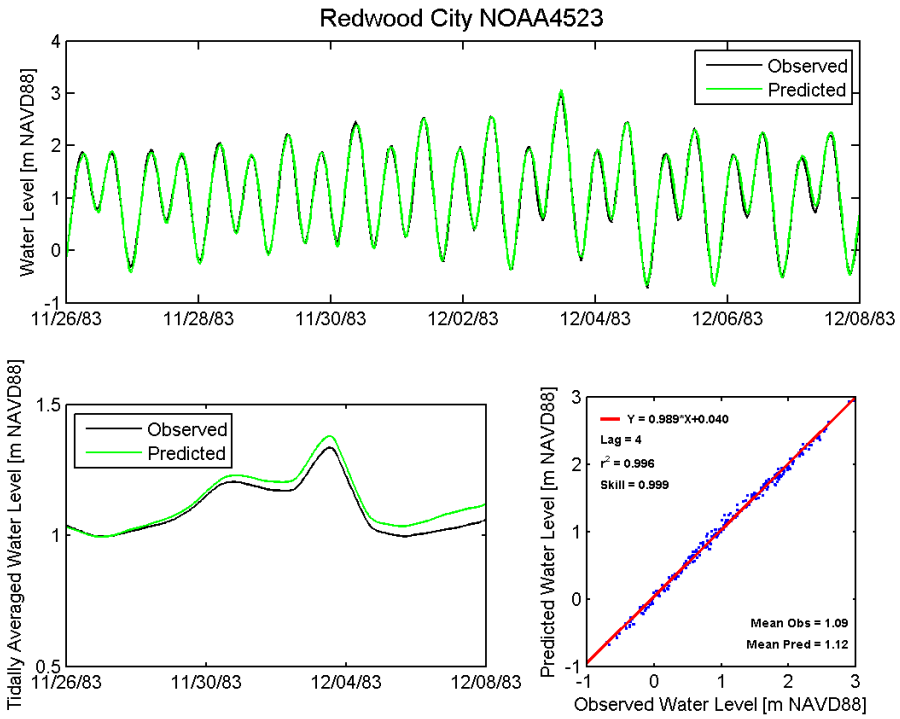


Figure 8.3-2
Observed and predicted water level at Redwood City during the 1983 simulation.

9 FLOW FIELD FOR SHIP NAVIGATION SIMULATIONS

This section documents the UnTRIM Bay-Delta hydrodynamic model simulations used to establish the flow field in both the Redwood City Harbor Channel and the San Bruno Shoal Channel for a future ship navigation simulation study to be performed by the USACE. The flow fields were predicted using both without-project and with-project conditions for Year 0 and Year 50. The period used to model the velocity fields for the ship navigation simulations is within the period used for model validation (Appendix C), so no additional model validation is presented in this section.

9.1 Regions of Provided Flow Field

This section describes the regions in the vicinity of the Redwood City Harbor Channel and the San Bruno Shoal Channel where the predicted flow field was output for the ship navigation simulations. The model grid used for the flow field simulations directly resolved the Redwood City Harbor Channel, the San Bruno Shoal Channel, and Bair Island (Figures 5.1-1 and 6.1-1). The outlines of the flow field regions were aligned with the edges of the model grid and were determined based on the configuration of the channels and the surrounding water depths. The entire Redwood City Harbor Channel was included in the provided flow field (Figure 9-1). The flow field region also included the mudflats, sloughs, and larger South San Francisco Bay main channel in the vicinity of the Redwood City Harbor Channel. The entire San Bruno Shoal Channel and the surrounding area were included in the flow field region of the San Bruno Shoal Channel (Figure 9-2).

9.2 Descriptions of Modeled Scenarios for Ship Simulation Flow Fields

Four hydrodynamic scenarios were used to predict the flow field for the ship simulations (Table 8.1-1). These simulations were identical to the four simulations used to determine the effects of deepening the Redwood City Harbor Channel on the hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island (Sections 8.1.1 and 8.2). The analysis period of the scenarios was developed using hydrology from December 25, 2005, through January 8, 2006, and included elevated discharge from Redwood Creek, strong winds, and spring tides (Figure 8.1-1). These scenarios included the future planned configuration of Bair Island and projected sea level rise between the model forcing year (2005) and Year 0 (2018) and the model forcing year and Year 50 (2068). The bathymetry in

the vicinity of the Redwood City Harbor Channel and the San Bruno Shoal Channel was determined as explained in Section 8.1.1, using a without-project depth of 30 feet MLLW and a with-project depth of 32 feet MLLW and including 2 feet of overdepth. The open boundary water level at San Francisco was adjusted by 0.09 foot in the Year 0 scenarios and by 2.51 feet in the Year 50 scenarios to account for sea level rise, as explained in Section 8.1.1.

9.3 Flow Field Output Provided to USACE

The format of the output flow fields was the same as that provided as part of the Sacramento Deep Water Ship Channel study (MacWilliams 2011). The flow field was provided to USACE as the predicted depth-averaged velocity components at the center of each model grid cell in the flow field regions. During the analysis period, the depth-averaged velocity components were calculated at an interval of every 15 minutes. This resulted in a total of 96 output times during each day of the analysis period. The guidance criteria used to select the appropriate flow field output times were: a) spring tide, b) elevated discharge from Redwood Creek, c) strong winds in the study region, and d) periods of high flood velocity, high ebb velocity, and near slack water. The depth-averaged velocity magnitude at one location within each of the Redwood City Harbor Channel (Figure 9-1) and the San Bruno Shoal Channel (Figure 9-2) flow field regions was plotted to determine the output times associated with peak flood velocity, peak ebb velocity, and slack water. To meet the guidance criteria, the flow fields were extracted from the model results at the times of peak depth-averaged flood and ebb velocities and also at slack water in the two navigation channels, centered around the peak discharge from Redwood Creek (Figures 9-3 and 9-4). Deepening the Redwood City Harbor Channel and the San Bruno Shoal Channel from 30 feet MLLW to 32 feet MLLW did not change the phasing of the predicted depth-averaged velocity in either of the channels. As a result, the date and time of the ship simulation output is the same for each of the considered project depths (Tables 9-1 and 9-2). The timing of peak flood, slack water, and peak ebb were predicted to only change by up to 15 minutes (one output time step) in the Year 50 scenarios relative to the Year 0 scenarios (Tables 9-1 and 9-2).

The depth-averaged velocity predictions for each of the scenarios was provided to the USACE following the file format used as part of the Sacramento Deep Water Ship Channel study (MacWilliams 2011), and consists of tabular space delimited data:

GNW	Node #	Xcord	Ycord	Zcord	Ruff	Xvel	Yvel	Depth	WSELEV
GNW	1	6066615.7	2014888.0	-33.13	-99.0	0.086	0.150	36.44	3.31
GNW	2	6065731.5	2015061.9	-9.65	-99.0	0.366	0.593	12.97	3.31
GNW	3	6065414.8	2015087.1	2.76	-99.0	0.095	0.031	0.56	3.31
GNW	4	6066031.9	2015026.9	-33.13	-99.0	0.399	0.454	36.44	3.31
GNW	5	6066533.0	2014925.0	-33.13	-99.0	0.144	0.212	36.44	3.31
GNW	6	6066461.1	2014962.4	-33.13	-99.0	0.207	0.273	36.44	3.31

Where:
Xcord, Ycord, and Zcord are xyz coordinates.
Ruff is a placeholder variable, specified as -99.0
Xvel and Yvel are velocities.
Depth is the water depth.
WSELEV is the water surface elevation.

All data were provided in the North American Datum of 1983 (NAD83), California Sate Plane Zone 3, NAVD88, U.S. Survey Feet. Velocity was provided in feet per second. Some of the model grid cells in the vicinity of the Redwood City Harbor Channel are shallow and can become dry as the water surface elevation varies with the tides. Model grid cells that are dry at a specific output time were not included in the output for that specific time. As a result, the number of output points varies between each output time. Sample flow fields for the Redwood City Harbor Channel and for the San Bruno Shoal Channel during strong ebb velocities from the 30 feet MLLW Year 0 scenario are shown in Figures 9-5 and 9-6.

Table 9-1
The scenario matrix and flow field output times for all 12 files of the Redwood City Harbor Channel ship simulation output.

Scenario	Channel Project Depth (feet MLLW)	Project Year For Sea Level Rise	Hydrodynamic Conditions	Output Date/Time
1	30 (Without-Project)	Year 0 (2018)	Slack Water	12/31/05 06:00
			Peak Flood	12/31/05 07:30
			Peak Ebb	12/31/05 15:45
2	32 (With-Project)		Slack Water	12/31/05 06:00
			Peak Flood	12/31/05 07:30
			Peak Ebb	12/31/05 15:45
3	30 (Without-Project)	Year 50 (2068)	Slack Water	12/31/05 05:45
			Peak Flood	12/31/05 07:15
			Peak Ebb	12/31/05 15:45
4	32 (With-Project)		Slack Water	12/31/05 05:45
			Peak Flood	12/31/05 07:15
			Peak Ebb	12/31/05 15:45

Table 9-2
The scenario matrix and flow field output times for all 12 files of the San Bruno Shoal Channel ship simulation output.

Scenario	Channel Project Depth (feet MLLW)	Project Year For Sea Level Rise	Hydrodynamic Conditions	Output Date/Time
1	30 (Without-Project)	Year 0 (2018)	Peak Flood	12/31/05 08:45
			Slack Water	12/31/05 12:00
			Peak Ebb	12/31/05 15:30
2	32 (With-Project)		Peak Flood	12/31/05 08:45
			Slack Water	12/31/05 12:00
			Peak Ebb	12/31/05 15:30
3	30 (Without-Project)	Year 50 (2068)	Peak Flood	12/31/05 09:00
			Slack Water	12/31/05 11:45
			Peak Ebb	12/31/05 15:15
4	32 (With-Project)		Peak Flood	12/31/05 09:00
			Slack Water	12/31/05 11:45
			Peak Ebb	12/31/05 15:15

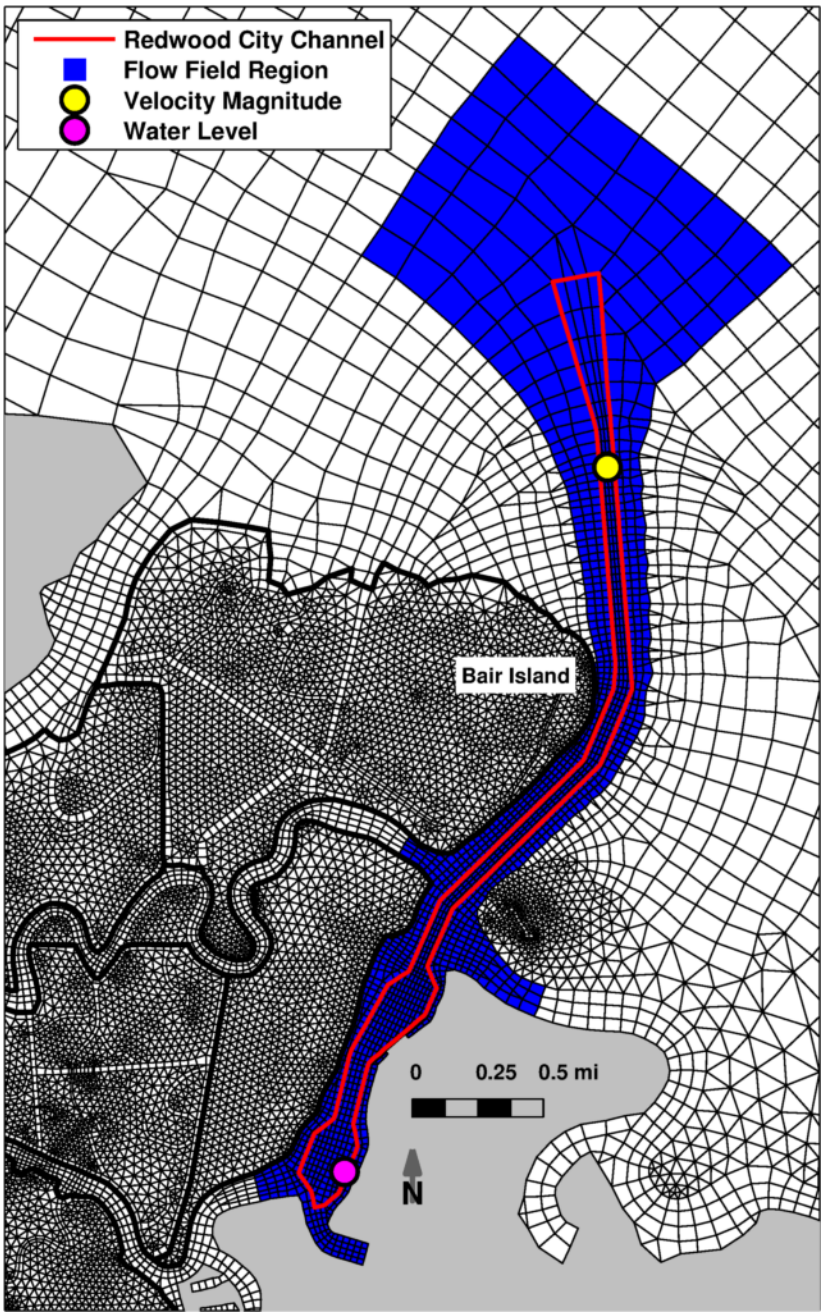


Figure 9-1
The region of the model grid in the vicinity of the Redwood City Harbor Channel that depth-averaged velocity was output for the future ship navigation simulations flow field. The Redwood City Harbor Channel is outlined in red and the flow field region is in blue. The depth-averaged velocity magnitude (yellow) and water level (magenta) stations for Figure 9-3 are shown with circles. Bair Island is outlined in dark black.

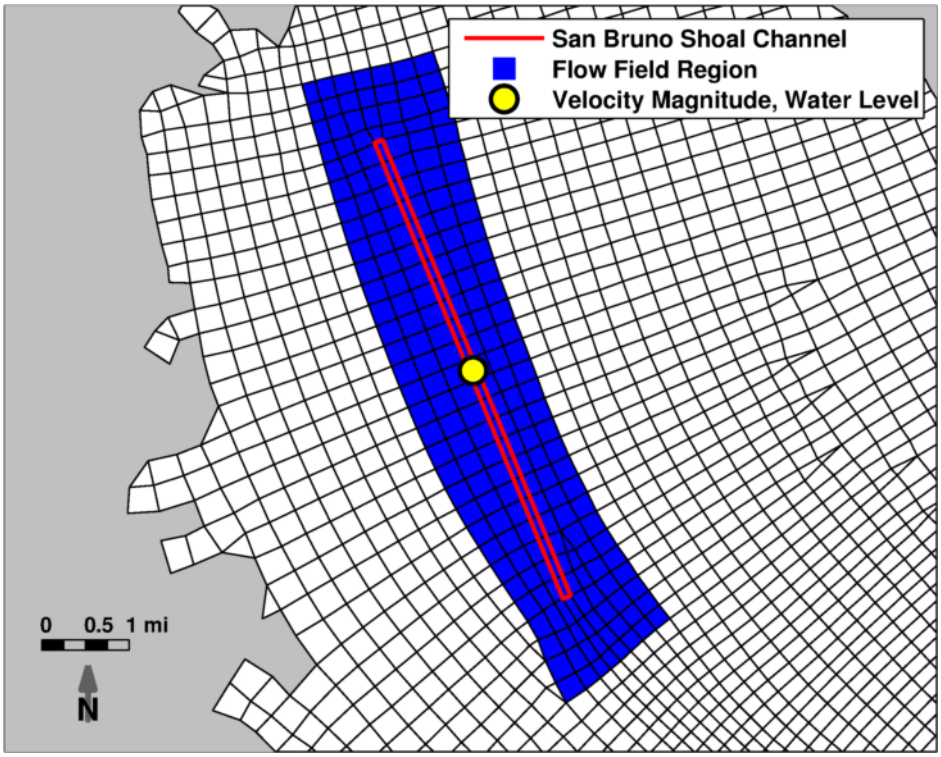


Figure 9-2
The region of the model grid in the vicinity of the San Bruno Shoal Channel that depth-averaged velocity was output for the future ship navigation simulations flow field. The San Bruno Shoal Channel is outlined in red and the flow field region is in blue. The depth-averaged velocity magnitude and water level station for Figure 9-4 is shown with a yellow circle.

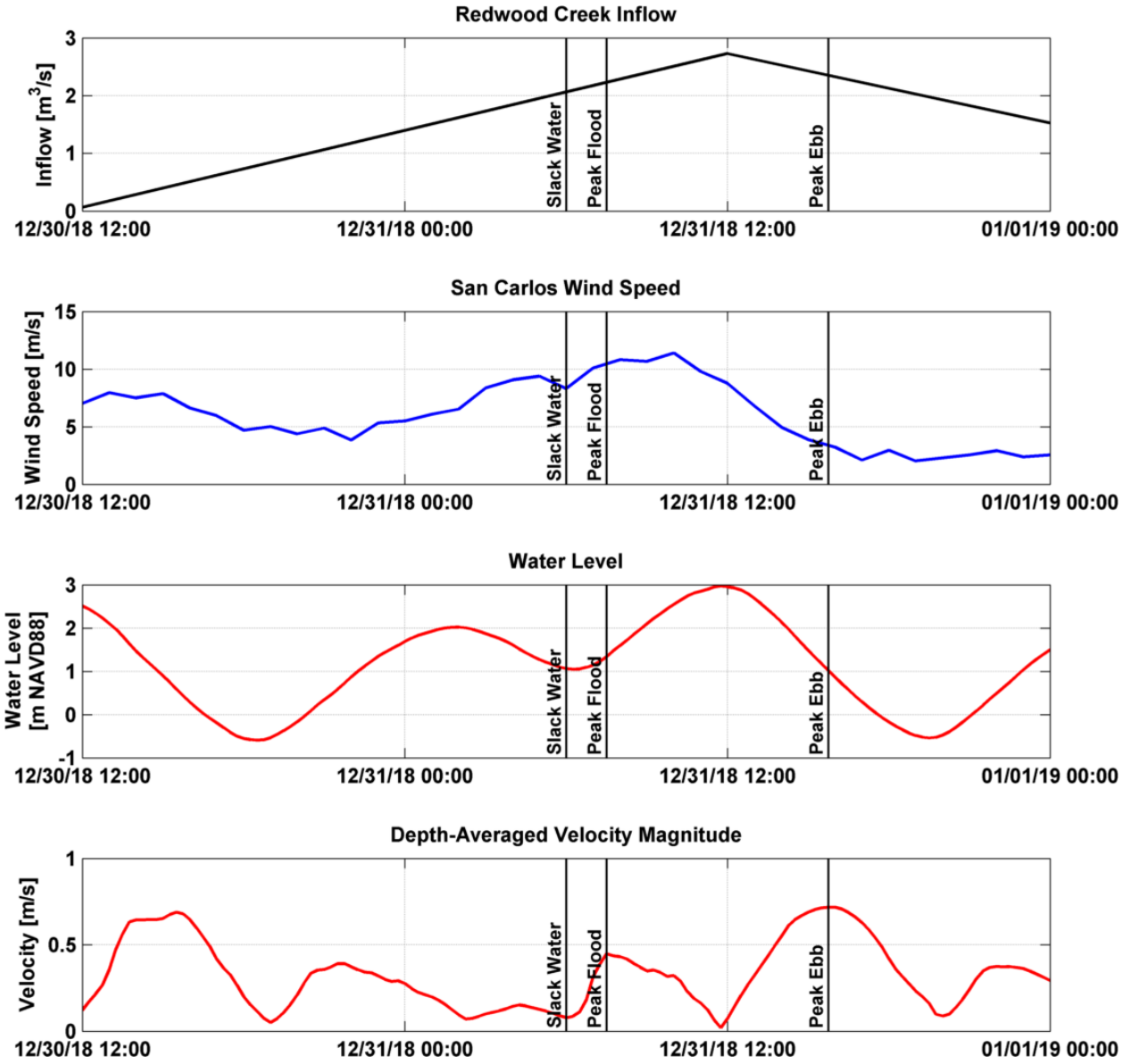


Figure 9-3

The Redwood Creek inflow, wind speed at San Carlos, predicted water level at the Redwood City tide gauge, and predicted depth-averaged velocity magnitude in the Redwood City Harbor Channel during the 30 feet MLLW project depth Year 0 simulation. The location of the velocity magnitude and water level are shown on Figure 9-1. Vertical lines mark the times of the ship simulation output for slack water, peak flood velocity, and peak ebb velocity, from left to right.

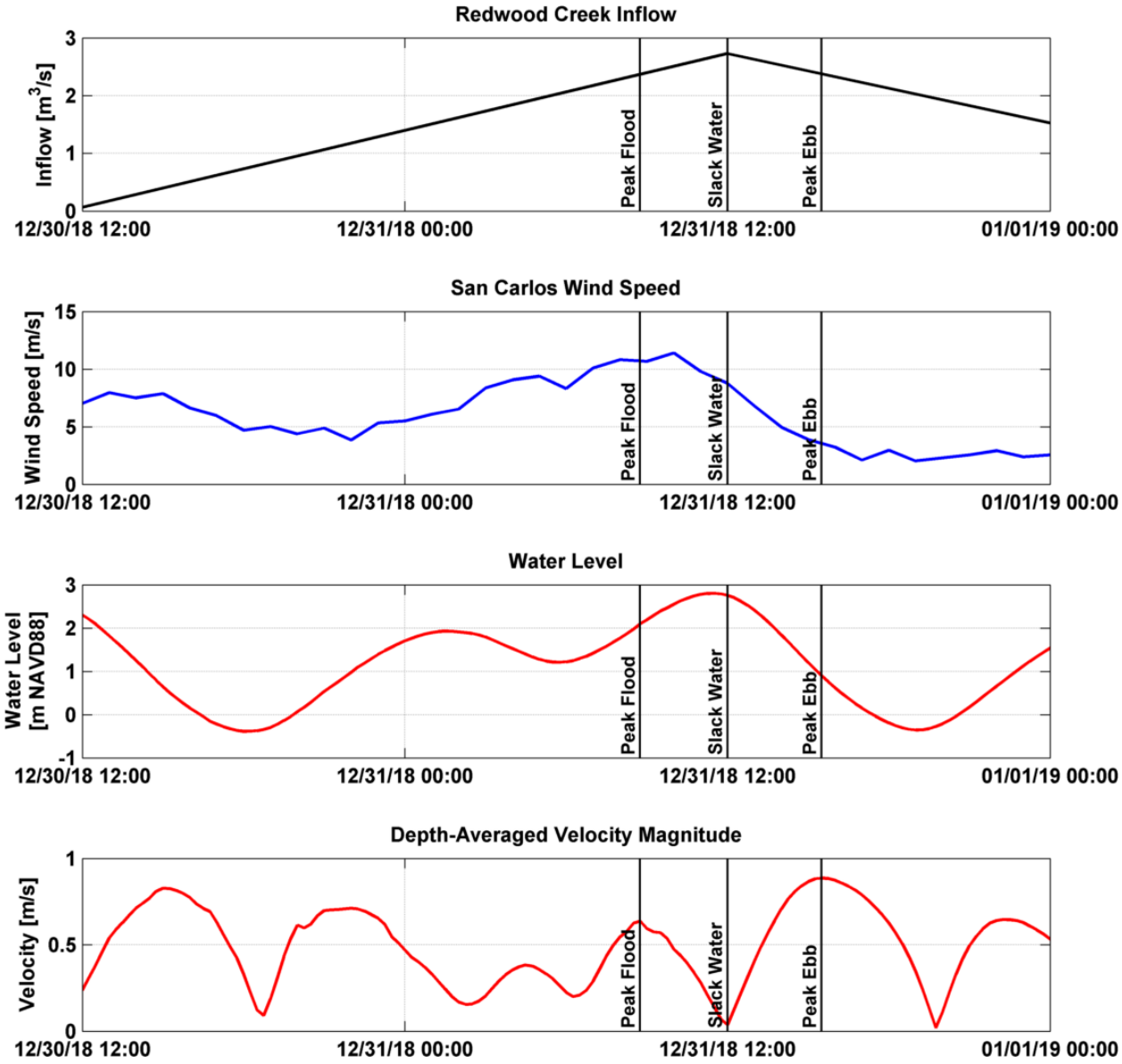


Figure 9-4

The Redwood Creek inflow, wind speed at San Carlos, predicted water level in the center of the San Bruno Shoal Channel, and predicted depth-averaged velocity magnitude in the San Bruno Shoal Channel during the 30 feet MLLW project depth Year 0 simulation. The location of the velocity and water level are shown on Figure 9-2. Vertical lines mark the times of the ship simulation output for peak flood velocity, slack water, and peak ebb velocity, from left to right.

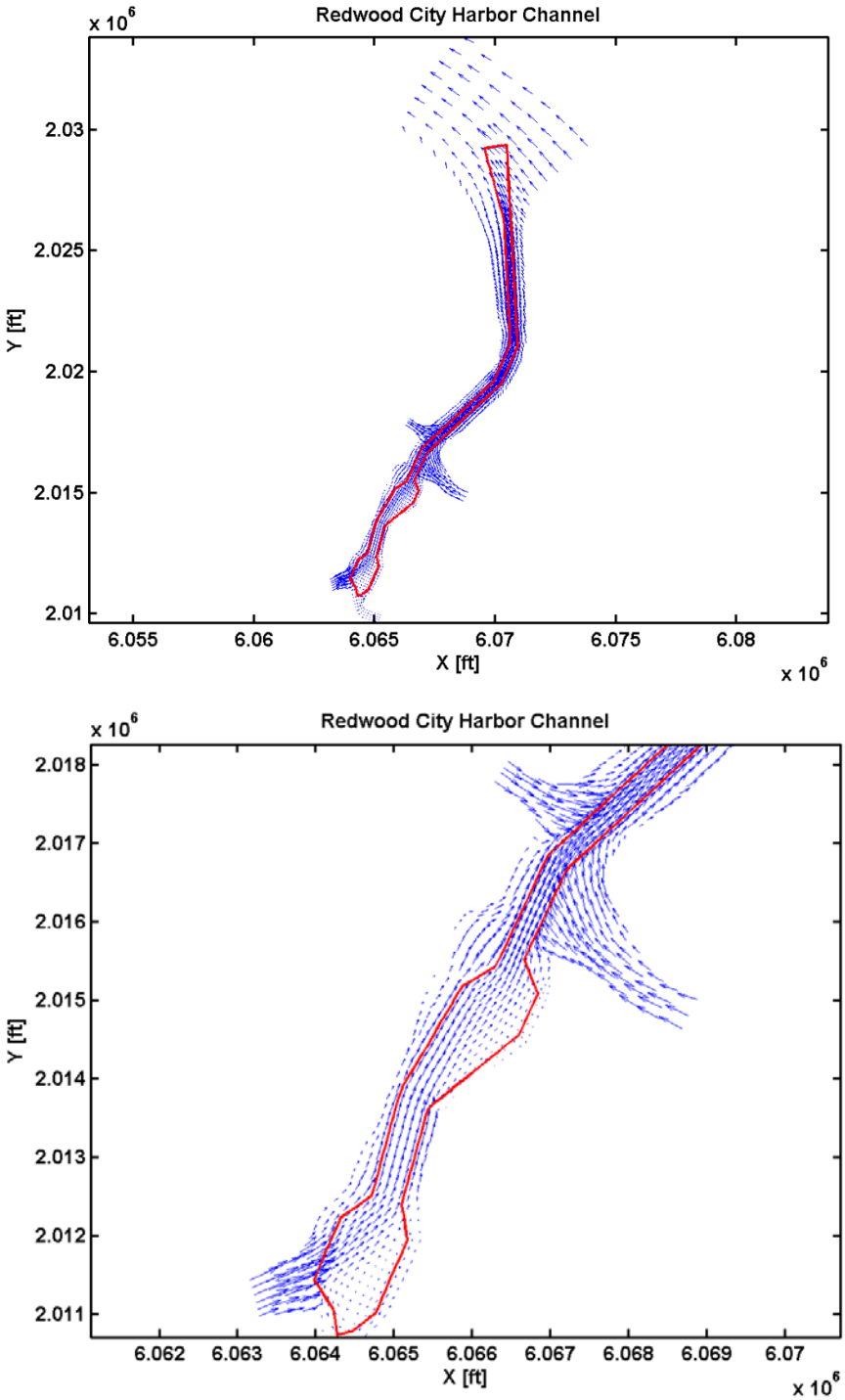


Figure 9-5
Depth-averaged velocity vectors from the ship simulation output in the vicinity of the Redwood City Harbor Channel during a period of strong ebb velocity (December 31, 2018 at 15:45) in the 30 feet MLLW Year 0 scenario. The top panel shows the entire flow field region and the bottom panel zooms in on the southern portion of the channel. The Redwood City Harbor Channel is outlined in red.

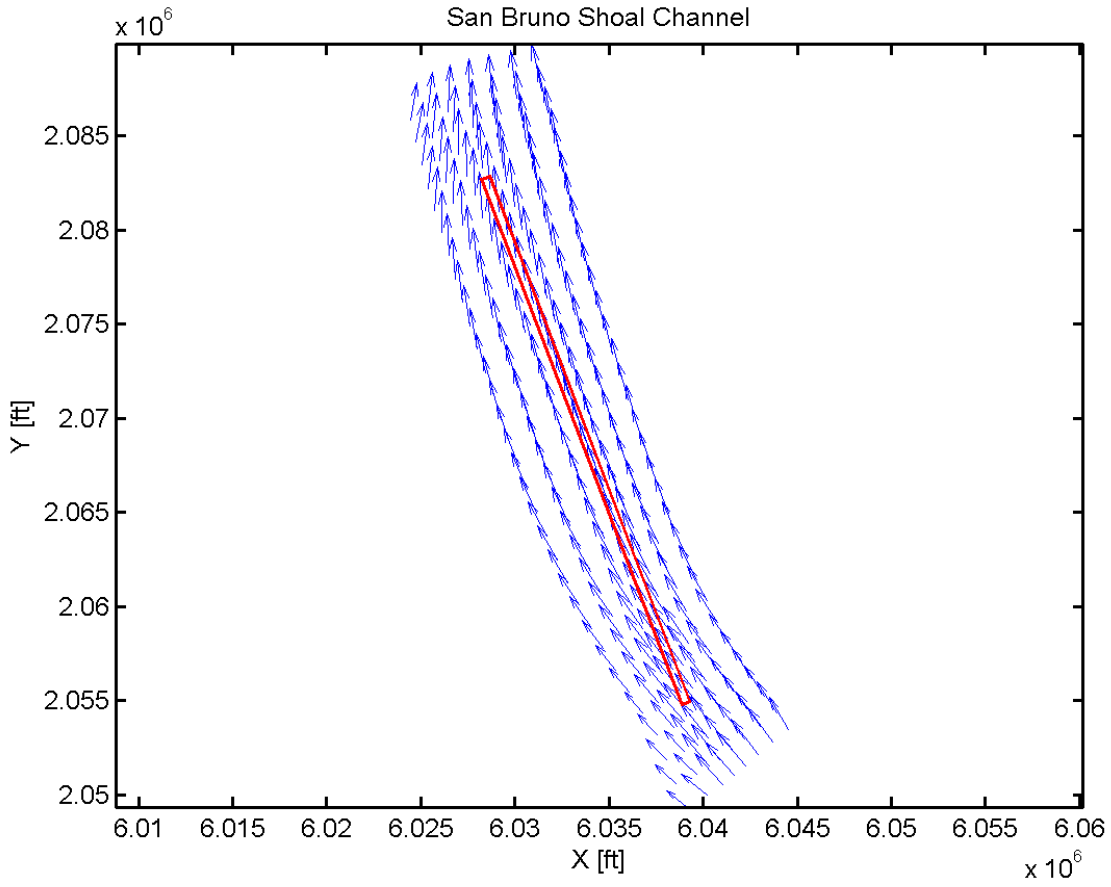


Figure 9-6
Depth-averaged velocity vectors from the ship simulation output in the vicinity of the San Bruno Shoal Channel during a period of strong ebb velocity (December 31, 2018 at 15:30) in the 30 feet MLLW Year 0 scenario. The San Bruno Shoal Channel is outlined in red.

10 SUMMARY AND CONCLUSIONS

This report documents the results of the Hydrodynamic and Sediment Transport Modeling for Navigation Channel Deepening of Redwood City Harbor project that was conducted in support of the Redwood City Harbor Navigation Improvement Feasibility Study. This project used both existing USACE hydrosurvey data and numerical model predictions to investigate the potential influence of increasing the project depth of the Redwood City Harbor Channel and the San Bruno Shoal Channel on shoaling rates. Sediment deposition was also evaluated for a potential realignment of the Redwood City Harbor Channel to assess whether the realignment of the channel could potentially decrease the above grade shoaling. The potential influence of channel deepening and sea level rise on water levels, flow, salinity, and shear stress in the vicinity of the Redwood City Harbor Channel was also evaluated.

Regular bathymetric surveys of the Redwood City Harbor Channel spanning an 8-year period were used to calculate an average sediment accretion rate of about 183,000 $yd^3\ yr^{-1}$. The short 176-day accretion rate calculated in 2012 during a winter to spring period potentially indicates that the sediment deposition in the Redwood City Harbor Channel is not constant throughout the year, but rather experiences periods of relatively higher sedimentation either seasonally or in response to storm events. Two hot spots within the Redwood City Harbor Channel were identified, where the hydrosurveys indicate deposition was consistently higher than in other portions of the channel. One hot spot is located southeast of Bair Island on the northwest side of the channel, and the other hot spot is located on the west side of the northern portion of the channel. These hot spots are potential candidates for advanced maintenance dredging or channel realignment to reduce the above grade shoaling problems in those areas. The hydrographic surveys of the San Bruno Shoal Channel suggested that the channel does not have a consistent rate of sediment accretion, but rather both periods of sediment accretion and erosion that lead to relatively little long-term net change of sediment volume in the channel.

The model predictions of sediment transport were validated using observations of suspended sediment concentration, estimates of observed sediment deposition volume and thickness in the Redwood City Harbor Channel and the San Bruno Shoal Channel, and estimates of the

percentage of the Redwood City Harbor Channel that shoaled to above project depth derived from the hydrosurveys. The model accurately predicted the suspended sediment concentration at the Alcatraz station in the Central Bay for the 2006 simulation and acceptably for the 2008 simulation. The average suspended sediment concentration was higher than observed at the Dumbarton Bridge station in 2006 and slightly lower in the 2008 simulation, although the peak concentrations were lower than observed in both simulations. Analysis of along-Bay transects suggested the model more accurately predicted the suspended sediment concentration near the Redwood City Harbor Channel and the San Bruno Shoal Channel than at Dumbarton Bridge, but less accurately than at the Alcatraz station. The model predicted a lower total volume of sediment deposited in the Redwood City Harbor Channel than was estimated from the hydrosurvey data; however, the model prediction was within the error bars of the hydrosurvey derived deposition volumes for both years simulated. The model correctly predicted the locations of the two shoaling hot spots south of Bair Island and near the northern end of the channel that were identified in the hydrosurvey analysis. The model also predicted the correct across-channel location of the hot spots on the western side of the channel in the 2006 simulation. The predicted reduction in the sedimentation rate in the Redwood City Harbor Channel from the 2006 to the 2008 simulations agreed with the reduction derived from the hydrosurvey data (23% vs. 21%), indicating that the model very accurately predicted the relative change in the sedimentation rate due to different channel depths and environmental conditions. The model predicted a larger volume of sediment deposition in the San Bruno Shoal Channel than was estimated from the hydrosurvey data; however, the predicted deposition volume was the same order of magnitude as the deposition volume derived from the hydrosurvey data and was within the error bars of the hydrosurvey derived deposition volumes for both years simulated.

The model validation indicated that the model was sufficiently accurate for investigating relative changes in the sediment deposition volume due to channel deepening of the Redwood City Harbor Channel and San Bruno Shoal Channel. The validation also indicated that the predicted percentage difference in the sedimentation rate between scenarios will have less uncertainty and likely be more accurate than the corresponding absolute differences in deposition volumes between scenarios. Because there is less uncertainty in analyses that compare the relative difference in sediment depositional volumes between scenarios, the analyses in this report focused on the relative difference between scenarios and

less on absolute differences between the scenarios. That is, the effect of channel deepening on sedimentation rates in the navigation channels is discussed predominantly as a percentage increase from the currently authorized 30 feet MLLW project depth and not as absolute deposition volume increases.

Increasing the project depth from 30 feet MLLW to either 32 feet MLLW or to 37 feet MLLW was predicted to increase sedimentation rates in both the Redwood City Harbor Channel and the San Bruno Shoal Channel. This suggests that the proposed channel deepening would result in an increase in annual maintenance dredging in both the Redwood City Harbor Channel and the San Bruno Shoal Channel. The sedimentation rate in the Redwood City Harbor Channel was predicted to increase relative to the 30 feet MLLW project depth by 13% with the 32 feet MLLW project depth and by 51% with the 37 feet MLLW project depth when evaluated over a full year. Based on the hydrosurvey derived average sedimentation rate of about 183,000 $yd^3\ yr^{-1}$, the predictions suggest an average future dredging requirement for the Redwood City Harbor Channel of about 207,000 $yd^3\ yr^{-1}$ with the 32 feet MLLW project depth. The average future dredging requirement for the Redwood City Harbor Channel with the 37 feet MLLW project depth was predicted to be about 276,000 $yd^3\ yr^{-1}$. However, these should be treated as approximations due to uncertainty in the model predictions, and potential variations due to interannual variability or future changes to sediment supply to the Bay.

The sedimentation rate in the San Bruno Shoal Channel was predicted to increase relative to the 30 feet MLLW project depth by 54% with the 32 feet MLLW project depth and by 86% with the 37 feet MLLW project depth when examining a complete year. The change in the sedimentation rate predicted for the San Bruno Shoal Channel may underestimate the increase in dredging requirements resulting from deepening the San Bruno Shoal Channel relative to the existing 30 feet MLLW project depth. This is because the results suggest that a larger portion of the channel may begin to experience above grade shoaling and require dredging for both the 32 feet MLLW and 37 feet MLLW project depths than currently occurs for the 30 feet MLLW project depth. The relative increase in the sedimentation rate caused by deepening project depths is likely to be relatively constant regardless of the water year type, even if the total deposition volume changes between different years, based on analysis of Oakland Harbor sedimentation rates (Delta Modeling Associates 2015). Analysis of the

sedimentation rate over different seasonal time periods suggested the sedimentation rate in the Redwood City Harbor Channel is less sensitive to seasonal influences than the San Bruno Shoal Channel. This is potentially caused by the location of the Redwood City Harbor Channel farther from the Central Bay than the San Bruno Shoal Channel. The influence of large sediment supply events from the Delta and North Bay on sedimentation in the Redwood City Harbor Channel will be reduced compared to at the San Bruno Shoal Channel because the Redwood City Harbor Channel is located farther from the Central Bay.

Two additional scenarios were used to evaluate the influence of a proposed realignment of the Redwood City Harbor Channel on sedimentation in the channel for the 37 feet MLLW project depth and to evaluate whether or not the realignment of the channel would decrease the above grade shoaling south of Bair Island or decrease the annual maintenance dredging requirements. The proposed realignment of the Redwood City Harbor Channel was predicted to have a minimal effect on the sedimentation rate in the channel with a 37 feet MLLW project depth, and thus the realignment was predicted to not likely decrease shoaling south of Bair Island with project depths from 30 feet MLLW to 37 feet MLLW. The sedimentation rate was predicted to increase by 3% in the realignment scenario compared to the existing alignment. The thickness of the hot spot south of Bair Island was also predicted to increase in the realignment scenario relative to the existing alignment scenario.

The effects of deepening the project depth on the hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island were evaluated by examining the water level, flow, salinity, and shear stress under without-project and with-project conditions for both Year 0 and Year 50. Without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions were evaluated under Year 0 and Year 50 conditions over a 2-week period that included elevated outflow from Redwood Creek, high winds, and spring tides, resulting in a total of four scenarios. These comparisons demonstrated that the deepening of the project depth from 30 feet MLLW to 32 feet MLLW resulted in essentially no effect on the water level, flows, salinity, or shear stress in the vicinity of Redwood City Harbor and Bair Island for both the Year 0 and the Year 50 scenarios.

The four scenarios used to evaluate the effect of deepening the project depth on hydrodynamics in the vicinity of the Redwood City Harbor Channel and Bair Island under

both Year 0 and Year 50 conditions were also used to provide flow fields for future ship navigation simulations. The predicted flow field was provided for two different regions, one in the vicinity of the Redwood City Harbor Channel and another in the vicinity of the San Bruno Shoal Channel. The depth-averaged velocity at each model grid cell in the two flow field regions was calculated at times of peak flood velocity, peak ebb velocity, and slack water. These four scenarios used for the ship navigation simulation output included both without-project and with-project channel bathymetry and Year 0 and Year 50 conditions. These flow field data were provided to USACE for future ship navigation simulations which are expected to be conducted during a later phase of this project.

Five additional scenarios were used to evaluate the effects of the channel deepening on peak water levels and storm surge in the Redwood City Harbor during a large storm event. One simulation was used to validate the peak water levels during the December 1983 storm, which had the highest peak water level ever measured at the NOAA Redwood City station. Without-project (30 feet MLLW) and with-project (32 feet MLLW) conditions were then simulated for both Year 0 and Year 50 conditions which included sea level rise. These four scenarios were used to determine the effect of increasing the project depth on water level resonance in Redwood City by examining the peak water levels in each scenario. Deepening the project depth from 30 feet MLLW to 32 feet MLLW was predicted to have almost no effect on the peak water levels and harbor resonance at Redwood City. The peak water level was predicted to change by less than 0.01 foot after deepening the project depth from 30 feet MLLW to 32 feet MLLW for both the Year 0 and Year 50 scenarios.

11 ACKNOWLEDGMENTS

This project was conducted for the USACE San Francisco District in regard to the feasibility of deepening the existing navigation channels at Redwood City Harbor and San Bruno Shoal under the supervision of Patrick Sing (USACE). The authors would like to thank Lisa Andes and Frank Wu (USACE) for their technical guidance on earlier portions of this work. The UnTRIM code was developed by Professor Vincenzo Casulli (University of Trento, Italy). The SediMorph model was originally developed at the German Federal Waterways Engineering and Research Institute in Hamburg (BAW-Hamburg) by Andreas Malcherek. The SediMorph model was provided for use on this project through a collaboration agreement with the BAW. The authors would like to thank Holger Weilbeer (BAW) for his guidance on the technical details of the UnTRIM-SediMorph coupling. We would like to thank Edward Gross for his work in the coupling of SWAN to UnTRIM and Jeremy Bricker for his insights on the UnTRIM SWAN coupling. The authors also thank Dave Schoellhamer, Scott Wright, Greg Shellenbarger, Tara Morgan-King, and Maureen Downing-Kunz at USGS for discussions on sediment transport in San Francisco Bay. Eric Mruz (USFWS) and Austin Payne (Ducks Unlimited) provided details on the current and planned future restoration of Bair Island.

12 REFERENCES

Ariathuria, C.R. and K. Arulanandan, 1978. Erosion rates of cohesive soils. *Hydraulics Division* 104, 279-282.

Barnard, P.L., A.C. Foxgrover, E.P.L. Elias, L.H. Erikson, J.R. Hein, M. McGann, K. Mizell, R.J. Rosenbauer, P.W. Swarzenski, R.K. Takesue, F. Wong, and D.L. Woodrow, 2013. Integration of bed characteristics, geochemical tracers, current measurements, and numerical modeling for assessing the provenance of beach sand in the San Francisco Bay Coastal System. *Marine Geology* 336:120-145. Available from: http://dx.doi.org/10.1016/j.margeo.2013.08.007.

BAW (German Federal Waterways Engineering and Research Institute), 2005. *Mathematical Module SediMorph, Validation Document – Version 1.1.* The Federal Waterways Engineering and Research Institute. March 2005.

Bever, A.J. and M.L. MacWilliams, 2013. Simulating sediment transport processes in San Pablo Bay using coupled hydrodynamic, wave, and sediment transport models. *Marine Geology* 345:235-253. Available from: http://dx.doi.org/10.1016/j.margeo.2013.06.012.

Bever, A.J. and M.L. MacWilliams, 2014. *South San Francisco Bay Sediment Transport Modeling*. Prepared for U.S. Army Corps of Engineers, San Francisco District. July 15 2014.

Bricker, J.D., 2003. Bed Drag Coefficient Variability under Wind Waves in a Tidal Estuary: Field Measurements and Numerical Modeling. Ph.D. Thesis, Stanford University. Stanford, California.

Bricker, J.D., S. Inagaki, and S.G. Monismith, 2004. Modeling the Effects of Bed Drag Coefficient Variability under Wind Waves in South San Francisco Bay. *Estuarine and Coastal Modeling* 2003 89-107. Available from: http://dx.doi.org/10.1061/40734(145)7.

Caffrey, J.M., 1995. Spatial and seasonal patterns in sediment nitrogen remineralization and ammonium concentrations in San Francisco Bay, California. *Estuaries* 18(1B):219-233. http:/dx.doi.org/10.2307/1352632.

CDEC (California Data Exchange Center), 2013. California Department of Water Resources California Data Exchange Center. Cited: November 2014. Available from: http://cdec.water.ca.gov/.

CDEC, 2014. Chronological Reconstructed Sacramento and San Joaquin Valley Water Year Hydrologic Classification Indices. Cited: November 2014. Available from: http://cdec.water.ca.gov/cgi-progs/iodir/wsihist.

CDWR (California Department of Water Resources), 1986. *DAYFLOW Program Documentation and Data Summary User's Guide*. California Department of Water Resources, Sacramento. February 1986.

CDWR. *Estimation of Delta Island Diversions and Return Flows*. Modeling Support Branch, Division of Planning. February 1995.

CDWR, 2013. Dayflow, An Estimate of Daily Average Delta outflow. Cited: November 7, 2013. Available from: http://www.water.ca.gov/dayflow/.

Casulli, V., 1990. Semi-implicit finite difference methods for the two-dimensional shallow water equations. *Journal of Computational Physics* 86:56-74. Available from: http://dx.doi.org/10.1016/0021-9991(90)90091-E.

Casulli, V. and R.T. Cheng, 1992, Semi-implicit finite difference methods for three-dimensional shallow water flow. *International Journal for Numerical Methods in Fluids* 15:629-648. Available from: http://dx.doi.org/10.1002/fld.1650150602.

Casulli, V. and E. Cattani, 1994. Stability, accuracy and efficiency of a semi-implicit method for three-dimensional shallow water flow. *Computers and Mathematics with Applications* 27(4):99-112. http://dx.doi.org/10.1016/0898-1221(94)90059-0.

Casulli, V., 1999. A semi-implicit numerical method for non-hydrostatic free-surface flows on unstructured grid, in Numerical Modelling of Hydrodynamic Systems. ESF Workshop, p. 175-193, Zaragoza, Spain.

Casulli, V. and R.A. Walters, 2000. An unstructured, three-dimensional model based on the shallow water equations. *International Journal for Numerical Methods in Fluids* 32:331-348. Available from: http://dx.doi.org/10.1002/(SICI)1097-0363(20000215)32:3<331::AID-FLD941>3.0.CO;2-C.

Casulli, V. and P. Zanolli, 2002. Semi-Implicit Numerical Modelling of Non-Hydrostatic Free-Surface Flows for Environmental Problems. *Mathematical and Computer Modelling* 36:1131-1149. Available from: http://dx.doi.org/10.1016/S0895-7177(02)00264-9.

Casulli, V. and P. Zanolli, 2005. High Resolution Methods for Multidimensional Advection-Diffusion Problems in Free-Surface Hydrodynamics. *Ocean Modelling* 10 (1-2): 137-151. Available from: http://dx.doi.org/10.1016/j.ocemod.2004.06.007.

Cheng, R.T., V. Casulli, and J.W. Gartner, 1993. Tidal residual intertidal mudflat (TRIM) model and its applications to San Francisco Bay, California. *Estuarine, Coastal and Shelf Science* 369:235-280. Available from: http://dx.doi.org/10.1006/ecss.1993.1016.

Cheng, R.T. and V. Casulli, 1996. Modeling the Periodic Stratification and Gravitational Circulation in San Francisco Bay. Proceedings of 4th Inter. Conf. on Estuarine and Coastal Modeling, Spaulding and Cheng (Eds.), ASCE, San Diego, California, October 1995, 240-254.

Cheng, R.T. and R.E. Smith, 1998. A Nowcast Model for Tides and Tidal Currents in San Francisco Bay, California, Ocean Community Conf. '98, Marine Technology Society, Baltimore, Maryland, November 15 to 19, 1998, 537-543.

Cheng, R.T., and V. Casulli, 2002. Evaluation of the UnTRIM model for 3-D Tidal Circulation. Proceedings of the 7th International Conference on Estuarine and Coastal Modeling, St. Petersburg, Florida, November 2001, 628-642.

Deleersnijder, E., J.M. Beckers, J.M. Campin, M. El Mohajir, T. Fichefet, and P. Luyten, P., 1997. Some mathematical problems associated with the development and use of marine models. The Mathematics of Models for Climatology and Environment, Vol. 148, J.I. Diaz, ed., Springer Verlag, Berlin, Heidelberg. Available from: http://dx.doi.org/10.1007/978-3-642-60603-8_2.

Delta Modeling Associates, Inc., 2014. *Evaluation of Effects of Prospect Island Restoration on Sediment Transport and Turbidity: Phase 2 Alternatives, Final Report, Prospect Island Tidal Habitat Restoration Project*. Prepared for California Department of Water Resources and Wetlands and Water Resources, Inc. March 2014.

Delta Modeling Associates, Inc., 2015. *Analysis of the Effect of Project Depth, Water Year Type and Advanced Maintenance Dredging on Shoaling Rates in the Oakland Harbor Navigation Channel, Central San Francisco Bay 3-D Sediment Transport Modeling Study, Final Report*. Prepared for U.S. Army Corps of Engineers, San Francisco District. March 2015.

Dietrich, J.C., M. Zijlema, P.-E. Allier, L.H. Holthuijsen, N. Booij, J.D. Meixner, J.K. Proft, C.N. Dawson, C.J. Bender, A. Naimaster, J.M. Smith, and J.J. Westerink, 2013. Limiters for spectral propagation velocities in SWAN. *Ocean Modelling* 70: 85-102. Available from: http://dx.doi.org/10.1016/j.ocemod.2012.11.005.

Eisma, D., 1986. Flocculation and de-flocculation of suspended matter in estuaries. *Netherlands Journal of Sea Research* 20:183-199. Available from: http://dx.doi.org/10.1016/0077-7579(86)90041-4.

Electricité de France, 2000. Telemac-2d validation document version 5.0, Note technique, Electricité de France, Direction des Etudes et Recherches, Chatou Cedex.

Fugate, D.C. and C.T. Friedrichs, 2003. Controls on suspended aggregate size in partially mixed estuaries. *Estuarine, Coastal and Shelf Science* 58:389-404. Available from: http://dx.doi.org/10.1016/S0272-7714(03)00107-0.

Funakoshi, Y., S.C. Hagen, and P. Bacopoulos, 2008. Coupling of Hydrodynamic and Wave Models: Case Study for Hurricane Floyd (1999) Hindcast. *Journal of Waterway, Port, Coastal, and Ocean Engineering* 134(6):321-335. Available from: http://dx.doi.org/10.1061/(ASCE)0733-950X(2008)134:6(321).

Ganju, N.K. and D.H. Schoellhamer, 2009. Calibration of an estuarine sediment transport model to sediment fluxes as an intermediate step for simulation of geomorphic evolution. *Continental Shelf Research* 29:148-158. Available from: http://dx.doi.org/10.1016/j.csr.2007.09.005.

Gross, E.S., J.R. Koseff, and S.G. Monismith, 1999. Three-dimensional salinity simulations of South San Francisco Bay. *Journal of Hydraulic Engineering* 125(11):1199-1209. Available from: http://dx.doi.org/10.1061/(ASCE)0733-9429(1999)125:11(1199).

Gross, E.S. and Schaaf & Wheeler, 2003. *South Bay Salt Ponds Initial Stewardship Plan: South San Francisco Bay Hydrodynamic Model Results Report.* Prepared for Cargill Salt. June 2003.

Gross, E.S., M.L. MacWilliams, and W. Kimmerer, 2006. Simulating Periodic Stratification in San Francisco Bay. Proceedings of the Estuarine and Coastal Modeling Conference, ASCE.

Gross, E.S., MacWilliams, M.L. and Kimmerer, W.J., 2010. Three-dimensional Modeling of Tidal Hydrodynamics in the San Francisco Estuary, San Francisco Estuary and Watershed Science. 7(2). https://escholarship.org/uc/item/9rv243mg.

Harris, C.K. and P.L. Wiberg, 1997. Approaches to quantifying long-term continental shelf sediment transport with an example from the Northern California STRESS mid-shelf site. *Continental Shelf Research* 17:1389-1418. Available from: http:/dx.doi.org/10.1016/S0278-4343(97)00017-4.

Hill, P.S. and I.N. McCave, 2001. Suspended particle transport in benthic boundary layers. *The Benthic Boundary Layer.* B. P. Boudreau and B. B. Jorgensen (eds.), Oxford University Press, 78-103.

Hofmann, E. E., B. Cahill, K. Fennel, M, Friedrichs, K. Hyde, C. Lee, A. Mannino, R. Najjar, J. O'Reilly, J. Wilkin, and J. Xue, 2011. Modeling the dynamics of continental shelf carbon. *Annual Review of Marine Science* 3:93-122.

Huzzey, L.M., J.E., Cloern, and T.M. Powell, 1990. Episodic changes in lateral transport and phytoplankton distribution in South San Francisco Bay. *Limnology and Oceanography* 35:472-478.

Inagaki, S., S.G. Monismith, J.R. Koseff, and J.D. Bricker, 2001. Sediment transport simulation in South San Francisco Bay. *Proceedings of Coastal Engineering, JSCE* 48:641-645.

Jenkins, C.J., 2010. dbSEABED: An information processing system for marine substrates. Available from: http://instaar.colorado.edu/~jenkinsc/dbseabed/.

Jolliff, J.K., J.C. Kindle, I. Shulman, B. Penta, M.A.M Friedrichs, R. Helber, and R.A. Arnone, 2009. Summary diagrams for coupled hydrodynamic-ecosystem model skill

assessment. *Journal of Marine Systems* 76:64-82. Available from: http://dx.doi.org/10.1016/j.jmarsys.2008.05.014.

Kahlfeld, A. and H. Schüttrumpf, 2006. UnTRIM modelling for investigating environmental impacts caused by a new container terminal within the Jade-Weser Estuary, German Bight, 7th International Conference on Hydroscience and Engineering (ICHE-2006), Philadelphia, Pennsylvania, September 10 to September 13, 2006.

Kantha, L.H. and C.A. Clayson, 1994. An improved mixed layer model for geophysical applications. *Journal of Geophysical Research* 99:25235–25266. Available from: http://dx.doi.org/10.1029/94JC02257.

Kilmon, S.P., 2010. Spatial navigation asset surveying and mapping. Presentation at Dredging Workshop II, Sausalito, California, May 11, 2010.

Kineke, G.C. and R.W. Sternberg, 1989. The effect of particle settling velocity on computed suspended sediment concentration profiles. *Marine Geology* 90:159-174. Available from: http://dx.doi.org/10.1016/0025-3227(89)90039-X.

MacWilliams, M.L. and R.T. Cheng, 2007. Three-dimensional hydrodynamic modeling of San Pablo Bay on an unstructured grid. The 7th Int. Conf. on Hydroscience and Engineering (ICHE-2006), Philadelphia, Pennsylvania, September 10 to September 13, 2007.

MacWilliams, M.L. and E.S. Gross, 2007. *UnTRIM San Francisco Bay-Delta Model Calibration Report, Delta Risk Management Study.* Prepared for California Department of Water Resources. March 2007.

MacWilliams, M.L., E.S. Gross, J.F. DeGeorge, and R.R. and Rachiele, 2007. Three-dimensional hydrodynamic modeling of the San Francisco Estuary on an unstructured grid, IAHR. 32nd Congress, Venice Italy, July 1 to 6, 2007.

MacWilliams, M.L., and R.T. Cheng, 2008. *Hamilton Wetland Restoration Project aquatic Transfer Facility Technical Study Hydrodynamic modeling Report, in Cacchione.* D.A. and Mull, P.A. eds., Technical Studies for the Aquatic Transfer Facility: Hamilton Wetlands restoration project: Chapter 3, Final draft technical report.

MacWilliams, M.L., F.G. Salcedo, and E.S. Gross, 2008. *San Francisco Bay-Delta UnTRIM Model Calibration Report, POD 3-D Particle Tracking Modeling Study.* Prepared for California Department of Water Resources. December 19, 2008.

MacWilliams, M.L., F.G. Salcedo, and E.S. Gross, 2009. *San Francisco Bay-Delta UnTRIM Model Calibration Report, Sacramento and Stockton Deep Water Ship Channel 3-D Hydrodynamic and Salinity Modeling Study.* Prepared for U.S. Army Corps of Engineers, San Francisco District. July 14, 2009.

MacWilliams, M.L., 2011. *Establishing the Sacramento DWSC Flow Field for Ship Simulations. Sacramento and Stockton Deep Water Ship Channel 3-D Hydrodynamic and Salinity Modeling Study.* Prepared for U.S. Army Corps of Engineers, San Francisco District. February 24, 2011.

MacWilliams, M.L., A.J. Bever, and E.S. Gross, 2012a. *Three-Dimensional Sediment Transport Modeling for San Francisco Bay RDMMP.* Prepared for U.S. Army Corps of Engineers, San Francisco District. November 21, 2012.

MacWilliams, M.L., N.W. Kilham, and A.J. Bever, 2012b. *South San Francisco Bay Long Wave Modeling Report.* Prepared for U.S. Army Corps of Engineers, San Francisco District. 2012.

MacWilliams, M.L. and E.S. Gross, 2013. Hydrodynamic Simulation of Circulation and Residence Time in Clifton Court Forebay. *San Francisco Estuary and Watershed Science* 11(2). Available from: http://www.escholarship.org/uc/item/4q82g2bz.

MacWilliams, M.L., A.J. Bever, E.S. Gross, G.A. Ketefian, and W.J. Kimmerer, 2015. Three-Dimensional Modeling of Hydrodynamics and Salinity in the San Francisco Estuary: An Evaluation of Model Accuracy, X2, and the Low Salinity Zone. *San Francisco Estuary and Watershed Science* 13(1): 37. Available from: http://dx.doi.org/10.15447/sfews.2015v13iss1art2.

Madsen, O.S., Y.K. Poon, H.C. and Graber, 1988. Spectral wave attenuation by bottom friction: Theory, Proc. 21 the International Conference of Coastal Engineering. *ASCE* 21:492-504.

Malcherek, A., 2001. Hydromechanik der Fließgewässer, Bericht Nr. 61, Institut für Strömungsmechanik and Elektron, Rechen im Bauwesen der Universität Hannover, Universität Hannover, Hannover.

Meyer-Peter, E. and R. Müller, 1948. Formulas for bed-load transport. Proceedings of the 2nd Meeting of the International Association for Hydraulic Structures Research. 39-64.

Mikkelsen, O. A., P.S. Hill, and T.G. Milligan, 2006. Single grain, microfloc and macrofloc volume variations observed with a LISST-100 and a digital floc camera. *Journal of Sea Research* 55(2): 87-102. Available from: http://dx.doi.org/10.1016/j.seares.2005.09.003.

NOAA (National Oceanic and Atmospheric Administration), 2014. Datums for 9414290, San Francisco CA. Cited: November 2014. Available from: http://tidesandcurrents.noaa.gov/datums.html?units=0&epoch=0&id=9414290&name=San+Francisco&state=CA.

Pratt, T.C., H.A. Benson, A.M. Teeter, and J.V. Letter, 1994. *San Francisco Bay long term management strategy (LTMS) for dredging and disposal Report 4 Field data collection*. Technical Report HL-94-1994.

Rogers, W.E., P.A. Hwang, and D.W. Wang, 2003. Investigation of wave growth and decay in the SWAN model: Three regional-scale applications. *Journal of Physical Oceanography* 33:366-389. Available from: http://dx.doi.org/10.1175/1520-0485(2003)033<0366:IOWGAD>2.0.CO;2.

Schoellhamer, D.H., N.K. Ganju, P.R. Mineart, and M.A. Lionberger, 2008. Sensitivity and spin up times of cohesive sediment transport models used to simulate bathymetric change. *Marine Science* 9:463-475. Available from: http://dx.doi.org/10.1016/S1568-2692(08)80033-2.

Sea Engineering, 2008. *Aquatic Transfer Facility Sediment Transport Analysis, in Cacchione*. D.A. and Mull, P.A., eds., Technical Studies for the Aquatic Transfer Facility: Hamilton Wetlands Restoration Project. Available from: http://www.rivermodeling.com/HamiltonDownloads/TechnicalReport/.

Smith, S.J. and C.T. Friedrichs, 2011. Size and settling velocities of cohesive flocs and suspended sediment aggregates in a trailing suction hopper dredge plume. *Continental Shelf Research* 31(10):550-563. Available from: http://dx.doi.org/10.1016/j.csr.2010.04.002.

Sohrmann, A. and H. Weilbeer, 2006. Influence of anthropogenic measures on sediment transport characteristics in the Elbe estuary - hindcast studies on different historical states with a three-dimensional model, 7th Int. Conf. on Hydroscience and Engineering (ICHE-2006), Philadelphia, Pennsylvania, September 10 to September 13, 2006

SCCOOS (Southern California Coastal Ocean Observing System), 2012. SIO Manual Shore Stations program, SE Farallon Island Shore Station. Available from: www.sccoos.org.

Stacey, M.T., 1996. Turbulent mixing and residual circulation in a partially stratified estuary. Ph.D. Thesis, Dept. of Civil Engineering, Stanford University, Stanford, California.

SWAN Team, 2009a. SWAN User Manual Version 40.72. Delft University of Technology. Delft, Netherlands.

SWAN Team, 2009b. SWAN Scientific and Technical Documentation 40.72. Delft University of Technology. Delft, Netherlands.

Trawle, M.J., 1981. *Effects of depth on dredging frequency. Report 2. Methods of estuarine shoaling analysis.* Prepared for the office of Chief Engineers, U.S. Army. July 1981.

Umlauf, L. and Burchard, H., 2003. A generic length-scale equation for geophysical turbulence models. *Journal of Marine Research* 61:235–265. http://dx.doi.org/10.1357/002224003322005087.

USACE (United States Army Corps of Engineers), 2014. Sea-Level Change Calculator. Cited: November 2014. Available from: http://corpsclimate.us/ccaceslcurves.cfm.

USGS (United States Geological Survey), 2013. USGS Water Quality of San Francisco Bay. Available from: http://sfbay.wr.usgs.gov/access/wqdata.

USGS, 2014. National Water Information System. Cited: November 2014. Available from: http://waterdata.usgs.gov/ca/nwis/.

van Der Wegen, M., 2010. Modeling morphodynamic evolution in alluvial estuaries. Ph.D. Thesis, Delft University of Technology. Delft, Netherlands.

van der Wegen, M., B.E. Jaffe, and J.A. Roelvink, 2011. Process-based, morphodynamic hindcast of decadal deposition patterns in San Pablo Bay, California, 1856-1887. *Journal of Geophysical Research* 116:F2. Available from: http://dx.doi.org/10.1029/2009JF001614.

Wang, B., S.N. Giddings, O.B. Fringer, E.S. Gross, D.A. Fong, and S.G. Monismith, 2011. Modeling and understanding turbulent mixing in a macrotidal salt wedge estuary. *Journal of Geophysical Research* 116:C2(C02036). Available from: http://dx.doi.org/10.1029/2010JC006135.

Warner J.C., C.S. Sherwood, H.G. Arango, and R.P. Signell, 2005. Performance of four turbulence closure models implemented using a generic length scale method. *Ocean Modeling* 8:81-113. Available from: http://dx.doi.org/10.1016/j.ocemod.2003.12.003.

Warner J.C., S.R. Sherwood, R.P. Signell, C.K. Harris, and H.G. Arango, 2008. Development of a three-dimensional, regional, coupled wave, current, and sediment-transport model. *Computers and Geosciences* 34:1284-1306. Available from: http://dx.doi.org/doi:10.1016/j.cageo.2008.02.012.

Weilbeer, H., 2005. Numerical simulation and analyses of sediment transport processes in the Ems-Dollard estuary with a three-dimensional model, Chapter 30, Sediment and Ecohydraulics: INTERCOH 2005, Edited by T. Kusuda, H. Yamanishi, J. Spearman, and J.Z. Gailani, Elsevier, Amsterdam, Netherlands.

Willmott, C., 1981. On the validation of models. *Physical Geography* 2:184–194. 1981.

Wright, S.A., and D.H. Schoellhamer, 2005. Estimating sediment budgets at the interface between rivers and estuaries with application to the Sacramento-San Joaquin River Delta. *Water Resources Research* 4:W09428. Available from: http://sfbay.wr.usgs.gov/publications/pdf/wright_2005_RiverEstuarySedBudgets.pdf.

Zijlema, M., 2010. Computations of wind-wave spectra in coastal waters with SWAN on unstructured grids. *Coastal Engineering* 57(3):267-277. Available from: http://dx.doi.org/10.1016/j.coastaleng.2009.10.011.

Zimmerman, J.R., J.D. Bricker, C. Jones, P.J. Dacunto, R.L. Street, and R.G. Luthy, 2008. The stability of marine sediments at a tidal basin in San Francisco Bay amended with activated carbon for sequestration of organic contaminants. *Water Research* 42:4133-4145. Available from: http://dx.doi.org/10.1016/j.watres.2008.05.023.

APPENDIX A
ASSUMPTIONS AND LIMITATIONS OF THE COUPLED MODELING SYSTEM

A.1 Data Sources Used Within the UnTRIM Bay-Delta Model

Detailed descriptions of the boundary conditions and the data used to develop the boundary conditions for the UnTRIM Bay-Delta model, the SWAN wave model and the SediMorph seabed and sediment transport model are presented in MacWilliams et al. (2015) and Bever and MacWilliams (2013). This appendix presents a summary of the model boundary conditions and data sources that can be used as a quick reference (Figure A-1, Table A-1), while the previously mentioned references should be consulted for detailed descriptions.

The UnTRIM Bay-Delta model grid was developed with varying grid resolution along the axis of the estuary as necessary to resolve the bathymetric variability, with smaller grid cells used in narrower channels and in regions of complex bathymetry. The bathymetry was incorporated into the model using the highest resolution data that were available at any location (MacWilliams et al. 2015). The observed water level at the NOAA San Francisco tide station (9414290) was used to force the tidal water level at the open boundary. The open boundary salinity was set using daily salinity observations from the Farallon Islands, approximately 20 km west of the open boundary (SCCOOS 2012). The initial salinity field in the Bay was specified based on vertical salinity profiles collected by the USGS at 38 stations along the axis of the estuary (USGS 2013) and in the Delta by interpolating from continuous monitoring stations (CDEC 2013). At the bottom boundary the roughness coefficient z_0 was specified according to the elevation of each grid cell edge following the approach used by Cheng et al. (1993), Gross et al. (2010) and MacWilliams and Gross (2013), with higher roughness coefficients in shallower and higher elevation areas.

River inflows to the model included tributaries to the Bay and Delta and discharges from water pollution control plants (Figure A-1). Daily water exports were also specified at six locations. Hourly wind data was specified for six subregions of the Bay-Delta based on observations from the Bay Area Air Quality Management District (BAAQMD). Evaporation and precipitation in the Bay was set based on hourly data from the California Irrigation Management Information System (CIMIS), while evaporation and precipitation in the Delta was included in the Delta Island Consumptive Use (DICU). Monthly estimates of DICU (CDWR 1995) were used to specify the seepage, agricultural diversions, return flows and return flow salinity within the Delta. Nine control gates and temporary barriers in the Delta were incorporated into the model to represent the effects of these gates and barriers on flow

and transport in the Delta (Figure A-1). For each control structure, the seasonal timing of the installation, removal, and associated culvert and gate operations were specified (MacWilliams et al. 2009; MacWilliams and Gross 2013).

Sediment transport calculations included four sediment classes, each with different particle size, settling velocity, critical shear stress, density and erosion rate parameter. The four sediment classes were chosen to represent the dominant constituents in the real San Francisco Bay grain size distribution, and were single particle silt, flocculated silts and clays called "flocs," sand, and gravel, with characteristics based on data from San Francisco Bay (Kineke and Sternberg 1989; Sea Engineering 2008; Smith and Friedrichs 2011). Observed surface grain size distributions were used to generate a realistic initial sediment bed for the entire San Francisco Bay-Delta system. Grain size distribution data were compiled from a USACE Long Term Management Strategy report (Pratt et al. 1994), the dbSEABED west coast surface grain size distribution database (Jenkins 2010), the USGS sand provenance study (Barnard et al. 2013) and the Delta sediment grain size study (S. Wright, Pers. Comm. 2012). Suspended sediment was supplied through river input to the Sacramento-San Joaquin Delta, the North Bay and the South Bay. Sediment was supplied to the Delta by five tributaries representing nearly 100% of the sediment inflow to the delta (Wright and Schoellhamer 2005). Sediment was supplied to the North Bay by one tributary and to the South Bay by four tributaries. Suspended sediment concentrations were set based on time series concentrations from the USGS (T. Morgan-King, Pers. Comm. 2013), daily concentrations from USGS (2014), or rating curves (Wright and Schoellhamer 2005), depending on data availability.

The SWAN wave calculations used the same model grid and bathymetry as the UnTRIM hydrodynamic model, except that the quadrilaterals in the UnTRIM grid were converted to triangles, as explained in Bever and MacWilliams (2013). The wind was the same as that used in the hydrodynamic model and the bottom roughness was the Nikuradse roughness based on the roughness from the hydrodynamic model.

Table A-1
Summary of data sources used for model boundary conditions.

Boundary Condition Type	Boundary Condition / Forcing	Description / Sources
UnTRIM Initial Conditions	Bathymetry	High-resolution bathymetric data from several sources
	Navigation channel alignments in the grid	Provided by USACE
	Salinity	Based on USGS water quality sampling in the Bay (USGS 2013) and interpolated using continuous monitoring stations in the Delta (CDEC 2013)
Hydrodynamic Forcing	Tidal forcing	Six minute data from NOAA San Francisco tide station (9414290)
	Open boundary salinity	Daily salinity at Farallon Islands (SCCOOS 2012)
	Inflows	Daily using DAYFLOW (CDWR 1986, 2013) for Delta tributaries and USGS data (USGS 2014) for Bay tributaries
	Exports	Daily from DAYFLOW (CDWR 1986, 2013) and the California Data Exchange Center (CDEC 2013)
	DICU	Monthly based on the Delta Island Consumptive Use Model (CDWR 1995)
	Flow control structures	Seasonally nine Delta control structures (see MacWilliams et al. 2009)
	Evaporation / precipitation	Hourly data from California Irrigation Management Information System (CIMIS)
	Wind	Hourly data from Bay Area Air Quality Management District (BAAQMD)
	Seabed roughness	Elevation dependent Z_0 ranging from 0.001 mm to 1.0 cm
Sediment	Sediment settling velocity, critical shear stress, diameter and erosion rate	Based on data in San Francisco Bay from Kineke and Sternberg (1989), Sea Engineering (2008), Smith and Friedrichs (2011)
	Seabed grain size distribution	Based on surface grain size distributions from the USGS (Barnard et al. 2013; S. Wright, Pers. Comm. 2012), USACE (Pratt et al. 1994) and dbSEABED database (Jenkins 2010)
	Inflow suspended sediment concentration	Daily based on USGS time series observations, USGS daily measurements, or rating curves, based on data availability.
Waves	Bathymetry	Same as the hydrodynamic model
	Wind	Same as the hydrodynamic model
	Bottom roughness	Nikuradse roughness based on the roughness used in the hydrodynamic model

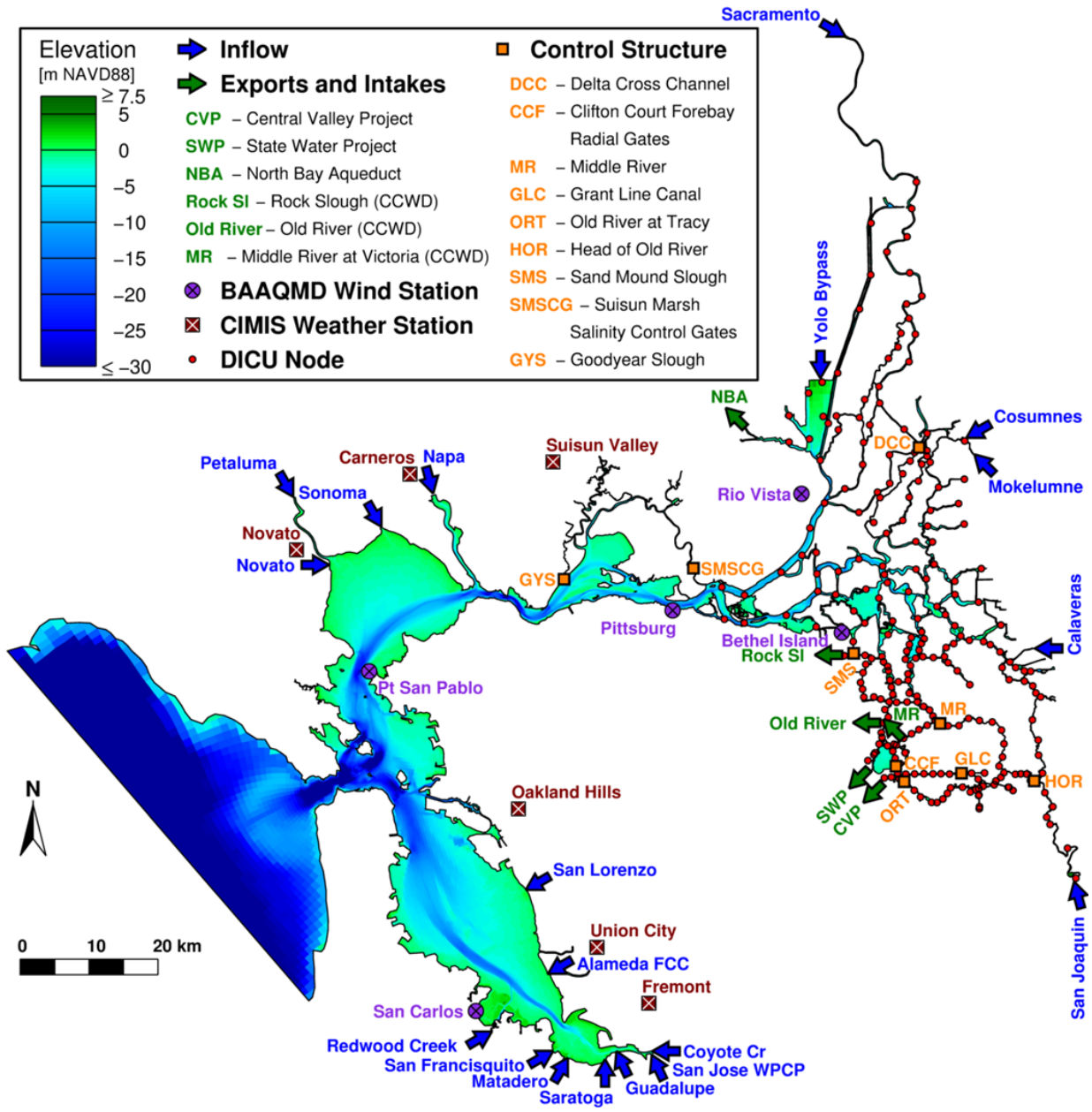


Figure A-1
UnTRIM San Francisco Bay-Delta model domain, bathymetry, and locations of model boundary conditions which include inflows, export facilities, intakes for the Contra Costa Water District (CCWD) wind stations from the Bay Area Air Quality Management District (BAAQMD), evaporation and precipitation from the California Irrigation Management System (CIMIS) weather stations, Delta Island Consumptive Use (DICU), and flow control structures. See Table A-1 for more information.

A.2 UnTRIM Numerical Model Uncertainty

As discussed in Section 3.1, the TRIM and UnTRIM models have been widely used in San Francisco Bay, and numerous detailed model calibrations have been performed (e.g., Cheng et al. 1993; Gross and Schaaf & Wheeler 2003; Gross et al. 2006; MacWilliams and Cheng 2007; MacWilliams and Gross 2007; MacWilliams et al. 2008, 2009, 2015). Due to this extensive history of application, these models are the best established three-dimensional models of San Francisco Bay.

The equations governing fluid motion and salt transport, representing conservation of water volume, momentum and salt mass, are well established, but cannot be solved analytically for complex geometry and boundary conditions. Therefore numerical models are used to give approximate solutions to these governing equations. Many decisions are made in constructing and applying numerical models. The governing equations are first chosen to represent the appropriate physical processes in one, two or three-dimensions and at the appropriate time scale. Then these governing equations that describe fluid motion and salt transport in a continuum are discretized giving rise to a set of algebraic equations. The resulting discretized algebraic equations must be solved, often requiring the use of an iterative matrix solver. The discretization and matrix solution must be developed carefully to yield a numerical scheme that is consistent with the governing equations, stable and efficient. To apply the models, the bathymetric grid, boundary conditions, initial conditions and several model parameters must be chosen. The accuracy of the model application depends on the appropriate choice of these inputs, including site-specific parameters, the numerical scheme for solving the governing equations, and the associated choice of time step and grid size.

The three-dimensional model applied in this project provides a more detailed description of fluid motion in San Francisco Bay than depth-averaged or one-dimensional models. The UnTRIM model, like almost all large scale hydrodynamic models, averages over the turbulent time scale to describe tidal time scale motions. The resulting three-dimensional hydrodynamic models represent the effect of turbulent motions as small scale mixing of momentum and salt, parameterized by eddy viscosity and eddy diffusivity coefficients, respectively. These turbulent mixing coefficients are estimated from the tidal flow properties (velocity and density) by turbulence closure models embedded within the three-

dimensional models. Three-dimensional models estimate the variability in velocity and salinity in all dimensions and through the tidal cycle, and therefore provide a detailed description of hydrodynamics and salinity. However, several sources of uncertainty are inherent in the application of these three-dimensional models:

- Spatial resolution/computational speed – the spatial resolution of the bathymetry of the model domain, and velocity and salinity distributions, is limited by the large computational expense associated with high-resolution models. The description of the Bay-Delta bathymetry is improved by the use of a flexible unstructured grid, with coarser grid resolution used in the open bay portions of the grid and higher grid resolution within the project study area in Redwood City Harbor Channel and the San Bruno Shoal Channel to optimize computational efficiency. The computational speed of the Bay-Delta model roughly scales with the number of grid cells. For example, halving of the horizontal resolution of the model would lead to four times as many three-dimensional grid cells and an implementation that takes roughly four times the computation time, making general system wide reductions in grid resolution infeasible and showcasing the benefit of using grid refinement approaching study regions.
- Bathymetric data – limited spatial coverage and accuracy of bathymetric data can be a substantial source of uncertainty. Converting all data to a uniform vertical datum and horizontal datum can lead to some error. In particular, Light Detection and Ranging (LiDAR) data may have substantial errors in vertical datum and removing vegetation from the dataset can be difficult. In the present application, bathymetric data from multiple sources were merged to develop the model bathymetry.
- Bottom roughness – the UnTRIM model requires bottom friction coefficients to parameterize the resistance to flow at solid boundaries. These parameters are specified and adjusted in model calibration. The roughness values used in the present application have been applied in several recent applications (e.g., MacWilliams et al. 2007, 2008, 2009, 2015).
- Turbulence closure – the effect of turbulent motions on the tidal time scale motions is parameterized by a turbulence closure (Section 3.1.1), as is done in other 3-D hydrodynamic numerical models of similar spatial and temporal scale as the UnTRIM Bay-Delta model (e.g., Warner et al. 2005; Wang et al. 2011). While many turbulence closures are available (e.g., Warner et al. 2005), this is an ongoing area of research

and, particularly in stratified settings, the effect of turbulence on tidal flows and salinity is not easy to estimate accurately. Different turbulence closures may give significantly different results in stratified settings (e.g., Stacey 1996).

- Numerical errors – a numerical method approximates the governing equations to some level of accuracy. The mathematical properties of the numerical method of the TRIM and UnTRIM models are well understood due to detailed mathematical analysis presented in several peer reviewed publications. While the stability and conservation properties of the method are ideal, a remaining source of error in the numerical method is some limited numerical diffusion of momentum, which may cause some damping of tidal propagation.
- Boundary conditions and initial conditions – The salinity in San Francisco Bay varies laterally (e.g., Huzzey et al. 1990) but this lateral variability cannot be described by existing observations. In addition, only limited observations are available to describe the vertical distribution of salinity. Therefore, lateral and vertical salinity distributions must be achieved by interpolation and extrapolation from the limited observations to obtain initial salinity fields. Inflows to the estuary are also quite uncertain in several regions due to un-gauged portions of watersheds and uncertainty in estimates of outflows and diversions in the Sacramento-San Joaquin Delta.

Though additional potential sources of uncertainty can be identified, the largest sources of uncertainty for hydrodynamic predictions are the accuracy and resolution of available bathymetry and the grid resolution used to represent this bathymetry in the model. This study makes use of the best available high resolution bathymetric data, especially in Central Bay and South Bay and within the area around Bair Island and the Redwood City Harbor Channel, and the highest computationally practical grid resolution throughout the domain. However, many of the available bathymetric data sets in other portions of the San Francisco Bay are fairly outdated and they required vertical and or horizontal coordinate transformations for the grid used in this project. Additionally, the most recent bathymetry for the Delta does not include many in-channel islands and other subtidal areas that are subject to flooding at high water, particularly during spring tide.

The uncertainty in Delta outflows can also be a substantial source of uncertainty in predicting salinity intrusion during summer conditions, particularly when consumptive use

within the Delta (which is only known approximately) is typically the same order of magnitude as Delta tributary flows. The current application makes use of monthly DICU estimates from DWR. However, because these estimates of diversions and return flows and salinities are approximate, they may not be representative of actual consumptive use in a particular year. This uncertainty would impact the accuracy of net Delta outflows predicted at the flow monitoring stations in the western Delta, when compared to observed flows, and would thereby influence salinity intrusion into the Western Delta during summer conditions. This uncertainty in Delta outflow may also influence the accuracy of sediment transport calculations.

A.3 SWAN Numerical Model Uncertainty

SWAN is a state-of-the-art and full featured spectral wave model. However, several simplifications and limitations are associated with this model. Wave-induced currents are not computed by SWAN. Because a phase-decoupled approach is used, SWAN "does not properly handle diffraction in harbors or in front of reflecting obstacles" (SWAN Team 2009b). Some additional uncertainty is introduced by interpolation of UnTRIM parameters and variables from side and cell center locations to node locations for use by SWAN. However, in practical SWAN applications, the uncertainty is likely to be driven primarily by the limited accuracy of input parameters such as wind velocity and bottom friction.

A.4 SediMorph Numerical Model Uncertainty

Significant uncertainty exists in the prediction of sediment transport. This uncertainty results from the complexity of representing sediment physics, the limited data available to characterize heterogeneous bed sediment and inflow sediment properties in a dynamic environment, and the difficulty in the specification of representative sediment parameters, such as settling velocity, critical shear stress, and erosion rate. Erosion and deposition processes are also highly sensitive both to the specified sediment parameters, and to the calculated bed shear stress, which in turn is sensitive to the selection or calculation of appropriate bed roughness parameters. Effective bed roughness is influenced by the grain size distribution of the bed material, and bed forms such as ripples and dunes, and can also vary significantly in both space and time.

A.5 Sediment Transport Modeling Assumptions and Limitations

The interaction of tides, winds, waves, and sediments results in complex physical processes which need to be simplified and parameterized in order to be represented in a numerical model. As a result, the numerical simulation of sediment transport processes requires some simplifying assumptions which can influence the accuracy of the model predictions. The interpretation of the model results must therefore take into account how these assumptions influence both the model predictions and any conclusions drawn from the model predictions. This section outlines the major assumptions and simplifications that were made in the development of the UnTRIM-SWAN-SediMorph coupled modeling system used in this study, and discusses how these simplifying assumptions may affect the interpretation of the model results.

The major simplifications made in this application were the partitioning of the full range of sediment sizes in the Bay to a discrete set of sediment classes with constant sediment parameters, assuming a single sediment class to represent flocculated particles rather than modeling the aggregation and disaggregation of sediment particles, and the treatment of sediment material in the seabed. Each of these simplifying assumptions is discussed below.

SediMorph allows for multiple sediment classes, each with different settling velocity, critical shear stress, erosion rate parameter, diameter, and density. In the simulations presented in this report the mud fraction was partitioned between the silt and floc sediment classes. The sediment properties for the four modeled sediment classes were selected to represent single particles of silt (silt), aggregated clay and silt particles which behave as flocculated particles (flocs), coarser material (sand), and gravel bedload (gravel). The characteristics of the "flocs" sediment class were set based on field observations of flocs within San Pablo Bay by Kineke and Sternberg (1989), from observations of the size and settling velocity of flocs in the plume from a suction hopper dredge in San Francisco Bay by Smith and Friedrichs (2011), from data on sediment mass eroded from the top of cores collected in San Pablo Bay by Sea Engineering (2008), and through comparison of modeled and observed time-series suspended sediment concentrations within San Francisco Bay. However, in reality, flocs continuously undergo aggregation and disaggregation due to physical and biological changes in the water (Mikkelsen et al. 2006), such as changes to turbulence and the Kolmogrov microscale, varying suspended sediment concentrations, compaction of the seabed and subsequent

resuspension, sediment interaction with biofilms, and incorporation into fecal pellets (some examples in Eisma 1986; Fugate and Friedrichs 2003; Hill and McCave 2001). These processes are extremely complex and are not easily incorporated into a numerical model. Previous sediment modeling studies in San Francisco Bay (e.g., Bever and MacWilliams 2013, 2014; van der Wegen et al. 2011; Schoellhamer et al. 2008; Ganju and Schoellhamer 2009) have also made a similar simplifying assumption by specifying a sediment class with characteristics representing flocculated material but assuming that mass is not aggregated or disaggregated between sediment classes. This simplification potentially leads to decreased peak suspended sediment concentrations during energetic periods and faster settling of the sediment from the water column because large flocs are not broken into smaller flocs or constituent particles. The simplification may also lead to an underestimation of the amount of sediment transported out of a channel onto the mudflats, because flocs may be disaggregated during high tidal flows into smaller particles that are more easily transported out of the channel.

Because bed consolidation is not currently represented in the model, the model may overpredict the transport distance of the sediment. With bed consolidation, some sediment would consolidate during neap tide periods and be harder to erode the following spring tide. Neglecting bed consolidation may lead to increased suspended sediment concentrations at the start of spring tides in the model predictions, because the sediment deposited in the model during neap tides does not consolidate and is easily erodible as the currents start to increase approaching spring tides. Without seabed consolidation the model also does not dewater or compact the seabed, which would reduce the depositional thicknesses and volumes over time. On a spring-neap time scale, compaction likely only negligibly affects model predictions of depositional thicknesses because of the relatively small depositional and erosional thicknesses undergoing compaction. However, on longer time scales with thicker deposition compaction could affect model predictions of depositional thickness and the feedbacks on the hydrodynamics. This lack of compaction and dewatering is mostly counteracted by tuning the seabed porosity based on the estimates of sediment depositional volume and thickness from the hydrosurvey data so the modeled thicknesses and volumes agree with the hydrosurvey estimates. However, additional data are needed to more fully validate predictions of sediment fluxes and morphologic change outside of the ship channels.

The complexity inherent in sediment transport modeling detailed above results in the accuracy of sediment transport predictions based on numeric skill metrics such as those used by MacWilliams et al. (2015) being lower for comparisons of suspended sediment concentrations than is typical for modeling of salinity or water level. This is especially true when considering simulations such as those in this report that span one year or more in length and simulate the transport of sediment over large distances from upstream portions of freshwater rivers through the entire San Francisco Estuary and into the Pacific Ocean. However, when the comparisons between observed and predicted suspended sediment concentrations indicate that the model is predicting a similar magnitude of concentration as the observations, captures the seasonal and spatial trends, and captures the observed tidal time-scale variations and along-estuary spatial structure, this suggests that the model is capturing the primary physical processes responsible for sediment transport in the system.

APPENDIX B
COUPLING OF THE UNTRIM, SWAN, AND SEDIMORPH NUMERICAL MODELS

The UnTRIM Bay-Delta model (MacWilliams et al. 2007, 2008, 2009) has been coupled with the SWAN wave model (SWAN Team 2009a) and the SediMorph sediment transport and seabed morphologic model (BAW 2005) to create a fully coupled hydrodynamic-wave-sediment transport modeling system. The physics represented by each model are discussed in previous sections and provided citations, and validation of the coupled modeling system, including validation of the coupling of the models and initial wave and sediment transport results within San Francisco Bay is presented in MacWilliams et al. (2012a) and Bever and MacWilliams (2013, 2014). As such, this appendix is limited to a description of how the model coupling is performed and what role each model plays in the coupled modeling system.

B.1 UnTRIM-SWAN-SediMorph Coupling Overview

The UnTRIM, SWAN, and SediMorph models run concurrently and pass information between one another to create a fully three-dimensional hydrodynamic, wave, and sediment transport modeling framework. The model coupling is performed such that UnTRIM can run either as a standalone hydrodynamic model, coupled with SWAN, coupled with SediMorph, or coupled with SWAN and SediMorph, giving freedom to use only the portion of the coupled modeling system that is necessary for any specific modeling objective.

In this framework the SWAN executable is called by the main UnTRIM program at specified intervals, while UnTRIM and SediMorph are compiled as a single executable and communicate every time-step. SWAN runs in stationary 2-D mode and uses a hot restart from the previous SWAN output as initialization conditions. Through the writing and reading of ascii files, UnTRIM passes to SWAN the following:

- Grid geometry
- Bathymetry
- Wind velocity
- Depth-averaged currents
- Nikuradse bottom friction coefficient

Because the unstructured version of SWAN only does computations on triangular meshes, each UnTRIM quadrilateral is divided into two SWAN triangles prior to writing grid

geometry and any other information for SWAN. However, the nodes remain identical between the quadrilateral cells and the resulting triangles, and SWAN calculations are made at the grid nodes. SWAN returns to UnTRIM the following:

- Significant wave height
- Peak wave period
- Peak wave direction

When the full UnTRIM-SWAN-SediMorph modeling system is run, these wave properties are held constant between iterations of the SWAN model.

UnTRIM and SediMorph run on identical grids, and because they are compiled as a single executable, UnTRIM and SediMorph do not require the reading and writing of files to pass information. SediMorph uses the currents, waves, and suspended sediment concentration from UnTRIM to calculate the seabed shear stress and the deposition and erosion fluxes, and then passes the net flux between the seabed and the water column back to UnTRIM for use in updating the suspended sediment concentration. SediMorph also calculates the bedload sediment transport and adjusts the bed elevation to account for erosion, deposition, and bedload within each grid cell. SediMorph then updates the fractions of each sediment class within the seabed. In this way the morphologic change of the seabed is calculated at every time-step and feeds back into the hydrodynamic calculations. Also, the bottom orbital velocity for shear stress calculations is calculated in the SediMorph sediment transport routines based on the provided wave properties, and thus the wave influence on seabed shear stress is impacted by the water depth at each time step. The suspended sediment advection, mixing, and settling are calculated in UnTRIM, which incorporates the suspended sediment concentration in the equation of state following Warner et al. (2008).

APPENDIX C
VALIDATION OF CENTRAL BAY AND SOUTH BAY WATER LEVEL AND SALINITY

Because the UnTRIM Bay-Delta model has already been extensively validated to water level, current speed, flow, and salinity in the San Francisco Bay-Delta system (MacWilliams et al. 2007, 2008, 2009, 2015), this appendix only presents an abbreviated model validation in the Central Bay and the South Bay at the stations closest to the study region.

C.1 Water Level Validation

Three NOAA water level stations in the Central Bay and South Bay were used to validate the predicted water levels for the 2006 simulation (Figure C-1). Using the target diagram statistics MacWilliams et al. (2015) defined very accurate model predictions as those whose length of the vector composed of the two target diagram statistics was less than 0.25, and using the model skill from Willmott (1981) they defined accurate water level predictions as greater than 0.975 (no threshold was set for very accurate using the Willmott (1981) skill metric). Using these thresholds for model accuracy Figures C-2 through C-4 and Table C-1 show the model very accurately predicted the water level at all three of the stations.

Table C-1
Predicted and observed water levels, cross-correlation statistics, model skills, and target diagram statistics for water level monitoring stations in Central Bay and South Bay. The ubRMSD is the unbiased root-mean-square difference. The bias and ubRMSD have both been normalized by the observed standard deviation. Station locations are shown on Figure C-1.

Station Location	Data Source	Figure Number	Mean Water Level		Cross Correlation		r^2	Skill	Target Diagram	
			Observed (m NAVD88)	Predicted (m NAVD88)	Amp Ratio	Lag (min)			Bias	ubRMSD
2006 Water Level Stations										
San Francisco	NOAA	C-2	1.02	1.05	0.986	0	0.994	0.998	0.056	-0.081
Alameda	NOAA	C-3	1.01	1.09	0.981	10	0.992	0.994	0.130	-0.088
Redwood City	NOAA	C-4	1.06	1.12	0.977	5	0.992	0.996	0.075	-0.091

C.2 Salinity Validation

Salinity was validated at three USGS continuous monitoring stations (Figure C-5). MacWilliams et al. (2015) defined accurate salinity predictions based on the Willmott (1981)

skill metric as greater than 0.85 (no threshold was set for very accurate using the Willmott (1981) skill metric). This validation showed the model accurately predicted the salinity in the Central Bay and South Bay using the thresholds for model accuracy detailed in MacWilliams et al. (2015) (Figures C-6 through C-9, Table C-2). However, the model predictions in the South Bay were generally more saline than the observations. This prediction of slightly higher salinity than observed is likely a result of the model not including the freshwater inflow from many small ungauged streams that only flow during rainfall events combined with 2006 being a very wet year.

Table C-2

Predicted and observed salinity, cross-correlation statistics, model skills, and target diagram statistics for salinity monitoring stations in Central Bay and South Bay. The ubRMSD is the unbiased root-mean-square difference. The bias and ubRMSD have both been normalized by the observed standard deviation. Station locations are shown on Figure C-5.

Station Location	Data Source	Figure Number	Mean Salinity		Cross Correlation		r^2	Skill	Target Diagram	
			Observed (PSU)	Predicted (PSU)	Amp Ratio	Lag (min)			Bias	ubRMSD
2006 Salinity Stations										
Alcatraz	USGS	C-6	25.63	24.90	0.974	18	0.947	0.983	-0.114	0.232
San Mateo Bridge Upper	USGS	C-7	21.99	22.48	0.877	19	0.981	0.989	0.086	-0.174
San Mateo Bridge Lower	USGS	C-8	22.59	23.09	0.886	35	0.966	0.986	0.094	-0.202
Dumbarton Bridge	USGS	C-9	18.92	19.85	0.832	-26	0.937	0.971	0.163	-0.273

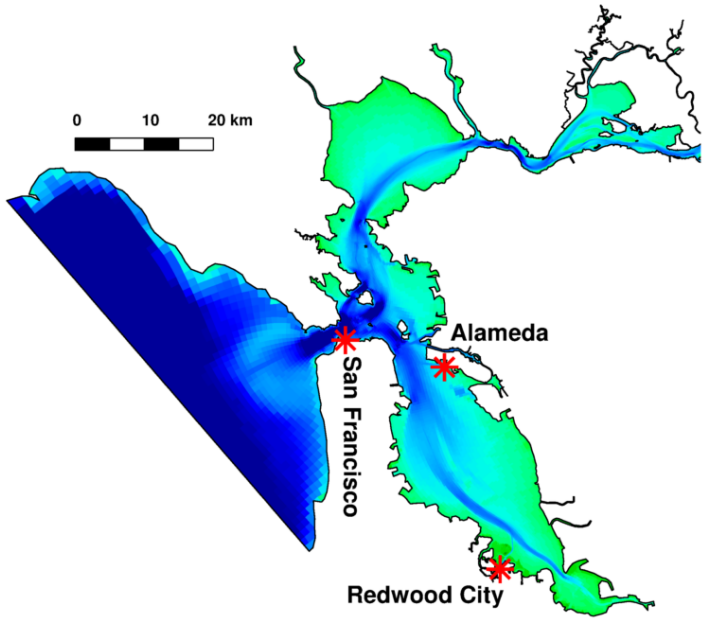


Figure C-1
Location of NOAA water level monitoring stations in the Central Bay and South Bay used for water level validation.

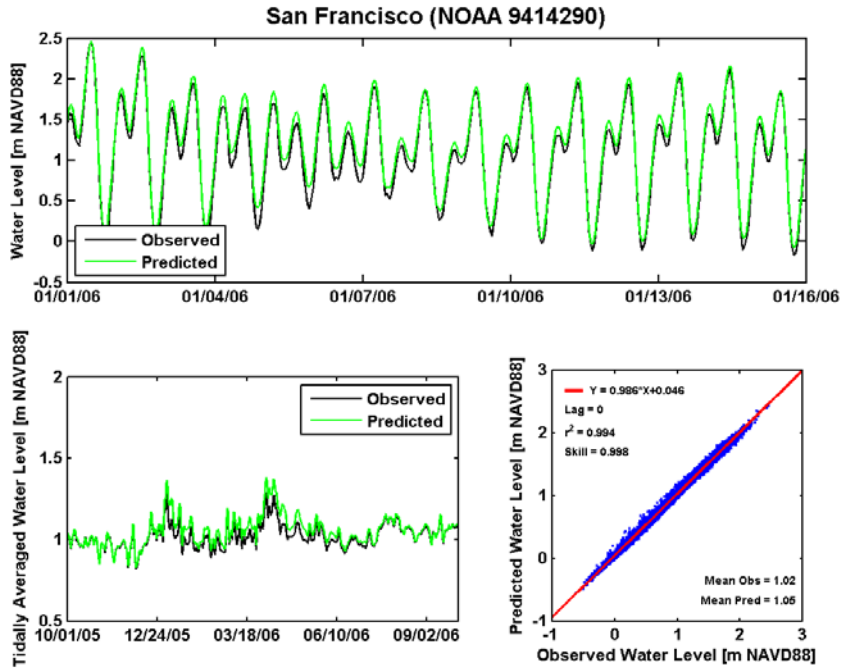


Figure C-2
Observed and predicted water level at San Francisco NOAA station (9414290) during the 2006 simulation period.

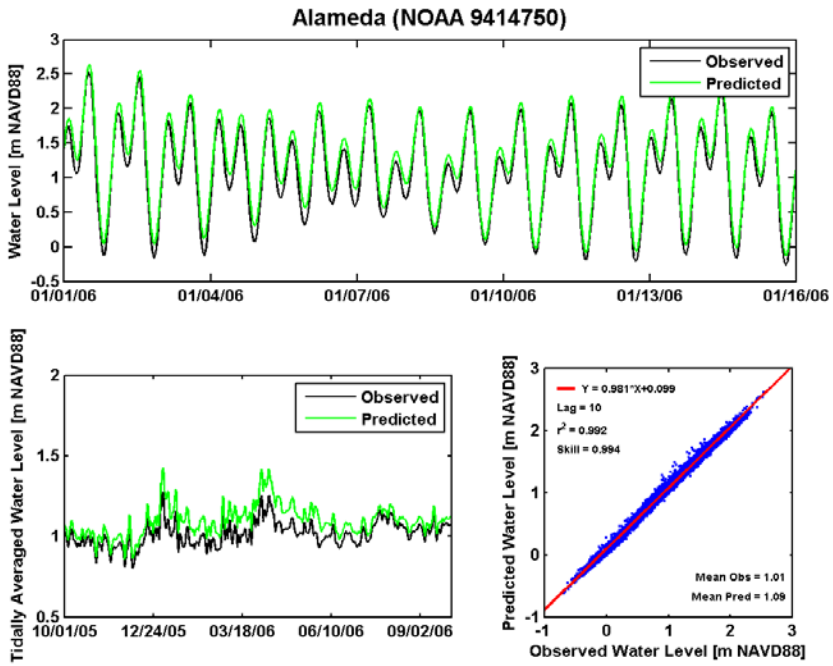


Figure C-3
Observed and predicted water level at Alameda NOAA station (9414750) during the 2006 simulation period.

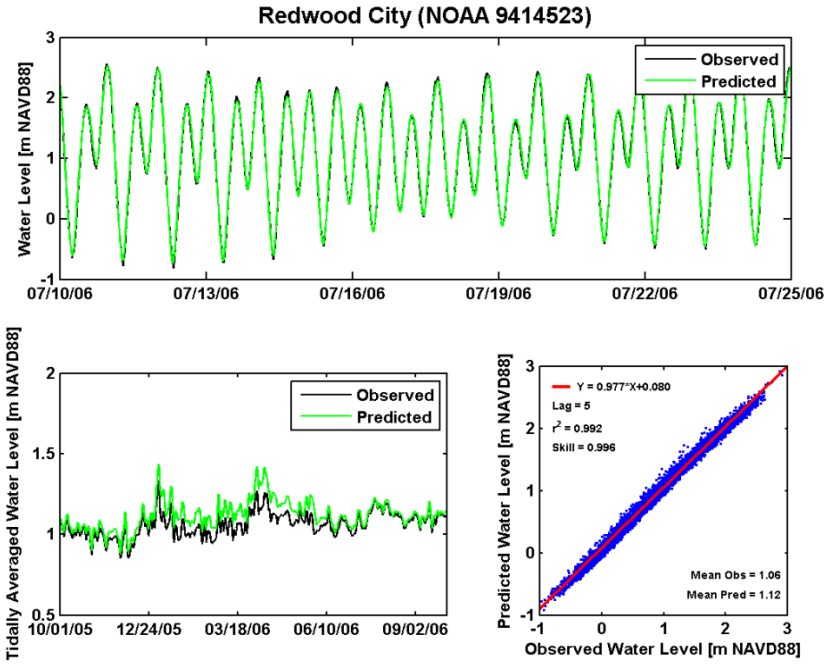


Figure C-4
Observed and predicted water level at Redwood City NOAA station (9414523) during the 2006 simulation period.

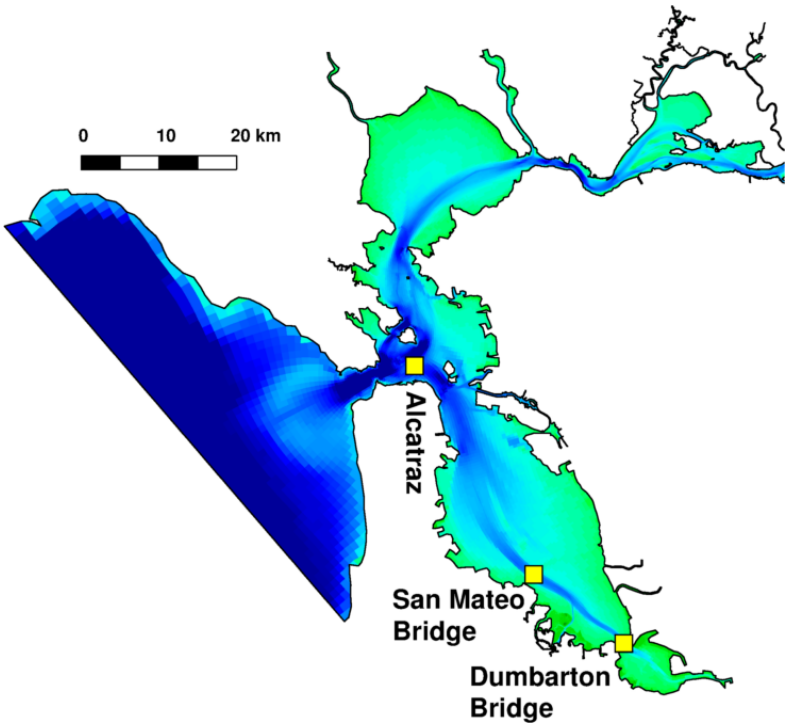


Figure C-5
Location of USGS salinity monitoring stations in the Central Bay and South Bay used for salinity validation.

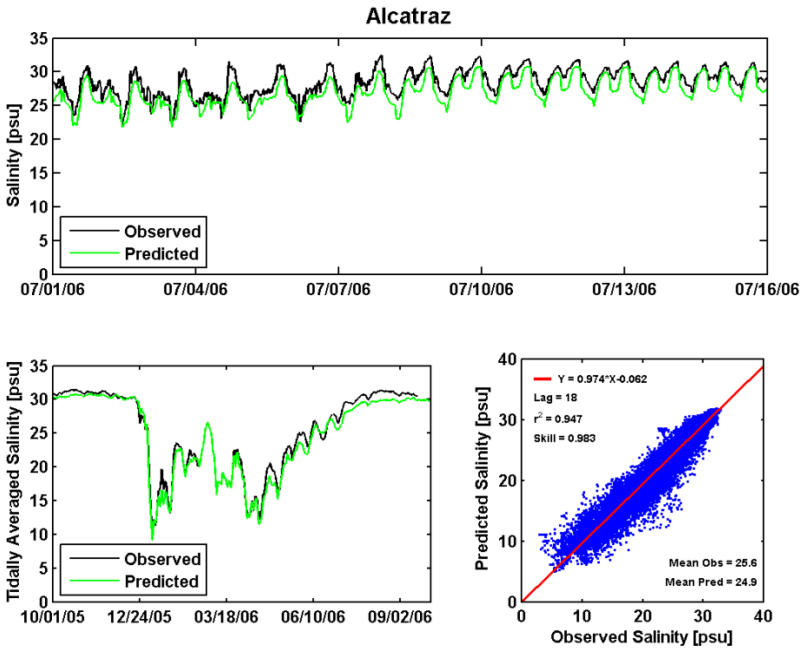


Figure C-6
Observed and predicted salinity at Alcatraz during the 2006 simulation period.

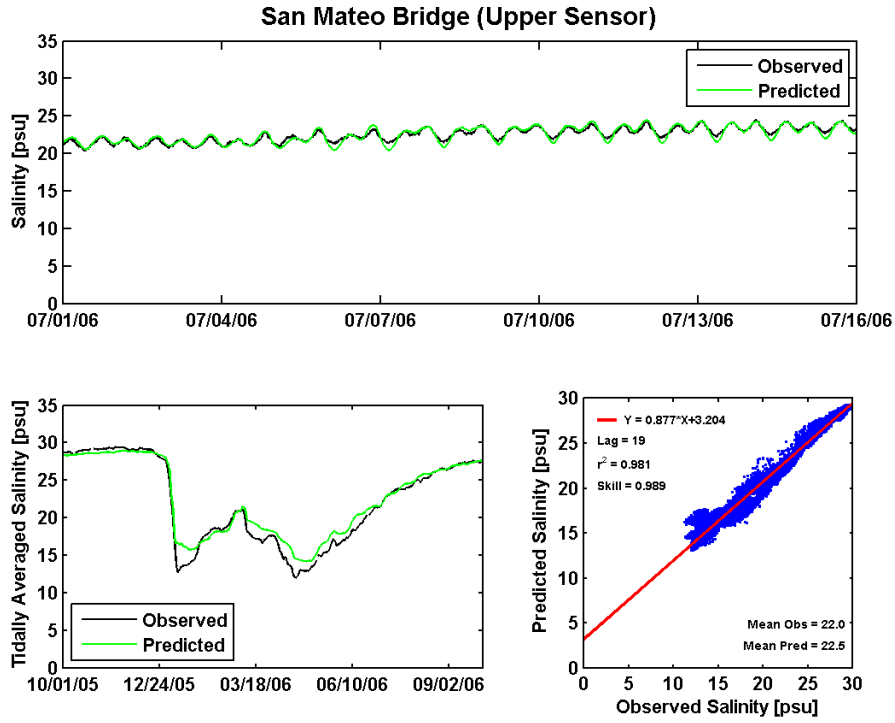


Figure C-7
Observed and predicted salinity at San Mateo Bridge (upper sensor) during the 2006 simulation period.

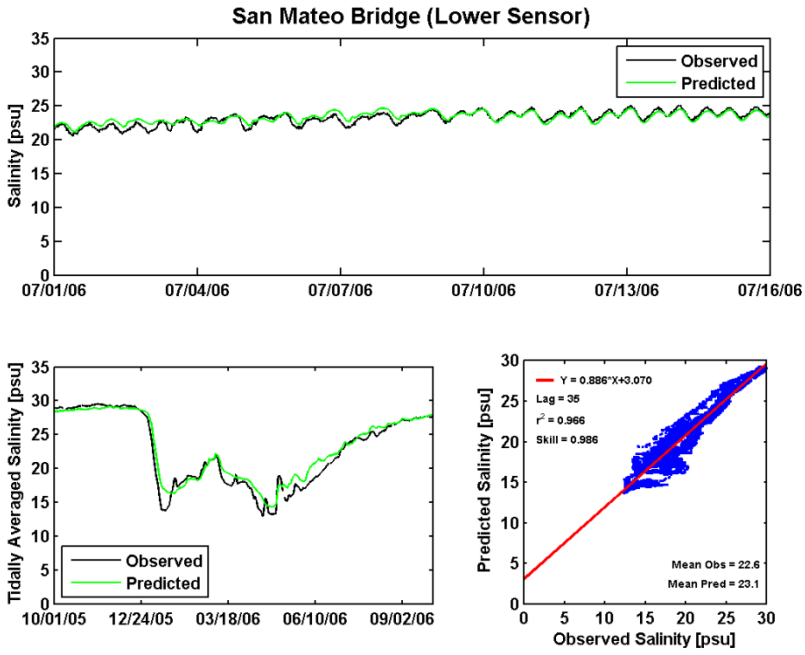


Figure C-8
Observed and predicted salinity at San Mateo Bridge (lower sensor) during the 2006 simulation period.

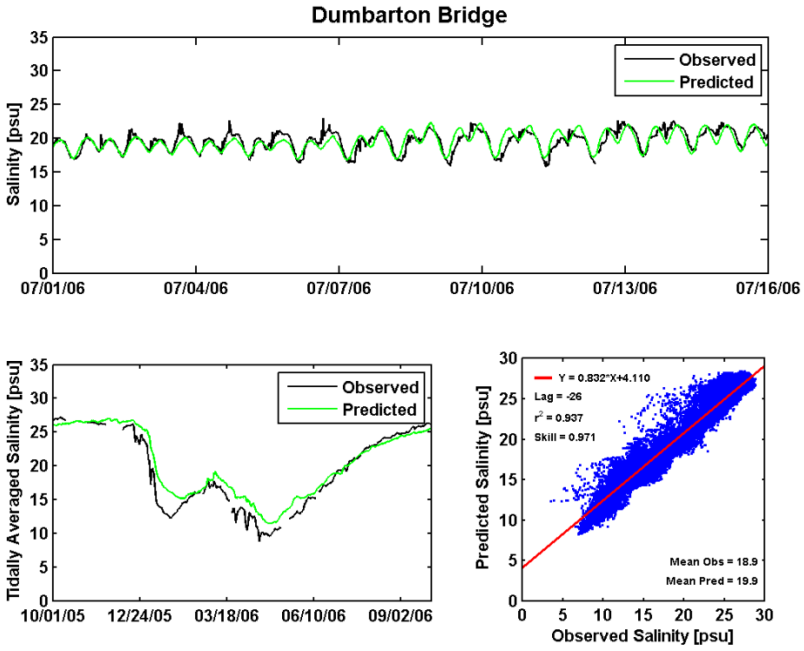


Figure C-9
Observed and predicted salinity at Dumbarton Bridge during the 2006 simulation period.

APPENDIX F
REAL ESTATE PLAN

Redwood City Harbor Navigation Improvement Feasibility Study,
Redwood City, California

PREPARED FOR THE
SAN FRANCISCO DISTRICT
SOUTH PACIFIC DIVISION

20 April 2015

PREPARED
BY THE
SACRAMENTO DISTRICT
REAL ESTATE DIVISION
SOUTH PACIFIC DIVISION

APPENDIX F

DRAFT - April 2015 DQC

TABLE OF CONTENTS

1. INTRODUCTION
2. PROJECT AUTHORITY
3. PROJECT DESCRIPTION
4. DESCRIPTION OF LERRD'S
5. LERRD'S OWNED BY THE NFS AND CREDITING
6. STANDARD FEDERAL ESTATES AND NON-STANDARD ESTATES
7. DESCRIPTION OF ANY EXISTING FEDERAL PROJECT IN OR PARTIALLY IN THE PROPOSED PROJECT
8. DESCRIPTION OF ANY FEDERALLY OWNED LAND NEEDED FOR THE PROJECT
9. APPLICATION OF NAVIGATIONAL SERVITUDE TO THE LERRD'S REQUIREMENT
10. PROJECT MAP
11. ANTICIPATED INCREASED FLOODING AND IMPACTS
12. COST ESTIMATE
13. RELOCATION ASSISTANCE BENEFITS
14. MINERAL / TIMBER ACTIVITY
15. NON-FEDERAL SPONSOR'S ABILITY TO ACQUIRE
16. ZONING ANTICIPATED IN LIEU OF ACQUISITION
17. ACQUISITION SCHEDULE
18. DESCRIPTION OF FACILITY AND UTILITY RELOCATIONS
19. HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE IMPACTS
20. ATTITUDE OF LANDOWNERS
21. EXHIBIT A – PROJECT MAPS
22. EXHIBIT B – ASSESSMENT OF NON-FEDERAL PARTNERS REAL ESTATE ACQUISITION CAPABILITY

DRAFT - April 2015 DQC

1. Introduction.

The Feasibility Study is investigating navigation improvements to the existing federal channels at the Redwood City Harbor and San Bruno Shoal, located in San Francisco Bay[1]. The existing project is maintained on an approximate three year dredging cycle to a project depth of -30' MLLW, with the last time the San Bruno Shoal was dredged as Fiscal Year 2006. As the need for construction materials in the South San Francisco Bay increased in the 1990s, the Port of Redwood City engaged USACE to conduct a reconnaissance study to determine if there was federal interest in conducting a feasibility study to investigate improvements to the navigation project. The reconnaissance study was completed in 1998 and recommended proceeding with a feasibility study. The Port and USACE executed a Feasibility Cost Share Agreement (FCSA) in July 2008.

A SMART planning Charette was completed in October 2012, and a favorable federal interest determination to continue the study was made on November 26, 2012.

The non-Federal sponsor is the Port of Redwood City. USACE and the Port of Redwood City executed a Feasibility Cost Sharing Agreement in 2008.

2. Project Authority.

River and Harbor Act of 1925

That the Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities:
Channel from Redwood City, California to the main channel in San Francisco Bay, with a view to securing a depth of thirty feet and width of three hundred feet.

House Resolution 2511, adopted May 7, 1997

Resolved by the Committee on Transportation and Infrastructure of the United States House of representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on Redwood City Harbor, California, published as House Document 104, 81st Congress, 1st Session, and any other pertinent reports to determine whether modifications of the recommendations contained therein are advisable at the present time in the interest of navigation improvements and related purposes at Redwood City Harbor, California, with particular reference to providing increased depths to accommodate new, larger vessels that now call on the port.

3. Project Description.

Redwood City Harbor, the only deepwater port in South San Francisco Bay, is located approximately 25 miles southeast of the City of San Francisco. An existing deep-draft navigation project, which was completed in 1965, is maintained by the U.S. Army Corps of Engineers (USACE). This proposed study will address deepening the project to a greater-than-authorized depth

1 Federal navigational servitude concerning the existing USACE authorized deep draft channels has been confirmed with Office of Counsel.

DRAFT - April 2015 DQC

of 30 feet mean lower low water (MLLW) to accommodate the new, larger vessels that currently call on the port and require more than the authorized depth to carry more tonnage. The project area is defined as the location of potential alternative plans and the area directly or indirectly impacted by construction or operation. The study is considering measures at the Redwood City Harbor and San Bruno Shoal channels. A comprehensive list of potential dredge material placement sites that have been considered for this study include Ravenswood Pond Complex, Alviso Pond Complex, Eden Landing Pond Complex, Crown Memorial State Beach, Bay Farm Barrow Pit, Oakland International Airport, and SF-11 Alcatraz, an in-Bay passive sediment transport site near Dumbarton Bridge, and San Francisco Deep Ocean Disposal Site (SFDODS). The Tentatively Selected Plan (TSP) will place the dredged material at the San Francisco Deep Ocean Disposal Site with 5% wetland non-cover material classified unsuitable for SFDODS to Montezuma (upland beneficial reuse site). A map showing the location of all potential placement sites considered for this study, is shown in Figure 1. Redwood City, California, Project Area.

Bair Island and Greco Island are adjacent to the Redwood City Harbor and are considered to be in the project area because of potential project impacts. Bair Island is operated by the U.S. Fish and Wildlife Service and is the site of a restoration project. The bay water around Bair Island and Redwood City Harbor is within the Don Edwards Marine Protected Area.

Port facilities adjacent to the study area include two office complexes, a conference center, a restaurant, and public access facilities (boat launch, walkways, restrooms, and parking). The Port maintains three berth facilities at a depth of -3430 feet MLLW, and a small facility used to unload cement and aggregates via barge. Union Pacific Railway tracks are located directly alongside Port facilities. U.S. Highway 101 is approximately one mile west of the Harbor. The area surrounding the Harbor is zoned as General Industrial (GI), Industrial Restricted (IR), and Industrial Park (IP). Slightly further south of the Harbor, on the east side of HWY 101, the area is zoned Mobile Home (MH). Slightly north of the Harbor, on the east side of HWY 101, the area is zoned Commercial General (CG), Commercial General Restricted (CG-R), and Planned Community District (CMD).

Commented [PVZ1]: Is it 34 feet or 30 feet? I think it's 30 feet?

Commented [L2]: Concur 30 feet

DRAFT - April 2015 DOC

Figure 1. Redwood City, California, Project Area



4. Description of Land, Easements, Rights-Of-Way, Relocation, and Disposal Areas (LERRDs).

The TSP is Alternative 1C: Deepen the channels at RWC Harbor and San Bruno Shoal to 32 ft and place dredged material at the San Francisco Deep Ocean Disposal Site (SF-DODS) with 5% wetland non-cover material to Montezuma (upland beneficial reuse site). . This plan is complete because the placement site is available, permitted, and has capacity to receive all of the project's dredged material. It meets the primary study objective of shipping the forecasted volume of goods to and from the Port of Redwood City with greater efficiency, and it is the most cost effective plan. If the plan is implemented, the channel at Redwood City Harbor would range from 350 ft wide near the entrance to 288 ft throughout the rest of the channel. The channel alignment at the turn into Redwood City Harbor will retain the existing width but will be slightly shifted 6 ft to the east to avoid adverse impact to the Bair Island wetland restoration site. As the channel moves between Bair and Greco Islands in Reach 3 and continues through to the end of the project at the inner turning basin in Reach 5, the channel will narrow so the existing side slopes and Port infrastructure will remain undisturbed on either side of the channel. The channel will narrow by a total of 6 ft assuming 3:1 side slopes between -30 ft and -32 ft. The channel at San Bruno Shoal will remain approximately 500 ft wide and 29,850 ft (5.65 miles) long and will not be realigned. Both channels will be deepened from -30 ft to -32 ft MLLW. The side slopes of both channels will be maintained at 3:1. Approximately 887,750 CY (this volume will likely be lower) of material will be dredged from the channels and placed at the deep ocean disposal site (SF-DODS).

The non-Federal sponsor will acquire the minimum interests in real estate to support the construction and subsequent operation and maintenance of the USACE project. At this time, all activities will occur within the channel where Navigational Servitude applies.

DRAFT - April 2015 DQC

SFDODS is located in the Pacific Ocean, approximately 55 nautical miles west of the Golden Gate Bridge. The site is approximately 85 nautical miles from RWC Harbor and approximately 75 nautical miles from SBS channel. The site was established in 1994 by the Long Term Management Strategy agencies, and is managed by the EPA. This is the only site in the initial array that is fully permitted and has capacity to receive dredge material.

Once the Chief's Report is complete and approved, the San Francisco District Engineering Branch will prepare the final design. During this process the tract register and tract maps will be updated to reflect any modifications. This information will be used for future crediting purposes.

5. LERRDs Owned by the Non-Federal Sponsor and Crediting.

Credit will only be applied to LERRDs owned and/or held by the sponsors that fall within the "project footprint," namely the LERRDs required for the Recommended Plan. Lands outside of the project requirements and that may be acquired for the sponsor's own purposes which do not support the minimum interests necessary to construct, operate and maintain the Project would not be creditable LERRDs. Only land deemed necessary to construct, operate and maintain the plan would be creditable.

Staging Areas – The Non Federal Sponsor have several options for staging areas on property that they currently own at the foot of newly constructed wharves 1, 2 and5. There are two large parking lots at the launch ramp and near the commercial office buildings. There is a 9-acre parcel near wharf 5 that is about 1/2 occupied and may be available for staging. It is estimated that staging areas at the wharves are approximately $24.00 per square foot. Staging will cost approximately $6300 per month with a 35% contingency or $204,120 for two years. Approximately .5 acres will be needed for staging.

Commented [PVZ3]: How much area does the project need for staging? Is it 9 acres?

Commented [L4]: ½ acres or 17,500 square feet was estimated for parking and to locate a 1000 sq foot trailer/office.

6. Standard Federal Estates and Non-Standard Estates.

The non-Federal sponsor will be required to acquire the minimum interest in real estate that will support the construction and subsequent operation and maintenance of the proposed USACE project, however all dredging and pipeline removal activities will take place within the channel where Navigational Servitude applies.

7. Description of any Existing Federal Projects in or Partially in the Proposed Project.

The Port of Redwood City is approximately 18 nautical miles south of San Francisco on the western side of San Francisco. The existing federal Redwood City Harbor project includes the San Bruno Shoal Channel, located in the South Bay, the Entrance Channel, Outer Turning Basin, Connecting Channel, and Inner Turning Basin. The Redwood City Harbor channels range from 300 to 900 feet wide, 20,800 feet long, and 209 acres. The entire project is maintained to 30 feet MLLW. The Entrance Channel, Outer Harbor Turning Basin, Connecting Channel and Inner Harbor Turning basing are dredged every 1 to 2 years and were dredged in 2014. The San Bruno Channel is only dredged about every 10 years, and was last dredged in 2005.

DRAFT - April 2015 DQC

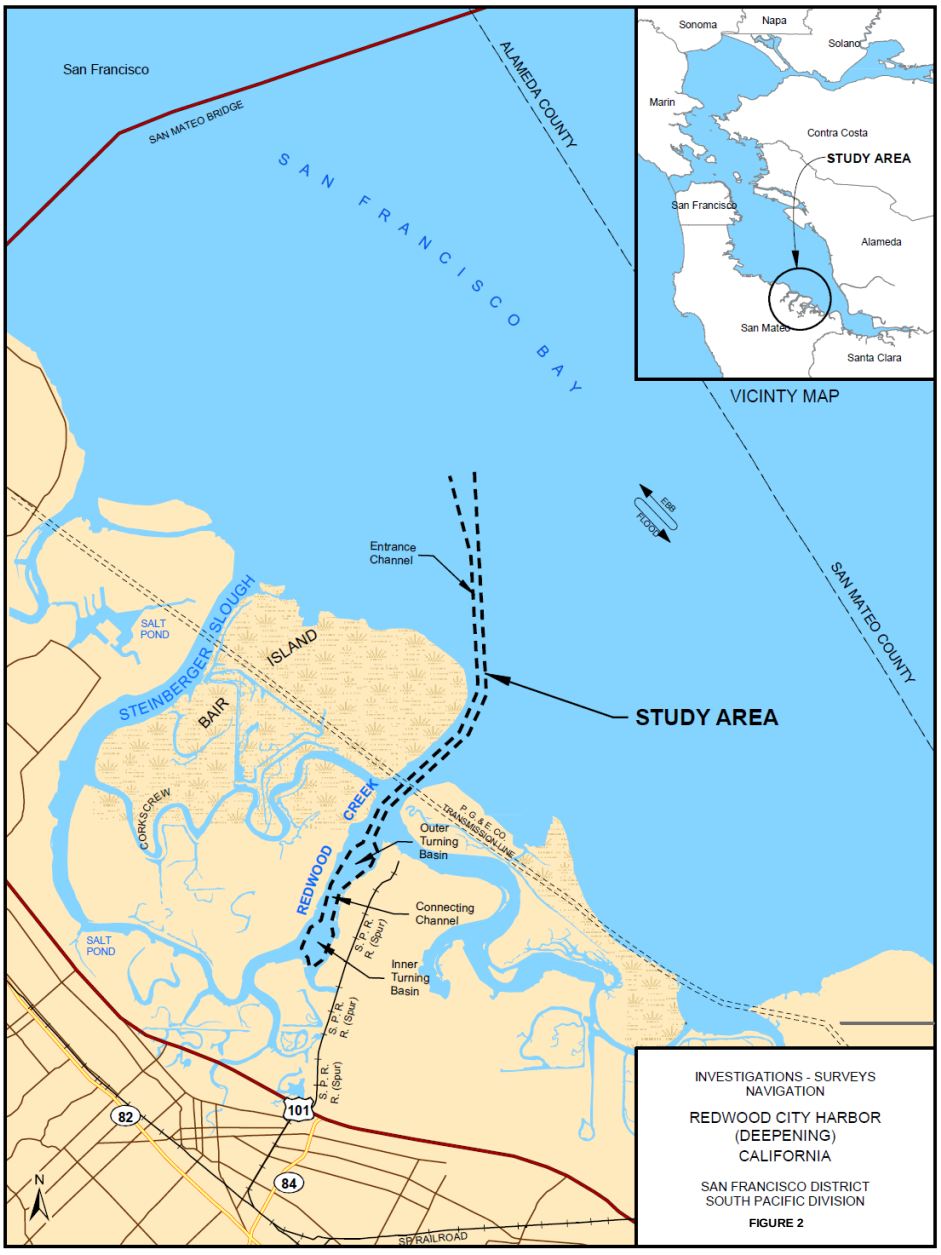
Bair Island and Greco Island are adjacent to the Redwood City Harbor and are considered to be in the project area. Bair Island is operated by the U.S. Fish and Wildlife Service and is the site of a restoration project. The bay water around Bair Island and Redwood City Harbor is within the Don Edwards Marine Protected Area.

Commented [PVZ5]: If Blair and Greco Islands are considered to be in this project, then we need to show the impacted project footprints? The NFS would not receive land acquisition credit for land that was used on a previous federal project.

Commented [L6]: Concur – There should be no impact to Bair and Greco Islands. They are located adjacent to the channel that will be dredged only.

DRAFT - April 2015 DQC

U.S. ARMY CORPS OF ENGINEERS



o

8. Description of any Federally-owned Land Needed for the Project.

There are no Federally-owned lands needed for the Project.

9. Application of Navigational Servitude to the LERRDs Requirement.

There will be navigational servitude associated with the project. Navigational Servitude may be exercised under statutory rights and powers without obligation for compensation to the riparian landowners. The determination of the availability of the navigation servitude is a two-step process. First the Government must determine whether the project feature serves a purpose which is in the aid of commerce. Such purposes recognized by the courts include navigation, flood control and hydro-electric power. If it is so determined, then the second step is to determine whether the land at issue is located below the mean or ordinary high water mark of a navigable watercourse.

Navigational servitude may be applicable where deepening of the channel will take place located below the mean or ordinary high water mark of a navigable watercourse within Redwood City Harbor and San Bruno Shoal. This has been coordinated and discussed with SPN Office of Counsel.

10. Real Estate Map.

A project map is included in Exhibit A.

11. Anticipated Increased Flooding and Impacts.

No induced flooding is expected to occur from the project.

12. Cost Estimate.

Tentatively Selected Plan	Cost	Contingency	Total Costs Rounded
Code of Accounts 01	FEDERAL		
Fed RE Admin	$23,750	(5%)$1,250	$25,000
Account 01	NON FEDERAL		
Staging Areas Duration 2 Years	$151,200	(35%)$52,920	$204,120
Non Federal Admin	$42,750	(5%)$2250	$45,000
		TOTAL LERRD'S	**$274,120**

*There are no real estate costs associated with disposals as actions are taken place in SF DODS and a small portion in Montezuma. These costs are captured under the Construction costs.

There are three pipelines that need to be relocated. A preliminary attorney's opinion of compensability has determined the pipelines to be non compensable. Pipeline relocations are

DRAFT - April 2015 DSC

estimated at $15 million and are the responsibility and expense of the pipeline owners to relocate.

13. Relocation Assistance Benefits.

There are no Public Law 91-646 Relocations required in connection with the project.

14. Mineral / Timber Activity.

There are no valuable minerals impacted by this project. There was no enhancement for mineral deposits included in the cost estimate. There is no timber activity. Dredging would not involve construction or operation of any facilities on or adjacent to any land-based mineral resource areas delineated on land use plans, and therefore would not result in the loss of availability of a land-based mineral resource. Sand is mined from the San Francisco Bay for industrial and agricultural uses. Geographically, mining activity occurs in three areas: the Central Bay west of Angel Island; at Middle Ground Shoal just east of Port Chicago; and in the eastern portion of Suisun Channel (USACE, 2012e). The USACE's continued maintenance of the federal navigation channels, and placement of dredged materials under any of the action alternatives would not adversely impact sand mining because it would not interfere with sand mining activities. Sediments in the San Francisco Main Ship, Pinole Shoal, and Suisun Bay channels are primarily sand. The federal standard placement site for each of these channels is in water and adjacent to or very near the channel. Therefore, USACE's continued maintenance dredging and placement activities would not be expected to deplete sand mineral resources, because dredged material would be redeposited relatively close to the location where it was removed. Beneficial impacts could result if USACE contracted maintenance dredging of a federal channel with sand mineral resources (e.g., Suisun Bay Channel) to a sand mining contractor, thereby facilitating mining of this resource. Sand miners would be responsible for meeting all legal requirements, environmental clearance, and obtaining any necessary permits or licenses.

15. Non-Federal Sponsor's Ability to Acquire.

COORDINATION ONGOING TO CONFIRM. The non-Federal sponsors have real estate staff and experience in acquiring real estate for county, state and Federal projects.

16. Zoning Anticipated in Lieu of Acquisition.

There is no zoning needed for the project.

17. Acquisition Schedule.

An acquisition schedule is attached as Schedule A to this Real Estate Plan. The schedule has been coordinated with the Project Manager. The non-Federal sponsors will be directed to begin acquisition of temporary work area easements needed for staging for the project only after the PPA is fully executed.

Commented [PVZ7]: This sentence does not make sense? Please clarify. Concur – that was a typo. Removed disposal site.

Commented [L8]: Concur – SFDODS disposal site was removed from sentence.

Commented [PVZ9]: I would go ahead and reinsert this sentence, since the NFS will need to acquire TWAE.

Commented [L10]: Concur – Sentence reinserted.

DRAFT - AWAITING DOC

18. Description of Facility and Utility Relocations.

There are two active pipelines owned by Kinder Morgan and one abandoned 10" owned by Shell Oil Company that will need to be removed and relocated as they cross through the project area, see Figure 3 below. The pipeline relocations is estimated at $15 million for three jet-fuel pipelines located underneath the channel at San Bruno Shoal. The estimated total project cost is $61 million. SPN Office of Counsel preliminary attorney's legal opinion has determined the pipelines to be non compensable.

In the event it is determined that the non-Federal sponsor does not have the capability to compel the owner of a facility obstructing a navigation project to remove the facility at owner cost and the non-Federal sponsor does not elect to directly negotiate with the facility owner for the removal of the facility, if the non-Federal sponsor is not a state, the non-Federal sponsor will request that the state exercise any capability that it has to compel the facility removal at owner costs. If the state does not have the capability to compel removal at owner cost, both the non-Federal sponsor and the state must request, in writing to the District Engineer, that the Corps exercise its rights under the navigation servitude and applicable Corps permit conditions to require the owner to perform the removal of the facility at owner expense. The letter from the state must be signed by the governor or a state official that the governor specifically designates to make the request. Based upon a request from the non-Federal sponsor and the state, the Corps will exercise its rights under the navigation servitude to compel removals at owner cost. If the state has the authority to compel removals at owner cost but declines to exercise its authority or does not have the authority but is not willing to request that the Corps exercise its authority, the Corps will not exercise its rights under the navigation servitude to compel relocations at owner cost. Under these circumstances, the navigation project cannot be implemented or recommended for implementation unless the non-Federal sponsor is willing to directly negotiate with facility owners for facility removal recognizing that any payments or reimbursements by the non-Federal sponsor to the facility owner would not be creditable against the non-Federal sponsor's required additional 10 percent share.

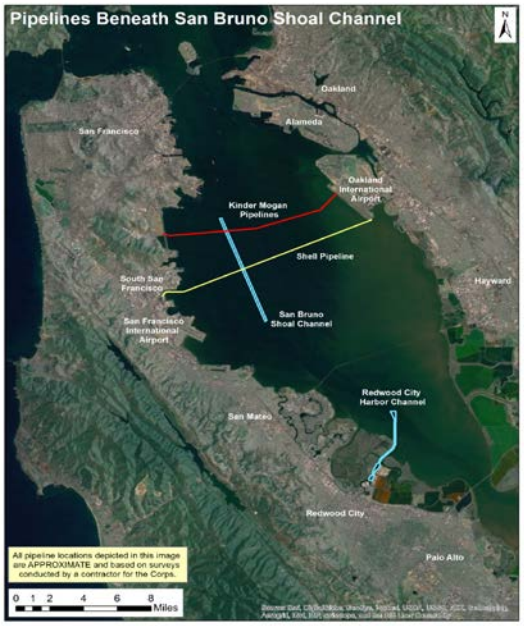
Further guidance is found in Policy Guidance Letter 44, Relocations and Removals at Navigation (Harbor Projects) located in Exhibit C.

Table 1 – Utility Relocations

Approx. Survey Project Stations	Channel	Description	Owner	Depth of Burial	Bottom of Trench Elevation (MLLW) Range
38+00	San Bruno Shoal	10" and 12" Pipelines	Kinder Morgan	2.6' to 6.8'	-35.80 to -39.67
148+70	San Bruno Shoal	Non-Operational 10" Pipeline	Shell	3.7' to 6.2'	-34.11 to -36.63

Figure 3. Location of Jet-fuels pipelines beneath San Bruno Shoal

DRAFT - APRIL 2015 DOC



"ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REPORT THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD'S RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES."

19. Hazardous, Toxic, and Radiological Waste (HTRW)

Recent operations and maintenance (O&M) sediment sampling to -32.5 feet mean lower low water (MLLW) indicates that material in Reach 5B (located at the inner turning basin in the Redwood City Harbor Channel) contains elevated total polychlorinated biphenyls (PCBs) concentrations. The highest concentration of total PCBs found in Reach 5B was 356 micrograms per kilogram or 0.356 parts per million (ppm) in the -32 to -32.5 foot depth range. According to 40 CFR 761, soil containing less than 1 ppm of PCBs is unregulated for disposal under the Federal Toxic Substances Control Act whether it is left on-site or removed from the site. If the material proposed for dredging exhibits PCBs concentrations that are greater than 1 ppm but less than 50 ppm, the material becomes classified as PCB remediation waste and must be disposed of in accordance with 40 CFR 761.61.

The Project Delivery Team (PDT) is current collecting additional sediment chemistry data to characterize the vertical extent of PCBs concentrations in Reach 5B. These test results will inform future planning decisions regarding whether the material is suitable for available

placement sites in and around the San Francisco Bay. If the material does not meet placement site acceptance criteria, the material will have to be disposed of at a landfill regardless of whether the PCBs concentrations are above 1 ppm or below 50 ppm. Test results will be available in July 2015.

20. Attitude of Landowners.
A NEPA scoping meeting was held in December 2014 for the study in order to inform the public about the study scope and gather input on the proposed alternatives.. Comments from the meeting were favorable, constructive and supportive.

Commented [PVZ11]: Why is this the case? If the concentrations are below 1 ppm, can't the materials be sent to SF-DOD? They can be sent to SF-DOD but the new test results that are not completed until July 2015 may contain concentrations above 1 ppm.

Commented [L12]: Concur – the concentrations below 1 ppm can be sent to SFDODS. The tests results must be above 1 ppm and below 50 ppm to reclassify the material as remediation waste. Sentence amended.

DRAFT - April 2015 DQC

SCHEDULE A – ACQUISITION SCHEDULE

REAL ESTATE MILESTONES				
Project Name: South San Francisco Bay Shoreline Study	**USACE Start**	**USACE Finish**	**NFS Start**	**NFS Finish**
Receipt of preliminary drawings from Engineering/PM	April 2015	April2015		
Receipt of final drawings from Engineering/PM	Nov 2016	Dec 2016		
Execution of PPA	August 2016	August 2016		
Formal transmittal of final drawings & instruction to acquire LERRDS ("Take Letter")	Dec 2016	Dec 2016		
Conduct landowner meetings (if applicable, NFS responsibility)			N/A	N/A
Prepare/review mapping & legal descriptions			N/A	N/A
Obtain/review title evidence			N/A	N/A
Obtain/review tract appraisals			N/A	N/A
Conduct negotiations			N/A	N/A
Perform closing			N/A	N/A
Prepare/review condemnations			N/A	N/A
Perform condemnations			N/A	N/A
Obtain Possession			N/A	N/A
Complete/review PL 91-646 benefit assistance			N/A	N/A
Conduct/review facility and utility relocations.			Jan 2017	June 2018
Certify all necessary LERRDS are available for construction			May2017	June 2016
Prepare and submit credit requests (3 months)			June 2016	July 2016
Review/approve or deny credit requests (2 months)	August 2016	December 2016		
Establish value for creditable LERRDS in F&A cost accounting system	December 2016	December 2016		

Commented [L13]: No time frame has been extended to 1.5 years to include negations and coordination required by NFS, State, Corp, Kinder Morgan, and Shell..

DRAFT - April 2015 DQC

*COE – Corps of Engineers
*NFS – Non-Federal Sponsor

EXHIBIT A

PROJECT MAP



EXHIBIT B

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY
Redwood City Harbor Deepening Project GI

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes?
YES
b. Does the sponsor have the power of eminent domain for this project?
YES – Except for lands in the San Bruno Shoals Channel
c. Does the sponsor have "quick-take" authority for this project?
NO
d. Are any of the lands/interests in land required for the project located outside of the sponsor's political boundary?
NO – Except for lands at San Bruno Shoals Channel
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?
NO

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including PL 91-646, as amended?
YES
b. If the answer to II. A. is "yes", has a reasonable plan been developed to provide such training?
No, not yet planned
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project?
YES
d. Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule?
YES
e. Can the sponsor obtain contractor support, if required, in a timely fashion
YES
f. Will the sponsor likely request USACE assistance in acquiring real estate?
Yes, for any pipeline relocation in the San Bruno Shoals Channel –
Policy Guidance 44, Relocations and Removal at Navigation (Harbor) Projects (Exhibit C) protocol must be followed before Federal participation or assistance can occur.

Commented [PVZ14]: Laurie and Bonievee, Do we know this for sure? The NFS will be requesting the Government to assist them in the relocations of the pipelines?

Commented [L15]: Yes the NFS requested assistance from the Corps in the assessment sheet. Don't know if the NFS is familiar with the protocol from PGL 44. PGL 44 has been enclosed as a Exhibit to provide guidance for deep draft utility relocations.

DRAFT - April 2015 DQC

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?
YES
b. Has the sponsor approved the project/real estate schedule/milestones?
PENDING – Project Schedule is still being developed and coordinated with the non federal sponsor.

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects?
YES
b. With regard to this project, the sponsor is anticipated to be: (Capable – Highly Capable – Not capable, etc.)
HIGHLY CAPABLE

V. Coordination:

a. Has this assessment been coordinated with the sponsor?
YES
b. Does the sponsor concur with this assessment?
YES

DRAFT - April 2015 DQC

Prepared by:

_____
BONIEVEE A. DELAPAZ
Real Estate Specialist

Reviewed and Approved by:

_____
STAN WALLIN
Chief, Real Estate Division

EXHIBIT C

CECW-AA 20 Oct 95

MEMORANDUM FOR COMMANDERS, MAJOR SUBORDINATE COMMANDS

SUBJECT: Policy Guidance Letter (PGL) No. 44, Relocations and Removals at Navigation (Harbor) Projects

1. Purpose. This PGL sets forth U.S. Army Corps of Engineers policy regarding the relocation and removal of facilities interfering with Federal navigation improvements. This guidance supersedes previous guidance on this subject. The guidance is applicable to navigation projects for harbors or inland harbors.

2. Background. Under Section 101(a) of the Water Resources Development Act of 1986 (WRDA 86), as amended by the Water Resources Development Act of 1988, the non-Federal sponsor provides the lands, easements, rights-of-way, relocations (other than utility relocations) and dredged material disposal areas necessary for the project. The non-Federal sponsor also is to perform or assure the performance of all relocations of utilities necessary to carry out the project. The law does not define what constitutes a relocation nor delineate who will be responsible to bear the costs of the relocation except that for utility relocations for projects of depth greater than 45 feet, one-half of the costs of relocation shall be borne by the owner of the facility being relocated and one-half by the non-Federal sponsors. Under Section 101(a)(2) of WRDA 86, as amended, the value of lands, easements, rights-of-way, relocations and dredged material disposal areas and the costs of utility relocations borne by the sponsor shall be credited to the additional 10 percent share of general navigation facilities costs.

3. Problem. Private property rights within navigable waters are subject to the common law principle of navigation servitude which is the public's right of free use of all streams and water bodies for navigation despite the private ownership of the bottom or shoreline. Therefore, no further Federal real estate interest is required for navigation projects in navigable waters below the ordinary high water mark. In support of the principle of navigation servitude and in exercise of Congress' power over navigation stemming from the Commerce Clause of the Constitution, Section 10 of the River and Harbor Act of 1899 requires approval from the Corps of Engineers prior to placing obstructions or excavating or disposing of material in navigable waters. Permits under Section 10 do not authorize interference with any existing or proposed Federal project and provide that the permittee pay for any corrective measures to comply with permit conditions. This PGL provides guidance on the interaction of the Federal rights under the navigation servitude and associated Federal permits and the non-Federal sponsor responsibilities under Section 101(a) of WRDA 86, as amended, with regard to relocations and removals of obstructions at Federal navigation projects.

4. Policy.

a. Relocation Definition. The term “relocation” shall mean providing a functionally equivalent facility, regardless of the depth of the navigation project, to the owner of an existing utility, cemetery, highway, railroad (including a bridge thereof), or other public facility (excluding existing bridges over navigable waters of the United States) when such action is authorized in accordance with applicable legal principles of just compensation. A “relocation” is also providing a functionally equivalent facility when such action is specifically provided for, and is identified as a relocation, in the authorizing legislation for a navigation project or any report referenced in the authorizing legislation. Providing a

DRAFT - April 2015 DQC

functionally equivalent facility may take the form of alteration, lowering, raising, or replacement and attendant removal of the affected facility or part thereof.

b. Discussion of Definition

(1) A relocation must occur when a facility or part of a facility must be altered, lowered, raised, or removed to allow for the construction, operation, or maintenance of the general navigation features of a project, including those necessary to enable the removal of borrow material or the proper disposal of dredged or excavated material, and the owner of the facility is entitled to a substitute facility due to just compensation principles. Just compensation principles generally dictate that a substitute facility is the proper measure of just compensation when the facility's owner has a compensable real property interest that must be extinguished in the land on which the facility is located; there is a public necessity for the service provided by the facility; and market value has been too difficult to find, or the application of market value would result in injustice to the owner or public. This definition focuses on the issue of just compensation as between the facility owner and the Federal government and takes into account all rights that the Federal government has within the navigation servitude. Therefore, the owner of a facility within the navigation servitude has no compensable real property interest that must be extinguished with regard to the Federal government for the portion of the structure within the navigation servitude and the owner of the facility within the servitude is not entitled to a substitute facility when compelled to remove the facility because it is an obstruction to the Federal navigation project.

(2) A relocation also must occur when it is specifically authorized as a relocation by Congress. When an authorizing document approved by Congress specifies that the alteration, lowering, raising, or removal and attendant replacement of a facility or portion of a facility constitutes a relocation, it is treated as a relocation even when it does not otherwise meet the definition discussed in paragraph 4.b.(1). The non-Federal sponsor will be required to perform or assure the performance of the relocation and the value of the relocation (or the costs borne by the non-Federal sponsor for any utility relocation) is creditable against the non-Federal sponsor's required additional 10 percent repayment under Section 101(a)(2) of WRDA 86, as amended. This definition of a relocation is included in this PGL to recognize that facility alterations, lowerings, raisings, and removals and attendant replacements have been authorized as relocations even though they do not meet the definition of a relocation discussed in paragraph 4.b.(1). For future navigation project formulation and preparation of feasibility reports, the definitions of relocations, removals and deep draft utility relocations contained in this PGL will be used to categorize and assign costs for actions involving facilities interfering with proposed navigation improvements authorizing legislation for a navigation project or any report referenced in the authorizing legislation. Providing a functionally equivalent facility may take the form of alteration, lowering, raising, or replacement and attendant removal of the affected facility or part thereof.

(3) If removing an obstruction falls within the definition of a relocation presented in 4.b.(1) and 4.b.(2), the non-Federal sponsor will be required to perform or ensure the performance of the relocation. For a relocation other than a utility relocation, the value of the relocation is creditable against the non-Federal sponsor's required additional 10 percent payment under Section 101(a)(2) of WRDA 86, as amended. For a utility relocation, the non-Federal sponsor's actual costs in performing or assuring the performance of the utility relocation are creditable against the non-Federal sponsor's required additional 10 percent repayment under Section 101(a)(2) of WRDA 86, as amended. In

DRAFT - April 2015

practice, under the terms of the project cooperation agreement (PCA), the cost of the relocation will be the basis for computing non-Federal sponsor credit for all relocations.

(4) If removing an obstruction within the navigation servitude does not fit within the definition of a relocation as discussed in paragraph 4.b.(1) and 4.b.(2), it will be treated as a removal necessary for the general navigation features (GNF) of the project, unless it qualifies as a deep draft utility relocation under paragraph 4.c. Removals are discussed in paragraph 4.d.

c. Deep-Draft Utility Relocations.

(1) "Deep draft utility relocations" are handled differently and are only applicable to projects authorized at a depth of greater than 45 feet. A deep draft utility relocation is defined as providing a functionally equivalent facility to the owner of an existing utility serving the general public when such action is not a "relocation" as defined in paragraph 4.a. and is necessary for the construction, operation, or maintenance of the general navigation features of the project, including those necessary to enable the removal of borrow material or the proper disposal of dredged or excavated material. In accordance with Section 101 (a)(4) of WRDA 86, as amended, one-half of the cost of the deep draft utility relocation shall be borne by the utility owner and one-half shall be borne by the non-Federal sponsor. Actual costs of deep draft utility relocations borne by the non-Federal sponsor up to 50 percent of the total cost of the utility relocation will be creditable against the non-Federal sponsor's additional 10 percent share.

(2) The Corps may compel deep draft utility relocations if confronted with reluctant utility owners. However, such involuntary deep draft utility relocations would be for the purpose of facilitating project construction and would not serve to change the statutory requirement for 50/50 cost sharing between the non-Federal sponsor and the utility owner. Therefore, in those cases where the utility owners are compelled to relocate, the non-Federal sponsor is responsible for one-half of the cost of these deep draft utility relocations. Administrative and any legal costs incurred by the Corps to compel deep draft utility relocations would be shared 50/50 between the non-Federal sponsor and the utility owner.

d. Removals.

(1) Where there is an obstruction to a navigation project that is within the navigation servitude, and that obstruction does not fit within the definition of a deep draft utility relocation as presented in paragraph 4.c. or the definition of a relocation in paragraph 4.a., the obstruction will be removed at owner cost to accommodate the navigation project.

(2) Where the non-Federal sponsor has the capability to compel the owner of a facility obstructing a navigation project to remove the facility solely at owner cost, the non-Federal sponsor will be required to exercise this capability. The capability of the non-Federal sponsor to successfully compel the removal of facilities at owner cost will be jointly assessed by the Corps and the non-Federal sponsor. Factors in this assessment will include the legal authorities available to the non-Federal sponsor and their strength, the applicability of the non-Federal sponsor's authorities to the Federal navigation project and the record of success in exercising the non-Federal sponsor's authorities. The non-Federal sponsor may also elect to directly negotiate with the owner of a facility obstructing a navigation project for the removal of the facility in lieu of exercising any non-Federal sponsor or Corps authorities to compel the facility removal at owner cost. However, any payments or reimbursements by the non-Federal sponsor to the facility owner for the removal of the facility would not be creditable against the non-Federal sponsor's required additional 10 percent repayment under Section 101(a) (2) of WRDA 86, as amended.

DRAFT - April 2015 SSC

(3) In the event it is determined that the non-Federal sponsor does not have the capability to compel the owner of a facility obstructing a navigation project to remove the facility at owner cost and the non-Federal sponsor does not elect to directly negotiate with the facility owner for the removal of the facility, if the non-Federal sponsor is not a state, the non-Federal sponsor will request that the state exercise any capability that it has to compel the facility removal at owner costs. If the state does not have the capability to compel removal at owner cost, both the non-Federal sponsor and the state must request, in writing to the District Engineer, that the Corps exercise its rights under the navigation servitude and applicable Corps permit conditions to require the owner to perform the removal of the facility at owner expense. The letter from the state must be signed by the governor or a state official that the governor specifically designates to make the request. Based upon a request from the non-Federal sponsor and the state, the Corps will exercise its rights under the navigation servitude to compel removals at owner cost. If the state has the authority to compel removals at owner cost but declines to exercise its authority or does not have the authority but is not willing to request that the Corps exercise its authority, the Corps will not exercise its rights under the navigation servitude to compel relocations at owner cost. Under these circumstances, the navigation project cannot be implemented or recommended for implementation unless the non-Federal sponsor is willing to directly negotiate with facility owners for facility removal recognizing that any payments or reimbursements by the non-Federal sponsor to the facility owner would not be creditable against the non-Federal sponsor's required additional 10 percent share.

(4) When a facility is removed at owner cost, the facility removal cost and any cost to replace the facility at a new location (for example at a greater depth) will be an owner cost. The administrative and legal cost to the non-Federal sponsor or the Corps of requiring the owner to remove the obstruction will be considered GNF costs and shared accordingly. Corps regulatory program funds will not be used for accomplishing removals or permitting owner replacements of removed facilities. Costs to the owner of a facility for its removal and any owner replacement costs, including any costs voluntarily paid or reimbursed by the non-Federal sponsor, will be accounted for as associated costs of the project and are not shared GNF costs or non-Federal sponsor costs for lands, easements, rights-of- way or relocations. As associated costs, owner removal and replacement costs are economic costs of the project that must be reflected in the calculation of net national economic development benefits. Where necessary, the Corps may also have the option to remove the obstruction itself. The costs to the Corps of removing the obstruction will be considered costs of the general navigation features of the project and shared accordingly. In these cases, the Corps will pursue appropriate remedies for reimbursement to the Corps and the non-Federal sponsor of the costs by the owner of the obstruction.

e. Court Actions. In the event a court determines that the owner of a facility within the navigation servitude is entitled to payment of just compensation as a result of a removal action, that compensation amount will be considered a cost for lands, easements, and rights-of-way, which the non-Federal sponsor will be required to pay in accordance with Section 101(a)(3) of WRDA 86, as amended. If the court also determines the appropriate measure of just compensation is provision of, or payment based on, a substitute facility, this will be considered a relocation, which the non-Federal sponsor will be required to provide in accordance with Section 101(a)(3) of WRDA 86, as amended.

5. Decision Process.

a. Feasibility Phase Survey. During the feasibility phase of the project, the Corps, in cooperation with the non-Federal sponsor, will identify all the facilities obstructing the proposed navigation project and determine, in each case, the ownership interest of the facility owner (for lands located outside the navigation servitude) and the Federal, state or local instrument (permit, easement, etc.), if any, through which the facility owner has use of the land. The survey will also determine, for facilities outside the navigation servitude, the nature of the use of the facility and whether the owner of the facility is entitled to a substitute

DRAFT - April 2015

facility. These surveys would be part of the cost of the feasibility study and would be cost shared on a 50-50 basis with the non-Federal sponsor.

b. Definition of Responsibilities. Based on the results of the information collected in the surveys of the facilities, the navigation feasibility report will clearly define responsibilities and assign costs for altering, lowering, raising, or removing and replacing facilities within the navigation servitude in accordance with the policies presented in this PGL. Responsibilities and costs will be assigned to the non-Federal sponsor or facility owners. A step-by-step decision process for classifying actions as relocations, removals or deep draft utility relocations is enclosed. It is recognized that considerations of costs and schedules may preclude final decisions on compensability and the need to provide substitute facilities during the feasibility study. In these cases the feasibility study will clearly define responsibilities and costs for relocations and removals based on preliminary findings but qualify these findings as subject to modification based on more detailed and complete post authorization studies. The feasibility report will also include a determination of the responsibility to compel removals including the assessment of the capability of the non-Federal sponsor and the state to compel removals at owner cost and, as applicable, the letters from the non-Federal sponsor and the state requesting the Corps to exercise its rights under the navigation servitude to compel removals at owner cost. In accordance with the policies presented in paragraph 4.d., the responsibility to compel relocations at owner cost will be assigned to the non-Federal sponsor, the state, or the Corps.

6. Regulation Modification. This PGL refines significantly the guidance concerning relocations and removals provided in ER 1165-2-131. Regulations will be modified, as required, to incorporate the guidance contained in this policy letter.

FOR THE COMMANDER:

/s/

Encl STANLEY G. GENEGA
Major General, USA
Director of Civil Works

DRAFT - April 2015

Draft Integrated Feasibility Report and Environmental Impact Statement/Environmental Impact Report

Contract No. W912P7-11-D-0004
Task Order No. 0013

Appendix G

Regulatory Setting



Prepared for:
U.S. Army Corps of Engineers, San Francisco District

Prepared by:
HydroPlan LLC, in collaboration with
GAIA
Moffatt and Nichol

July 2015

This page was intentionally left blank.

G. Regulatory Setting Appendix

This appendix provides information describing the Project's regulatory setting. Federal and State laws, regulations, and plans that are general relevant to the Project are summarized in ***Table G-1***. Local plans and policies applicable to the resource areas that were evaluated in detail in Chapter 4 of the integrated report are summarized in ***Tables G-2 through H-12***.

Contents

G.1 Table G-1. Federal (U.S.) and State (CA) Laws, Regulations, and Policies Potentially Applicable to the Project G-2
G.2 Table G-2. Local Plans and Policies Relevant to Air Quality G-19
G.3 Table G-3. Local Plans and Policies Relevant to Biological Resources G-20
G.4 Table G-4. Local Plans and Policies Pertaining to Cultural Resources G-33
G.5 Table G-5. Local Plans and Policies Pertaining to Geology/Soils/Seismicity G-38
G.6 Table G-6. Local Plans and Policies Pertaining to Hazards and Hazardous Material .G-41
G.7 Table G-7. Local Plans and Policies Pertaining to Land Use and Planning G-47
G.8 Table G-8. Local Plans and Policies Pertaining to Noise and Vibration.....G-51
G.9 Table G-9. Local Plans and Policies Pertaining to Recreation G-58
G.10 Table G-10. Local Plans and Policies Pertaining to Socioeconomics G-64
G.11 Table G-11. Local Plans and Policies Pertaining to Utilities/Service Systems G-68
G.12 Table G-12. Local Plans and Policies Pertaining to Water Quality and Hydrology.G-74

G.1 Table G-1. Federal (U.S.) and State (CA) Laws, Regulations, and Policies Potentially Applicable to the Project

Multiple Environmental Issue Areas		
CA	The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6301, 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the Common Law Public Trust. As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the U.S. in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion.	
CA	*McAteer-Petris Act	The McAteer-Petris Act created the San Francisco Bay Conservation and Development Commission (BCDC), which is responsible for the regulation of development for the San Francisco Bay portion of the Coastal Zone. Any filling, dredging or development within BCDC's jurisdiction, which is approximately 100 feet of the Bay, requires a BCDC permit.
CA	San Francisco Bay Plan	The Bay Plan provides BCDC policies on Appearance, Design, and Scenic Views around the Bay. Several of these policies are to ensure and maintain the visual quality around the Bay.
	Air Quality and Greenhouse Gases	
US	Federal Clean Air Act (FCAA) (42 USC 7401 et seq.)	The FCAA requires the U.S. Environmental Protection Agency (USEPA) to identify National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. National standards are established for ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), and lead (Pb). In 2007, the U.S. Supreme Court ruled that carbon dioxide (CO_2) is an air pollutant as defined under the FCAA, and that the USEPA has authority to regulate GHG emissions. Pursuant to the 1990 FCAA Amendments, USEPA classifies air basins (or portions thereof) as in "attainment" or "nonattainment" for each criteria air pollutant, based on whether or not the NAAQS are achieved. The classification is determined by comparing monitoring data with State and Federal standards. • An area is classified as in "attainment" for a pollutant if the pollutant concentration is lower than the standard.An area is classified as in "nonattainment" for a pollutant if the pollutant concentration exceeds the standard. • An area is designated "unclassified" for a pollutant if there are not enough data available for comparisons.
CA	California Clean Air Act of 1988 (CCAA) (Assembly Bill	The CCAA requires all air districts in the State to endeavor to achieve and maintain State ambient air quality standards for O_3, CO, SO_2, NO_2, and PM; attainment plans for areas that did not demonstrate attainment of State standards until after 1997 must specify emission reduction strategies and meet milestones to implement emission controls and achieve more healthful

	[AB] 2595)	air quality. California's ambient air standards are generally stricter than national standards for the same pollutants; the State has also established standards for sulfates, hydrogen sulfide (H_2S), vinyl chloride, and visibility-reducing particles. The 1992 CCAA Amendments divide O_3 nonattainment areas into four categories of pollutant levels (moderate, serious, severe, and extreme) to which progressively more stringent requirements apply.
CA	California Global Warming Solutions Act of 2006 (AB 32)	Under Assembly Bill [AB] 32, CARB is responsible for monitoring and reducing GHG emissions in the State and for establishing a statewide GHG emissions cap for 2020 that is based on 1990 emissions levels. CARB (2009) has adopted the AB 32 Climate Change Scoping Plan (Scoping Plan), which contains the main strategies for California to implement to reduce CO_2 equivalent (CO_2e) emissions by 169 million metric tons (MMT) from the State's projected 2020 emissions level of 596 MMT CO_2e under a business-as-usual scenario. The Scoping Plan breaks down the amount of GHG emissions reductions the CARB recommends for each emissions sector of the State's GHG inventory, but does not directly discuss GHG emissions generated by construction activities.
CA	Senate Bill (SB) 97 and 375	• Pursuant to SB 97, the State Office of Planning and Research prepared and the Natural Resources Agency adopted amendments to the State CEQA Guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions. Effective as of March 2010, the revisions to the CEQA Environmental Checklist Form (Appendix G) and the Energy Conservation Appendix (Appendix F) provide a framework to address global climate change impacts in the CEQA process; State CEQA Guidelines section 15064.4 was also added to provide an approach to assessing impacts from GHGs. • SB 375 (effective January 1, 2009) requires CARB to develop regional reduction targets for GHG emissions, and prompted the creation of regional land use and transportation plans to reduce emissions from passenger vehicle use throughout the State. The targets apply to the regions covered by California's 18 metropolitan planning organizations (MPOs). The 18 MPOs must develop regional land use and transportation plans and demonstrate an ability to attain the proposed reduction targets by 2020 and 2035.
CA	Executive Orders (EOs)	• Under EO S-01-07, which set forth a low carbon fuel standard for California, the carbon intensity of California's transportations fuels is to be reduced by at least 10 percent by 2020. • EO S-3-05 established statewide GHG emission targets of reducing emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80 percent below the 1990 level by 2050.
CA	Other	• Under California's Diesel Fuel Regulations, diesel fuel used in motor vehicles, except harbor craft, has been limited to 500 parts per million (ppm) sulfur since 1993. The sulfur limit was reduced to 15 ppm beginning September 1, 2006, and harbor craft were included starting in 2009. • CARB's Heavy Duty Diesel Truck Idling Rule (Cal. Code Regs., tit. 13, § 2485) prohibits heavy-duty diesel trucks from idling for longer than 5 minutes at a time. Truck idling for longer than 5 minutes while queuing is allowed, however, provided the queue is located beyond 100 feet (30 meters) from

		any homes or schools. • The Statewide Portable Equipment Registration Program (PERP) establishes a uniform program to regulate portable engines/engine-driven equipment units. Once registered in the PERP, engines and equipment units may operate throughout California without the need to obtain individual permits from local air districts.
	Biological Resources	
U.S.	Coastal Zone Management Act (CZMA) of 1972	The Coastal Zone Management Act (CZMA) of 1972, as amended, set forth the federal policy that state coastal management programs should provide for public access to the coasts for recreational purposes. While boating and associated activities, such as marinas, are an important means of public access, they may also pose a threat to the health of aquatic systems if poorly planned or managed. In 1990, Congress passed the Coastal Zone Act Reauthorization Amendments (CZARA) to address nonpoint source pollution problems in coastal waters. Section 6217 of CZARA and Section 319 of the CWA require California and 28 other states to develop coastal nonpoint source pollution control programs, incorporating required management measures to reduce or prevent polluted runoff to coastal waters from specific sources. The California Coastal Commission has jurisdiction for CZMA implementation throughout the state except within the San Francisco Bay-Delta where the San Francisco Bay Conservation and Development Commission (BCDC) has authority for implementation of the CZMA within its jurisdictional area.
U.S.	Endangered Species Act (FESA) (7 USC 136, 16 USC 1531 et seq.)	The FESA, which is administered in California by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), provides protection to species listed as threatened or endangered, or proposed for listing as threatened or endangered. Section 9 prohibits the "take" of any member of a listed species. • Take is defined as "...to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." • Harass is "an intentional or negligent act or omission that creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering." • Harm is defined as "...significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering." When applicants are proposing projects with a Federal nexus that "may affect" a federally listed or proposed species, the Federal agency is required to consult with the USFWS or NMFS, as appropriate, under Section 7, which provides that each Federal agency must ensure that any actions authorized, funded, or carried out by the agency are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of areas determined to be critical habitat.
U. S.	Estuary	The Estuary Protection Act highlights the value of estuaries and the need for

	Protection Act (16 USC 1221–1226)	conservation of their valuable natural resources. It authorizes the Secretary of the Interior, in cooperation with other federal agencies and the states, to study and inventory estuaries of the United States and to determine whether any areas should be acquired by the federal government for future protection. Under this act, the Secretary of the Interior is required to review all project plans and reports for land and water resource development affecting estuaries and make an assessment of likely impacts and related recommendations for conservation, protection, and enhancement of estuaries.
U.S.	Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801 et seq.)	The MSA is the primary law governing marine fisheries management in U.S. Federal waters. The MSA was first enacted in 1976 and amended in 1996. Amendments to the 1996 MSA require the identification of Essential Fish Habitat (EFH) for federally managed species and the implementation of measures to conserve and enhance this habitat. Any project requiring Federal authorization, such as a USACE permit, is required to complete and submit an EFH Assessment with the application and either show that no significant impacts to the essential habitat of managed species are expected or identify mitigations to reduce those impacts. Under the MSA, Congress defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1802(10)). The EFH provisions of the MSA offer resource managers a means to heighten consideration of fish habitat in resource management. Pursuant to section 305(b)(2), Federal agencies shall consult with the NMFS regarding any action they authorize, fund, or undertake that might adversely affect EFH.
U.S.	Marine Mammal Protection Act (MMPA) (16 USC 1361 et seq.)	The MMPA is designed to protect and conserve marine mammals and their habitats. It prohibits takes of all marine mammals in the U.S. (including territorial seas) with few exceptions. The NMFS may issue a take permit under section 104 if the activities are consistent with the purposes of the MMPA and applicable regulations at 50 CFR, Part 216. The NMFS must also find that the manner of taking is "humane" as defined in the MMPA. If lethal taking of a marine mammal is requested, the applicant must demonstrate that using a non-lethal method is not feasible.
U.S.	Migratory Bird Treaty Act (MBTA) (16 USC 703-712)	The MBTA was enacted to ensure the protection of shared migratory bird resources. The MBTA prohibits the take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase, or barter, of any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit. The responsibilities of Federal agencies to protect migratory birds are set forth in EO 13186. The USFWS is the lead agency for migratory birds. The USFWS issues permits for takes of migratory birds for activities such as scientific research, education, and depredation control, but does not issue permits for incidental take of migratory birds.
U.S.	Marine Protection, Research and Sanctuaries Act (MPRSA)	Regulates the transport of dredged material for disposal in ocean waters where it is determined that the disposal will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities.

	Section 103	
U.S.	National Invasive Species Act of 1996	The United States Coast Guard (USCG) established national voluntary ballast water guidelines. The USCG published regulations on June 14, 2004, establishing a national ballast water management program with mandatory requirements for all vessels equipped with ballast water tanks that enter or operate in U.S. waters. The regulations carry mandatory reporting requirements to aid in the USCG's responsibility, under the National Invasive Species Act, to determine patterns of ballast water movement. The regulations also require ships to maintain and implement vessel-specific ballast water management plans.
U.S.	Other	• The Bald and Golden Eagle Protection Act makes it illegal to import, export, take (including molest or disturb), sell, purchase or barter any bald eagle or golden eagle or parts thereof. • Clean Water Act (33 USC 1251 et seq.) (See 3.3.8, Hydrology and Water Quality) • Executive Order 13112 requires Federal agencies to use authorities to prevent introduction of invasive species, respond to and control invasions in a cost-effective and environmentally sound manner, and to provide for restoration of native species and habitat conditions in ecosystems that have been invaded. • Executive Order 13158 requires Federal agencies to (1) identify actions that affect natural or cultural resources that are within a Marine Protected Area (MPA); and (2) in taking such actions, to avoid harm to the natural and cultural resources that are protected by a MPA. • Rivers and Harbors Act (33 USC 401) (See 3.3.8, Hydrology and Water Quality)
CA	California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.)	The CESA provides for the protection of rare, threatened, and endangered plants and animals, as recognized by the California Department of Fish and Wildlife (CDFW), and prohibits the taking of such species without its authorization. Furthermore, the CESA provides protection for those species that are designated as candidates for threatened or endangered listings. Under the CESA, the CDFW has the responsibility for maintaining a list of threatened species and endangered species (Fish & G. Code, § 2070). The CDFW also maintains a list of candidate species, which are species that the CDFW has formally noticed as under review for addition to the threatened or endangered species lists. The CDFW also maintains lists of Species of Special Concern that serve as watch lists. Pursuant to the requirements of the CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any State-listed endangered or threatened species may be present in the project site and determine whether the proposed project will have a potentially significant impact on such species. In addition, the CDFW encourages informal consultation on any proposed project that may affect a candidate species. The CESA also requires a permit to take a State-listed species through incidental or otherwise lawful activities (§ 2081, subd. (b)).
CA	California Marine Life Protection Act	Passed by the State Legislature in 1999, the MLPA required the CDFW to redesign its system of MPAs to increase its coherence and effectiveness at protecting the state's marine life, habitats, and ecosystems. For the purposes

	(MLPA) (Fish & G. Code, §§ 2850–2863)	of MPA planning, a public-private partnership commonly referred to as the MLPA Initiative was established, and the State was split into five distinct regions (four coastal and the San Francisco Bay) each of which had its own MPA planning process. All four coastal regions have completed these individual planning processes. As a result the coastal portion of California's MPA network is now in effect statewide. Options for a planning process in the San Francisco Bay have been developed for consideration at a future date.
CA	Other relevant California Fish and Game Code sections	• The California Native Plant Protection Act (Fish & G. Code, § 1900 et seq.) is intended to preserve, protect, and enhance endangered or rare native plants in California. This Act includes provisions that prohibit the taking of listed rare or endangered plants from the wild and a salvage requirement for landowners. The Act directs the CDFW to establish criteria for determining what native plants are rare or endangered. Under section 1901, a species is endangered when its prospects for survival and reproduction are in immediate jeopardy from one or more causes. A species is rare when, although not threatened with immediate extinction, it is in such small numbers throughout its range that it may become endangered. • The California Species Preservation Act (Fish & G. Code §§ 900-903) provides for the protection and enhancement of the amphibians, birds, fish, mammals, and reptiles of California. • Fish and Game Code sections 3503 & 3503.5 prohibit the taking and possession of native birds' nests and eggs from all forms of needless take. These regulations also provide that it is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nests or eggs of any such bird except as otherwise provided by this Code or any regulation adopted pursuant thereto. • Fish and Game Code sections 3511 (birds), 4700 (mammals), 5050 (reptiles and amphibians), & 5515 (fish) designate certain species as "fully protected." Fully protected species, or parts thereof, may not be taken or possessed at any time without permission by the CDFW. • Fish and Game Code section 3513 does not include statutory or regulatory mechanism for obtaining an incidental take permit for the loss of non-game, migratory birds.
CA	California Native Plant Protection Act (Fish & G. Code, § 1900 et seq.)	This Act is intended to preserve, protect, and enhance endangered or rare native plants in California. This Act includes provisions that prohibit the taking of listed rare or endangered plants from the wild and a salvage requirement for landowners. The Act directs the CDFW to establish criteria for determining what native plants are rare or endangered. Under section 1901, a species is endangered when its prospects for survival and reproduction are in immediate jeopardy from one or more causes. A species is rare when, although not threatened with immediate extinction, it is in such small numbers throughout its range that it may become endangered.
	Cultural Resources	
U.S.	National Historic	

	Preservation Act (NHPA) (16 US*C* 470 et seq.)	The 1966 National Historic Preservation Act (NHPA) set forth national policy for recognizing and protecting historic properties. It established the National Register of Historic Places, State Historic Preservation Officers and programs, and the Advisory Council on Historic Preservation (ACHP). Under Section 106 of the Act, federal agencies are required to take into account the effects of their undertakings on historic properties and provide the ACHP an opportunity to comment on those undertakings. Historic properties are defined in federal law as those properties that are listed in, or meet the criteria for listing in, the National Register of Historic Places. Federal agencies are required to "take into account" the effects of their actions and undertakings on "historic properties." A historic property is the federal term that describes historical and cultural resources, including prehistoric or historic archaeological sites, historical shipwrecks, and other artifacts.
U.S.	Other	• Executive Order 13158 requires Federal agencies to (1) identify actions that affect natural or cultural resources that are within a MPA; and (2) in taking such actions, to avoid harm to the natural and cultural resources that are protected by a MPA.
U.S.	Abandoned Shipwreck Act	The Abandoned Shipwreck Act of 1987 (43 USC 2101–2106) protects shipwrecks found in state waters. The NPS has issued guidelines that are intended to: maximize the enhancement of cultural resources; foster a partnership among sport divers, fishermen, archeologists, sailors, and other interests to manage shipwreck resources of the states and the U.S.; facilitate access and utilization by recreational interests; and recognize the interests of individuals and groups engaged in shipwreck discovery and salvage. Specific provisions of the Act's guidelines include procedures for locating and identifying shipwrecks, methods for determining which shipwrecks are historic, and preservation and long-term management of historic shipwrecks.
U.S.	Sunken Military Craft Act	The Sunken Military Craft Act (SMCA) was enacted on October 28, 2004. As stated on the U.S. Navy's official website "Naval History and Heritage Command": Its primary purpose is to preserve and protect from unauthorized disturbance all sunken military craft that are owned by the United States government as well as foreign sunken military craft that lie within U.S. waters. Pursuant to the SMCA, the Navy's sunken military craft remain property of the U.S. regardless of their location or the passage of time and may not be disturbed without permission from the U.S. Navy.
CA	California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.)	As the CEQA lead agency, the CSLC is responsible for complying with all provisions of the CEQA and State CEQA Guidelines that relate to "historical resources." A historical resource includes: (1) a resource listed in, or eligible for listing in, the California Register of Historic Resources (CRHR); (2) a resource included in a local register of historical or identified as significant in an historical resource surveys; and (3) any resource that a lead agency determines to be historically significant for the purposes of CEQA, when supported by substantial evidence in light of the whole record. The CRHR was

		created to identify resources deemed worthy of preservation on a State level and was modeled closely after the National Register. The criteria, which are nearly identical to those of the National Register but focus on resources of statewide significance (see State CEQA Guidelines § 15064.5, subd. (a)(3)), are defined as any resource that meets any of the following criteria: (1) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage; (2) Is associated with lives of persons important in our past; (3) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or (4) Has yielded, or may be likely to yield, information important in prehistory or history. Properties listed, or formally designated as eligible for listing, on the National Register are automatically listed on the CRHR, as are certain State Landmarks and Points of Interest. A lead agency is not precluded from determining that the resource may be an historical resource as defined in Public Resources Code sections 5020.1, subdivision (j), or 5024.1 (State CEQA Guidelines § 15064.5, subd. (a)(4)).
CA	Public Resources Code § 5097.9	Section 5097.9 of the California Public Resources Code states that "No public agency, and no private party using or occupying public property, or operating on public property, under a public license, permit, grant, lease, or contract made on or after July 1, 1977, shall in any manner whatsoever interfere with the free expression or exercise of Native American religion as provided in the United States Constitution and the California Constitution; nor shall any such agency or party cause severe or irreparable damage to any Native American sanctified cemetery, place of worship, religious or ceremonial site, or sacred shrine located on public property, except on a clear and convincing showing that the public interest and necessity so require."
CA	Health and Safety Code § 7050.5	Section 7050.5 of the California Health and Safety Code states that it is a misdemeanor to knowingly disturb a human grave. In the event that human graves are encountered, work should halt in the vicinity and the County Coroner should be notified immediately. At the same time, an archaeologist should be contacted to evaluate the situation. If human remains are of Native American origin, the Coroner must notify the NAHC within 24 hours of this identification. According to Section 15064.5 of the CEQA Guidelines, all human remains are a significant resource. Section 15064.5 of the CEQA Guidelines also assigns special importance to human remains and specifies procedures to be used when Native American remains are discovered. These procedures are spelled out under Public Resources Code Section 5097.

	Geology, Soils, and Seismicity	
U.S.	None applicable.	
CA	Alquist-Priolo Earth-quake Fault Zoning Act (Pub. Resources Code, §§ 2621-2630)	This Act requires that "sufficiently active" and "well-defined" earthquake fault zones be delineated by the State Geologist and prohibits locating structures for human occupancy across the trace of an active fault.
CA	California Building Code (CBC) (Cal. Code Regs., tit. 23)	The CBC contains requirements related to excavation, grading, and construction of pipelines alongside existing structures. A grading permit is required if more than 50 cubic yards of soil are moved. Sections 3301.2 and 3301.3 contain provisions requiring protection of the adjacent property during excavations and require a 10-day written notice and access agreements with the adjacent property owners.
	Hazards/Hazardous, Toxic, and Radioactive Waste	
U.S.	Clean Water Act (CWA) (33 USC 1251 et seq.)	The CWA is comprehensive legislation (it generally includes reference to the Federal Water Pollution Control Act of 1972, its supplementation by the CWA of 1977, and amendments in 1981, 1987, and 1993) that seeks to protect the nation's water from pollution by setting water quality standards for surface water and by limiting the discharge of effluents into waters of the U.S. *(see below and in Section 3.8, Hydrology and Water Resources).*
U.S.	California Toxics Rule (40 CFR 131)	In 2000, the USEPA promulgated numeric water quality criteria for priority toxic pollutants and other water quality standards provisions to be applied to waters in the State of California. USEPA promulgated this rule based on the Administrator's determination that the numeric criteria are necessary in the State of California to protect human health and the environment. (Under CWA section 303(c)(2)(B), the USEPA requires states to adopt numeric water quality criteria for priority toxic pollutants for which the USEPA has issued criteria guidance, and the presence or discharge of which could reasonably be expected to interfere with maintaining designated uses.) These Federal criteria are legally applicable in California for inland surface waters, enclosed bays, and estuaries.
U.S.	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC 9605	CERCLA, commonly known as Superfund, created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. The Act establishes prohibitions and requirements concerning closed and abandoned hazardous waste sites; provides for liability of persons responsible for releases of hazardous waste at these sites; and establishes a trust fund to provide for cleanup when no responsible party could be identified. CERCLA was amended by the Superfund Amendments and Reauthorization Act of 1986.
U.S.	Hazardous Materials	The HMTA delegates authority to the United States Department of Transportation (DOT) to develop and implement regulations pertaining to the

	Transportation Act (HMTA) (49 USC 5901)	transport of hazardous materials and hazardous wastes by all modes of transportation. Additionally, the USEPA's Hazardous Waste Manifest System is a set of forms, reports, and procedures for tracking hazardous waste from a generator's site to the disposal site. Applicable Federal regulations are contained primarily in CFR Titles 40 and 49.
U.S.	National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300)	Authorized under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. 99 through 499; and by CWA section 311(d), as amended by the Oil Pollution Act of 1990 (OPA), Pub. L. 101 through 380. The NCP outlines requirements for responding to both oil spills and releases of hazardous substances. It specifies compliance, but does not require the preparation of a written plan. It also provides a comprehensive system for reporting, spill containment, and cleanup. The United States Coast Guard (USCG) and USEPA co-chair the National Response Team. In accordance with 40 CFR 300.175, the USCG has responsibility for oversight of regional response for oil spills in "coastal zones," as described in 40 CFR 300.120.
U.S.	Occupational Safety and Health Act (OSHA) 1970	The Federal OSHA sets standards for safe workplaces and work practices, including the reporting of accidents and occupational injuries (29 CFR). The main goal is to ensure that employers provide employees with an environment free from recognized hazards, such as exposure to toxic chemicals, excessive noise levels, mechanical dangers, heat or cold stress, or unsanitary conditions.
U.S.	Oil Pollution Act (OPA) (33 USC 2712)	The OPA requires owners and operators of facilities that could cause substantial harm to the environment to prepare and submit plans for responding to worst-case discharges of oil and hazardous substances. The passage of the OPA motivated California to pass a more stringent spill response and recovery regulation and the creation of the Office of Spill Prevention and Response (OSPR) to review and regulate oil spill plans and contracts.
U.S.	Resource Conservation and Recovery Act (RCRA) (42 USC 6901 et seq.)	The RCRA authorizes the USEPA to control hazardous waste from "cradle-to-grave," which encompasses its generation, transportation, treatment, storage, and disposal. RCRA's Federal Hazardous and Solid Waste Amendments from 1984 include waste minimization and phasing out land disposal of hazardous waste as well as corrective action for releases. The Department of Toxic Substances Control (DTSC) is the lead State agency for corrective action associated with RCRA facility investigations and remediation.
U.S.	Superfund Amendments and Reauthorization Act (SARA) 1986	SARA, also known as the Community Right-to-Know Act of 1986, imposes requirements to ensure that hazardous materials are properly handled, used, stored, and disposed of and to prevent or mitigate injury to human health or the environment in the event that such materials are accidentally released.
U.S.	Toxic Substance Control Act 1976 (TSCA)	TSCA 15 U.S.C. §2601 et seq addresses the production, importation, use, and disposal of specific chemicals including polychlorinated biphenyls (PCBs), asbestos, radon and lead-based paint. The Act provides EPA with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. TSCA specifically regulates

		PCBs and authorizes the EPA to regulate disposal of PCBs.
U.S.	Other	• Rivers and Harbors Act (33 USC 401) (See 3.3.8, Hydrology and Water Quality) • The Act to Prevent Pollution from Ships (1980) requires ships in U.S. waters, and U.S. ships wherever located, to comply with International Convention for the Prevention of Pollution from Ships (MARPOL). • Convention on the International Regulations for Preventing Collisions at Sea (COLREGS). These regulations establish "rules of the road" such as rights-of-way, safe speed, actions to avoid collision, and procedures to observe in narrow channels and restricted visibility. • Inspection and Regulation of Vessels (46 USC Subtitle II Part B). Federal regulations for marine vessel shipping are codified in 46 CFR parts 1 through 599 and are implemented by the USCG, Maritime Administration, and Federal Maritime Commission. These regulations provide that all vessels operating offshore, including those under foreign registration, are subject to requirements applicable to vessel construction, condition, and operation. All vessels (including motorboats) operating in commercial service (e.g., passengers for hire, transport of cargoes, hazardous materials, and bulk solids) on specified routes (inland, near coastal, and oceans) are subject to requirements applicable to vessel construction, condition, and operation. These regulations also allow for inspections to verify that vessels comply with applicable international conventions and U.S. laws and regulations. • Navigation and Navigable Waters regulations (33 CFR) include requirements pertaining to prevention and control of releases of materials (including oil spills) from vessels, traffic control, and restricted areas, and general ports and waterways safety.
CA	Hazardous Waste Control Act (HWCA) (Cal. Code Regs., tit. 26	The HWCA is the California equivalent of the Federal RCRA of 1976. This Act, which is more stringent than RCRA, establishes requirements for the proper management of hazardous substances and wastes with regard to criteria for (1) identification and classification of hazardous wastes; (2) generation and transportation of hazardous wastes; (3) design and permitting of facilities that recycle, treat, store, and dispose of hazardous wastes; (4) treatment standards; (5) operation of facilities; (6) staff training; (7) closure of facilities; and (8) liability requirements. In California, the DTSC regulates the generation, transportation, treatment, storage, and disposal of hazardous waste.
CA	Lempert-Keene-Seastrand Oil Spill Prevention and Response Act (Gov. Code § 8574.1 et seq.; Pub. Resources Code § 8750	This Act and its implementing regulations seek to protect State waters from oil pollution and to plan for the effective and immediate response, removal, abatement, and cleanup in the event of an oil spill. The Act requires vessel and marine facilities to have marine oil spill contingency plans and to demonstrate financial responsibility, and requires immediate cleanup of spills, following the approved contingency plans, and fully mitigating impacts on wildlife. The Act assigns primary authority to the OSPR division within the CDFW to direct prevention, removal, abatement, response, containment, and cleanup efforts with regard to all aspects of any oil spill in the marine waters of the State. The CSLC assists OSPR with spill investigations and response. The Act also specifies that BCDC must carry out certain responsibilities critical to the achievement of

	et seq.)	the goals of the state oil spill act. During a spill event, BCDC assists the response by monitoring activities and providing technical expertise.
CA	Other	The California Clean Coast Act (SB 771) establishes limitations for shipboard incinerators, and the discharge of hazardous material—including oily bilgewater, graywater, and sewage—into State waters or a marine sanctuary. It also provides direction for submitting information on visiting vessels to the CSLC and reporting of discharges to the State water quality agencies. The California Harbors and Navigation Code specifies a State policy to "promote safety for persons and property in and connected with the use and equipment of vessels," and includes laws concerning marine navigation that are implemented by local city and county governments. This Code also regulates discharges from vessels within territorial waters of the State of California to prevent adverse impacts on the marine environment. This Code regulates oil discharges and imposes civil penalties and liability for cleanup costs when oil is intentionally or negligently discharged to the State waters. California Seismic Hazards Mapping Act (Pub. Resources Code, § 2690) and Seismic Hazards Mapping Regulations (Cal. Code Regs., tit. 14, Div. 2, Ch. 8, Art. 10) *(See 3.3.6, Geology and Soils)* Porter-Cologne Water Quality Control Act (Cal. Water Code, § 13000 et seq.) *(See 3.3.8, Hydrology and Water Quality)*
	Land Use and Planning	
CA	San Francisco Bay Plan	BCDC has jurisdiction over the open water, marshes, and mudflats of the greater San Francisco Bay; the first 100 feet from the shoreline; the portion of the Suisun Marsh below the ten foot contour line; portions of most creeks, rivers, slough, and other tributaries that flow into the San Francisco Bay; and salt ponds, duck hunting preserves, game refuges, and other managed wetlands that have been diked off from San Francisco Bay. Permits from BCDC are required for most projects proposed along the shoreline, particularly if they include the following: • Placing solid material, building or repairing docks or pile-supported or cantilevered structures, disposing of material, or mooring a vessel for a long period in San Francisco Bay or in certain tributaries that flow into the Bay; • Dredging or extracting material from the Bay bottom; • Substantially changing the use of any structure or area; • Constructing, remodeling, or repairing a structure; or Subdividing property or grading land.
	Noise and Vibration	
U.S.	Noise Control Act (42 USC 4910)	Required the USEPA to establish noise emission criteria, as well as noise testing methods (40 CFR Chapter 1, Subpart Q). These criteria generally apply to interstate rail carriers and to some types of construction and transportation equipment. The USEPA published a guideline (USEPA 1974) containing recommendations for acceptable noise level limits affecting residential land use of 55 dBA L_{dn} for outdoors and 45 dBA L_{dn} for indoors.
U.S.	Department of Housing	Sets forth the following exterior noise standards for new home construction (for interior noise levels, a goal of 45 dBA is set forth and attenuation

	and Urban Development Environmental Standards (24 CFR Part 51)	requirements are geared to achieve that goal): 65 L_{dn} or less – Acceptable 65 L_{dn} and < 75 L_{dn} – Normally unacceptable, appropriate sound attenuation measures must be provided > 75 L_{dn} – Unacceptable
U.S.	NTIS 550\9-74-004, 1974 ("Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety").	In response to a Federal mandate, the USEPA provided guidance in this document, commonly referenced as the, "Levels Document," that establishes an L_{dn} of 55 dBA as the requisite level, with an adequate margin of safety, for areas of outdoor uses including residences and recreation areas. The USEPA recommendations contain a factor of safety and do not consider technical or economic feasibility (i.e., the document identifies safe levels of environmental noise exposure without consideration for achieving these levels or other potentially relevant considerations), and therefore should not be construed as standards or regulations.
	Recreation	
U.S.	Administration Act and Refuge Recreation Act 1962	The Recreation Act of 1962 (16 USC 460k–460k-4) governs the administration and public use of the National Wildlife Refuge System (NWRS).
U.S.	NWRS Improvement Act 1997 (PL 105-57)	The Improvement Act established six wildlife-dependent recreational uses, when compatible, as the priority general public uses of the NWRS. These uses sometimes referred to as the "Big Six" or "Priority Uses" are: hunting, fishing, wildlife observation, photography, environmental education, and interpretation.
CA	California Code of Regulations	Under **Title 14, Natural Resources**, Division 1. Chapter 11. Ecological Reserves, public entry and use of ecological reserves shall be compatible with the primary purposes of such reserves, and subject to the general rules and regulations, except as otherwise provided for in the special area regulations. The CDFG is governed by Areas and Special Regulations for Use (45) ELER, Alameda County at the ELER.
CA	Suisun Marsh Protection Act	In 1974, the California Legislature passed the Suisun Marsh Protection Act, designed to preserve Suisun Marsh from residential, commercial, and industrial development. The act directs BCDC and DFG to prepare a protection plan for Suisun Marsh "to preserve the integrity and assure continued wildlife use" of the marsh. The objectives of the protection plan are to preserve and enhance the quality and diversity of the Suisun Marsh's aquatic and wildlife habitats and to ensure retention of upland areas adjacent to the marsh in uses compatible with its protection.
	Socioeconomics, Population, and Housing	
U.S.	Executive Order (EO)	Executive Order (EO) 12898 requires all federal agencies to seek to achieve environmental justice by "…identifying and addressing, as appropriate,

	12898	disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations." The socioeconomic data presented in this section will be used to assess environmental justice (EJ) impacts, where applicable (see Chapter 5). The EJ implications of local economic effects are discussed in this section. The EJ discussion in Chapter 4, Socioeconomics, addresses whether certain environmental effects are resulting in disproportionately high and adverse effects on minority and low-income populations.
CA		There are no specific requirements for the analysis of socioeconomic and environmental justice issues under state law. CEQA Guidelines Section 15131(a) through (c) provides guidance on the discussion of economic and social effects in an EIR. Specifically, such effects may be included in an EIR but "shall not be treated as significant effects on the environment." However, economic and social effects may be used to determine the significance of physical changes caused by a project, but these changes "need not be analyzed in any detail greater than necessary to trace the chain of cause and effect." CEQA Guidelines provide for the consideration of economic, social, and particularly housing factors together with technological and environmental factors to determine whether changes in a project are feasible to reduce or avoid the significant effects on the environment identified in the EIR.
	Transportation, Navigation, and Traffic	
U.S.	Ports and Waterways Safety Act	This Act provides the authority for the USCG's program to increase vessel safety and protect the marine environment in ports, harbors, waterfront areas, and navigable waters, including by authorizing the Vessel Traffic Service, controlling vessel movement, and establishing requirements for vessel operation.
CA	California Vehicle Code	Chapter 2, Article 3 of the Vehicle Code defines the powers and duties of the California Highway Patrol, which has enforcement responsibilities for the vehicle operation and highway use in the State.
CA	California Harbors and Navigation Code	Authorizes the California Department of Boating and Waterways (Cal Boating) to establish and enforce recreational boating operation and equipment regulations in conformity with federal navigation rules promulgated by the Coast Guard. Most rules address boating practices, equipment requirements and liability issues. Amended under the Federal Boating Act of 1958. Section 656 requires a boater involved in an accident to file a written report with Cal Boating when a) a person dies, disappears, or is injured requiring medical attention beyond first aid; or b) damage to a vessel or other property exceeds $500, or there is complete loss of a vessel. This code also gives local governments the authority to regulate recreational boating in waters within their jurisdiction through time-of-day restrictions, speed zones, special-use areas and sanitation and pollution controls.
	Utilities and Service Systems	

U.S.	The Pipeline and Hazardous Materials Safety Administration 49 USC §60101 et seq.	The Pipeline and Hazaardous Materials Safety Administration (PHMSA) develops and enforces regulations for the safe, reliable and environmentally sound operation of the nations' pipeline transportation system. In PHMSA, the Office of Pipeline Safety which ensures safety in the design, construction, operation and maintenance, and spill response planning of America's oil, natural gas and hazardous liquid transportation per the duties regarding pipeline safety set forth in 49 USC Section 60101 et seq. and 49 CFR Section 190.1. The regulations apply to the owners and operators of the facilities and cover the design, installation, inspection, emergency plans and procedures, testing, construction, extension, operation, replacement, and maintenance of pipeline facilities transporting oil, gas, and hazardous liquid. The regulations require operators of gas pipelines to participate in a public safety program, such as a one-call system that would notify the operator of any proposed demolition, excavation, tunneling, or construction that would take place near or affect the facility.
CA	Office of the State Fire Marshal	The Office of the State Fire Marshal, Pipeline Safety Division, regulates the safety of approximately 5,500 miles (8,851 kilometers) of intrastate hazardous liquid (e.g., oil, gas) transportation pipelines and acts as an agent of the Federal Office of Pipeline Safety concerning the inspection of more than 2,000 miles (3,219 kilometers) of interstate pipelines. Pipeline safety staff inspects, tests, and investigates to ensure compliance with all federal and state pipeline safety laws and regulations. All spills, ruptures, fires, or similar incidents are responded to immediately; all such accidents are investigated for cause.
CA	Other	The California Public Utilities Commission, General Order 95, includes rules governing line clearance for overhead electrical transmission lines. The code states the following: *Rule 11.* Water areas not suitable for sailboating must have a line clearance of at least 25 feet (8 meters) above high water. (Rule 11 can be applied to areas where sailboating is prohibited and where other boating activities are allowed). *Rule 12.* Water areas suitable for sailboating, with a surface area over 2,000 acres, must have a line clearance of at least 47 feet (14 meters) above high water.
Water Quality and Hydrology		

U.S.	Clean Water Act (CWA) (33 USC 1251 et seq.)	The CWA is a comprehensive piece of legislation that generally includes reference to the Federal Water Pollution Control Act of 1972, and its substantial supplementation by the CWA of 1977. Both Acts were subsequently amended in 1981, 1987, and 1993. Overall, the CWA seeks to protect the nation's water from pollution by setting water quality standards for surface water and by limiting the discharge of effluents into waters of the U.S. These water quality standards are promulgated by the USEPA and enforced in California by the State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCBs). CWA sections include: • State Water Quality Certification. Section 401 (33 USC 1341) requires certification from the State or interstate water control agencies that a proposed water resources project is in compliance with established effluent limitations and water quality standards. U. S. Army Corps of Engineers (USACE) projects, as well as applicants for Federal permits or licenses are required to obtain this certification. • National Pollution Discharge Elimination System (NPDES). Section 402 (33 USC 1342) establishes conditions and permitting for discharges of pollutants under the NPDES. • Ocean Discharges. Section 403 (33 USC 1343) addresses criteria and permits for discharges into the territorial seas, the contiguous zone, and the oceans. • Permits for Dredged or Fill Material. Section 404 (33 USC 1344) authorizes a separate permit program for disposal of dredged or fill material in U.S. waters.
U.S.	Oil Pollution Act (OPA) (33 USC 2712)	The OPA requires owners and operators of facilities that could cause substantial harm to the environment to prepare and submit plans for responding to worst-case discharges of oil and hazardous substances. The passage of the OPA motivated California to pass a more stringent spill response and recovery regulation and the creation of the Office of Spill Prevention and Response (OSPR) to review and regulate oil spill plans and contracts.
U.S.	Rivers and Harbors Act (33 USC 401)	This Act governs specified activities in "navigable waters" (waters subject to the ebb and flow of the tide or that are presently used, have been used in the past, or may be susceptible for use to transport interstate or foreign commerce). Specifically, it limits the construction of structures and the discharge of fill into navigable waters of the U.S. Under section 10 of the Rivers and Harbors Act, the building of any wharf, pier, jetty, or other structure is prohibited without Congressional approval, and excavation or fill within navigable waters requires approval from the USACE.
CA	Porter-Cologne Water Quality Control Act (Cal. Water Code § 13000 et seq.)	Porter-Cologne is the principal law governing water quality in California. The Act established the SWRCB and nine RWQCBs, which have primary responsibility for protecting State water quality and the beneficial uses of State waters. Porter-Cologne also implements many provisions of the Federal CWA, such as the National Pollutant Discharge Elimination System (NPDES) permitting program. Pursuant to the CWA § 401, applicants for a Federal license or permit for activities that may result in any discharge to waters of the

	(Porter-Cologne)	U. S. must seek a Water Quality Certification (Certification) from the State in which the discharge originates. Such Certification is based on a finding that the discharge will meet water quality standards and other appropriate requirements of State law. In California, RWQCBs issue or deny certification for discharges within their jurisdiction. The SWRCB has this responsibility where projects or activities affect waters in more than one RWQCB's jurisdiction. If the SWRCB or a RWQCB imposes a condition on its Certification, those conditions must be included in the Federal permit or license. Statewide Water Quality Control Plans include: individual RWQCB Basin Plans; the California Ocean Plan; the San Francisco Bay/Sacramento-San Joaquin Delta Estuary Water Quality Control Plan (Bay-Delta Plan); the Water Quality Control Plan for Enclosed Bays and Estuaries of California; and the Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (Thermal Plan). These Plans contain enforceable standards for the various waters they address. For example: • Basin Plan. Porter-Cologne (§ 13240) requires each RWQCB to formulate and adopt a Basin Plan for all areas within the Region. Each RWQCB must establish water quality objectives to ensure the reasonable protection of beneficial uses and a program of implementation for achieving water quality objectives within the basin plans. 40 CFR 131 requires each State to adopt water quality standards by designating water uses to be protected and adopting water quality criteria that protect the designated uses. In California, the beneficial uses and water quality objectives are the State's water quality standards. • The California Ocean Plan establishes water quality objectives for California's ocean waters and provides the basis for regulation of wastes discharged into the State's ocean and coastal waters. It incorporates the State water quality standards that apply to all NPDES permits for discharges to ocean waters.
CA	San Francisco Bay Plan	Pursuant to the Bay Plan, BCDC responsibilities include the following: Regulation of all filling and dredging in the Bay: • Administration of the Federal Coastal Zone Management Act within the Bay segment of the California coastal zone; • Regulation of new development within the first 100 feet inland from the Bay to ensure public access to the Bay is provided; • Pursuit of an active planning program to implement studies of Bay issues so that BCDC plans and policies are based on the best available current information; • Participation in the region-wide State and Federal program to establish a Long Term Management Strategy for dredging and dredged material disposal to be conducted in an environmentally sound and economically prudent way.

G.2 Table **G-2. Local Plans and Policies Relevant to Air Quality**

Regional and Local Jurisdictions	Key Provisions
San Francisco Bay Area	The Bay Area Air Quality Management District (BAAQMD) takes on the responsibility of improving air quality standards by, among other things, assisting lead agencies in air quality analysis through review and comments on air quality impacts of a proposed project or plan. As part of the basis of their review, the BAAQMD has established emissions significance thresholds with which to compare expected project-related emissions as well as projected future emissions. These thresholds are described in the following section.

G.3 **Table G-3. Local Plans and Policies Relevant to Biological Resources**

Regional and Local Jurisdictions	Key Provisions
Alameda County (Eden Landing)	Alameda County defines sensitive habitat areas as the following in the General Plan: All areas supporting native vegetation or providing suitable habitat for special-status species are considered sensitive habitat areas, including oak riparian woodland and naturalized native trees that provide potential nesting habitat for bird species. Sensitive habitat areas also include creeks and wetlands with the potential to be considered jurisdictional by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act or by the California Department of Wildlife habitat exists in small pockets woven throughout residential neighborhoods, primarily along creeks. Fish and Game under California Fish and Game Code Sections 1600-1607. Alameda County ash the following Vegetative and Wildlife Resource goals: l Protect and enhance wildlife habitats and natural vegetation areas in Alameda County.
San Mateo County (RWC, SBS)	The Environmental Services Agency of the Planning and Building Division of San Mateo County present the following policies in their 1986, General Plan: VEGETATIVE, WATER, FISH AND WILDLIFE RESOURCES POLICIES. GOALS AND OBJECTIVES 1.1 Conserve, Enhance, Protect, Maintain and Manage Vegetative, Water, Fish and Wildlife Resources: Promote the conservation, enhancement, protection, maintenance and managed use of the County's Vegetative, Water, Fish and Wildlife Resources. 1.2 Protect Sensitive Habitats: Protect sensitive habitats from reduction in size or degradation of the conditions necessary for their maintenance. 1.3 Protection and Productive Use of Economically Valuable Vegetative, Water, Fish and Wildlife Resources: Protect the availability and encourage the productive use of the County's economically valuable vegetative, water, fish and wildlife resources in a manner which minimizes adverse environmental impacts. GENERAL POLICIES 1.21 Importance of Sensitive Habitats: Consider areas designated as sensitive habitats as a priority resource requiring protection. 1.22 Importance of Economically Valuable Vegetative, Water, Fish and Wildlife Resources: Consider Vegetative, Water, Fish and Wildlife Resources, which are economically valuable as a priority resource to be enhanced, utilized, managed and maintained for the needs of present and future generations.

	1.29 Establish Buffer Zones a. Establish necessary buffer zones adjacent to sensitive habitats, which include areas that directly affect the natural conditions in the habitats and areas expected to experience changing vulnerabilities due to impacts of climate change. b. As part of Countywide efforts to foster resilience and adapt to impacts of climate changes, establish wildlife corridors in appropriate locations to maintain a functional network of connected wildlands, to support native biodiversity, and to encourage movement of wildlife species. PRODUCTIVE USES 1.34 Regulate Productive Uses of Vegetative, Water, Fish and Wildlife Resources: Regulate resource productive uses which are subject to local control in order to prevent and if infeasible mitigate to the extent possible significant adverse impacts on vegetative, water, fish and wildlife resources and to maintain and enhance the (1) productivity of forests and other vegetative resources; (2) productive capacity and quality of groundwater basins and recharge areas, streams, reservoirs, and other water bodies; (3) productivity of fisheries and other fish and wildlife resources; and (4) the recreational value and aesthetic value of these areas. 1.35 Protect Productive Uses of Vegetative, Water, Fish and Wildlife Resources: Regulate development in order to protect and promote the managed use of vegetative, water, fish and wildlife resources. 1.37 Protect the Productive Use of Water Resources: Ensure that land uses and development on or near water resources will not impair the quality or productive capacity of these resources. CONTROL OF INCOMPATIBLE VEGETATIVE, FISH AND WILDLIFE RESOURCES 1.39 Control Incompatible Vegetation, Fish and Wildlife: Encourage and support the control of vegetation, fish and wildlife resources which are harmful to the surrounding environment or pose a threat to public health, safety and welfare. 1.40 Minimize Adverse Impacts of Programs Controlling Incompatible Vegetation, and Fish and Wildlife: Minimize the negative impacts and risks of programs controlling incompatible vegetation, fish and wildlife. RESOURCE MANAGEMENT COORDINATION 1.41 Encourage Coordinated, Countywide Management of Vegetative, Water, Fish and Wildlife Resources: Encourage all Federal, State, regional, County, and city agencies with jurisdiction in San Mateo County to cooperate and coordinate the management and protection of vegetative, water, fish and wildlife resources.
Santa Clara County (Alviso)	The Planning office for the County of Santa Clara includes the following policies in their general plan, pertaining to habitat and biodiversity, namely how knowledge can be improved, it can be protected and restored, as well as evaluating the effectiveness of environmental mitigations under CEQA (County of Santa Clara 1994):

	R-RC 1. Natural and heritage resources shall be protected and conserved for their ecological, functional, economic, aesthetic, and recreational values.. Heritage resources shall be preserved to the maximum extent possible for their scientific, cultural, and "sense of place" values. R-RC 2. The County shall provide leadership in protecting and restoring valuable natural resources, such as wetlands, riparian areas, and others, for County-owned lands and by means of multijurisdictional endeavors. R-RC 3. Multiple uses of public lands intended for open space and conservation shall be encouraged so long as the uses are consistent with the objectives of resource management and conservation. For resources of critical concern, such as habitat for threatened or endangered species, priority shall be given to conservation of the resource. R-RC 4. For both public and private lands in rural unincorporated areas, the overall strategy for resource management and conservation shall be to: a. Improve and update current knowledge of resources; b. Emphasize pro-active, preventive measures; c. Minimize or compensate for adverse human impacts; d. Restore resources where possible; and, e. Monitor the effectiveness of required mitigations. R-RC 5. Public and private development projects shall be evaluated and conditioned to assure they are environmentally sound, do not degrade natural resources, and that all reasonable steps are taken to mitigate potentially adverse impacts. R-RC 19. Habitat types and biodiversity within Santa Clara County and the region should be maintained and enhanced for their ecological, functional, aesthetic, educational, medicinal, and recreational importance. R-RC 20. Strategies and policies for maintaining and enhancing habitat and biodiversity should include the following: 1. Improve current knowledge and awareness of habitats and natural areas. 2. Protect the biological integrity of critical habitat areas. 3. Encourage habitat restoration wherever possible. 4. Evaluate the effectiveness of project mitigations as required under CEQA. R-RC 21. Critical habitat areas should be excluded from cities' Urban Service Areas unless retained in non-urban uses, and rural unincorporated development should be designed to avoid or mitigate impacts upon habitat and natural areas. R-RC 22. Recreational uses of public lands proposed within areas of natural habitat should be limited to those kinds and intensities of activities that are compatible with preserving natural vegetation and wildlife and which very minimally disturb overall habitat value: 1. Examples of low intensity activities that may be allowed include limited hiking, horseback riding, picnicking, camping, and interpretative

	study. 2. For critical habitat areas, uses and activities should not be allowed to create a significant impact; if necessary, facilities for such activities should be limited to those of a very primitive, non-disruptive nature only or precluded from such areas. 3. Nesting and breeding areas potentially affected by such activities should be seasonally closed to recreational use. R-RC 24. Areas of habitat richest in diversity, of particularly fragile ecological nature, or necessary for preserving threatened or endangered species should receive special consideration for preservation as open space and protection from development impacts. Examples include baylands and riparian areas, serpentine geology, and other critical habitat areas identified by local legislative bodies. R-RC 25. Wetlands habitats of San Francisco Bay shall be preserved and enhanced. R-RC 26. Within wetlands areas, allowable uses shall be limited to those which cause little or no adverse impacts, possibly including: a. natural ecological functions, such as bay waters, sloughs, marshes and flats, preserved in open space; b. salt ponds; c. small piers, walkways, and wildlife observation areas; d. trail-related uses, such as walking, bicycling, and, horseback riding as compatible with resource preservation; e. fishing, boating, swimming, and limited hunting; f. aquaculture; g. marinas; and h. nature centers or other facilities for the study and appreciation of natural resources. R-RC 27. There shall be no filling or alteration of wetlands areas except for such alterations which enhance habitat resources. Construction of small levees, piers, or walkways for public use and education may be allowed. If construction of any type will result in significant loss of habitat or alteration of wetlands hydrology, mitigations shall be required. R-RC 30. Land uses in areas adjacent to the Baylands should have no adverse impact upon wetlands habitats or scenic qualities of the Baylands. Uses adjacent to the National Wildlife Refuge should be compatible with the Refuge. R-RC 31. Natural streams, riparian areas, and freshwater marshes shall be left in their natural state providing for percolation and water quality, fisheries, wildlife habitat, aesthetic relief, and educational or recreational uses that are environmentally compatible. Streams which may still provide spawning areas for anadromous fish species should be protected from pollution and development impacts which would degrade the quality of the stream environment. R-RC 32. Riparian and freshwater habitats shall be protected through the following general means:

	a. setback of development from the top of the bank; b. regulation of tree and vegetation removal; c. reducing or eliminating use of herbicides, pesticides, and fertilizers by public agencies; d. control and design of grading, road construction, and bridges to minimize environmental impacts and avoid alteration of the streambed and stream bank (freespan bridges and arch culverts, for example); and e. protection of endemic, native vegetation. R-RC 33. Public projects shall be designed to avoid damage to freshwater and stream environments. R-RC 34. In flood plains which are not already developed, land uses shall be restricted to avoid the need for major flood control projects which would alter stream flows and vegetation. R-RC 35. Flood control modifications to be made in streams that have substantial existing natural areas should employ flood control designs which enhance riparian resources and avoid to the maximum extent possible significant alteration of the stream, its hydrology, and its environs. R-RC 37. Lands near creeks, streams, and freshwater marshes shall be considered to be in a protected buffer area, consisting of the following: 1. 150 feet from the top bank on both sides where the creek or stream is predominantly in its natural state; 2. 100 feet from the top bank on both sides of the waterway where the creek or stream has had major alterations; and 3. In the case that neither (1) nor (2) are applicable, an area sufficient to protect the stream environment from adverse impacts of adjacent development, including impacts upon habitat, from sedimentation, biochemical, thermal and aesthetic impacts. R-RC 38. Within the aforementioned buffer areas, the following restrictions and requirements shall apply to public projects, residential subdivisions, and other private non-residential development: a. No building, structure or parking lots are allowed, exceptions being those minor structures required as part of flood control projects. b. No despoiling or polluting actions shall be allowed, including grubbing, clearing, unrestricted grazing, tree cutting, grading, or debris or organic waste disposal, except for actions such as those necessary for fire suppression, maintenance of flood control channels, or removal of dead or diseased vegetation, so long as it will not adversely impact habitat value. c. Endangered plant and animal species shall be protected within the area. R-RC 49. Retention and planting of native plant species shall be encouraged, especially for landscape uses. R-RC 51. Preservation of habitat linkages and migration corridors should be encouraged where needed to allow for species migration, prevent species isolation, and otherwise compensate for the effects of habitat R-RC 53. Restoration of habitats should be encouraged and utilized

	wherever feasible, especially in cases where habitat preservation and flood control, water quality, or other objectives can be successfully combined. R-RC 56. Specific mitigations required for new development for conserving habitat should be monitored as required by state law to assess their effectiveness and the need for improved mitigations for future projects.
Solano County (Cullinan, Montezuma)	Solano County's General Plan lays out the following applicable goals and policies for biological resources: **Goals** RS.G-1: Manage and preserve the diverse land, water, and air resources of the county for the use and enrichment of the lives of present and future generations. RS.G-2: Ensure continued presence and viability of the county's various natural resources. RS.G-3: Repair environmental degradation that has occurred, and seek an optimum balance between the economic and social benefits of the county's natural resources. RS.G-4: Preserve, conserve, and enhance valuable open space lands that provide wildlife habitat; conserve natural and visual resources; convey cultural identity; and improve public safety. **Policies** RS.P-1: Protect and enhance the county's natural habitats and diverse plant and animal communities, particularly occurrences of special-status species, wetlands, sensitive natural communities, and habitat connections. RS.P-2: Manage the habitat found in natural areas and ensure its ecological health and ability to sustain diverse flora and fauna. RS.P-3: Focus conservation and protection efforts on high-priority habitat areas depicted in Figure RS-1. RS.P-4: Together with property owners and federal and state agencies, identify feasible and economically viable methods of protecting and enhancing natural habitats and biological resources. RS.P-5: Protect and enhance wildlife movement corridors to ensure the health and long-term survival of local animal and plant populations. Preserve contiguous habitat areas to increase habitat value and to lower land management costs. **General Marsh-Delta Policies** RS.P-7: Preserve and enhance the diversity of habitats in marshes, delta to maintain these unique wildlife resources. RS.P-8: Protect marsh waterways, managed wetlands, tidal marshes, seasonal marshes, and lowland and grasslands because they are critical habitats for marsh-related wildlife and are essential to the integrity of the marshes. RS.P-9: Encourage restoration of historic marshes to wetland status, either as tidal marshes or managed wetlands. When managed wetlands

	are no longer used for waterfowl hunting, restore them as tidal marshes. The following policies apply specifically to the Suisun Marsh area. These policies are more specific than the balance of the General Plan to address the requirements of the *Suisun Marsh Protection Plan and the Suisun Marsh Protection Act of 1977.* RS.P-10: The County shall preserve and enhance wherever possible the diversity of wildlife and aquatic habitats found in the Suisun Marsh and surrounding upland areas to maintain these unique wildlife resources. RS.P-11: The County shall protect its marsh waterways, managed and natural wetlands, tidal marshes, seasonal marshes and lowland grasslands which are critical habitats for marsh related wildlife. RS.P-12: Existing uses should continue in the upland grasslands and cultivated areas surrounding the critical habitats of the Suisun Marsh in order to protect the Marsh and preserve valuable marsh-related wildlife habitats. Where feasible, the value of the upland grasslands and cultivated lands as habitat for marsh-related wildlife should be enhanced. RS.P-15: In marsh areas, the County shall encourage the formation and retention of parcels of sufficient size to preserve valuable tidal marshes, seasonal marshes, managed wetlands and contiguous grassland areas for the protection of aquatic and wildlife habitat. RS.P-16 The County shall ensure that development in the County occurs in a manner which minimizes impacts of earth disturbance, erosion and water pollution. Sacramento–San Joaquin Delta Policies The following policies apply specifically to the Delta area. These resource policies are more specific to address the requirements of the Delta Protection Plan. RS.P-21: Preserve and protect the natural resources of the Delta including soils and riparian habitat. Lands managed primarily for wildlife habitat should be managed to provide inter-related habitats. RS.P-23: Ensure that extension of new utilities and infrastructure facilities, including those that support uses and development outside the Delta is consistent with the Land Use and Resource Management Plan for the Primary Zone of the Delta. Where construction of new utility and infrastructure facilities is appropriate, the effects of such new construction on the integrity of levees, wildlife, and agriculture activities shall be minimized to the extent feasible. RS.P-28: Protect long-term water quality in the Delta in coordination with water agencies at local, state, and federal levels for designated beneficial uses, including agriculture, municipal, water-dependent industrial, water-contact recreation, boating and fish and wildlife habitat. **Napa Sonoma Marsh Restoration Project Policy** RS.P-32: Require marsh restoration activities and land use development within the Napa Sonoma Marsh Restoration Project area to be consistent with the requirements of the Napa Sonoma Marsh Restoration Project. RS.P-35: Protect the unique scenic features of Solano County, particularly

	hills, ridgelines, wetlands, and water bodies. RS.P-36: Support and encourage practices that reduce light pollution and preserve views of the night sky. RS.P-60: Work with cities to maintain open space separators around cities to preserve their identity and character. RS.P-63: Encourage cities to maintain defined community separators in appropriate productive agricultural or open space use. (Solano County 2008)
City of Brisbane (SBS)	Chapter IX-Conservation of Brisbane's General Plan provides goals and policies for Local Economic Development, including the following applicable policies: Policy 118 Preserve areas containing rare and endangered species habitat to the extent allowed by law and available resources. Policy 120 Cooperate with local, State and Federal agencies in conservation efforts for biological resources. Policy 122 Cooperate with other agencies in conservation efforts. Program 122a: Work with the Habitat Conservation Plan Operator, the State Department of Fish and Game, the U. S Fish and Wildlife Service, and other agencies as appropriate regarding plans and programs that may affect biological resources in the planning area. Policy 123 Conserve important biological communities through sensitive project design. Program 123a: In land use development applications, consider the siting of structures and utilities so as to conserve identified biological communities. Policy 130 Conserve water resources in the natural environment. Policy 130.1 The City requires restoration of wetland losses. The determination of which land areas are wetlands will be done by those Federal and State agencies having jurisdiction. The City, however, is especially concerned with those wetlands surrounding the perimeter of the Brisbane Lagoon, the Bay shoreline, the Levinson Marsh and the Quarry sediment ponds. The ratios of restoration may exceed the regulatory agencies' mitigation minimums. Policy 131 Emphasize the conservation of water quality and of riparian and other water-related vegetation, especially that which provides habitat for native species, in planning and maintenance efforts. (City of Brisbane 1994)
City of Hayward (Eden Landing Ponds E1 and E2)	The Natural Resources Element of the Hayward General Plan contains the following applicable goals and policies: GOAL NR-1 Protect, enhance, and restore sensitive biological resources, native habitat, and vegetation communities that support wildlife species so they can be sustained and remain viable. NR-1.2 Sensitive Habitat Protection. The City shall protect sensitive biological resources, including State and Federally designated sensitive, rare, threatened, and endangered plant, fish, and wildlife species and their habitats from urban development and incompatible

	land uses. NR-1.3 Sensitive Species Identification, Mapping, and Avoidance. The City shall require qualified biologists to identify, map, and make recommendations for avoiding all sensitive biological resources on the project site, including State and Federally sensitive, rare, threatened, and endangered plant, fish, and wildlife species and their habitats using methods and protocols in accordance with the U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, and California Native Plant Society for all development applications proposed within sensitive biological resource areas. NR-1.4 Shoreline Protection and Enhancement. The City shall coordinate with the Hayward Area Shoreline Planning Agency, Bay Conservation and Development Commission, and California Coastal Commission to conserve, protect, and enhance natural and cultural resources along the San Francisco Bay shoreline by balancing uses that support multiple community needs, such as recreation, tourism, cultural resource preservation, and natural resource protection. NR-1.6 Migratory Bird Habitat Protection. The City shall support the efforts of the Hayward Area Shoreline Planning Agency and other agencies to preserve and protect tidal flats and salt ponds with low salinity for migratory waterfowl that depend on these areas. NR-1.8 Invasive Species Mitigation on Public Lands The City shall coordinate with the East Bay Regional Park District, Hayward Area Recreation and Park District, and California Invasive Plant Council to identify ways to control invasive, nonnative vegetation to the extent feasible in all public parks and open space areas. NR-1.9 Native Plant Species Protection and Promotion. The City shall protect and promote native plant species in natural areas as well as in public landscaping. GOAL NR-3 Preserve, enhance, and expand natural baylands, wetlands, marshes, hillsides, and unique ecosystems within the Planning Area in order to protect their natural ecology, establish the physical setting of the city, provide recreational opportunities, and assist with improved air quality and carbon dioxide sequestration. NR-3.2 Interagency Restoration Coordination. The City shall coordinate with Hayward Area Shoreline Planning Agency, East Bay Regional Park District, Bay Conservation and Development Commission, California Coastal Commission, and other Federal, State, and regional agencies to identify methods for acquiring and restoring baylands and marsh habitats, expanding the National Wildlife Refuge, and funding the purchase and restoration of wetland habitats. (City of Hayward 2014)
City of Mountain View (Alviso Ponds A1/A2W)	The City of Mountain View General Plan contains the following relevant policies pertaining to biological resources:

	Species and Habitat Policies INC 16.1: Natural areas. Work with regional agencies to protect and enhance natural areas. INC 16.2: Shoreline at Mountain View. Manage Shoreline at Mountain View Regional Park to balance the needs of recreational, open space, habitat, commercial and other uses. INC 16.3: Habitat. Protect and enhance nesting, foraging and other habitat for special-status species and other wildlife. INC 16.4: Invasive species. Contain and reduce the amount of invasive species. INC 16.5: Wetland habitat. Collaborate with and support regional efforts to restore and protect wetlands, creeks, tidal marshes and open-water habitats adjacent to San Francisco Bay. *Watershed and Floodplain Management Policies* INC 17.2: Natural hydrology in watersheds. Promote an ecologically sensitive approach to flood protection, encouraging natural hydrology and preserving habitat and ecology within watercourses. *Parks and Open Space Policies* POS 3.1: Preservation of natural areas. Preserve natural areas, creeks and Shoreline at Mountain View Regional Park primarily for low-intensity uses. In special circumstances more active uses may be permitted if the overall natural character of the larger area is retained. (City of Mountain View 2012)
Redwood City (RWC)	The Redwood City General Plan lays out goals and policies pertaining to natural resources, including: Goal NR-5: Protect, restore, and maintain creeks, sloughs, and streams to ensure adequate water flow, prevent erosion, provide for viable riparian plant and wildlife habitat and, where appropriate, allow for recreation opportunities. Policy NR-5.1: Restore, maintain, and enhance Redwood City's creeks, streams, and sloughs to preserve and protect riparian and wetland plants, wildlife and associated habitats, and where feasible, incorporate public access. Goal NR-6: Preserve and enhance the baylands, natural wetlands, and ecosystem to assist with improved air quality and carbon dioxide sequestration.

	Policy NR-6.2: Restore and maintain marshlands including tidal flats, tidal marshes, and salt marshes as appropriate. Policy NR-6-5: Take steps to reduce urban runoff into creeks and the Bay. Goal NR-8: Identify, protect, and restore open spaces, sensitive biological resources, native habitat, and vegetation communities that support wildlife species. Policy NR-8.1: Pursue efforts to protect sensitive biological resources, including local, State, and federally designated sensitive, rare, threatened, and endangered plant, fish, and wildlife species and their habitats. Policy NR-8.2: Preserve and create contiguous wildlife habitat and movement corridors. Policy NR-8.3: Replace and control invasive, non-native vegetation and animals to the extent feasible in parks and open space areas. Encourage restoration of native vegetation. Policy NR-8.4: Consult with regulatory agencies, nonprofit groups, and other organizations in the conservation, maintenance, acquisition, and restoration of open space lands that include wildlife, plant species, and animal habitat. Policy NR-8.5: Enhance fisheries habitat and restore access for native fishes in Redwood City's creeks. (City of Redwood City 2010)
City of San Jose (Alviso Pond A9)	The General Plan for San Jose includes discussion of the community forest, natural communities, wildlife and wildlife movement. The following applicable policies and goals are cited: *Bay and Baylands* The San Francisco Bay and the baylands are a vital biotic, cultural and recreational open space resource. Goal ER-3 – Bay and Baylands Preserve and restore natural characteristics of the Bay and adjacent lands, and recognize the role of the Bay's vegetation and waters in maintaining a healthy regional ecosystem. *Policies – Bay and Baylands* ER-3.1 Protect, preserve and restore the baylands ecosystem in a manner consistent with the fragile environmental characteristics of this area and the interest of the citizens of San José in a healthful environment. ER-3.2 Cooperate with the County, U.S. Army Corps of Engineers, EPA, California Department of Fish and Game, Bay Conservation and Development Commission (BCDC), and other appropriate jurisdictions to prevent the degradation of baylands by discouraging new filling or dredging of Bay waters and baylands. ER-3.3 In cooperation and, where appropriate, in consultation with other interested agencies and with projects such as the South Bay Salt Ponds Restoration Project, encourage the restoration of diked historic wetlands, including salt ponds, to their natural state by opening them to

	tidal action. ER-3.4 Avoid new development which creates substantial adverse impacts on the Don Edwards San Francisco Bay National Wildlife Refuge or results in a net loss of baylands habitat value. ER-3.5 Prohibit planting of invasive non-native plant species in or near baylands habitats. *Special-Status Plants and Animals* Natural habitats and communities, including streams, oak woodlands, grassland, chaparral, riparian forest, salt marsh, freshwater wetlands, and others, harbor a number of species that are rare, declining, or particularly sensitive to human activities. These "special- status species" include plants and animals that are protected under State and Federal Endangered Species Acts, the Federal Migratory Bird Treaty Act, and the California Fish and Game Code, and other species listed by the California Department of Fish and Game and the California Native Plant Society. (See Table ER-4: Special-Status Animal Species) Goal ER-4 – Special-Status Plants and Animals Preserve, manage, and restore habitat suitable for special-status species, including threatened and endangered species. *Policies – Special Status Plants and Animals* ER-4.1 Preserve and restore, to the greatest extent feasible, habitat areas that support special-status species. Avoid development in such habitats unless no feasible alternatives exist and mitigation is provided of equivalent value. ER-4.2 Limit recreational uses in wildlife refuges, nature preserves and wilderness areas in parks to those activities which have minimal impact on sensitive habitats. ER-4.3 Prohibit planting of invasive non-native plant species in natural habitats that support special-status species. ER-4.4 Require that development projects incorporate mitigation measures to avoid and minimize impacts to individuals of special-status species. *Migratory Birds* More than 350 species of birds have been observed in the diverse array of habitats provided by the City. Goal ER-5 – Migratory Birds Protect migratory birds from injury or mortality. Policies – Migratory Birds ER-5.1 Avoid implementing activities that result in the loss of active native birds' nests, including both direct loss and indirect loss through abandonment, of native birds. Avoidance of activities that could result in impacts to nests during the breeding season or maintenance of buffers between such activities and active nests would avoid such impacts. ER-5.2 Require that development projects incorporate measures to avoid impacts to nesting migratory birds. *Wildlife Movement* Goal ER-7 – Wildlife Movement

	Minimize adverse effects of future development on wildlife movement and remove or reduce existing impediments to wildlife movement. *Policies – Wildlife Movement* (City of San Jose 2011)
City of South San Francisco (SBS)	Chapter 7.1 of the City of South San Francisco General Plan lays out the following applicable guiding policies for habitat and biological resources conservation: 7.1-G-1 *Protect special status species and supporting habitats within South San Francisco, including species that are State or federally listed as Endangered, Threatened, or Rare.* New development projects in ecologically sensitive areas should consider impacts on valuable and sensitive natural habitats. 7.1-G-2 *Protect and, where reasonable and feasible, restore saltmarshes and wetlands.* Although much of South San Francisco's saltmarshes and wetlands have been severely degraded through years of fill, they could be restored along portions of the city's southern bayshore. *Special Habitat Areas* 7.1-I-1 Cooperate with State and federal agencies to ensure that development does not substantially affect special status species appearing on any State or federal list for any rare, endangered, or threatened species. Require assessments of biological resources prior to approval of any development on sites with ecologically sensitive habitat. (City of South San Francisco 2015)

G.4 **Table G-4. Local Plans and Policies Pertaining to Cultural Resources**

Regional and Local Jurisdictions	Key Provisions
San Mateo County (RWC, SBS)	General Plan Historical and Archaeological Resources Goals and Objectives: 5.1 Historic Resource Protection – Protect historic resources for their historic, cultural, social and educational values and the enjoyment of future generations. 5.3 Protection of Archaeological/Paleontological Sites – Protect archaeological/paleontological sites from destruction in order to preserve and interpret them for future scientific research, and public educational programs. General Plan Historical and Archaeological Resources Policies: Protection of Archaeological/Paleontological Resources 5.20 Site Survey – Determine if sites proposed for new development contain archaeological/paleontological resources. Prior to approval of development for these sites, require that a mitigation plan, adequate to protect the resource and prepared by a qualified professional, be reviewed and implemented as a part of the project. 5.21 Site Treatment – a. Encourage the protection and preservation of archaeological sites. b. Temporarily suspend construction work when archaeological/paleontological sites are discovered. Establish procedures which allow for the timely investigation and/or excavation of such sites by qualified professionals as may be appropriate. c. Cooperate with institutes of higher learning and interested organizations to record, preserve, and excavate sites. (County of San Mateo 1986)
Santa Clara County (Alviso)	General Plan Heritage Resources Strategies: #1 – Inventory and Evaluate Heritage Resources

Regional and Local Jurisdictions	Key Provisions
	#2 – Prevent or Minimize Adverse Impacts on Heritage Resources #3 – Restore, Enhance and Commemorate Resources General Plan Heritage Resources Policies and Implementation: C-RC 49 – Cultural heritage resources within Santa Clara County should be preserved, restored whenever possible, and commemorated as appropriate for their scientific, cultural, historic and place values. (County of Santa Clara 1994)
Solano County (Cullinan, Montezuma)	The following General Plan policies are relevant to the project: RS.P-38 – Identify and preserve important prehistoric and historic structures, features, and communities. RS.P-40- Consult with Native American governments to identify and consider Native American cultural places in land use planning. The following Implementation Programs are relevant to the project: RS.1-25 – Require cultural resources inventories of all new development projects in areas identified with medium or high potential for archeological or cultural resources. Where a preliminary site survey finds medium to high potential for substantial archaeological remains, the County shall require a mitigation plan to protect the resource before issuance of permits. (County of Solano 2008)
City of Brisbane	The following General Plan Policy is relevant to the project: Policy 137 – Conserve pre-historic resources in accordance with State and Federal requirements.
City of Hayward (Eden Landing Ponds E1 and E2)	The following General Plan goals and policies are applicable to the project: Goal LU-8: Preserve Hayward's historic districts and resources to maintain a unique sense of pace and to promote an understanding of the regional and community history.

Regional and Local Jurisdictions	Key Provisions
	LU-8.1: Value of Historic Preservation – The City shall recognize the value and co-benefits of local historic preservation, including job creation, economic development, increased property values, and heritage tourism. LU-8.13: Planning Study Considerations - The City shall consider historical and cultural resources when developing planning studies and documents. (City of Brisbane 1994)
City of Mountain View (Alviso Ponds A1/A2W)	General Plan goals and policies relevant to the project are as follows: Goal LUD-11 – Preserved and protected important historic and cultural resources. Policy LUD 11.1 – Historical preservation. Support the preservation and restoration of structures and cultural resources listed in the Mountain View Register of Historic Resources, the California Register of Historic Places or National Register of Historic Places. Policy LUD 11.5 – Archaeological and paleontological site protection. Require all new development to meet state codes regarding the identification and protection of archaeological and paleontological deposits. Policy LUD 11.6 – Human remains. Require all new development to meet state codes regarding the identification and protection of human remains. (City of Mountain View 2012)
Redwood City (RWC)	Almost half of Redwood City's land area is under water, in the San Francisco Bay. *Redwood City Historic Preservation Ordinance* The City of Redwood City adopted the Historic Preservation Ordinance (Chapter 40 of the Municipal Code) in 1980. The Historic Preservation Ordinance is intended to "safeguard the City's heritage by providing for the protection of historic

Regional and Local Jurisdictions	Key Provisions
	landmarks, encourage public knowledge of the City's history, and foster a sense of identity within the community" (City of Redwood City 2010b.) The Ordinance established an inventory of designated historical resources, which is the city's list of buildings, sites, structures, objects and/or districts that have been evaluated pursuant to the NRHP, the CRHR, and determined historically significant within a specific historic context and theme of development. The Historic Preservation Ordinance requires that projects affecting historical resources comply with local, state and federal laws and incorporates the U.S. Secretary of the Interior's Standards. (City of Redwood City. 2010a,b). *Redwood City General Plan* The following General Plan goals and policies are applicable to the project: Goal BE-36: Identify, study, and document historic resources. Goal bE-37: Protect, preserve, restore, rehabilitate, and/or enhance historic resources. Policy BE-37.1: Enhance, restore, preserve, and protect, as appropriate, historic resources throughout the city. (City of Redwood City 2010a,b)
City of San Jose (Alviso Pond A9)	The following General Plan goals and policies are applicable to the project: Goal ER-10: Preserve and conserve archaeologically significant structures, sites, districts and artifacts in order to promote a greater sense of historic awareness and community identify. Policy ER-10.3: Ensure that city, State, and Federal historic preservation laws, regulations, and codes are enforced, including laws related to archaeological and paleontological resources, to ensure the adequate protection of historic and prehistoric resources. (City of San Jose 2011)
City of South San Francisco	The following General Plan Guiding Policies are relevant to the

Regional and Local Jurisdictions	Key Provisions
(SBS)	project: 7.5-G-1 – Conserve historic, cultural, and archaeological resources for the aesthetic, educational, economic, and scientific contribution they make to South San Francisco's identity and quality of life. The following General Plan Implementing Policies are relevant to the project: 7.5-I-4 – Ensure the protection of known archaeological resources in the city by requiring a records review for any development proposed in areas of known resources. 7.5-I-5 – In accordance with State law, require the preparation of a resource mitigation plan and monitoring program by a qualified archaeologist in the event that archaeological resources are uncovered. (City of South San Francisco)

G.5 **Table G-5. Local Plans and Policies Pertaining to Geology/Soils/Seismicity**

Regional and Local Jurisdictions	Key Provisions
San Mateo County General Plan (RWC, SBS)	The Seismic and Safety Element of the General Plan (County of San Mateo 1986), adopted in 1976, contains policies which generally: (1) propose strategies for the reduction of the risk of geotechnical hazards to acceptable levels; and (2) support the integration of data on geotechnical hazards into the development review process.
Redwood City General Plan (RWC Channel)	Objectives and policies from the *Safety Element* (adopted in 1990 and updated in 2010) of the General Plan (Redwood City 2010) seek to protect the community from hazards of soil erosion, weak and expansive soils, and geologic instability. Relevant policies and goals are excerpted below. *Safety Policy* S-1: Identify structural types and land uses highly sensitive to earthquake activity, and abate or modify them to achieve acceptable risk. *Goal PS-6:* Minimize the potential damage to structures and loss of life that result from earthquakes and other geological hazards. *Policy PS-6.1:* Identify structural types, land uses, and sites that are highly sensitive to earthquake activity and other geological hazards, and seek abate or modify them to achieve acceptable levels of risk. *Policy PS-6.3:* Work to ensure that structures and the public in Redwood City are exposed to reduced risks from seismic and geological events.
City of Brisbane (SBS)	None Identified.
City of South San Francisco (SBS)	The Geologic and Seismic Hazard Guiding Policy is listed under the Health and Safety Element of the City's General Plan (City of SSF 2015). **8.1-G-1:** Minimize the risk to life and property from seismic activity and geologic hazards in South San Francisco.
Solano County (Cullinan, Montezuma)	The goals of the Public Health and Safety chapter of the General Plan (Solano County 2008) address the County's desire to protect its residents, their property, and the environment from natural

Regional and Local Jurisdictions	Key Provisions
	and human-caused hazards. The relevant seismic safety and land stability policy is: **HS.P-16:** Require minimum setbacks for construction along creeks between the creek bank and structure, except for farm structures that are not dwellings or places of work, based on the susceptibility of the bank to lurching caused by seismic shaking.
Alameda County (Eden Landing)	The Safety Element of the General Plan (Alameda County 1994) was adopted in 2013. The goal is to minimize risks to lives and property due to seismic and geologic hazards. **P1:** To the extent possible, projects should be designed to accommodate seismic shaking and should be sited away from areas subject to hazards induced by seismic shaking (landsliding, liquefaction, lurching, etc.) where design measures to mitigate the hazards will be uneconomic or will not achieve a satisfactory degree of risk reduction.
City of Hayward (Eden Landing)	Under the General Plan Hazards element (City of Hayward 2014), the following policy may apply: **HAZ-2.8 Tsunamis:** The City shall coordinate with the Hayward Area Recreation and Park District (HARD), the East Bay Regional Parks District (EBRPD), and the Alameda County Flood Control and Water Conservation District to efficiently evacuate shoreline parks during potential tsunami events.
Santa Clara County (Alviso)	Under the Health and Safety section of the General Plan (Santa Clara County 1994), the following policies are relevant: **C-HS 29**: Inventories and mapping of natural hazards should be adequately maintained for use in planning and decision-making. **C-HS 33**: Development in areas of natural hazards should be designed, located, and otherwise regulated to reduce associated risks, by regulating the type, density, and placement of development where it will not: a. be directly jeopardized by hazards; b. increase hazard potential; and c. increase risks to neighboring properties.
City of Mountain View	Under the Public Safety chapter of the General Plan (City of

Regional and Local Jurisdictions	Key Provisions
(Alviso Ponds A1/A2W)	Mountain View 2012) goal PSA-5 addresses the protection of life and property from seismic hazards. **PSA 5.1: New development**. Ensure new development addresses seismically induced geologic hazards.
City of San Jose (Alviso Pond A9)	The Environmental Leadership Chapter of the General Plan (City of San Jose 2007) contains the following Seismic Hazard policy and Geologic and Soil Hazard policy: **EC-3.4:** The City of San José will maintain up-to-date seismic hazard maps with assistance from the California Geological Survey (or other state agencies) under the Alquist-Priolo Earthquake Fault Zoning Act and the California Seismic Hazards Mapping Act. **EC-4.5:** Ensure that any development activity that requires grading does not impact adjacent properties, local creeks and storm drainage systems by designing and building the site to drain properly and minimize erosion. An Erosion Control Plan is required for all private development projects that have a soil disturbance of one acre or more, are adjacent to a creek/river, and/or are located in hillside areas. Erosion Control Plans are also required for any grading occurring between October 15th and April 15th.

G.6 **Table G-6. Local Plans and Policies Pertaining to Hazards and Hazardous Material**

Regional and Local Jurisdictions	Key Provisions
Alameda County (Eden Landing Ponds)	The following policy in the Safety Element of the Alameda County General Plan (amended 2014) is applicable: *P1.* Uses involving the manufacture, use or storage of highly flammable (or toxic) materials and highly water reactive materials should be located at an adequate distance from other uses and should be regulated to minimize the risk of on-site and off-site personal injury and property damage. The transport of highly flammable materials by rail, truck, or pipeline should be regulated and monitored to minimize risk to adjoining uses.
San Mateo County (RWC, SBS)	In the San Mateo County General Plan-Hazardous Materials section, the following goal and objectives apply: *16.47: Strive to Protect Life, Property, and the Environment From Hazardous Material Exposure* Strive to protect public health and safety, environmental quality, and property from the adverse effects of hazardous materials through adequate and responsible management practices. *16.48: Strive to Ensure Responsible Hazardous Waste Management* Strive to ensure that hazardous waste generated within San Mateo County is stored, treated, transported and disposed of in a legal and environmentally safe manner so as to prevent human health hazard and/or ecological disruption. *16.49: Strive to Reduce Public Exposure to Hazardous Materials* Strive to reduce public exposure to hazardous materials through programs which: (1) promote safe transportation, (2) prevent accidental discharge, and (3) promote effective incident response, utilizing extensive inventory and monitoring techniques.
Santa Clara County GP (Alviso)	In the Health and Safety section of the County's General Plan (Santa Clara County 1994), the following strategy and policies are relevant: *Strategy #1: Manage Hazardous Materials Safely and Efficiently* *Policy C-HS 14* All feasible measures to safely and effectively

Regional and Local Jurisdictions	Key Provisions
	manage hazardous materials and site hazardous materials treatment facilities should be used, including complying with all federal and state mandates. *Policy C-HS 15* To achieve a more effective, efficient and economical regulatory environment, all feasible means to simplify and coordinate locally-implemented hazardous materials management regulations should be considered.
Solano County (Cullinan and Montezuma)	In the Health and Safety Element of the County's General Plan, the following policies apply to this resource area: *HS.P-26:* Minimize the risks associated with transporting, storing, and using hazardous materials through methods that include careful land use planning and coordination with appropriate federal, state, or County agencies. *HS.P-28:* Encourage the use of programs and products by businesses that will result in a reduction of hazardous waste and materials.
City of Brisbane (SBS)	In the Community Health and Safety Chapter of the city's General Plan (City of Brisbane 1994), the following policy would apply: *Policy 166:* Protect the community's health, safety, welfare, natural resources and property through regulation of the handling and storage of hazardous materials, with specific focus on prevention of accidents.
City of Hayward (Eden Landing ponds)	In the Hazards Element of the city's General Plan (City of Hayward 2014), the following goal and policies may apply: *Goal Haz-6: Protect peopleand environmental resources from contaminated hazardous material sites and minimize risks associated with the use, storage, transport, and disposal of hazardous materials.* *Policy HAZ-6.1Hazardous Materials Program* The City shall maintain its status as a Certified Unified Program Agency and implement the City's Unified Hazardous Materials and Hazardous Waste Management Program, which includes Hazardous Materials Release Response Plans and Inventories

Regional and Local Jurisdictions	Key Provisions
	(Hazardous Materials Business Plans -HMBP); and California Accidental Release Prevention (CalARP) Program; *Policy HAZ-6.7 Agency Coordination* The City shall coordinate with State, Federal, and local agencies to develop and promote best practices related to the use, storage, transportation, and disposal of hazardous materials.
City of Mountain View (Alviso)	In the Public Safety chapter of the city's General Plan (City of Mountain View 2012), the following goal and policies may be applicable: Goal PSA-3: *A community protected from fire, hazardous materials and environmental contamination.* *Policy PSA 3.2: Protection from hazardous materials.* Prevent injuries and environmental contamination due to the uncontrolled release of hazardous materials through prevention and enforcement of fire and life safety codes *Policy PSA 3.4: Oversight agencies.* Work with local, state and federal oversight agencies to encourage remediation of contamination and protection of public and environmental health and safety.
Redwood City (RWC)	In the Redwood City General Plan, Public Safety Element (2010), the following policy would apply: *Policy PS-8.1*: Establish policies to regulate and reduce hazardous waste within Redwood City that are consistent with the County's Hazardous Waste Management Plan and other County regulatory programs. The Port of Redwood City Tariff (Port of Redwood City 2014) includes the following provisions: EXPLOSIVES AND OTHER DANGEROUS CARGOES (A) It is unlawful to handle, transport, load, discharge or retain any dangerous cargo on a port or private facility or on a vessel within the Port area of Redwood City unless all Local, State and Federal

Regional and Local Jurisdictions	Key Provisions
	laws and regulations including, but not limited to the following are met and complied with: (1) Federal Regulations, titles "Explosive or Other Dangerous Articles on Board Vessel" CFR, Sec.4472, amended U.S. 46-CFR-170 and "U.S. Coast Guard Tank Vessel Regulations" amended U.S. 46-USC-391a. (B) It is unlawful to allow any acid, flammable or any dangerous cargoes to remain overnight on or inside any facility (public or private) within the Port area. Exception: The Port Manger may designate, with approval of the City Fire Marshal, such place or places where cargo described in (B) may remain pending load out or delivery. (C) The Port Manager may have cargo, described in parts (A) and (B), removed from the Port area at the expense of the vessel, the cargo owner and/or its consignee. (D) Before handling any class of explosive in this Port, a "Joint Explosives Permit" must be applied for in writing and obtained from the Port Manager after approval of the City Fire Marshal. (1) The person obtaining this permit must agree and comply with all terms and conditions specified in the permit which, in addition to referencing the Federal, State and Municipal requirements, may also contain specific instructions from the Port Manager. DISPOSAL OF VESSEL'S OILY WASTE Vessels requiring discharge of oily waste at the Port of Redwood City shall inquire of the Port's Manager for the name(s) of oily waste hauler(s) permitted by the Port of Redwood City to provide equipment and operate at the Port of Redwood City to receive, haul and dispose of oily waste. The vessel shall arrange directly with such oily waste hauler(s) for such services and equipment. Payment of charges for these services and equipment provided by such oily waste hauler shall be made directly to the oily waste hauler by the vessel, its agent, owner, charterer or any other party responsible for such payment of charges by the vessel.

Regional and Local Jurisdictions	Key Provisions
	HANDLING OF FLAMMABLE OR COMBUSTIBLE LIQUIDS (A) Vessels may load or discharge flammable or combustible liquids through stationary pipelines, at locations approved by the Port Manager and the City Fire Marshal. (B) Vessels are allowed to load or discharge flammable or combustible liquids in approved standard containers within the Port area, subject to the following: (1) Permitted between 0800 and 1700 hrs. (a) Advance notice must be given to the City Fire Marshal if handling is to take place during other hours of the day. (2) Trucks or railroad cars containing such packaged flammable or combustible liquids are not permitted to stand-by on a covered terminal or to remain in an open area on terminal property unless the vessel is ready to load within a reasonable time. (3) Flammable or combustible liquids in containers discharged from a vessel must be removed at once from the terminal area. If unloaded direct to a truck or railcar, the carrier must move this cargo from the terminal area as it is loaded. (See Exception). (4) Empty containers which have held flammable or combustible liquids must be removed from terminal areas at once.
City of San Jose (Alviso)	In the city's General Plan Hazards Element, the following policies may be applicable: *Hazardous Materials Policies:* *1.* The City should require proper storage and disposal of hazardous materials to prevent leakage, potential explosions, fires, or the escape of harmful gases, and to prevent individually innocuous materials from combining to form hazardous substances, especially at the time of disposal. *2.* The City should support State and Federal legislation which strengthen safety requirements for the transportation of hazardous materials. *3.* The City should incorporate soil and groundwater contamination analysis within the environmental review process for development proposals. When contamination is present on a site, the City should report this information to the appropriate agencies that

Regional and Local Jurisdictions	Key Provisions
	regulate the cleanup of toxic contamination. *Hazardous Waste Management Policy:* *9.* Proper storage and disposal of hazardous wastes shall be required to prevent leaks, explosions, fires, or the escape of harmful gases, and to prevent materials from combining to form hazardous substances and wastes.
City of South San Francisco (SBS)	In the Health and Safety Element Chapter of the General Plan (City of South San Francisco 2015), the following guiding policy may be relevant: *8.3-G-2* Minimize the risk to life and property from the generation, storage, and transportation of hazardous materials and waste in South San Francisco. Comply with all applicable regulations and provisions for the storage, use and handling of hazardous substances as established by federal (EPA), State (DTSC, RWQCB, Cal OSHA, Cal EPA), and local (County of San Mateo, City of South San Francisco) regulations.

G.7 **Table G-7. Local Plans and Policies Pertaining to Land Use and Planning**

Regional and Local Jurisdictions	Key Provisions
Alameda County (Eden Landing)	Alameda County General Plan Open Space Element, Principles for Shoreline and Bay Open Space • Preserve natural ecological habitats in shoreline areas • Provide continuity in shoreline open space • Bay or marsh filling and development should not be permitted except in selected areas for recreational use. • Provide for orderly transition of phased out salt extraction areas to uses compatible with the Open Space Plan • Local, regional, state and federal agencies should coordinate policies and plans for preservation of San Francisco Bay and shoreline.
San Mateo County (RWC, SBS)	General Land Use Goals and Objectives: 7.4 Natural Resources. Designate land uses in order to enhance the protection and management of natural resources.
Santa Clara County (Alviso)	In the Santa Clara General Plan, the site designated as a "Resource Conservation Area." The relevant Resource Conservation (RC) Element and Land Use (LU) Element policies are: R-LU 3: The general intent of each "Resource Conservation Area" designation is to encourage land uses and densities appropriate to the rural unincorporated areas that also: • help preserve rural character; • conserve natural, scenic, and cultural resources; • protect public health and safety from natural and man-made hazards; • preserve agriculture and prime agricultural soils; • protect watersheds and water quality; • enhance air quality; and • minimize the demand for and cost of public services and facilities. R-LU 4: The Baylands are of major environmental importance for the climate and the quality of life within the county. Current uses include the National Wildlife Refuge, parks, salt ponds, marshes, public solid waste disposal facilities, wildlife habitat for rare, endangered and locally unique plants and animals,

Regional and Local Jurisdictions	Key Provisions
	public educational facilities and harbors. R-LU 5: The edges of the San Francisco Bay shall be preserved and restored as open space. Allowable uses shall include: • bay waters and sloughs; • marshes, wetlands and wetlands restoration; • salt extraction; • wildlife habitat; • open space preserves; • small piers and walkways; • wildlife observation; and • recreational uses, such as walking, horseback riding, bicycling, fishing, boating, education, swimming, limited hunting, aquaculture, and marinas. R-LU 6: There shall be no filling of wetlands except for very limited construction of small levees, piers, or walkways necessary for the public use or study of the baylands. C-RC 3: Multiple uses of lands intended for open space and conservation shall be encouraged so long as the uses are consistent with the objectives of resource management, conservation, and preservation, particularly habitat areas. R-RC 30: Land uses in areas adjacent to the Baylands should have no adverse impact upon wetlands habitats or scenic qualities of the Baylands. Uses adjacent to the Don Edwards National Wildlife Refuge should be compatible with the Refuge. C-RC 34: Restoration of habitats should be encouraged and utilized where feasible, especially in cases where habitat preservation and flood control, water quality, or other objectives can be successfully combined.
Solano County (Cullinan, Montezuma)	The General Plan provides a "marsh" designation with a resource conservation overlay. The "marsh" designation provides for protection of marsh and wetland areas. Allowed are aquatic and wildlife habitat, marsh-oriented recreational uses, agricultural activities compatible with the marsh environment and marsh habitat, educational and scientific research, educational facilities supportive of and compatible with marsh functions, and restoration of historic tidal wetlands.

Regional and Local Jurisdictions	Key Provisions
City of Brisbane (SBS)	The City of Brisbane General Plan includes the following policies: Policy 13- Integrate physical, social, environmental and financial elements of the community for the benefit of current and future residents. Policy 16- Acknowledge the mountain setting and the proximity to the Bay as central factors in forming the physical character of the City.
City of Hayward (Eden Landing Ponds E1 and E2)	The General Plan includes a "Baylands" designation for the Eden Landing area of the Hayward Shoreline. The Baylands designation generally applies to the open space resources located along the Hayward shoreline. Future changes to the Baylands are expected to include the continued restoration of salt and fresh water marshes and upland habitat, improvements to regional levees to protect the shoreline from rising sea levels, and the construction of various trails and compatible recreational facilities throughout the area. *Allowed Uses* • Salt and freshwater marsh • Upland habitat *Supporting Uses* • Ancillary educational and recreational support uses that are compatible with the ecology of the Bay and Baylands (fishing, hiking and bicycling, bird watching, wetland and marshland tours, and kayaking) • Nature centers *Development Standards* • Density: Not applicable • Maximum FAR: 0.05
City of Mountain View (Alviso Ponds A1/A2W)	The City of Mountain View General Plan includes the following goal: Goal LU-15. An area that is a model of highly sustainable and innovative development, protective of natural and biological assets.
City of Redwood City (RWC)	The City of Redwood City General Plan includes the following goal: Goal BE-21: Maintain the viability of the Port of Redwood City as a center for goods and people movement and large-scale industrial activity.

Regional and Local Jurisdictions	Key Provisions
City of San Jose (Alviso Pond A9)	The primary land-use goal contained in the City's General Plan is related to identifying growth areas. **LU-19.4** Reserve areas outside the Greenline/Urban Growth Boundary (UGB) for rural, agricultural, open space, habitat, or other very low-intensity uses. Prohibit new urban development outside of the Greenline/Urban Growth Boundary (UGB). Appropriate land use designations for areas outside of the UGB include Agriculture; Open Hillside; Open Space, Parklands and Habitat; Urban Reserve; and the Open Hillside Golf Course Site Overlay. Other designations may not be applied to lands outside of the UGB. **LU-19.8** Due to the increased potential for some particular environmental impacts on lands located outside of the Urban Growth Boundary, limit new development in these areas to projects that will not result in substantial direct or indirect environmental impacts upon sensitive habitat areas, special status species, geologic hazard avoidance or the visual environment. Additionally, incorporate measures within new development to ensure substantial wildlife corridor protection and prohibit planting of invasive species with the potential to impact sensitive habitat within the project vicinity.
City of South San Francisco (SBS)	The City of Redwood City's General Plan includes the following policy. Implementing policy 2-I-13-As part of development review in environmentally sensitive areas, require specific environmental studies and/or review as stipulated in Section 7.1: Habitat and Biological Resources Conservation.

G.8 **Table G-8. Local Plans and Policies Pertaining to Noise and Vibration**

Regional and Local Jurisdictions	Key Provisions
Alameda County (Eden Landing)	The Countywide Noise Element of the General Plan established interior and exterior noise average noise levels (Ldn) of 45 dBA and 55 dBA respectively for residential land uses based on Federal noise level standards. The Noise Element also references noise compatibility standards developed by the Association of Bay Area Governments, which identified an exterior noise level of 65 dBA CNEL or less as a basis for finding little noise impact on residential land uses, 65 to 70 dBA as a moderate impact, and any level above 70 dBA as a significant impact. Commercial uses allow a maximum of 80dBA exterior noise level. There is a 5 dBA evening "penalty" from 10 PM to 7 AM (County of Alameda 2015). **Policy 11.1-1 Siting of Noise-Sensitive Uses.** Avoid siting new noise-sensitive uses in areas with projected noise levels greater than 70 dBA. Where such uses are permitted, require incorporation of mitigation measures to ensure that interior noise levels are acceptable. (Alameda County General Plan 2014)
San Mateo County (RWC, SBS)	There are a number of San Mateo County goals and objectives that address noise. These are laid out in the 1986 General Plan and include: • *Strive Toward a Livable Noise Environment*: Strive toward an environment for all residents of San Mateo County, which is free from unnecessary, annoying, and injurious noise. • Reduce Noise Impacts Through Noise/Land Use Compatibility and Noise Mitigation • *Promote Protection of Noise Sensitive Land Uses and Noise Reduction in Quiet Areas and Noise Impact Areas*: Promote measures which: (1) protect noise sensitive land uses, (2) preserve and protect existing quiet areas, especially those which contain noise sensitive land uses, and (3) promote noise compatibility in Noise Impact Areas. • *Regulate Distribution of Land Uses*: Regulate the distribution of land uses to attain noise compatibility. Measures may include preference toward locating: (1) noise sensitive land uses within quiet areas, removed from Noise Impact Areas, and (2) noise generating land uses

Regional and Local Jurisdictions	Key Provisions
	separate from noise sensitive land uses. • *Regulate Noise Levels*: Regulate noise levels emanating from noise generating land uses through measures, which establish maximum land use compatibility and nuisance thresholds. • *Site Planning Noise Control:* Incorporate acoustic site planning into the design of new development, particularly large scale, master planned development, through measures which may include: (1) separation of noise sensitive buildings from noise generating sources and (2) use of natural topography and intervening structures to shield noise sensitive land uses. • *Noise Barriers Noise Control:* Promote measures which incorporate use of noise barriers into the design of new development, particularly within Noise Impact Areas. Noise barriers may include earth berms, walls, fencing, or landscaping. • *Construction Techniques Noise Control:* Promote measures that incorporate noise control into the construction of existing and new buildings including, but not limited to, use of dense noise insulating building materials. (County of San Mateo 1986)
Santa Clara County (Alviso)	Chapter VIII, Section B-11 of the Santa Clara County Code prohibits unnecessary, excessive, and annoying noise to ensure public health, welfare and safety (Santa Clara County 2003). It provides maximum exterior noise limits for specific land uses during specified time periods. Permissible noise levels range from 45 to 75 dBA, for residential uses during the night (10 pm to 7 am) to heavy industrial uses anytime during the day, respectively. Residential public space is limited to 55 dBA during the daytime hours (7 am to 10 pm). Higher noise levels are permitted for construction and demolition activities. The maximum noise levels for repetitively scheduled and relatively long-term operation stationary equipment ranges from 60 to 70 dBA between the hours of 7 am to 7 pm, depending on the land use. Noise levels for nonscheduled, intermittent short-term operation increases by 15 dBA above the stationary source. Variance to noise provisions may

Regional and Local Jurisdictions	Key Provisions
	be authorized by the Director, assuming that permitted conditions included by the Director are protective. The Santa Clara County Code also provides exterior noise limits for various receiving land use categories. For one- to two- story residential uses, noise levels cannot exceed 45 and 55 dBA for more than 30 minutes in any hour from 10 pm to 7 am and from 7 am to 10 pm, respectively (Santa Clara County 2003) (SBSPRP 2007). Relevant noise strategies, policies, and implementation include: • Strategy #1: Prevent or Minimize Noise Conflicts. • *Policy C-HS 24.* Environments for all residents of Santa Clara County free from noises that jeopardize their health and well-being should be provided through measures which promote noise and land use compatibility. • *Policy C-HS 25.* Noise impacts from public and private projects should be mitigated. • *Policy C-HS(i) 25.* Prohibit construction in areas which exceed applicable interior and exterior standards, unless suitable mitigation measures can be implemented. (Santa Clara County 2003)
Solano County (Cullinan, Montezuma)	Solano County has a number of policies and guidelines in place to protect residences and other noise- sensitive uses from unacceptable sound levels. • *Policy HS.G-3*: Protect people living, working, and visiting Solano County from the harmful impacts of excessive noise. • *Policy HS.G-4:* Protect important agricultural, commercial, and industrial uses in Solano County from encroachment by land uses sensitive to noise and air quality impacts. • Policy HS.I.71: Locate industrial and other noise-generating land uses away from noise-sensitive land uses and/or require substantial noise sources to be completely enclosed within buildings or structures. Thresholds for unacceptable noise range from 65-80 dBA,

Regional and Local Jurisdictions	Key Provisions
	depending on the receptors. For residential low density, single family, duplex or mobile homes, less than 60 dB is normally acceptable, 55 to 70 dB is conditionally acceptable, 70 to 75 is normally unacceptable, and greater than 75 is clearly unacceptable. Multifamily residential has the same thresholds for unacceptable, but 5 dB higher thresholds for the acceptable ranges. If the ambient noise level exceeds the standard, the standard becomes the ambient level plus 5 dB. Applicable standards are reduced by 5 dB if they exceed the ambient level by 10 or more dB. Solano County does not set legal noise thresholds for wildlife receptors. The closest category is for Playgrounds and Parks, etc., which sets a non-transportation noise standard of 65/75 average dBA Leq and maximum dBA Lmax, respectively. Where it is not possible to reduce noise levels in outdoor activity areas to 60 dB or less using practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB may be allowed, provided that all available exterior noise level reduction measures have been implemented. Noise mitigation is required to reduce construction and other short-term noise impacts above the thresholds already outlined. Related policies: HS.P-48, HS.P-50, HS.P-51, HS.P-52 (Solano County General Plan 2008)
City of Brisbane (SBS)	*Policy 176* Minimize the intrusion of unwarranted and intrusive noise on community life. *Program 176a:* Discourage new sources that generate excessive noise. (City of Brisbane 1994)
City of Hayward (Eden Landing Ponds E1 and E2)	Unacceptable noise levels range from 65 to 80 dBA, depending on type of land use nearby (City of Hayward 2011a). Chapter 4, Article 1, Section 4-1.03.4 of Hayward's Municipal Code (City of Hayward 2011a) allows construction activities to operate an individual device or piece of equipment with noise levels up to

Regional and Local Jurisdictions	Key Provisions
	83 dBA at a distance of 25 feet from the source, and activities that do not produce a noise level exceeding 86 dBA at any point outside of the property plane.
City of Mountain View (Alviso Ponds A1/A2W)	The following policies pertaining to noise are presented in Mountain View's General Plan (City of Mountain View 2012): Policies *NOI 1.1: Land use compatibility.* Use the Outdoor Noise Environment Guidelines as a guide for planning and development decisions. *NOI 1.2: Noise-sensitive land uses.* Require new development of noise-sensitive land uses to incorporate measures into the project design to reduce interior and exterior noise levels to the following acceptable levels: • New single-family developments shall maintain a standard of 65 dBA Ldn for exterior noise in private outdoor active use areas. • New multi-family residential developments shall maintain a standard of 65 dBA Ldn for private and community outdoor recreation use areas. Noise standards do not apply to private decks and balconies in multi-family residential developments. • Interior noise levels shall not exceed 45 dBA Ldn in all new single-family and multi-family residential units. • Where new single-family and multi-family residential units would be exposed to intermittent noise from major transportation sources such as train or airport operations, new construction shall achieve an interior noise level of 65 dBA through measures such as site design or special construction materials. This standard shall apply to areas exposed to four or more major transportation noise events such as passing trains or aircraft flyovers per day. *NOI 1.3: Exceeding acceptable noise thresholds.* If noise levels in the area of a proposed project would exceed normally acceptable thresholds, the City shall require a detailed analysis of proposed noise reduction measures to determine whether the proposed use is compatible. As needed, noise insulation features shall be included in the design of such projects to reduce exterior noise levels to meet acceptable thresholds, or for uses with no active outdoor use areas, to ensure acceptable interior noise levels.

Regional and Local Jurisdictions	Key Provisions
	NOI 1.4: Site planning. Use site planning and project design strategies to achieve the noise level standards in NOI 1.1 (Land use compatibility) and in NOI 1.2 (Noise-sensitive land uses). The use of noise barriers shall be considered after all practical design-related noise measures have been integrated into the project design. *NOI 1.6: Sensitive uses.* Minimize noise impacts on noise-sensitive land uses, such as residential uses, schools, hospitals and child-care facilities. *NOI 1.7: Stationary sources.* Restrict noise levels from stationary sources through enforcement of the Noise Ordinance.
Redwood City (RWC)	Chapter 24 of Redwood City's Municipal Code (City of Redwood City 2012) prohibits excessive and unreasonable noises, defined as (A) noise levels generated by construction activities at more than 110 dB measured at any point within a residential district of the City and outside of the plane of said property, or (B) noise levels generated by an individual item of machinery, equipment or device used during construction activities at more than 110 dB measured within a residential district of the City at a distance of twenty-five feet from said machinery, equipment or device. In addition, construction activities that generate noise levels exceeding the local ambient (measured at any point within the residential district and outside of the plane of said property) are unlawful between the hours of 8:00 p.m. and 7:00 a.m. Monday through Friday, or at any time on Saturdays, Sundays or holidays. The Noise Element of the Redwood City General Plan identifies the objectives and general policies to minimize noise impacts on people, reduce the impact of point noise sources, and reduce ambient noise levels. Applicable policies to achieve such objectives include limiting the hours of operation at all noise generation sources wherever practicable and requiring all exterior noise sources (e.g., construction operations, air compressors, and pumps) to use available noise suppression devices and techniques to bring exterior noise down to acceptable levels compatible with adjacent land. (SPBSPRP 2007) The Noise section of the City of Redwood City's General Plan (City

Regional and Local Jurisdictions	Key Provisions
	of Redwood City, 2010) provides additional guidelines for acceptable noise levels that are compatible with various land use categories. Normally unacceptable ranges for residential land uses are 60 to 75 dB, while commercial and marina land uses have normally unacceptable ranges of 75 to 80 dB. The Port and Industrial uses are much less restrictive; the Plan defines the normally acceptable noise threshold for the Port as less than 75 dBA, the conditionally acceptable threshold as greater than 75 dBA; no threshold is given for an unacceptable noise level. The Redwood City Municipal Code allows construction noise of up to 110 dBA in residential areas and does not provide a threshold for industrial areas. Open Space/Recreation spaces have a normally unacceptable noise range of 75 to 80, with greater than 85 being clearly unacceptable.
City of San Jose (Alviso Pond A9)	The Envision San Jose 2040 General Plan (City of San Jose 2011) states that the city's acceptable noise level objective is 60 dBA DNL or less for residential and most institutional land uses. Section 20.100.450 of the San Jose Municipal Code (City of San Jose 2012) prohibits construction activity on a site located within 500 feet of a residential unit before 7:00 a.m. or after 7:00 p.m. Monday through Friday, or at any time on weekends. In addition, ordinances for different types of zoning districts contained in the Municipal Code set specific noise standards for various land uses**.** These vary from 55 to 70 dBA, with stricter standards set in residential or residential adjacent than commercially used areas and the least stringent standards in industrial zones.
City of South San Francisco (SBS)	Policies governing noise in South San Francisco are laid out in the General Plan and include: Policy 9-G-1 Protect public health and welfare by eliminating or minimizing the effects of existing noise problems, and by preventing increased noise levels in the future. Policy 9-G-2 Continue efforts to incorporate noise considerations into land use planning decisions, and guide the location and design of transportation facilities to minimize the effects of noise on adjacent land uses.

Regional and Local Jurisdictions	Key Provisions
	(City of South San Francisco 2015)

G.9 **Table G-9. Local Plans and Policies Pertaining to Recreation**

Regional and Local Jurisdictions	Key Provisions
All Counties	San Francisco Bay Trail Plan (ABAG 2015d): Polices related to recreational resources in the Bay Trail Plan include the following: *Policy 1.* Trail alignment policies reflect the goal of the Bay Trail program—to develop a continuous trail which highlights the wide variety of recreational and interpretive experiences offered by the diverse bay environment and is situated as close as feasible to the shoreline, within the constraints defined by other policies of the plan. Don Edwards San Francisco Bay National Wildlife Refuge Comprehensive Conservation Plan (CCP) (USFWS 2012): *Public Use, Goal 3:* Provide the local community and other visitors with compatible wildlife oriented outdoor recreation opportunities to enjoy, understand, and appreciate the resources of the Refuge.
Alameda County (Eden Landing Ponds)	The following principles in the Open Space Element of the Alameda County General Plan (Alameda County 1994) are applicable: • Provide a variety of open space for specific open space uses • Provide park and recreation and nature areas in open space adjacent to each community • Limit development within open space areas Under the Recreation Plan, the following principle is relevant: Planning Principle 5. Parks and recreation areas should be planned and developed in conjunction with other conservation and development programs to serve multiple purposes when appropriate, including flood, erosion and watershed control, reservoir development, land conservation and reclamation.

Regional and Local Jurisdictions	Key Provisions
Alameda County (Eden Landing)	EBRPD Master Plan Update 2012 (EBRPD 2012) The Master Plan provides policies and guidelines in order to achieve the highest standards of service in resource conservation, management, interpretation, public access and education. The following policies are related to recreational resources: *Natural Resource Management NRM1:* The District will maintain, manage, conserve, enhance, and restore park wildland resources to protect essential plant and animal habitat within viable, sustainable ecosystems. *Recreational Facilities and Areas (RFA), RFA 2*: The District will provide a diverse system of non-motorized trails to accommodate a variety of recreational users including hikers, joggers, people with dogs, bicyclists and equestrians. Both wide and narrow trails will be designed and designated to accommodate either single or multiple users based on location, recreational intensity, environmental and safety considerations. The District will focus on appropriate trail planning and design, signage and trail users education to promote safety and minimize conflicts between users. *RFA4:* The District will expand its unpaved multi-use trail system as additional acreage and new parks are added. The District will continue to provide multi-use trails to link parks and to provide access to park visitor destinations.
San Mateo County (RWC, SBS)	San Mateo County General Plan Recreation Goals and Objectives (County of San Mateo 1986): *6.1 Equitable and Balanced System of Facilities* Provide for a balanced and equitable system of park and recreation facilities. Consider identified and/or changing needs and the impact upon environmental, service, competing land use, fiscal and organizational constraints.
Santa Clara County GP (Alviso)	In the Parks and Recreation section of the County's General Plan (Santa Clara County 1994), the following policies are relevant: *Policy C-PR 1.* An integrated and diverse system of accessible local and regional parks, scenic roads, trails, recreation facilities, and recreation services should be provided. *Policy C-PR 4*. The public open space lands system should:

Regional and Local Jurisdictions	Key Provisions
	a. preserve visually and environmentally significant open space resources; and b. provide for recreation activities compatible with the enjoyment and preservation of each site's natural resources, with trail linkages to adjacent and nearby regional park lands. *Policy C-PR 9*. The parks and recreation system should be designed and implemented to help attain open space and natural environment goals and policies.
Solano County (Cullinan and Montezuma)	The following components of the Parks and Recreation Element of Solano County's General Plan (Solano County 2008) are applicable: *Objective 1:* Coordinate the planning and development of regional recreational facilities between federal, state, and local agencies within Solano County. *Policy A:* The County shall work with and assist local agencies and districts in identifying and protecting significant regional recreation resources. *Objective 5:* Encourage appropriate multiple uses of public land for recreation and other uses *Policies* A. The County shall make the optimum use of public lands by developing or promoting development of facilities that are compatible with the primary resources of the site. B. The County shall support passive and active recreational uses that are compatible with the primary resources of the land. Resource Chapter: General Marsh/Delta Resource Policies: *RS.P-7:* Preserve and enhance the diversity of habitats in marshes, delta to maintain these unique wildlife resources. *RS.P-9:* Encourage restoration of historic marshes to wetland status, either as tidal marshes or managed wetlands. When managed wetlands are no longer used for waterfowl hunting,

Regional and Local Jurisdictions	Key Provisions
	restore them as tidal marshes. Chapter 12, Suisun Marsh Local Protection Program: The following policies govern the Suisun Marsh: *SM.P-36:* Within the Suisun Marsh, provision should be made for public and private recreational development to allow for public recreation and access to the Marsh for such uses as fishing, hunting, boating, picnicking, hiking and nature study. *SM.P-37:* Recreational uses in the Marsh should be located on the outer portions near population centers and easily accessible from existing roads. *SM.P-38:* Recreational activities that could result in adverse impacts on the environment for the Suisun Marsh should not be permitted. *SM.P-39*: Public access at appropriate locations shall be provided and protected along the county's significant waterways within the Suisun Marsh to the maximum extent feasible. The Suisun Marsh Local Protection Program General Plan policies governing the Suisun Marsh are contained in Chapter 12 and are listed above.
City of Brisbane (SBS)	In the Open Space chapter of the General Plan (City of Brisbane 1994), the following policies are applicable: *Policy 81.1:* Work to preserve open space lands to protect the natural environment and to provide outdoor educational and recreational opportunities consistent with the sensitivity of the resource. *Policy 85:* Encourage the preservation and conservation of aquatic resources in Brisbane: the Lagoon, the Bayfront and the Marsh. *Policy 90:* On an ongoing basis, aggressively seek opportunities to preserve open space.
City of Hayward (Eden	In the Natural Resource Element of the General Plan (City of

Regional and Local Jurisdictions	Key Provisions
Landing ponds)	Hayward 2014), the following policy is applicable: *NR-1.5* Large Scale Natural Area Access The City shall support efforts to improve access to publicly owned large scale natural areas located within the Planning Area, including the shoreline, creeks, regional parks, riparian corridors, and hillside open space areas, by allowing them to be open for controlled access to improve public enjoyment and education, while also limiting access to extremely sensitive natural habitat and minimizing human related environmental impacts.
City of Mountain View (Alviso)	In the Parks, Open Space and Community Facilities Chapter of the General Plan (City of Mountain View 2012), the following policies apply: *POS 2.4:* Access to Bay and natural areas. Promote safe access to San Francisco Bay, creeks, scenic features and other natural resources in the city and surrounding region. *POS 3.1:* Preservation of natural areas. Preserve natural areas, creeks and Shoreline at Mountain View Regional Park primarily for low-intensity uses. In special circumstances more active uses may be permitted if the overall natural character of the larger area is retained.
Redwood City (RWC)	In the Natural Resource Section of the General Plan (Redwood City 2010), the following goals/policies are applicable: *Goal NR-5:* Protect, restore, and maintain creeks, sloughs, and streams to ensure adequate water flow, prevent erosion, provide for viable riparian plant and wildlife habitat and, where appropriate, allow for recreation opportunities. *Policy NR - 5.1*: Restore, maintain, and enhance Redwood City's creeks, streams, and sloughs to preserve and protect riparian and wetland plants, wildlife and associated habitats, and where feasible, incorporate public access. *Policy NR-6.4*: Allow for appropriate public access to bayfront

Regional and Local Jurisdictions	Key Provisions
	open space lands for recreation activities while protecting and restoring the bayfront's natural ecosystem and minimizing environmental damage, as appropriate. *Program NR-40*: Consult with the Bay Conservation Development Commission (BCDC) and other interested stakeholders to integrate public recreation and access opportunities with restoring and preserving bayfront lands.
City of San Jose (Alviso)	Within the Environmental Resource section, in the Parks, Open Space, and Recreation section, and in the Trails Network section of the General Plan (City of San Jose 2007), the following policies may apply: Water Resource Policy *ER-9.4:* Work with the SCVWD to preserve water quality by establishing appropriate public access and recreational uses on land adjacent to rivers, creeks, wetlands, and other significant water courses. Sustainable Parks and Recreation *PR-6.3*: Encourage public land agencies to accept dedications of open space lands of regional significance, including watersheds, wildlife habitats, wetlands, historic sites and scenic lands National Model for Trail Development and Use *TN-1.2:* Minimize environmental disturbance in the design, construction and management of trails.
City of South San Francisco (SBS)	In the Parks, Public Facilities, and Services Chapter of the General Plan (City of South San Francisco 2015), the following goals/policies are relevant: *5.1-G-2*: Improve bayfront access along its entire length and endorse the prominence of this important natural asset. *5.1-G-5:* Develop linear parks in conjunction with major infrastructure improvements and along existing public utility and transportation rights-of-way.

G.10 **Table G-10. Local Plans and Policies Pertaining to Socioeconomics**

Regional and Local Jurisdictions	Key Provisions
Alameda County (Eden Landing)	None found.
San Mateo County (RWC, SBS)	None found.
Santa Clara County (Alviso)	The Santa Clara General Plan lays out policies for implementing strategies to improve the economic wellbeing of the County. Applicable policies include: ***C-EC 3***: Diversification in the mix of local industry should be encouraged in Santa Clara County to achieve a broader base of industrial and commercial activities in order to insulate the local economy from possible future economic down-turns and to provide more lower skilled jobs. ***C-EC 6***: Local governments should work to maintain a favorable climate for businesses. ***C-EC 11***: Local governments should adequately plan for infrastructure improvements needed to accommodate planned growth. ***C-EC 12***: Infrastructure improvement plans should be consistent with local growth management and land use plans. ***C-EC 13***: Existing infrastructure should be adequately maintained. (County of Santa Clara 1994)
Solano County (Cullinan, Montezuma)	Solano County's General Plan lays out the following applicable goals and policies for economic development: ***ED.G-1***: Maintain and improve the County's strong, diversified economic base and provide for a wide range of employment opportunities and support services, such as job training and childcare. ***ED.G-4***: Promote business development by the County and in coordination with cities. ***ED.P-5***: Encourage the retention and expansion of existing businesses and provide support for locally owned businesses.

Regional and Local Jurisdictions	Key Provisions
	ED.P-8**:* Target economic development activities toward particular industries or service areas with special importance to the future of Solano County's economy. ***ED.P-9: Encourage commercial and industrial development to locate in areas with adequate services. Consider the needs of existing and future commercial and industrial uses in infrastructure planning decisions. ***ED.P-10***: Cooperate with cities to identify appropriate locations for large or heavy industrial uses and to maintain and expand the supply of land available for these types of use. ***ED.P-13***: Collaborate with cities to improve infrastructure in targeted areas where necessary to support economic development policies. (Solano County 2008)
City of Brisbane (SBS)	Chapter IV of Brisbane's General Plan provides goals and policies for Local Economic Development, including the following applicable policy: ***Policy 9***: Seek fuller employment of Brisbane residents. (City of Brisbane 1994)
City of Hayward (Eden Landing Ponds E1 and E2)	Part 3.3 of the Hayward General Plan is the Economic Development Element, which contains the following applicable policies: ***ED-1.3 Commercial and Industrial Development*** The City shall encourage commercial and industrial development by ensuring the availability of suitable sites for development and providing appropriate zoning. ***ED-1.4 Emerging and Growing Business Sectors*** The City shall establish business attraction efforts that focus on small and medium-sized businesses within emerging and growing business sectors. ***ED-6.1 Business-Friendly Values*** The City shall ensure that the entire City organization, including employees, volunteers, and elected and appointed officials, understand and embrace Hayward's business-friendly values. (City of Hayward 2014)

Regional and Local Jurisdictions	Key Provisions
City of Mountain View (Alviso Ponds A1/A2W)	None found. (City of Mountain View 2012)
Redwood City (RWC)	The Redwood City General Plan lays out goals and policies for Economic Development, including: ***Guiding Principle:*** Strengthen economic vitality to provide jobs, services, revenues, and opportunities. ***Policy BE-32.2:*** Improve infrastructure and public facilities in targeted areas where necessary to support economic development. ***Policy BE-32.4:*** Maintain the Port of Redwood City as a critically important use, and protect long-term Port, Port-related, and surrounding industrial uses from the encroachment of incompatible land uses as appropriate. ***Policy BE-32.5:*** Encourage emerging industries and businesses. ***Policy BE-34.2:*** Continue to support industries that provide a range of jobs at prevailing living wages through land use policies and other City activities. ***Policy BE-35.1:*** Focus economic development activities toward particular industries or service areas contributing to the city's economy. (City of Redwood City 2010a)
City of San Jose (Alviso Pond A9)	The General Plan for San Jose includes the following applicable policies for promoting broad economic prosperity: ***IE-6.1:*** Provide incentives that promote the creation of high-quality jobs across all industries. ***IE-6.2:*** Attract and retain a diverse mix of businesses and industries that can provide jobs for the residents of all skill and education levels to support a thriving community. ***IE-6.3:*** Attract job opportunities accessible to all of San José's residents, particularly residents in low-income neighborhoods. (City of San Jose 2011)
City of South San Francisco (SBS)	The City of South San Francisco General Plan lays out the following applicable guiding policies for economic development strategy:

Regional and Local Jurisdictions	Key Provisions
	6-G-2: Establish economic development priorities and undertake targeted investments to facilitate expansion, retention, and attraction of businesses that meet the City's economic development objectives. ***6-G-3:*** Maintain and enhance an attractive climate for conducting business in South San Francisco. ***6-G-4:*** Undertake a leadership role in the coordination and completion of infrastructure improvements, and in facilitating environmental remediation, particularly where the City can provide these services more effectively than the private sector. (City of South San Francisco 2015)

G.11 **Table G-11. Local Plans and Policies Pertaining to Utilities/Service Systems**

Regional and Local Jurisdictions	Key Provisions
San Mateo County General Plan (RWC, SBS)	The following policies from the county's General Plan may be applicable: Water Supply Policies *10.1 Coordinate Planning* Coordinate water supply planning with land use and wastewater management planning to assure that the supply and quality of water is commensurate with the level of development planned for an area. *10.2 Safeguarding Water Supplies* Seek to safeguard the productive capacity of groundwater aquifers and storage reservoirs. *10.26 Wastewater Reuse* c. Support small-scale and on-site water recycling technologies, which meet public health and safety standards, for landscaping and agriculturalpurposes. Wastewater policies *11.7 Phasing Sewerage Improvements* Phase the development of wastewater facility improvements in areas with substantial growth potential so that sufficient capacity becomes available when needed by new growth in accordance with adopted land use plans. *11.9 Sewerage Capacity for Priority Land Uses* Provide for the reservation of sewerage capacity for priority land uses where required by State law or local policy.
Redwood City General Plan (RWC Channel)	Policies from the *Infrastructure Element* (adopted in 1990 and updated in 2010) of the General Plan (Redwood City 2010) are excerpted below. **Policy BE-40.1:** Improve the level of service, reliability, quality, and life cycle of the city's potable and recycled water storage and distribution system. **Policy BE-40.2:** Maintain the city's water system to ensure adequate fire flow. **Policy BE-41.1:** Continue to ensure adequate treatment capacity

Regional and Local Jurisdictions	Key Provisions
	and collection system for Redwood City's wastewater conveyed to at South Bayside System Authority (SBSA) treatment facilities while protecting water quality and public health, and minimizing adverse impacts to the environment. **Policy BE-41.3:** Minimize groundwater infiltration and inflow to the wastewater collection system to maintain sufficient peak wet weather capacity and continue to explore other possible options to reduce peak wet weather flow. **Policy BE-42.1:** Require that improvements and maintenance to electric and gas transmission and distribution systems that are made to accommodate new growth be performed in a manner that maintains safety, reliability, and environmental compatibility. **Policy BE-42.3:** Accommodate alternative energy infrastructure as new technology evolves. **Policy BE-43.3:** Make efforts to accommodate future communications and information technologies as they develop and to replace or remove redundant or outdated technology and its associated equipment. **Policy BE-44.2:** Continue to require the placement of utilities underground with new development. **Policy BE-45.1:** Meet or exceed State mandates regarding the diversion of waste from landfills. **Policy BE-45.4:** Support retention and expansion of businesses and industries in Redwood City involved in recycling materials, especially in areas proximate to the Port of Redwood City.
City of Brisbane (SBS)	In the Community Health and Safety chapter of the city's General Plan (1994) the following policies may apply to utilities: *Policy 206* Upgrade and maintain the existing water distribution system. *Policy 212* Monitor the City's sanitary sewer trunk lines in Central Brisbane and the lines in Crocker Park for signs of failure and to identify areas in need of repair. *Policy 219* Monitor the City's storm drain system for signs of siltation and flooding. Identify areas in need of maintenance, repair or replacement. *Policy 224* In conjunction with development applications that place

Regional and Local Jurisdictions	Key Provisions
	substantial increased demands upon the existing system, require that the system be upgraded or replaced to the satisfaction of the City. Contributions from responsible parties should be proportional to the impact of their projects.
City of South San Francisco (SBS)	Guiding Policies applicable to Utilities are listed under the Parks, Public Facilities, and Services Element of the City's General Plan (City of SSF 2015). *5.3-G-1 Promote the orderly and efficient operation and expansion of the water supply system to meet projected needs.* *5.3-G-4 Promote the orderly and efficient operation and expansion of the wastewater system to meet projected needs.* *5.3-G-6 Maintain environmentally appropriate wastewater management practices.*
Solano County (Cullinan, Montezuma)	Utility policies within the Public Service and Facilities chapter of the General Plan (Solano County 2008) are directed at locating future utility alignments and avoiding disruption to natural areas. The following policies are applicable: PF.P-49: Use parallel or existing rights-of-way for gas, electric, and telephone utility alignments in a manner that avoids heavily developed areas. PF.P-50: Locate, design, and construct transmission lines in a manner that minimizes disruption of natural vegetation, agricultural activities, scenic areas, and avoids unnecessary scarring of hill areas. PF.P-51: Encourage undergrounding of local utility distribution lines where feasible. PF.P-52: Increase high-speed wireless access for all residents.
Alameda County (Eden Landing)	The Public Service and Utilities Element of the General Plan (Alameda County 1994) was adopted in 2013. The goal is to Provide public services and utilities that are designed, located, and sized to serve existing and future development. The following policies are applicable to Utilities: Policy 9.7-1 Non-Municipal Utility Supply. Coordinate with nonmunicipalutility providers to monitor the need for utility expansion to ensure that facilities are designed and planned to minimize the impact on existing and future residents.

Regional and Local Jurisdictions	Key Provisions
	Policy 9.7-2 Transmission Line Corridors. Work with PG&E to improve the appearance of transmission line corridors and promote joint use of corridors to the extent feasible. Policy 9.7-3 Undergrounding Utilities. With the exception of high voltage lines and facilities, install all utilities underground within residential and commercial areas and in scenic open space areas.
City of Hayward (Eden Landing)	Under the General Plan Public Facilities and Service element (City of Hayward 2014), the following policy may apply: **PFS-3.5 Water System Reliability** The City shall focus major water system projects on improving water system reliability, and shall replace or repair water lines that are leaking or otherwise meet the City's criteria for replacement, when deemed financially feasible. **PFS-3.16 Recycled Water** ☐ The City shall increase use of recycled water where appropriate, cost effective, safe, and environmentally sustainable. The City shall work with regional partners to encourage expansion of recycled water infrastructure. **PFS-4.7 Reduce Infiltration/Inflow** The City shall develop and implement a plan to repair or replace underperforming wastewater facilities serving the community to remove excessive infiltration/inflow. **PFS-5.1 Accommodate New and Existing Development** The City shall work with the Alameda County Flood Control and Water Conservation District to expand and maintain major stormwater drainage facilities to accommodate the needs of existing and planned development. **PFS-8.2 Utility Providers** The City shall encourage utility providers to provide efficient, reliable, affordable, and state-of-the-art service, and shall promote technological improvements and upgrading of utility services. **PFS-9.1 Access and Availability** The City shall work with service providers to ensure access to and availability of a wide range of state-of-the-art telecommunication systems and services for households, businesses, institutions,

Regional and Local Jurisdictions	Key Provisions
	public spaces, and public agencies throughout the city.
Santa Clara County (Alviso)	Under the Resource Conservation and the Health and Safety chapters of the General Plan (Santa Clara County 1994), the following policies are relevant: *C-RC 22* Countywide, compliance should be achieved with the requirements of the National Pollution Discharge Elimination System (NPDES) permit for discharges into S.F. Bay, and to that end, the Countywide Nonpoint Source Pollution Control Program should receive the full support and participation of each member jurisdiction. C-HS 42 The long-term viability and safety of underground aquifers and groundwater systems countywide shall be protected to highest degree feasible.
City of Mountain View (Alviso Ponds A1/A2W)	The Infrastructure and Services section of the city's General Plan (City of Mountain View 2012) contains policies which outline the City's approach to providing infrastructure in the future and to ensuring the continued operation of infrastructure at all times. The following policies may be applicable: *INC 1.5: Utility service.* Coordinate with all utility providers to ensure safe and adequate utility services. *INC 2.2: Emergency service providers.* Ensure long-term reliability from service providers and suppliers, especially in the case of an emergency or natural disaster. *INC 3.6: Utility separation.* Preserve adequate separations between utilities and reserve future City pipeline corridors in public streets to maintain and continue to provide public utilities. *INC 6.1: Citywide wastewater.* Ensure high-quality wastewater collection services and a well-maintained wastewater system. *INC 7.3: Recycled water in parks.* Promote the use of recycled water at City parks and open spaces or where available. *INC 8.1: Citywide stormwater system.* Maintain the stormwater system in good condition. *INC 8.2: National Pollutant Discharge Elimination System Permit.* Comply with requirements in the Municipal Regional Stormwater National Pollutant Discharge Elimination System Permit (MRP). *INC 9.1: Citywide telecommunications.* Work with

Regional and Local Jurisdictions	Key Provisions
	telecommunication service providers to ensure high-quality products and services for Mountain View residents and businesses.
City of San Jose (Alviso Pond A9)	The following provisions in the Infrastructure section of the city's General Plan (City of San Jose 2007) may apply: **IN-1.1** Provide and maintain adequate water, wastewater, and stormwater services to areas in and currently receiving these services from the City. **IN-1.2** Consistent with fiscal sustainability goals, provide and maintain adequate water, wastewater, and stormwater services to areas in the city that do not currently receive these City services upon funding and construction of the infrastructure necessary to provide them. **IN-1.8** To achieve economy and efficiency in the provision of services and facilities, support the development of joint-use water, stormwater, and other utility facilities as appropriate in conjunction with schools, parks, golf courses, and other suitable uses. **IN-3.7** Design new projects to minimize potential damage due to storm waters and flooding to the site and other properties. **IN-3.8** In designing improvements to creeks and rivers, protect adjacent properties from flooding consistent with the best available information and standards from the Federal Emergency Management Agency (FEMA) and the California Department of Water Resources (DWR). Incorporate **IN-6.1** Work with service providers to ensure access to and availability of a wide range of state-of-the-art telecommunication systems and services for households, businesses, institutions, and public agencies throughout the city. **IN-6.2** Work with utility companies to retrofit areas that are not served by current telecommunication technologies and provide strategic long-range planning of telecommunication facilities for newly developing areas, as feasible.

G.12 **Table G-12. Local Plans and Policies Pertaining to Water Quality and Hydrology**

Regional and Local Jurisdictions	Key Provisions
Alameda County (Eden Landing)	The Alameda County General Plan has the flowing policies: C-RC 19 The strategies for maintaining and improving water quality on a countywide basis, in addition to ongoing point source regulation, should include: • effective non-point source pollution control; • restoration of wetlands, riparian areas, and other habitats which serve to improve Bay water quality; and • comprehensive Watershed Management • Plans and "best management practices" (BMPs). C-RC 20 Adequate safeguards for water resources and habitats should be developed and enforced to avoid or minimize water pollution of various kinds, including: • erosion and sedimentation; • organic matter and wastes; • pesticides and herbicides; • effluent from inadequately functioning septic systems; • effluent from municipal wastewater treatment plants; • chemicals used in industrial and commercial activities and processes; • industrial wastewater discharges; • hazardous wastes; and • non-point source pollution. R-RC 10 For lands designated as Resource Conservation Areas (Hillsides, Ranchlands, Agriculture, and Baylands) and for Rural Residential areas, water resources shall be protected by encouraging land uses compatible and consistent with maintenance of surface and ground water quality. • Uses that pose a significant potential hazard to water quality should not be allowed unless the potential impacts can be adequately mitigated. • The amounts of impervious surfaces in the immediate vicinity of water courses or reservoirs should be minimized. R-LU 3 The general intent of each 'Resource Conservation Area' designation is to encourage land uses and densities appropriate to

Regional and Local Jurisdictions	Key Provisions
	the rural unincorporated areas that also: • help preserve rural character; • conserve natural, scenic, and cultural resources; • protect public health and safety from natural and man-made hazards; • preserve agriculture and prime agricultural soils; • protect watersheds and water quality; • enhance air quality; and • minimize the demand for and cost of public services and facilities.
San Mateo County (RWC, SBS) http://planning.smcgov.org/documents/general-plan-policies	The San Mateo General Plan includes the following policies: 1.1 Conserve, Enhance, Protect, Maintain and Manage Vegetative, Water, Fish and Wildlife Resources Promote the conservation, enhancement, protection, maintenance and managed use of the County's Vegetative, Water, Fish and Wildlife Resources. 1.22 Importance of Economically Valuable Vegetative, Water, Fish and Wildlife Resources. Consider Vegetative, Water, Fish and Wildlife Resources which are economically valuable as a priority resource to be enhanced, utilized, managed and maintained for the needs of present and future generations. REGULATION OF DEVELOPMENT 1.23 Regulate Development to Protect Vegetative, Water, Fish and Wildlife Resources. a. Regulate land uses and development activities to prevent, and if infeasible mitigate to the extent possible, significant adverse impacts on vegetative, water, fish and wildlife resources. b. Place a priority on the managed use and protection of vegetative, water, fish and wildlife resources in rural areas of the County. 1.24 Regulate Location, Density and Design of Development to Protect Vegetative, Water, Fish and Wildlife Resources. Regulate the location, density and design of development to minimize significant adverse impacts and encourage enhancement of

Regional and Local Jurisdictions	Key Provisions
	vegetative, water, fish and wildlife resources. RESOURCE PROTECTION 1.25 Protect Vegetative Resources. Ensure that development will: (1) minimize the removal of vegetative resources and/or; (2) protect vegetation which enhances microclimate, stabilizes slopes or reduces surface water runoff, erosion or sedimentation; and/or (3) protect historic and scenic trees. 1.26 Protect Water Resources. Ensure that development will: (1) minimize the alteration of natural water bodies, (2) maintain adequate stream flows and water quality for vegetative, fish and wildlife habitats; (3) maintain and improve, if possible, the quality of groundwater basins and recharge areas; and (4) prevent to the greatest extent possible the depletion of groundwater resources. PRODUCTIVE USES 1.34 Regulate Productive Uses of Vegetative, Water, Fish and Wildlife Resources. Regulate resource productive uses which are subject to local control in order to prevent and if infeasible mitigate to the extent possible significant adverse impacts on vegetative, water, fish and wildlife resources and to maintain and enhance the (1) productivity of forests and other vegetative resources; (2) productive capacity and quality of groundwater basins and recharge areas, streams, reservoirs, and other water bodies; (3) productivity of fisheries and other fish and wildlife resources; and (4) the recreational value and aesthetic value of these areas. 1.35 Protect Productive Uses of Vegetative, Water, Fish and Wildlife Resources. Regulate development in order to protect and promote the managed use of vegetative, water, fish and wildlife resources. 1.37 Protect the Productive Use of Water Resources. Ensure that

Regional and Local Jurisdictions	Key Provisions
	land uses and development on or near water resources will not impair the quality or productive capacity of these resources. 1.41 Encourage Coordinated, Countywide Management of Vegetative, Water, Fish and Wildlife Resources.
Santa Clara County (Alviso) http://www.sccgov.org/sites/planning/PlansPrograms/GeneralPlan/Documents/GP_Book_B.pdf	In the Santa Clara General Plan Book A, the site is designated as a "Resource Conservation Area." The relevant Resource Conservation (RC) Element and Land Use (LU) Element policies are: R-LU 3: The general intent of each "Resource Conservation Area" designation is to encourage land uses and densities appropriate to the rural unincorporated areas that also: • help preserve rural character; • conserve natural, scenic, and cultural resources; • protect public health and safety from natural and man-made hazards; • preserve agriculture and prime agricultural soils; • protect watersheds and water quality; • enhance air quality; and • minimize the demand for and cost of public services and facilities. Goals for Responsible Resource Conservation: 1.1 Natural environmental resources such as wildlife, vegetation, soils, air, water and minerals permanently protected and managed for their functional and ecological values. • C-RC 18 Water quality countywide should be maintained and improved where necessary to ensure the safety of water supply resources for the population and the preservation of important water environments and habitat areas. • C-RC 19 The strategies for maintaining and improving water quality on a countywide basis, in addition to ongoing point source regulation, should include: o effective non-point source pollution control; o restoration of wetlands, riparian areas, and other habitats which serve to improve Bay water quality; and o comprehensive Watershed Management o Plans and "best management practices" (BMPs). • C-RC 20 Adequate safeguards for water resources and

Regional and Local Jurisdictions	Key Provisions
	habitats should be developed and enforced to avoid or minimize water pollution of various kinds, including: o erosion and sedimentation; o organic matter and wastes; o pesticides and herbicides; o effluent from inadequately functioning septic systems; o effluent from municipal wastewater treatment plants; o chemicals used in industrial and commercial activities and processes; o industrial wastewater discharges; o hazardous wastes; and o non-point source pollution. • R-RC 10 For lands designated as Resource Conservation Areas (Hillsides, Ranchlands, Agriculture, and Baylands) and for Rural Residential areas, water resources shall be protected by encouraging land uses compatible and consistent with maintenance of surface and ground water quality. o Uses that pose a significant potential hazard to water quality should not be allowed unless the potential impacts can be adequately mitigated. o The amounts of impervious surfaces in the immediate vicinity of water courses or reservoirs should be minimized.
Solano County (Cullinan, Montezuma) http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp. Accessed 4/9/15	The Solano County General Plan includes the following goals: • RS.G-1: Manage and preserve the diverse land, water, and air resources of the county for the use and enrichment of the lives of present and future generations. • RS.G-9: Protect, monitor, restore and enhance the quality of surface and groundwater resources to meet the needs of all beneficial uses. • RS.G-10: Foster sound management of the land and water resources in Solano County's watersheds to minimize erosion and protect water quality using best management practices and protect downstream waterways and wetlands.

Regional and Local Jurisdictions	Key Provisions
Alameda County Flood Control District (Zone 3A) (Eden Landing) http://acfloodcontrol.org/projects-and-programs/environmental-restoration/eden-landing-salt-ponds. Accessed 2.22.15. http://acfloodcontrol.org/about-the-district/history-of-the-district/district-act-205. Accessed 2.22.15.	Alameda Flood Control and Water Conservation Act 205 includes the following policy: #4. The objects and purposes of this act are to provide for the control of the flood and storm waters of said district and the flood and storm waters of streams that have their source outside of said district, but which streams and the flood waters thereof flow into said district, and to conserve such waters for beneficial and useful purposes by spreading, storing, retaining and causing to percolate into the soil within said district, or without such district, such waters, or to save or conserve in any manner all or any of such waters and protect from such flood or storm waters the watercourses, watersheds, harbors, public highways, life and property in said district, and to prevent waste of water or diminution of the water supply in, or exportation of water from said district and to obtain, retain and reclaim drainage, storm, flood and other waters for beneficial use in said district, and to engage in recreation activities incidental to and in connection with said purposes.
Santa Clara Valley Water District (District 7) (Alviso) http://www.valleywater.org/Services/EnvironmentalEnhancementProgram.aspx Accessed 2.22.15.	The Santa Clara Valley Water District Act includes the following applicable policies: The district may take actions to do all of the following: • Protect, save, store, recycle, distribute, transfer, exchange, manage, and conserve in any manner any of the waters. • Enhance, protect, and restore streams, riparian corridors, and natural resources in connection with carrying out the purposes set forth in this section.
City of Brisbane (SBS) http://www.ci.brisbane.ca.us/sites/default/files/brisbaneca/ChapterIXConservation.pdf Accessed 1.8.15	The City of Brisbane General Plan includes the following policy: Policy 131: Emphasize the conservation of water quality and of riparian and other water-related vegetation, especially that which provides habitat for native species, in planning and maintenance efforts.
City of Hayward (Eden Landing Ponds E1 and E2). http://www.hayward-ca.gov/generalplan/. Accessed 4/9/15.	The General Plan includes the following applicable goal: Improve overall water quality by protecting surface and groundwater sources, restoring creeks and rivers to their natural state, and conserving water resources.
City of Mountain View	The City of Mountain View General Plan has “Species and habitat”

Regional and Local Jurisdictions	Key Provisions
(Alviso Ponds A1/A2W) http://www.mountainview.gov/depts/comdev/planning/regulations/general.asp. Accessed 4/9/15	policies that protect and sustainably manage the unique biological resources within the city. The General Plan also has "Watershed management" policies that promote an integrated approach to sustainable watershed management while recognizing the different roles watershed management plays in protecting surface water quality, stormwater management, protecting the potable water supply, protecting valuable biological resources and protecting property and public safety from the threat of flooding. Watershed management policies address protection of surface water and groundwater recharge.
City of Redwood City (RWC) http://www.redwoodcity.org/phed/planning/generalplan/FinalGP_Docs.html http://www.redwoodcity.org/phed/planning/generalplan/FinalGP/05_Natural%20Resourses_FINAL.pdf. Accessed 12/8/15.	The City of Redwood City General Plan Natural Resources Element includes the following goal: • Goal NR-5: Protect, restore, and maintain creeks, sloughs, and streams to ensure adequate water flow, prevent erosion, provide for viable riparian plant and wildlife habitat and, where appropriate, allow for recreation opportunities. • Goal NR-6: Preserve and enhance the baylands, natural wetlands, and ecosystem to assist with improved air quality and carbon dioxide sequestration. • Goal NR-7: Reduce pollution from stormwater runoff in our creeks and the San Francisco Bay.
City of San Jose (Alviso Pond A9) https://www.sanjoseca.gov/index.aspx?nid=1737. Accessed 4/9/15	The applicable environmental resources goals included in the City's General Plan areas are: • Goal ER-3 – Bay and Baylands. Preserve and restore natural characteristics of the Bay and adjacent lands, and recognize the role of the Bay's vegetation and waters in maintaining a healthy regional ecosystem. • Goal ER-9 – Water Resources. Protect water resources because they are vital to the ecological and economic health of the region and its residents.
City of South San Francisco (SBS) http://www.ssf.net/360/Read-the-Plan. Accessed 4/9/15	The City of South San Francisco's General Plan Water Quality Guiding Policies includes the following policy: • 7.2-G-1 Comply with the San Francisco Bay RWQCB regulations and standards to maintain and improve the quality of both surface water and groundwater resources. • 7.2-G-2 Enhance the quality of surface water resources and

Regional and Local Jurisdictions	Key Provisions
	prevent their contamination. • 7.2-G-3 Discourage use of insecticides, herbicides, or toxic chemical substances within the city.

Draft Integrated Feasibility Report and Environmental Impact Statement/Environmental Impact Report

Appendix H

Contract No. W912P7-11-D-0004
Task Order No. 0013

Special-status Species



Prepared for:
U.S. Army Corps of Engineers, San Francisco District

Prepared by:
HydroPlan LLC, in collaboration with
GAIA
Moffatt and Nichol

July 2015

This page was intentionally left blank.

H. Special-status Flora and Fauna with Potential to Occur in the Project Area

Contents

H. Special-status Flora and Fauna with Potential to Occur in the Project Area H-1

H.1 Table H-1. Special-status Aquatic Species with Potential to Occur in the Project Area-Dredge Sites and SF-DODS H-2

H.2 Table H-2. Special-status Aquatic Species with Potential to Occur at Placement Sites in the Project Area – Eden, Alviso, Cullinan, Montezuma.....H-15

H.3 Table H-3. Special-status Terrestrial Species with Potential to Occur at Dredge Sites in the Project Area and SF-DODS....H-24

H.4 Table H-4. Special-status Terrestrial Species with Potential to Occur at Placement Sites in the Project Area – Eden, Alviso, Cullinan, and Montezuma.....H-50

H.1 **Table H-1. Special-status Aquatic Species with Potential to Occur in the Project Area-Dredge Sites and SF-DODS**

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
FISH					
Chinook salmon - Central Valley fall / late fall-run ESU *(Oncorhynchus tshawytscha)*	NMFS-SC/SSC	Spawns in fresh water; juveniles rear in fresh and estuarine water before migrating to the ocean. Require clean, cold water and gravel beds for spawning. Central Valley rivers and streams; critical habitat for winter-run Chinook designated in San Pablo Bay (58 FR 33213). The chinook salmon is an anadromous fish, spawning in freshwater rivers and streams, but spends most of its adult life at sea. Almost all chinook salmon occurring in San Francisco Bay are from the Sacramento-San Joaquin watershed. Chinook salmon have not historically spawned in streams flowing into South San Francisco Bay. Since the mid-1980s, however, small numbers of fall-run chinook salmon have been found in several such streams, including Coyote Creek, Los Gatos Creek, and the Guadalupe River. These fish are probably strays from Central Valley	Potential to occur. Suitable spawning habitat is not present, however foraging habitat for the species may be present within aquatic habitats near Bair Island. Adult chinook use open water areas within the Bay during migration and may occasionally be present in the slough channels at Bair Island Juveniles also may forage within the tidal waters adjacent to Bair Island.	Potential to occur. Suitable foraging habitat for the species may be present. Adult chinook use open water areas within the Bay during migration.	Low potential to occur.

[1] Confirmed using the 2015 Threatened and endangered animal list, Threatened, Endangered and Rare Plant List, and Fully Protected Animal List. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed 3/3/2015.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		runs. These fall-run chinook salmon typically arrive in South San Francisco Bay streams in October or later. No spawning occurs in streams adjacent to Bair Island. Juvenile fish of all runs could forage in tidal wetlands throughout San Francisco Bay, including those around Bair Island.			
Chinook salmon - Central Valley spring-run ESU *(Oncorhynchus tshawytscha)*	FT/ST	Spawns in fresh water; juveniles rear in fresh and estuarine water before migrating to the ocean. Require clean, cold water and gravel beds for spawning. Central Valley rivers and streams; critical habitat for winter-run Chinook designated in San Pablo Bay (58 FR 33213). The chinook salmon is an anadromous fish, spawning in freshwater rivers and streams, but spends most of its adult life at sea. Almost all chinook salmon occurring in San Francisco Bay are from the Sacramento-San Joaquin watershed. Chinook salmon have not historically spawned in streams flowing into South San Francisco Bay. Since the mid-1980s, however, small numbers of fall-run chinook salmon have been found in	Low potential to occur. Adult and juveniles chinook may use open water areas during migration.	Low potential to occur. Adult and juveniles chinook may use open water areas during migration.	Low potential to occur.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		several such streams, including Coyote Creek, Los Gatos Creek, and the Guadalupe River. These fish are probably strays from Central Valley runs. These fall-run chinook salmon typically arrive in South San Francisco Bay streams in October or later. No spawning occurs in streams adjacent to Bair Island. Juvenile fish of all runs could forage in tidal wetlands throughout San Francisco Bay, including those around Bair Island.			
Chinook salmon - Sacramento River winter-run ESU *(Oncorhynchus tshawytscha)*	FE/SE	Spawns in fresh water; juveniles rear in fresh and estuarine water before migrating to the ocean. Require clean, cold water and gravel beds for spawning. Central Valley rivers and streams; critical habitat for winter-run Chinook designated in San Pablo Bay (58 FR 33213). The chinook salmon is an anadromous fish, spawning in freshwater rivers and streams, but spends most of its adult life at sea. Almost all chinook salmon occurring in San Francisco Bay are from the Sacramento-San Joaquin watershed. Chinook salmon have not historically spawned in	Low potential to occur. Adult and juveniles chinook may use open water areas during migration.	Low potential to occur. Adult and juveniles chinook may use open water areas during migration.	Low potential to occur.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		streams flowing into South San Francisco Bay. Since the mid-1980s, however, small numbers of fall-run chinook salmon have been found in several such streams, including Coyote Creek, Los Gatos Creek, and the Guadalupe River. These fish are probably strays from Central Valley runs. These fall-run chinook salmon typically arrive in South San Francisco Bay streams in October or later. No spawning occurs in streams adjacent to Bair Island. Juvenile fish of all runs could forage in tidal wetlands throughout San Francisco Bay, including those around Bair Island.			
Coho salmon - central California coast ESU *(Oncorhynchus kisutch)*	FE/SE	Rears and forages for first half of life in streams and small freshwater tributaries. Spawns in small streams with stable gravel substrates. The remainder of the life cycle is spent foraging in estuarine and marine waters of the Pacific Ocean. Need cool, clear water with instream cover in streams. Spawn in tributaries to large rivers or streams directly connected to the ocean.	Not expected to occur. Spawns in streams directly connected to the ocean.	Not expected to occur. Spawns in streams directly connected to the ocean.	Low potential to occur.
Delta smelt	FT/SE	Inhabit slightly brackish and turbid	Not expected to	Not expected to	Not expected to

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
(Hypomesus transpacificus)		deltas, estuaries, backwater sloughs and marshes, or other edgewaters. School in open surface waters. Found primarily in the Delta below Isleton on the Sacramento River and below Mossdale on the San Joaquin River, as well as in Suisun Bay Designated critical habitat for the Delta smelt includes the Delta west to the Carquinez Bridge. Spawning occurs primarily in sloughs and shallow edge-waters of channels in the upper Delta and in the Sacramento River.	occur. No suitable habitat within the Project Area.	occur. No suitable habitat within the Project Area.	occur. No suitable habitat within the Project Area.
North American Green sturgeon, Southern DPS *(Acipenser medirostris)*	FT/NMFS-SC/SSC	An anadromous fish that spawns in well-oxygenated, cool, riverine habitat; juveniles rear in estuarine waters. Spends majority of life in nearshore oceanic waters, bay, and estuaries. Spawns in Sacramento River but not known to spawn in South Bay. Expected to occur only as a rare and irregular visitor to estuarine habitats in the South Bay / Alviso Slough. Green sturgeon is known to forage in estuaries and bays, including San Francisco Bay. Adult green sturgeon probably enter the San Francisco Bay estuary and	Low potential to occur. Not known to spawn in South Bay. Known to be present in the South Bay and expected to occur only as a rare and irregular visitor to estuarine habitats in the South Bay.	Low potential to occur. May use open water areas during migration.	Low potential to occur.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		move up the Sacramento River in early spring. The San Joaquin-Sacramento Delta and San Francisco Bay including the South Bay is are critical habitat for the green sturgeon Southern DPS.			
Longfin smelt, Bay-Delta DPS *(Spirinchus thaleichthys)*	FC/ST/SSC	Adult habitat includes bays, estuaries, and nearshore coastal areas. Longfin smelt migrate into low salinity or freshwater reaches of coastal rivers and tributary streams to spawn. Spawns in lower Sacramento-San Joaquin River and Suisun Bay; pre-spawning adults and juveniles inhabit shoal areas of San Pablo Bay. Spawns in tidally influenced freshwater wetlands and seasonally submerged uplands. Generally found in estuarine bays. Occurs in Alviso Slough. Spend the majority of their lives within the San Francisco Bay, moving upstream to spawn in low salinity waters in winter/spring.	Potential to occur. Found south to Dumbarton Bridge	Potential to occur. Found south to Dumbarton Bridge	Low Potential to occur. Longfin smelt occasionally migrate between estuaries on the West Coast.
River lamprey (*Lampreta ayresii)*	-/SSC	Lower Sacramento and San Joaquin Rivers, Napa River, Sonoma Creek, Alameda Creek, Salmon Creek, Russian River tributaries, and tributaries to San Francisco Bay.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		Spawn in fresh water habitats in gravelly riffles; ammocoetes (juveniles) rear in fresh water for 3–5 years before migrating to the ocean (Sears Point 2009)			
Sacramento splittail *(Pogonichthys macrolepidotus)*	-/-/SSC	The species is tolerant of brackish water and can be found in Suisun Bay, San Pablo Bay, the Napa River, and the Carquinez Strait following high fresh water outflows from the Delta Region. At present, its range includes the main channel of the Sacramento River, the lower part of the Delta, the Napa and Petaluma Rivers, and sloughs adjoining Suisun Bay and San Pablo Bay. Spawn over submerged vegetation in flooded areas, typically where the water depth is at least 3 feet. Spawning habitat includes disjunct segments of floodplain adjacent to the Sacramento and San Joaquin rivers and tributaries.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Steelhead - central California coast DPS *(Oncorhynchus mykiss irideus)*	FT/-	Spawns in fresh water; juveniles rear in fresh and estuarine water before migrating to the ocean. Cool streams with suitable spawning habitat and conditions allowing migration, as well as marine	Potential to occur. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the South	Potential to occur. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the	Potential to occur.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		habitats. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the San Francisco Bay on their migrations to and from upstream spawning areas. Steelhead usually migrate upstream to spawning areas in late fall or early winter. Spawning occurs between December and March in streams in the San Francisco Bay Area. Critical habitat is Coastal streams in California; critical habitat in San Pablo Bay (70 FR 52571). The Central California Coast ESU occupies includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in California streams from the Russian River, Sonoma County, CA, (inclusive) to Aptos Creek, Santa Cruz County, CA, (inclusive), and the drainages of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), Napa County, CA. Occurs in Alviso Slough.	Bay on their migrations to and from upstream spawning areas. Suitable spawning habitat not present within streams near the Project Area, however adult steelhead may utilize the slough channels along Bair Island for foraging during migration.	South Bay on their migrations to and from upstream spawning areas.	
Steelhead - Central Valley DPS *(Oncorhynchus*	FT/-	Spawns in fresh water; juveniles rear in fresh and estuarine water before migrating to the ocean. Cool	Potential to occur. Steelhead use estuarine habitats as	Potential to occur. Steelhead use estuarine habitats	Potential to occur.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
mykiss irideus)		streams with suitable spawning habitat and conditions allowing migration, as well as marine habitats. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the San Francisco Bay on their migrations to and from upstream spawning areas. Steelhead usually migrate upstream to spawning areas. Critical habitat is Coastal streams in California; critical habitat in San Pablo Bay (70 FR 52571).	rearing habitat for juveniles, and move through the South Bay on their migrations to and from upstream spawning areas.	as rearing habitat for juveniles, and move through the South Bay on their migrations to and from upstream spawning areas.	
INVERTEBRATES					
Black abalone *(Haliotes cracherodii)*	FE/-	During low tides, these marine gastropods can typically be found wedged into crevices, cracks, and holes of intertidal and shallow subtidal rocks, where they are fairly concealed. They generally occur in areas of moderate to high surf. However, when immersed or during night time, they have been observed using their muscular feet to move freely over rock surfaces. Black abalone can withstand extreme variation in temperature, salinity, moisture, and wave action.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Mammals					

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
Blue whale *(Balaenoptera musculus)*	FE/-	Inhabits and feeds in both coastal and pelagic environments. Blue whales are frequently found on the continental shelf (e.g., in areas off the California coast) and also far offshore in deep water (e.g., in the northeastern tropical Pacific)	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. Suitable habitat within the Project Area.
Finback (=fin) whale *(Balaenoptera physalus)*	FE/-	Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes, and less commonly in the tropics. They occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. Suitable habitat within the Project Area.
North Pacific right whale *(Eubalaena japonica)*	FE/SFP	Most known right whale nursery areas are in shallow, coastal waters. Right whales have occurred historically in all the world's oceans from temperate to subpolar atitudes. They primarily occur in coastal or shelf waters, although movements over deep waters are known. Right whales migrate to higher latitudes during spring and summer.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. Suitable habitat within the Project Area.
Sei whale *(Balaenoptera*	FE/-	Sei whales prefer subtropical to subpolar waters on the continental	Not expected to occur. No suitable	Not expected to occur. No suitable	Potential to occur. Suitable habitat

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
borealis)		shelf edge and slope worldwide. They are usually observed in deeper waters of oceanic areas far from the coastline.	habitat within the Project Area.	habitat within the Project Area.	within the Project Area.
Sperm whale *(Physeter catodon (=macrocephalus))*	FE/-	Sperm whales are found in the Atlantic, Pacific, Indian, and Arctic Oceans: sperm whales roam the deep waters of all the oceans, though they seldom approach polar ice fields and are most common in temperate and tropical latitudes. They have also been seen occasionally near coastlines in the Gulf of Mexico, where they were once quite common. Sperm whales swim through deep waters to depths of 3,219external link m, apparently limited in depth only by the time it takes to swim down and back to the surface. Their distributions depend upon season and sexual/social status, however they are most likely to be found in waters inhabited by squid—at least 1,000 external link m deep and with cold-water upwellings. (MarineBio 2015)	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. Suitable habitat within the Project Area.
REPTILES					
Leatherback sea	FE/-	Leatherbacks are pelagic (open	Low potential to	Low potential to	Potential to occur.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
turtle *(Dermochelys coriacea)*		ocean) animals but also forage in coastal waters. Leatherbacks are the most migratory and wide ranging of sea turtle species. They can tolerate very cold water temperatures. Leatherbacks mate in the waters adjacent to nesting beaches and along migratory corridors. After nesting, female leatherbacks migrate from tropical waters to more temperate latitudes. NMFS designated additional critical habitat to provide protection for endangered leatherback sea turtles along the U.S. West Coast (77 FR 4170).	occur.	occur.	Suitable habitat within the Project Area.
Loggerhead sea turtle-North Pacific DPS *(Caretta caretta)*	FE/-	Loggerheads occupy three different ecosystems during their lives: beaches (terrestrial zone), water (oceanic zone), and nearshore coastal areas. Loggerheads nest on ocean beaches and immediately after hatchlings emerge from the nest, they begin to move from their nest to the ocean. Migrations of adult loggerheads along the mid- and southeast U.S. coasts have also been documented. Juvenile loggerheads occur off the California	Low potential to occur.	Low potential to occur.	Potential to occur. Suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State [1]/ CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		coast.			
Olive (=Pacific) ridley sea turtle *(Lepidochelys olivacea)*	FT/-	The olive ridley is mainly a "pelagic" sea turtle, but has been known to inhabit coastal areas, including bays and estuaries. They occur from Southern California to northern Chile. Olive ridleys mostly breed annually and have an annual migration from pelagic foraging, to coastal breeding and nesting grounds, back to pelagic foraging. Trans-Pacific ships have observed olive ridleys over 2,400 from shore. Olive ridleys dive to depths of about 500 feet (150 m) to forage on "benthic" invertebrates.	Low potential to occur.	Low potential to occur.	Low potential to occur.

Federal Listing Codes	**California State Listing Codes**
FE - Federally listed as Endangered	SE - State listed as Endangered
FT - Federally listed as Threatened	ST - State listed as Threatened
FPT - Federally proposed for listing as Threatened	SCT - State candidate for listing as Threatened
FDL-Federally Delisted	SDL-State Delisted
FC - Federal candidate species (former Category 1 candidates)	SSC - California Species of Special Concern
NMFS-SC – Species of Concern (NMFS regulated species only)	SFP- Fully Protected
BCC-USFWS Bird of Conservation Concern	FDL-Federally delisted
ESU-Ecologically significant unit	WL - Watch List
DPS-Distinct Population Segment	SR-State Rare (no Federal rare classification)

H.2 **Table H-2. Special-status Aquatic Species with Potential to Occur at Placement Sites in the Project Area – Eden, Alviso, Cullinan, Montezuma**

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
FISH					
Chinook salmon - Central Valley fall / late fall-run ESU *(Oncorhynchus tshawytscha)*	NMFS-SC/SSC	Potential to occur. Chinook salmon occur in Coyote Creek. Known to be present in several South Bay area creeks (including Coyote Creek and Alameda Creek) and associated marshes and small channels in the study area, especially as habitat for smolts as they transition to life in a marine environment. Suitable spawning habitat is not present in the Project Area, but individual strays from the Sacramento and San Joaquin River systems have been observed spawning in Coyote Creek and presumably move	Potential to occur. Suitable foraging habitat for the species may be present. Adult chinook use open water areas within the Bay during migration. Known to be present in several South Bay area creeks (including Alameda Creek) and associated marshes and small channels in the study area, especially as habitat for smolts as they transition to life in a marine environment.	Potential to occur. Suitable foraging habitat for the species may be present. Adult and juveniles chinook use open water areas during migration. Juveniles migrating to the ocean may occur in Dutchman's Slough.	Potential to occur. Suitable foraging habitat for the species may be present. Adult and juveniles chinook use open water areas during migration.

[2] Confirmed using the 2015 Threatened and endangered animal list, Threatened, Endangered and Rare Plant List, and Fully Protected Animal List. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed 3/3/2015.

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
		through the area in search of suitable spawning habitat in Coyote Creek. However, Coyote Creek provides limited, low-quality spawning habitat and does not support a population of fall- and late-fall-run Chinook salmon. Nonetheless, during certain times of the year, Coyote Creek, and Alviso Slough may contain migrating or rearing Chinook salmon.			
Chinook salmon - Central Valley spring-run ESU *(Oncorhynchus tshawytscha)*	FT/ST	Low potential to occur. Adult and juveniles chinook may use open water areas during migration.	Low potential to occur. Adult and juveniles chinook may use open water areas during migration.	Potential to occur. Suitable foraging habitat for the species may be present. Adult and juveniles chinook use open water areas during migration.	Potential to occur. Suitable foraging habitat for the species may be present. Adult and juveniles chinook use open water areas during migration.
Chinook salmon - Sacramento River winter-	FE/SE	Low potential to occur. Adult and juveniles chinook may use open water areas during	Low potential to occur. Adult and juveniles chinook may use open water areas during	Potential to occur. Juveniles migrating to the ocean may occur in Dutchman's Slough. San	Potential to occur. Suitable foraging habitat for the species may be present. Adult and

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
run ESU *(Oncorhynchus tshawytscha)*		migration.	migration.	Pablo Bay is within the critical habitat for Chinook salmon.	juveniles chinook use open water areas during migration.
Coho salmon - central California coast ESU *(Oncorhynchus kisutch)*	FE/SE	Not expected to occur. Spawns in streams directly connected to the ocean.	Not expected to occur. Spawns in streams directly connected to the ocean.	Not expected to occur. Spawns in streams directly connected to the ocean.	Not expected to occur. Spawns in streams directly connected to the ocean.
Delta smelt *(Hypomesus transpacificus)*	FT/SE	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Low potential to occur. From January to July they move into freshwater for spawning and, during high flows, they can be washed downstream into San Pablo Bay.	Potential to occur. Suitable habitat is present.
North American Green sturgeon, Southern DPS *(Acipenser medirostris)*	FT/NMFS-SC/SSC	Low potential to occur- Present in the South Bay; unlikely to be inside ponds. Green sturgeon has been caught infrequently by anglers in the South Bay. Although one acoustically tagged green sturgeon was identified by a receiver	Low potential to occur. Not known to spawn in South Bay. Known to be present in the South Bay and expected to occur only as a rare and irregular visitor to estuarine habitats in the South Bay.	Potential to occur. Adults migrate through San Pablo Bay on their way to spawning grounds in the Sacramento River juveniles and sub-adults rear in San Pablo Bay.	Potential to occur. Adults migrate through San Pablo Bay on their way to spawning grounds in the Sacramento River.

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
		located on the Dumbarton Railroad Bridge during 2012, it is likely that green sturgeon are present infrequently, and in low numbers, in Alviso Sloughs and in the portions of the open bay adjacent to Pond A9.			
Longfin smelt *(Spirinchus thaleichthys)*	FC/ST/SSC	Potential to occur- Occurs year round in the SF Bay and known to occur in the South Bay. Longfin smelt have been caught in Coyote Creek and Alviso Slough. Seasonally documented (winter assemblage) in the tidal sloughs of the Alviso pond complex.	Potential to occur- Occurs year round in the SF Bay and known to occur in the South Bay.	Potential to occur. Suitable foraging habitat for the species is present; spawns in upper end of Suisun Bay and the Delta.	Potential to occur. Suitable foraging habitat for the species is present; spawns in upper end of Suisun Bay and the Delta.
River lamprey (*Lampreta ayresii)*	-/SSC	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. May occur in San Pablo Bay during migration.	Potential to occur. May occur in San Pablo Bay during migration.
Sacramento splittail *(Pogonichthys*	-/-/SSC	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	**Low** Potential to occur. Suitable habitat present and although not known to occur at Cullinan.	Potential to occur.

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
macrolepidotus)					
Steelhead - central California coast DPS *(Oncorhynchus mykiss irideus)*	FT/-	Potential to occur- Known to be present in several South Bay creeks (including Coyote, Alameda Creeks, and the Guadalupe River) and associated slough channels within the project area. Suitable spawning habitat is not present in the project area, but this species moves through the area to spawn upstream. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the project area Steelhead are present in Alviso Slough during upstream migration of adults to spawning areas in the Guadalupe River watershed and downstream migration of both adults and smolts	Potential to occur- Known to be present in several South Bay creeks (including Coyote and Alameda Creeks and the Guadalupe River) and associated slough channels within the project area. Suitable spawning habitat is not present in the project area, but this species moves through the area to spawn upstream. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the project area on their migrations to and from upstream spawning areas.	Potential to occur. Juveniles migrating to the ocean may occur in Dutchman's Slough.	Potential to occur. Adults migrating to the spawning habitat and juveniles migrating to the ocean.

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
		heading toward the ocean. The Guadalupe River and Coyote Creek are both designated critical habitat for this Steelhead DPS.			
Steelhead - Central Valley DPS *(Oncorhynchus mykiss irideus)*	FT/-	Potential to occur. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the South Bay on their migrations to and from upstream spawning areas	Potential to occur. Steelhead use estuarine habitats as rearing habitat for juveniles, and move through the South Bay on their migrations to and from upstream spawning areas	Potential to occur. Juveniles migrating to the ocean may occur in Dutchman's Slough.	Potential to occur. Adults migrating to the spawning habitat and juveniles migrating to the ocean.
Tidewater goby *(Eucyglobius newberryi)*	FE/-/SSC	Not expected to occur. No suitable habitat within the Project Area. Species is believed to have been extirpated from San Francisco Bay due to habitat loss.	Not expected to occur. No suitable habitat within the Project Area. Species is believed to have been extirpated from San Francisco Bay due to habitat loss.	Not expected to occur. No suitable habitat within the Project Area. Species is believed to have been extirpated from San Francisco Bay due to habitat loss.	Not expected to occur. No suitable habitat within the Project Area. Species is believed to have been extirpated from San Francisco Bay due to habitat loss.
INVERTEBRATES					
Black abalone *(Haliotes cracherodii)*	FE/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Mammals					

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
Blue whale *(Balaenoptera musculus)*	FE/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Finback (=fin) whale *(Balaenoptera physalus)*	FE/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
North Pacific right whale *(Eubalaena japonica)*	FE/SFP	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Sei whale *(Balaenoptera borealis)*	FE/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Sperm whale *(Physeter catodon (=macrocephalus)*	FE/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
REPTILES					
Leatherback sea turtle	FE/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[2]/ CNPS Status	Alviso A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
(Dermochelys coriacea)					
Loggerhead sea turtle-North Pacific DPS *(Caretta caretta)*	FE/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Olive (=Pacific) ridley sea turtle *(Lepidochelys olivacea)*	FT/-	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Federal Listing Codes
FE - Federally listed as Endangered
FT - Federally listed as Threatened
FPT - Federally proposed for listing as Threatened
FDL-Federally Delisted
FC - Federal candidate species (former Category 1 candidates)
NMFS-SC – Species of Concern (NMFS regulated species only)
BCC-USFWS Bird of Conservation Concern
ESU-Ecologically significant unit
DPS-Distinct Population Segment

California State Listing Codes
SE - State listed as Endangered
ST - State listed as Threatened
SCT - State candidate for listing as Threatened
SDL-State Delisted
SSC - California Species of Special Concern
SFP- Fully Protected
FDL-Federally delisted
WL - Watch List
SR-State Rare (no Federal rare classification)

H.3 **Table H-3. Special-status Terrestrial Species with Potential to Occur at Dredge Sites in the Project Area and SF-DODS**

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
BIRDS					
Alameda song sparrow *(Melospiza melodia pusillula)*	-/-/BCC/SSC	Breeds and forages in tidal salt marshes of San Francisco Bay. Typically nests low in gumplant (*Grindelia*) shrubs and in pickleweed (*Salicornia*). Endemic to California, where it is restricted to tidal salt marshes along the edges of San Francisco Bay. The species is a year-round resident (nonmigratory), and breeds from late February to mid-August. Alameda song sparrows prefer upland marsh vegetation, along tidal marsh edges. It is most abundant in the taller vegetation found along tidal sloughs.	Not expected to occur. No suitable habitat within the project site but suitable habitat is likely adjacent to the project site. Suitable breeding habitat for this species is present at Bair Island and adjacent tidal marshes.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
American peregrine falcon *(Falco peregrinus anatum)*	-/SFP (nesting)	Year-round resident widely distributed around the Bay. Nests on bridges, towers, and buildings, often at bay edge. Forages in many habitats. Regular forager (on other birds) in the region, primarily during migration and winter. Species has been confirmed nesting in the plan area as recently as 2007 in the south	Potential to occur: Regular foragers but no suitable breeding habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

[3] Confirmed using the 2015 Threatened and endangered animal list, Threatened, Endangered and Rare Plant List, and Fully Protected Animal List. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed 3/3/2015.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		BAy near the Project Area.			
American white pelican *(Pelecanus erythrorhynchos)*	-/-/SSC (nesting))	Special status only at nesting sites. Use exposed mudflats as roosting or loafing areas when they are available. When the tides rise, most of these birds will return to roosting areas in salt ponds or other alternate habitats. Also forages in freshwater lakes and rivers. Nests at freshwater lakes in northeast California, usually on small islands or remote dikes. Species nests colonially, and will commute long distances between foraging and nesting areas (50-184 miles). Breeding occurs April to September.	Potential to occur: Regular foragers but unlikely to breed. Species forages within salt ponds and tidal marsh habitats in San Francisco Bay.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Ashy storm-petrel *(Oceanodroma homochroa)*	-/-/SSC (nesting)	Ashy storm-petrels feed near their nesting islands in the offshore waters of the California Current. Nests in islands off the California coast. Forages in ocean. Fifty percent of the world's population of ashy storm-petrels breed on San Miguel, Santa Barbara, Santa Cruz and Anacapa islands.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
Bald eagle *(Haliaeetus leucocephalus)*	/SE/SFP[4] (nesting and wintering)	Occurs mainly along seacoasts, rivers and lakes; nests in tall trees or on cliffs. Feeds mostly on fish. Breeds usually by lakes, large rivers and on coasts. Nest is a large conspicuous structure with a wide view, in a large tree, rocky outcrop, or on the ground on islands. Swoops from hunting perches to catch fish from the water. Roosts communally in winter in dense conifer stands. Breeding begins in May.	Low Potential to occur. Suitable habitat not present. There are no known nesting or roosting sites for bald eagle within or adjacent to the Project Area. May occur as a flyover due to large habitat range.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Bank swallow *(Riparia riparia)*	-/ST (nesting)	Nests on vertical banks or cliffs with fine-textured soils, near water. Nests in colonies in vertical banks along creeks, rivers and sea cliffs with friable soils. Breeds from April to August. Most of California's nesting colonies occur along the upper Sacramento River. Breeding begins in April.	Low Potential to occur: uncommon to rare foragers but unlikely to breed. Suitable nesting habitat not present.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Barrow's goldeneye *(Bucephala islandica)*	-/-/SSC (nesting)	Nests in freshwater marshes by lakes and rivers, winters in coastal marine habitats. This species is an uncommon visitor to San Francisco Bay. Breeding begins mid-May.	Low potential to occur: Uncommon winter visitor; does not breed in the in or adjacent to Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

[4] Although this species is federally delisted it is still protected by the Bald and Golden Eagle Act, Migratory Bird Treaty Act, and the Lacey Act (USFWS. 2013. Bald Eagle. July 2. http://www.fws.gov/midwest/eagle/. Accessed March 2, 2015. The Bald Eagle continues to be listed as endangered in California (CDFW. Bald Eagles in California. https://www.dfg.ca.gov/wildlife/nongame/t_e_spp/bald_eagle/. Accessed March 2, 2015.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
Belding's savannah sparrow *(Passerculus sandwichensis beldingi)*	-/SE/-	Sparrow is a salt marsh endemic, ranging historically from Goleta in Santa Barbara County, California on the north, south to el Rosario, Baja California, Mexico. Nests in salt marsh. Forages in low, tidally influenced habitats, adjacent ruderal areas, and moist grasslands.	Not expected to occur. No suitable habitat in the RCH Channel or adjacent habitat.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Black skimmer *(Rynchops niger)*	-/-/BCC/SSC (nesting)	Nests on abandoned levees and islands in salt ponds and marshes of San Francisco Bay. Breeding for this species in San Francisco Bay has been documented only from 1994. Breeding begins early-May. Black skimmers forage mainly in tidal waters of bays, estuaries and lagoons but also utilize rivers, and salt marsh pools, creeks, and ditches. Forage while gliding along the surface of the water. This species primarily breeds in southern California, but has become more common in northern California including San Francisco Bay.	Potential to Occur. Suitable foraging habitat in San Francisco Bay. Suitable nesting habitat may be present in habitat adjacent to the Project Area.	Potential to Occur. Suitable foraging habitat in San Francisco Bay.	Not expected to occur. No suitable habitat within the Project Area.
Brant (Branta bernicla)	-/-/SCC-	A common winter resident along the coast of California. Species forages within coastal waters during migratory movements along coast. Grazes on eelgrass and other aquatic	Low potential to occur. Marginally suitable habitat in San Francisco Bay.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		plants. Does not breed in California.			
Bryant's savannah sparrow *(Passerculus sandwichensis alaudinus)*	-/-/-/SSC	A subspecies of savannah sparrow (Passerculus sandwichensis), Bryant's savannah sparrow is endemic to California. Occurs only in the narrow coastal strip from Humboldt Bay in the north to the Morro Bay area in the south with its center of abundance in the San Francisco Bay area. Is a year-round resident of California's coastal prairies and marshes. Savannah sparrows avoid areas with unusually tall grasses. Birds nest on the ground in open-cup nests that are near grass bunches or under matted plants. The nests are hidden under the grass canopy.			Not expected to occur. No suitable habitat within the Project Area.
Burrowing owl *(Athene cunicularia)*	-/-/BCC/SSC (burrowing and some wintering site)	Forages and nests in grasslands and open scrub with small mammal burrows. Flat grasslands and ruderal habitats. Wintering observations with/without a burrow in San Francisco, Ventura, Sonoma, Marin, Napa and Santa Cruz counties. Breeding begins in March. For Western burrowing owl (*Athene cunicularia hypugaea*)-Burrowing owls occur in lowlands and at the edge of tidal wetlands, especially in the non-breeding season. This	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		species is largely extirpated from former breeding sites around the Bay. Nearly all of the remaining nesting burrowing owls in the Bay area are between Palo Alto and the Fremont-Newark area of the South Bay. The only sites that support viable breeding populations are the NASA Ames Research Center and the San Jose Airport.			
California black rail *(Laterallus jamaicensis coturniculus)*	-/ST/BCC/SFP	A year-round resident of California's coastal prairies and marshes. Salt marshes bordering larger bays; pickleweed typically present. Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations. Breeds in fresh, brackish, and tidal salt marsh .The species does not appear to migrate. Lack of suitable habitat (high marsh) may limit nesting in the south bay however tidal marsh restoration projects may be increasing habitat for this species. Resident population is confined almost entirely to San Pablo and Suisun Bays and restricted to the tidal and brackish marsh vegetation.	Not expected to occur in or adjacent to RCH channel.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
California brown pelican (*Pelecanus*	-/SFP	Occurs in nearshore marine habitats and coastal bays. Nests on islands in	Potential to occur both in the Project	Not expected to occur. No suitable	Not expected to occur. No

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
occidentalis californicus)		Mexico and southern California. Roosts on levees in the interiors of pond complexes, forages in salt ponds and Bay. Visitor to San Francisco Bay in non-breeding season, from May through November; forages in shallow nearshore waters.	Area and adjacent habitat. No nesting areas within the Project Area but species forages in San Francisco Bay and may roost on Bair Island.	habitat within the Project Area.	suitable habitat within the Project Area.
California gull *(Larus californicus)*	-/-/-/-/ WL	California gulls nest on freshwater lakes, inland areas, and in salt ponds in San Francisco Bay. Forages at landfills and within tidal marshes throughout the San Francisco Bay. Year round resident of California. Breeding begins early May.	Potential to Occur. Common resident. Breeds and forages throughout the South Bay area. Forages throughout study area. (	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
California least tern *(Sternula antillarum browni)*	FE/SE/SFP	Nests along the coast on bare or sparsely vegetated flat substrates The South Bay is an important post-breeding staging area for Least Terns, although this species does not currently breed within the Project Area at Alviso but least terns could occasional forage in nearby t ponds. The species nests in California, and migrates to California in April and remains through August; wintering takes place south of the United States. They nest in colonies on bare or sparsely vegetated sandy beaches, alkali flats and landfills. Presently,	Low potential to occur within the Project Area although marginally suitable habitat may be present in adjacent areas. Species has been historically recorded nesting at Bair Island but not since the early 1980"s. Potential nesting habitat is present within Bair	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		most nesting occurs on beaches or in coastal wetlands near estuaries, bays, harbors or the ocean and feeds on small fish. Active nesting sites near the Project Area are located at Montezuma Slough, Napa Plant Site and Montezuma Slough wetlands. They have also nested historically at Bair Island.	Island and adjacent upland areas near San Francisco Bay.		
Cassin's auklet *(Ptychoramphus aleuticus)*	-/-/BCC/SSC	San Miguel Island and its islets, particularly Prince Island and Castle Rock, provide the most important nesting sites for the Cassin's auklet in the Southern California bight. It also breeds colonially on the other islands of the Channel Islands National Park, except Santa Rosa Island. During the non-breeding seasons, Cassin's auklets will spend most of their time at sea.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to forage in the area.
Cooper's hawk *(Accipiter cooperii)*	-/-/WL (nesting)	Inhabits primarily open, interrupted or marginal woodlands. Nests mainly in riparian groves of deciduous trees in canyon bottoms on river flood-plains. Also nests in coast live oak. Forages in many habitats in winter and migration. Breeding begins in April.	Low potential to occur. No suitable habitat within the Project Area although may forage in adjacent areas.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Eleant tern	WL	Coastal waters, occasionally ocean			Not expected to

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
(Thalasseus elegans)		far from land. Breeds on low, flat, sandy islands. (Cornell Lab of Ornithology 2015)			occur. No suitable habitat within the Project Area.
Ferruginous hawk *(Buteo regalis)*	WL	Does not nest in California; winter visitor along the coast from Sonoma County to San Diego County. Open terrain in plains and foothills where ground squirrels and other prey are available.	Not expected to occur. No suitable habitat within the Project Area. Species is rarely detected in San Mateo County.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Forster's tern *(Sterna forsteri)*	WL (nesting)	Foster's terns nest on inland lakes of California and marshes of San Francisco Bay. The species forages within San Francisco by diving for small fish. Year round resident of California. Breeding begins mid-May.	Potential to occur. Suitable foraging habitat is present within the Project Area. No suitable habitat for nesting but may nest in adjacent area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Golden eagle *(Aquila chrysaetos)*	-/-/SFP/WL (nesting and wintering)	Nest on cliffs or in large trees or electrical towers, forages in open areas. Forages in annual grasslands, chaparral, and oak woodlands with plentiful medium and large-sized mammals.	Not expected to occur. No suitable habitat within the Project Area. May occasionally forage in habitat along adjacent channels, primarily during the nonbreeding season.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
Least bittern (Ixobrychus exilis)	-/-/BCC/SCC (nesting)	Forages and breeds in freshwater or brackish marshes with tall emergent vegetation. Ground nester in dense stands of vegetation. Very rare inhabitant of fresh to brackish marshes with dense emergent vegetation. More likely to occur in Delta than San Francisco Bay.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Loggerhead shrike *(Lanius ludovicianus)*	-/-/BCC/SSC (nesting)	Nests in dense shrubs and trees, forages in grasslands, marshes, and ruderal habitats. Inhabits a variety of habitats from open grasslands and scrub to woodlands and riparian areas. Species typically uses fenceposts, shrubs and small trees for perching while foraging in open habitats. Year-round resident of California. Breeding begins in February.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Long-billed curlew *(Numenius americanus)*	-/-/BCC/WL (nesting)	Nests on prairies and short-grass fields; forages on mudflats, marshes, pastures, and agricultural fields. Nests in northeastern California in Modoc, Siskiyou, and Lassen Counties on prairies and short-grass fields. Winters along the coast and in interior valleys west of Sierra Nevada. During migration and in winter;	Potential to occur. Forages on mudflats, marshes, and grasslands and roosts on levees, diked marshes, and ponds as a migrant and winter resident. Species does not	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		frequents coastal beaches and mudflats and interior grasslands and agricultural fields.	nest within Project Area.		
Marbeled murrelet *(Brachyramphus marmoratus)*	FT/SE (nesting)	Occurs year-round in marine subtidal and pelagic habits from Oregon to Point Sal, Santa Barbara. Uses stands of mature Douglas fir and redwoods up to 40 miles inland for nesting. Nests from May to September. Adults may commute from ocean to nest site daily.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Northern harrier *(Circus cyaneus)*	-/-/SSC- (nesting)	Nests and forages in marshes, grasslands, and ruderal habitats. Inhabits coastal salt and freshwater marshes.	Potential to Occur. Suitable foraging in a variety of habitats. May also breed in adjacent habitat in small numbers in marsh habitats in the Species has been recorded nesting at Bair Island.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Rhinoceros auklet *(Cerorhinca monocerata)*	WL	Mostly pelagic; nests on islands in ground burrows. (Cornell Lab of Ornithology 2015)	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to forage in the area.
Ridgway's rail, formerly California clapper rail *(Rallus obsoletus*	FE/SE/SFP	Salt and brackish marsh habitat and tidal sloughs usually dominated by pickleweed and cordgrass. Resident in SF Bay with entire population	Potential to occur. Forage in the Project area. Suitable breeding	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
obsoletus, formerly Rallus longirostris obsoletus)		restricted to tidal marshlands of San Pablo, Central, and South Bays. Sloughs and channels along the Bay shore provide critical habitat with birds occupying vegetated marsh along the full range of tidal influence.	habitat for this species is present at Bair Island, Greco Island, and adjacent tidal marshes but they are not known to nest in the area.		Area.
Redhead (Aythya americana)-(Waterfowl)	SCC	Found in Southern Don Edwards Wildlife Refuge. Forages and breeds in ponds and lakes. Nests are floating.	Potential to occur. Forage in the Project area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
San Pablo song sparrow (*Melospiza melodia samuelis*)	-/-/BCC/SSC	Inhabits salt marshes bordering north side of San Pablo and San Francisco Bay. Nests in grindelia spp. (marsh gumplant) bushes. Forages over mudbanks and in the pickleweed.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Saltmarsh common yellowthroat *(Geothlypis trichas sinuosa)* aka San Francisco common yellowthroat	-/-/BCC/SSC	Year-round resident of the San Francisco Bay Area. Found only in San Francisco Bay Area in Marin, Napa, Sonoma, Solano, San Francisco, San Mateo, Santa Clara, and Alameda Counties. Nests in freshwater marshes in summer and salt or brackish marshes in fall and winter; requires tall grasses, tules, and willow thickets for nesting and cover. Breeding begins in April. Forages in	Not expected to occur. No suitable habitat within the Project Area. Suitable habitat maybe present adjacent to the Project Area within tidal marshes and associated uplands.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		all marsh types.			
Short-eared owl *(Asio flammeus)*	-/-/SSC (nesting)	Nests on ground in tall emergent vegetation or grasses, forages over a variety of open habitats. Inhabits open grasslands, prairies, marshes and agricultural fields with sufficient cover and abundant small mammal prey. Breeding begins in April.	Not expected to occur. No suitable habitat within the Project Area. Suitable habitat maybe present adjacent to the Project Area where species has been recorded nesting in adjacent habitat at Bair Island.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Short-tailed albatross *(Diomedea albatrus)*	FE/-/SCC	Short-tailed albatross forage at sea but specific geographic and seasonal distribution patterns within the marine range are not well understood. The short-tailed albatross is a frequent visitor to the productive waters in shelf break areas of the Northern Gulf of Alaska, Aleutians Islands, and Bering Sea. The marine range of the short-tailed albatross within U.S. territorial waters includes Alaska's vast coastal shelf break areas and the marine waters of Hawaii for foraging, but we do not know how much or to what extent it utilizes open ocean areas of the Gulf of Alaska, North Pacific	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to forage in the area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		Ocean, and Bering Sea.			
Alameda song sparrow (*Melospiza melodia Pusillula)*	-/-/-/SSC	Breeds in salt marsh habitats in the San Francisco Bay Area. Forages in salt marsh habitat. It is most abundant in the taller vegetation found along tidal sloughs, including salt marsh cordgrass and marsh gumplant. Present in suitable habitat throughout the South Bay being particularly abundant in more extensive marshes but also present fairly commonly in narrower marshes along tidal sloughs such as Alviso Slough as long as taller herbaceous vegetation for nesting is present.	Not expected to occur. No suitable habitat within the Project Area. Suitable habitat maybe present adjacent to the Project Area where species may forage within the tidal marshes. Species forages within tidal marsh habitats in San Francisco Bay.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Suisun song sparrow *(Melospiza melodia maxillaris)*	-/-/BCC/SSC	Suisun Song Sparrows occur in virtually every tidal marsh in Suisun Bay, though densities vary considerably, presumably reflecting variation in habitat suitability. Dense vegetation is required for nesting sites, song perches, and cover for refuge from predators. Suisun Song Sparrows are associated primarily with tidal channels, especially in marshes where Pickleweed dominates and Gumplant lines the channels. Sparrow territories are lined single file every 10 to 50 m along sloughs, providing each pair			Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		with access to the slough and its overhanging banks for food and cover. In marshes where there are no sloughs, some tidal influence is still required; few Song Sparrows occur in diked areas with stagnant water. In brackish or freshwater marshes with substantial cover of tall Scirpus maritimus, Tule (S. acutus), or cattail, the association of Song Sparrows with channels is weaker.			
Tricolored blackbird *(Agelaius tricolor)*	SE[5]/BCC/SSC (nesting colony)	Breeds at scattered coastal locations from Marin County south to San Diego County; and at scattered locations in Lake, Sonoma, and Solano Counties. Breeds near fresh water in dense emergent vegetation and sites with blackberries, nettles, thistles, and grainfields.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Vaux's swift *(Chaetura vauxi)*	-/-/SSC (nesting)-	Nest in snags in costal coniferous forest or occasionally chimneys**.**	Not Expected to Occur: No suitable habitat. This species is rarely detected in San Mateo County.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Western snowy plover *(Charadrius*	FT/-/BCC/SSC (nesting)	Nests in sandy substrate such as sandy coastal beaches, salt panne	Low potential to occur. Suitable	Not expected to occur. No suitable	Not expected to occur. No

[5] Emergency state status until 6/2015 (CDFW list).

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
alexandrinus nivosus)		habitat, coastal dredged spoils sites, dry salt ponds, salt pond levees, and gravel bars. and forages in sandy marine and estuarine bodies. Population defined as those birds that nest adjacent to or near tidal waters, including all nests along the mainland coast, peninsulas, offshore islands, and adjacent bays and estuaries. Nest in San Francisco Bay. Most nesting in San Francisco Bay is associated with emergent or dry salt pond beds, or sometimes levee roads. Breeding locations in the Estuary at Eden Landing Ecological Reserve/ Baumberg North, Alviso, and Ravenswood. In the North Bay nesting occurs at Ponds 7 and 7A in the Napa Sonoma Marshes Wildlife Area and at the Montezuma Slough Wetland Restoration site.	habitat maybe present in mudflats and adjacent to the Project Area where species may forage within the tidal marshes. Species has been recorded nesting at Bair Island though no nesting has been documented since the late 1970"s. Potential nesting habitat is present within Bair Island and adjacent upland areas near San Francisco Bay.	habitat within the Project Area.	suitable habitat within the Project Area.
White-tailed kite *(Elanus leucurus)*	-/-/SFP (nesting)	Nests in tall shrubs and trees, forages in grasslands, marshes, and ruderal habitats. Inhabits grasslands, agriculture fields, oak woodlands, savannah and riparian habitats in rural and urban areas. Feeds primarily on California voles. Forages over grassland and nests in shrubs and trees. Year-round resident of	Not expected to occur. No suitable habitat within the Project Area. Suitable habitat may be present in adjacent habitat. Species has been recorded nesting at	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		Central and Coastal California. Breeding begins in February.	Bair Island.		
Yellow-headed blackbird *(Xanthocephalus xanthocephalus)*	-/-/-/SSC	Nests in freshwater emergent wetlands with dense vegetation and deep water, often along the borders of lakes and ponds. Often forages in fields, typically wintering in large, open agricultural areas.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Yellow warbler *(Dendroica petechia brewsteri)*	-/-/BCC/SSC (nesting)	Breeds in riparian woodlands, particularly those dominated by willows and cottonwoods. Species forages in suitable habitat during migration in the fall.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
MAMMALS					
Guadalupe fur-seal *(Arctocephalus townsendi)*	FT/ST/SFP	Guadalupe fur seals reside in the tropical waters of the Southern California/ Mexico region. During breeding season, they are found in coastal rocky habitats and caves. Little is known about their whereabouts during the non-breeding season.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Low potential to occur.
Pacific Harbor Seal (*Phoca vitulina richardsi)*	Fed: MMPA	Pacific harbor seals inhabit near-shore coastal and estuarine areas from Baja California, Mexico to Alaska. Pacific harbor seals are the only species of marine mammal that breed and bear young in San Francisco Bay. Harbor seals are present in the Bay year-round and	Potential to occur. Suitable habitat within the Project Area. Haul-out and pupping sites for this species are present at Bair Island and Greco	Potential to occur. Suitable habitat within the Project Area.	Not expected to occur.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		use it for foraging, resting, and reproduction. Mating occurs from April to July. There are 12 haul-out sites and rookeries in the Bay. At Bair Island and Greco Island, seals use haul-outs on the outer shore of Outer Bair Island, and several sites within Corkscrew Slough. The primary haul-out in Corkscrew Slough is along the west bank of the slough, near the bend closest to Redwood Creek (RWC GP DEIR 2010)). Known pupping sites are: Bair Island, Corkscrew Slough, Greco Island, Newark Slough, and Mowry Slough.	Island adjacent to the project site.		
Pallid bat *(Antrozous pallidus)*	-/-/-/SSC	Uncommon to rare foragers but unlikely to breed. (SBSP Restoration Project Biology and Habitat Exiting conditions Report March 2005). Inhabits rocky terrain in open areas in lowlands, foothills and mountainous areas near water throughout California below 2,000 meters. Roost in caves, rock crevices, mines, hollow trees, buildings and bridges in arid regions in low numbers (<200). Active from March-November; migrates in some areas, but may hibernate locally. Preys on large beetles and scorpions. This species is typically	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		found in dry grasslands and oak savannah habitats, and currently can be detected in the south and east San Francisco Bay area. (RWC GP DEIR 2010)			
Salt-marsh harvest mouse *(Reithrodontomys raviventris)*	FE/SE/SFP	The salt marsh harvest mouse is restricted to the salt and brackish water marshes in San Francisco Bay. Found in salt marsh habitat dominated by pickleweed , mature brackish marshes, and tidal and diked salt marshes that can include dense plant cover of pickleweed and fat hen . Marshes fringing Alviso Slough lack pickleweed and are thus not considered prime habitat. The species was found in brackish marsh dominated by alkali bulrush (*Scirpus robustus*). Does not occur in the small isolated patch of diked pickleweed within the Pond A8. Could occur in suitable habitat year-round. The species is adapted to life within the tidal zone, and can escape tidal inundation through climbing upward within the marsh vegetation, and is a good swimmer. The species can drink saltwater. Young are born from spring to fall, and breeding occurs 2-3 times per year.	Not expected to occur. No suitable habitat within the Project Area. Suitable habitat may be present in adjacent habitat. This species has been documented to occur on Bair and Greco Islands.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
Salt-marsh wandering shrew *(Sorex vagrans halicoetes)*	-/-/-/SSC	Species is restricted to salt marshes in San Francisco Bay. Feeds mainly on invertebrates and some plant material within a low, dense cover of Salicornia. Most young are born March to May. Occurs in middle and high marsh zones with abundant driftwood and pickleweed.	Not expected to occur. No suitable habitat within the Project Area. Suitable habitat may be present in adjacent habitat. Species has been detected at Bair Island.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Suisun shrew *(Sorex ornatus sinuosus)*	-/-/-/SSC	Restricted to San Pablo Bay and Suisun Bay, both in Solano and Sonoma County. Tidal, salt, and brackish marshes containing pickleweed, grindelia, bulrushes, or cattails; requires driftwood or other objects for nesting cover.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Townsend's big-eared bat *(Corynorhinus townsendii) (AKA Pacific Townsend or western big eared bat)*	-/-/SCT/SSC	An obligate cave rooster and moth specialist. Inhabits caves, bridges, mines, buildings, rock crevices and tree hollows in coastal lowlands, cultivated valleys and nearby hills characterized by mixed vegetation throughout California below 3,300 meters. Exhibits high site fidelity and is highly sensitive to disturbance. Forages along edge habitats near water; may travel long distances during foraging. This species has been detected in the north and east	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		San Francisco Bay area. Very sensitive to disturbances and may abandon a roost after one onsite visit.			
Western mastiff bat *(Eumops perotis californicus)*	-/-/-/SSC	Suitable habitat consists of extensive open areas with abundant roost locations provided by crevices in rock outcrops and buildings. Primarily a cliff roosting species. Inhabits a variety of vegetation communities near suitable cliff roosting habitat throughout central and southern California below 3,000 meters. Often forages high above the ground and over great distances. Highly sensitive to human disturbance. This species ranges from San Francisco southward. It has been detected in the San Francisco Bay area (East Bay hills and in the south bay).	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
REPTILES					
Western pond turtle *(Emys marmorata)*	-/SSC	Aquatic habitats including ponds, streams, and irrigation ditches. Requires basking sites such as partially submerged logs, vegetation mats, or open mud banks. (Permanent or nearly permanent fresh or brackish water in a variety of habitats.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
PLANTS					
Alkali milk-vetch	-/-/1B.2	Alkaline soils in playas, vernal pools,	Not expected to	Not expected to	Not expected to

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
(Astragalus tener var. tener)		and adobe clay areas within grassland. Alameda, Merced, Solano, and Yolo counties. A recently rediscovered population in seasonal wetlands at the Pacific Commons Preserve in Fremont. Considered extirpated from Santa Clara County. Currently no suitable habitat in Alviso Slough Restoration Project or SBSP Phase 2 area. Occurs in mesic coastal dunes, coastal salt marshes, swamps and stream sides.	occur. No suitable habitat in RCH Channel area.	occur. No suitable habitat in SBS Channel area.	occur. No suitable habitat within the Project Area.
Congdon's tarplant *(Centromadia parryi ssp. Congdonii)*	-/-/1B.1	Moist, alkaline soils within grassland. Tolerates disturbance. Annual; blooms June through November. Known from Alameda, Contra Costa, San Mateo, Monterey, San Luis Obispo, and Santa Clara counties.. Known from several locations in Newark, Fremont, Alviso, and Sunnyvale. The species requires disturbance to establish, and so, it is unlikely that any population could establish within the Alviso restoration Project area except ephemerally. Population locations and sizes are likely to fluctuate. Recent populations have been reported from South San Francisco Bay localities in or in the vicinity of diked baylands	Not expected to occur. No suitable habitat in RCH Channel area.	Not expected to occur. No suitable habitat in SBS Channel area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		(Newark to Sunnyvale). May potentially occur along high tidal marsh edges .			
Delta tule pea *(Lathyrus jepsonii var. jepsonii)*	-/-/1B.2	High marsh zone in brackish and freshwater marshes. Known from Suisun Marsh (Sacramento, San Joaquin, Solano and Contra Costa counties) and Napa marshes. Perennial; blooms May through September. Historic and current records from North Bay area only. Occurs along tidal marsh banks of sloughs in Napa-Sonoma. May be difficult to detect during droughts (saline years) in Napa Marsh.	Not expected to occur. No suitable habitat in RCH Channel area.	Not expected to occur. No suitable habitat in SBS Channel area.	Not expected to occur. No suitable habitat within the Project Area.
Lyngbye's sedge *(Carex lyngbyei)*	-/-/2B	Coastal salt marsh and brackish marshes. Known from central and northern coastal California.			Not expected to occur. No suitable habitat within the Project Area.
Marin knotweed *(Polygonum marinense)*	-/-/3.1	Coastal Marin, Napa, and Sonoma Counties. Salt marsh (Sears Pt 2009). Formerly restricted in San Francisco Bay to tidal marshes near Larkspur (Marin County), but this species has spread widely across the North Bay and western Suisun Bay area.	Not expected to occur. No suitable habitat in RCH Channel area.	Not expected to occur. No suitable habitat in SBS Channel area.	Not expected to occur. No suitable habitat within the Project Area.
Mason's lilaeopsis *(Lilaeopsis masonii)*	-/SR/1B.1	Exposed banks of tidal meanders and channels within brackish to freshwater marsh. Locally common in	Not expected to occur. No suitable habitat in RCH	Not expected to occur. No suitable habitat in SBS	Not expected to occur. No suitable habitat

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		Suisun Marsh. Not known to occur in the Alviso Slough Project area; historic and current records in Suisun Bay area only. Typically restricted to brackish tidal marsh banks subject to slumping or wave erosion, or nearby tidal marsh; also occurs in mud on rip-rap or concrete. Known populations occur from northern San Pablo Bay (Tolay Creek mouth) east through Suisun Marsh and Contra Costa shoreline.	Channel area.	Channel area.	within the Project Area.
Point Reyes salty bird's-beak *(Chloropyron maritimum ssp. Palustre)*	FE/SE/1B.2	Coastal salt marsh habitats, growing with pickleweed and saltgrass, swamps (and coarser substrates within salt marsh (high marsh pans, sandy barrier beaches). Known from Northern California, from Oregon to Santa Clara County; Oregon. Extirpated from the South Bay Area. Historically found in coastal salt marshes in Alameda, Humboldt, Marin, Santa Clara, San Francisco, San Mateo, and Sonoma Counties. Presumed extirpated from Alameda, Santa Clara and San Mateo counties.	Not expected to occur. No suitable habitat in RCH Channel area. It may occur in adjacent salt marshes in Bair Island.	Not expected to occur. No suitable habitat in SBS Channel area.	Not expected to occur. No suitable habitat within the Project Area.
Saline clover *(Trifolium hydrophilum)*	-/-/1B.2	Edges of salt marshes, alkali meadows, and vernal pools along the coast from Sonoma County south to	Not expected to occur. No suitable habitat in RCH	Not expected to occur. No suitable habitat in SBS	Not expected to occur. No suitable habitat

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
		San Luis Obispo, as well as in the inland counties of Solano and Colusa. Annual Historic collection (in 1886) from Belmont Slough; not recorded since in the South Bay area. Occurs in marshes and swamps and valley and foothill grassland and vernal pools.	Channel area. It may occur in adjacent salt marshes in Bair Island.	Channel area.	within the Project Area.
Soft salty bird's-beak *(Chloropyron molle ssp. molle)*	FE/SR/1B.2	Coastal salt marshes and swamps. An annual, herb with fluctuating population levels. Occurs in upper tidal marsh near the limits of tidal action with pickleweed, salt grass, fleshy jaumea, alkali heath, perennial ryegrass, arrow grass, and Suisun marsh aster.	Not expected to occur. No suitable habitat in RCH Channel area.	Not expected to occur. No suitable habitat in SBS Channel area.	Not expected to occur. No suitable habitat within the Project Area.
Suisun marsh aster *(Symphyotrichum lentum)*	-/-/1B.2	Found in Sacramento–San Joaquin Delta, Suisun Marsh, Suisun Bay, Contra Costa county, Solano county. Brackish and freshwater marsh. Typically forming colonies along brackish or freshwater marsh banks or upland edges tidal marshes in northern San Pablo Bay eastward to Suisun Marsh and Contra Costa shoreline. Presumed extirpated in San Francisco Bay.	Not expected to occur. No suitable habitat in RCH Channel area or adjacent habitat.	Not expected to occur. No suitable habitat in SBS Channel area.	Not expected to occur. No suitable habitat within the Project Area.

Common Name *(Scientific Name)*	Federal/State[3] / CNPS Status	Geographic Distribution/Habitats	RWC Channel	SBS Channel	SFDODS
Federal Listing Codes FE - Federally listed as Endangered FT - Federally listed as Threatened FPT - Federally proposed for listing as Threatened FDL-Federally Delisted FC - Federal candidate species (former Category 1 candidates) BCC-USFWS Bird of Conservation Concern DPS-Distinct Population Segment			**California State Listing Codes** SE - State listed as Endangered ST - State listed as Threatened SCT - State candidate for listing as Threatened SSC - California Species of Special Concern SFP- Fully Protected WL - Watch List SR-State Rare (no Federal rare classification)		

H.4 **Table H-4. Special-status Terrestrial Species with Potential to Occur at Placement Sites in the Project Area – Eden, Alviso, Cullinan, and Montezuma**

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
BIRDS					
Alameda song sparrow *(Melospiza melodia pusillula)*	-/-/BCC/SSC	Potential to occur. Common resident foraging in tidal salt marsh and may breed near the Project Area.	Low potential to occur. Common resident foraging in tidal salt marsh		Not expected to occur. No suitable habitat at the Montezuma offloader.
American peregrine falcon *(Falco peregrinus anatum)*	-/SFP (nesting)	Potential to occur. Regular foragers but no suitable breeding habitat within the Project Area.	Potential to occur. Regular foragers but no suitable breeding habitat within the Project Area.	Potential to occur. Regular foragers but no suitable breeding habitat within the Project Area.	Not expected to occur. No suitable habitat at the Montezuma offloader.
American white pelican *(Pelecanus erythrorhynchos)*	-/-/SSC (nesting))	Potential to occur. Found in or near ponds A1, A2w, A9, and other Alviso ponds. Occur as foragers but not known to breed in the pond complex. Regular visitor from late summer to spring.	Potential to occur. Found in or near Eden Landing ponds. Occur as foragers but nesting sites are not located in the pond complex.		
Ashy storm-petrel *(Oceanodroma*	-/-/SSC (nesting)	Low Potential to occur. May be occasional winter visitor; does not breed in	Low Potential to occur. May be occasional winter visitor; does not breed in		Not expected to occur. No suitable habitat at the Montezuma

[6] Confirmed using the 2015 Threatened and endangered animal list, Threatened, Endangered and Rare Plant List, and Fully Protected Animal List. http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/. Accessed 3/3/2015.

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
homochroa)		the Project Area.	the Project Area.		offloader.
Bald eagle *(Haliaeetus leucocephalus)*	/SE/SFP[7] (nesting and wintering)	Potential to occur. Uncommon to rare foragers most likely during fall migration but unlikely to breed.	Potential to occur. Uncommon to rare foragers most likely during fall migration but unlikely to breed.		
Bank swallow *(Riparia riparia)*	-/ST (nesting)	Low Potential to occur. uncommon to rare foragers but unlikely to breed. Suitable nesting habitat not present.	Low Potential to occur. uncommon to rare foragers but unlikely to breed. Suitable nesting habitat not present.		Not expected to occur. No suitable habitat at the Montezuma offloader.
Barrow's goldeneye *(Bucephala islandica)*	-/-/SSC (nesting)	Potential to occur. Uncommon winter visitor; does not breed in the Project Area.	Potential to occur. Uncommon winter visitor; does not breed in the Project Area.		Not expected to occur. No suitable habitat at the Montezuma offloader.
Belding's savannah sparrow *(Passerculus sandwichensis beldingi)*	-/SE/-	Potential to occur. Common breeder in salt marsh (including diked, muted tidal, and tidal) and adjacent ruderal/grassland habitat in the study area.	Potential to occur. Common breeder in salt marsh (including diked, muted tidal, and tidal) and adjacent ruderal/grassland habitat		

[7] Although this species is federally delisted it is still protected by the Bald and Golden Eagle Act, Migratory Bird Treaty Act, and the Lacey Act (USFWS. 2013. Bald Eagle. July 2. http://www.fws.gov/midwest/eagle/. Accessed March 2, 2015. The Bald Eagle continues to be listed as endangered in California (CDFW. Bald Eagles in California. https://www.dfg.ca.gov/wildlife/nongame/t_e_spp/bald_eagle/. Accessed March 2, 2015.

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
			in the study area.		
Black skimmer *(Rynchops niger)*	-/-/BCC/SSC (nesting)	Potential to occur. Likely to forage and may breed adjacent to the Project Area, particularly on islands in salt ponds.	Potential to occur. Likely to forage and may breed adjacent to the Project Area, particularly on islands in salt ponds.		
Brandt (Branta bernicla)	-/-/SCC-				
Bryant's savannah sparrow *(Passerculus sandwichensis alaudinus)*	-/-/-/SSC				
Burrowing owl *(Athene cunicularia)*	-/-/BCC/SSC (burrowing and some wintering site)	Low potential to occur. May forage within marshes.	Low potential to occur. May forage within marshes.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat at the Montezuma offloader.
California black rail *(Laterallus jamaicensis coturniculus)*	-/ST/BCC/SFP	Potential to occur. Individuals winter in small numbers in tidal marsh within the Project Area and a likely breeder. Fourteen individuals were captured adjacent to SBSP Project Pond A15 in 2012 during the breeding season .	Potential to occur. Individuals may winter in tidal marsh within the Project Area.	Potential to occur. Suitable nesting and foraging habitat along the outboard levees. Known to occur at the site.	

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
California brown pelican (*Pelecanus occidentalis californicus)*	-/SFP	Potential to occur. Regular but not abundant during nonbreeding season (summer and fall) in Alviso.	Potential to occur. May roosts on levees in the interiors of pond complexes; forages in ponds and in San Francisco Bay.		
California gull *(Larus californicus)*	-/-/-/-/ WL	Potential to occur. Common resident, breeding on several salt ponds in the Project Area. The colony in Pond A6 is the second largest colony in California. Forages throughout SBSP area.	Potential to occur. Common resident, breeding on several salt ponds in the Project Area.		
California least tern *(Sternula antillarum browni)*	FE/SE/SFP	Potential to occur. The South Bay is an important post-breeding staging area for least terns, though species does not currently breed within the Project Area. Forages and roosts in a number of South Bay ponds, especially Alviso ponds in the vicinity of the Moffett Federal Airfield.	Potential to occur.		Not expected to occur. No suitable habitat at the Montezuma offloader. Active nesting sites are located at Montezuma Slough and Montezuma Slough wetlands
Cassin's auklet *(Ptychoramphus aleuticus)*	-/-/BCC/SSC	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Cooper's hawk	-/-/WL	Potential to occur.	Potential to occur.		

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
(Accipiter cooperii)	(nesting)	Observed on SBSP Restoration area as a migrant and winter resident. Breeds in limited numbers in upland habitats adjacent to the SBSP Restoration area, within the South Bay, but not within the immediate SBSP Restoration Project pond complexes.	Observed on SBSP Restoration area as a migrant and winter resident. Breeds in limited numbers in upland habitats adjacent to the SBSP Restoration area, within the South Bay, but not within the immediate SBSP Restoration Project pond complexes.		
Elegant tern *(Thalasseus elegans)*	WL				
Ferruginous hawk *(Buteo regalis)*	WL	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. Suitable foraging habitat present.	Not expected to occur. No suitable habitat within the Project Area.
Forster's tern *(Sterna forsteri)*	WL (nesting)	Potential to occur. Suitable foraging habitat present. Although not in the Project Area it has been identified as breeding on ponds A1, A2W and A8 (prior to flooding).	Potential to occur. Suitable foraging habitat present and nest in the South Bay.		
Golden eagle *(Aquila chrysaetos)*	-/-/SFP/WL (nesting and	Low Potential to occur. Uncommon to rare foragers primarily during	Low Potential to occur. Uncommon to rare foragers primarily during		

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
	wintering)	the nonbreeding season and unlikely to breed. No nesting records within the SBSP Area.	the nonbreeding season and unlikely to breed. No nesting records within the SBSP Area.		
Least bittern (Ixobrychus exilis)	-/-/BCC/SCC (nesting)	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.		
Loggerhead shrike *(Lanius ludovicianus)*	-/-/BCC/SSC (nesting)	Potential to occur. Breeds in Alviso Pond Complex. Resident in low numbers in adjacent habitat within the Project Area.	Potential to occur. Resident in low numbers in adjacent habitat within the Project Area.		
Long-billed curlew *(Numenius americanus)*	-/-/BCC/WL (nesting)	Potential to occur. Forages on mudflats, marshes, and grasslands and roosts on levees, diked marshes, and ponds within the SBSP area as a migrant and winter resident. Does not nest in the Project Area.	Potential to occur. Forages on mudflats, marshes, and grasslands and roosts on levees, diked marshes, and ponds within the SBSP area as a migrant and winter resident. Does not nest in the Project Area.	Potential to occur. Suitable foraging habitat present. Known to occur at the site.	
Marbeled murrelet *(Brachyramphus marmoratus)*	FT/SE (nesting)				
Northern harrier *(Circus cyaneus)*	-/-/SSC- (nesting)	Potential to occur. Breeds in small numbers in marsh habitats in the SBSP	Potential to occur. Breeds in small numbers in marsh habitats in the	Potential to occur. Suitable foraging habitat present and	

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
		restoration areas, forages in a variety of habitats. Northern harriers nest on transmission towers in several ponds, in Alviso, complex.	SBSP restoration areas, forages in a variety of habitats. Northern harriers nest on transmission towers in several ponds, including the Eden Landing.	known to occur.	
Rhinoceros auklet *(Cerorhinca monocerata)*	WL	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Ridgway's rail, formerly California clapper rail *(Rallus obsoletus obsoletus, formerly Rallus longirostris obsoletus)*	FE/SE/SFP	Potential to Occur. Ridgway's rails occur in a number of locations. The highest numbers are likely to occur within the more extensive tidal salt marshes along Coyote Creek, although this species is also present in Alviso Slough, and in smaller marsh remnants along sloughs and the Bay edge . Recorded using tidal marsh habitats along Coyote Creek and Alviso Slough	Potential to occur. Forage in the Project area. Primary habitat in adjacent marsh.	Low potential to occur. Incidental occurrence.	
Redhead (Aythya americana)-(Waterfowl)	SCC	Potential to occur. Common winter visitor; does not breed in the	Potential to occur. Forage in the Project Area.		

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
		Project Area.			
San Pablo song sparrow (*Melospiza melodia samuelis*)	-/-/BCC/SSC	Inhabits salt marshes bordering north side of San Pablo and San Francisco Bay. Nests in grindelia spp. (marsh gumplant) bushes. Forages over mudbanks and in the pickleweed.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	
Saltmarsh common yellowthroat *(Geothlypis trichas sinuosa)* aka San Francisco common yellowthroat	-/-/BCC/SSC	Potential to Occur. Common resident, breeding in freshwater and brackish marshes (and possibly to a limited extent in salt marshes), and foraging in all marsh types during the nonbreeding season.	Potential to Occur. Common resident, breeding in freshwater and brackish marshes (and possibly to a limited extent in salt marshes), and foraging in all marsh types during the nonbreeding season.	Potential to occur. Suitable foraging habitat present.	Potential to Occur. Common resident, breeding in freshwater and brackish marshes (and possibly to a limited extent in salt marshes), and foraging in all marsh types during the nonbreeding season.
Short-eared owl *(Asio flammeus)*	-/-/SSC (nesting)	Low Potential to occur. Uncommon. Has bred in small numbers within the SBSP Area, although current breeding status unknown. Most numerous in area in migration and winter.	Low Potential to occur. Uncommon. Has bred in small numbers within the SBSP Area, although current breeding status unknown. Most numerous in area in migration and winter .	Potential to occur. Suitable foraging habitat present.	
Short-tailed albatross	FE/-/SCC	Not expected to occur. No suitable habitat within the	Not expected to occur. No suitable habitat	Not expected to occur. No suitable	Not expected to occur. No suitable habitat

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
(Diomedea albatrus)		Project Area.	within the Project Area.	habitat within the Project Area.	within the Project Area.
Alameda song sparrow (*Melospiza melodia Pusillula)*	-/-/-/SSC	Potential to occur. Species forages within tidal marsh habitats in San Francisco Bay.	Potential to occur. Species forages within tidal marsh habitats in San Francisco Bay.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.
Suisun song sparrow *(Melospiza melodia maxillaris)*	-/-/BCC/SSC				
Tricolored blackbird *(Agelaius tricolor)*	SE[8]/BCC/SSC (nesting colony)	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area. Suitable foraging habitat present in adjacent areas.	Not expected to occur. No suitable habitat within the Project Area.
Vaux's swift *(Chaetura vauxi)*	-/-/SSC (nesting)-	Potential to occur. Uncommon to rare foragers but unlikely to breed. Forages over SBSP area during spring. No nesting habitat within area.	Potential to occur. Uncommon to rare foragers but unlikely to breed. Forages over SBSP area during spring. No nesting habitat within area.		
Western snowy	FT/-	Potential to Occur. In the	Potential to Occur. May	Low potential to occur.	Not expected to occur.

[8] Emergency state status until 6/2015 (CDFW list).

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
plover *(Charadrius alexandrinus nivosus)*	/BCC/SSC (nesting)	past, prior to the levee breach, western snowy plovers have bred in Pond A8. Breeds and forages at sites near the Project Area including Ponds A16, A17, A23 and Pond A13. Additional birds are present in the study area during winter. Species may forage in mudlfats and tidal salt marsh.	forage in the Project Area. Snowy plovers are present at Eden Landing with the largest number of nests at Ponds E8 and E8A. Species may forage in mudlfats and tidal salt marsh.	Species may forage in mudlfats and tidal salt marsh..	No suitable habitat within the Project Area nut suitable habitat may be present in adjacent areas. In the North Bay nesting occurs at the Montezuma Slough Wetland Restoration site
White-tailed kite *(Elanus leucurus)*	-/-/SFP (nesting)	Potential to occur. Common resident; breeds within the SBSP Area where suitable nesting habitat occurs.	Potential to occur. Common resident; breeds within the SBSP Area where suitable nesting habitat occurs.	Potential to occur. Suitable foraging habitat present and known to occur at Cullinan.	
Yellow-headed blackbird *(Xanthocephalus xanthocephalus)*	-/-/-/SSC	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.		Not expected to occur. No suitable habitat within the Project Area.
Yellow warbler *(Dendroica petechia brewsteri)*	-/-/BCC/SSC (nesting)	Low Potential to occur: uncommon to rare foragers but unlikely to breed. Observed on site as a migrant. No nesting habitat within the immediate SBSP pond complexes.	Low Potential to occur: uncommon to rare foragers but unlikely to breed. No nesting habitat within the immediate SBSP pond complexes.		
MAMMALS					

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
Guadalupe fur-seal *(Arctocephalus townsendi)*	FT/ST/SFP	Not expected to occur.	Not expected to occur.	Not expected to occur.	Not expected to occur.
Phoca vitulina richardsi Pacific Harbor Seal	Fed: MMPA	Potential to occur. Suitable habitat within the Project Area.	Potential to occur. Suitable habitat within the Project Area.	Not expected to occur. No known haul out or pupping sites.	Not expected to occur. No known haul out or pupping sites.
Pallid bat *(Antrozous pallidus)*	-/-/-/SSC	Low Potential to occur: uncommon but suitable foraging habitat present.	Low potential to occur. Suitable foraging habitat present.	Low Potential to occur: uncommon but suitable foraging habitat present.	Not expected to occur.
Salt-marsh harvest mouse *(Reithrodontomys raviventris)*	FE/SE/SFP	Potential to Occur. Salt marsh harvest mouse habitat in the Alviso pond complex is limited, but occurs in tidal salt marshes that fringe the existing salt ponds. Salt marsh harvest mice have been recently discovered in Alviso brackish marsh areas. While their use of these brackish habitats in the South Bay is not well understood, early indications are that populations in the brackish marshes are not as dense	Potential to occur. Suitable habitat within the Project Area.	Not expected to occur.	Not expected to occur.

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
		as those in mature salt marsh dominated by pickleweed. .			
Salt-marsh wandering shrew *(Sorex vagrans halicoetes)*	-/-/-/SSC	Potential to occur. May occur in salt marshes throughout the SBSP area.	Potential to occur. May occur in salt marshes throughout the SBSP area.		
Suisun shrew *(Sorex ornatus sinuosus)*	-/-/-/SSC	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Low potential to occur. Suitable habitat may be present along outboard levee.	Not expected to occur. No suitable habitat within the Project Area.
Townsend's big-eared bat *(Corynorhinus townsendii) (AKA Pacific Townsend or western big eared bat)*	-/-/SCT/SSC	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. Suitable foraging habitat present.	Not expected to occur. No suitable habitat within the Project Area.
Western mastiff bat *(Eumops perotis californicus)*	-/-/-/SSC	Low potential to occur.	Low potential to occur.	Potential to occur. Suitable foraging habitat present.	Not expected to occur. No suitable habitat within the Project Area.
REPTILES					
Western pond turtle *(Emys marmorata)*	-/SSC	Low potential to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat at the offloader.
PLANTS					
Alkali milk-vetch	-/-/1B.2	Not expected to occur. No	Not expected to occur.	Not expected to occur.	Not expected to occur.

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
(Astragalus tener var. tener)		suitable habitat within the Project Area.	No suitable habitat within the Project Area.	No suitable habitat within the Project Area.	No suitable habitat at the Montezuma offloader.
Congdon's tarplant *(Centromadia parryi ssp. Congdonii)*	-/-/1B.1	Low Potential to occur**.** Known from several locations in Newark, Fremont, Alviso, and Sunnyvale. Peripheral halophyte or disturbed upland zones but not currently associated with salt marsh.	Low Potential to occur**.** Known from several locations in Newark, Fremont, Alviso, and Sunnyvale. Peripheral halophyte or disturbed upland zones but not currently associated with salt marsh.		Not expected to occur. No suitable habitat at the Montezuma offloader.
Delta tule pea *(Lathyrus jepsonii var. jepsonii)*	-/-/1B.2	Not expected to occur. No suitable habitat within the Project Area.	Not expected to occur. No suitable habitat within the Project Area.	Potential to occur. Could occur in Cullinan although no species have been identified in the immediate area.	Not expected to occur. No suitable habitat at the Montezuma offloader.
Lyngbye's sedge *(Carex lyngbyei)*	-/-/2B				Not expected to occur. No suitable habitat at the Montezuma offloader.
Marin knotweed *(Polygonum marinense)*	-/-/3.1	Not expected to occur. No suitable habitat.	Not expected to occur. No suitable habitat.	Potential to occur. Could occur in Cullinan although not recorded.	Not expected to occur. No suitable habitat at the Montezuma offloader.
Mason's lilaeopsis *(Lilaeopsis*	-/SR/1B.1	Not expected to occur. No suitable habitat in the Project Area.	Not expected to occur. No suitable habitat in the Project Area.	Potential to occur. Could occur in Cullinan although not recorded.	Not expected to occur. No suitable habitat at the Montezuma

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
masonii)					offloader.
Point Reyes salty bird's-beak *(Chloropyron maritimum ssp. Palustre)*	FE/SE/1B.2	Low potential to occur. Assume extirpated in the Southern San Francisco Bay.	Low potential to occur. Assume extirpated in the Southern San Francisco Bay.		Not expected to occur. No suitable habitat at the Montezuma offloader.
Saline clover *(Trifolium hydrophilum)*	-/-/1B.2	Not expected to occur. No suitable habitat.	Not expected to occur. No suitable habitat.	Low potential to occur. May occur in diked or tidal marsh habitats of northern San Pablo Bay and Suisun Marsh.	Not expected to occur. No suitable habitat at the Montezuma offloader.
Soft salty bird's-beak *(Chloropyron molle ssp. molle)*	FE/SR/1B.2			Potential to occur. Could occur in Cullinan although not recorded.	Not expected to occur. No suitable habitat at the Montezuma offloader.
Suisun Marsh aster *(Symphyotrichum lentum)*	-/-/1B.2	Not Expected to Occur. No suitable habitat.	Not Expected to Occur. No suitable habitat.	Potential to occur. Could occur in Cullinan although not recorded.	Not expected to occur. No suitable habitat at the Montezuma offloader.

Common Name *(Scientific Name)*	Federal/State[6]/ CNPS Status	Alviso Ponds A2W and A9	Eden Landing Pond E2	Cullinan Project	Montezuma Offloader
Federal Listing Codes FE - Federally listed as Endangered FT - Federally listed as Threatened FPT - Federally proposed for listing as Threatened FDL-Federally Delisted FC - Federal candidate species (former Category 1 candidates) BCC-USFWS Bird of Conservation Concern DPS-Distinct Population Segment			**California State Listing Codes** SE - State listed as Endangered ST - State listed as Threatened SCT - State candidate for listing as Threatened SSC - California Species of Special Concern SFP- Fully Protected WL - Watch List SR-State Rare (no Federal rare classification)		

Appendix I

Sediment Data

Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

June 2015

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Nov-95										Nov-97			
	1	2	3	4	5	6	7	8	9	10	9A	9B	10A	10B
Grain Size (%, dry wt)														
Sand/Gravel (>0.063 mm)	2.6	1.4	1	1.2	2.2	1	0.3	0.4	0.6	0.7	7	7.6	6	5
Silt (0.004 mm - 0.063 mm	40.6	40	41	37.4	34.4	33.3	30.7	32.1	30.3	29.4	29	30	29	29
Clay (<0.004 mm)	56.8	58.6	58	61.4	63.4	65.7	69	67.5	68.8	69.9	64	64	66	66
Conventionals														
% Solids (%)	41.5	44.1	43	41	40.4	41.8	39.6	38.8	36.7	37.4	37	33	34	35
TOC (%)	1.48	1.25	1.2	1.42	1.33	1.31	1.35	1.36	1.47	1.46	0.68	0.85	1.4	1.2
Metals (mg/kg, ppm, dry wt)														
Antimony														
Arsenic	8.2	7.4	7.2	7.9	8.3	8.2	7.9	9.4	7.8	7.7	9.4	9.9	9.2	7.4
Barium														
Beryllium														
Cadmium	0.18	0.14	0.1	0.17	0.24	0.2	0.2	0.26	0.29	0.27	0.2	0.39	0.35	0.36
Chromium	97.4	76.2	75	82.2	92.3	93.6	92.2	103	95.3	86.7	190	170	140	160
Cobalt														
Copper	47.1	40.7	41	46	50.6	51.4	49.4	60.8	57.9	58.3	74	75	68	75
Lead	37.4	33.4	33	37.6	41.1	41.7	42.5	49	47.4	45.2	54	50	47	45
Mercury	0.32	0.33	0.3	0.33	0.36	0.36	0.34	0.39	0.41	0.4	0.84	0.48	0.54	0.53
Nickel	89.1	77	75	84.1	91	90.6	89.3	99.5	95.1	90.6	140	160	110	130
Selenium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.41	0.35	0.38	0.37
Silver	0.65	0.57	0.6	0.62	0.66	0.71	0.68	0.66	0.87	0.96	1.1	0.75	0.85	0.89
Thallium														
Vanadium														
Zinc	116	108	106	118	129	128	126	146	138	132	190	200	150	190
Butyltins (microgram/kg, ppb, dry wt)														
Monobutylin	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1.0	<1.0	<1.0	<1.0
Dibutylin	<10	<10	<10	<10	<10	<10	<10	<10	19	14	8.2	6.3	6.5	8.3
Tributylin	<10	11	14	12	12	17	<10	<10	26	19	5.9	6.6	5.1	6
Tetrabutylin	--	--	--	--	--	--	--	--	--	--	<1.0	<1.0	<1.0	<1.0
Total (Σ detected) Butyltins	0	11	14	12	12	17	0	0	45	33	14.1	12.9	11.6	14.3
Pesticides (microgram/kg, ppb, dry)														
Aldrin	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
alpha-BHC	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
beta-BHC	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
delta-BHC	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
Gamma-BHC (Lindane)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
Total BHCs														
alpha-Chlordane														
gamma-Chlordane														

Sediment Chemistry

Analyte	Nov-95										Nov-97			
	1	2	3	4	5	6	7	8	9	10	9A	9B	10A	10B
Chlordane	--	--	--	--	--	--	--	--	--	--	<6.0	<6.0	<6.0	<6.0
Total Chlordane														
4,4'-DDD	<2	<2	<2	<2	<2	5	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
4,4'-DDE	<2	<2	<2	<2	2	6	2	5	3	3	5.4	3.6	4.4	4.5
4,4'-DDT	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
2,4'-DDD	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,4'-DDE	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,4'-DDT	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total (Σ detected) DDTs	0	0	0	0	2	11	2	5	3	3	5.4	3.6	4.4	4.5
Dieldrin	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
Endosulfan I	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
Endosulfan II	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
Endosulfan sulfate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<3.0	<3.0	<3.0	<3.0
Endrin	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	3	7.6	6.2
Endrin Aldehyde	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
Endrin Ketone														
Heptachlor	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<3.0	<3.0	<3.0	<3.0
Heptachlor epoxide	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<3.0	<3.0	<3.0	<3.0
Methoxychlor														
Toxaphene	--	--	--	--	--	--	--	--	--	--	<45	<45	<45	<45
trans-Nonachlor														
Aroclor PCBs (microgram/kg, ppb dry wt)														
PCB 1016	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCB 1221	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCB 1232	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCB 1242	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<30	<30	<30	<30
PCB 1248	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<30	<30	<30	<30
PCB 1254	<50	<50	<50	<50	<50	180	<50	180	84	73	<30	<30	<30	<30
PCB 1260	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	51	33	56	42
Total (Σ detected) PCBs	0	0	0	0	0	180	0	180	84	73	51	33	56	42
PCB Congeners (microgram/kg, ppb dry wt)														
PCB008														
PCB018														
PCB028														
PCB031														
PCB033														
PCB044														
PCB049														
PCB052														

Sediment Chemistry

Analyte	Nov-95										Nov-97			
	1	2	3	4	5	6	7	8	9	10	9A	9B	10A	10B
PCB056														
PCB060														
PCB066														
PCB070														
PCB074														
PCB087														
PCB095														
PCB097														
PCB099														
PCB101														
PCB105														
PCB110														
PCB118														
PCB128														

Sediment Chemistry

Analyte	Nov-95										Nov-97			
	1	2	3	4	5	6	7	8	9	10	9A	9B	10A	10B
PCB132														
PCB138/158														
PCB141														
PCB149														
PCB151														
PCB153														
PCB156														
PCB170														
PCB174														
PCB177														
PCB180														
PCB183														
PCB187														
PCB194														
PCB195														
PCB201														
PCB203														
Total (∑ detected) PCB Congeners														
PAHs (micrograms/kg, ppb, dry wt)														
1-Methylnaphthalene														
1-Methylphenanthrene														
2,3,5-Trimethylnaphthalene														
2,6-Dimethylnaphthalene														
2-Methylnaphthalene														
Acenapthene	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<22	<22	<22	<22
Acenaphthylene	<20	<20	<20	<20	<20	34	<20	<20	<20	<20	<22	<22	<22	<22
Anthracene	<20	<20	<20	<20	<20	74	<20	32	21	27	22	57	59	54
Benzo(a)anthracene	40	36	43	29	34	120	38	53	41	45	65	120	120	120
Benzo(a)pyrene	90	81	95	68	84	290	98	110	110	120	200	390	380	400
Benzo(b)fluoranthene	93	78	100	74	92	340	110	120	130	130	140	290	350	340
Benzo(e)pyrene														
Benzo(g,h,i)perylene	98	86	100	73	98	310	110	120	120	130	210	390	380	400
Benzo(k)fluoranthene	28	30	26	21	27	99	30	44	39	48	120	240	230	230
Biphenyl														
Chrysene	47	40	48	34	39	150	46	65	54	57	87	160	180	160
Dibenzo(a,h)anthracene	<20	<20	<20	<20	<20	32	<20	<20	<20	<20	<57	<57	<57	<57
Dibenzothiophene														
Fluoranthene	150	130	150	120	120	440	130	180	130	150	150	270	270	270
Fluorene	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<22	<22	<22	<22
Indeno(1,2,3-cd)pyrene	75	69	81	57	82	280	100	110	100	110	250	480	500	540

Sediment Chemistry

Analyte	Nov-95										Nov-97			
	1	2	3	4	5	6	7	8	9	10	9A	9B	10A	10B
Naphthalene	<20	<20	<20	<20	<20	29	<20	<20	<20	<20	<22	<22	<22	<22
Perylene														
Phenanthrene	58	45	53	42	40	130	38	63	41	47	70	120	130	130
Pyrene	210	170	210	170	180	690	180	230	220	250	240	420	440	420
Total LPAHs														
Total HPAHs														
Total (Σ detected)PAHs	889	765	926	688	796	3018	880	1127	1006	1114	1600	2900	3000	3100
Dioxins/Furans (ng/kg, dry wt)														
2,3,7,8-Tetra CDD														
1,2,3,7,8-Penta CDD														
1,2,3,4,7,8-Hexa CDD														
1,2,3,6,7,8-Hexa CDD														
1,2,3,7,8,9-Hexa CDD														
1,2,3,4,6,7,8-Hepta CDD														
Total Octa CDD														
Total Tetra CDD														
Total Penta CDD														
Total Hexa CDD														
Total Hepta CDD														
2,3,7,8-Tetra CDF														
1,2,3,7,8-Penta CDF														
2,3,4,7,8-Penta CDF														
1,2,3,4,7,8-Hexa CDF														
1,2,3,6,7,8-Hexa CDF														
2,3,4,6,7,8-Hexa CDF														
1,2,3,7,8,9-Hexa CDF														
1,2,3,4,6,7,8-Hepta CDF														
1,2,3,4,7,8,9-Hepta CDF														
Octa CDF														
Total Tetra CDF														
Total Penta CDF														
Total Hexa CDF														
Total Hepta CDF														
Total TEQ														
Effects Range-Median Quotient (ERMq)														

FOOTNOTES:

Exceeds SF Bay Ambient Levels

Exceeds SF-DODS Database Values*

Exceeds more than one reference value

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	May-01							
	1	2	3	4	5	6	7	**SF-11**
Grain Size (%, dry wt)								
Sand/Gravel (>0.063 mm)	2.9	2	1.1	0.7	0.8	0.8	1.7	90.7
Silt (0.004 mm - 0.063 mm	56.7	56.7	61.7	65.6	86.9	69.4	71.1	0.5
Clay (<0.004 mm)	40.3	41.3	37.1	33.7	30.4	29.8	27.2	1.8
Conventionals								
% Solids (%)	43.6	44	41.1	40	38.3	38.3	38.6	83.5
TOC (%)	1.4	1.3	1.4	1.5	1.4	1.5	1.6	0.2
Metals (mg/kg, ppm, d								
Antimony								
Arsenic	8.8	8.8	9.3	9.4	9.4	9.2	8.9	5.4
Barium								
Beryllium								
Cadmium	<0.2	<0.2	<0.2	<0.3	<0.3	<0.3	0.4	<0.1
Chromium	80.5	7.8	79.8	86.2	87.2	86.6	88.7	18
Cobalt								
Copper	42.4	44.4	44.6	46	49.6	49.6	67	2.5
Lead	27.9	31.5	27.7	28.6	30.7	32	42.9	3.1
Mercury	0.31	0.29	0.25	0.29	0.33	0.32	0.42	<0.02
Nickel	78.8	80	84.7	86.9	90.5	87	93.1	18.8
Selenium	0.7	0.6	0.7	0.7	0.7	0.6	0.7	<0.1
Silver	0.4	0.5	0.3	2	0.4	0.3	0.8	<0.1
Thallium								
Vanadium								
Zinc	102	107	108	112	118	120	134	13.5
Butyltins (microgram/k								
Monobutylin	<4.6	<4.5	<4.9	<5.0	<5.2	<5.2	<5.2	<2.4
Dibutylin	<4.6	<4.5	<4.9	<5.0	<5.2	<5.2	<5.2	<2.4
Tributylin	<2.3	<2.3	<2.4	<2.5	<2.6	<2.6	<2.6	<1.2
Tetrabutylin	<2.3	<2.3	<2.4	<2.5	<2.6	<2.6	<2.6	<1.2
Total (Σ detected) Butyltins	0	0	0	0	0	0	0	0
Pesticides (microgra								
Aldrin	<1.22	<1.20	<1.29	<1.33	<1.38	<1.38	<1.37	<0.63
alpha-BHC	<2.29	<2.27	<2.43	<2.51	<2.61	<2.61	<2.59	<1.20
beta-BHC	<1.41	<1.40	<1.5	<1.54	<1.61	<1.61	<1.59	<1.74
delta-BHC	<1.47	<1.45	<1.56	<1.6	<1.67	<1.67	<1.66	<1.77
Gamma-BHC (Lindane)	<1.44	<1.43	<1.53	<1.58	<1.64	<1.64	<1.63	<0.75
Total BHCs								
alpha-Chlordane								
gamma-Chlordane								

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	May-01							
	1	2	3	4	5	6	7	**SF-11**
Chlordane	<5.42	<5.29	<5.75	<5.93	<6.17	<6.17	<6.13	<2.83
Total Chlordane								
4,4'-DDD	<1.41	<1.40	<1.5	<1.54	<1.61	<1.61	<1.59	<0.74
4,4'-DDE	<1.23	<1.22	<1.3	<1.34	<1.40	<1.40	<1.39	<0.64
4,4'-DDT	<2.29	<2.27	<2.43	<2.51	<2.61	<2.61	<2.59	<1.20
2,4'-DDD	<1.41	<1.40	<1.5	<1.54	<1.61	<1.61	<1.59	<0.74
2,4'-DDE	<1.23	<1.22	<1.3	<1.34	<1.40	<1.40	<1.39	<0.64
2,4'-DDT	<2.29	<2.27	<2.43	<2.51	<2.61	<2.61	<2.59	<1.20
Total (Σ detected) DDTs	0	0	0	0	0	0	0	0
Dieldrin	<1.49	<1.48	<1.58	<1.63	<1.70	<1.70	<1.69	<0.78
Endosulfan I	<1.87	<1.85	<1.98	<2.04	<2.13	<2.13	<2.11	<0.98
Endosulfan II	<1.95	<1.93	<2.07	<2.13	<2.22	<2.22	<2.20	<1.02
Endosulfan sulfate	<1.65	<1.64	<1.75	<1.80	<1.88	<1.88	<1.87	<0.86
Endrin	<1.72	<1.70	<1.82	<1.88	<1.96	<1.96	<1.94	<0.90
Endrin Aldehyde	<1.86	0.84	<1.97	<2.03	<2.11	<2.11	<2.10	<0.97
Endrin Ketone								
Heptachlor	<1.92	<1.90	<1.03	<2.09	<2.18	<2.18	<2.16	<1.00
Heptachlor epoxide	<1.90	<1.89	<2.02	<2.08	<2.17	<2.17	<2.15	<0.99
Methoxychlor								
Toxaphene	<10.1	<10.0	<10.7	<11	<11.5	<11.5	<11.4	<5.27
trans-Nonachlor								
Aroclor PCBs (microg								
PCB 1016	--	--	--	--	--	--	--	--
PCB 1221	--	--	--	--	--	--	--	--
PCB 1232	--	--	--	--	--	--	--	--
PCB 1242	<5.3	<5.2	<5.6	<5.8	<6.0	<6.0	<6.0	<2.8
PCB 1248	<5.3	<5.2	<5.6	<5.8	<6.0	<6.0	<6.0	<2.8
PCB 1254	<5.3	<5.2	<5.6	<5.8	<6.0	<6.0	<6.0	<2.8
PCB 1260	<5.3	<5.2	<5.6	<5.8	<6.0	<6.0	<6.0	<2.8
Total (Σ detected) PCBs	0	0	0	0	0	0	0	0
PCB Congeners (micr								
PCB008								
PCB018								
PCB028								
PCB031								
PCB033								
PCB044								
PCB049								
PCB052								

Sediment Chemistry

Analyte	May-01							
	1	2	3	4	5	6	7	**SF-11**
PCB056								
PCB060								
PCB066								
PCB070								
PCB074								
PCB087								
PCB095								
PCB097								
PCB099								
PCB101								
PCB105								
PCB110								
PCB118								
PCB128								

Sediment Chemistry

Analyte	May-01							
	1	2	3	4	5	6	7	**SF-11**
PCB132								
PCB138/158								
PCB141								
PCB149								
PCB151								
PCB153								
PCB156								
PCB170								
PCB174								
PCB177								
PCB180								
PCB183								
PCB187								
PCB194								
PCB195								
PCB201								
PCB203								
Total (∑ detected) PCB Co								
PAHs (micrograms/k								
1-Methylnaphthalene								
1-Methylphenanthrene								
2,3,5-Trimethylnaphthalen								
2,6-Dimethylnaphthalene								
2-Methylnaphthalene								
Acenapthene	<8.3	<8.2	<8.8	<9.0	<9.4	<9.4	<9.3	<4.3
Acenaphthylene	<10.8	<10.7	<11.4	<11.8	<12.3	<12.3	<12.2	<5.6
Anthracene	<14.4	<14.3	<15.3	<15.8	<16.4	<16.4	<16.3	<7.5
Benzo(a)anthracene	64	59	<16.3	<16.8	<17.5	<17.5	<17.4	<8.0
Benzo(a)pyrene	149	140	40	40	30	27	20	<8.9
Benzo(b)fluoranthene	100	92	<21.7	27	<23.2	25	<23.1	<10.7
Benzo(e)pyrene								
Benzo(g,h,i)perylene	85	96	<23.6	<24.3	<25.3	<25.3	<25.1	<11.6
Benzo(k)fluoranthene	50	44	<16.5	<17.0	<17.8	<17.8	<17.6	<8.1
Biphenyl								
Chrysene	67	67	13	13	<10.2	<10.2	<10.1	<4.7
Dibenzo(a,h)anthracene	<21.1	<20.9	<22.4	<23.1	24	<24	<23.8	<11
Dibenzothiophene								
Fluoranthene	191	176	80	91	45	91	21	<6.9
Fluorene	<10.6	<10.5	<11.2	<11.5	<12	<12	<11.9	<5.5
Indeno(1,2,3-cd)pyrene	99	92	<24.3	27	27	<26.1	<25.9	<12

Sediment Chemistry

Analyte	May-01							
	1	2	3	4	5	6	7	**SF-11**
Naphthalene	<4.4	<4.3	<4.6	<4.8	<5.0	<5.0	<4.9	<5.0
Perylene								
Phenanthrene	80	72	25	16	<11	<11	<10.9	<2.3
Pyrene	263	231	117	128	79	148	102	<7.3
Total LPAHs								
Total HPAHs								
Total (Σ detected)PAHs	1148	1069	275	342	181	239	291	143
Dioxins/Furans (ng/k								
2,3,7,8-Tetra CDD								
1,2,3,7,8-Penta CDD								
1,2,3,4,7,8-Hexa CDD								
1,2,3,6,7,8-Hexa CDD								
1,2,3,7,8,9-Hexa CDD								
1,2,3,4,6,7,8-Hepta CDD								
Total Octa CDD								
Total Tetra CDD								
Total Penta CDD								
Total Hexa CDD								
Total Hepta CDD								
2,3,7,8-Tetra CDF								
1,2,3,7,8-Penta CDF								
2,3,4,7,8-Penta CDF								
1,2,3,4,7,8-Hexa CDF								
1,2,3,6,7,8-Hexa CDF								
2,3,4,6,7,8-Hexa CDF								
1,2,3,7,8,9-Hexa CDF								
1,2,3,4,6,7,8-Hepta CDF								
1,2,3,4,7,8,9-Hepta CDF								
Octa CDF								
Total Tetra CDF								
Total Penta CDF								
Total Hexa CDF								
Total Hepta CDF								
Total TEQ								
Effects Range-Mediar								

Sediment Chemistry

Analyte	Jun-05					
	1	2	3	4	5	**SF-11**
Grain Size (%, dry wt)						
Sand/Gravel (>0.063 mm)	7.3	6.5	9.6	4.1	4.3	100
Silt (0.004 mm - 0.063 mm	73.7	76.4	73.4	78	75.5	0
Clay (<0.004 mm)	19	17	17.1	17.9	20.1	0
Conventionals						
% Solids (%)	40.5	34.6	40.5	37.6	37	37.1
TOC (%)	1.28	1.38	1.34	1.45	1.6	0.04
Metals (mg/kg, ppm, d						
Antimony						
Arsenic	7.12	8.42	7.38	8.75	8.62	8.4
Barium						
Beryllium						
Cadmium	0.15	0.22	0.18	0.21	0.32	0.33
Chromium	116	139	106	135	148	137
Cobalt						
Copper	38.7	48.8	36.8	49	66	61.5
Lead	22.4	27.4	21.1	28.2	38.5	35.3
Mercury	0.288	0.395	0.284	0.364	0.588	0.44
Nickel	80.7	99.5	75	95.1	112	103
Selenium	0.037	<0.025	0.09	<0.02	0.0457	<0.025
Silver	<0.025	0.27	0.16	0.21	0.64	0.67
Thallium						
Vanadium						
Zinc	102	130	100	127	156	151
Butyltins (microgram/k						
Monobutylin	<1	<1	<1	<1	<1	<1
Dibutylin	<1	<1	<1	<1	<1	<1
Tributylin	<1	<1	<1	<1	<1	<1
Tetrabutylin	<1	<1	<1	<1	<1	<1
Total (Σ detected) Butyltins	0	0	0	0	0	0
Pesticides (microgra						
Aldrin	<1	<1	<1	<1	<1	<1
alpha-BHC	<1	<1	<1	<1	<1	<1
beta-BHC	<1	<1	<1	<1	<1	<1
delta-BHC	<1	<1	<1	<1	<1	<1
Gamma-BHC (Lindane)	<1	<1	<1	<1	<1	<1
Total BHCs						
alpha-Chlordane						
gamma-Chlordane						

Sediment Chemistry

Analyte	Jun-05					
	1	2	3	4	5	**SF-11**
Chlordane	<2	<2	<2	<2	<2	<2
Total Chlordane						
4,4'-DDD	<1	<1	<1	<1	<1	<1
4,4'-DDE	<1	<1	<1	<1	<1	<1
4,4'-DDT	<1	<1	<1	<1	<1	<1
2,4'-DDD	<1	<1	<1	<1	<1	<1
2,4'-DDE	<1	<1	<1	<1	<1	<1
2,4'-DDT	<1	<1	<1	<1	<1	<1
Total (Σ detected) DDTs	0	0	0	0	0	0
Dieldrin	<1	<1	<1	<1	<1	<1
Endosulfan I	<1	<1	<1	<1	<1	<1
Endosulfan II	<1	<1	<1	<1	<1	<1
Endosulfan sulfate	<1	<1	<1	<1	<1	<1
Endrin	<1	<1	<1	<1	<1	<1
Endrin Aldehyde	<1	<1	<1	<1	<1	<1
Endrin Ketone						
Heptachlor	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	<1	<1	<1	<1	<1	<1
Methoxychlor						
Toxaphene	<10	<10	<10	<10	<10	<10
trans-Nonachlor						
Aroclor PCBs (microg						
PCB 1016	<10	<10	<10	<10	<10	<10
PCB 1221	<10	<10	<10	<10	<10	<10
PCB 1232	<10	<10	<10	<10	<10	<10
PCB 1242	<10	<10	<10	<10	<10	<10
PCB 1248	<10	<10	<10	<10	<10	<10
PCB 1254	<10	<10	<10	<10	<10	<10
PCB 1260	<10	<10	<10	<10	<10	<10
Total (Σ detected) PCBs	0	0	0	0	0	0
PCB Congeners (micr						
PCB008						
PCB018						
PCB028						
PCB031						
PCB033						
PCB044						
PCB049						
PCB052						

Sediment Chemistry

Analyte	Jun-05					
	1	2	3	4	5	**SF-11**
PCB056						
PCB060						
PCB066						
PCB070						
PCB074						
PCB087						
PCB095						
PCB097						
PCB099						
PCB101						
PCB105						
PCB110						
PCB118						
PCB128						

Sediment Chemistry

Analyte	Jun-05					
	1	2	3	4	5	**SF-11**
PCB132						
PCB138/158						
PCB141						
PCB149						
PCB151						
PCB153						
PCB156						
PCB170						
PCB174						
PCB177						
PCB180						
PCB183						
PCB187						
PCB194						
PCB195						
PCB201						
PCB203						
Total (∑ detected) PCB Co						
PAHs (micrograms/k						
1-Methylnaphthalene						
1-Methylphenanthrene						
2,3,5-Trimethylnaphthalene						
2,6-Dimethylnaphthalene						
2-Methylnaphthalene						
Acenapthene	3.7	1.7	1.7	4.6	2.4	<1
Acenaphthylene	7.9	5.7	2.8	4.4	4.8	<1
Anthracene	22.2	12.7	6.1	13.9	15.5	<1
Benzo(a)anthracene	84.3	52.3	84.7	57.4	70.4	<1
Benzo(a)pyrene	124	79.8	50.4	60.5	109	<1
Benzo(b)fluoranthene	89.4	57.1	39.8	57.7	104	<1
Benzo(e)pyrene						
Benzo(g,h,i)perylene	100	74.7	49.7	65	116	<1
Benzo(k)fluoranthene	100	47.6	27.8	47.1	102	<1
Biphenyl						
Chrysene	98.6	54.5	40	88.5	142	<1
Dibenzo(a,h)anthracene	<1	<1	<1	<1	<1	<1
Dibenzothiophene						
Fluoranthene	205	105	81.1	132	145	5.1
Fluorene	5	4	2	5.6	4.5	<1
Indeno(1,2,3-cd)pyrene	101	63	42.6	50.4	96.6	<1

Sediment Chemistry

Analyte	Jun-05					
	1	2	3	4	5	**SF-11**
Naphthalene	14.3	9.6	7.7	12.4	16.4	3.1
Perylene						
Phenanthrene	63.9	40.9	24.2	48.1	41.2	4.9
Pyrene	273	146	110	165	218	8.3
Total LPAHs						
Total HPAHs						
Total (Σ detected)PAHs	1297	755	521	813	1188	21
Dioxins/Furans (ng/k						
2,3,7,8-Tetra CDD						
1,2,3,7,8-Penta CDD						
1,2,3,4,7,8-Hexa CDD						
1,2,3,6,7,8-Hexa CDD						
1,2,3,7,8,9-Hexa CDD						
1,2,3,4,6,7,8-Hepta CDD						
Total Octa CDD						
Total Tetra CDD						
Total Penta CDD						
Total Hexa CDD						
Total Hepta CDD						
2,3,7,8-Tetra CDF						
1,2,3,7,8-Penta CDF						
2,3,4,7,8-Penta CDF						
1,2,3,4,7,8-Hexa CDF						
1,2,3,6,7,8-Hexa CDF						
2,3,4,6,7,8-Hexa CDF						
1,2,3,7,8,9-Hexa CDF						
1,2,3,4,6,7,8-Hepta CDF						
1,2,3,4,7,8,9-Hepta CDF						
Octa CDF						
Total Tetra CDF						
Total Penta CDF						
Total Hexa CDF						
Total Hepta CDF						
Total TEQ						
Effects Range-Mediar						

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Feb-08				
	1	2	3	SF-10	SF-11
Grain Size (%, dry wt)					
Sand/Gravel (>0.063 mm)	3.56	2.13	1.6	41.16	99.24
Silt (0.004 mm - 0.063 mm	40.3	39.5	33	25	0.53
Clay (<0.004 mm)	56.2	59.1	65.4	33.8	0.23
Conventionals					
% Solids (%)	44.13	44.01	40.5	39.78	83.7
TOC (%)	1.33	1.39	1.49	0.9	0.09
Metals (mg/kg, ppm, d					
Antimony					
Arsenic	8.0	8.91	9.8	10.2	5.01
Barium					
Beryllium					
Cadmium	0.2555	0.469	0.621	0.256	<0.118
Chromium	97.6	94.9	122	81.3	24.8
Cobalt					
Copper	38.1	38.5	52.1	36.8	2.51
Lead	29.8	30.1	41.7	22	11
Mercury	0.28	0.23	0.33	0.16	0.02
Nickel	77.2	77.9	97.5	71.1	21.9
Selenium	0.114	0	0.168	0.145	0.004
Silver	0.54	0.46	0.97	<0.21	<0.12
Thallium					
Vanadium					
Zinc	117	146	172	117	28
Butyltins (microgram/k					
Monobutylin	<1.18	<1.28	<1.44	<1.16	<0.65
Dibutylin	<2.47	<2.67	<3.00	<2.42	<1.36
Tributylin	<2.13	<2.30	<2.58	<2.08	<1.17
Tetrabutylin	<1.91	<2.06	<2.32	<1.87	<1.05
Total (Σ detected) Butyltins					
Pesticides (microgra					
Aldrin	<1.12	<1.21	<1.36	<1.10	<0.62
alpha-BHC	<2.15	<2.32	<2.61	<2.10	<1.18
beta-BHC	<1.31	<1.42	<1.59	<1.28	<0.72
delta-BHC	<1.31	<1.42	<1.59	<1.28	<0.72
Gamma-BHC (Lindane)	<1.35	<1.46	<1.64	<1.32	<0.75
Total BHCs					
alpha-Chlordane					
gamma-Chlordane					

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Feb-08				
	1	2	3	SF-10	SF-11
Chlordane	<5.12	<5.52	<6.21	<5.00	<2.82
Total Chlordane					
4,4'-DDD	<1.31	<1.42	<1.59	<1.28	<0.72
4,4'-DDE	<1.16	<1.25	<1.41	<1.13	<0.64
4,4'-DDT	<2.15	<2.32	<2.61	<2.10	<1.18
2,4'-DDD	<1.31	<1.42	<1.59	<1.28	<0.72
2,4'-DDE	<1.16	<1.25	<1.41	<1.13	<0.64
2,4'-DDT	<2.15	<2.32	<2.61	<2.10	<1.18
Total (Σ detected) DDTs					
Dieldrin	<1.40	<1.51	<1.70	<1.37	<0.77
Endosulfan I	<1.76	<1.90	<2.14	<1.72	<0.97
Endosulfan II	<1.83	<1.97	<2.22	<1.79	<1.01
Endosulfan sulfate	<1.55	<1.67	<1.88	<1.51	<0.85
Endrin	<1.63	<1.76	<1.98	<1.60	<0.90
Endrin Aldehyde	<1.74	<1.88	<2.11	<1.70	<0.96
Endrin Ketone					
Heptachlor	<1.81	<1.95	<2.19	<1.76	<1.00
Heptachlor epoxide	<1.78	<1.93	<2.17	<1.74	<0.98
Methoxychlor					
Toxaphene	<18.9	<20.4	<23.0	<18.5	<10.4
trans-Nonachlor					
Aroclor PCBs (microg					
PCB 1016	<5.03	<5.43	<6.11	<4.92	<2.77
PCB 1221	<5.03	<5.43	<6.11	<4.92	<2.77
PCB 1232	<5.03	<5.43	<6.11	<4.92	<2.77
PCB 1242	<5.03	<5.43	<6.11	<4.92	<2.77
PCB 1248	<5.03	<5.43	<6.11	<4.92	<2.77
PCB 1254	<5.03	<5.43	<6.11	<4.92	<2.77
PCB 1260	<5.03	<5.43	<6.11	<4.92	<2.77
Total (Σ detected) PCBs	<5.03	<5.43	<6.11	<4.92	<2.77
PCB Congeners (micr					
PCB008					
PCB018					
PCB028					
PCB031					
PCB033					
PCB044					
PCB049					
PCB052					

Sediment Chemistry

Analyte	Feb-08				
	1	2	3	SF-10	SF-11
PCB056					
PCB060					
PCB066					
PCB070					
PCB074					
PCB087					
PCB095					
PCB097					
PCB099					
PCB101					
PCB105					
PCB110					
PCB118					
PCB128					

Sediment Chemistry

Analyte	Feb-08				
	1	2	3	SF-10	SF-11
PCB132					
PCB138/158					
PCB141					
PCB149					
PCB151					
PCB153					
PCB156					
PCB170					
PCB174					
PCB177					
PCB180					
PCB183					
PCB187					
PCB194					
PCB195					
PCB201					
PCB203					
Total (∑ detected) PCB Co					
PAHs (micrograms/k					
1-Methylnaphthalene					
1-Methylphenanthrene					
2,3,5-Trimethylnaphthalene					
2,6-Dimethylnaphthalene					
2-Methylnaphthalene					
Acenapthene	<7.74	<8.35	<9.40	<7.56	<4.27
Acenaphthylene	<10.1	<10.9	<12.2	<9.83	<5.55
Anthracene	<13.5	<14.6	<16.4	<13.2	<7.46
Benzo(a)anthracene	17.4	24.9	<17.4	<14.0	<7.90
Benzo(a)pyrene	22.1	35.8	<19.3	<15.5	<8.74
Benzo(b)fluoranthene	21.7	34.1	<23.2	<18.7	<10.5
Benzo(e)pyrene					
Benzo(g,h,i)perylene	<20.9	28.2	<25.4	<20.4	<11.5
Benzo(k)fluoranthene	<14.7	<15.9	<17.9	<14.4	<8.10
Biphenyl					
Chrysene	9.53	16.2	<10.3	<8.32	<4.69
Dibenzo(a,h)anthracene	<19.7	<21.3	<24.0	<19.3	<10.9
Dibenzothiophene					
Fluoranthene	24.6	42.9	21.6	<12.1	<6.82
Fluorene	<10.1	<10.9	<12.2	<9.83	<5.55
Indeno(1,2,3-cd)pyrene	<21.5	26.9	<26.1	<21.0	<11.8

Sediment Chemistry

Analyte	Feb-08				
	1	2	3	SF-10	SF-11
Naphthalene	<4.11	<4.43	<4.99	<4.01	<2.26
Perylene					
Phenanthrene	11	21.1	<10.9	<8.80	<4.96
Pyrene	34.8	59.4	33.6	<12.8	9.8
Total LPAHs					
Total HPAHs					
Total (Σ detected)PAHs	263	376	285	210	121
Dioxins/Furans (ng/k					
2,3,7,8-Tetra CDD					
1,2,3,7,8-Penta CDD					
1,2,3,4,7,8-Hexa CDD					
1,2,3,6,7,8-Hexa CDD					
1,2,3,7,8,9-Hexa CDD					
1,2,3,4,6,7,8-Hepta CDD					
Total Octa CDD					
Total Tetra CDD					
Total Penta CDD					
Total Hexa CDD					
Total Hepta CDD					
2,3,7,8-Tetra CDF					
1,2,3,7,8-Penta CDF					
2,3,4,7,8-Penta CDF					
1,2,3,4,7,8-Hexa CDF					
1,2,3,6,7,8-Hexa CDF					
2,3,4,6,7,8-Hexa CDF					
1,2,3,7,8,9-Hexa CDF					
1,2,3,4,6,7,8-Hepta CDF					
1,2,3,4,7,8,9-Hepta CDF					
Octa CDF					
Total Tetra CDF					
Total Penta CDF					
Total Hexa CDF					
Total Hepta CDF					
Total TEQ					
Effects Range-Mediar					

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Feb-11							
	1	2	3	4	5	6	7	SF-10
Grain Size (%, dry wt)								
Sand/Gravel (>0.063 mm)	0	0	0	0	0	0	0	0.81
Silt (0.004 mm - 0.063 mm	42.1	40.2	37.2	33.4	29.2	39.2	40.4	26.1
Clay (<0.004 mm)	55.7	59.1	62.1	65.9	69.9	59.9	58.8	28.4
Conventionals								
% Solids (%)	44.9	42.5	42.2	39.9	38.7	47.2	48.6	53.1
TOC (%)	1.4	1.4	1.4	1.5	1.6	1.4	1.3	1.1
Metals (mg/kg, ppm, d								
Antimony								
Arsenic	**7.95**	**7.88**	**7.38**	**8.22**	**8.2**	**7.8**	**8.0**	7.6
Barium								
Beryllium								
Cadmium	0.458	0.460	0.463	0.501	0.6	0.5	0.5	0.4
Chromium	75.70	81.80	81.80	88.70	94.2	81.2	81.1	65.1
Cobalt								
Copper	39.100	39.400	40.700	46.600	57.5	40.5	43.5	38.7
Lead	**28.2**	**26.9**	**27.1**	**31.7**	**37.8**	**29.0**	**29.9**	19.5
Mercury	**0.304**	**0.288**	**0.321**	**0.347**	**0.4**	**0.3**	**0.329**	0.156
Nickel	77.4	78.0	80.0	87.8	94.8	79.4	81.8	73.3
Selenium	0.374	0.389	0.425	0.488	0.5	0.4	0.39	<0.067
Silver	0.499	0.447	0.442	0.554	**0.763**	0.5	0.496	0.249
Thallium								
Vanadium								
Zinc	108	109	112	124	141	115	112	99.5
Butyltins (microgram/k								
Monobutylin	<2.2	35	<2.3	<2.4	<2.5	<2.1	<2.0	<1.8
Dibutylin	<1.3	64	<1.4	<1.5	<1.5	<1.3	<1.2	<1.1
Tributylin	<0.74	<0.79	<0.79	<0.84	<0.86	<0.71	<.69	<0.63
Tetrabutylin	<0.80	<0.84	<0.85	<0.90	>0.92	<0.76	<0.74	<0.67
Total (Σ detected) Butyltins								
Pesticides (microgra								
Aldrin	<0.69	<0.73	<0.73	<0.77	<0.80	<0.65	<0.64	<0.58
alpha-BHC	<0.66	<0.69	<0.70	<0.74	<0.76	<0.62	<0.61	<0.55
beta-BHC	<0.57	<0.60	<0.60	<0.64	<0.66	<0.54	<0.52	<0.48
delta-BHC	<0.71	<0.75	<0.75	<0.80	<0.82	0.67	<0.65	<0.60
Gamma-BHC (Lindane)	<0.51	<0.54	<0.54	<0.57	<0.59	<0.48	<0.47	<0.43
Total BHCs								
alpha-Chlordane								
gamma-Chlordane								

Sediment Chemistry

Analyte	Feb-11							
	1	2	3	4	5	6	7	SF-10
Chlordane	<8.9	<9.4	<9.5	<10.0	<10.0	<8.5	<8.2	<7.5
Total Chlordane								
4,4'-DDD	<0.57	<0.61	<0.61	<0.65	<0.67	<0.55	<0.53	<0.49
4,4'-DDE	<1.1	<0.71	1.5	1.1	2.2	1.3	1.3	1.4
4,4'-DDT	<0.73	<0.77	<0.78	<0.82	<0.85	<0.69	<0.67	<0.62
2,4'-DDD	<0.45	<0.47	<0.48	<0.50	<0.52	<0.43	<0.41	<0.38
2,4'-DDE	<0.40	<0.42	<0.42	<0.45	<0.46	<0.38	<0.37	<0.33
2,4'-DDT	<0.31	<0.33	<0.33	<0.35	<0.36	<0.30	<0.29	<0.26
Total (Σ detected) DDTs	1.1	<0.77	1.5	1.1	2.2	1.3	1.3	1.4
Dieldrin	<0.51	<0.53	<0.54	<0.57	<0.59	<0.48	<4.7	0.43
Endosulfan I	<0.79	<0.84	<0.84	<0.89	<0.92	<0.75	<0.73	<0.67
Endosulfan II	<0.39	<0.41	<0.42	<0.44	<0.45	<0.37	<0.36	<0.33
Endosulfan sulfate	<0.59	<0.62	<0.62	<0.66	<0.68	<0.56	<0.54	<0.50
Endrin	<0.45	<0.47	<0.48	<0.51	<0.52	<0.43	<0.41	<0.38
Endrin Aldehyde	<0.44	<0.46	<0.46	<0.49	<0.50	<0.41	<0.40	<0.37
Endrin Ketone								
Heptachlor	<0.50	<0.52	<0.53	<0.56	<0.58	<0.47	<0.46	<0.42
Heptachlor epoxide	<0.41	<0.43	<0.44	<0.46	<0.47	<0.39	<0.38	<0.35
Methoxychlor								
Toxaphene	<19.0	<20.0	<20.0	<21.0	<22.0	<18.0	<17.0	<16
trans-Nonachlor								
Aroclor PCBs (microg								
PCB 1016	<4.5	<4.7	<4.8	<5.1	<5.2	<4.3	<4.1	<3.8
PCB 1221	<4.5	<4.7	<4.7	<5.0	<5.2	<4.2	<4.1	<3.8
PCB 1232	<4.5	<4.7	<4.7	<5.0	<5.2	<4.2	<4.1	<3.8
PCB 1242	<4.5	**200,000**	<4.7	<5.0	<5.2	<4.2	<4.1	<3.8
PCB 1248	<4.5	<4.7	<4.7	<5.0	<5.2	<4.2	<4.1	<3.8
PCB 1254	<4.5	<4.7	<4.7	<5.0	<5.2	<4.2	<4.1	<3.8
PCB 1260	17.00	<5.2	16.00	16.00	19.00	16.0	14	<4.2
Total (Σ detected) PCBs	17.00	**200,000**	16.00	16.00	19.00	16.0	14	<4.2
PCB Congeners (micr								
PCB008								
PCB018								
PCB028								
PCB031								
PCB033								
PCB044								
PCB049								
PCB052								

Sediment Chemistry

Analyte	Feb-11							
	1	2	3	4	5	6	7	SF-10
PCB056								
PCB060								
PCB066								
PCB070								
PCB074								
PCB087								
PCB095								
PCB097								
PCB099								
PCB101								
PCB105								
PCB110								
PCB118								
PCB128								

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Feb-11							
	1	2	3	4	5	6	7	SF-10
PCB132								
PCB138/158								
PCB141								
PCB149								
PCB151								
PCB153								
PCB156								
PCB170								
PCB174								
PCB177								
PCB180								
PCB183								
PCB187								
PCB194								
PCB195								
PCB201								
PCB203								
Total (∑ detected) PCB Co								
PAHs (micrograms/k								
1-Methylnaphthalene								
1-Methylphenanthrene								
2,3,5-Trimethylnaphthalene								
2,6-Dimethylnaphthalene								
2-Methylnaphthalene								
Acenapthene	14.0	49	8.2	13.0	6.6	6.0	6.7	3.5
Acenaphthylene	24.0	39	20.0	19.0	17.0	12.0	13.0	<31.7
Anthracene	32.0	180	37.0	33.0	34.0	22.0	27.0	<3.4
Benzo(a)anthracene	110	980	130	95.0	110	74	88	5.8
Benzo(a)pyrene	250	1000	310	230	290	190	200	12
Benzo(b)fluoranthene	160	1100	220	170	230	130	140	4.8
Benzo(e)pyrene								
Benzo(g,h,i)perylene	240	510	300	230	280	180	180	9.3
Benzo(k)fluoranthene	170	1100	180	150	180	120	140	6.7
Biphenyl								
Chrysene	130	1200	160	120	140	94	110	7.3
Dibenzo(a,h)anthracene	15	97	22	16	20	12	14	<3.7
Dibenzothiophene								
Fluoranthene	210	1600	240	190	190	160	170	14.0
Fluorene	18.0	<41	13.0	16.0	12.0	8.8	10	<3.3
Indeno(1,2,3-cd)pyrene	210	520	260	200	250	160	160	7.5

Sediment Chemistry

Analyte	Feb-11							
	1	2	3	4	5	6	7	SF-10
Naphthalene	37.0	200	40.0	35.0	40.0	27.0	28.0	4.7
Perylene								
Phenanthrene	120	680	120	84.0	89.0	71.0	88.0	6.2
Pyrene	330	1600	380	290	360	240	270	21
Total LPAHs								
Total HPAHs								
Total (Σ detected)PAHs	2,070	10290	2,377	1,827	2,193	1,468	1,601	99
Dioxins/Furans (ng/k								
2,3,7,8-Tetra CDD								
1,2,3,7,8-Penta CDD								
1,2,3,4,7,8-Hexa CDD								
1,2,3,6,7,8-Hexa CDD								
1,2,3,7,8,9-Hexa CDD								
1,2,3,4,6,7,8-Hepta CDD								
Total Octa CDD								
Total Tetra CDD								
Total Penta CDD								
Total Hexa CDD								
Total Hepta CDD								
2,3,7,8-Tetra CDF								
1,2,3,7,8-Penta CDF								
2,3,4,7,8-Penta CDF								
1,2,3,4,7,8-Hexa CDF								
1,2,3,6,7,8-Hexa CDF								
2,3,4,6,7,8-Hexa CDF								
1,2,3,7,8,9-Hexa CDF								
1,2,3,4,6,7,8-Hepta CDF								
1,2,3,4,7,8,9-Hepta CDF								
Octa CDF								
Total Tetra CDF								
Total Penta CDF								
Total Hexa CDF								
Total Hepta CDF								
Total TEQ								
Effects Range-Mediar								

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Mar-14									
	1	2	3	4	5	6	7	SF-10	1Z	7Z
Grain Size (%, dry wt)										
Sand/Gravel (>0.063 mm)	7.9	0	0	0	0	0	0	51		
Silt (0.004 mm - 0.063 mm	56	65	63	59	61	47	47	35		
Clay (<0.004 mm)	36	35	37	41	39	53	53	14		
Conventionals										
% Solids (%)	44.6	43.3	43.2	42.5	42.6	39	39.4	55.6		45.7
TOC (%)	1.7	1.6	1.6	1.7	1.6	1.8	1.9	1		
Metals (mg/kg, ppm, d										
Antimony	<0.087	<0.090	<0.090	<0.091	<0.091	<0.099	<0.098	<0.070		
Arsenic	8.22	8.07	8.14	8.23	8.48	8.11	7.57	7.09		
Barium	63	62	59	58	60.4	63.7	69.3	45.7		
Beryllium	0.72J	0.753J	0.62J	0.691J	0.838J	0.813J	0.895J	0.475J		
Cadmium	**0.513**	**0.451**	**0.486**	**0.485**	**0.472**	**0.476**	**0.695**	**0.427**		
Chromium	92.8	94.9	91.3	93.4	97.8	98.9	103.0	70.4		
Cobalt	17.2	17.0	16.5	16.4	17.3	17.1	16.8	15.7		
Copper	46.5	45.9	44.0	44.5	47.2	52.3	61.3	36.0		
Lead	29.1	27.3	26.0	26.2	28.1	29.8	36.6	19.4		
Mercury	0.296	0.281	0.248	0.247	0.265	0.268	0.34	0.159		
Nickel	92.1	92.5	88.8	88.9	94.9	98.5	103	75.6		
Selenium	0.517	0.261	0.233	0.354	0.427	0.245J	0.372	0.22		
Silver	0.525	0.415	0.403	0.400	0.419	0.489	**0.757**	0.194		
Thallium	0.162J	0.176J	0.15J	0.15J	0.163J	0.166J	0.17J	0.106J		
Vanadium	71.6	74.3	71.7	72.1	76.3	76.2	77	66.2		
Zinc	136	135	131	132	141	153	**163**	111		
Butyltins (microgram/k										
Monobutylin	2.6J	<1.5	<1.5	<1.5	2.5J	<1.7	5.4J	<1.2		
Dibutylin	3.3J	3.1J	2.7J	3.5J	1.6J	4.1J	11	2.9J		
Tributylin	3J	2.2J	1.5J	3.7J	1.7J	1.6J	3.4J	1.6J		
Tetrabutylin	<1.7	<1.8	<1.8	<1.8	<1.8	<2	<1.9	<1.4		
Total (Σ detected) Butyltins	8.9	5.3	4.2	7.2	5.8	5.7	19.8	4.5		
Pesticides (microgra										
Aldrin	<0.7	<0.73	<0.72	<0.74	<0.75	<0.81	<0.79	<0.56		
alpha-BHC	<0.73	<0.75	<0.74	<0.76	<0.77	<0.83	<0.81	<0.58		
beta-BHC	<0.59	<0.61	<0.61	<0.62	<0.63	<0.68	<0.66	<0.47		
delta-BHC	<7.3	<7.6	<7.5	<.7.7	<7.7	<8.4	<8.2	<5.9		
Gamma-BHC (Lindane)	<0.66	<0.68	<0.67	<0.69	<0.7	<0.76	<0.74	<0.53		
Total BHCs	<0.57	<0.59	<0.59	<0.6	<0.61	<0.66	<0.64	<0.46		
alpha-Chlordane	<0.74	<0.76	<0.76	<0.77	<0.78	<0.85	<0.83	<0.59		
gamma-Chlordane	<0.72	<0.75	<0.74	<0.75	<0.76	<0.83	<0.81	<0.58		

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Mar-14									
	1	2	3	4	5	6	7	SF-10	1Z	7Z
Chlordane	<0.59	<0.61	<0.6	<0.61	<0.62	<0.67	<0.66	<0.47		
Total Chlordane	ND	ND	ND	ND	ND	ND	ND	ND		
4,4'-DDD	<0.71	<0.73	<0.73	<0.74	<0.75	<0.81	<0.79	<0.57		
4,4'-DDE	<0.67	<0.69	<0.69	<0.7	<0.71	<0.77	<0.75	<0.54		
4,4'-DDT	<0.75	<0.78	<0.77	<0.78	<0.79	<0.86	<0.84	<0.6		
2,4'-DDD	<0.76	<0.79	<0.78	<0.79	<0.8	<0.87	<0.85	<0.61		
2,4'-DDE	<0.68	<0.71	<0.7	<0.72	<0.72	<0.79	<0.77	<0.55		
2,4'-DDT	<0.67	<0.7	<0.69	<0.7	<0.71	<0.77	<0.76	<0.54		
Total (Σ detected) DDTs	ND	ND	ND	ND	ND	ND	ND	ND		
Dieldrin	<0.72	<0.74	<0.74	<0.75	<0.76	<0.83	<0.81	<0.57		
Endosulfan I	<0.76	<0.78	<0.78	<0.79	<0.8	<0.87	<0.85	<0.61		
Endosulfan II	<0.8	<0.83	<0.82	<0.84	<0.85	<0.92	<0.9	<0.64		
Endosulfan sulfate	<0.55	<0.57	<0.56	<0.57	<0.58	<0.63	<0.61	<0.44		
Endrin	<0.78	<0.81	<0.8	<0.81	<0.82	<0.89	<0.87	<0.62		
Endrin Aldehyde	<0.71	<0.74	<0.73	<0.74	<0.75	<0.82	<0.8	<0.57		
Endrin Ketone	<0.77	<0.8	<0.8	<0.81	<.82	<0.89	<0.87	<0.62		
Heptachlor	<0.8	<0.82	<0.82	<0.83	<0.84	<0.92	<0.89	<0.64		
Heptachlor epoxide	<0.73	<0.75	<0.75	<0.76	<0.77	<0.84	<0.82	<0.58		
Methoxychlor	<0.63	<0.65	<0.65	<0.66	<0.67	<0.72	<.71	<0.5		
Toxaphene	<14	<15	<15	<15	<15	<16	<16	<11		
trans-Nonachlor	<0.64	<0.67	<0.66	<0.67	<0.68	<0.74	<0.72	<0.52		
Aroclor PCBs (microg										
PCB 1016										
PCB 1221										
PCB 1232										
PCB 1242										
PCB 1248										
PCB 1254										
PCB 1260										
Total (Σ detected) PCBs										
PCB Congeners (micr										
PCB008	<0.19	<0.19	<0.2	<0.2	<0.2	<0.22	0.36J	<0.15		<0.19
PCB018	<0.35	<0.36	<0.36	<0.37	<0.37	<0.4	<0.4	<0.28		<0.34
PCB028	0.43J	<0.23	0.26J	0.33J	<0.23	0.35J	0.73J	<0.18		<0.22
PCB031	0.53J	<0.27	<0.27	0.54J	<0.27	<0.3	0.83J	<0.21		<0.25
PCB033	<0.24	<0.25	<0.25	0.31J	<0.25	<0.28	0.37J	<0.19		<0.24
PCB044	0.78J	<0.3	<0.3	0.47J	<0.31	<0.34	<0.33	<0.24		0.97J
PCB049	0.54J	<0.27	<0.27	0.35J	<0.28	<0.3	0.75J	<0.21		0.86J
PCB052	0.99J	<0.22	<0.22	0.7J	<0.23	<0.25	1.1J	<0.17		2

Sediment Chemistry

Analyte	Mar-14									
	1	2	3	4	5	6	7	SF-10	1Z	7Z
PCB056	<0.31	<.32	<.32	<0.32	<0.32	<0.35	<0.35	<0.25		<0.3
PCB060	<0.24	<0.24	<.24	<.25	<.25	<.27	<0.27	<0.19		<0.23
PCB066	1J	0.49J	0.38J	0.52J	<0.21	<0.23	0.98J	<0.16		1.70
PCB070	0.83J	0.45J	0.26J	0.48J	<0.19	<0.21	0.93J	<0.15		1.1J
PCB074	0.52J	0.23J	<0.22	0.27J	<0.22	<0.24	0.5J	<0.17		0.31J
PCB087	0.32J	<0.23	<0.23	<0.24	<0.24	<0.26	0.63J	<0.18		<0.22
PCB095	0.93J	<0.38	0.46J	0.4J	0.5J	0.59J	1.7	0.53J		2.70
PCB097	0.59J	<0.31	0.36J	0.4J	<0.32	<0.35	0.79J	<0.25		<0.3
PCB099	0.86J	0.43J	0.46J	0.45J	0.38J	0.46J	1.3	0.29J		1.60
PCB101	1.4	0.59J	0.8J	0.76J	0.69J	0.87J	2.4	0.58J		3.90
PCB105	0.6J	<0.24	<0.24	0.39J	<0.25	<0.27	0.95J	<0.19		<0.23
PCB110	1J	0.48J	0.55J	0.62J	<0.24	0.64J	1.9	0.55J		3.00
PCB118	1.1J	0.65J	0.63J	0.71J	0.69J	0.74J	2	0.49J		4.10
PCB128	<0.23	0.24	<0.24	<0.24	<0.24	<0.26	<0.26	<0.18		<0.22

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Mar-14									
	1	2	3	4	5	6	7	SF-10	1Z	7Z
PCB132	<0.37	<0.38	<0.38	<0.39	<0.39	<0.42	<0.42	<0.3		<0.36
PCB138/158	1.6J	1J	0.99J	1.1J	0.99J	1.3J	3.4	0.7J		5.60
PCB141	<0.25	<0.25	<0.26	<0.26	<0.26	<0.28	<0.28	<0.2		<0.24
PCB149	1.2	0.57J	0.84J	0.66J	0.66J	0.84J	2.2	0.49J		3.60
PCB151	0.31J	<0.24	<0.24	<0.24	<0.24	0.33J	0.91J	0.28J		1.20
PCB153	2	1.1J	1.2	1.2	1.3	1.4	3.9	0.77J		5.50
PCB156	<0.22	<0.23	<0.23	<0.23	<0.23	<0.25	<0.25	<0.18		<0.21
PCB170	0.67J	0.42J	0.46J	<0.22	0.43J	0.67J	1.2J	0.41J		1.50
PCB174	<0.24	<0.25	0.33J	<0.25	<0.25	<0.27	0.89J	<0.19		1.60
PCB177	<0.27	<0.28	<0.28	<0.29	<0.29	<0.32	0.53J	<0.22		0.76J
PCB180	0.84J	0.46J	0.56J	0.63J	0.56J	0.86J	1.9	0.48J		2.90
PCB183	0.28J	<0.26	<0.26	<0.26	<0.26	<0.29	0.58J	<0.2		0.98J
PCB187	0.77J	0.42J	0.56J	0.59J	0.59J	0.72J	1.7	0.4J		2.00
PCB194	0.4J	<0.22	<0.22	0.29J	<0.22	0.43J	0.93J	<0.17		0.96J
PCB195	<0.12	<0.12	<0.12	<0.12	<0.12	<0.14	<0.13	<0.095		<0.12
PCB201	<0.13	<0.13	<0.13	<0.13	<0.13	<0.15	<0.14	<0.1		<0.12
PCB203	<0.24	<0.25	<0.25	<0.25	<0.25	<0.28	<0.27	<0.19		<0.24
Total (∑ detected) PCB Co	**20.5**	7.29	9.1	12.2	6.79	10.2	**36.4**	5.97		**48.9**
PAHs (micrograms/k										
1-Methylnaphthalene	<4.5	6.3J	5.6J	5.2J	11J	7J	7.1J	3.9J		
1-Methylphenanthrene	<3.6	<3.7	<3.8	<3.8	<3.8	<4.2	<4.1	<2.9		
2,3,5-Trimethylnaphthalene	<3.1	<3.2	<3.3	<3.3	<3.3	<3.6	<3.6	<2.5		
2,6-Dimethylnaphthalene	<3.7	10J	9.7J	10J	**21**	10J	11J	6.9J		
2-Methylnaphthalene	<4	12J	11J	11J	21J	12J	13J	7.3J		
Acenapthene	<4	7.9J	7.9J	6.3J	13J	7.2J	7.1J	5.3J		
Acenaphthylene	<3.4	16J	15J	13J	25	13J	14J	7.1J		
Anthracene	6.3J	35	31	26	51	30	30	15J		
Benzo(a)anthracene	<3.1	9.5J	9.2J	10J	17J	11J	10J	5.2J		
Benzo(a)pyrene	20J	100	98	87	170	84	85	38		
Benzo(b)fluoranthene	36	230	220	200	**390**	230	210	75		
Benzo(e)pyrene	34	160	160	160	**310**	160	180	60		
Benzo(g,h,i)perylene	27	140	130	130	240	140	150	48		
Benzo(k)fluoranthene	52	**260**	240	**260**	**470**	240	240	81		
Biphenyl	**24**	**110**	**120**	**110**	**180**	**130**	**130**	**41**		
Chrysene	21J	120	110	100	190	100	110	43		
Dibenzo(a,h)anthracene	4.4J	26	24	24	**48**	24J	26	7.8J		
Dibenzothiophene	<3	7J	6.7J	5.8J	11J	6J	5.6J	4.6J		
Fluoranthene	<3.3	13J	13J	12J	22J	13J	13J	8.3J		
Fluorene	**42**	**210**	**190**	**180**	**310**	**170**	**170**	**84**		
Indeno(1,2,3-cd)pyrene	45	260	240	250	**470**	240	260	78		

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	Mar-14									
	1	2	3	4	5	6	7	SF-10	1Z	7Z
Naphthalene	11J	32	27	28	54	31	35	15J		
Perylene	31	110	100	98	**200**	97	95	71		
Phenanthrene	19J	98	97	81	150	71	68	48		
Pyrene	56	300	280	260	460	250	280	120		
Total LPAHs	36	247	233	208	396	211	214	127		
Total HPAHs	392	2026	1912	1859	**3438**	1865	1936	747		
Total (Σ detected)PAHs	429	2273	2145	2067	**3834**	2076	2150	873		
Dioxins/Furans (ng/k										
2,3,7,8-Tetra CDD	<0.13	<0.16	<0.16	0.28J	<0.14	<0.13	<0.33	<0.22		
1,2,3,7,8-Penta CDD	0.78J	<0.53	0.7J	0.58J	0.76J	0.82J	1.21J	0.44J		
1,2,3,4,7,8-Hexa CDD	0.7J	0.69J	0.59J	0.78J	0.831J	0.99J	1.77J	0.38J		
1,2,3,6,7,8-Hexa CDD	2.62J	2.34J	2.19J	2.57J	2.6J	3.13J	5.70	2.46J		
1,2,3,7,8,9-Hexa CDD	2.2J	2.14J	2.64J	2.7J	<2.5	3.07J	5.71	2.47J		
1,2,3,4,6,7,8-Hepta CDD	47.0	42.5	38.2	42.3J	44.2J	60.7	111.0	35.1		
Total Octa CDD	319	279	265	263	291	400	757	264		
Total Tetra CDD	4.37	5.04	5.05	5.40	6.56	6.09	5.63	1.64J		
Total Penta CDD	5.24	3.04J	3.84J	1.74J	3.69J	2.74J	7.19	1.68J		
Total Hexa CDD	32.0	26.9	27.7	30.3	29.7	37.7	60.9	21.7		
Total Hepta CDD	117	104	94.9	103	109	185	311	80.8		
2,3,7,8-Tetra CDF	3.23	2.87	2.61	3.27	3.30	2.97	3.92	1.66J		
1,2,3,7,8-Penta CDF	0.98J	0.84J	0.9J	0.79J	<0.64	0.91J	1.26J	<0.36		
2,3,4,7,8-Penta CDF	1.71J	1.42J	1.29J	1.61J	1.52J	1.66J	2.38J	0.68J		
1,2,3,4,7,8-Hexa CDF	1.76J	1.5J	1.38J	1.75J	1.76J	1.8J	2.57J	0.97J		
1,2,3,6,7,8-Hexa CDF	1.4J	0.97J	1.18J	0.95J	0.94J	0.96J	1.46J	0.505J		
2,3,4,6,7,8-Hexa CDF	0.86J	0.72J	0.79J	1.07J	0.85J	0.86J	1.31J	0.38J		
1,2,3,7,8,9-Hexa CDF	<0.14	<0.15	<0.12	<0.28	<0.26	<0.23	0.17J	<0.12		
1,2,3,4,6,7,8-Hepta CDF	10.8	9.29	9.33	10.5	<11	13.5	22.8	10.8		
1,2,3,4,7,8,9-Hepta CDF	0.65J	0.53J	0.52J	0.89J	<0.64	<0.75	1.42J	<0.4		
Octa CDF	19.5	17.1	15.2	17.7J	20.1J	22.4J	39.6J	19.5		
Total Tetra CDF	22.9	19.6	16.0	13.8	17.9	14.3	20.8	7.1		
Total Penta CDF	16.0	14.0	13.2	6.97	10.1	11.5	20.6	1.37J		
Total Hexa CDF	16.8	14.5	13.2	11.5	12.7	14.9	25.2	8.35		
Total Hepta CDF	25.5	20.9	20.9	26.9J	14.0J	31.2J	56.4	25.8		
Total TEQ	3.37	2.82	2.93	3.26	3.25	3.69	6.04	2.29		
Effects Range-Mediar	0.07	0.10	0.09	0.09	0.11	0.10	0.11	0.06		

Table I-1
Redwood City Harbor Navigation Improvement Integrated Feasibility Study and EIS/EIR

Sediment Chemistry

Analyte	SFEI Ambient Sediment >40% Fines		SF-11	SFDODS	HWRP
Grain Size (%, dry wt)					
Sand/Gravel (>0.063 mm)	66.3		0-17	16-60	
Silt (0.004 mm - 0.063 mm	--		0-3	25-62	--
Clay (<0.004 mm)	--		0 -6	13 -24	
Conventionals					
% Solids (%)	--		1.32 - 2.60	2.34-5.74	--
TOC (%)			0.07--0.19	0.63-1.45	
Metals (mg/kg, ppm, d					
Antimony					
Arsenic	15.3		13.2	5.3	15.3
Barium					
Beryllium					
Cadmium	0.33		0.4	0.6	0.7
Chromium	112		121.0	283.0	112.0
Cobalt					
Copper	68.1		12.4	86.3	68.1
Lead	43.2		14.4	26.0	43.2
Mercury	0.43		0.156	0.2	0.43
Nickel	112		40.7	238.0	112.0
Selenium	0.64		0.41	2.6	0.64
Silver	0.58		<0.10	1.0	0.58
Thallium					
Vanadium					
Zinc	158		106.8	288	158
Butyltins (microgram/k					
Monobutylin				--	--
Dibutylin			--	--	--
Tributylin	--			--	--
Tetrabutylin				--	--
Total (Σ detected) Butyltins					
Pesticides (microgra					
Aldrin				--	
alpha-BHC				ND	
beta-BHC	--			ND	--
delta-BHC				ND	
Gamma-BHC (Lindane)			--	ND	
Total BHCs					
alpha-Chlordane					
gamma-Chlordane					

Sediment Chemistry

Analyte	SFEI Ambient Sediment >40% Fines		SF-11	SFDODS	HWRP
Chlordane	1.1			ND	1.1
Total Chlordane					
4,4'-DDD	--		--	--	
4,4'-DDE				--	
4,4'-DDT				--	
2,4'-DDD	--		--	--	--
2,4'-DDE				--	
2,4'-DDT				--	
Total (Σ detected) DDTs	7		7	2.1	7
Dieldrin	0.44		0.44	NA	0.72
Endosulfan I				ND	
Endosulfan II				ND	--
Endosulfan sulfate				ND	
Endrin				ND	
Endrin Aldehyde				ND	6.4
Endrin Ketone	--		--		
Heptachlor				ND	0.3
Heptachlor epoxide				ND	
Methoxychlor					
Toxaphene					
trans-Nonachlor				--	--
Aroclor PCBs (microg					
PCB 1016					
PCB 1221					
PCB 1232					
PCB 1242	--		--	--	--
PCB 1248					
PCB 1254					
PCB 1260					
Total (Σ detected) PCBs	26				45
PCB Congeners (micro					
PCB008					
PCB018					
PCB028					
PCB031					
PCB033					
PCB044					
PCB049					
PCB052					

Sediment Chemistry

Analyte	SFEI Ambient Sediment >40% Fines		SF-11	SFDODS	HWRP
PCB056					
PCB060					
PCB066					
PCB070					
PCB074					
PCB087					
PCB095					
PCB097					
PCB099					
PCB101					
PCB105					
PCB110					
PCB118					
PCB128					

Sediment Chemistry

Analyte	SFEI Ambient Sediment >40% Fines		SF-11	SFDODS	HWRP
PCB132					
PCB138/158					
PCB141					
PCB149					
PCB151					
PCB153					
PCB156					
PCB170					
PCB174					
PCB177					
PCB180					
PCB183					
PCB187					
PCB194					
PCB195					
PCB201					
PCB203					
Total (∑ detected) PCB Co	14.8 (29.6)				
PAHs (micrograms/k					
1-Methylnaphthalene	12.1				
1-Methylphenanthrene	31.7				
2,3,5-Trimethylnaphthalene	9.8				
2,6-Dimethylnaphthalene	12.1				
2-Methylnaphthalene	19.4				
Acenapthene	26.6				
Acenaphthylene	31.7				
Anthracene	88				
Benzo(a)anthracene	244				
Benzo(a)pyrene	412				
Benzo(b)fluoranthene	371				
Benzo(e)pyrene	294.0				
Benzo(g,h,i)perylene	310				
Benzo(k)fluoranthene	258				
Biphenyl	12.9				
Chrysene	289				
Dibenzo(a,h)anthracene	32.7				
Dibenzothiophene					
Fluoranthene	514				
Fluorene	25.3				
Indeno(1,2,3-cd)pyrene	382				

Sediment Chemistry

Analyte	SFEI Ambient Sediment >40% Fines		SF-11	SFDODS	HWRP
Naphthalene	55.8				
Perylene	145.0				
Phenanthrene	237				
Pyrene	665				
Total LPAHs	434				
Total HPAHs	3060				
Total (Σ detected)PAHs	3,390				
Dioxins/Furans (ng/k					
2,3,7,8-Tetra CDD					
1,2,3,7,8-Penta CDD					
1,2,3,4,7,8-Hexa CDD					
1,2,3,6,7,8-Hexa CDD					
1,2,3,7,8,9-Hexa CDD					
1,2,3,4,6,7,8-Hepta CDD					
Total Octa CDD					
Total Tetra CDD					
Total Penta CDD					
Total Hexa CDD					
Total Hepta CDD					
2,3,7,8-Tetra CDF					
1,2,3,7,8-Penta CDF					
2,3,4,7,8-Penta CDF					
1,2,3,4,7,8-Hexa CDF					
1,2,3,6,7,8-Hexa CDF					
2,3,4,6,7,8-Hexa CDF					
1,2,3,7,8,9-Hexa CDF					
1,2,3,4,6,7,8-Hepta CDF					
1,2,3,4,7,8,9-Hepta CDF					
Octa CDF					
Total Tetra CDF					
Total Penta CDF					
Total Hexa CDF					
Total Hepta CDF					
Total TEQ					
Effects Range-Median					

Table I-2
Redwood City Harbor Navigation Improvement
Integrated Feasiblity Report and EIS/EIR

Historical Toxicity Results

Benthic Toxicity Tests Performed	May-01									Jun-05							Feb-08					SF-11 Ref. Database
	1	2	3	4	5	6	7	Home	SF-11	1	2	3	4	5	Home	SF-11	1	2	3	SF-10	SF-11	
Amphipod (*Rhepoxynius abronius*) Survival (%)										100	100	96	96	92	100	100						93
Amphipod (*Ampelisca abdita*) Survival (%)	86	80	91	87	91	84	87	95	76	90	84	90	97	94	97	90	96	92	96	90	96	92
Polychaete (*Nephtys caecoides*) Survival (%)																	66	91	72	82	98	94
Polychaete (*Neanthes arenaceodenta*) Survival (%)	88	100	88	88	88	88	92	96	88													
A. abdita Survivial (%)																						
N. arenaceodentata Survivial (%)																						

	Feb-11									March-14							
	1	2	3	4	5	6	7	SF-10	Contro	1	2	3	4	5	6	7	SF-10
Amphipod (*Rhepoxynius abronius*) Survival (%)																	
Amphipod (*Ampelisca abdita*) Survival (%)	94	92	94	89	78	95	89	87	97	95	98	96	87	93	95	92	96
Polychaete (*Nephtys caecoides*) Survival (%)																	
Polychaete (*Neanthes arenaceodenta*) Survival (%)	100	98	100	100	100	100	94	100	100	100	100	98	100	100	100	100	100

Water Column Toxicity Tests Performed	May-01	Jun-05	Feb-08	Feb-11							Mar-14							
				1	2	3	4	5	6	7	1	2	3	4	5	6	7	SF-10
Bivalve larvae (*Mytilus edulis*) Survival & Development lowest LC50 or EC50 (%)	22		>100															
Mussel larvae (*Mytilus galloprovincialis*) Survival Lowest LC50 (%)				>100	>100	>100	>100	>100	86.0	88.2	35.2	35.4	35.2	70.7	66.3	35.5	66.6	>100
Mysid (Americamysis bahia) Survival lowest LC50 (%)		>100		>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100	>100
Menidia beryllina Survival lowest LC50 (%)				>100	>100	>100	99.1	>100	96.0	89.6	80.6	69.5	>100	70.4	89.3	>100	>100	>100

STFATE modeling (with barge disposal at SF-11) shows that toxicity thresholds were not exceeded for any of the water column bioassays.

Bioaccumulation Sediment Exposure Survival	Feb-11								14-Mar							
	Contro	1	2	3	4	5	6	7	1	2	3	4	5	6	7	SF-10
Macoma nasuta Survival (%)	100	93	100	97	100	100	97	93	92	91	93	91	99	95	98	97
Nephtys caecoides Survival (%)	99	83	83	79	81	72	82	84								
Nereis Virens Survival (%)									78	68	74	80	70	78	78	90

Table I-3
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

MET Data

	Jun-05					
Metals (µg/l)	1	2	3	4	5	SF-11 reference
Arsenic (total)	**34.3**	**35**	**23.8**	**27.3**	**28.2**	2.6
Arsenic (dissolved)	**33.7**	**32.5**	**17.3**	**23.4**	**29.1**	2.6
Cadmium (total)	<.01	<0.01	<0.01	<0.01	<0.01	0.082
Cadmium (dissolved)	<0.01	<0.01	<0.01	<0.01	<0.01	0.075
Chromium (total)	0.485	0.815	23.8	1.24	0.515	1.3
Chromium (dissolved)	0.395	0.415	0.325	0.375	0.365	0.295
Copper (total)	0.41	0.632	0.583	0.595	0.465	2.26
Copper (dissolved)	0.461	0.603	0.651	0.683	0.447	1.8
Lead (total)	0.315	0.401	0.369	0.479	0.297	0.642
Lead (dissolved)	0.012	0.021	0.068	0.015	0.018	0.095
Mercury (total)	**0.00237**	**0.00377**	**0.00366**	**0.00483**	**0.00431**	0.00158
Mercury (dissolved)	**0.00231**	**0.00311**	**0.00294**	**0.00344**	**0.00328**	0.00168
Nickel (total)	2.23	1.96	1.68	2.2	1.58	2.47
Nickel (dissolved)	1.98	1.97	1.33	2.17	1.32	1.77
Selenium (total)	**0.252**	**0.059**	**0.198**	<0.015	**0.169**	<0.015
Selenium (dissolved)	<0.015	<0.015	<0.015	0.038	**0.167**	0.061
Zinc (total)	3.08	3.59	3.04	**4.09**	2.51	4.08
Zinc (dissolved)	**4.66**	4.08	3.88	**4.7**	4.1	4.17

	Feb-08					
Metals (µg/l)	1	2	3	SF-10	SF-11	Water Quality Objectives
TSS (mg/L)	48.1	39.3	65.7	78.6	39.6	NA
Arsenic (total)	4.75	6.75	9.05	1.21	2.86	36
Arsenic (dissolved)	4.85	6.77	8.13	2.47	2.6	
Cadmium (total)	0.018	0.018	0.019	0.007	0.106	9.3
Cadmium (dissolved)	0.014	0.015	0.022	0.012	0.109	
Chromium (total)	0.92	1.01	1.22	0.4	1.35	50
Chromium (dissolved)	0.08	0.09	0.16	0.13	0.18	
Copper (total)	0.94	1.17	1.42	0.7	3.62	3.1
Copper (dissolved)	0.6	0.64	0.82	0.69	2.97	
Lead (total)	0.588	0.588	0.873	0.223	2.79	8.1
Lead (dissolved)	0.122	0.064	0.193	0.096	0.157	
Mercury (total)	0.00683	0.0077	0.00778	0.0069	0.037	0.025
Mercury (dissolved)	0.0015	0.00159	0.00128	0.00079	0.00109	
Nickel (total)	2.22	2.74	3.28	1.81	2.79	8.3
Nickel (dissolved)	2.75	1.82	3.63	3.09	2.84	
Selenium (total)	0.38	0.38	0.42	0.07	0.25	7.1
Selenium (dissolved)	0.33	0.36	0.38	0.17	0.19	
Silver (total)	0.005	0.005	0.011	0.005	0.014	23
Sivler (dissolved)	0.005	0.005	0.01	0.005	0.012	
Zinc (total)	2.26	2.4	2.4	1.47	3.79	58
Zinc (dissolved)	0.53	0.74	0.61	1.3	1.54	

	Feb-11								
Metals (µg/l)	1	2	3	4	5	6	7		Water Quality Objectives
TSS (mg/L)	<0.95	26	5	229	72	77	155		NA
Arsenic (total)	5.92	5.78	4.72	3.65	6.32	4.8	0.007		36
Arsenic (dissolved)	6.41	5.58	3.87	3.28	5.82	4.53	3.4		
Cadmium (total)	0.013	0.017	0.014	0.01	0.02	0.014	<0.006		9.3
Cadmium (dissolved)	0.016	0.017	0.012	0.012	0.016	0.016	0.013		
Chromium (total)	0.574	0.572	0.507	0.687	1.95	0.697	<0.040		50
Chromium (dissolved)	0.153	0.254	0.153	0.198	0.282	0.273	0.332		
Copper (total)	0.848	1.05	1.05	0.78	2.22	2.04	0.066		6
Copper (dissolved)	0.624	1.05	0.867	0.864	1.69	1.13	1.4		
Lead (total)	0.206	0.22	0.228	0.131	0.662	0.705	0.0135		8.1
Lead (dissolved)	0.068	0.101	0.066	0.072	0.01	0.102	0.091		
Mercury (total)	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035		2.1
Mercury (dissolved)	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035		
Nickel (total)	3.55	4.17	4.12	3.46	4.78	4.71	0.035		8.2
Nickel (dissolved)	3.47	4.03	3.61	3.55	3.0	4.29	4.57		
Selenium (total)	0.246	0.218	0.252	0.221	0.329	0.261	<0.011		7.1
Selenium (dissolved)	0.202	0.169	0.187	0.179	0.307	0.279	0.279		
Zinc (total)	3.92	3.71	3.44	4.61	6.42	4.92	0.335		81
Zinc (dissolved)	1.83	2.47	1.65	2.75	5.46	5.09	5.09		

Table I-3
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

MET Data

	Mar-14											
Metals (µg/l)	1	2	3	4	5	6	7	SF-10	Background Water	SF Basin Plan/CTR		MWRP Effluent Daily Max Limit
										Criteria Max. Conc. Salt	Criteria Contin. Conc. Salt	
TSS (mg/L)	4.8	3.8	3.3	8	6.5	5.7	6.9	4.9	24.0	NA	NA	NA
Arsenic (dissolved)	1.98	2.74	4.44	10.2	2.44	8.21	11.8	2.71	1.94	69	36	69
Cadmium (dissolved)	0.0459	0.0521	0.0495	0.0389	0.0588	0.0504	0.0535	0.0547	0.159J	42	9.3	3.9
Chromium (dissolved)	<0.164	<0.164	<0.164	<0.164	<0.164	<0.164	0.228J	<0.164	0.242J	1100	50	16
Copper (dissolved)	1.22	0.985	0.791	0.748	1.52	0.842	0.797	0.893	3.18	10.8	6.9	9.4
Lead (dissolved)	0.0192J	0.0194J	0.0205J	<0.0135	0.0199J	0.0201J	0.0328	0.0358	0.0349	210	8.1	65
Mercury (total)	0.00358	0.00404	0.00333	0.00432	0.00449	0.0054	0.00554	0.0039	0.01	2.1	0.025	2.1
Nickel (dissolved)	4.39	3.67	3.15	2.49	4.4	2.42	2.16	3.18	4.14	62.4	11.9	74
Selenium (total)	0.12	0.184	0.143	0.132	0.184	0.179	0.205	0.131	0.221J	20	5.0	20
Sivler (dissolved)	<0.0082	<0.0082	<0.0082	<0.0082	<0.0082	<0.0082	<0.0082	<0.0082	<0.0082	1.9	NA	1.9
Zinc (dissolved)	2.42	2.9	3.05	1.85	2.95	3.84	5.53	3.94	3.08	90	81	90

Table I-4
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

DI-WET Data

	Mar-14								
Metals (µg/l)	1	2	3	4	5	6	7	SF Basin Plan/CTR	
								Criteria Maximum Concentration	Criteria Continuous Concentration
Hardness (mg/L)	110	110	140	140	140	150	130	NA	NA
Arsenic	28	29	**36**	**36**	35	24	25	69	36
Cadmium	0.0147J	0.016J	0.0129J	0.0127J	0.0128J	0.00865J	0.0147J	42	9.3
Chromium	0.849	0.924	0.593	0.591	0.632	0.555	0.689	1100	50
Copper	1.68J	1.97J	1.81J	1.6J	1.37J	1.23J	1.49J	10.8	6.9
Lead	0.319	0.314	0.234	0.2	0.217	0.163	0.317	210	8.1
Mercury	0.00476	0.00439	0.00482	0.00489	0.00487	0.00353	0.00538	2.1	0.025
Nickel	1.6	2.33	2.09	1.81	1.8	1.3	1.47	62.4	11.9
Selenium	0.138	0.138	0.164	0.156	0.135	0.122	0.112	20	5.0
Silver	<0.00822	<0.00822	<0.00822	<0.00822	<0.00822	<0.00822	<0.00822	1.9	NA
Zinc	7.57J	11.8J	11.8J	3.79J	4.35J	4.9J	14.3J	90	81

Historic Results of Chemical and Physical Analyses of Redwood City Channel Sediment for Reuse at Hamilton

	Jun-08					
Metals (mg/kg)	1	2	3	SF-10	SF-11	Screening Criteria
Arsenic	8.00	8.91	9.8	10.2	5.01	15.3
Barium	70.4	75	86.9	61.1	12.8	190
Berylluim	0.695	0.658	0.889	0.559	0.132	1.03
Boron	29.9	28.9	33.8	15.9	6.93	36.9
Cadmium	0.255	0.469	0.621	0.256	0.118	0.7
Chromium	97.6	94.9	122	81.3	24.8	112
Cobalt	15.7	15.9	18.6	17.1	7.01	27.6
Copper	38.1	38.5	52.1	36.8	2.51	68.1
Lead	29.8	30.1	41.7	22.0	11.0	43.2
Manganese	670	749	762	503	369	943
Mercury	2.28	0.23	0.33	0.16	0.02	0.43
Nickel	77.2	77.9	97.5	71.1	21.9	112
Selenium	0.114	0.131	0.168	0.145	0.004	0.64
Silver	0.54	0.46	0.97	<0.21	<0.12	0.58
Vandaium	74.0	75.2	90.3	73.6	18.1	118
Zinc	117	146	172	117	28	158
	Jun-08					
Organics (µg/kg)	1	2	3	SF-10	SF-11	Screening Criteria
Total PAH	263	376	285	210	121	3,390
Pentachlorophenol	<12.9	<14.0	<15.7	<12.6	<7.13	17
Phenol	<18.9	<20.4	<23.0	<18.5	<10.4	130
TPH diesel/ motor oil	<8.6	<9.3	<10.4	<8.4	<4.7	144,000
TPH gasoline/JP-4	<8.6	<9.3	<10.4	<8.4	<4.7	12,000
Total BHC	<1.12	<1.21	<1.36	<1.10	<0.62	0.99
Total DDT	<1.16	<1.25	<1.41	<1.13	<0.64	7
Total Chlordane	<5.12	<5.52	<6.21	<5.00	<2.82	1.1
Dichlor prop	NT	NT	NT	NT	NT	140
Dieldrin	<1.40	<1.51	<1.70	<1.37	<0.77	0.72
Endrin aldehyde	<1.74	<1.88	<2.11	<1.70	<0.96	6.4
Heptachlor	<1.81	<1.95	<2.19	<1.76	<1.00	0.3
Heptachlor epoxide	<1.78	<1.93	<2.17	<1.74	<0.98	0.3
MCPA	NT	NT	NT	NT	NT	7,900
MCPP	NT	NT	NT	NT	NT	3,000
Methoxychlor	<3.20	<3.46	<3.89	<3.13	<1.77	90
Total PCB	<5.03	<5.43	<6.11	<4.92	<2.77	22.7
2,3,7,8-TCDD	<0.00000085	<0.00000075	<0.00000072	<0.00000072	<0.00000071	0.02

	Jun-11							Hamilton Acceptance Criteria
Organics (µg/kg)	1	2	3	4	4	6	7	
Pentachlorophenol*	<3.35	<3.54	<3.57	<3.77	<3.89	<3.19	<3.10	17
Phenol*	<4.91	<5.18	<5.22	<5.52	<5.69	64.8	86.4	130
TPH diesel / motor oil	<11.0	<11.0	<11.0	<12.0	<12.0	<10.0	<9.9	144,000
TPH gasoline / JP-4	<11.0	<11.0	<11.0	<12.0	<12.0	<10.0	<9.9	12,000
Methoxychlor	<0.37	<0.39	<0.40	<0.42	<0.43	<0.35	<0.34	90
Dioxins (Total TEQ)	0.0037	0.0031	0.0037	0.0042	0.0061	0.0039	0.004	0.02
Barium	42.8	45.3	44.9	48.4	53.7	46.4	48.4	190
Beryllium	0.594	0.689	0.647	0.791	0.798	0.639	0.638	1.03
Boron	1.96	2.91	3.51	2.59	1.9	<1.33	<1.29	36.9
Cobalt	14.7	14.4	14.5	15.6	15.7	14.7	15.2	27.6
Manganese	720	842	751	728	498	761	835	943
Vanadium	55.2	59.4	59.1	63.9	63.7	57.6	59.8	118

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	Mar-14 (Composite Area 7 Individual Sample Analysis)				
	7-1	7-2	7-3	7-4	7-1
Conventionals					
% Solids	35.1	41	37.7	35.5	38.6
PCB Congeners (microgram/kg, ppb dry wt)					
PCB008	<0.24	<0.21	<0.22	<0.24	<0.12
PCB018	<0.45	<0.39	<0.41	<0.44	<0.10
PCB028	<0.28	<0.24	<0.26	<0.28	<0.14
PCB031	<0.33	<0.28	<0.31	<0.32	<0.076
PCB033	<0.31	<0.27	<0.29	<0.3	<0.089
PCB044	<0.37	<0.32	<0.35	<0.37	<0.24
PCB049	<0.33	<0.29	<0.31	<0.33	<0.22
PCB052	<0.27	<0.24	<0.26	<0.27	<0.13
PCB056	<0.39	<0.34	<0.36	<0.39	<0.12
PCB060	<0.3	<0.26	<0.28	<0.3	<0.16
PCB066	<0.26	<0.22	<0.24	<0.26	0.32J
PCB070	<0.23	<0.2	<0.22	<0.23	0.38J
PCB074	<0.27	<0.23	<0.25	<0.26	0.19J
PCB087	<0.29	<0.25	<0.27	<0.28	<0.11
PCB095	<0.47	<.41	<0.44	<0.47	<0.13
PCB097	<0.39	<0.33	<0.36	<0.38	<0.11
PCB099	<0.24	0.94J	0.7J	1.3J	0.41J
PCB101	<0.23	1.5	1J	2.4	1.1
PCB105	<0.3	<0.26	<0.28	<0.29	0.50J
PCB110	1.3J	1.4	1J	1.7	0.77
PCB118	1.5	1.4	1.3	1.9	0.99
PCB128	<0.29	<0.25	<0.27	<0.29	<0.10
PCB132	<0.47	<0.41	<0.44	<0.46	2.1
PCB138/158	2.5J	2.3J	2J	2.8J	1.4
PCB141	<0.31	<0.27	<0.29	<0.31	<0.25
PCB149	1.7	1.5	1.6	2.2	1.0
PCB151	0.51J	0.51J	0.46J	0.67J	0.40J

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	Mar-14 (Composite Area 7 Individual Sample Analysis)				
	7-1	7-2	7-3	7-4	7-1
PCB153	2.6	2.6	2.3	3.3	--
PCB156	<0.28	<0.24	<0.26	<0.27	<0.17
PCB170	1.2J	1.4	0.77J	1.2J	0.53
PCB174	0.96J	0.65J	0.76J	0.92J	0.32J
PCB177	0.56J	0.45J	<0.33	0.46J	0.34J
PCB180	1.9	1.6	1.8	1.7	0.93
PCB183	0.63J	0.47J	0.4J	0.5J	0.37J
PCB187	1.3J	1.2J	1.2J	1.3J	0.72
PCB194	<0.27	<0.23	<0.25	<0.27	<0.11
PCB195	<0.15	<0.13	<0.14	<0.15	<0.083
PCB201	<0.16	<0.14	<0.15	<0.16	0.13J
PCB203	<0.3	<0.26	<0.28	<0.3	<0.090
Total (∑ detected) PCB Congeners	16.7	17.9	15.3	22.4	12.9

Notes

Overlying sampes collected from the mudline to -32 feet within labeled 7-(1-12).

Z-Layer samples collected from -32 to -32.5 feet within Compo 12)Z.

Comparison Levels

SFEI Ambient Sediment >40% Fines	14.8
2014 TMDL Limit	29.6
Montezuma Reuse Limits (Cover/Non-Cover)	22.7/180

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	7-1Z	7-2	7-2Z	7-3	7-3Z
Conventionals					
% Solids	40.8	38.2	42.6	42.8	40.8
PCB Congeners					
PCB008	<.12	0.29J	<0.12	0.95	0.84J
PCB018	<0.096	<0.10	<0.091	<0.10	<0.096
PCB028	<0.14	0.47J	1.3	1.3	2.1
PCB031	<0.072	0.38J	1.1	0.98	2.5
PCB033	<0.085	0.38J	1.3	1.4	3
PCB044	0.89	<0.24	1.5	1.6	3.2
PCB049	0.83	0.38J	1.2	1.4	3.4
PCB052	0.89	0.78	1.8	2.6	5.6
PCB056	<0.12	<0.12	<0.11	0.52	3.2
PCB060	<0.15	<0.16	<0.15	0.38J	0.6
PCB066	1.2	0.56	1.8	2.1	4.4
PCB070	0.93	0.55	1.2	2.0	4.8
PCB074	0.44J	0.22J	0.69	1.1	1.8
PCB087	<0.1	<0.11	<0.096	1.6	4.4
PCB095	1.6	0.73	2.1	3.7	9.4
PCB097	2.6	1.6	3.4	2.9	7.5
PCB099	1.5	0.80	2.80	3.2	6.6
PCB101	2.5	1.2	3.3	6.3	15
PCB105	1.2	<0.11	1.3	2.0	5.9
PCB110	2	1.2	3	5.1	14
PCB118	2.3	1.5	3.4	5.7	13
PCB128	0.69	<0.10	0.78	1.9	3.3
PCB132	6.1	3.6	7.1	9.6	22
PCB138/158	4.3	2.4	4.5	7.9	18
PCB141	0.73	<0.26	0.8	1.1	2.4
PCB149	3.1	1.6	3.5	5.2	11
PCB151	0.91	0.62	1.1	1.2	2.7

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	7-1Z	7-2	7-2Z	7-3	7-3Z
PCB153	--	--	--	--	--
PCB156	0.45J	<0.17	<0.16	0.73	2
PCB170	1.4	0.82	1.4	2.0	3.3
PCB174	1.3	0.69	1.2	1.3	2.8
PCB177	0.92	0.42J	0.81	1.1	2.1
PCB180	3	1.7	2.7	3.7	7
PCB183	0.8	0.48J	0.76	0.94	2
PCB187	2.1	1.2	2.3	2.7	4.8
PCB194	1	<0.11	1.1	1.1	2.3
PCB195	<0.079	<0.084	<0.075	<0.075	1.2
PCB201	0.22J	<0.12	0.25J	0.24J	0.37J
PCB203	0.92	<0.092	0.69	1.3	2.4
Total (∑ detected) PCB Congeners	46.8	24.6	61.0	88.2	201

Composite Area 7 are

site Area 7 are labeled 7-(1-

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	Oct-14 (Composi				
	7-4	7-4Z	7-5	7-5Z	7-6
Conventionals					
% Solids	37.7	41.5	39.4	39.7	38.7
PCB Congeners					
PCB008	<0.12	1.3	<0.12	<0.11	0.30J
PCB018	<0.10	<0.095	<0.099	<0.098	<0.10
PCB028	0.73	0.89	<0.14	2	0.61
PCB031	0.55	1.3	<0.074	1.7	<0.076
PCB033	<0.092	0.86	<0.087	2.5	<0.089
PCB044	0.36J	2	0.89	2.1	<0.24
PCB049	0.52J	1.4	0.72	2.3	0.51J
PCB052	0.91	2.5	1.7	2.7	0.61
PCB056	<0.13	<0.12	<0.12	<0.12	<0.12
PCB060	<0.17	<0.15	<0.16	<0.16	<0.16
PCB066	0.81	2	1.3	3.5	0.76
PCB070	0.89	0.18	1.1	2.4	0.60
PCB074	0.42J	0.99	0.56	1.3	<0.12
PCB087	<0.11	<0.099	<0.10	<0.1	<0.11
PCB095	0.98	3.4	2.0	4.9	1.1
PCB097	<0.11	6.4	2.2	4.1	<0.11
PCB099	1.0	3.8	2.0	5	1.1
PCB101	1.9	5.4	3.1	7.4	1.7
PCB105	1.0	1.8	1.8	2.8	<0.11
PCB110	1.9	4.8	3.0	5.8	1.4
PCB118	2.2	4.1	3.0	6.3	1.7
PCB128	0.067	<0.095	1.1	1.4	<0.10
PCB132	4.5	9.8	5.7	16	4.4
PCB138/158	3.3	6.3	3.8	9.1	3.1
PCB141	0.68	1.6	0.62	1.7	<0.25
PCB149	2.2	5.3	2.5	8.3	2.0
PCB151	0.86	1.7	0.82	2	0.65

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	Oct-14 (Composi				
	7-4	7-4Z	7-5	7-5Z	7-6
PCB153	--	--	--	--	--
PCB156	<0.18	0.74	<0.17	0.88	<0.17
PCB170	1.1	2.2	1.3	3.5	1.2
PCB174	0.87	1.5	0.95	2.4	0.89
PCB177	0.78	1.1	0.70	2.00	0.68
PCB180	2.1	3.3	2.2	6.1	2.3
PCB183	0.61	1.1	0.70	1.80	0.61
PCB187	1.5	3.1	1.7	5.1	1.5
PCB194	<0.11	1.2	<0.10	2.1	0.76
PCB195	<0.085	<0.078	<0.081	<0.08	<0.082
PCB201	<0.12	0.37J	<0.11	0.58	<0.11
PCB203	<0.092	1.4	<0.088	2.8	<0.089
Total ($\sum$ detected) PCB Congeners	33.3	84.1	45.5	124	28.5

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	te Area 7 High Resolution Samples)				
	7-6Z	7-7	7-7Z	7-8	7-8Z
Conventionals					
% Solids	41.6	38.8	42.8	38.9	44
PCB Congeners					
PCB008	1.1	0.24J	1.6	0.64J	<0.11
PCB018	<0.094	<0.10	<0.091	<0.10	<0.089
PCB028	2.1	0.50J	<0.13	1.1	2.3
PCB031	1.6	0.34J	<0.068	0.67	2.1
PCB033	3.4	0.30J	<0.08	0.72	2.8
PCB044	2.8	0.63	1.3	1.2	3.3
PCB049	2.5	0.32J	1.7	0.92	3.2
PCB052	4.9	0.79	2.8	1.7	5.7
PCB056	<0.12	<0.12	<0.11	<0.12	<0.11
PCB060	<0.15	<0.16	<0.15	<0.16	<0.14
PCB066	3.6	0.48J	2.3	1.7	4.1
PCB070	2.40	0.62	2	1.5	3.9
PCB074	1.9	<0.12	<0.11	0.67	2.1
PCB087	<0.099	<0.11	<0.095	<0.10	<0.094
PCB095	7.4	0.75	4	2.6	7.9
PCB097	4.9	1.3	5.6	<0.11	6.2
PCB099	5.7	0.81	3.8	2.5	7.1
PCB101	11	1.2	5.9	5.1	14
PCB105	3.9	<0.11	1.9	2.3	5
PCB110	8.4	1.2	5.4	4.0	11.0
PCB118	9.2	1.3	5.2	4.1	12
PCB128	2.6	<0.10	1.6	1.2	2.8
PCB132	27	3.1	10	9.9	23
PCB138/158	17	2.2	7.2	7.1	17
PCB141	3.3	0.37J	1.1	1.3	2.5
PCB149	14.0	1.6	5.4	5.2	<0.11
PCB151	4.7	0.54	1.6	1.6	3.5

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	te Area 7 High Resolution Samples)				
	7-6Z	7-7	7-7Z	7-8	7-8Z
PCB153	--	--	--	--	--
PCB156	1.3	<0.17	1.1	0.75	2
PCB170	7.4	0.81	2.4	2.0	5.1
PCB174	5.3	0.58	1.6	1.7	3.7
PCB177	3.7	0.51J	1.1	1.3	2.4
PCB180	14	1.4	3.4	4.2	8.8
PCB183	3.3	0.49J	0.88	1.2	2.6
PCB187	10	1.3	2.6	3.2	6.5
PCB194	4.2	<0.11	1.1	1.2	3.5
PCB195	2.1	<0.083	<0.075	<0.082	2.1
PCB201	0.87	<0.11	0.32J	0.29J	0.53
PCB203	4.5	<0.090	1.3	1.3	3
Total ($\sum$ detected) PCB Congeners	**203**	23.7	84.6	74.9	**183**

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	7-9	7-9Z	7-10	7-10Z	7-11
Conventionals					
% Solids	40.6	39.9	37.4	43.9	38.1
PCB Congeners					
PCB008	0.53J	1.7	0.43J	2.1	<0.12
PCB018	<0.097	<0.098	<0.10	<0.09	<0.10
PCB028	0.95	3.5	0.72	0.86	0.65
PCB031	0.63	3.4	0.48J	0.85	0.55
PCB033	1.0	4.6	<0.092	1.2	<0.091
PCB044	1.3	5.1	0.77	1.4	0.56
PCB049	1.1	5.7	0.57	1.4	0.43J
PCB052	1.5	9.5	0.86	1.8	0.89
PCB056	<0.12	<0.12	<0.13	<0.11	<0.13
PCB060	<0.16	<0.16	<0.17	<0.14	<0.16
PCB066	1.6	7.3	0.83	2.1	0.86
PCB070	1.2	6.9	0.81	1.3	0.74
PCB074	0.88	2.8	0.47J	0.6	0.40J
PCB087	<0.10	<0.1	<0.11	<0.094	<0.11
PCB095	2.2	14	1.5	2.8	0.92
PCB097	2.1	13	<0.11	3.4	<0.11
PCB099	2.2	12	1.4	3.1	1.1
PCB101	3.7	23	2	4.5	1.6
PCB105	<0.10	8.2	<0.11	1.3	<0.11
PCB110	3.0	18.0	2.0	4.0	1.4
PCB118	3.3	17	2.0	4.1	1.9
PCB128	0.86	5.6	0.74	0.93	0.50J
PCB132	7.4	44	4.8	7.8	3.9
PCB138/158	5.2	31	3.5	5	2.7
PCB141	0.8	5.7	0.47J	0.71	<0.26
PCB149	4.1	24	2.3	4.4	1.9
PCB151	1.1	6.6	0.72	1.1	0.56

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	7-9	7-9Z	7-10	7-10Z	7-11
PCB153	--	--	--	--	--
PCB156	0.66	3.3	0.42J	<0.15	<0.17
PCB170	1.9	9.9	1.3	1.9	1.1
PCB174	1.4	7.9	0.74	1.2	0.63
PCB177	0.96	4.8	0.67	0.96	0.52J
PCB180	3.3	19	2.1	2.9	1.8
PCB183	0.90	5.20	0.58	0.8	0.48
PCB187	2.5	15	1.5	2.5	1.3
PCB194	1.2	7.7	<0.11	1.1	<0.11
PCB195	<0.079	2.6	<0.085	<0.073	<0.084
PCB201	0.29J	1.4	<0.12	<0.1	0.26J
PCB203	1.1	6.3	<0.093	1.5	<0.091
Total (∑ detected) PCB Congeners	60.9	**356**	34.7	68.4	27.7

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	7-11Z	7-12	7-12Z
Conventionals			
% Solids	41	38.1	74.8
PCB Congeners			
PCB008	0.57J	<0.12	0.56J
PCB018	<0.095	<0.10	<0.052
PCB028	1.2	0.68	0.58
PCB031	0.9	<0.078	0.46
PCB033	0.83	<0.091	0.79
PCB044	1.5	1.2	0.83
PCB049	1.3	0.86	0.64
PCB052	1.9	1.7	1.6
PCB056	<0.12	<0.13	<0.064
PCB060	<0.15	<0.17	<0.083
PCB066	1.8	1.3	0.75
PCB070	1.7	1.6	0.86
PCB074	1	0.77	0.35
PCB087	<0.099	<0.11	0.85
PCB095	2.6	2.6	2
PCB097	2.9	<0.11	2.1
PCB099	3	2.3	1.3
PCB101	4.3	4.3	3.2
PCB105	1.8	1.8	1.4
PCB110	3.6	3.8	2.7
PCB118	4	3.6	2.4
PCB128	0.84	1.2	0.85
PCB132	8.7	7.5	4.6
PCB138/158	5.2	5.5	3.5
PCB141	0.97	1.0	0.64
PCB149	4.2	3.8	2.4
PCB151	1.5	1.2	0.71

Table I-6
Redwood City Harbor Navigation Improvement Integrated Feasibility Report and EIS/EIR

High Resolution Sampling - Inner Turning Basin

Analyte	7-11Z	7-12	7-12Z
PCB153	--	--	--
PCB156	<0.16	0.70	0.38
PCB170	1.7	1.6	0.83
PCB174	1.2	1.3	0.7
PCB177	0.93	0.89	0.52
PCB180	3.6	3.2	1.5
PCB183	0.81	0.94	0.55
PCB187	2.5	2.2	1.2
PCB194	<0.1	1.0	0.69
PCB195	<0.078	<0.085	<0.043
PCB201	<0.11	<0.12	0.2J
PCB203	1.3	<0.092	0.63
Total (∑ detected) PCB Congeners	68.3	58.5	43.0

Port of Redwood City

Deep Draft Navigation Project

Appendix J

Economics

Redwood City, California

June 2015

U.S. Army Corps of Engineers
San Francisco District
South Pacific Division

This page intentionally left blank.

Table of Contents

List of Tables ..... **vi**

List of Figures ..... **vi**

List of Acronyms ..... **ix**

1.0 Introduction **1**

1.1 Study Purpose and Scope 1

1.2 Document Layout **1**

2.0 Historical & Existing Conditions **2**

2.1 Economic Study Areas (Hinterlands) 2

2.1.1 Inland Distribution Areas 2

2.1.2 Maritime Businesses 6

2.1.3 Cargo Profile 6

2.2 Facilities and Infrastructure 7

2.4 Historical Commerce 8

2.5 Existing Fleet 9

2.6 Shipping Operations 10

2.6.1 Underkeel Clearance 10

2.6.2 Tidal Range 10

2.7 Design Vessel 11

3.0 Future Conditions **11**

3.1 Terminal Expansions 11

3.2 Commodity Forecast 12

3.3.2 Trade Forecast 12

3.2 Forecast Assumptions 15

3.3 Steel Scrap 19

3.3.1 National Overview 19

3.3.2 Scrap Metal Exports Background 21

3.4 Scrap Metal Export Forecasts 22

4.0 Transportation Cost Savings Benefit Analysis **26**

4.1 Methodology 26

4.1.1 HarborSym Model 26

4.1.3 Vessel Call List 33

4.2 Origin-Destination Transportation Cost Savings Benefits by Project Depth 39

4.4 Transportation Cost Saving Benefit Analysis 42

5.0 Sensitivity Analysis 43
5.1 Discussion 43
6.0 Multiport Analysis 43
7.0 Regional Economic Development Analysis 45
7.2 Regional Analysis 45
7.2 Results of the Economic Impact Analysis 46

This page left intentionally blank.

List of Tables

Table 1. Redwood City Cement Hinterland Indicators 4
Table 2. Redwood City Scrap Metal Hinterlands Indicators 5
Table 3. Port of Redwood City Historical Commerce – All Commerce (Metric Tons) 8
Table 4. Vessel Class Definitions 9
Table 5. Characteristics of Vessels Calling on the Port of Redwood City 9
Table 6. Projected Growth in Commerce at the Port of Redwood City 13
Table 7. Metropolitan Areas for Cement Hinterland Demand 14
Table 8. Sand & Aggregate proxy Import Forecasts 18
Table 9. Scrap Metal Exports Forecasts 24
Table 10. Redwood City Channel Dimensions and Docking Facilities 31
Table 11. HarborSym Route Groups 31
Table 12. HarborSym Commodity Transfer Rates 32
Table 13. HarborSym Vessel Speed in Reach for Vessels (knots) 32
Table 14. Vessel Speeds 32
Table 15. Vessel Fleet Forecasts 37
Table 16. Vessel Load Factors 38
Table 17. Origin-Destination Annual Transportation Cost (in Million $) 40
Table 18. O-D Annual Transportation Cost Saving Benefits by Channel Depth (in Million $) 40
Table 19. Origin-Destination AAEQ Transportation Cost and Cost Saving Benefits by Project Depth (Million $) 40
Table 20. Origin-Destination AAEQ Cost Statistics by Project Depth (Million $) 41
Table 21. Origin-Destination AAEQ Transportation Cost Saving Benefits by Route Group and Project Depth (Million $) 41
Table 22. Origin-Destination Benefit Cost Analysis (Million $) SF-DODS 42
Table 23. Origin-Destination Benefit Cost Analysis (Million $) Cullinan 42
Table 24. Origin-Destination Benefit Cost Analysis (Million $) Montezuma 42
Table 25. Project Information 45
Table 26. Economic Impact Regions 45
Table 27. Input Assumptions (Spending and LPCs) 46
Table 28. Overall Summary of Economic Impacts 47
Table 29. Economic Impact at Regional Level 48
Table 30. Economic Impact at State Level 49
Table 31. Economic Impact at National Level 50
Table 32. Top Ten Industries Affected by Work Activity (2008) 51
Table 33. Top Ten Industries that Benefit from Project Expenditures 51

List of Figures

Figure 1. Port of Redwood City Cement Hinterland 4
Figure 2. Port of Redwood City Scrap Metal Hinterland 6
Figure 3. Port of Redwood City Terminal Facilities 7
Figure 4. Historical Trends in Commerce in Metric Tons 8
Figure 5. Random, Typical Tide Scenario from NOAA Website 11
Figure 6. Projected Trendlines for Growth in Commerce at Port of Redwood City 13
Figure 7. Construction Spending 15

Figure 8. Redwood City Cement Imports Forecast 18
Figure 9. U.S. Shredded Scrap Exports, 2006-2012 20
Figure 10. Price of Shredded Steel Scrap, 2008-2013 21
Figure 11. Exports of Scrap Metal at Redwood City, 2000-2010 22
Figure 12. Metal Scrap Exports to Asia from the U.S. South Pacific Region 23
Figure 13. Metal Scrap Export Forecasts for Redwood City and West Sacramento 25
Figure 14. Redwood City Channel Nodes, Turning Basin, and Wharves 30
Figure 15. Allowance for Operations by Vessel DWT – Non-containerized Vessels 36

This page intentionally left blank.

List of Acronyms

AAEQ – Average Annual Equivalent
BLT – Bulk Loading Tool
CY – Calendar Year
DWT – Deadweight Tonne
ETTC – Estimate Total Trip Cargo
FY – Fiscal Year
GDP – Gross Domestic Product
GI – Global Insight
GRP – Gross Regional Product
HMST – HarborSym Modeling Suite of Tools
IMO – International Maritime Organization
IWR – Institute for Water Resources
LAUS – Local Area Unemployment Statistics
LFA – Loading Factor Analysis
LOA – Lengths Overall
MSA – Metropolitan Statistical Area
MXSLLD – Maximum Summer Loadline Draught
NED – National Economic Development
OD – Origin-to-Destination
OECD - Organization for Economic Co-operation and Development
PDT – Project Delivery Team
PX - Panamax
QCEW – Quarterly Census of Employment and Wages
RECONS – Regional Economic System
RED – Regional Economic Development
TPI – Tons Per Inch Immersion
TSP – Tentatively Selected Plan
UKC – Underkeel Clearance
USACE – United States Army Corps of Engineers

This page intentionally left blank.

Port of Redwood City
Deep Draft Navigation Project
Economic Evaluation

1.0 Introduction

This document presents the economic evaluations performed for the proposed Port of Redwood City channel improvement project. The current federally authorized channel depth for the Redwood City channel and harbor is 30 feet. The U.S. Army Corps of Engineers (USACE) San Francisco District was approved by the Office of Management and Budget to begin a multi-year feasibility study to determine if deepening Redwood City channel and harbor is both economically beneficial and environmentally acceptable to the nation. The Deep Draft Navigation Planning Center of Expertise together with the San Francisco District USACE District performed the economic analyses contained within this document to evaluate the proposed channel modification.

1.1 Study Purpose and Scope

The purpose of this study is to evaluate problems and opportunities for improved navigation for the Port of Redwood City and identify the plan that best satisfies the environmental, economic, and engineering criteria. The scope of this feasibility study involves analysis of existing conditions and requirements, identifying opportunities for improvement, preparing economic analyses of alternatives, identifying environmental impacts, and analyzing the National Economic Development (NED) plan.

Potential navigation improvements include deepening and widening (for O&M savings) of navigational channels, turning basin expansion, and other operational changes. The purpose of these potential improvements is to increase the efficiency of cargo vessel operations on Panamax vessels, which are already calling on the Port and are projected to call on the port with increased frequency in the future. This study identifies and evaluates alternatives that will:

- Accommodate recent and anticipated future growth in bulk and general cargo traffic;
- Improve the efficiency of operations for bulk and general cargo vessels within the Port of Redwood City Harbor Navigation Project; and
- Allow more efficient (i.e., increased load factors) bulk and general cargo ships to call on the Port.

1.2 Document Layout

Section 2 details the existing conditions at the Port of Redwood City. Section 3 examines future without and with project conditions and includes an evaluation and description of forecast trade, the vessel fleet, and operations at the harbor. Section 4 presents the transportation cost savings benefit analysis. In Section 5, sensitivities to the forecast are explored. Section 6 examines the multi-port analysis while Section 7 describes the socioeconomics of Redwood City and the surrounding region.

2.0 Historical & Existing Conditions

The existing conditions are defined in this report as the project conditions that exist (empirical data from 2013) The last significant improvement to the federal project was in 1964, when the channel was widened to 400 feet and deepened to its current authorized depth of 30 feet. This improvement was designed to serve bulk vessels primarily for the salt industry that served California and the Pacific Northwest, as well as exports to Japan. The following year, cement, lumber, and sand & gravel firms became major tenants of the Port. In 1975, the company now known as Sims Metal Management (still a primary Port customer) set up at the Port to establish a major recycling center that exports scrap metal to Asian markets.

Since the late 1980s, the Port has marketed itself as a "niche" focusing upon bulk products catering to the construction industry that serves the greater south San Francisco Bay area. Over the past three decades, the Port has received imports of bauxite (for Northern California cement plants) and gypsum rock (used in the manufacturing of wallboard). In fact, the Port has become key to supplying the building trades industry, due in large part to the closures of rock quarries in the early 2000s, with no new domestic facilities planned to replace them. While cement is not currently being imported due to the still recovering post Great Recession economy, during the late 90s and early "Oughts" the cement that crossed the Port's wharves was used to build the San Francisco Giants' stadium and to expand the San Francisco Airport, as well as many others.

Today, the Port continues primarily to support the construction industry throughout the San Francisco Bay/San Jose region. For the state fiscal year ending June 30, 2015, the Port has processed nearly 1.3 million metric tonnes of sand and aggregates. And it has exported nearly a quarter million metric tonnes of scrap metal. Additionally, modest amounts of ground slag (cement component), gypsum (drywall/sheetrock component), and bauxite (world's main sorce of aluminum)are imported through the port for use in the construction industry.

2.1 Economic Study Areas (Hinterlands)

2.1.1 Inland Distribution Areas

In 2011, San Francisco District Economics Section contracted with IHS Global Insight to complete the report "Commodity Forecasts and Competitive Market Analysis for the Ports of West Sacramento, Stockton, and Redwood City". The following documents their analyses of the hinterlands for the commodities of cement and scrap metal. While the Port isn't currently importing cement, their main commodities of Canadian sand and aggregates is primarily used for domestic cement production throughout the area.

According to the IHS report, the use of import projections of stone, clay, and other crude minerals for the South Pacific region of the United States from IHS Global Insight's World Trade Service (WTS) is likely too broad a measure to adequately address the uniqueness of the ports in this study. First, the category of stone, clay, and other crude minerals contains 78 commodities ranging from table salt to asbestos. Second, the regional grouping includes not only the ports in this study area but also 31 of the larger ports in California plus four ports in Hawaii.

Therefore, IHS decided that a better proxy for cement demand could be found in IHS Global Insight's U.S. Construction Service. The Construction Service maintains historical and forecast data for real and nominal spending on construction at the national, state, and metropolitan levels of geography. The forecasts produced by the Construction Service are directly linked to the well-regarded forecasts

produced by our U.S. Macroeconomic Service and our U.S. Regional Service. As such, the Construction Service forecasts embody IHS' forward view of the nation as a whole and at the specific levels of Metropolitan Statistical Areas (MSAs). Thus, though the report talks about cement specifically, the data and forecasts are actually based upon their Construction Service tied to commodities closely related to the sand and aggregates that constitute much of the Port's annual throughput

CEMENT (Sand and Aggregate proxy)

The cement hinterland for the Port of Redwood City was determined to be a 25-county area that surrounds the port. According to the HIS report cited above, the hinterland has a population base of approximately 12 million people, with 4.3 million employed in 2010. Per capita personal income was just over $48 thousand in 2010 and is expected to grow by 2.2% annually through 2036. Gross product was $595 billion in gross product, growing to $1.3 billion in 2036, an annualized growth rate of 3.2%. Population and employment are expected to grow by an annual average rate of 1.1% and 1.4%, respectively, between 2010 and 2036.

Table 1. Redwood City Cement Hinterland Indicators

Hinterland Statistics	Cement - Port of Redwood City 2007	2008	2009	2010	2016	2036	Compound Average Annual Growth 2010 / 2007	2016 / 2010	2036 / 2016
Indicators									
Real Gross Product *(Billions)*	$597.0	$595.3	$579.8	$594.5	$718.0	$1,331.7	-0.1%	3.2%	3.1%
Real Per Capita Personal Income *(Thousands)*	$44.9	$43.9	$42.2	$42.1	$48.1	$73.4	-2.1%	2.2%	2.1%
Population *(Millions)*	11.6	11.8	11.9	12.1	12.9	15.9	1.2%	1.2%	1.0%
Employment *(Millions)*	4.8	4.7	4.4	4.3	4.9	6.2	-3.2%	1.9%	1.2%
Related Industry (Inflation Adjusted, Billions)									
Construction Spending	$27.7	$21.2	$16.8	$15.6	$35.2	$59.7	-17.4%	14.5%	2.7%

Figure 1. Port of Redwood City Cement Hinterland



SCRAP METAL

Using Transearch to trace scrap metal freight flows destined for the Port of Redwood City, the scrap metal hinterland, or inland supply area, was determined to be a 14-county area that surrounds the port .

According tho the IHS report previously cited, the hinterland has a population base of a little over 9 million people, and 3.8 million were employed in 2010. The hinterland generates a little over $42 thousand in real per capita personal income and nearly $540 billion in gross product. Population and employment are expected to grow by an annual average rate of 1.0% and 1.3%, respectively, between 2010 and 2036. Income and GDP are foreseen to grow by 2.2% and 3.0% respectively through 2036.

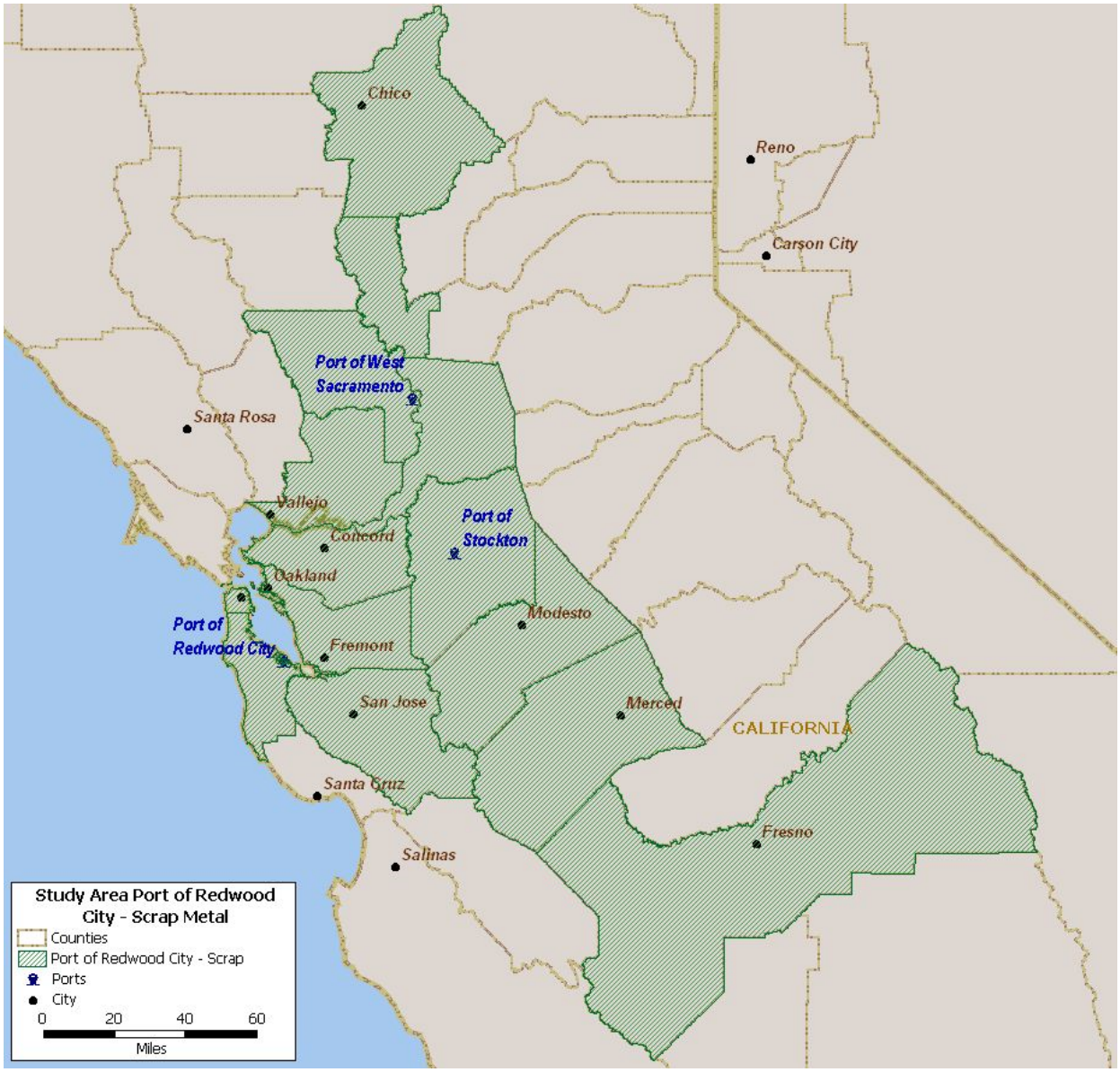
Table 2. Redwood City Scrap Metal Hinterlands Indicators

	Scrap Metal - Port of Redwood City						Compound Average Annual Growth		
Hinterland Statistics	**2007**	**2008**	**2009**	**2010**	**2016**	**2036**	**2010 / 2007**	**2016 / 2010**	**2036 / 2016**
Indicators									
Real Gross Product *(Billions)*	$539.7	$539.7	$526.0	$538.6	$647.1	$1,174.9	-0.1%	3.1%	3.0%
Real Per Capita Personal Income *(Thousands)*	$45.5	$44.4	$42.5	$42.2	$47.9	$73.7	-2.5%	2.1%	2.2%
Population (Millions)	9.1	9.2	9.3	9.4	10.0	12.1	1.2%	1.1%	1.0%
Employment (Millions)	4.2	4.1	3.9	3.8	4.2	5.3	-3.1%	1.8%	1.1%
Related Industries *(Inflation Adjusted Sales, Millions)*									
Fabricated Metal Products Mfg.	$6,952	$6,518	$5,840	$6,403	$7,583	$9,922	-2.7%	2.9%	1.4%
Primary Metal Manufacturing	$1,023	$935	$764	$926	$1,099	$1,824	-3.3%	2.9%	2.6%

In this hinterland's counties, the fabricated metal products industry generated nearly $7 billion in sales in 2010. From 2007 to 2010, this industry's sales shrank by 2.7% per year, in line with the global economic downtown. This industry is expected to expand at a slightly slower rate than in the Sacramento hinterlands, with average annual growth of 1.7% from 2010 through 2036.

The primary metal manufacturing industry in this hinterland generated nearly $1 billion in sales in 2010. From 2007 to 2010, this industry's sales dropped by 3.3% per year, once again due to the decline in overall U.S. metals-intensive manufacturing and the global recession. Average annual growth for this industry is projected to be 2.6%.

Figure 2. Port of Redwood City Scrap Metal Hinterland



2.1.2 Maritime Businesses

The Port has a number of businesses that currently use its facilities. There are four firms operating related to the cement business (Cemex, Central Concrete, International Materials, Inc.—imports bauxite from Australia for use in cement kilns, and Lehigh Southwest Cement Company). Cemex Aggregates and Pabco Gypsum imports commodities used in the Building and construction business. Sims Metals recycles junked vehicles to export shredded scrap to Asia.

2.1.3 Cargo Profile

In Fiscal Year (FY) 2013, the Port served 53 deep draft vessels at its wharfs. The Port of Redwood City, handled 1.5 million metric tonnes, up 13.6 percent from the previous fiscal year. Top commodities across Redwood City wharfs include aggregates, sand, and scrap metal. Other commodities consisted of gypsum and bauxite.

2.2 Facilities and Infrastructure

There are three terminal (comprising 5 wharves) at the Port of Redwood City. Two of the three existing terminals handle dry bulk and general cargo. The third terminal is for petroleum and liquid bulk products. The Port plans, designs, constructs, and operates its marine terminal facilities. The three facilities are shown within Figure 6 and described below.

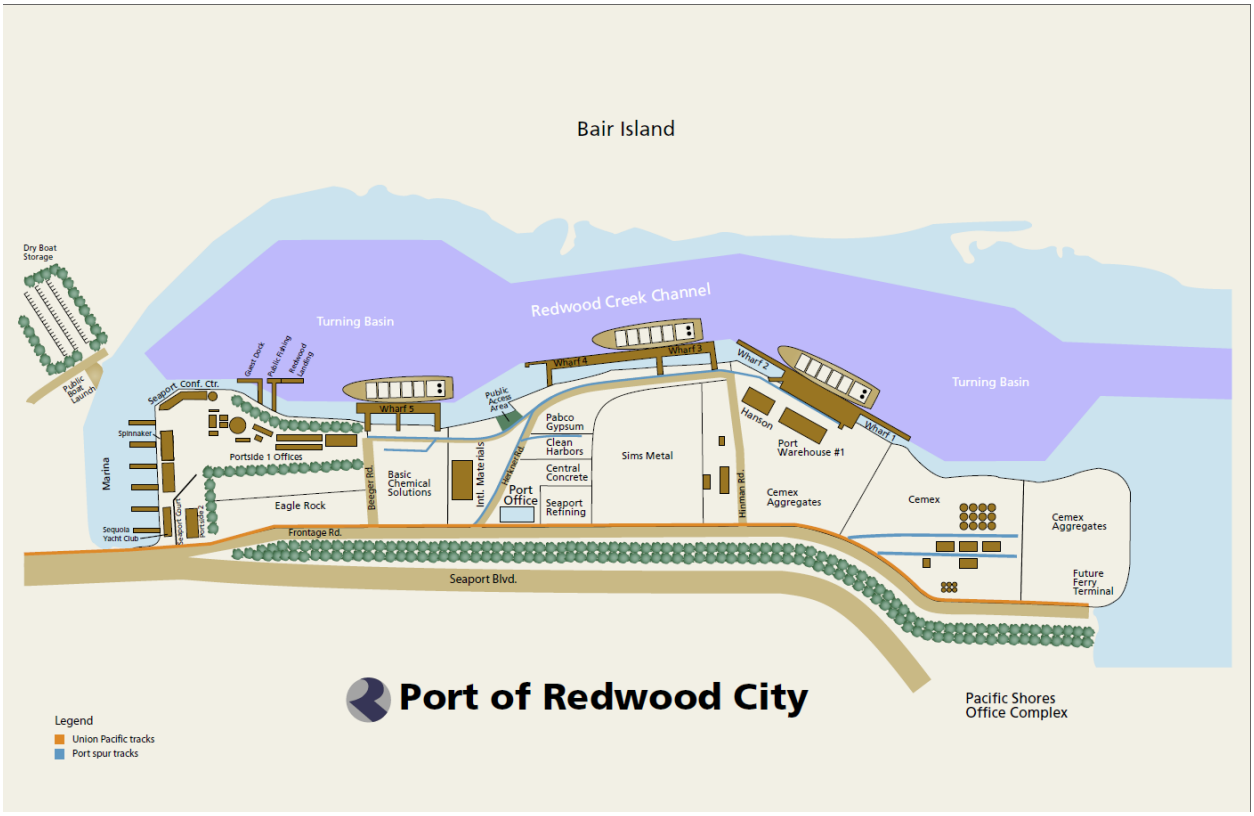


Figure 3. Port of Redwood City Terminal Facilities

The Port's three berthing facilities are:

- Wharves No. 1 & 2—overall length 855'; 34' alongside depth (MLLW); unload conveyor 800/1000 tons per hour; bulk cement pipeline and hoppers; adjacent to 30,000sq ft transit shed; bulk cement and general cargo
- Wharves No. 3 & 4—overall length 450' long plus additional berthing of 280' with dolphins, 34' alongside depth (MLLW), reinforced concrete pile and deck, load conveyor 300 tons per hour, open upland area for marshaling/storage, scrap metal and dry bulk cargo
- Wharf No. 5—overall length 500'; 34' alongside depth (MLLW); reinforced concrete deck; petroleum pipeline; adjacent to paved area and storage tanks; petroleum and liquid bulk products
- All wharves lighted for 24 hour operation; electric, telephone and water hookups; US Coast Guard certified oil waste reception facility; handling equipment: 25-ton mobile crane, tractors, and forklifts
- Union Pacific tracks run adjacent to the entire Port.

2.4 Historical Commerce

Figure 8 shows the historical total commerce at the Port of Redwood City as reported by the Port. The top line depicts total commodity shipments for each year from 1995 through 2014. As illustrated, total commerce has varied over time with substantial growth from 1990 to 2006. There was a precipitous 56 percent decline from 2005 to 2010. Since 2010, commodity tonnage has rebounded by nearly 112 percent.

Figure 4. Historical Trends in Commerce in Metric Tons

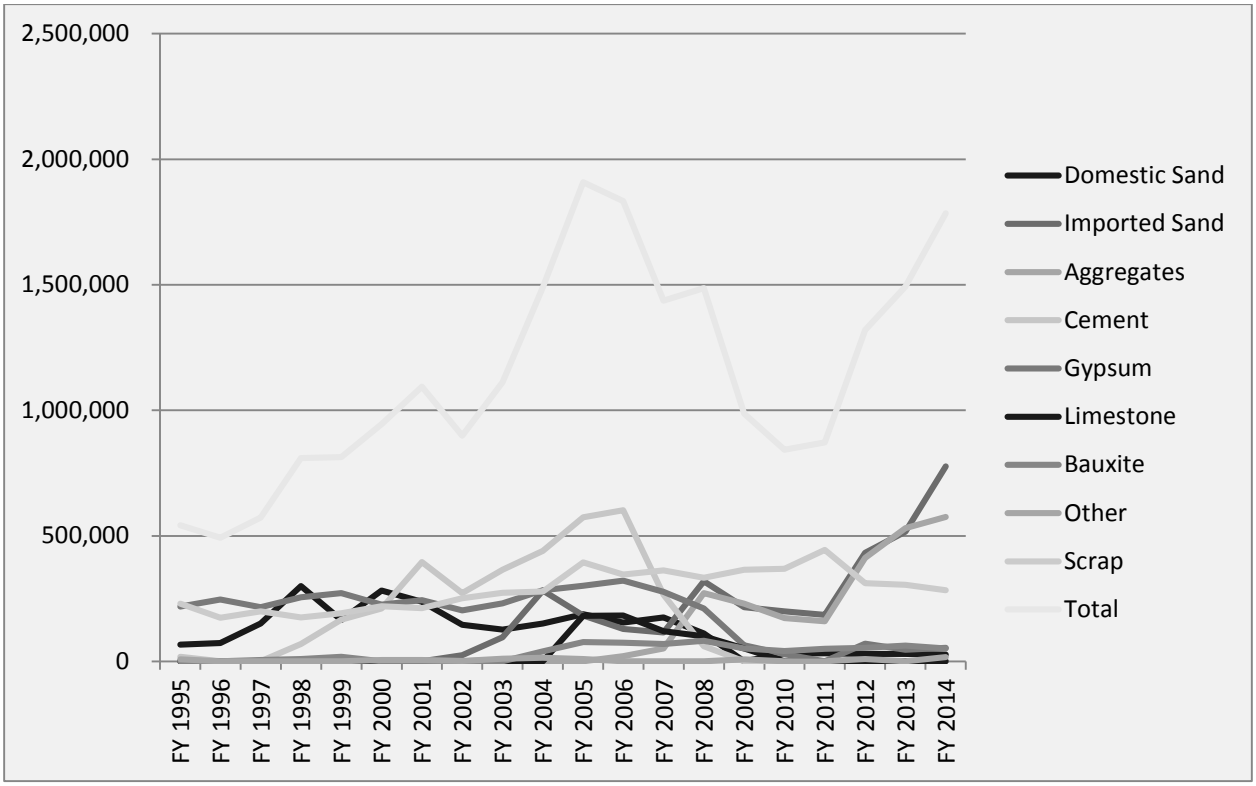


Table 3. Port of Redwood City Historical Commerce – All Commerce (Metric Tons)

Commodity	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	**FY 2013**	FY 2014
Domestic Sand	67,225	72,561	151,233	300,521	164,409	282,339	237,732	145,800	127,079	151,505	187,690	154,578	174,949	110,997	0	30,967	31,775	30,482	**30,049**	27,734
Imported Sand	0	0	0	0	0	0	0	24,977	95,676	281,989	182,763	129,878	115,049	318,532	216,503	199,489	186,566	432,166	**517,297**	776,360
Aggregates	0	0	0	0	0	0	0	0	7,158	0	0	20,735	52,020	272,112	230,091	172,409	160,378	412,204	**530,508**	575,455
Cement	18,321	0	0	69,946	165,901	211,070	395,375	272,223	365,079	440,483	573,542	602,469	265,685	59,800	0	0	0	0	**0**	0
Gypsum	218,061	246,135	216,290	255,201	271,444	226,574	244,021	202,935	231,553	282,863	301,413	321,778	277,100	211,128	64,734	28,972	0	70,266	**46,825**	53,469
Limestone	0	0	0	0	0	0	0	0	0	0	181,729	182,927	120,101	100,010	51,373	0	0	0	**0**	0
Bauxite	0	0	5,591	10,050	18,597	0	0	0	0	40,000	76,761	74,489	69,432	81,888	50,909	41,754	49,629	53,517	**63,554**	51,764
Other	8,288	0	0	0	1,000	5,354	5,364	2,347	11,043	15,005	10,000	0	0	0	8,471	0	0	8,857	**0**	16,952
Scrap	229,869	174,311	199,564	174,642	192,279	219,966	212,030	251,371	273,814	278,780	394,274	346,169	362,290	332,596	364,646	369,136	444,591	311,705	**304,956**	282,925
Total	541,764	493,007	572,678	810,360	813,630	945,303	1,094,582	899,653	1,111,402	1,490,625	1,906,172	1,833,023	1,436,626	1,487,063	986,727	842,727	871,939	1,319,197	**1,493,190**	1,784,659

2.5 Existing Fleet

Data for vessel fleet was obtained from the Port of Redwood City and then cross-referenced using vesseltracker.com to obtain the International Maritime Organization (IMO), a unique vessel identification number. In 2013 a variety of different vessel classes called on the Port of Redwood City. These ships are classified as Handy, Handymax, Supramax, and Panamax, depending on their capacity. The vessels are distinguished based on physical and operation characteristics, including lengths overall (LOA), design draft, beam, speed, and DWT capacity.

Table 4. Vessel Class Definitions

Vessel Class	Beam	LOA	Capacity (DWT)	Draft	2013 Calls
Handy	85 –93	550 – 607	22000 - 40000	17 – 36	12
Handymax	93 –99	607 – 643	40000 – 50000	27 – 39	5
Supramax	99 – 104	643 – 678	50000 – 60000	22 – 41	6
Panamax	104 – 114	678 – 742	60000 - 80000	26 – 45	30

There were 23 unique vessels that called on the Port in 2013. The design drafts ranged from 32.9 to 45.7 feet, all of which are greater than the current depth of 30 feet for the Redwood City federal channel.

Table 5. Characteristics of Vessels Calling on the Port of Redwood City

Vessel Name	Vessel Identifier	Vessel Class	LOA	Beam	Capacity	Flag	TPI Factor	Design Draft
CSL TRAILBLAZ	7708857	Bulker small	584	85	24478	Z_Fore	103.1	32.9
IVS ORCHARD	9528029	Bulker small	591	92	29932	Z_Fore	103.1	33.5
HANJIN MIMITSU	9527958	Bulker med A	607	102	35399	Z_Fore	111.7	34.1
BONNIE VENTU	9612155	Bulker small	582	93	29900	Z_Fore	103.1	34.1
NEW FRONTIER	9561796	Bulker small	577	92	32212	Z_Fore	103.1	35.7
CSL CABO	9288904	Bulker small	596	84	28856	Z_Fore	103.1	35.8
GIOVANNI TOPI	9251315	Bulker med B	623	105	48116	Z_Fore	129	36.1
PIONEER	7925613	Bulker small	731	76	34452	Z_Fore	103.1	36.4
EMERALD	9595967	Bulker small	623	92	34057	Z_Fore	103.1	36.4
MAINE DREAM	9520601	Bulker med C	623	105	53457	Z_Fore	146.6	36.7
NEMTAS-2	9299915	Bulker med B	623	105	44948	Z_Fore	129	38.1
CONDOR	9224659	Bulker med B	620	105	46272	Z_Fore	129	38.4
SOPHIE OLDEN	9138109	Bulker large	738	105	64431	Z_Fore	182.7	39
JUERGEN SCHU	9146003	Bulker med B	623	102	44366	Z_Fore	129	39
SPAR URSA	9490856	Bulker med C	623	106	53360	Z_Fore	146.6	39.7
GREAT SCENER	9264049	Bulker med B	617	102	43939	Z_Fore	129	39.7
BALTIC PEARL	7930137	Bulker med A	597	98	35684	Z_Fore	111.7	40.4
UNITED MADER	9632600	Bulker med C	620	105	53360	Z_Fore	146.6	42.3
LUSITANIA G.	9500091	Bulker med C	643	66	54280	Z_Fore	146.6	42.7
BALTO	9600982	Bulker large	721	98	65780	Z_Fore	182.7	44.3
CSL TECUMSEH	9600994	Bulker large	751	105	65780	Z_Fore	182.7	45
RT.HON.PAUL E.	9600970	Bulker large	748	105	65780	Z_Fore	182.7	45.3
NELVANA	8105492	Bulker large	797	106	68977	Z_Fore	182.7	45.67

2.6 Shipping Operations

2.6.1 Underkeel Clearance

The measure of underkeel clearance (UKC) for economic studies is applied according to planning guidance. According to this guidance, UKC is evaluated based on actual vessel operator and pilot practice within a harbor and subject to present conditions, with adjustment as appropriate or practical for with-project conditions. Generally, practices for UKC are determined through review of written pilotage rules and guidelines, interviews with pilots and vessel operators, and analysis of actual past and present practices based on relevant data for vessel movements. Typically, UKC is measured relative to immersed vessel draft in the static condition (i.e., motionless at dockside). When clearance is measured in the static condition, explicit allowances for squat, trim, and sinkage are unnecessary. Evaluation of when the vessel is moved or initiates transit relative to immersed draft, tide stage, and commensurate water depth allows reasonable evaluation of clearance throughout the time of vessel transit.

Evaluation of all movements renders a distribution of UKC requirements. Evaluation of minimal clearance (i.e., some level of clearance below which operators or pilots will not move a vessel due to concerns for insufficient safety) helps to quantify the period of time each day a given vessel with a specified immersed draft can be moved relative to tide.

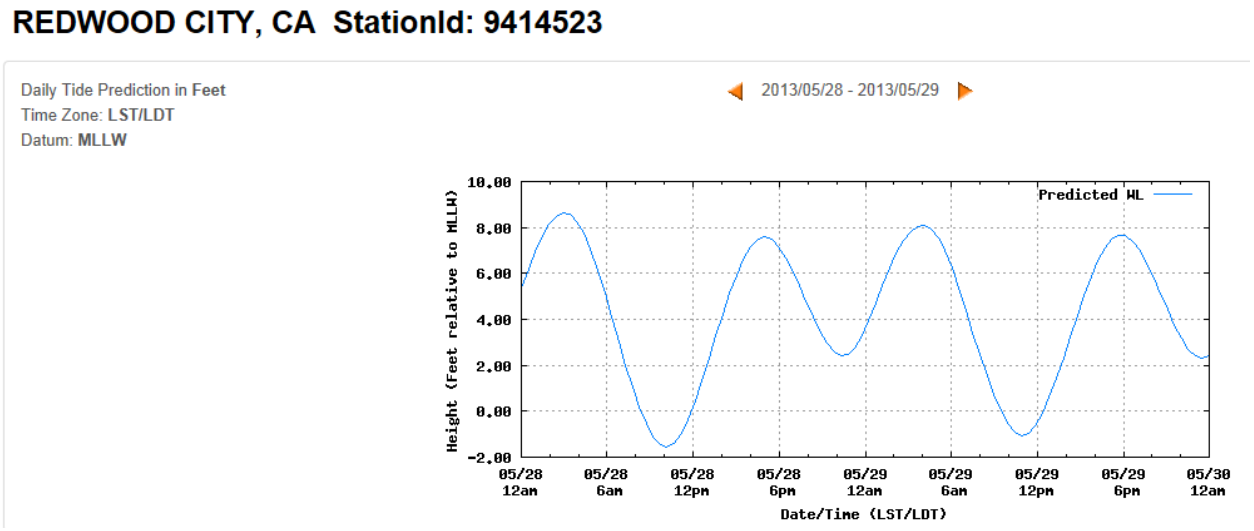
According to the San Francisco Bar Pilots Operations Guidelines for the Movement of Vessels on San Francisco Bay and Tributaries published 18 September 2014, the minimum UKC for non-tank vessels is two feet. Meetings with San Francisco Bay Bar Pilots over the course of this study confirm that while tidal ranges are frequently used to navigate loaded ships to the Port with drafts greater than 30 feet, the two-foot safety UKC is maintained.

2.6.2 Tidal Range

Tides are used often in order to transport cargo to the wharfs of the Port of Redwood City. High tides average approximately 7 to 8.5 feet above MLLW while load tides typically fall from -0.8 feet to 2.9 feet below MLLW. The Tide Tool included in the HarborSym model was incorporated for the analysis described later in this report. The IWR Tide Tool makes use of standard astronomical tidal prediction techniques and databases of tidal stations. The Tide Tool generates tidal height and current information for primary and secondary tidal stations as well as statistics on tidal availability, for example the cumulative distribution function of tidal availability at a location. A geographical interface making use of Google Earth™ allows for simple identification of tidal stations, and supports creation of secondary tidal stations for use in HarborSym.

Here is a random, typical tide scenario from 2013, taken from the NOAA website.

Figure 5. Random, Typical Tide Scenario from NOAA Website



2.7 Design Vessel

The selection of vessel specifications for fleet service forecasts sometimes poses unique concerns given requirements to evaluate design and improvements for waterway systems over time. Generally, waterway improvements should be designed to be optimized across the entire forecasted fleet. In this case, it would include service by several forms or types of vessels (i.e., tankers and dry cargo carriers, etc.). Where vessel designs are relatively mature (tankers and dry bulk carriers), the task is straightforward.

Such is the case with the Port of Redwood City. The design vessel class of Panamax ships already calls on the Port, albeit light-loaded. The Port has indicated that the new CSL Trillium Class Self-Unloaders will be the largest vessels that will regularly call on the Port throughout the foreseeable future. There is currently a fleet of five of these vessels (Rt. Honorable Paul E. Martin, Balto, Balchen, Tacoma, and Tecumseh) that regularly bring sand and aggregates to the Port from Vancouver Canada. Four of the five were built in 2013 (the fifth in 2012) and are classified as Panamax ships. Their DWT capacity is approximately 71,500 tonnes with design drafts of roughly 44 feet. In 2013, design vessel ships comprised 57% of Port calls and carried nearly 64% of total tonnage to the Port.

3.0 Future Conditions

3.1 Terminal Expansions

Currently the Port has indicated that they have no plans to expand annual throughput capacity, which is estimated to be up to about 3.5 million tonnes per year. The Port has recently upgraded its Wharf 1 facilities and continues to seek out new customers, particularly in light of the continued absence of cement imports.

3.2 Commodity Forecast

3.3.2 Trade Forecast

3.3.2.2 IHS Global Insight

In 2011, bulk trade forecasts were obtained from GI, which operates as a research firm to provide economic and financial coverage of countries, regions, and industries. It offers data collection of macro, regional and global economics; financial markets and securities; survey; U.S. economic; energy; industry; and international trade.

When making global trade forecasts, GI employs sophisticated macroeconomic models which contain all commodities that have physical volume. The commodities are then grouped into 88 categories derived from the International Standard Industrial Classification. GI tracks 66 major countries then groups the remaining world trade partners into 12 regions according to their geographic location. Accordingly, they forecast 88 commodities among 78 countries or regions and include 582,528 potential trade flows.

When performing the Redwood City Harbor commodity forecast, GI considered four areas of concern that may threaten to slow the trajectory of global trade, among them the uncertainty over how the sovereign debt of the Eurozone will be resolved; concerns about China "hard-landing" and whether the government can prevent a recession; jitters about potential impact of sharply higher oil prices on the global economy; and political transitions in countries like Russia, China and Venezuela.

3.3.2.2.1 GI Trade Data Sources

GI obtains trade data from a wide variety of public and proprietary resources. IHS Global Insight resources included the data and expertise of the U.S. Macroeconomic Service, U.S. Regional Service, World Trade Service, Agriculture Service, U.S. Construction Service, Pricing and Purchasing Service, Trade and Transportation Service, and Energy Service, plus the resources of IHS CERA. Additional information was provided by government agencies, such as the U.S. Department of Agriculture's Economic Research Service, and the Bureau of Labor Statistics; industry associations and publications; academic publications; interest group publications, and the general press.

GI world trade forecast models use its comprehensive macroeconomic history and forecast databases and in particular, data on population, GDP, GDP deflators, industrial output, foreign exchange rates, and export prices by country. The data are used as exogenous variables in the trade forecast models. In this case, for cement (proxy for aggregates and sand) the forecasting process began with the historical data available on the imports of those commodities. IHS reviewed the forecasts in the draft report for each commodity and made changes as appropriate in the assumptions, methodology, or data sources to develop our baseline forecasts. The chapters for each commodity contain more detailed information on the forecasting methodology and assumptions used for that particular commodity.

For scrap metal, the methodologies for generating forecasts primarily focused on the potential demand for each commodity. The hinterland is the most likely area from which raw material would be supplied, and it is assumed that the demand for raw material would be met without constraint. Therefore, the overseas demand for these commodities was the principal driver of their forecasts.

Based upon the 2011 analysis by GI and using historical data from 1995 through 2014 and the TREND function in Microsoft Excel, the following commodities forecast has been developed for the channel improvement study. Multiple trend lines were examined, after making adjustments to reflect that several historical commodities have disappeared and not expected to return for at least several years

(and thus not included in the benefits, as based upon most likely scenario). The trendline chosen for forecasts that follow is approximately 2.8% per year.

Figure 6. Projected Trendlines for Growth in Commerce at Port of Redwood City

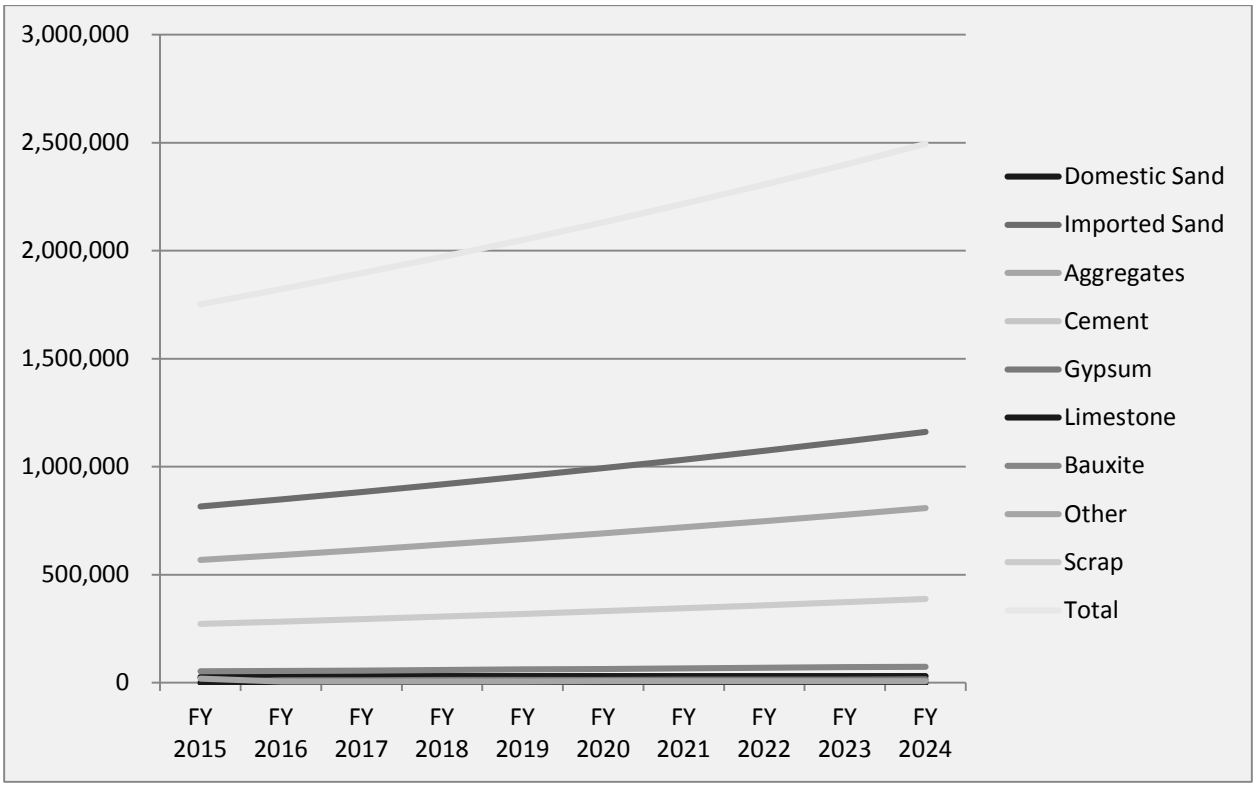


Table 6. Projected Growth in Commerce at the Port of Redwood City

Commodity	FY 2015	FY 2016	FY 2017	**FY 2018**	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	**FY 2024**
Domestic Sand	26,000	30,000	30,000	**30,000**	30,000	30,000	30,000	30,000	30,000	**30,000**
Imported Sand	816,000	848,640	882,586	**917,889**	954,605	992,789	1,032,500	1,073,800	1,116,752	**1,161,422**
Aggregates	568,000	590,720	614,349	**638,923**	664,480	691,059	718,701	747,449	777,347	**808,441**
Cement	0	0	0	**0**	0	0	0	0	0	**0**
Gypsum	0	11,000	11,440	**11,898**	12,374	12,868	13,383	13,919	14,475	**15,054**
Limestone	0	0	0	**0**	0	0	0	0	0	**0**
Bauxite	52,000	54,080	56,243	**58,493**	60,833	63,266	65,797	68,428	71,166	**74,012**
Other	18,000	5,200	5,408	**5,624**	5,849	6,083	6,327	6,580	6,843	**7,117**
Scrap	272,000	282,880	294,195	**305,963**	318,202	330,930	344,167	357,933	372,251	**387,141**
Total	1,752,000	1,822,080	1,894,963	**1,970,762**	2,049,592	2,131,576	2,216,839	2,305,512	2,397,733	**2,493,642**

SAND AND AGGREGATES IMPORT FORECASTS (IHS Global Insight)

As previously noted, IHS prepared a report for San Francisco District in 2011 incorporating forecasts for the Port of Redwood City. While cement was being considered, they concluded that an index tied to the construction industry was the appropriate one to use. Therefore, the following IHS forecast analysis is being used as a reasonable proxy for sand and aggregates that are imported through the Port. The table below depicts the MSAs that were used as a proxy for construction demand for cement for all three study areas.

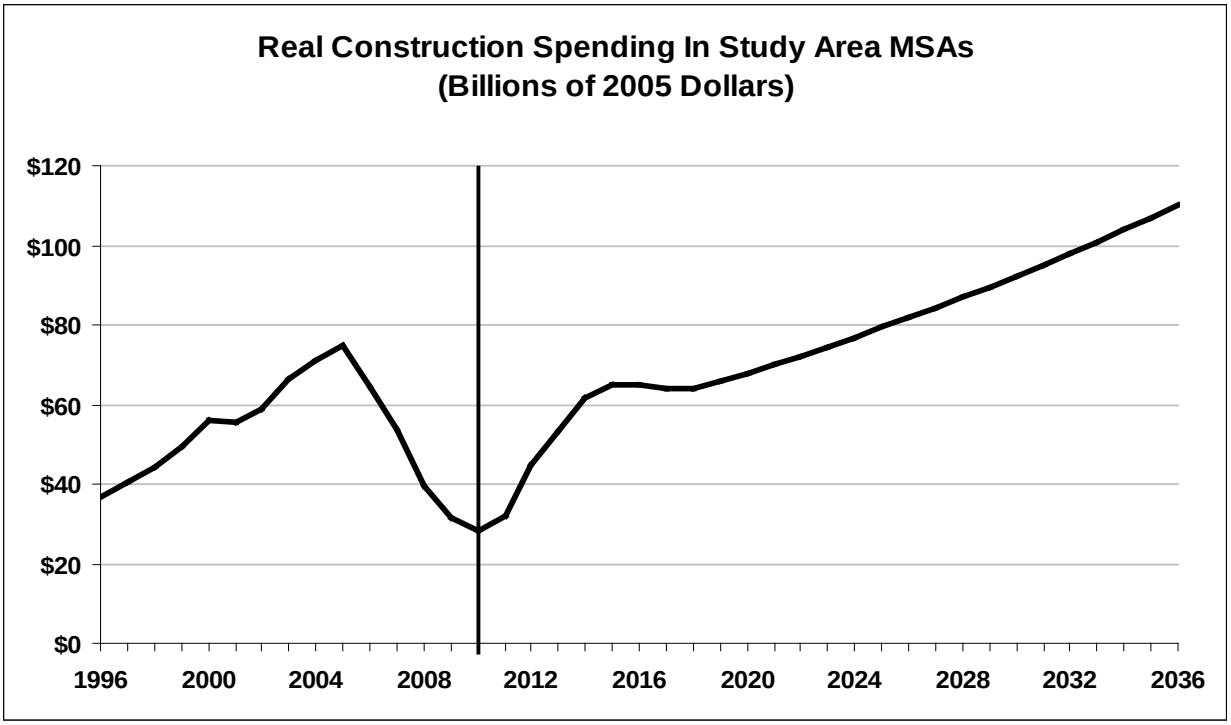
Table 7. Metropolitan Areas for Cement Hinterland Demand

Metropolitan Statistical Areas Used to Represent Hinterland's Cement Demand		
Sacramento	**Redwood**	**Stockton**
Chico	San Francisco-Oakland-Fremont	Fresno
Napa	San Jose-Sunnyvale-Santa Clara	Hanford-Corcoran
Redding	Salinas	Madera-Chowcilla
Sacramento--Arden-Arcade--Roseville		Merced
San Francisco-Oakland-Fremont		Modesto
Santa Rosa-Petaluma		Sacramento--Arden-Arcade--Roseville
Vallejo-Fairfield		Stockton
Yuba City		Visalia-Porterville

Upon examination of the data, the pattern of construction spending over the period from 1996 to 2010 exhibits the same trends as seen in the ports' cement import data. According to the Construction Service's latest forecast for the California Metropolitan Statistical Areas (MSAs) that lie within this report's study area, real (adjusted for inflation) construction spending is expected to increase by an average of 15% per year from 2011 to 2016. This strong growth is the result of fulfilling the pent-up demand that has been accruing while the construction industry wallowed during the recent recession, particularly in the housing segment. And according to California Financial & Economic Data—Construction: Housing Permits & Starts, the annual rate of change was 23% in 2010, almost 6% in 2011, 25% in 2012, and just over 44% in 2013.

Strong growth is also expected in the infrastructure segment as a result of Federal stimulus spending. Growth then is projected to be flat for four years, but spending will remain above $60 billion per year, which is 150% higher than the 2006 level of spending. For the remainder of the forecast period, the industry will settle into long-term trend growth of 3.1% per year, in line with the area's growth in gross domestic product. Despite the strong growth expected over the next five years, spending equivalent to the 2005 peak will not be achieved again until 2023.

Figure 7. Construction Spending



3.2 Forecast Assumptions

Construction spending was used as the driver for forecasting the demand sand and aggregates imported primarily for cement production. Several key concepts were considered prior to forecasting:

- Wet cement can only be moved locally a short distance, with the maximum range typically 50 miles. As such, the three ports do not compete for market shares of wet cement. However, the demand for dry cement extends well beyond a 50-mile radius around each port, as indicated in the hinterland maps. It is also understood from interviews and research that the majority of the cement moved through the hinterlands is dry, and it is moved by truck. Because the hinterlands for each of the ports overlap, the ports compete, to varying degrees, for dry cement market share.

- Delivered costs certainly will influence market penetration. However, existing facilities could mitigate some marine-related cost differentials. For instance, CEMEX has facilities at Redwood City and Sacramento. Depending on geographic demand, CEMEX will likely use those facilities rather than diverting shipments to Stockton. Similarly, the cement companies at Stockton would use their facilities for imports. This also indicates that import volumes would be influenced by intra-industry competition.

- All three ports have imported and distributed cement in the past. Therefore, connectivity to hinterland markets is not a constraint, but it is a factor in delivered cost.

- Capacity is not a constraint on the cement forecasts. Capacity at Sacramento is over 2 million metric tons per year, as is capacity at Stockton. Redwood City has capacity of roughly 850,000 metric tons. All three ports have demonstrated the ability to dramatically ramp up import volumes when demand nears or supersedes domestic production.

- In 2010, Polaris Materials Corporation entered into an amended and restated 20-year shipping agreement with CSL International Inc. for the bulk transportation of sand and gravel from the Orca Quarry (Orca), primarily to locations in California. Through this action, Polaris secured the long-term ability to supply existing and future terminals using rapid self-discharging Panamax vessels. Through its US subsidiary company, Eagle Rock Aggregates, Inc. (ERA) Polaris supplies Orca sand and gravel to a combination of owned and third-party terminals. In northern California, supplies are made to the Company's own Richmond Terminal within the Port of Richmond, which commenced the storage and distribution of Orca aggregate in 2008. Three additional locations are supplied directly: Redwood City, Pier 92 in the Port of San Francisco and Petaluma through a terminal operated by Landing Way Depot, Inc. In February, 2013 the Company commenced sales on an ex-quarry, or Free-on-Board, basis to a company with its own shipping capacity, these materials being delivered into Pier 94 in the Port of San Francisco. In respect of Pier 92 and Landing Way Depot deliveries, sand and gravel is loaded into customers' barges while the Panamax vessel is at anchor in San Francisco Bay. In this way the residual cargo can be discharged directly into the Richmond or Redwood City terminals, where shallow water prevents access to a fully loaded Panamax vessel.
- The Orca Quarry is located on the north east coast of Vancouver Island west of Port McNeill, British Columbia. Polaris Materials Corporation owns 88% of Orca Sand & Gravel Ltd. with the remaining 12% participating interest held by the 'Namgis First Nation. Trading commenced in April 2007, when the first shipment of sand and gravel departed for San Francisco. The Orca Quarry is permitted to produce 6.6 million tons of sand and gravel per year and has a dedicated ship loading facility capable of rapidly loading ships and barges, including 'Panamax' vessels with a capacity of up to 80,000 tons. The sand and gravel produced is of very high quality and exceeds all specification requirements for use in the United States, particularly in California, as well as in Canada. It has become well accepted in markets through its use in several major infrastructure projects such as the new San Francisco-Oakland Bay Bridge. The Orca Quarry has a long life with remaining permitted reserves at December 31, 2009 of 128.8 million tons. In 2008, the Company drilled and sampled two adjacent sites and confirmed the presence of suitable sand and gravel deposits which can be expected to add significantly to the life of the quarry, subject to obtaining final tenure and permitting.
- Polaris Minerals has a conveyor system over 1 kilometer long that brings the material directly from the quarry to a ship loader which can load Panamax ships at a rate of 5,000 tons/hour. CSL International has brought 4 newly built state-of-the-art Panamax ships into this aggregate materials trade. They have self unloading conveyors which can unload 35,000 - 40,000 tons in Redwood City in 18 - 24 hours. The high quality material from the Orca quarry, and the highly efficient transportation system that brings it to the Port of Redwood City, makes this material competitive with locally available material for the production of redi-mix concrete.
- According to the Port's internal analysis, Northern California has a deficit in construction aggregates supply to meet the growing demand. This is due to a gradual production slow down and/or closing of quarries from the Russian River valley in the north to

Gilroy/Watsonville in the south. Trucking material into this traffic congested area is difficult and expensive. There is a steady increase in demand based on population growth in the SF Bay area. Each person in a growing economy "consumes" an average of 7 tons of construction aggregates per year. Add to this construction cycles when demand increases (spikes) above the normal growth. In the last 15 years there have been 2 major spikes in demand for construction material - the housing boom roughly from early 2000 to 2007, which was wide spread in Northern California, and the Silicon Valley building boom starting in 2011 and which is still going strong. Canadian sand started to be shipped to Redwood City in 2003. Aggregates (two sizes of gravel) from Canada followed several years later. The sand and aggregates are used almost exclusively for making redi-mix concrete. Total tonnage grew gradually from 96,000 tons in 2003 to over 400,000 in 2010 as the material became more widely accepted and, in terms of quality, exceeded building specifications. Redwood City was the first port in the SF Bay Area to receive these shipments be followed by Richmond and later San Francisco. In 2011 the tonnage of construction aggregate material shipped to Redwood City doubled in one year to 850,000 tons and has grown steady every year since then to reach 1.3 million tons in 2014. This is due to the growth of the Silicon Valley economy and the building boom occurring from San Francisco to San Jose. According to experts in the construction industry, this is the hottest construction market in the US. They don't see the market slowing appreciably in this cycle; it may moderate briefly once these companies build their buildings and new campuses, but the long term outlook is this is the tech hub of the world and these companies will continue to grow and change and expand for the foreseeable future.

On the supply side, the Canadian company, Polaris Minerals, opened the Orca quarry on the northeast coast of Vancouver Island in 2007. It is the largest construction materials quarry in Canada and is currently permitted to produce 6.6 million tons per year. It has a conveyor system over 1 kilometer long that brings the material directly from the quarry to a ship loader which can load Panamax ships at a rate of 5,000 tons/hour. CSL International has brought 4 newly built state-of-the-art Panamax ships into this aggregate materials trade. They have self unloading conveyors which can unload 35,000 - 40,000 tons in Redwood City in 18 - 24 hours. The high quality material from the Orca quarry, and the highly efficient transportation system that brings it to the Port of Redwood City, makes this material competitive with locally available material for the production of redi-mix concrete.

sThe first pass at forecasting produced reasonable growth rates for imports at all three ports. However, the tonnage levels did not appear to be reasonable, as none of the ports approached the volumes seen in the prior construction boom. This was due to the fact that the volume for the beginning of the forecast jump-off period, 2010, was so low that despite the growth in construction spending, significant volumes were not attained.

To adjust for this, IHS looked at the historical relationship of construction spending within each port's hinterland versus their cement imports to determine a year-by-year factor representative of this relationship. The significance of this factor is to replicate the potential for these ports to "bounce back" when demand warrants a sharp increase in imports. IHS then took an average of these factors over history to create a single "bounce back" factor for use in an appropriate future year. An average was used to avoid bias of either a high- or low-import year.

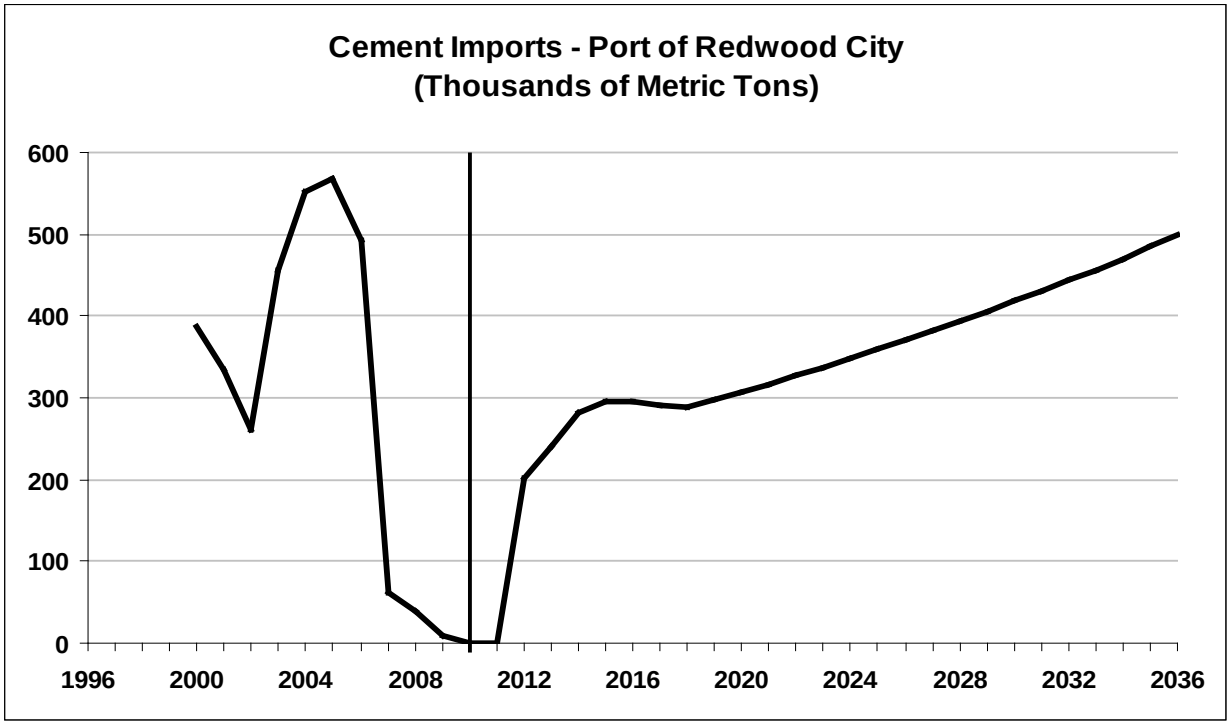
IHS applied the factor in the year 2013 by multiplying the estimate of construction spending by each port's "bounce back" factor. This resulted in an import "bounce back" in 2013, the consequence of two consecutive years of strong growth in construction spending. .

Using this methodology, a second round of import forecasts was developed. These forecasts were deemed to be a more reasonable prediction of imports in a recovering market, given historical patterns seen in a rising market.

Table 8. Sand & Aggregate proxy Import Forecasts

	Metric Tons						Compound Average Annual Growth		
	2007	2008	2009	2010	2016	2036	2010 / 2007	2016 / 2010	2036 / 2016
Redwood City	61,012	38,799	8,471	0	294,380	499,472	N/A	N/A	2.7%
Stockton	1,150,997	233,764	183,980	243,947	826,378	1,417,073	-40.4%	22.6%	2.7%
West Sacramento	207,025	156,893	176,571	32,833	264,871	448,692	-45.9%	41.6%	2.7%

Figure 8. Redwood City Cement Imports Forecast



3.3 Steel Scrap

3.3.1 National Overview

As of 2011, the metal recycling industry is an $86 billion global industry that in the United States employs about 85,000 people and processes 150 million tons of recyclable material each year, including 85 million tons of iron and steel.[1] Export demand is the largest driver for the steel scrap market in the United States, which is the world's largest steel scrap exporter.

Although the global demand for scrap was affected sharply by the global economic downtown, demand is on the rebound. One factor behind the growth in demand is the worldwide increase in the use of electric arc furnace technology, which uses steel scrap as its primary production input. This is particularly true in Europe, where companies using EAF technology account for over 40% of all steel production – that proportion will increase as new plants come online.[2] In addition, steel scrap demand will grow to support the rapidly expanding economies of the emerging markets where steel consumption per capita is well below that of developed markets.[3]

Nearly 40% of U.S. scrap exports went to China in 2009; continued strong demand in China leads IHS Global Insight to project that as of 2010, China will pass the United States in scrap consumption and will continue as the world's largest consumer for the foreseeable future. South Korea and Taiwan are other major importers of U.S. scrap; demand in these countries is expected to continue to be strong. Another support for scrap demand is the fact that scrap recycling reduces the need for raw ore mining, thereby reducing mining's impact on the environment. Continued foreign demand plus the expectation that the U.S. dollar will remain weak versus other currencies suggests that the demand for U.S. scrap exports should be sustainable into the future.

In the United States, steel use remains well below historical averages, even with a bounce back in 2010 from the depressed levels of 2009.[4] As the U.S. economy picks up speed, domestic demand for scrap by U.S. companies is expected to rise.[5] For example, even though significant sectors of the American economy have yet to fully recover from the recession, some sectors – such as energy, aerospace, defense and automotive –are gaining strength and are consuming more scrap. Eventually, the rise in activity will result in the generation of more domestic scrap.

Domestic supply conditions have recently tightened in the United States for several reasons. First, there has been a decline in overall metals-intensive manufacturing in the United States, which has led to a significant drop off in the generation of industrial or "prompt" scrap, which traditionally accounts for 50

---

[1] West Coast Recycling Group LLC's Proposed Metal Recycling Facility for the Port of West Sacramento, Project Overview.
http://westcoastrecyclinggroup.com/

[2] "Scrap Outlook Points to Steel Recovery," Breakbulk Online, August 13, 2010.
http://www.breakbulk.com/steel-metals/scrap-outlook-points-steel-recovery

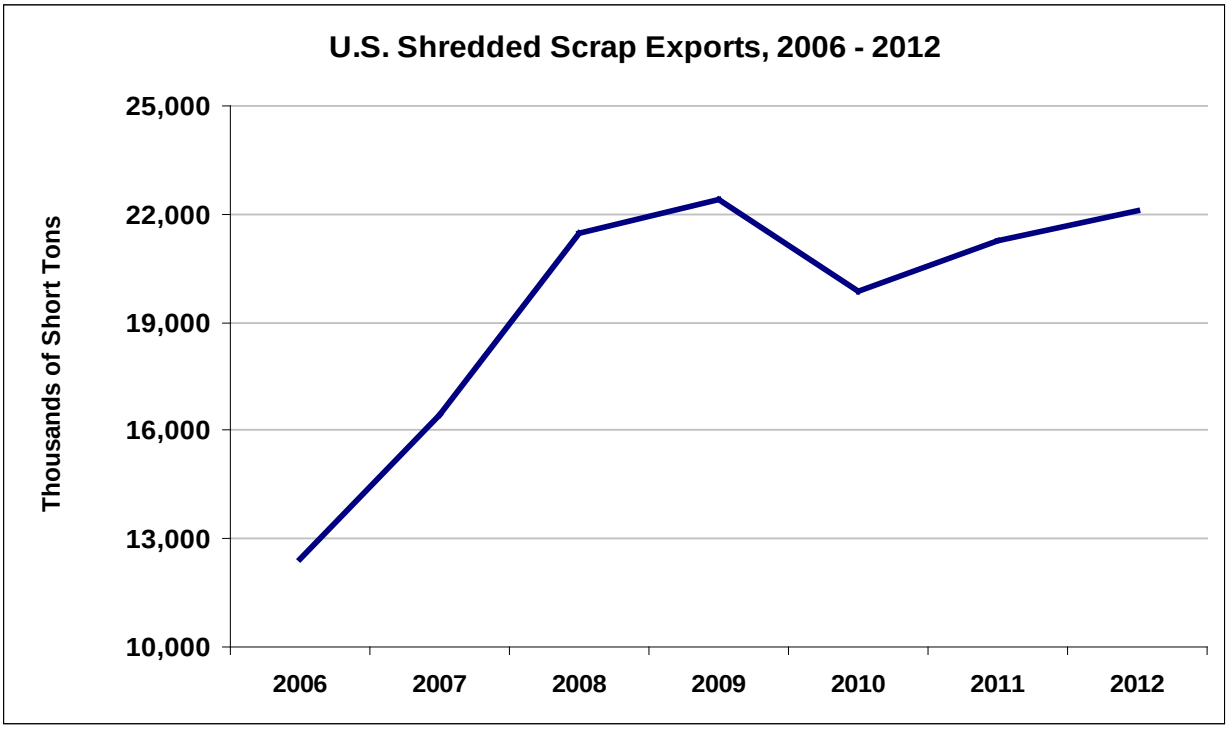
[3] Steel & Input Cost Economics 2010," McCoy Bolt Works, January 2010.
http://mccoybolt.com/assets/files/Steel-and-Input-Cost-Economics-2010.pdf

[4] MetalsOutlook January 2011", All Metals & Forge Group, January 2011.
http://www.steelforge.com/metalswatch/2011/January.htm

[5] "Scrap Metal's Lament: Few Scraps," *Wall Street Journal*, March 18, 2010.

percent of the country's scrap supply. Second, steel manufacturing efficiency has improved, resulting in less "home" scrap being produced.[6] Third, supply dried up during the recession as people were more likely to repair potential sources of scrap, such as an old appliance, than to discard it. This is known as obsolete scrap.

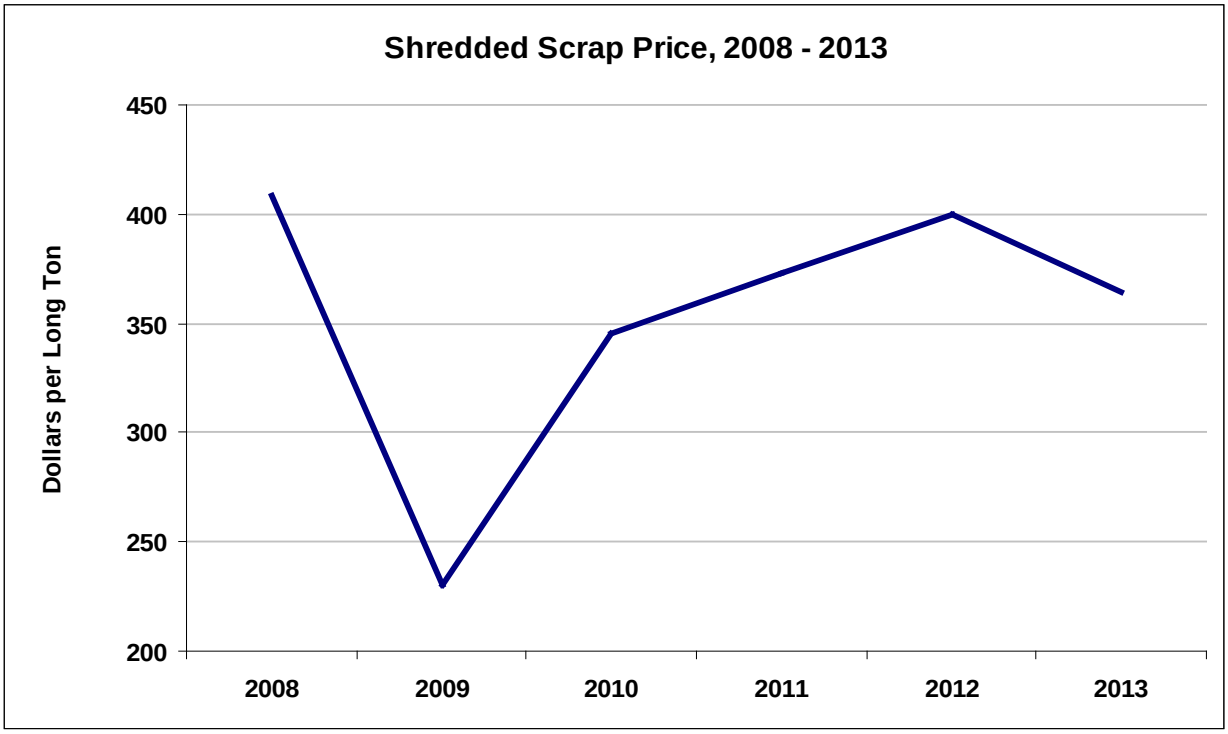
***Figure 9.** U.S. Shredded Scrap Exports, 2006-2012*



However, the potential reservoir of scrap material is not in question. Studies commissioned by Institute of Scrap Recycling Industries (ISRI) estimate U.S. scrap reserves (obsolete scrap) are in excess of one billion tons. Following the dynamics of the supply-demand equation, high scrap prices will provide the incentive to bring more obsolete scrap to the market. Because of the enormous amount of obsolete scrap supply, its introduction to the market as scrap prices increase tends to result in moderating prices.

[6] What's Up with the Price of Scrap? Economic Recovery and Global Demand Setting the Pace, ISRI, Institute of Scrap Recycling Industries, Inc, February 2011.
http://www.isri.org

Figure 10. Price of Shredded Steel Scrap, 2008-2013



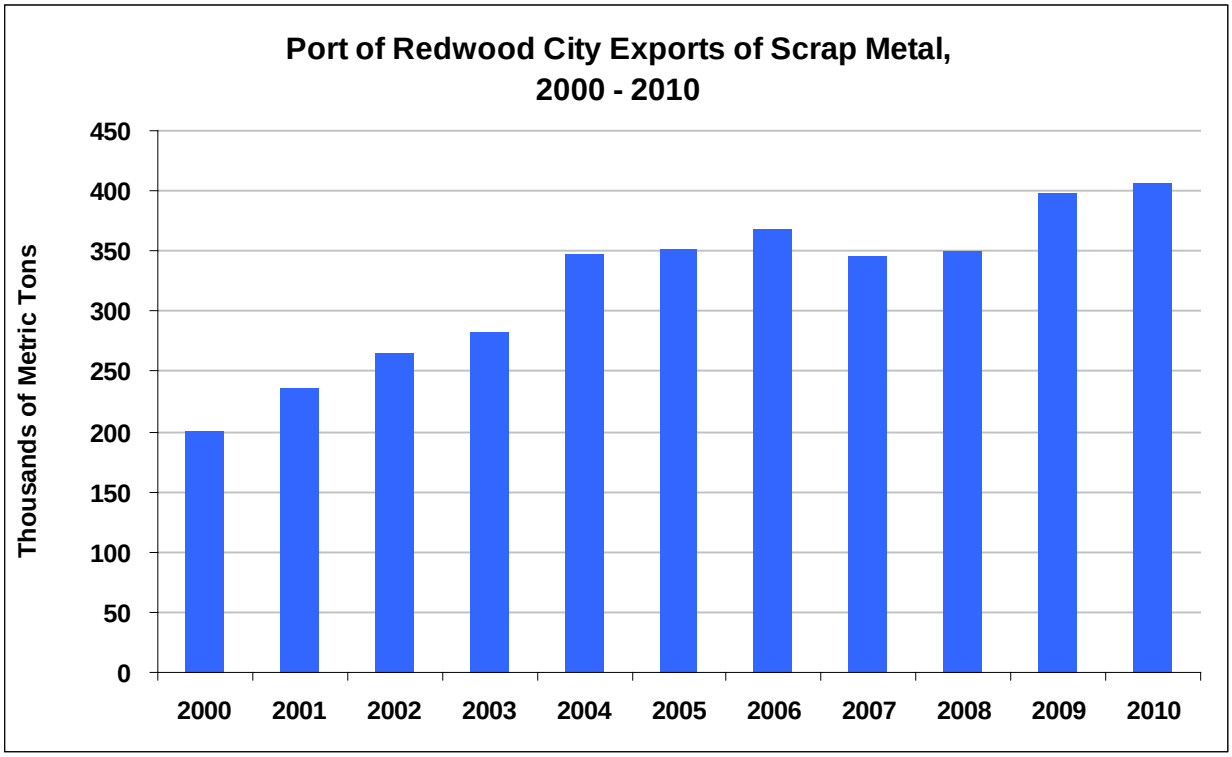
Although the global recession put the brakes on commodity price appreciation for a time, prices have heated up again as the world's economies begin to recover.[7] Prices for a metric ton of shredded steel scrap, the type that would be produced by the new Sacramento facility, fluctuated between $305 and $397 in 2010[8] and are predicted to remain in the $300-$400 range through 2012. IHS Global Insight does not predict a crash and even the bottom of our forecast represents levels 15% higher than the average in 2007. The rising tide of demand from steel mills around the world means the floor for scrap prices (both in the United States and around the world) is edging higher as well.

3.3.2 Scrap Metal Exports Background

Port of Redwood City: Scrap metal exports from Redwood City began in 2000, with 200,524 metric tons exported in that calendar year. Tonnage increased steadily until a slight drop in 2007 and 2008, but rebounded strongly in 2009 to nearly 400,000 tons in 2009 and peaked at 406,025 tons in 2010.

[7] Ibid.
[8] "The Buyers' Perspective, November 2010", IHS Pricing and Purchasing Service.

Figure 11. Exports of Scrap Metal at Redwood City, 2000-2010



3.4 Scrap Metal Export Forecasts

To produce a forecast of import tonnage for the two ports, we reviewed the work that the Corps had done for Sacramento and their sources of information. The Corps approach was similar to the approach that we applied, namely, that there is ample supply in the hinterland and that demand would ultimately drive the potential for scrap exports. However, we had the benefit of additional data sources from which to build and validate a forecast.

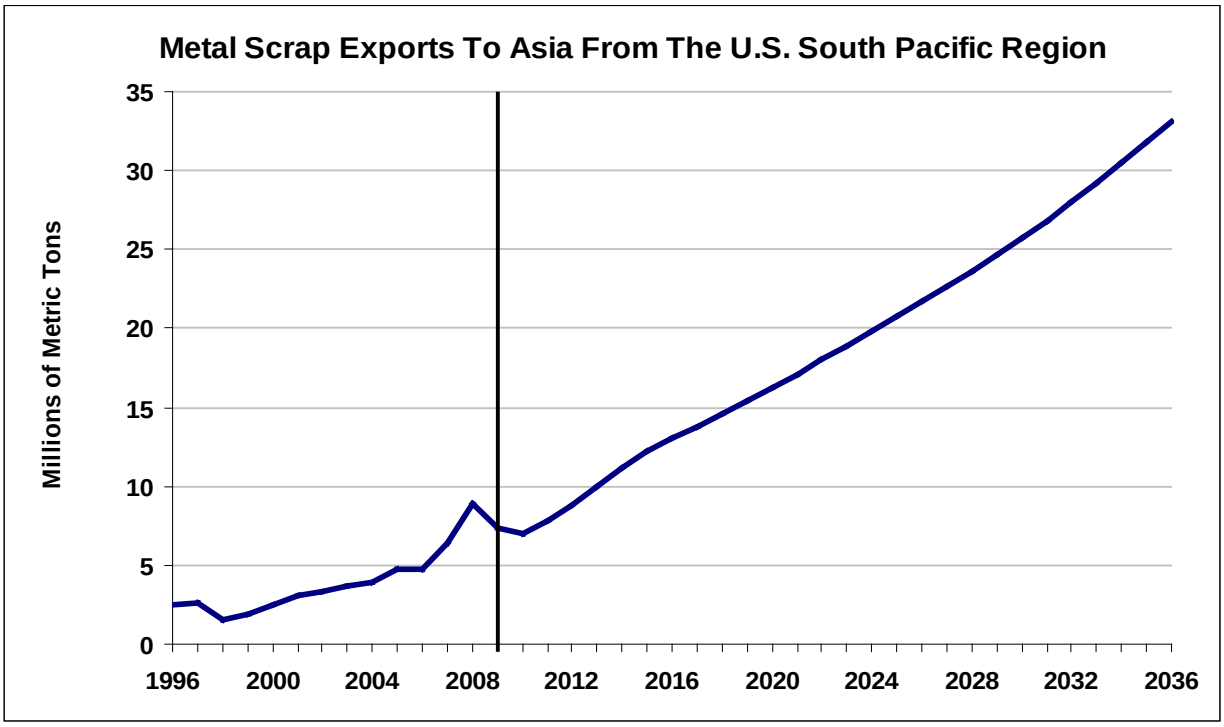
First, because Redwood City was not a part of the Corps' study, the history of Redwood City's exports was not part of their review. As depicted in Figure IVI-X, over the last decade, Redwood City's annual scrap metal exports have doubled from 200,000 tons to 400,000 tons, exhibiting growth despite the recession. This demonstrates the continuing strength of demand for scrap metal.

The Corps used information from IHS Global Insight's World Trade Service (WTS), which was the forecast of scrap exports from the North Pacific region. As opposed to the commodity used by the Corps in producing a cement forecast, the scrap category in WTS is narrowly defined, with only five sub-categories (mainly centered on whether the scrap is ferrous or non-ferrous). The Corps used a December 2009 forecast; we were able to incorporate the December 2010 version into our analysis. Another minor point is that the Corps used the North Pacific region data for their forecast, whereas these two ports actually are part of the South Pacific region.

From the WTS data, it is apparent that Asia is the leading destination for scrap exports from the U.S. South Pacific region – in 2009, exports to Asia were 7.3 million metric tons, while exports to Europe totaled fewer than 6,000 tons. Exports to Asia are expected to grow considerably over the forecast

interval. The WTS forecast expects average annual growth to be 6.3% from 2009 through 2036, when scrap exports are forecast to reach 33 million tons.

Figure 12. Metal Scrap Exports to Asia from the U.S. South Pacific Region



Our third source was IHS Global Insight's World Industry Service (WIS). Information from WIS was reviewed to cross-check the WTS data because exports and imports serve as inputs into the WIS forecast process, and we did not want to "double-count" the expectations for exports from the South Pacific region or imports into Asia. Note that there are many other inputs into the WIS forecast process, so if these forecasts did not complement each other, it would be a signal that additional research would be necessary to understand the differences.

The Asian industries that would be most likely to generate the primary demand for scrap metal are construction, steel making, and automobile manufacturing. From WIS, we looked at the production indices for each of these industries as a representative sample of Asian countries: India, Japan, South Korea, Thailand, and Vietnam. (Industrial production index data is not yet available for China.) With the exception of Japan, which is not an economic growth engine for the region, these industries are expected to grow by an average of 6.0% over the forecast interval in these countries. Therefore, the cross-check of the expectations for scrap metal exports lends credence to the predicted export growth.

Land-side delivery costs then were reviewed to determine whether or not they would favor one port over the other. The analysis revealed that the hinterlands were distinct enough to ensure supply to both ports (please see Table 4 in Appendix II), but Sacramento does have the advantage of being closer to a larger number of supplying counties. The introduction of Sacramento as a user of scrap metal would likely shift some supply away from Redwood City, thus slowing the growth of Redwood City's exports. As can be seen in the table, dredging of the channel would reduce the total delivered costs of scrap exports from Sacramento by approximately $4/ton.

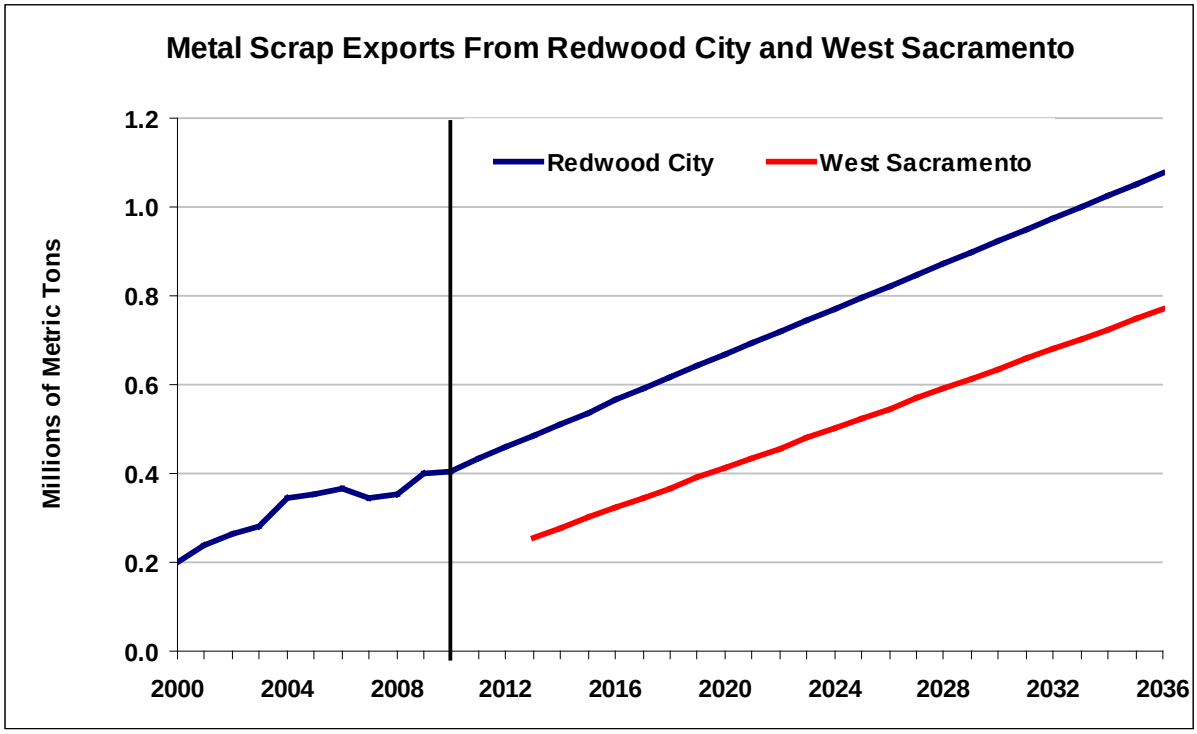
The final piece of analysis was to assume that the Sacramento scrap facility will become operational and to determine exports from Sacramento would commence. Clearly, the current appetite for scrap metal in Asia and the expected near-quintupling of demand is sufficient to support multiple suppliers. It is unlikely that meaningful volumes of scrap will begin to be exported from Sacramento in 2011. To be conservative, 2013 was picked as the starting year for Sacramento scrap exports, allowing ample time for permitting and for demand to build as a result of global economic recovery. Under this scenario, exports from Sacramento begin at 256,000 tons (eight 32,000 MT shipments) and grow at an average annual rate of 4.9%. Exports from Redwood City grow at a slightly slower pace of 3.5% annually, reflecting the competition for supply from Sacramento. Combined, their scrap exports grow at 6.0% per year from 2010 to 2036, consistent with the forecast of export growth from the IHS World Trade Service.

The question of whether or not exports actually will start cannot be answered within the confines of this analysis. If the scrap processing plant is not built, the forecast is obviously zero for Sacramento, and Redwood City would experience stronger growth over the forecast interval.

Table 9. Scrap Metal Exports Forecasts

	Metric Tons						Compound Average Annual Growth		
							2010 /	2016 /	2036 /
	2007	2008	2009	2010	2016	2036	2007	2010	2016
Redwood City	344,928	351,077	351,077	351,077	563,893	1,077,634	0.6%	8.2%	3.3%
		2013	2014	2015	2016	2036			
West Sacramento		256,000	278,316	300,632	322,948	769,265	N/A	N/A	4.4%

Figure 13. Metal Scrap Export Forecasts for Redwood City and West Sacramento



4.0 Transportation Cost Savings Benefit Analysis

The purpose of this analysis is to describe the benefits associated with the deepening at the Port of Redwood City channel. NED benefits were estimated by calculating the reduction in transportation cost for each project depth using the HarborSym Modeling Suite of Tools (HMST) developed by IWR. The HMST reflects USACE guidance on transportation cost savings analysis[9].

4.1 Methodology

Channel improvement modifications result in reduced transportation cost by allowing a more efficient future fleet mix and higher load factors when traversing the port. The HMST was designed to allow users to model these benefits. With a deepened channel, carriers will be able to load Panamax vessels more efficiently and thereby reduce transiting costs. In the future, these carriers are anticipated to replace smaller less efficient vessels with modern Panamax that will continue to call on Port of Redwood City. The primary effect from channel deepening that could induce changes in the future fleet at Redwood City an increase in a vessel's maximum practicable loading capacity, if the vessel is depth constrained in the current channel. Channel restrictions can limit a vessels capacity by limiting its ability to load to its design draft. Deepening the channel can reduce this constraint and the vessel's maximum practicable capacity can increase towards its design capacity if commodities are available to transit, vessel loading practices allow, and the weight of all commodities on a vessel can "push" deeper into the water. This increase in vessel capacity utilization can result in fewer vessel trips being required to transport the forecasted cargo.

To begin, HarborSym was setup with the basic required variables. To estimate cost saving benefits, the Bulk Loading Tool (BLT), a module within the HMST, was used to generate a vessel call list based on the commodity forecast at the Port of Redwood City and available channel depth under the various alternatives. The resulting vessel traffic was simulated using HarborSym, producing average annual vessel transportation costs. The transportation costs saving benefits were then calculated from the existing 30-foot depth for each additional project depth. The Tentatively Selected Plan (TSP) was identified by considering the highest net benefit based on the transportation cost saving benefits.

4.1.1 HarborSym Model

IWR developed HarborSym as a planning level, general-purpose model to analyze the transportation costs of various waterway modifications within a harbor. HarborSym is a Monte Carlo simulation model of vessel movements at a port for use in economic analyses. While many harbor simulation models focus on landside operations, such as detailed terminal management, HarborSym instead concentrates on specific vessel movements and transit rules on the waterway, fleet and loading changes, as well as incorporating calculations for both within harbor costs and costs associated with the ocean voyage.

HarborSym represents a port as a tree-structured network of reaches, docks, anchorages, and turning areas. Vessel movements are simulated along the reaches, moving from the bar to one or more docks, and then exiting the port. Features of the model include intra-harbor vessel movements, tidal influence, the ability to model complex shipments, incorporation of turning areas and anchorages, and within-simulation visualization. The driving parameter for the HarborSym model is a vessel call at the port. A HarborSym analysis revolves around the factors that characterize or affect a vessel movement within the harbor.

[9] HarborSym and the Bulk Loading Tool (BLT) are USACE certified planning models.

4.1.1.1 Model Behavior

HarborSym is an event driven model. Vessel calls are processed individually and the interactions with other vessels are taken into account. For each simulation, the vessel calls for an iteration that fall within the simulation period are accumulated and placed in a queue based on arrival time. When a vessel arrives at the port, the route to all of the docks in the vessel call is determined. This route is comprised of discrete legs (contiguous sets of reaches, from the entry to the dock, from a dock to another dock, and from the final dock to the exit). The vessel attempts to move along the initial leg of the route. Potential conflicts with other vessels that have previously entered the system are evaluated according to the user-defined set of rules for each reach within the current leg, based on information maintained by the simulation as to the current and projected future state of each reach. If rule activation occurs, such as no passing allowed in a given reach, the arriving vessel must either delay entry or proceed as far as possible to an available anchorage, waiting there until it can attempt to continue the journey. Vessels move from reach to reach, eventually arriving at the dock that is the terminus of the leg.

After the cargo exchange calculations are completed and the time the vessel spends at the dock has been determined, the vessel attempts to exit the dock, starting a new leg of the vessel call; rules for moving to the next destination (another dock or an exit of the harbor) are checked in a similar manner to the rule checking on arrival, before it is determined that the vessel can proceed on the next leg. As with the entry into the system, the vessel may need to delay departure and re-try at a later time to avoid rule violations and, similarly, the waiting time at the dock is recorded.

A vessel encountering rule conflicts that would prevent it from completely traversing a leg may be able to move partially along the leg, to an anchorage or mooring. If so, and if the vessel can use the anchorage (which may be impossible due to size constraints or the fact that the anchorage is filled by other vessels), then HarborSym will direct the vessel to proceed along the leg to the anchorage, where it will stay and attempt to depart periodically, until it can do so without causing rule conflicts in the remainder of the leg. The determination of the total time a vessel spends within the system is the summation of time waiting at entry, time transiting the reaches, time turning, time transferring cargo, and time waiting at docks or anchorages. HarborSym collects and reports statistics on individual vessel movements, including time in system, as well as overall summations for all movements in an iteration.

HarborSym was initially developed as a tool for analyzing channel widening projects, which were oriented toward determining time savings for vessels transiting within a harbor. It did not allow for assessing changes in vessel loading or in shipping patterns. The most recent release of HarborSym was designed to assist analysts in evaluating channel-deepening projects, in addition to the original model capabilities. The deepening features consider fleet and loading changes, as well as incorporating calculations for both within harbor costs and costs associated with ocean voyage.

Each vessel call has a known (calculated) associated cost, based on time spent in the harbor and ocean voyage and cost per hour. Also for each vessel call, the total quantity of commodity transferred to the port (both import and export) is known, in terms of commodity category, quantity, and tonnage. The basic problem is to allocate the total cost of the call to the various commodity transfers that are made. Each vessel call may have multiple dock visits and multiple commodity transfers at each visit, but each commodity transfer record refers to a single commodity and specifies the import and export tonnage. Also, at the commodity level, the “tons per unit” for the commodity is known, so that each commodity transfer can be associated with an export and import tonnage. As noted above, the process is greatly simplified if all commodity transfers within a call are for categories that are measured in the same unit, but that need not be the case.

When a vessel leaves the system, the total tonnage, export tonnage, and import tonnage transferred by the call are available, as is the total cost of the call. The cost per ton can be calculated at the call level (divide total cost by respective total of tonnage). Once these values are available, it is possible to cycle through all of the commodity transfers for the vessel call. Each commodity transfer for a call is associated with a single vessel class and unit of measure. Multiplying the tons or value in the transfer by the appropriate per ton cost, the cost totals by class and unit for the iteration can be incremented. In this fashion, the total cost of each vessel call is allocated proportionately to the units of measure that are carried by the call, both on a tonnage and a value basis. Note that this approach does not require that each class or call carry only a commensurate unit of measure.

The model calculates import and export tons and import and export allocated cost. This information allows for the calculation of total tons and total cost, allowing for the derivation of the desired metrics at the class and total level. The model can thus deliver a high level of detail on individual vessel, class, and commodity level totals and costs.

Either all or a portion of the at-sea costs are associated with the subject port, depending on whether the vessel call is a partial or full load. The at-sea cost allocation procedure is implemented within the HarborSym Monte-Carlo processing kernel and utilizes the estimate total trip cargo (ETTC) field from the vessel call information along with import tonnage and export tonnage. In all cases the ETTC is the user's best estimate of total trip cargo. Within the BLT, the ETTC field is estimated as cargo on board the vessel at arrival plus cargo on board the vessel at departure, in tons. ETTC can also be expressed as:

$$\text{ETTC} = 2*\text{Cargo on Board at Arrival} - \text{Import tons} + \text{Export tons}$$

There is a basic algorithm implemented to determine the fraction of at-sea costs to be allocated to the subject port. First, if ETTC for a vessel call is equal to zero or null, then none of the at-sea costs are associated with the port. The algorithm then checks if import or export tons are zero for a vessel call. If either are zero, then the following equation is applied to determine the at-sea cost allocation fraction associated with the subject port:

$$\text{At-Sea Cost Allocation Fraction} = (\text{Import tons} + \text{Export tons})/\text{ETTC}$$

Finally, when both import and export tons are greater than zero, the following equation is applied to determine the at-sea cost allocation fraction associated with the subject port:

$$\text{At-Sea Cost Allocation Fraction} = 0.5 * (\text{Import tons}/\text{Tonnage on board at arrival}) + 0.5 * (\text{Export tons}/\text{Tonnage on board at departure})$$

Where:

$$\text{Tonnage on board at arrival} = (\text{ETTC} + \text{Imports} - \text{Exports})/2$$

$$\text{Tonnage on board at departure} = \text{Tonnage on board at arrival} - \text{Imports} + \text{Exports}$$

4.1.1.2 Data Requirements

The data required to run HarborSym are separated into six categories, as described below. Key data for the Redwood City Channel Improvement study are provided. These data imputs were developed with assistance from the Port, the San Francisco Bay Bar Pilots Asoociation, and the Institute for Water Resources.

Simulation Parameters: Parameters include start date, the duration of the iteration, the number of iterations, the level of detail of the result output, and the wait time before rechecking rule violations when a vessel experiences a delay. These inputs were included in the model runs for the Redwood City study. The base year for the model was 2018. A model run was performed for the following years: 2013 (empirical data), 2018 (year in which benefits are expected to accrue), and 2025 (the year that the Port will meet its forecasted maximum of 2.5M tonnes. After 2025 the forecast number of tonnes was held constant until the end of the period of analysis. Each model run consisted of 100 iterations.

Physical and Descriptive Harbor Characteristics: These data inputs include the specific network of Redwood City Harbor such as the node location and type, reach length, width, and depth, in addition to tide and current stations. This also includes information about the docks in the harbor such as length and the maximum number of vessels the dock can accommodate at any given time.

Figure 14. Redwood City Channel Nodes, Turning Basin, and Wharves



Table 10. Redwood City Channel Dimensions and Docking Facilities

Reach

Length (ft)	Width (ft)	Depth (ft)	Description	Reach Safety Zone Active	ID(#)
1000	200	30	Reach - 1	☐	6
1500	200	30	Reach - 2	☐	7
2000	200	30	Reach - 3	☐	8
750	200	30	Reach - 4	☐	9
500	200	30	Reach - 5	☐	10
1750	200	30	Reach - 6	☐	11

Docks

Dock Description	Length (ft)	Limiting Depth (ft)	Max Vessels	Default Turning Basin	Default Usage	ID(#)	VSU Capacity
Wharves 1 & 2	855	34	2	Main TB	Before	3	250
Wharves 3 & 4	730	34	2	Main TB	Before	4	250
Wharf 5	500	34	2	Main TB	Before	5	250

General Information. General information used as inputs to the model include: specific vessel and commodity classes, route groups (Table 11), commodity transfer rates at each dock (Table 12), specifications of turning area usage at each dock, and specifications of anchorage use within the harbor. Distances between the route groups were developed by evaluating the trade routes calling on Redwood City Harbor in 2013.

Table 11. HarborSym Route Groups

Route Group Name	Description	Distance to Prior Port (nautical miles)	Distance to Next Port (nautical miles)
Aus-Vanc	Australia - Vancouver	6,600	820
Can-Can	Canada – Canada	900	900
Can-Mex	Canada - Mexico	900	1,800
China-China	China – China	5,650	5,650
Chi-May	China – Malaysia	5,650	7,550
Chi-SK	China – South Korea	5,650	4,550
Mal-Can	Malaysia – China	7,550	5,650
Mex-Mex	Mexico – Mexico	1,800	1,800
Pusan SK	Pusan, South Korea	4,514	4,514
SD-Chi	San Diego – China	1,000	5,650
CentAm-Chi	Central America – China	2,500	5,650

Table 12. HarborSym Commodity Transfer Rates

Dock Name	Loading/Unloading Rate for Commodities (tonnes/hour)		
	Min	Most Likely	Max
Wharves 1 & 2	600	800	1000
Wharves 3, 4, & 5 (load)	200	250	300
Wharves 3, 4, & 5 (unload)	650	700	750

Vessel Speeds. The speed at which vessels operate in the harbor, by vessel class both loaded and light loaded, were determined for each channel segment by evaluating pilot logs and port records and verifying the data with the pilots. Vessel speed inputs are provided in Table 14 for each reach of the node network for vessels.

Table 13. HarborSym Vessel Speed in Reach for Vessels (knots)

Reach		Handy		Handymax		Supramax		Panamax	
		Light	Loaded	Light	Loaded	Light	Loaded	Light	Loaded
All		10	7	10	7	10	7	10	7

Vessel Operations. Hourly operating costs while in-port and at-sea were determined by IWR for both domestic and foreign flagged vessels in accordance with Economic Guidance Memorandum 11-05. Sailing speeds at-sea were also taken from IWR tables based upon vessel class. These values are entered as a triangular distribution.

Table 14. Vessel Speeds

Description	Handy	Handymax	Supramax	Panamax
Vessel Speed at Sea, Min (knots)	11	11.3	11.3	11.3
Vessel Speed at Sea, Most Likely (knots)	12.6	12.7	12.7	12.8
Vessel Speed at Sea, Max (knots)	14.3	14.3	14.4	14.4

Reach Transit Rules.

Only one transit rule was identified and used in HarborSym: Draft Exceeds Depth Using Tide/Underkeel, and was applied to all reaches.

Vessels Calls. The vessel call lists are made up of forecasted vessel calls for a given year as generated by the BLT (see Section 4.1.3). Each vessel call list contains the following information: arrival date, arrival time, vessel name, entry point, exit point, entry draft, import/export, dock name, dock order, commodity, units, origin/destination, vessel type, dead weight tons, capacity, length overall, beam, draft, flag, tons per inch immersion factor, ETTC, and the route group for which it belongs.

4.1.3 Vessel Call List

The vessel call list for future years was developed using the BLT, a tool within the HarborSym Modeling Suite of Tools. Users must provide data to specify the framework for generating the synthetic vessel call list. The BLT relies on much of the information and data from HarborSym, but has data additional specific requirements. Within the BLT, the input requirements include:

- Commodity forecasts (annual import/export) at each dock;
- Description of the available fleet by vessel class, including:
  - Statistical data describing the cumulative distribution function for deadweight tons of vessels within the class,
  - Regression information for deriving length overall (LOA), beam and design draft from capacity,
  - Regression information for calculating TPI based on beam, design draft, capacity and LOA;
  - The number of potential calls that can be made annually by each vessel class;
- Logical constraints describing:
  - Commodities that can be carried by each vessel class,
  - Vessel classes that can be serviced at each dock,
  - Parameters, defined at the vessel class/commodity level for determination of how individual calls and commodity transfers are generated, such as commodity loading factors, allocation priorities, and commodity flow direction (import or export calls).

Procedures exist, using the Extreme Optimization package and some Access routines, to populate much of the required forecast information based on an examination of an existing vessel call list created from historical data. Statistical measures, commodity transfer amounts, and logical constraints can all be derived from an examination of a set of historical calls that have been stored in a HarborSym database. The system populator function facilitates data entry by providing a basis for the forecasts, which the user can edit as necessary.

4.1.3.1 BLT Loading Algorithm

With the user provided input requirements, the BLT creates and loads a synthetic fleet according to the following steps.

1. Generation of a fleet of specific vessels based upon a known number of vessel calls by class and a statistical description of the characteristics of the vessel class. This process begins by generating one specific vessel for each call in the class. The capacity of the vessel is set by a random draw from the cumulative density function that is stored for the class. Based on the regression coefficients that are stored for the class, each of which is of the form:

   - log (parameter) = a + b* log (Capacity)
   - LOA, Beam and Design Draft are determined for the vessel using a linear regression of the form:

     $$TPI = a + b*Beam + c*Design\ Draft + d*Capacity + e*LOA$$

   - The TPI is calculated based on the previously generated physical characteristics and coefficients stored, at the class level, for this regression model. This process is repeated

until a unique vessel is created for each available call in the forecast. If no TPI is generated, the default TPI specified by the user for the vessel class is assigned.

2. Attempt to assign a portion of the commodity forecast at a dock to a vessel. Each commodity forecast at a dock is processed in turn. If a vessel is available that can serve the commodity at the dock, it is loaded for either export only, import only, or both export and import. Potential vessels that can carry the forecast are assigned in a user-specified (at the class level) allocation order, so that the most economical vessel classes will always be used first. Under the current assumptions, a vessel call handles a single commodity at a single dock, i.e., each call consists of a single dock visit and a single commodity transfer (which may contain both an export quantity and an import quantity). The specification of the actual call assignment and commodity loading is dependent upon the maximum that a vessel can draft and still reach and leave the dock.

    - The amount of the commodity forecast that is actually carried on the vessel is used to decrement the remaining quantity to be allocated for that particular commodity forecast. After a single vessel call is assigned to a particular forecast, the total number of remaining available vessels for the class is decremented and the next commodity forecast in turn is processed. That is, each forecast attempts to have a portion of its demand satisfied by a single vessel call and then the next forecast is processed. This is to prevent all of the most efficient vessels from being assigned to a single commodity forecast.
    - This process proceeds, in a loop, continually attempting to assign commodity to a vessel from the remaining available fleet. Whenever a successful assignment is made, this generates a vessel call, dock visit, and the associated commodity transfer. This effort continues until no more assignments to a vessel call can be made, either because all commodity forecasts have been satisfied or there is no available vessel that can service the remaining quantities (because there is no vessel of the required class that can handle the particular commodity/dock combination of the forecast or because no vessel can be loaded to satisfy the dock controlling depth constraint).

3. At the end of the process, when no more assignments are possible, arrival times are assigned for each vessel. The algorithm used to assign arrival times assumes a uniform inter-arrival time for all calls within a class. After the allocation process is complete, the number of calls made by each class of vessel is known. This is used to calculate the inter-arrival time of vessels for that class. The arrival of the first vessel in the class is set randomly at a time between the start of the year and the calculated inter-arrival time, but all subsequent vessel arrivals for the class will have the identical inter-arrival time.

4. The generated vessel calls are written to a HarborSym vessel call database and the user is presented with output information on which commodity forecasts were satisfied, any remaining unsatisfied forecasts and detailed information on each vessel loading and the vessels that were used to satisfy each commodity forecast.

The intended approach is for the user to work iteratively within the BLT, making runs, examining the forecast satisfaction that is achieved and varying the fleet character and composition for subsequent runs, so that the final result is a balanced, reasonable projection of vessel calls to satisfy the input forecast demand. The BLT provides extensive output to assist the user in this regard.

Once a vessel is determined to be available for loading for a particular forecast, the BLT must determine the type of loading, the quantity loaded, and the arrival draft of the vessel. The user can control certain

aspects of the process through data specification, in particular the type of call (import, export or both) and the percent of capacity that is loaded for import and export, as described below.

Any given vessel call can attempt to satisfy an import demand (arrive with cargo for the port, leave empty), an export demand (arrive empty, leave with cargo loaded at the port) or simultaneously an import and export demand (that is, arriving with cargo to unload at the port [import], and then departing with cargo bound for another port [export]), based on the user defined directional movement assigned to the vessel class. Four possibilities are defined for this behavior, with specification at the Vessel Class/Commodity Category level:

- Export Only
- Import Only
- Random
- Both Export and Import

Certain combinations of class and commodity categories might be exclusively import only or export only. A "Random" assignment designates that calls from the class/commodity combination can be either import or export at a dock, but not both simultaneously. If a "Random" type is assigned, then the ratio of calls that will be randomly generated as import is specified.

The quantity of a vessel's capacity that is to be loaded for satisfaction of the import and export demands is described, again at the Vessel Class/Commodity Category level, by a triangular distribution that specifies a loading factor. A minimum, most likely, and maximum, in percent of total available capacity, is defined for both export and import.

When a vessel is available for satisfying a demand, first the type of satisfaction (import only, export only, random or both) is determined, as noted above. If "random" is associated with the current class/commodity, then a random draw is made from a uniform distribution and compared with the user-specified import ratio, to determine if the call is import only or export only. For example, if the user has entered a value of 70 percent for imports, indicating that 30 percent of the calls are exports, then a random draw is made from a uniform (0.1) distribution. If the random number is less than or equal to 0.7, then the call is assigned as an import, otherwise it is assigned as export.

Once the type of call is determined, the BLT must next ascertain how much capacity can be loaded on the vessel while satisfying the draft constraints. The process is similar for both export and import. First, a draw is made from the respective triangular distribution to get a percentage loading factor. This is then applied to the vessel DWT, adjusted to reduce the available tonnage based on allowance for operations, to get a tentative quantity to be loaded. The import/export capacity to be loaded is adjusted only if the available loading capacity is less than the initial calculation.

The tonnage associated with allowance for operations is based on IWR-developed data given fractional allowance for operations as a function of vessel tonnage (DWT), see Figure 31. The additional draft implied by the tentative quantity to be loaded is calculated based on the vessel TPI. A value of empty vessel draft for each vessel has previously been calculated, based on an assumption that the vessel DWT is associated with the vessel design draft. The empty vessel draft from which loading can start is then calculated as:

$$\text{Empty Vessel Draft} = \text{Design Draft} - (\text{DWT}/\text{TPI})/12.0$$

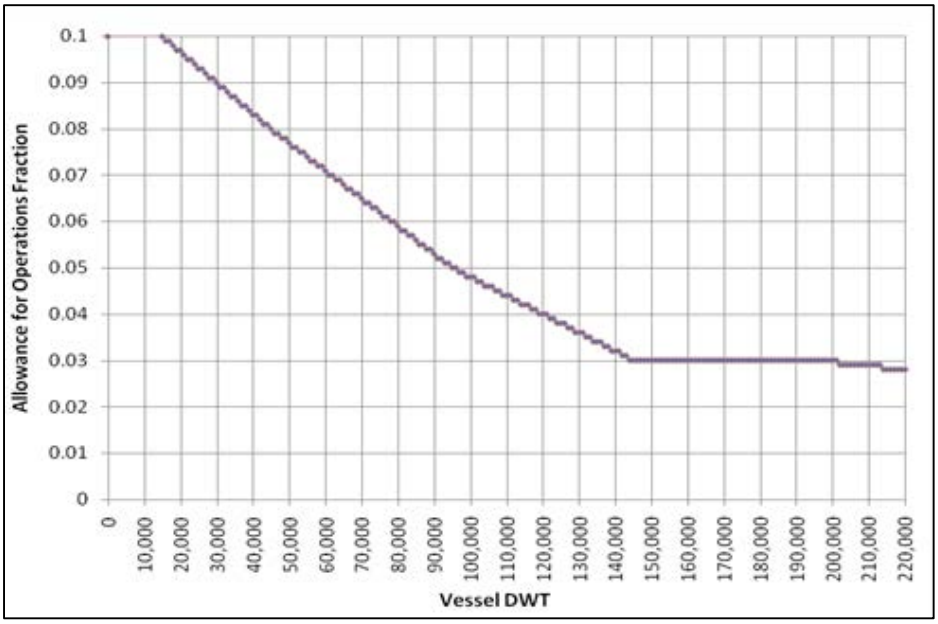


Figure 15. Allowance for Operations by Vessel DWT – Non-containerized Vessels

The total draft associated with the tentative loading is then calculated as the sum of four drafts:

Total Draft (tentative loading) = Empty Vessel Draft + Additional Draft Associated with Tentative Loading + Additional Draft associated with Allowance for Operations + Underkeel Clearance

In order to test the ability of the vessel to arrive at or leave the dock, to this total draft associated with tentative loading must be added the required underkeel clearance (a function of the vessel class). This gives the "test draft" that is checked against the limiting depth to the dock. Note that this is not the same as the eventually calculated arrival draft of the vessel at the bar, which is written to the vessel call data base. If this test draft is greater than the limiting depth to the dock (as defined by user input), the quantity loaded must be reduced, so that the calculated draft is less than the limiting depth to the dock. This calculation is executed to determine if the tentative loading can be reduced sufficiently to meet the dock limiting depth. If so, then the vessel is loaded with the amount of commodity to reach the target draft. If it is not possible to assign a commodity quantity that, when loaded on the vessel, does not exceed the dock limiting depth, then the vessel cannot service the allocation.

Once the commodity allocation has been completed, the vessel loading is known and the arrival draft (at the bar) must be determined. A class level "minimum sailing draft" has been specified by the user at the vessel class level. This minimum sailing draft, or empty vessel draft, reflects the ballasted draft at which a light vessel will sail. If a vessel is handling an export only, then it is assumed to arrive light, at the empty vessel sailing draft. If a vessel is handling an import to the port, then it arrives at the draft associated with the import loading (which may have been reduced to the limiting depth at the dock). It is important to note that underkeel clearance is not included in the arrival draft that is stored in the vessel call database because it does not factor into the actual sailing draft, but, as noted above it is used in checking the constraint associated with the limiting depth to the dock. In practice, underkeel clearance is used in the BLT to handle the depth constraint, but is not incorporated in the actual sailing draft. Underkeel clearance is then added back in as an additional constraint that is applied in HarborSym itself

based on sailing rules. In this manner, the arrival draft is consistently calculated based on the sum of empty vessel draft, draft associated with loading, and draft associated with allowance for operations.

The BLT module writes all the needed fields to the vessel call database. Of note is how the ETTC field is handled. Within the BLT, ETTC is populated by simply adding together import tons and export tons, which assumes that all at-sea costs for a vessel call generated by the BLT are allocated to the subject port.

4.1.3.2 BLT Data Inputs

The bulk fleet was developed using historical calls from July 1, 2012 to June 30, 2013. The table below provides the resulting bulk vessel fleet.

Table 15. Vessel Fleet Forecasts

Existing Condition 30 Foot

	2018	2025-2067
Handy	15	16
Handymax	7	8
Supramax	10	15
Panamax	50	65
Total	82	104

32 Foot

	2018	2025-2067
Handy	10	15
Handymax	8	8
Supramax	10	12
Panamax	47	60
Total	75	95

34 Foot

	2018	2025-2067
Handy	8	14
Handymax	7	0
Supramax	10	19
Panamax	44	55
Total	69	87

37 Foot

	2018	2025-2067
Handy	8	6
Handymax	5	7
Supramax	10	15
Panamax	40	50
Total	63	78

Table 16. Vessel Load Factors

Vessel Class	30 FOOT CHANNEL		
	Minimum	Average	Maximum
Handy (<40k DWT)	50%	66%	80%
Handymax (40k - 50k DWT)	32%	41%	46%
Supramax (50k - 60k DWT)	29%	37%	43%
Panamax (70k - 75k DWT)	21%	44%	58%

Vessel Class	32 FOOT CHANNEL		
	Minimum	Average	Maximum
Handy (<40k DWT)	56%	72%	86%
Handymax (40k - 50k DWT)	38%	47%	52%
Supramax (50k - 60k DWT)	35%	43%	49%
Panamax (70k - 75k DWT)	27%	50%	64%

Vessel Class	34 FOOT CHANNEL		
	Minimum	Average	Maximum
Handy (<40k DWT)	62%	78%	92%
Handymax (40k - 50k DWT)	44%	53%	58%
Supramax (50k - 60k DWT)	41%	49%	55%
Panamax (70k - 75k DWT)	33%	56%	70%

Vessel Class	37 FOOT CHANNEL		
	Minimum	Average	Maximum
Handy (<40k DWT)	71%	87%	92%
Handymax (40k - 50k DWT)	53%	62%	67%

Supramax (50k - 60k DWT)	50%	58%	64%
Panamax (70k - 75k DWT)	39%	65%	79%

Note: per the Immersion Factors by class from the IWR Vessel Characteristics spreadsheet, load factors were increased 3% per foot of deepening. Except when a cap of 92% was reached for the Handy vessels

4.2 Origin-Destination Transportation Cost Savings Benefits by Project Depth

Transportation cost benefits were estimated using the HarborSym Economic Reporter, a tool that summarizes and annualizes HarborSym results from multiple simulations. This tool collects the transportation costs from various model run output files and generates the transportation cost reduction for all project years, and then produces an Average Annual Equivalent (AAEQ). Results and calculations were verified using spreadsheet models as well.

Transportation costs were estimated for a 50-year period of analysis for the years 2018 through 2067. Transportation costs were estimated using HarborSym for the years 2018 and 2025. Since forecasted capacity is expected to be reached in 2025, the transportation costs were held constant beyond 2025. The present value was estimated by interpolating between the modeled years and discounting at the current FY 2015 Federal Discount rate of 3.375 percent. Estimates were determined for each alternative project depth.

The table below provides the annual transportation costs in total and for the at-sea and in-port portions. The transportation cost saving benefit is provided in Table 18. The AAEQ transportation costs and cost saving benefits are provided in Table 19. AAEQ cost statistics are also provided (Table 20).

Table 17. Origin-Destination Annual Transportation Cost (in Million $)

Year	30	32	34	37
2018	**$31.4**	**$28.1**	**$25.9**	**$23.5**
2019	$32.3	$28.9	$26.5	$24.4
2020	$33.2	$29.7	$27.1	$25.3
2021	$34.1	$30.6	$27.7	$26.1
2022	$35.1	$31.4	$28.2	$27.0
2023	$36.0	$32.2	$28.8	$27.9
2024	$36.9	$33.0	$29.4	$28.8
2025	**$37.9**	**$33.8**	**$30.0**	**$29.7**
2026-2067	$37.9	$33.8	$30.0	$29.7

Table 18. O-D Annual Transportation Cost Saving Benefits by Channel Depth (in Million $)

Year	32	34	27
2018	$3.2	$5.4	$7.9
2019	$3.4	5.8	$7.9
2020	$3.5	$6.1	$8.0
2021	$3.6	$6.5	$8.0
2022	$3.7	$6.8	$8.0
2023	$3.8	$7.2	$8.1
2024	$4.0	$7.6	$8.1
2025	$4.1	$7.9	$8.1
2026-2067	$4.1	$7.9	$8.1

Table 19. Origin-Destination AAEQ Transportation Cost and Cost Saving Benefits by Project Depth (Million $)

Project Depth	OD AAEQ Transportation Cost (Million $)	OD AAEQ Transportation Cost Savings (Million $)
30	$36.9	-
32	$32.9	$4.0
34	$29.3	$7.5
37	$28.8	$8.1

Table 20. Origin-Destination AAEQ Cost Statistics by Project Depth (Million $)

Statistic	30	32	34	37
Mean	$36.9	$32.9	$29.3	$28.8
Standard Deviation	$0.6	$0.7	$0.5	$0.8
Median	$36.9	$32.9	$29.3	$28.8
Min	$34.2	$30.9	$27.9	$26.6
Max	$38.6	$35.2	$31.1	$30.8
Range	$4.4	$4.4	$3.2	$4.2
Confidence for Mean +/-	$0.04	$0.05	$0.03	$0.06

Note: Confidence calculation assumes a normal distribution and 95 percent confidence level

Table 21 provides the OD cost saving benefits for the benefiting trade routes for each alternative depth.

Table 21. Origin-Destination AAEQ Transportation Cost Saving Benefits by Route Group and Project Depth (Million $)

	32		34		37		
Route Group	$	% TOT	$	% TOT	$	% TOT	
Aus-Van	-0.5	-13.7%	0.0	0%	0.5	5.7%	
Can-Can	0.7	18.9%	1.8	23.7%	3.0	36.9%	
Can-Mex	0.0	0%	0.0	0%	0.0	0%	
CentAm-Chi	0.7	16.5%	0.2	2.1%	1.2	14.4%	
Chi-Chi	0.9	22.2%	1.7	3%	1.6	19.1%	
Chi-May	0.8	21.1%	3.8	49.9%	1.4	16.6%	
Chi-SK	0.0	0.0%	2.1	28.1%	0.5	6.2%	
Mex-SK	0.5	12.1%	-1.3	-17.5%	-0.2	-1.8%	
Pusan SK	0.0	0.0%	1.6	20.8%	0.4	4.3%	
SD-Chi	1.0	24.9%	-0.7	-8.9%	0.0	0%	

Note: Totals affected by rounding.

4.4 Transportation Cost Saving Benefit Analysis

The benefit cost analysis presented in this section is for the project depths determined to be the most likely selected plans based on the OD benefits and the rough order cost analysis. Tables 22 through 24 below provide the Origin-Destination benefit cost analysis for the 32, 34, and 37 at three different disposal sites. As shown, the 32 depth provides the greatest total net benefits in the OD analysis between either the Deep Ocean Disposal Site or the Cullinan disposal area.

Table 22. Origin-Destination Benefit Cost Analysis (Million $) SF-DODS

Project Depth	Total AAEQ Costs	O-D AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	Benefit/Cost Ratio
32	$3.5	$4.0	$0.5	-	1.2
34	$7.2	$7.5	$0.3	-$0.2	1.1
37	$13.8	$8.1	-$5.7	-$6.0	0.6

Table 23. Origin-Destination Benefit Cost Analysis (Million $) Cullinan

Project Depth	Total AAEQ Costs	O-D AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	Benefit/Cost Ratio
32	$3.5	$4.0	$0.5	-	1.2
34	$7.1	$7.5	$0.4	-$0.1	1.1
37	$14.2	$8.1	-$6.1	-$6.5	0.6

Table 24. Origin-Destination Benefit Cost Analysis (Million $) Montezuma

Project Depth	Total AAEQ Costs	O-D AAEQ Benefits	Total Net Benefits	Incremental Net Benefits	Benefit/Cost Ratio
32	$3.6	$4.0	$0.4	-	1.1
34	$7.7	$7.5	-$0.2	-$0.6	0.9
37	$14.8	$8.1	-$6.7	-$6.5	0.6

The AAEQ costs estimates include increases in annual costs for O&M dredging due to increased shoaling and increased maintenance.

5.0 Sensitivity Analysis

5.1 Discussion

In the interest of further testing the sensitivity of project justification to uncertainty in parameters, future scenarios must be assessed. The analysis of these scenarios is intended to illustrate the effect of changes in different assumptions on project benefits and project justification. There are both microeconomic and macroeconomic risks that add to the uncertainty of the commodity forecasts. The microeconomic risk is the company-specific risk that stems from issues such as permitting, project financing, commodity prices, etc.

The broader macroeconomic risk is associated with factors such as overall economic growth in the U.S. and its major trading partners, and the unemployment rate. For example, the domestic demand for sand and aggregates is closely tied to growth in the residential and non-residential construction industries. As the overall U.S. economic growth recovers, the construction industry is expected to follow suit, which will increase demand

While all of the shippers are exposed to both microeconomic and macroeconomic risks, sand and aggregate is primarily associated with macroeconomic risk and is estimated to have the lowest level of overall risk. The facilities are already constructed, there is a history of shipping this commodity through the Port, and there are no foreseeable regulatory or permitting challenges that would delay or prevent imports from moving through the Port. Alternatively, the greater risk to scrap metal is connected primarily to the overall health of Asian economies, China's being the most important.

At this time not enough information is known to be able to assign probabilities to any of the alternative scenarios. They are simply intended to provide information to help decision-makers understand the economic risk associated with the Tentatively Selected Plan. In all likelihood based upon the HarborSym model runs and the modest positive economic benefits reported above, without sustained growth in the tonnage of benefiting commodities moving through the channel, no deepening project is economically justified.

6.0 Multiport Analysis

This multiport analysis presents the results of a systematic assessment of potential effects the deepening of the Port of Redwood City could have on other ports. The analysis considers factors related to port competition such as proximity, hinterland overlap, commodity throughput and sea, port and land-based transportation options and costs. Since the purpose of a multiport analysis is to estimate potential changes in the with-project condition traffic forecasts, only the commodities affecting benefits and handled by alternative ports were analyzed.

The intent of the multi-port analysis introduced above is to understand the potential for regional shifts in commodity flows between the region's ports. An important component of this analysis is an estimate of the total delivered cost (also known as delivered price) of each of the relevant, overlapping commodities at each of the regional ports. The estimates were also developed by IHS Global Insight as part of the broader contract that included commodity forecasts. The total delivered cost is defined here as the cost per metric ton to deliver the commodity to the appropriate hinterland counties, and it is comprised of both landside and waterside costs – including port-specific charges such as dockage fees. This is an important component of the analysis because it provides an indication of the relative competitiveness of two or more ports that share a commodity (or have substituting products) and also

have some product market or hinterland overlap. Large differences between ports for a particular commodity could signal a future shift to the lower cost port. In general, the IHS Global Insight analysis finds that the consideration of the delivered cost of commodities that are shipped (or anticipated to ship) through both the Port of Redwood City and other regional ports—specifically West Sacramento and Stockton should not alter the commodity forecasts; either the cost differential is too small to make a material difference, or there are good reasons why regional competition is limited into the foreseeable future.

The Port of Redwood City deepening project alone will not cause traffic to be diverted from or to other ports. Other factors involved in port developments such as new facilities, location of distribution centers, and landside transportation improvements appear to have a greater influence on cargo diversions.

7.0 Regional Economic Development Analysis

The regional economic development (RED) account measures changes in the distribution of regional economic activity that would result from each alternative plan. Evaluations of regional effects are measured using nationally consistent projection of income, employment, output and population.

7.2 Regional Analysis

The USACE Online Regional Economic System (RECONS) is a system designed to provide estimates of regional, state, and national contributions of federal spending associated with Civil Works and American Recovery and Reinvestment Act (ARRA) Projects. It also provides a means for estimating the forward linked benefits (stemming from effects) associated with non-federal expenditures sustained, enabled, or generated by USACE Recreation, Navigation, and Formally Utilized Sites Remedial Action Program (FUSRAP). Contributions are measured in terms of economic output, jobs, earnings, and/or value added. The system was used to perform the regional analysis for the Port of Redwood City Channel Improvement Project.

This report provides estimates of the economic impacts of Civil Works Budget Analysis for New Analysis Project. The Corps' IWR, the Louis Berger Group, and Michigan State University developed RECONS to provide estimates of regional and national job creation, and retention and other economic measures such as income, value added, and sales. This modeling tool automates calculations and generates estimates of jobs and other economic measures, such as income and sales associated with USACE's ARRA spending, annual Civil Work program spending, and stem-from effects for Ports, Inland Water Way, FUSRAP, and Recreation. This is done by extracting multipliers and other economic measures from more than 1,500 regional economic models that were built specifically for USACE project locations. These multipliers were then imported to a database and the tool matches various spending profiles to the matching industry sectors by location to produce economic impact estimates.

Table 25 provides the project information while Table 26 provides the economic impact regions for the Port of Redwood City analysis.

Table 25. Project Information

Project Name:	Port of Redwood City
Project ID:	
Division:	SWD
District:	San Francisco District
Type of Analysis:	Civil Works Budget Analysis
Business Line:	Navigation
Work Activity:	CWB - Navigation Construction

Table 26. Economic Impact Regions

Regional Impact Area:	Metropolitan Area Generic Model
Regional Impact Area ID:	METRO
Counties included	
State Impact Area:	California

National Impact:	Yes

7.2 Results of the Economic Impact Analysis

The RED impact analysis was evaluated at three geographical levels: Local, State, and National. The Local analysis represents the Redwood City impact area which encompasses the area included in about a 50-mile radius around the project area. The State level analysis includes the State of California. The National level includes the 48 contiguous U.S.

Table 27 displays the overall spending profile that makes up the dispersion of the total project construction cost among the major industry sectors. The spending profile also identifies the geographical capture rate, also called Local Purchase Coefficient (LPC) in RECONS, of the cost components. The geographic capture rate is the portion of USACE spending on industries (sales) captured by industries located within the impact area. In many cases, IMPLAN's trade flows Regional Purchase Coefficients (RPCs) are utilized as a proxy to estimate where the money flows for each of the receiving industry sectors of the cost components within each of the impact areas.

Table 27. Input Assumptions (Spending and LPCs)

Category	Spending (%)	Spending Amount	Local LPC (%)	State LPC (%)	National LPC (%)
Dredging Fuel	6%	$4,401,150	52%	84%	90%
Metals and Steel Materials	4%	$3,102,450	29%	56%	90%
Textiles, Lubricants, and Metal Valves and Parts (Dredging)	2%	$1,515,150	17%	43%	65%
Pipeline Dredge Equipment and Repairs	5%	$3,751,800	32%	51%	100%
Aggregate Materials	3%	$2,092,350	75%	79%	97%
Switchgear and Switchboard Apparatus Equipment	0%	$216,450	25%	42%	80%
Hopper Equipment and Repairs	2%	$1,370,850	3%	10%	97%
Construction of Other New Nonresidential Structures	14%	$9,812,400	84%	100%	100%
Industrial and Machinery Equipment Rental and Leasing	7%	$5,266,950	71%	99%	100%
Planning, Environmental, Engineering and Design Studies and Services	5%	$3,318,900	60%	100%	100%
USACE Overhead	7%	$4,761,900	85%	85%	100%
Repair and Maintenance Construction Activities	4%	$2,958,150	85%	100%	100%
Industrial Machinery and Equipment Repair and Maintenance	11%	$7,575,750	89%	100%	100%
USACE Wages and Benefits	13%	$9,595,950	75%	100%	100%
Private Sector Labor or Staff Augmentation	15%	$11,038,950	100%	100%	100%
All Other Food Manufacturing	2%	$1,370,850	28%	75%	90%
Total	**100%**	**$72,150,000**	**-**	**-**	**-**

The USACE is planning on expending $72,150,000 on the project. Of this total project expenditure $52,150,000 will be captured within the regional impact area. The rest will be leaked out to the state or the nation. The expenditures made by the USACE for various services and products are expected to generate additional economic activity in that can be measured in jobs, income, sales and gross regional product as summarized in the following table and includes impacts to the region, the State impact area, and the Nation. Table 28 is the overall economic impacts for this analysis.

The labor income represents all forms of employment earnings. In IMPLAN's regional economic model, it is the sum of employee compensation and proprietor income. The Gross Regional Product (GRP) which is also known as value added, is equal to gross industry output (i.e., sales or gross revenues The GRP, which is also known as value added, is equal to gross industry output (i.e., sales or gross revenues) less its intermediate inputs (i.e., the consumption of goods and services purchased from other U.S. industries or imported). The number of jobs equates to the labor income. An interesting note is that in the local geography, one job averages an annual wage of $55,227, the State equivalent is $57,877 and the National equivalent is $58,044 (labor income/job). The total impact, direct and secondary, yields a local average wage of $51,975, State average wage of $56,710, and $56,081 average wage at the national level.

Table 28. Overall Summary of Economic Impacts

Impacts / Impact Areas		Regional	State	National
Total Spending		$72,150,000	$72,150,000	$72,150,000
Direct Impact				
	Output	$52,149,509	$64,456,952	$70,559,556
	Job	590.11	659.76	690.49
	Labor Income	$32,590,295	$38,185,201	$40,079,145
	GRP	$37,123,891	$44,267,690	$46,857,149
Total Impact				
	Output	$96,025,942	$133,853,729	$187,820,008
	Job	920.86	1,091.24	1,397.00
	Labor Income	$47,861,879	$61,884,605	$78,346,445
	GRP	$63,327,501	$85,616,390	$113,138,201

Tables 29, 30, and 31 present the economic impacts by industry sector both for each geographical region. Note that Labor -5001- is the largest impact area at the regional, state and national levels, implying that all the labor demand can be met at the regional level. Impacts at the National level show a tremendous expansion most certainly due to the many multiple turnover of money that ripples throughout the National economy.

Table 29. Economic Impact at Regional Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$1,745,533	0.21	$57,238	$268,199
171	Steel product manufacturing from purchased steel	$419,285	0.85	$71,481	$86,816
198	Valve and fittings other than plumbing manufacturing	$72,684	0.23	$17,472	$33,748
201	Fabricated pipe and pipe fitting manufacturing	$526,377	1.87	$123,909	$214,617
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$674,008	3.97	$314,232	$378,945
268	Switchgear and switchboard apparatus manufacturing	$22,442	0.06	$5,220	$10,807
290	Ship building and repairing	$29,832	0.12	$9,522	$11,497
319	Wholesale trade businesses	$1,395,556	7.93	$620,421	$1,090,026
322	Retail Stores - Electronics and appliances	$5,754	0.06	$2,505	$3,278
323	Retail Stores - Building material and garden supply	$377,621	4.54	$180,025	$258,992
324	Retail Stores - Food and beverage	$8,241	0.14	$4,242	$6,071
326	Retail Stores - Gasoline stations	$110,711	1.57	$45,591	$77,501
332	Transport by air	$1,969	0.01	$472	$860
333	Transport by rail	$63,724	0.18	$20,276	$34,322
334	Transport by water	$13,083	0.03	$2,775	$5,804
335	Transport by truck	$959,212	7.37	$433,975	$521,260
337	Transport by pipeline	$18,887	0.03	$6,293	$6,019
36	Construction of other new nonresidential structures	$8,194,773	57.29	$3,018,880	$3,606,379
365	Commercial and industrial machinery and equipment rental and leasing	$3,755,189	12.77	$987,620	$2,064,421
375	Environmental and other technical consulting services	$1,976,650	16.98	$1,377,438	$1,382,365
386	Business support services	$4,063,840	71.05	$2,510,454	$2,485,502
39	Maintenance and repair construction of nonresidential structures	$2,528,814	19.85	$1,053,417	$1,268,340
417	Commercial and industrial machinery and equipment repair and maintenance	$6,731,829	61.53	$4,118,800	$5,018,155
439	* Employment and payroll only (federal govt, non-military)	$7,196,963	61.07	$6,538,148	$7,196,962
5001	Labor	$11,038,950	259.81	$11,038,950	$11,038,950
69	All other food manufacturing	$217,581	0.60	$30,941	$54,053
	Total Direct Effects	$52,149,509	590.11	$32,590,295	$37,123,891
	Secondary Effects	$43,876,433	330.75	$15,271,585	$26,203,609
	Total Effects	**$96,025,942**	**920.86**	**$47,861,879**	**$63,327,501**

Table 30. Economic Impact at State Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$3,076,305	0.36	$102,770	$477,893
171	Steel product manufacturing from purchased steel	$1,216,324	2.47	$219,018	$266,531
198	Valve and fittings other than plumbing manufacturing	$447,520	1.45	$114,210	$221,517
201	Fabricated pipe and pipe fitting manufacturing	$1,145,657	4.11	$269,687	$467,114
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$714,759	4.23	$333,230	$401,856
268	Switchgear and switchboard apparatus manufacturing	$54,711	0.15	$12,726	$26,345
290	Ship building and repairing	$114,798	0.47	$38,949	$46,837
319	Wholesale trade businesses	$1,654,798	9.41	$735,672	$1,292,512
322	Retail Stores - Electronics and appliances	$6,909	0.07	$3,089	$4,043
323	Retail Stores - Building material and garden supply	$377,621	4.54	$180,025	$258,992
324	Retail Stores - Food and beverage	$9,571	0.17	$4,927	$7,051
326	Retail Stores - Gasoline stations	$118,176	1.67	$48,693	$82,726
332	Transport by air	$3,146	0.01	$804	$1,440
333	Transport by rail	$65,794	0.19	$20,935	$35,437
334	Transport by water	$16,636	0.03	$3,529	$7,380
335	Transport by truck	$1,019,310	7.84	$461,220	$554,022
337	Transport by pipeline	$22,887	0.04	$8,399	$8,046
36	Construction of other new nonresidential structures	$9,812,400	68.60	$3,680,438	$4,437,630
365	Commercial and industrial machinery and equipment rental and leasing	$5,209,759	17.71	$1,370,174	$2,872,987
375	Environmental and other technical consulting services	$3,317,155	29.29	$2,311,575	$2,319,843
386	Business support services	$4,063,840	71.05	$2,510,454	$2,485,502
39	Maintenance and repair construction of nonresidential structures	$2,953,806	23.18	$1,242,394	$1,507,749
417	Commercial and industrial machinery and equipment repair and maintenance	$7,575,750	69.24	$4,639,390	$5,647,245
439	* Employment and payroll only (federal govt, non-military)	$9,592,333	81.40	$8,716,196	$9,592,333
5001	Labor	$11,038,950	259.81	$11,038,950	$11,038,950
69	All other food manufacturing	$828,038	2.29	$117,750	$205,708
	Total Direct Effects	$64,456,952	659.76	$38,185,201	$44,267,690
	Secondary Effects	$69,396,777	431.47	$23,699,404	$41,348,700
	Total Effects	**$133,853,729**	**1,091.24**	**$61,884,605**	**$85,616,390**

Table 31. Economic Impact at National Level

IMPLAN No.	Industry Sector	Sales	Jobs	Labor Income	GRP
	Direct Effects				
115	Petroleum refineries	$3,295,347	0.39	$119,814	$551,902
171	Steel product manufacturing from purchased steel	$2,247,333	4.57	$409,863	$499,001
198	Valve and fittings other than plumbing manufacturing	$776,960	2.51	$199,232	$386,546
201	Fabricated pipe and pipe fitting manufacturing	$2,962,983	10.69	$711,768	$1,237,973
26	Mining and quarrying sand, gravel, clay, and ceramic and refractory minerals	$1,033,539	6.23	$481,850	$581,083
268	Switchgear and switchboard apparatus manufacturing	$135,333	0.38	$31,955	$65,936
290	Ship building and repairing	$1,311,444	5.37	$453,390	$544,549
319	Wholesale trade businesses	$1,677,235	9.53	$745,647	$1,310,037
322	Retail Stores - Electronics and appliances	$6,926	0.07	$3,098	$4,055
323	Retail Stores - Building material and garden supply	$387,360	4.65	$184,701	$265,753
324	Retail Stores - Food and beverage	$9,596	0.17	$4,939	$7,069
326	Retail Stores - Gasoline stations	$118,828	1.68	$48,964	$83,183
332	Transport by air	$4,194	0.02	$1,100	$1,959
333	Transport by rail	$85,578	0.24	$27,253	$46,129
334	Transport by water	$24,094	0.05	$5,110	$10,739
335	Transport by truck	$1,081,135	8.31	$489,248	$587,727
337	Transport by pipeline	$48,396	0.08	$21,831	$20,970
36	Construction of other new nonresidential structures	$9,812,400	68.60	$3,680,438	$4,437,630
365	Commercial and industrial machinery and equipment rental and leasing	$5,259,256	17.88	$1,383,191	$2,900,501
375	Environmental and other technical consulting services	$3,318,460	29.30	$2,312,484	$2,320,756
386	Business support services	$4,760,397	83.22	$2,974,050	$2,944,291
39	Maintenance and repair construction of nonresidential structures	$2,957,307	23.21	$1,243,951	$1,509,721
417	Commercial and industrial machinery and equipment repair and maintenance	$7,575,750	69.24	$4,639,390	$5,647,245
439	* Employment and payroll only (federal govt, non-military)	$9,595,949	81.43	$8,719,484	$9,595,949
5001	Labor	$11,038,950	259.81	$11,038,950	$11,038,950
69	All other food manufacturing	$1,034,807	2.86	$147,443	$257,497
	Total Direct Effects	$70,559,556	690.49	$40,079,145	$46,857,149
	Secondary Effects	$117,260,453	706.51	$38,267,300	$66,281,052
	Total Effects	**$187,820,008**	**1,397.00**	**$78,346,445**	**$113,138,201**

Table 32. Top Ten Industries Affected by Work Activity (2008)

Project:	New Analysis
Business Line:	Navigation
Work Acitiy:	CWB - Navigation

The following table shows the top ten industries that typically benefit from the types of expenditures made for this project by the USACE. This analysis was conducted at the national level and thus it cannot be guaranteed that these industries would be present in the regional impact area as analyzed.

Table 33. Top Ten Industries that Benefit from Project Expenditures

Rank	Industry (millions)	IMPLAN No.	% of Total Employment
1	* Employment and payroll only (federal govt, non-military)	439	8 %
2	Business support services	386	7 %
3	Construction of other new nonresidential structures	36	6 %
4	Food services and drinking places	413	5 %
5	Commercial and industrial machinery and equipment repair and maintenance	417	4 %
6	Real estate establishments	360	3 %
7	Wholesale trade businesses	319	3 %
8	Employment services	382	3 %
9	Maintenance and repair construction of nonresidential structures	39	3 %
10	Offices of physicians, dentists, and other health practitioners	394	2 %
			43 %

Redwood City Harbor Navigation Improvement Integrated Feasibility Study & EIS/EIR

Appendix K

National Environmental Policy Act/California Environmental Quality Act

Scoping Meeting Summary

December 2014

Contents

1 Purpose 2
2 Scoping Meeting Announcement 2
3 Scoping Meeting 2
3.1 Attendance 2
3.2 Meeting Presentations 3
3.2.1 Public Comment 6

Attachments

Attachment 1: Notice of Intent
Attachment 2: Notice of Preparation
Attachment 3: Scoping Meeting Announcement, Redwood City Tribune
Attachment 4: Scoping Meeting Read-Ahead
Attachment 5: Scoping Meeting Sign-in Sheet
Attachment 6: Scoping Meeting Transcript
Attachment 7: Scoping Meeting Presentation

1 Purpose

On 10 December 2014, the San Francisco District, U.S. Army Corps of Engineers (USACE) and the Port of Redwood City conducted a scoping meeting in compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The purpose of the scoping meeting was to obtain public and agency input on the issues that should be considered in decision making for the Redwood City Harbor Navigation Feasibility Study and Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) study process. This document provides a summary of the meeting and its results.

2 Scoping Meeting Announcement

The San Francisco District, USACE, is the lead agency for preparation of the EIS and the Port of Redwood City is the lead CEQA agency. A notice of intent to prepare an EIS (***Attachment 1***) was published in the Federal Register on 25 November 2014. A notice of preparation (***Attachment 2***) was submitted to the California State Clearinghouse on 24 November 2014 by the Port of Redwood City. Note that the form is titled Notice of Completion, but it is the same form used to announce the preparation of an EIR.

The meeting was announced in an ad published in the Redwood City Tribune on 24 November 2014 (***Attachment 3***). Additionally, a read-ahead with a summary of the study and a meeting announcement (***Attachment 4***) was mailed to potentially interested individuals, organizations, and agencies two weeks prior to the scoping meeting.

3 Scoping Meeting

The scoping meeting was held at 7 pm PST on 10 December 2014 at the Redwood City Hall.

3.1 Attendance

A sign-in sheet was provided at the meeting entrance so that meeting participants could provide contact information for subsequent distribution of study information. However, not all participants chose to sign in. The sign-in sheet is provided as ***Attachment 5***. Those meeting participants that signed in or announced their names during the meeting are listed below:

San Francisco District, USACE

Major Adam Czekanski, Deputy District Engineer

Katherine Reyes, Project Manager

Arden Sansom, Economist

Jaime O'Halloran, Planning Technical Lead

Frank Sun, Civil Design

Patrick Sing, Hydrologist

Port of Redwood City

Mike Giari, Executive Director

Chris Fajkos, Environmental Programs Manager

Rajesh Sewak, Finance and Administration Manager

Ralph Garcia, Redwood Harbor Commission Chairman

Lorianna Kastrop, Redwood Harbor Commissioner

Ellen Joslin Johnck, Consultant

HydroPlan Team

Lewis Hornung, Project Manager

Susa Gates, GAIA Consulting

Meeting Participants

Greg Greenway, Seaport Industries

Matt Leddy

Mark Kalnias

John Bourgeois, South Bay Salt Pond Restoration Project Manager

Clem Kloloay

3.2 Meeting Presentations

A transcript and the meeting presentation are provided as ***Attachments 6 and 7***, respectively.

Major Adam Czekanski facilitated the meeting. He started with opening comments describing the purpose of the meeting, outlining the meeting agenda, and introducing the study team. He stated that the purposes of the meeting were to: 1) solicit comments from the participants; 2) obtain stakeholder participation; and 3) answer questions.

Jaime O'Halloran then described the Corps' planning process and how the NEPA/CEQA processes are being integrated with the planning activities. She summarized the six step planning process and how it aligns with the NEPA/CEQA process. We are currently in the scoping phase of the study. It will be followed by alternative formulation and analysis. In that phase, alternatives will be evaluated and compared, and all potential impacts will be identified. If necessary, mitigation plans will be developed to offset any unavoidable adverse environmental impacts. In the next phase, the tentatively selected plan that best meets the study objectives will be identified. A more detailed analysis of this plan's impacts will be performed.

After identification of the tentatively selected plan, a draft integrated feasibility report and EIS/EIR will be released for a 45 day public review. Sometime during the review period in the summer of 2015, another public meeting will be conducted to obtain additional input. All comments received will be addressed in the final report which will be released for a final 30 day public review period. The process culminates with a report of the Chief of Engineers that is submitted to Congress for authorization.

Ms. O'Halloran pointed out that Congress must authorize the recommended plan and provide appropriations before any improvements can be made. The purpose of the NEPA/CEQA process is to insure that all environmental impacts are properly disclosed to the public.

Mike Giari provided a description of the Port of Redwood City and the project setting. The port is the only deep water port on the southwest side of San Francisco Bay. The study is evaluating improvements to the San Bruno Shoals Channel and the Redwood City Harbor Entrance Channel and Turning Basins. Commodities handled at the Port are exports of recycled metals and imports of dry bulk materials, the major import being construction related material such as sand, gravel aggregates, cement, gypsum, etc.

Mr. Giari indicated that the latest Port statistics show that in fiscal year 2014, the Port handled almost 1.8 million tons of commodities. Over the last 15 years, the Port's tonnage has increased at an average annual rate of 4.1 percent. It is projected that in the next 10 years, the Port's tonnage will increase to 2.1 million tons. He emphasized the Port's commitment to the project.

Lewis Hornung provided additional descriptions of the project setting, described the study objectives, identified the alternative plans being considered, and provided evaluation criteria that will be applied. The study area will include all areas that will be directly or indirectly impacted by the project – including the routes and methods for placement of dredged material.

The primary project objective is to provide for more efficient navigation to the Port of Redwood City. A deeper channel will allow shippers to increase their loads each trip thereby reducing transportation costs. This would be a national economic development benefit that could potentially be great enough to justify the cost of channel improvements. Other objectives include reducing the impacts of shoaling in the Redwood City Harbor Channel, support environmental enhancement through the beneficial reuse of dredged material, and to place dredged material in a safe and economically feasible location.

In addition to the No Action alternative, Mr. Hornung described 3 action alternatives; deepening the San Bruno Shoals and Redwood City Channels, addressing shoaling in the Redwood City Channel, and a combination plan. All three action alternatives will require placement of dredged material. The options for managing this material are beneficial reuse to restore wetlands in South San Francisco Bay; passive sediment transport; disposal at a designated disposal site; or a combination of these options.

A range of channel depths will be evaluated to identify the depth that provides the greatest net economic benefits. The project team currently estimates that that depth will be between 32 and 37 feet. Two pipelines that cross the San Bruno Shoals Channel have been identified and are being evaluated. If it is determined that relocation of the pipelines could not be safely accomplished or that it would be prohibitively expensive, then the team will consider a plan that does not involve deepening the San Bruno Shoals Channel. Ships would use high tide to cross the shoals and would still have deep enough water to enter the Redwood City Channel.

Currently, excessive shoaling in the Redwood City Channel requires frequent maintenance dredging. A plan to address such shoaling would improve navigation efficiency even with the existing 30 foot authorized depth. Options to be considered are realigning the channel, modifying the cross section, and providing advance maintenance. The team will also consider a combination of channel deepening and addressing shoaling.

Mr. Hornung stated that, during the planning process, the team will avoid adverse environmental impacts; unsafe ship operating conditions, impacts to Bair Island and San Mateo Bridge, and impacts to existing Port infrastructure.

Originally, nine potential dredged material placement sites were identified that were then screened to six. Three of the potential placement sites involve placement of dredged material to raise subsided wetlands as part of the South Bay Salt Pond Restoration Project. The first and most proximal site is Ravenswood Pond Complex. This site has limited capacity (less than 1 million cubic yards) and will probably not be ready until 2023. The second restoration site is Edens Landing. It has about 3 million cubic yard capacity and should be available in time for the projected 2017 dredging of Redwood City Channel. The third restoration site is the Alviso Pond Complex. It has the largest capacity and could be available by 2018.

The Dumbarton Bridge Passive Sediment Transport option is a new concept that would involve in-bay placement of dredged material at a location south of Dumbarton Bridge. Then, natural processes (tides and currents) would move the material to help restore subsided wetlands and salt ponds. Analysis of this option is underway.

The SF-11 Alcatraz potential placement site is currently used for maintenance dredging. It has limited capacity and its use would require the approval of regulatory agencies.

The deep ocean disposal site (SF-DODS) is available, permitted, and has adequate capacity. However, due to its distance from the proposed dredging, it would be the most expensive.

The evaluation of alternatives will be comprehensive. It will involve assessing national economic development benefits (through benefit to cost ratio and the net economic benefits), regional economic impacts, other social effects, and insuring compliance with applicable regulatory requirements.

3.2.1 Public Comment

Major Czekanski opened the meeting for public comments. He said that the comment period would remain open for two weeks. Comments can be provided at the meeting (the court reporter will record all comments), comments can be mailed to the addresses provided on the handouts, or comments can be emailed to USACE or the Port. The feedback received will be used to prepare the integrated report and EIS/EIR. Another opportunity for public input will be provided when the draft report is released this summer.

Matt Leddy asked whether a cost analysis would be performed for all the different disposal options to determine if they are feasible. Mr. Hornung responded that cost estimates will be developed for the final screened disposal options.

John Bourgeois, Executive Project Manager for the South Bay Salt Pond Restoration Project, indicated that he has been following this project and is encouraged that the Dumbarton Bridge Passive Sediment Transport option is being considered. He said that he believes the restoration community has a lot of interest in this concept. He asked whether it would be possible to perform a small pilot project as part of this study. It might go a long way to identifying a realistic option for future dredging. There would be a lot of support for this kind of assessment.

Ms. O'Halloran responded that it's something that can be considered. Other opportunities for a pilot project would be through the Operations and Maintenance Program. We'll note the comment and discuss it at our next meeting.

Ellen Johnck, Consultant to the Port of Redwood City, stated that USACE contracted with Delta Modeling Associates to perform numerical modeling of how effective the Dumbarton Bridge Passive Transport would be. She is supportive of a pilot project. She's talked to the Colonel about presenting the modeling results to the Long Term Management Strategy Agencies at one of their quarterly meetings. Mr. Giari indicated that the Port would support the idea of a pilot project.

Greg Greenway is Executive Director of the Seaport Industrial Association, which is a business group that includes most of the tenants of the Port and all the users of the channel. His organization is interested in this project and excited that the project is moving forward. The wo biggest comments his organization has are: 1) there's a tremendous need for this project from the view of the channel users; and 2) there's a tremendous demand for the bulk products that come out of the property. The Port serves Silicon Valley and the Peninsula which will grow in the future. The lack of channel depth compared to the potential draft of ships is a huge economic cost for shippers. Mr. Greenway offered assistance with providing data or stories about the particular impacts on business and light-loading, or the impacts of the no action alternative. What are the air emissions and greenhouse gas impacts of not having a deeper channel?

The meeting adjourned at 7:40 pm PST.

3.3 Correspondence

- Scott Morgan, Director of the California State Clearinghouse distributed the NOP to selected state agencies by letter dated 25 November 2014 (***Attachment 8***).
- Diana Hearnley, Secretary of the California State Lands Commission provided a staff comment letter on 22 December 2014 (***Attachment 9***).

70168 **Federal Register** / Vol. 79, No. 227 / Tuesday, November 25, 2014 / Notices

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Notice of Intent To Prepare an Environmental Impact Statement and Conduct Scoping Meeting for the Redwood City Harbor Navigation Improvement Feasibility Study and Integrated EIS/EIR Redwood City and County of San Mateo, CA (SPN–2014–125242)

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The purpose of this notice is to initiate the scoping process for the preparation of an integrated Feasibility Report and Environmental Impact Statement/Environmental Impact Report for proposed improvements to the existing navigation project at Redwood City Harbor and San Bruno Shoal.

DATES: A public scoping meeting will be held on December 10, 2014 at 7:00 p.m. (PST). Submit comments concerning this notice on or before December 15, 2014.

ADDRESSES: The scoping meeting location is: the Redwood City Hall, 1017 Middlefield Road, Redwood City, CA 94063. Meeting will be held at the City Council Chamber Meeting Room. Mail written comments concerning this notice to: U.S. Army Corps of Engineers, San Francisco District, Project Management Division, ATTN: SPN–2014–125242, 1455 Market Street, San Francisco, CA 94103–1398. Comment letters should include the commenter's physical mailing address, the project title and the Corps file number in the subject line.

FOR FURTHER INFORMATION CONTACT: Katherine Reyes, U.S. Army Corps of Engineers, San Francisco District, Project Management Division, ATTN: CESPN–PM–B, 1455 Market Street, San Francisco CA 94103–1398, (415) 503–6847, *katherine.m.reyes@usace.army.mil.*

SUPPLEMENTARY INFORMATION: In accordance with the National Environmental Policy Act (NEPA), the U.S. Army Corps of Engineers intends to prepare an Environmental Impact Statement (EIS). The primary Federal actions under consideration are dredging, channel realignment, dredged material placement, and transport of dredged material for the purpose of ocean placement.

Pursuant to the California Environmental Quality Act (CEQA) the Port of Redwood City will serve as Lead Agency in preparing an Environmental Impact Report (EIR). The Corps and the Port of Redwood City have agreed to jointly prepare a Draft EIS/EIR to optimize efficiency and avoid duplication. The Draft EIS/EIR is intended to be sufficient in scope to address the Federal, state and local requirements and environmental issues concerning the proposed activities and permit approvals.

Project Site and Background Information: The project site is located at Redwood City Harbor (RWC), and San Francisco Bay, CA. The harbor is located in San Mateo County, on the southwest side of San Francisco Bay, approximately 18 miles south of San Francisco. The project site includes the existing Federal navigation channel and turning basins at RWC, extending from the mouth of Redwood Creek to deep water in the San Francisco Bay, as well as the channel at San Bruno Shoal in San Francisco Bay. Both channels are authorized to a depth of 30 feet Mean Lower Low Water (MLLW). It is the only deep-water port in South San Francisco Bay and was completed to its present-day authorized depth in 1965. The Port of Redwood City is the local sponsor and the U.S. Army Corps of Engineers is the Federal partner. The port maintains three berth facilities at a depth of 34 feet MLLW and a small facility to unload cement and aggregates via barge. Maritime activities include the export of recycled metal and the import of dry bulk building materials such as cement, bauxite, gypsum and aggregates.

Proposed Action(s): The proposed action is to evaluate alternatives to improve the existing navigation project at RWC and San Bruno Shoal. The study is authorized by House Resolution 2511, adopted May 7, 1997 *". . . in the interest of navigation improvements and related purposes at Redwood City Harbor, California, with particular reference to providing increased depths to accommodate new, larger vessels that now call on the port."*

Issues: Potentially significant issues associated with the project may include: aesthetics/visual impacts, air quality emissions, biological resource impacts, environmental justice, geologic impacts related to seismicity, hazards and hazardous materials, hydrology and water quality, noise, traffic and transportation, and cumulative impacts from past, present and reasonably foreseeable future projects. Bair Island and Greco Island are adjacent to RWC and are within the NEPA scope of analysis due to potential project impacts. Bair Island is operated by the USFWS and is the site of an ongoing wetland restoration effort. The bay water around Bair Island and RWC is within the Don Edwards Marine Protected Area.

Alternatives: Four alternative plans will be evaluated. Alternative 1 would deepen the RWC and the San Bruno Shoal Channels. Alternative 2 would deepen the RWC and San Bruno Shoal channels and implement measures to address shoaling including, realigning the turn into RWC channel, modifying the cross section of the RWC channel entrance and/or conducting advance maintenance. Alternative 3 would address shoaling by realigning the turn into RWC channel, modifying the cross section to the RWC channel entrance and/or conducting advance maintenance. Alternative 4 would be the no-action alternative, which would include continued maintenance of the authorized Federal channels to a depth of 30 feet MLLW at RWC and San Bruno Shoal.

Six dredge material placement sites are being evaluated. Multiple sites may be used depending on the quantity of material dredged from the channels and the capacity of the placement sites. The potential dredge material placement sites include:

1. Ravenswood Pond Complex (Upland Beneficial Reuse Site).
2. Eden Landing Pond Complex (Upland Beneficial Reuse Site).
3. Alviso Pond Complex (Upland Beneficial Reuse Site).
4. SF–11 Alcatraz (In-Bay Aquatic).
5. Dumbarton Bridge—Passive Sediment Transport (In-Bay Aquatic).
6. San Francisco Deep Ocean Disposal Site (SFDODS) (Ocean Aquatic).

Scoping Process: The Corps is seeking participation and input of all interested federal, state, and local agencies, Native American groups, and other concerned private organizations or individuals on the scope of the draft EIS/EIR through this public notice. The purpose of the public scoping meeting is to solicit comments regarding the potential impacts, environmental issues, and alternatives associated with the proposed action to be considered in the draft EIS/EIR. The meeting place, date and time will be advertised in advance in local newspapers, and meeting announcement letters will be sent to interested parties. The final draft Integrated Feasibility Report and EIS/EIR is expected to be available for public review and comment in the

summer of 2015 and a public meeting will be held after its publication.

Brenda S. Bowen,

Army Federal Register Liaison Officer.

[FR Doc. 2014–27787 Filed 11–24–14; 8:45 am]

BILLING CODE 3720–58–P

DELAWARE RIVER BASIN COMMISSION

Notice of Public Hearing and Business Meeting; December 9–10, 2014

Notice is hereby given that the Delaware River Basin Commission will hold a public hearing on Tuesday, December 9, 2014. A business meeting will be held the following day on Wednesday, December 10, 2014. The hearing and business meeting are open to the public and will be held at the Washington Crossing Historic Park Visitor Center, 1112 River Road, Washington Crossing, Pennsylvania.

Public Hearing. The public hearing on December 9, 2014 will begin at 1:30 p.m. Hearing items will include draft dockets for withdrawals, discharges and other water-related projects subject to the Commission's review, and a resolution adopting the Commission's Water Resources Program FY 2015–17. The list of projects scheduled for hearing, including project descriptions, will be posted on the Commission's Web site, *www.drbc.net,* in a long form of this notice at least ten days before the hearing date. Written comments on draft dockets and resolutions scheduled for hearing on December 9 will be accepted through the close of the hearing that day. After the hearing on all scheduled matters has been completed, there will be an opportunity for public dialogue.

The public is advised to check the Commission's Web site periodically prior to the hearing date, as items scheduled for hearing may be postponed if additional time is deemed necessary to complete the Commission's review, and items may be added up to ten days prior to the hearing date. In reviewing docket descriptions, the public is also asked to be aware that project details commonly change in the course of the Commission's review, which is ongoing.

Public Meeting. The public business meeting on December 10, 2014 will begin at 1:00 p.m. and will include: Adoption of the Minutes of the Commission's September 10, 2014 business meeting, announcements of upcoming meetings and events, a report on hydrologic conditions, reports by the Executive Director and the Commission's General Counsel, and consideration of any items for which a hearing has been completed or is not required. The meeting will include a resolution honoring Robert F. Molzahn, President of the Water Resources Association of the Delaware River Basin, on his retirement.

There will be no opportunity for additional public comment at the December 10 business meeting on hearing items for which the hearing was completed on December 9 or a previous date. Commission consideration on December 10 of items for which the public hearing is closed may result in either approval of the item (docket or resolution) as proposed, approval with changes, denial, or deferral. When the Commissioners defer an action, they may announce an additional period for written comment on the item, with or without an additional hearing date, or they may take additional time to consider the input they have already received without requesting further public input. Any deferred items will be considered for action at a public meeting of the Commission on a future date.

Advance Sign-Up for Oral Comment. Individuals who wish to comment for the record at the public hearing on December 9 or to address the Commissioners informally during the public dialogue portion of the hearing on December 9 are asked to sign up in advance by contacting Ms. Paula Schmitt of the Commission staff, at *paula.schmitt@drbc.state.nj.us* or by phoning Ms. Schmitt at 609–883–9500 ext. 224.

Addresses for Written Comment. Written comment on items scheduled for hearing may be delivered by hand at the public hearing or in advance of the hearing, either: by hand, U.S. Mail or private carrier to: Commission Secretary, P.O. Box 7360, 25 State Police Drive, West Trenton, NJ 08628; by fax to Commission Secretary, DRBC at 609–883–9522; or by email to *paula.schmitt@drbc.state.nj.us.* If submitted by email in advance of the hearing date, written comments on a docket should also be sent to Mr. William Muszynski, Manager, Water Resources Management at *william.muszynski@drbc.state.nj.us.*

Accommodations for Special Needs. Individuals in need of an accommodation as provided for in the Americans with Disabilities Act who wish to attend the informational meeting, conference session or hearings should contact the Commission Secretary directly at 609–883–9500 ext. 203 or through the Telecommunications Relay Services (TRS) at 711, to discuss how we can accommodate your needs.

Updates. Items scheduled for hearing are occasionally postponed to allow more time for the Commission to consider them. Other meeting items also are subject to change. Please check the Commission's Web site, *www.drbc.net,* closer to the meeting date for changes that may be made after the deadline for filing this notice.

Additional Information, Contacts. The list of projects scheduled for hearing, with descriptions, will be posted on the Commission's Web site, *www.drbc.net,* in a long form of this notice at least ten days before the hearing date. Draft dockets and resolutions for hearing items will be available as hyperlinks from the posted notice. Additional public records relating to hearing items may be examined at the Commission's offices by appointment by contacting Carol Adamovic, 609–883–9500, ext. 249. For other questions concerning hearing items, please contact Project Review Section assistant Victoria Lawson at 609–883–9500, ext. 216.

Dated: November 19, 2014.

Pamela M. Bush,

Commission Secretary and Assistant General Counsel.

[FR Doc. 2014–27880 Filed 11–24–14; 8:45 am]

BILLING CODE 6360–01–P

DEPARTMENT OF ENERGY

[Certification Notice—230]

Notice of Filing of Self-Certification of Coal Capability Under the Powerplant and Industrial Fuel Use Act

AGENCY: Office of Electricity Delivery and Energy Reliability, DOE.

ACTION: Notice of filing.

SUMMARY: On October 21, 2014, Footprint Power Salem Harbor Development LP, as owner and operator of a new base load electric powerplant, submitted a coal capability self-certification to the Department of Energy (DOE) pursuant to 201(d) of the Powerplant and Industrial Fuel Use Act of 1978 (FUA), as amended, and DOE regulations in 10 CFR 501.60, 61. FUA and regulations thereunder require DOE to publish a notice of filing of self-certification in the **Federal Register**. 42 U.S.C. 8311(d) and 10 CFR 501.61(c).

ADDRESSES: Copies of coal capability self-certification filings are available for public inspection, upon request, in the Office of Electricity Delivery and Energy Reliability, Mail Code OE–20, Room 8G–024, Forrestal Building, 1000 Independence Avenue SW., Washington, DC 20585.

COPY

Print Form

Appendix C

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH #

Project Title: Redwood City Navigation Improvement Study

Lead Agency: Port of Redwood City — Contact Person: Michael Giari
Mailing Address: 675 Seaport Blvd. — Phone: 650-306-4150
City: Redwood City — Zip: 94063 — County: San Mateo

Project Location: County: San Mateo — City/Nearest Community: Redwood City
Cross Streets: Seaport Blvd. and Herkner Road — Zip Code: 94063
Longitude/Latitude (degrees, minutes and seconds): ____° ____ ′ ____ ″ N / ____° ____ ′ ____ ″ W Total Acres: ____
Assessor's Parcel No.: ____ Section: ____ Twp.: ____ Range: ____ Base: ____
Within 2 Miles: State Hwy #: 92 — Waterways: San Francisco Bay and Redwood Creek
Airports: ____ — Railways: Union Pacific — Schools: ____

Document Type:

CEQA: ☒ NOP ☐ Draft EIR — NEPA: ☐ NOI — Other: ☐ Joint Document
☐ Early Cons ☐ Supplement/Subsequent EIR ☐ EA ☐ Final Document
☐ Neg Dec (Prior SCH No.) ____ ☐ Draft EIS ☐ Other: ____
☐ Mit Neg Dec Other: ____ ☐ FONSI

Local Action Type:

☐ General Plan Update ☐ Specific Plan ☐ Rezone ☐ Annexation
☐ General Plan Amendment ☐ Master Plan ☐ Prezone ☐ Redevelopment
☐ General Plan Element ☐ Planned Unit Development ☐ Use Permit ☐ Coastal Permit
☐ Community Plan ☐ Site Plan ☐ Land Division (Subdivision, etc.) ☒ Other: Joint EIR/EIS

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____ ☒ Transportation: Type Navigation Channel
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____ ☐ Mining: Mineral ____
☐ Industrial: Sq.ft. ____ Acres ____ Employees ____ ☐ Power: Type ____ MW ____
☐ Educational: ____ ☐ Waste Treatment: Type ____ MGD ____
☐ Recreational: ____ ☐ Hazardous Waste: Type ____
☐ Water Facilities: Type ____ MGD ____ ☐ Other: ____

Project Issues Discussed in Document:

☒ Aesthetic/Visual ☐ Fiscal ☐ Recreation/Parks ☐ Vegetation
☐ Agricultural Land ☐ Flood Plain/Flooding ☐ Schools/Universities ☒ Water Quality
☒ Air Quality ☐ Forest Land/Fire Hazard ☐ Septic Systems ☐ Water Supply/Groundwater
☐ Archeological/Historical ☒ Geologic/Seismic ☐ Sewer Capacity ☒ Wetland/Riparian
☒ Biological Resources ☐ Minerals ☐ Soil Erosion/Compaction/Grading ☐ Growth Inducement
☐ Coastal Zone ☒ Noise ☐ Solid Waste ☐ Land Use
☐ Drainage/Absorption ☐ Population/Housing Balance ☐ Toxic/Hazardous ☒ Cumulative Effects
☒ Economic/Jobs ☐ Public Services/Facilities ☒ Traffic/Circulation ☐ Other: ____

Present Land Use/Zoning/General Plan Designation:

Navigation Channel for Industrial Seaport

Project Description: *(please use a separate page if necessary)*

See Attached Sheet

Scanned

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Revised 2010

COPY

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

x	Air Resources Board		Office of Historic Preservation
x	Boating & Waterways, Department of		Office of Public School Construction
	California Emergency Management Agency		Parks & Recreation, Department of
	California Highway Patrol		Pesticide Regulation, Department of
x	Caltrans District #4		Public Utilities Commission
	Caltrans Division of Aeronautics	x	Regional WQCB #2
	Caltrans Planning	x	Resources Agency
	Central Valley Flood Protection Board		Resources Recycling and Recovery, Department of
	Coachella Valley Mtns. Conservancy	x	S.F. Bay Conservation & Development Comm.
	Coastal Commission		San Gabriel & Lower L.A. Rivers & Mtns. Conservancy
	Colorado River Board		San Joaquin River Conservancy
	Conservation, Department of		Santa Monica Mtns. Conservancy
	Corrections, Department of	x	State Lands Commission
	Delta Protection Commission		SWRCB: Clean Water Grants
	Education, Department of	x	SWRCB: Water Quality
	Energy Commission		SWRCB: Water Rights
x	Fish & Game Region #10		Tahoe Regional Planning Agency
	Food & Agriculture, Department of		Toxic Substances Control, Department of
	Forestry and Fire Protection, Department of		Water Resources, Department of
	General Services, Department of		
	Health Services, Department of		Other:
	Housing & Community Development		Other:
	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date November 24, 2014 Ending Date December 24, 2014

Lead Agency (Complete if applicable):

Consulting Firm: _____
Address: _____
City/State/Zip: _____
Contact: _____
Phone: _____

Applicant: _____
Address: _____
City/State/Zip: _____
Phone: _____

Signature of Lead Agency Representative: _____ **Date:** 11-24-14

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

Port of Redwood City

PORT OF REDWOOD CITY
Serving Silicon Valley

Notice of Preparation
Notice of Scoping Session
Redwood City Harbor Navigation Improvement Feasibility Study

Date: November 24, 2014

To: Public Agencies and Interested Parties

From: Michael J. Giari, Executive Director, Port of Redwood City

Subject: Notice of Preparation of a Draft Environmental Impact Report and Conduct Scoping Meeting for the Redwood City Harbor Navigation Improvement Feasibility Study and Integrated EIR/EIS

SUMMARY

The purpose of this notice is to initiate the scoping process for the preparation of an integrated Feasibility Report and Environmental Impact Statement/Environmental Impact Report for proposed improvements to the existing navigation project at Redwood City Harbor and San Bruno Shoal.

Pursuant to the California Environmental Quality Act (CEQA) the Port of Redwood City will serve as Lead Agency in preparing an Environmental Impact Report (EIR) for its consideration of development approvals within its jurisdiction. The U.S. Army Corps of Engineers (USACE) and the Port of Redwood City have agreed to jointly prepare a Draft EIS/EIR to optimize efficiency and avoid duplication. The primary actions under consideration are dredging, channel realignment, transport and placement of dredged material to sites for beneficial reuse, and/or which may include in San Francisco Bay at SF11 Alcatraz and/or ocean placement at the San Francisco Ocean Disposal Site (SFDODS). The Draft EIS/EIR is intended to be sufficient in scope to address the Federal, state and local requirements and environmental issues concerning the proposed activities and permit approvals.

The project description, location, and potential environmental effects of the proposed project are described in the attached materials. The Port of Redwood City is soliciting comments regarding the scope and content of the environmental information, which are germane to your agency's statutory responsibilities in connection with the proposed project. Your agency may need to use the EIR when considering permitting or other approvals. Because of time limits mandated by State law, your response must be sent at the earliest possible date but not later than 30 days after receipt of this notice. The 30 day Comment Period for this NOP is November 24, 2014 to December 24, 2014.

Please provide your written response to the address shown below no later than December 24, 2014. Please provide a contact person in your agency.

Port of Redwood City
675 Seaport Boulevard
Redwood City, CA 94063
Attn: Michael Giari
Phone: (650) 306-4150
Fax: (650) 369-7636
Info@redwoodcityport.com

PORT OF REDWOOD CITY
Serving Silicon Valley

PROJECT LOCATION AND DESCRIPTION

The project site is located at Redwood City Harbor (RCH), and San Francisco Bay, California. See Figure 1. The harbor is located in San Mateo County, on the southwest side of San Francisco Bay, approximately 18 miles south of San Francisco. The project site includes the existing Federal navigation channel and turning basins at RCH, extending from the mouth of Redwood Creek to deep water in the San Francisco Bay, as well as the channel at San Bruno Shoal in San Francisco Bay. Both channels are authorized to a depth of -30 feet Mean Lower Low Water (MLLW). It is the only deep-water port in South San Francisco Bay and was completed to its present-day authorized depth in 1965. The Port of Redwood City is the local sponsor for the navigation channel and shares the cost of the feasibility study on a 50/50 basis with the US Army Corps of Engineers (USACE). The port maintains three ship berth facilities at a depth of -34 feet MLLW and a small facility to unload cement and aggregates via barge. Maritime activities include the export of recycled metal and the import of dry bulk building materials such as cement, bauxite, gypsum and construction aggregates.

POTENTIAL ENVIRONMENTAL EFFECTS

Potentially significant issues associated with the project may include: aesthetics/visual impacts, air quality emissions, biological resource impacts, environmental justice, geologic impacts related to seismicity, hazards and hazardous materials, hydrology and water quality, noise, traffic and transportation, and cumulative impacts from past, present and reasonably foreseeable future projects. Bair Island and Greco Island are adjacent to RCH and are considered to be in the project area due to potential project impacts. Bair Island is the site of an ongoing marsh restoration effort by U.S. Fish & Wildlife. Bair Island and Greco Island are within the Don Edwards San Francisco Bay National Wildlife Refuge.

ALTERNATIVES

Four alternative plans will be evaluated:

Alternative 1 would deepen the RCH and the San Bruno Shoal Channels.

Alternative 2 would deepen the RCH and San Bruno Shoal channels and implement measures to address shoaling including, realigning the turn into Redwood City Harbor channel, modifying the cross section of the RWC channel entrance and/or conducting advance maintenance.

Alternative 3 would address shoaling by realigning the turn into Redwood City Harbor channel, modifying the cross section to the RCH channel entrance and/or conducting advance maintenance.

Alternative 4 would be the no-action alternative, which would include continued maintenance of the authorized Federal channels to a depth of -30 feet MLLW at RCH and San Bruno Shoal.

Six dredge material placement sites are being evaluated. Multiple sites may be used depending on the quantity of material dredged from the channels and the capacity of the placement sites. The potential dredge material placement sites include:

1. Ravenswood Pond Complex (Upland Beneficial Reuse Site)
2. Eden Landing Pond Complex (Upland Beneficial Reuse Site)
3. Alviso Pond Complex (Upland Beneficial Reuse Site)
4. SF-11 Alcatraz
5. Dumbarton Bridge - Passive Sediment Transport
6. San Francisco Deep Ocean Disposal Site (SFDODS)

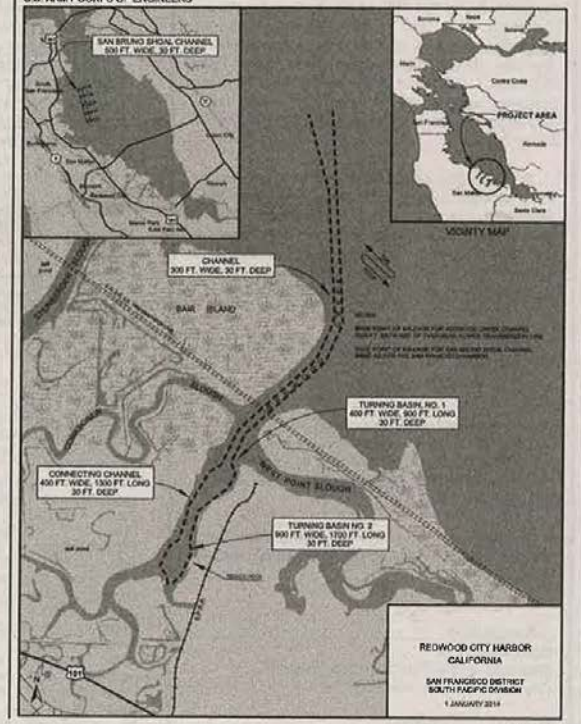
PORT OF REDWOOD CITY
Serving Silicon Valley

SCOPING PROCESS

The Port is soliciting participation and input of all interested federal, state, and local agencies and other interested parties or individuals on the scope and content of the draft EIS/EIR through this public notice. The meeting place, date and time for the Scoping Session is:

December 10, 2014, at 7:00PM.
Redwood City – City Hall
City Council Chambers
1017 Middlefield Road
Redwood City, CA 94063

U.S. ARMY CORPS OF ENGINEERS



CNS#2691290

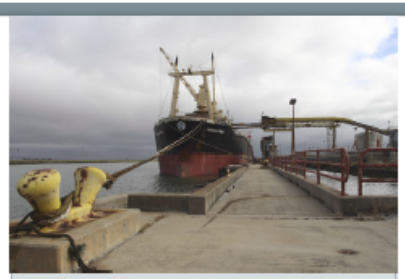
MEETING PURPOSE

- Solicit comments on proposed alternatives and potential impacts
- Obtain participation and input from interested agencies, tribes, private organizations, and individuals
- Answer questions

ENGAGEMENT PROCESS

Issues or concerns identified during this process will be addressed in the final draft report and/or a response will be provided. The draft Integrated Feasibility Report and Environmental Impact Statement/Report is expected to be available for public review and comment in the summer of 2015. A public meeting will be held after its release and prior to the final recommendation of the study.





HOW TO SUBMIT COMMENTS

Oral and written comments will be collected at the scoping meeting. Written comments can be emailed to Katherine.M.Reyes@usace.army.mil or mailed to:

U.S. Army Corps of Engineers
San Francisco District
Project Management Division
ATTN: Katherine Reyes
1455 Market Street
San Francisco, CA 94103-1398

Comment letters should include the commenter's physical mailing address and the project title in the subject line.

CONTACT US

U.S. Army Corps of Engineers
Katherine Reyes, Project Manager
Phone: (415) 503-6847
Katherine.M.Reyes@usace.army.mil

Port of Redwood City
Michael Giari, Executive Director
Phone: (650) 306-4150
Mgiari@redwoodcityport.com

Redwood City Harbor

Navigation Improvement Feasibility Study

PUBLIC MEETING



December 10, 2014
7:00 p.m.

Redwood City Hall
1017 Middlefield Road
Redwood City, CA 94063
City Council
Chamber Meeting Room

Port of Redwood City — Serving Silicon Valley

US Army Corps of Engineers
San Francisco District

Study Purpose & Overview



The Port of Redwood City is located approximately 25 miles southeast of San Francisco and is the only deepwater port in South San Francisco Bay. The port is strategically located between San Francisco and the rapidly growing Silicon Valley/San Jose region. It provides excellent inland transportation access via U.S. Highway 101 and Union Pacific Railroad. The location allows tenants to save both time and shipping costs. Each year roughly two million tons of commercial goods move through the port, including recycled metal exports and dry bulk building materials imports such as cement, bauxite, gypsum, and aggregates.

The Redwood City channel and channel at the San Bruno Shoal is a federal navigation project maintained at 30 feet mean lower low water (MLLW). This study evaluates options to improve navigation efficiency and accommodate the new larger vessels, which currently call on the port and require more than the current authorized depth. These vessels are currently forced to light load and top off at other ports, significantly adding to the cost of transporting commodities.

To address this problem, four alternatives and six potential dredged material placement sites have been identified for evaluation.

Proposed Alternatives

Detailed descriptions of the alternatives and potential placement sites will be provided at the Scoping Meeting. The alternatives combine various measures to deepen, realign or modify the channel, reduce impacts from shoaling, and perform advanced maintenance in order to meet project objectives.

Potential Placement Sites

1. Ravenswood Pond Complex (Upland Beneficial Reuse Site)
2. Eden Landing Pond Complex (Upland Beneficial Reuse Site)
3. Alviso Pond Complex (Upland Beneficial Reuse Site)
4. SF-11 Alcatraz.
5. Dumbarton Bridge - Passive Sediment Transport
6. San Francisco Deep Ocean Disposal Site (SFDODS)

Redwood City Navigation Improvement Integrated Feasibility Study and EIS/EIR

National Environmental Policy Act and California Environmental Quality Act

Scoping Meeting

If you would like to be added to our mailing list for notification of future meetings and release of documents for review, please provide your contact information below.

Name and Organization (if applicable): Ellen Johnck
Mailing Address: 101 Lombard St. #217E
Email: ellen@ellenjohnckconsulting.com

Name and Organization (if applicable): Mark Kalnins
Mailing Address: 2169-G E. Francisco Blvd. San Rafael 94903
Email: kalninsm@mra-ca.com

Name and Organization (if applicable): Charlotte Roche Court Reporter
Mailing Address: 22320 Foothill
Email: Hayward dagos@bayareacourtreporters.com

Name and Organization (if applicable):
Mailing Address:
Email:

US Army Corps of Engineers
San Francisco District

Port of Redwood City

Redwood City Navigation Improvement Integrated Feasibility Study and EIS/EIR

National Environmental Policy Act and California Environmental Quality Act

Scoping Meeting

If you would like to be added to our mailing list for notification of future meetings and release of documents for review, please provide your contact information below.

Name and Organization (if applicable): Matt Leddy
Mailing Address: 275 D street Redwood City CA 94063
Email: mtleddy@sbcglobal.net

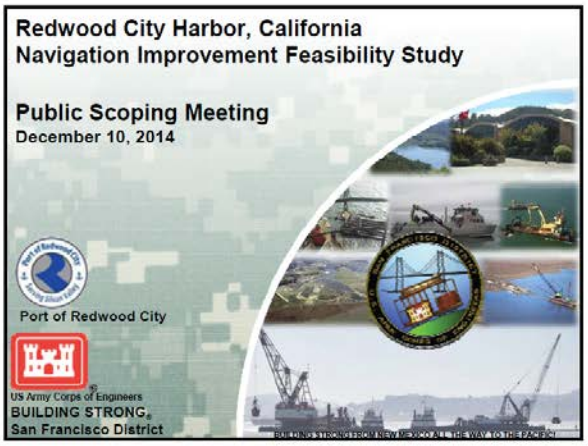
Name and Organization (if applicable): John Bourgeois, SCC
Mailing Address: 1330 Broadway, 13th floor, Oakland
Email: John.Bourgeois@scc.ca.gov

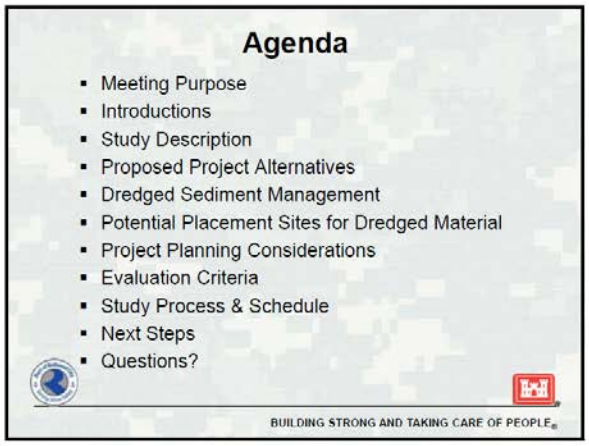
Name and Organization (if applicable): Greg Greenway Seaport Industrial Assn.
Mailing Address: 675 Seaport Blvd RWC 94063
Email: seaportindustrial@yahoo.com

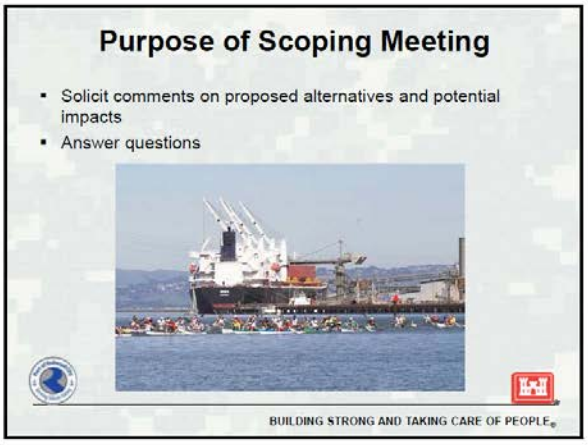
Name and Organization (if applicable): Clem Moloay
Mailing Address: 1966 Menalto Ave Menlo Park CA 94025
Email: clemoloay@msn.com

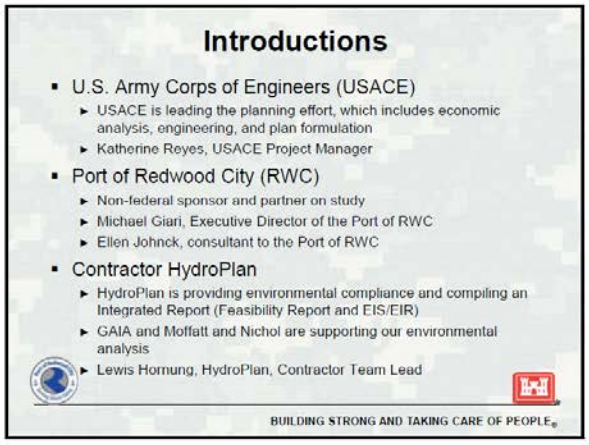
US Army Corps of Engineers
San Francisco District

Port of Redwood City


Redwood City Harbor, California
Navigation Improvement Feasibility Study
Public Scoping Meeting
December 10, 2014
Port of Redwood City
US Army Corps of Engineers
BUILDING STRONG®
San Francisco District


Agenda
Meeting Purpose
Introductions
Study Description
Proposed Project Alternatives
Dredged Sediment Management
Potential Placement Sites for Dredged Material
Project Planning Considerations
Evaluation Criteria
Study Process & Schedule
Next Steps
Questions?
BUILDING STRONG AND TAKING CARE OF PEOPLE®


Purpose of Scoping Meeting
Solicit comments on proposed alternatives and potential impacts
Answer questions
BUILDING STRONG AND TAKING CARE OF PEOPLE®

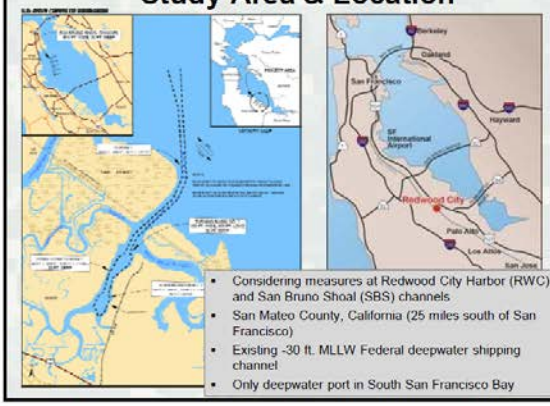

Introductions
U.S. Army Corps of Engineers (USACE)
USACE is leading the planning effort, which includes economic analysis, engineering, and plan formulation
Katherine Reyes, USACE Project Manager
Port of Redwood City (RWC)
Non-federal sponsor and partner on study
Michael Giari, Executive Director of the Port of RWC
Ellen Johnck, consultant to the Port of RWC
Contractor HydroPlan
HydroPlan is providing environmental compliance and compiling an Integrated Report (Feasibility Report and EIS/EIR)
GAIA and Moffatt and Nichol are supporting our environmental analysis
Lewis Hornung, HydroPlan, Contractor Team Lead
BUILDING STRONG AND TAKING CARE OF PEOPLE®

Study Process

USACE Study Phases	USACE Planning Fundamentals	NEPA/CEQA Process	Estimated Schedule
Scoping	*Step 1.* Identify Problems and Opportunities	Publish Notice of Intent (NOI)/Notice of Preparation (NOP) & 30-day agency/public review	Completed
	Step 2. Inventory and Forecast	Conduct scoping process	Completion 2014
		Prepare Statement of Purpose and Need/Project Objectives Describe existing and future without-project conditions	Completed
Alternative Formulation and Analysis	*Step 3.* Formulate Alternatives	Identify reasonable alternatives	Early 2015
	Step 4. Evaluate Alternatives	Evaluate impacts Develop mitigation	Spring 2015
	Step 5. Compare Alternatives	Compare alternatives	
Feasibility-Level Analysis	*Step 6.* Select Alternative	Draft EIR/EIS: public notice and 45-day public review	Summer 2015
Chief's Report		Final EIR/EIS: respond to public comments	Fall 2015
		Final EIR/EIS: public notice and 30-day public review	Winter 2015
		Record of Decision (ROD)/Notice of Determination (NOD)	Spring 2016

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Study Area & Location



- Considering measures at Redwood City Harbor (RWC) and San Bruno Shoal (SBS) channels
- San Mateo County, California (25 miles south of San Francisco)
- Existing -30 ft. MLLW Federal deepwater shipping channel
- Only deepwater port in South San Francisco Bay

Project Setting

Port of Redwood City

- Supplies construction and scrap metal industries
- ~1.78M tons/year
- Growing at 4.1% average annual growth rate



"The Port of Redwood City believes in the lasting value this project will have for our community and a strong economy. We are committed to full 50/50 partnership with the U.S. Army Corps of Engineers to see this study through."

-Michael Giari, Executive Director for the Port of RWC

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Project Setting

- Adjacent Bair Island and Greco Island part of Don Edwards San Francisco Bay National Wildlife Refuge (NWR)
- Waters around border of project area are part of the Don Edwards San Francisco Bay NWR
- Endangered species present
- Placement sites are part of project area
- Dredged material transport routes will also be analyzed for impacts

Present in Marsh and Sloughs
- Ridgeway's rail (formerly California clapper rail)
- Salt marsh harvest mouse
- Central coast steelhead

Occasional Feeding in Harbor
- California least tern
- Brown pelican

Mudflat Visitor
- Western snowy plover



Ridgeway's Rail at Don Edwards Marine Protected Area
Photo credit: Fish & Wildlife Service

Study Objectives





- Navigation Improvement Feasibility Study
  - Reduce transportation costs
  - Address inefficiency and inability to accommodate existing modern fleet of vessels
  - Improve maneuverability
  - Reduce impacts from shoaling
  - Support environmental restoration efforts with dredged sediment for beneficial use
  - Place dredged material in a safe, feasible, and sustainable manner

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Proposed Project Alternatives

1. Deepen the Existing RWC and SBS Channels
2. Address RWC Harbor Shoaling
3. Combined: Deepen Existing Channels and Address Shoaling

No Action – required to be analyzed in all EIS/EIRs and Feasibility Studies

Alternatives 1 through 3 Require Dredged Sediment Management

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Dredged Sediment Management

Dredged Sediment Could Be:

1. Reused for wetland creation (upland beneficial reuse)
2. Reused to support flood risk management measures, i.e. levee strengthening/reinforcement (upland beneficial reuse)
3. Reused by placing it in-bay at a passive sediment transport site
4. Disposed of at a designated dredge material disposal site
5. Placed at a combination of the above types of sites

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Alternative 1

Deepen Existing Channels

Deepen the channels at Redwood City Harbor and San Bruno Shoal to depths of:

a. -32 feet MLLW
b. -34 feet MLLW
c. -37 feet MLLW
d. Varying depths at San Bruno Shoal and RWC Harbor channel



BUILDING STRONG AND TAKING CARE OF PEOPLE®

Alternative 2

Address RWC Harbor Shoaling

Improve performance of the existing RWC channel and reduce the need for maintenance dredging by reducing shoaling into the channel through:

a. Realigning a portion of the channel to the south
b. Modifying the cross sectional area of the channel
c. Conducting advance maintenance
d. A combination of measures a. through c.

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Alternative 3

Combined: Deepen Existing Channels and Address Shoaling

Combination of Alternatives 1 and 2, including channel deepening of RWC and San Bruno Shoal channels and one or more of the measures to address shoaling. Measures to reduce shoaling again include realigning the channel, modifying the cross sectional area of the channel, and/or conducting advance maintenance.

BUILDING STRONG AND TAKING CARE OF PEOPLE®

No Action Alternative

No Action/No Project

Continue to maintain existing channels at -30 feet MLLW through regular maintenance dredging. Maintain current channel profile and footprint.

This alternative is compared against all other alternatives

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Project Planning Considerations & Constraints

- Avoid or minimize adverse impacts to environmental resources.
  - ▸ Adverse environmental impacts to be avoided or mitigated, as required
- Avoid unsafe ship operating conditions
- Avoid impacts to San Mateo Bridge
- Avoid impacts to Bair Island
- Avoid impacts to Port's existing infrastructure

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Potential Dredge Material Placement Sites



Identified 9 Potential Placement Sites and Screened to 6:

1. Ravenswood Pond Complex
   - Upland Beneficial Reuse Site
2. Eden Landing Pond Complex
   - Upland Beneficial Reuse Site
3. Alviso Pond Complex
   - Upland Beneficial Reuse Site
4. Dumbarton Bridge – Reuse through Passive Sediment Transport
5. SF-11 Alcatraz
   - In-Bay Aquatic Disposal
6. San Francisco Deep Ocean Disposal Site (SFDODS)
   - Ocean Aquatic Disposal

Note: Three of the sites are reuse sites within the South San Francisco Bay Salt Pond Restoration Project

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Potential Placement Sites

Upland Placement Sites Under Consideration In South San Francisco Bay



- **Ravenswood Pond Complex**
  - Close proximity to Redwood City Harbor
  - Backup site (available 2023)
  - Insufficient stand-alone capacity (<1 MCY)
  - Pond and nesting island restoration for resting and nesting shorebirds
  - Snowy plover habitat restoration complete



Ravenswood Pond Complex

Images: SouthBayRestoration.org 2014

BUILDING STRONG AND TAKING CARE OF PEOPLE®

Potential Placement Sites

- **Eden Landing Pond Complex**
  - Potentially available in 2018
  - Capacity is 3 MCY (equivalent to -34' to -35' ft. MLLW)
  - Eden Landing Restoration Draft EIR mid-2015
  - Restoring tidal wetlands and nesting islands for migrating shorebirds
  - Flood management component for 2,000+ acreage tidal restoration
  - Material compatible with restoration needs
  - Coordination with SBSP Restoration ongoing

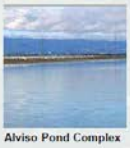


Eden Landing Pond Complex

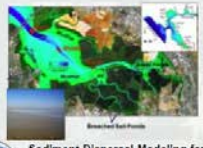
BUILDING STRONG AND TAKING CARE OF PEOPLE®

Potential Placement Sites

- **Alviso Pond Complex**
  - Not permitted, potentially available 2018
  - Capacity is 34 MCY
  - Restoring tidal salt marsh, tidal channel habitat, shallow water habitats, and nesting islands
  - Material is compatible with restoration needs



Alviso Pond Complex

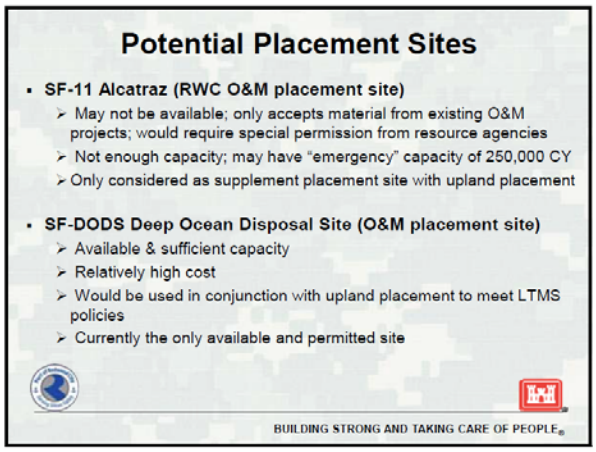


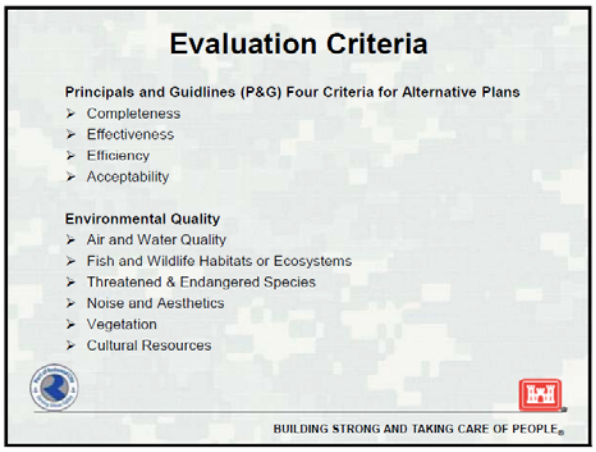
Sediment Dispersal Modeling for South San Francisco Bay

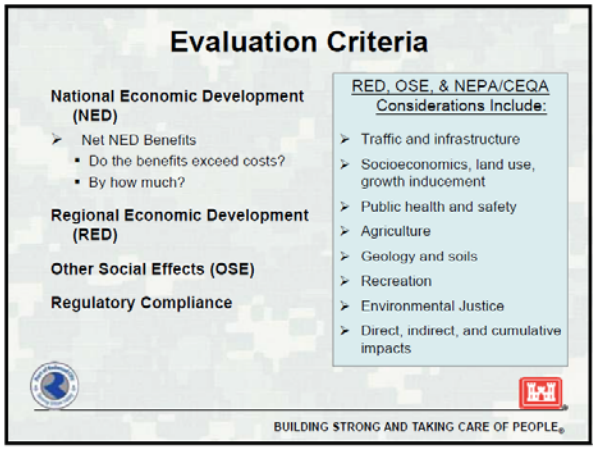
- **Dumbarton Bridge:** Passive Sediment Transport
  - Not permitted, may not be available
  - Capacity may be limited

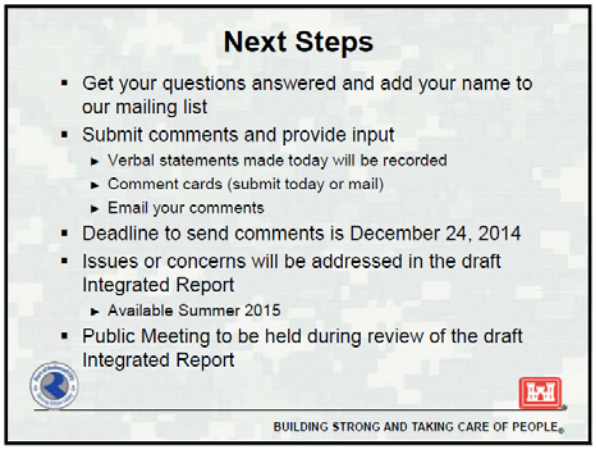
Top right image: SouthBayRestoration.org 2014
Bottom left image: U.S. Army Corps of Engineers and Delta Modeling Associates, October 2014

BUILDING STRONG AND TAKING CARE OF PEOPLE®

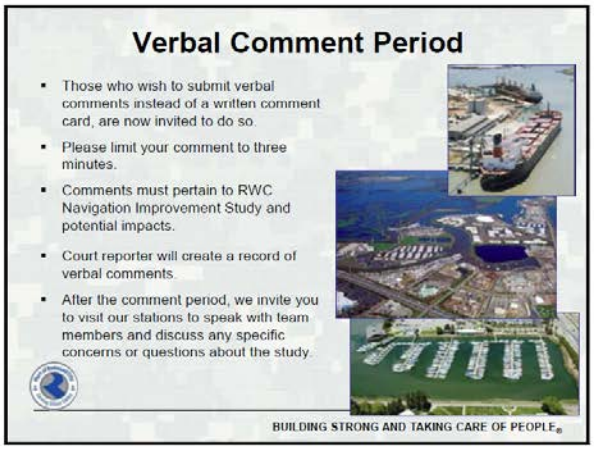

Potential Placement Sites
SF-11 Alcatraz (RWC O&M placement site)
May not be available; only accepts material from existing O&M projects; would require special permission from resource agencies
Not enough capacity; may have "emergency" capacity of 250,000 CY
Only considered as supplement placement site with upland placement
SF-DODS Deep Ocean Disposal Site (O&M placement site)
Available & sufficient capacity
Relatively high cost
Would be used in conjunction with upland placement to meet LTMS policies
Currently the only available and permitted site
BUILDING STRONG AND TAKING CARE OF PEOPLE®


Evaluation Criteria
Principals and Guidlines (P&G) Four Criteria for Alternative Plans
Completeness
Effectiveness
Efficiency
Acceptability
Environmental Quality
Air and Water Quality
Fish and Wildlife Habitats or Ecosystems
Threatened & Endangered Species
Noise and Aesthetics
Vegetation
Cultural Resources
BUILDING STRONG AND TAKING CARE OF PEOPLE®


Evaluation Criteria
National Economic Development (NED)
Net NED Benefits
Do the benefits exceed costs?
By how much?
Regional Economic Development (RED)
Other Social Effects (OSE)
Regulatory Compliance
RED, OSE, & NEPA/CEQA Considerations Include:
Traffic and infrastructure
Socioeconomics, land use, growth inducement
Public health and safety
Agriculture
Geology and soils
Recreation
Environmental Justice
Direct, indirect, and cumulative impacts
BUILDING STRONG AND TAKING CARE OF PEOPLE®


Next Steps
Get your questions answered and add your name to our mailing list
Submit comments and provide input
Verbal statements made today will be recorded
Comment cards (submit today or mail)
Email your comments
Deadline to send comments is December 24, 2014
Issues or concerns will be addressed in the draft Integrated Report
Available Summer 2015
Public Meeting to be held during review of the draft Integrated Report
BUILDING STRONG AND TAKING CARE OF PEOPLE®


Comments?
Katherine Reyes
Project Manager
U.S. Army Corps of Engineers
San Francisco District
(415) 503-6847
Katherine.M.Reyes@usace.army.mil
Michael Giari
Executive Director
Port of Redwood City
(650) 306-4150
mgiari@redwoodcityport.com
BUILDING STRONG AND TAKING CARE OF PEOPLE®


Verbal Comment Period
Those who wish to submit verbal comments instead of a written comment card, are now invited to do so.
Please limit your comment to three minutes.
Comments must pertain to RWC Navigation Improvement Study and potential impacts.
Court reporter will create a record of verbal comments.
After the comment period, we invite you to visit our stations to speak with team members and discuss any specific concerns or questions about the study.
BUILDING STRONG AND TAKING CARE OF PEOPLE®

STATE OF CALIFORNIA
Governor's Office of Planning and Research
State Clearinghouse and Planning Unit

Edmund G. Brown Jr.
Governor

Ken Alex
Director

Notice of Preparation

November 25, 2014

RECEIVED
DEC - 3 2014
Port of Redwood City

To: Reviewing Agencies

Re: Redwood City Navigation Improvement Study
SCH# 2014112062

Attached for your review and comment is the Notice of Preparation (NOP) for the Redwood City Navigation Improvement Study draft Environmental Impact Report (EIR).

Responsible agencies must transmit their comments on the scope and content of the NOP, focusing on specific information related to their own statutory responsibility, within 30 days of receipt of the NOP from the Lead Agency. This is a courtesy notice provided by the State Clearinghouse with a reminder for you to comment in a timely manner. We encourage other agencies to also respond to this notice and express their concerns early in the environmental review process.

Please direct your comments to:

Michael Giari
Port of Redwood City
675 Seaport Boulevard
Redwood City, CA 94063

with a copy to the State Clearinghouse in the Office of Planning and Research. Please refer to the SCH number noted above in all correspondence concerning this project.

If you have any questions about the environmental document review process, please call the State Clearinghouse at (916) 445-0613.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Attachments
cc: Lead Agency

Document Details Report
State Clearinghouse Data Base

RECEIVED
DEC - 3 2014
Port of Redwood City

SCH#	**2014112062**
Project Title	Redwood City Navigation Improvement Study
Lead Agency	Redwood City, Port of

Type	**NOP** Notice of Preparation
Description	The project site includes the existing Federal navigation channel and turning basins at RCH, extending from the mouth of Redwood Creek to deep water in the San Francisco Bay, as well as the channel at San Bruno Shoal in San Francisco Bay. Both channels are authorized to a depth of -30 feet Mean Lower Low Water (MLLW). It is the only deep-water port in South San Francisco Bay and was completed to its present-day authorized depth in 1965. The Port of Redwood City is the local sponsor the navigation channel and shares the cost of the feasibility study on a 50/50 basis with the US Army Corps of Engineers (USACE). The port maintains three ship berth facilities at a depth of -34 feet MLLW and a small facility to unload cement and aggregates via barge. Maritime activities include the export of recycled metal and the import of dry bulk building materials such as cement, bauxite, gypsum and construction aggregates.

Lead Agency Contact

Name	Michael Giari		
Agency	Port of Redwood City		
Phone	650-306-4150	***Fax***	
email			
Address	675 Seaport Boulevard		
City	Redwood City	***State*** CA	***Zip*** 94063

Project Location

County	San Mateo			
City	Redwood City			
Region				
Cross Streets	Seaport Blvd. and Kerkner Road			
Lat / Long				
Parcel No.				
Township		***Range***	***Section***	***Base***

Proximity to:

Highways	Hwy 92
Airports	
Railways	Union Pacific
Waterways	San Francisco Bay and Redwood Creek
Schools	
Land Use	Navigation Channel for Industrial Seaport

Project Issues	Aesthetic/Visual; Air Quality; Biological Resources; Economics/Jobs; Geologic/Seismic; Noise; Traffic/Circulation; Water Quality; Wetland/Riparian; Cumulative Effects
Reviewing Agencies	Resources Agency; Department of Boating and Waterways; Department of Parks and Recreation; Resources, Recycling and Recovery; San Francisco Bay Conservation and Development Commission; Department of Water Resources; Department of Fish and Wildlife, Region 3; Native American Heritage Commission; State Lands Commission; California Highway Patrol; Caltrans, District 4; Air Resources Board; Regional Water Quality Control Board, Region 2; Department of Fish and Wildlife, Marine Region

Date Received 11/25/2014 ***Start of Review*** 11/25/2014 ***End of Review*** 12/24/2014

Note: Blanks in data fields result from insufficient information provided by lead agency.

NOP Distribution List

County: San Mateo

SCH# 2014112062

Resources Agency

- ■ **Resources Agency** Nadell Gayou
- ■ **Dept. of Boating & Waterways** Nicole Wong
- ☐ **California Coastal Commission** Elizabeth A. Fuchs
- ☐ **Colorado River Board** Lisa Johansen
- ☐ **Dept. of Conservation** Elizabeth Carpenter
- ☐ **California Energy Commission** Eric Knight
- ☐ **Cal Fire** Dan Foster
- ☐ **Central Valley Flood Protection Board** James Herota
- ☐ **Office of Historic Preservation** Ron Parsons
- ■ **Dept of Parks & Recreation** Environmental Stewardship Section
- ■ **California Department of Resources, Recycling & Recovery** Sue O'Leary
- ■ **S.F. Bay Conservation & Dev't. Comm.** Steve McAdam
- ■ **Dept. of Water Resources** Resources Agency Nadell Gayou

Fish and Game

- ☐ **Depart. of Fish & Wildlife** Scott Flint Environmental Services Division
- ☐ **Fish & Wildlife Region 1** Donald Koch
- ☐ **Fish & Wildlife Region 1E** Laurie Harnsberger
- ☐ **Fish & Wildlife Region 2** Jeff Drongesen
- ☐ **Fish & Wildlife Region 3** Charles Armor
- ☐ **Fish & Wildlife Region 4** Julie Vance
- ☐ **Fish & Wildlife Region 5** Leslie Newton-Reed Habitat Conservation Program
- ☐ **Fish & Wildlife Region 6** Tiffany Ellis Habitat Conservation Program
- ☐ **Fish & Wildlife Region 6 I/M** Heidi Sickler Inyo/Mono, Habitat Conservation Program
- ☐ **Dept. of Fish & Wildlife M** George Isaac Marine Region

Other Departments

- ☐ **Food & Agriculture** Sandra Schubert Dept. of Food and Agriculture
- ☐ **Depart. of General Services** Public School Construction
- ☐ **Dept. of General Services** Anna Garbeff Environmental Services Section
- ☐ **Delta Stewardship Council** Kevan Samsam
- ☐ **Housing & Comm. Dev.** CEQA Coordinator Housing Policy Division

Independent Commissions,Boards

- ☐ **Delta Protection Commission** Michael Machado
- ☐ **OES (Office of Emergency Services)** Dennis Castrillo
- ■ **Native American Heritage Comm.** Debbie Treadway
- ☐ **Public Utilities Commission** Leo Wong
- ☐ **Santa Monica Bay Restoration** Guangyu Wang
- ■ **State Lands Commission** Jennifer Deleong
- ☐ **Tahoe Regional Planning Agency (TRPA)** Cherry Jacques

Cal State Transportation Agency CalSTA

- ☐ **Caltrans - Division of Aeronautics** Philip Crimmins
- ☐ **Caltrans – Planning HQ LD-IGR** Terri Pencovic
- ■ **California Highway Patrol** Suzann Ikeuchi Office of Special Projects

Dept. of Transportation

- ☐ **Caltrans, District 1** Rex Jackman
- ☐ **Caltrans, District 2** Marcelino Gonzalez
- ☐ **Caltrans, District 3** Eric Federicks – South Susan Zanchi - North
- ■ **Caltrans, District 4** Erik Alm
- ☐ **Caltrans, District 5** Larry Newland
- ☐ **Caltrans, District 6** Michael Navarro
- ☐ **Caltrans, District 7** Dianna Watson
- ☐ **Caltrans, District 8** Mark Roberts
- ☐ **Caltrans, District 9** Gayle Rosander
- ☐ **Caltrans, District 10** Tom Dumas
- ☐ **Caltrans, District 11** Jacob Armstrong
- ☐ **Caltrans, District 12** Maureen El Harake

Cal EPA

Air Resources Board

- ■ All Other Projects Cathi Slaminski
- ☐ Transportation Projects Nesamani Kalandiyur
- ☐ Industrial/Energy Projects Mike Tollstrup
- ☐ **State Water Resources Control Board** Regional Programs Unit Division of Financial Assistance
- ☐ **State Water Resources Control Board** Jeffery Werth Division of Drinking Water
- ☐ **State Water Resources Control Board** Student Intern, 401 Water Quality Certification Unit Division of Water Quality
- ☐ **State Water Resouces Control Board** Phil Crader Division of Water Rights
- ☐ **Dept. of Toxic Substances Control** CEQA Tracking Center
- ☐ **Department of Pesticide Regulation** CEQA Coordinator

Regional Water Quality Control Board (RWQCB)

- ☐ **RWQCB 1** Cathleen Hudson North Coast Region (1)
- ■ **RWQCB 2** Environmental Document Coordinator San Francisco Bay Region (2)
- ☐ **RWQCB 3** Central Coast Region (3)
- ☐ **RWQCB 4** Teresa Rodgers Los Angeles Region (4)
- ☐ **RWQCB 5S** Central Valley Region (5)
- ☐ **RWQCB 5F** Central Valley Region (5) Fresno Branch Office
- ☐ **RWQCB 5R** Central Valley Region (5) Redding Branch Office
- ☐ **RWQCB 6** Lahontan Region (6)
- ☐ **RWQCB 6V** Lahontan Region (6) Victorville Branch Office
- ☐ **RWQCB 7** Colorado River Basin Region (7)
- ☐ **RWQCB 8** Santa Ana Region (8)
- ☐ **RWQCB 9** San Diego Region (9)

■ Other DFG MARINE REGION

☐ _____ Conservancy

Last Updated 10/13/2014

RECEIVED
DEC 22 2014
Port of Redwood City

Rita Artist

From: Hearnley, Diana@SLC [Diana.Hearnley@slc.ca.gov]
Sent: Monday, December 22, 2014 12:16 PM
To: info
Cc: state.clearinghouse@opr.ca.gov; Herzog, Cynthia@SLC; Sampson, Jonathan@SLC; Rader, Jessica@SLC
Subject: 2014112062 Port of Redwood City_NOP
Attachments: 2014112062 Port of Redwood City_NOP.pdf

Please accept the attached electronic copy of the California State Lands Commission staff comment letter on the above-referenced document.

The original hard-copy has been mailed via postal mail to the lead agency also.

Diana Hearnley
State Lands Commission
Secretary
Environmental Planning

(916) 574-1890 Work
Diana.Hearnley@slc.ca.gov
100 Howe Avenue Suite 100S
Sacramento, CA 95825

RECEIVED
DEC 22 2014
Port of Redwood City

STATE OF CALIFORNIA — EDMUND G. BROWN JR., *Governor*

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

Established in 1938

JENNIFER LUCCHESI, *Executive Officer*
(916) 574-1800 *Fax* (916) 574-1810
California Relay Service TDD Phone 1-800-735-2929
from Voice Phone 1-800-735-2922

Contact Phone: **(916) 574-1890**
Contact FAX: **(916) 574-1885**

December 19, 2014

File Ref: SCH # 2014112062

Port of Redwood City
Attn: Michael Giari
675 Seaport Boulevard
Redwood City, CA 94063

Subject: Notice of Preparation (NOP) for a Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Redwood City Harbor Navigation Improvement Project, San Mateo County

Dear Mr. Giari:

The California State Lands Commission (CSLC) staff has reviewed the subject NOP for a draft EIR/EIS for the Redwood City Harbor Navigation Improvement Project (Project), which is being prepared by the Port of Redwood City (Port). The Port, as the public agency proposing to carry out a project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.), and the U.S. Army Corps of Engineers (USACE) is the lead agency under the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et seq.). The CSLC is a trustee agency for projects that could directly or indirectly affect sovereign lands and their accompanying Public Trust resources or uses. Additionally, because a portion of the Project involves work on sovereign lands, the CSLC will act as a responsible agency. CSLC staff requests that the lead agencies consult with us on preparation of the draft EIR/EIS as required by CEQA section 21153, subdivision (a), and the State CEQA Guidelines section 15086, subdivisions (a)(1) and (a)(2).

CSLC Jurisdiction and Public Trust Lands

The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6301, 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the Common Law Public Trust.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State

for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion or where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

Based on the NOP, at least some of the dredging activities for the deepening of the navigation channels in South San Francisco Bay appear to take place waterward of the mean high tide line in the Redwood Creek and San Francisco Bay. Some of this area is within the lands granted to Redwood City (Chap. 1359, Stat. 1945, as amended) and as such, the approval for any portion of the Project within that area would be through Redwood City, as the grantee. However, any dredging activities waterward of the mean high tide line located in the areas not granted to Redwood City would require CSLC authorization prior to commencing those activities. Please contact Jonathan Sampson (see contact information below) at your earliest convenience for further information about CSLC leasing. For questions regarding granted lands, please contact Reid Boggiano at (916) 574-0450, or Reid.Boggiano@slc.ca.gov.

Please also be advised that while some of the waterways involved in the Project may not be under the CSLC's leasing jurisdiction, those waterways are still subject to a public navigational easement. This easement provides that the public has the right to navigate and exercise the incidences of navigation in a lawful manner on State waters that are capable of being physically navigated by oar or motor-propelled small craft. Such uses may include, but are not limited to, boating, rafting, sailing, rowing, fishing, fowling, bathing, skiing, and other water-related public uses. The activities completed under the Project must not restrict or impede the easement right of the public.

This conclusion is without prejudice to any future assertion of State ownership or public rights, should circumstances change, or should additional information come to our attention. This letter is not intended, nor should it be construed as, a waiver or limitation of any right, title, or interest of the State of California in any lands under its jurisdiction.

Project Description

The Project site is located at the Redwood City Harbor (RCH) on the southwest side of San Francisco Bay, and in the San Francisco Bay approximately 18 miles south of San Francisco. The project site includes an existing Federal navigation channel and turning basins at the RCH, extending from the mouth of Redwood Creek to deep water in the San Francisco Bay, as well as the channel at San Bruno Shoal in San Francisco Bay. Both channels are authorized to a depth of -30 feet Mean Lower Low Water (MLLW). The RCH is the only deep-water port in South San Francisco Bay and was completed to its present-day authorized depth in 1965. The Port maintains three ship berth facilities at a depth of -34 feet MLLW and a small facility to unload cement and aggregates via barge.

Although a Preferred Alternative or Proposed Project are not identified within the "Project Description" section of the NOP, under "Summary" it states the following: "The primary

actions under consideration are dredging, channel realignment, transport and placement of dredged material to sites for beneficial reuse, and/or which may include in San Francisco Bay at SF11 Alcatraz and/or ocean placement at the San Francisco Ocean Disposal Site (SFDODS)." (NOP, page 1)

Environmental Review

CSLC staff requests that the lead agencies consider the following comments when preparing the draft EIR/EIS.

General Comments

1. Project Description: The NOP states that four possible alternative "plans" will be evaluated in the draft EIR/EIS. CSLC staff recommends that a "Preferred Alternative" (NEPA) and "Proposed Project" (CEQA) be incorporated into and presented in the EIR/EIS, as CEQA requires that a Project Description be included that identifies a thorough and complete description of the preferred/proposed activities, and then further requires that a range of reasonable alternatives be presented against which the proposed Project can be compared (see generally State CEQA Guidelines §§ 15124, 15126.6). Presenting a proposed Project, and then comparing the remaining three alternatives against the proposed Project, would facilitate CSLC staff's review under CEQA better than simply presenting four alternatives equally without stating which one the Port intends to implement. The Project Description should be as precise as possible in describing the details of all allowable activities (e.g., types of equipment or methods that may be used, maximum area of impact or volume of sediment removed or disturbed, seasonal work windows, locations for material disposal, etc.), as well as the details of the timing and length of activities. Thorough descriptions will facilitate CSLC staff's determination of the extent and locations of its leasing jurisdiction, make for a more robust analysis of the work that may be performed, and minimize the potential for subsequent environmental analysis to be required.

2. Permit requirements: Pursuant to Public Resources Code section 6826, the CSLC regulates geophysical survey operations in State waters. Any acoustic-generating geophysical surveys conducted in conjunction with the proposed dredging activities should be carried out only by an operator holding a valid permit under the CSLC's Offshore Geophysical Permit Program (OGPP). Information about the OGPP and a list of permitted survey operators can be found on the CSLC website at: http://www.slc.ca.gov/Division_Pages/DEPM/OGPP/OGPP.html.

Biological Resources

3. Sensitive Species: Due to the Project's location near the Don Edwards San Francisco Bay National Wildlife Refuge, the draft EIR/EIS should fully disclose and analyze all potentially significant effects on sensitive species and habitats in and around the Project area, including special-status wildlife, fish, and plants, and if appropriate, identify feasible mitigation measures to reduce those impacts. The lead agencies should conduct queries of the California Department of Fish and Wildlife's (CDFW) California Natural Diversity

Database (CNDDB) and U.S. Fish and Wildlife Service's (USFWS) Special Status Species Database to identify any special-status plant or wildlife species that may occur in the Project area. The draft EIR/EIS should also include a discussion of consultation with the CDFW and USFWS, including any recommended mitigation measures and potentially required permits identified by these agencies.

4. Noise: The draft EIR/EIS should also evaluate noise impacts on fish, marine mammals, and birds from dredging and transport activities. Mitigation measures could include a Marine Wildlife Monitoring and Contingency Plan and species-specific work windows as defined by CDFW, USFWS, and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS). Again, staff recommends early consultation with these agencies to minimize the impacts of the Project on sensitive species.

Climate Change

5. Greenhouse Gases: NEPA and CEQA differ with respect to analyzing climate change impacts and greenhouse gas (GHG) emissions. In order to ensure the EIR/EIS meets the requirements under CEQA, a GHG analysis consistent with the California Global Warming Solutions Act (Assembly Bill [AB] 32) and required by the State CEQA Guidelines should be included in the draft EIR/EIS. This analysis should identify a threshold for significance for GHG emissions, calculate the level of GHGs that will be emitted as a result of the Project, determine the significance of the impacts of those emissions, and, if impacts are significant, identify mitigation measures that would reduce them to the extent feasible. For the proposed Project, the transport of dredged materials, in addition to the actual dredging activities, should be included in the GHG analysis.

Cultural Resources

6. Submerged Resources: The draft EIR/EIS should evaluate potential impacts to submerged cultural resources in the Project area. The CSLC maintains a shipwrecks database that can assist with this analysis. CSLC staff requests that the lead agencies contact Assistant Chief Counsel Pam Griggs (see contact information below) to obtain shipwrecks data from the database and CSLC records for the Project site. The database includes known and potential vessels located on the State's tide and submerged lands; however, the locations of many shipwrecks remain unknown. Please note that any submerged archaeological site or submerged historic resource that has remained in State waters for more than 50 years is presumed to be significant. Because of this possibility, please add a mitigation measure requiring that in the event cultural resources are discovered during any construction activities, Project personnel shall halt all activities in the immediate area and notify a qualified archaeologist to determine the appropriate course of action.

7. Title to Resources: The draft EIR/EIS should also mention that the title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the State and under the jurisdiction of the CSLC. CSLC staff requests that the lead agencies consult with Assistant Chief Counsel

Pam Griggs (see contact information below), should any cultural resources on State lands be discovered during construction of the proposed Project.

Mitigation and Alternatives

8. Deferred Mitigation: In order to avoid the improper deferral of mitigation, mitigation measures should either be presented as specific, feasible, enforceable obligations, or should be presented as formulas containing "performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way" (State CEQA Guidelines, §15126.4, subd. (b)).

9. Alternatives: Pursuant to section 15126.6, subdivision (e)(2) of the State CEQA Guidelines, an EIR shall identify and evaluate both a "no project" alternative, as well as an environmentally superior alternative among the other alternatives. The NOP identifies Alternative 4 as the no project (or "no action") alternative; CSLC staff requests that the lead agencies identify whether the no project alternative is also the environmentally superior alternative, and if so, identify an environmentally superior alternative among the other three alternatives, to ensure that the draft EIR/EIS meets the guidelines for CEQA compliance.

Thank you for the opportunity to comment on the NOP for the Project. As a trustee and responsible agency, the CSLC requests that you consult with us on this Project and keep us advised of changes to the Project Description and all other important developments. Please send additional information on the Project to the CSLC staff listed below as the draft EIR/EIS is being prepared.

Please refer questions concerning environmental review to Cynthia Herzog, Senior Environmental Scientist, at (916) 574-1310 or via e-mail at Cynthia.Herzog@slc.ca.gov. For questions concerning archaeological or historic resources under CSLC jurisdiction, please contact Assistant Chief Counsel Pam Griggs at (916) 574-1854 or via email at Pamela.Griggs@slc.ca.gov. For questions concerning CSLC leasing jurisdiction, please contact Jonathan Sampson at (916) 574-0909 or by e-mail at Jonathan.Sampson@slc.ca.gov.

Sincerely,

For Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
C. Herzog, CSLC
J. Sampson, CSLC
J. Rader, CSLC